TOPIC SEVEN - HAZMAT

CONTENTS

SECTION ONE - LEGISLATION

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1 LEGISLATION

1.1 Introduction

Under the powers of the *Fire Brigades Act 1989* the NSWFB is the lead Combat Agency for all land based Hazardous Materials Incidents in NSW.

Hazardous material means anything that, when produced, stored, moved, used or otherwise dealt with without adequate safeguards to prevent it from escaping, may cause injury or death or damage to property; (*Fire Brigades Act*) (see Fig 1.1).

A hazardous material incident refers to an actual or impending land-based spillage or other escape of hazardous material that caused or threatens to cause injury or death or damage to property; (*Fire Brigades Act*).

Fig 1.1 Hazardous Materials Sign

1.2 DISPLAN

In NSW, the Hazardous Material Incident and Emergency Sub-Plan (HazMat Plan) has been developed as a supporting plan to the State Disaster Plan (DISPLAN). DISPLAN is put into effect only during a large scale emergency or an environmental disaster. This Plan outlines responsibility of emergency services and organisations. It details State level arrangements for response to, and recovery from, major land-based hazardous material incidents and emergencies in NSW.

1.2.1 Emergency Operations Centres

These Centres are manned and operated during a large scale emergency (DISPLAN). Support agencies will commit a Liaison Officer (LO) to co-ordinate activities between the Emergency Operations Controller (EOCON) and the agencies the LO is responsible for.

1.2.2 Emergency Operations Controller

The EOCON receives information from the LO's in relation to the emergency. The EOCON will access this information and advise the LO of any changes.

1.3 HazMat Plan

In the event of a Hazardous Materials Incident being a part of a declared emergency, the *State Legislation HazMat Plan*, may be enforced. Under *HazMat Plan* the role of the NSWFB is still that of the lead Combat Agency.

1.4 HazMat Titles

There are four key functions in managing any emergency incident:

- Control
- Operations
- Planning
- Logistics

At large incidents, individuals may be assigned to manage each of these Incident Control System (ICS) functions. At smaller incidents the first arriving Station Commander will fill all four roles.

Apart from their normal duties, firefighters maybe required to undertake differing roles. It is the responsibility of every firefighter to be familiar with the titles and responsibilities of each of these positions listed in Table 1A.

TITLE	ABBREVIATION
Incident Controller	IC
Operations Officer	OO
Planning Officer	PO
Logistics Officer	LO
Site Controller	SC

Table 1A HazMat Titles

1.4.1 Incident Controller

The first arriving Station Commander assumes the role of IC and their appliance becomes the Control Point for all messages relating to that incident. The IC then uses the call sign CONTROL along with the geographical location of the incident, e.g., Jones Street Control, ICI Control, Engadine Control, etc., for all subsequent radio communications from the incident.

⚠ NOTE

Seniority amongst Station Commanders plays no part in the establishment of the Control Point. The first arriving Station Commander will be the IC (until relieved by a higher ranking officer) and has the responsibility of initiating strategies, tactics and tasking for arriving appliances.

1.4.2 Operations Officer

The role of the OO at a HazMat incident ground is to ensure that no person enters the combat zone without good cause, and that all personnel entering the hazard area are fully protected and briefed. The OO will also ensure that personnel exiting the hazard area exit via the decontamination zone only.

The OO will deploy appliances and personnel to ensure that strategies and tactics are being implemented in an efficient and safe manner.

1.4.3 Planning Officer

The PO sizes up the scene and formulates a plan of attack. He/she considers the likely progress of the incident, assesses whether additional support is required, gathers information about the incident, and looks at the impact of the incident on the community and the environment.

1.4.4 Logistics Officer

When specialised support, technical advice, and refreshments are needed, the LO requests this from the Fire Command Centre and ensures that back up resources are provided.

1.4.5 Site Controller

The Site Controller is responsible for overall control of the Incident Site (includes the combat zone).

1.5 Roles and Responsibilities of Combat Agencies

For hazardous material incidents or emergencies in any area of NSW which is land-based, regardless of fire districts, and including waterways other than State waters, the NSWFB is the Combat Agency for rendering the incident or emergency safe with respect to public health and property.

For hazardous material incidents or emergencies which occur on State Waters, the Combat Agency for all operations is the *Office of Marine Safety and Port Strategy.*

1.5.1 Render Safe Stage

Combat Area Control

During the render safe stage of a incident or emergency, the Combat Zone will be controlled by the IC who will operate under the provisions of the *Fire Brigades Act 1989.*

Rescue

The NSWFB is responsible for rescuing trapped or injured persons and animals within the Combat Zone. Co-ordination of rescue activities outside the Combat Area remains the responsibility of the Site Controller (Senior Police Officer on site).

Clean-up Stage

Once the IC declares the area rendered safe, the cleaning up and removal becomes the responsibility of the Clean-up Controller (normally the owner of the contaminate). The owner may have to seek advice from the *EPA* as to the means of disposal.

Clean-up operations may commence during the render safe stage with control of the Combat Zone remaining with the IC.

Where requested by the Clean-up Controller, the NSWFB will provide all possible assistance.

Participating and Supporting Organisations

A number of NSW Government and other organisations' resources may be utilised by the IC. These can be arranged through the Fire Command Centres.

1.6 Types of Hazardous Contaminates

Hazardous materials may be classified as belonging to one of the following categories:

- chemical;
- biological;
- radioactive; and
- orphan waste.

1.6.1 Chemical

Chemical is the main type of contaminate encountered by the NSWFB. The danger to persons and the environment from substances in this group range from little or no danger, to extremely dangerous.

1.6.2 Biological

This group includes human and animal tissue, or waste, germs and viruses etc. These may be encountered either in transport or in institutions such as laboratories, hospitals and veterinary clinics.

1.6.3 Radioactive

Radioactive materials are becoming progressively more common in industrial and medicinal applications and may be encountered in many factories and medical centres. They are generally only found in small quantities and are covered by strict packaging rules.

1.6.4 Orphan Waste

Orphan waste (abandoned waste products) can be either one or all of the above. Orphan waste are waste products outside the confines of private property, e.g. a product left on the side of the road either deliberately or accidentally.

Under Occupational Health and Safety - **Do not under any circumstances transport waste products in a NSWFB appliance**. If in any doubt as to disposal of Orphan waste contact the HazMat Response Unit on (02) 9742 7320.

⚠ NOTE

Orphan waste is not to be transported or stored under any circumstances by the NSWFB.

SECTION TWO - PROCEDURES

CONTENTS

2 PROCEDURES

2.1 Introduction

HazMat incidents may occur in a wide range of situations. Some spills may occur indoors while others will be outside. Accidents may occur in transit and others due to storage or industrial manufacturing problems. For these reasons it is impossible to have strict procedures regarding how, or when, certain tasks must be performed. Following is a list of guidelines to help effectively handle most incidents:

- a safe approach;
- establish incident command;
- secure the scene;
- identify hazardous materials;
- assess potential harm;
- call in resources;
- monitor information; and
- decontaminate and render safe.

2.2 Safe Approach

A safe approach to a hazardous material emergency is of absolute importance to the safety of personnel and equipment, and should be carried out using the procedures outlined under the headings **Approaching the Incident** (2.2.1) and **Entering the Combat Zone** (2.2.2).

2.2.1 Approaching the Incident

When responding to a HazMat incident, it is important to remember the following points:

- approach from upwind and upgrade where possible; and
- to avoid contamination of both equipment and personnel alighting from the vehicle, position the appliance remote from the spillage.

⚠ NOTE

The first Officer on the scene is to estimate the size and nature of the incident and, notify the Communications Centre of the safest route (if any) for other responding appliances.

2.2.2 Entering the Combat Zone

Total protection of personnel is the first consideration at all incidents. When entering the combat zone personnel must:

- always assume the worst substance until proven otherwise, and wear maximum available protection;
- maintain teams of a minimum of two members;
- remain upwind of material where possible and avoid any contact with leaked substances; and
- **do not** enter the hot zone until a back-up crew and decontamination are in place.

2.3 Establishing Incident Control

The first arriving Station Commander assumes the role of Incident Controller (IC) and their appliance becomes the Control Point for all messages relating to that incident. The IC then uses the call sign **CONTROL** along with the geographical location of the incident, e.g. Jones Street Control, ICI Control, Engadine Control, for all subsequent radio communications from the incident.

The IC is to set up an incident command point which is to be located:

- away from any danger of contamination;

- in an area that is easily identifiable and clear to see; and
- in a position with a full view of the incident to allow effective decisions to be made.

The IC is to obtain from various sources, information about the chemicals involved and is to determine and obtain resources to enable the NSWFB and other authorities, to contain and render safe the incident.

The IC will take the following actions:

- identify the hazardous material involved;
- ensure that adequate action is taken for anyone trapped, injured or otherwise affected by the hazardous material;
- define the extent of the combat zone;
- obtain and assess all available information from the combat zone;
- utilise information carried on NSWFB Hazmat Response vehicles;
- seek further information from the NSWFB Communications Centre, the *EPA* Hazardous Materials Officer, specialist authorities and the chemical industry;
- seek further information from the owner of the hazardous materials, and the transport company (in transport incidents and emergencies);
- inform all personnel involved of the known hazards associated with the incident or emergency;
- determine, arrange and control combative actions to be taken by the NSWFB;
- arrange for any chemicals or materials (such as neutralising agents or sand) to be provided by relevant chemical companies or authorities;
- contact or arrange to contact all authorities, companies and persons, including local residents and property owners, directly affected by the incident;
- arrange with the owner and/or transporter of the hazardous materials and/or the *EPA* Hazardous Materials Officer for the collection, removal and treatment as required;
- determine when the combat zone is safe and formally declare it as such; and
- provide a written report of the incident to the *EPA* outlining any problems encountered and/or any suggestions to improve the overall response of all parties to such an incident or emergency.

Declared Emergency

In a *declared emergency* (see SOP's for DISPLAN, ENVIROPLAN and DATPLAN) the IC will:

- notify the Emergency Operations Controller (EOCON) of any co-ordination requirements, including evacuation;
- provide a LO to the Emergency Operations Centre, when such a centre is established to respond to an emergency;

The IC shall also designate personnel to the following positions:

- Operations Officer (OO); and
- Planning Officer (PO).

2.4 Securing the Scene

One of the first steps towards gaining control of any HazMat incident is to secure the scene. Securing the scene achieves two objectives:

- provides safety to the public and personnel not involved in a combat role; and
- defines the area in which proper protection is required.

The following actions should always occur at a HazMat incident ground:

- in the initial stages of an event, before identification of the substance has occurred, and where no physical evidence of danger is apparent, designate a minimum distance of 30 m in all directions around the material to be the **Hot Zone**;
- seal the **Hot Zone** off with barrier tape to prevent unauthorised entry. Establish an entry and exit point on the perimeter of the **Hot Zone** and closely monitor these areas;
- treat all spillages or escapes of material(s) as dangerous until conclusively proven otherwise by a competent person. The competent person being a member of the *EPA* or *WorkCover Authority*;
- where a situation exists requiring the immediate rescue of affected people, wear at least the minimum protection of a splash suit and the BA whilst performing the rescue operation.
- immediately remove all non-involved persons from the **Hot Zone**;
- when deceased persons are involved, if possible the bodies should be left in-situ pending a coronial inquiry;
- gather all exposed persons at an assembly point. It may be necessary for some, or all, of these people to be decontaminated and/or receive medical attention.
- establish a decontamination zone according to the resources available; and
- extinguish all ignition sources in the **Hot Zone** where a flammable risk is present or suspected.

If the situation is likely to deteriorate through the spread of the material to watercourses or other sensitive environmental areas, take steps to confine the hazardous material(s) as early as possible.

The safety of personnel performing confinement measures is always the highest priority. This is achieved by one or more of the following methods:

- diversion;
- dyking; and
- retention.

Diversion

Diversion is changing the flow direction of a fluid. Usually this is achieved using a hose, sand or earth to make a barrier along which the liquid will run to a holding area.

Fig 2.1 An Example of Diversion

Dyking

This is the application of a barrier which prevents passage of the material completely. Dykes should be considered as only temporary remedies intended to buy time.

Retention

This is the containment of a substance in an area where it can be absorbed, neutralised or vacuumed for correct disposal. It also involves, where possible, the containment of the material in its original container. Retention tactics are designed to be more permanent and may require resources such as portable basins, bags, plugs, leak sealing equipment or other special items.

2.4.1 Three Zone System

Due to the volatile nature of many hazardous materials it is necessary to incorporate a buffer zone between the hazard area and personnel or public not directly involved in operations. As a result a **Three Zone System** (Combat Area) has been developed and should be used at an incident.

The three zones are as follows:

- Hot Zone;
- Warm; and
- Cold Zone.

Hot Zone

The Hot Zone (see Fig 2.2) is the area that exists inside the barrier tape and designates the area into which only authorised, fully protected personnel may enter.

Warm Zone

The Warm Zone (see Fig 2.2) is an area that provides a buffer from the contaminate and personnel. Where possible this area should be marked by a physical means. This area

contains the decontamination zone and staging area where equipment is laid out and where back-up crews await entry.

Cold Zone

The Cold Zone (see Fig 2.2) is an area of limited access to personnel involved in the support of working crews. It is the area in which the incident command point should be located and where the dedicated pump for decontamination purposes is situated. Past this zone is the Incident Site where the public, media and non-involved personnel are allowed access, the Incident Site is Police responsibility.

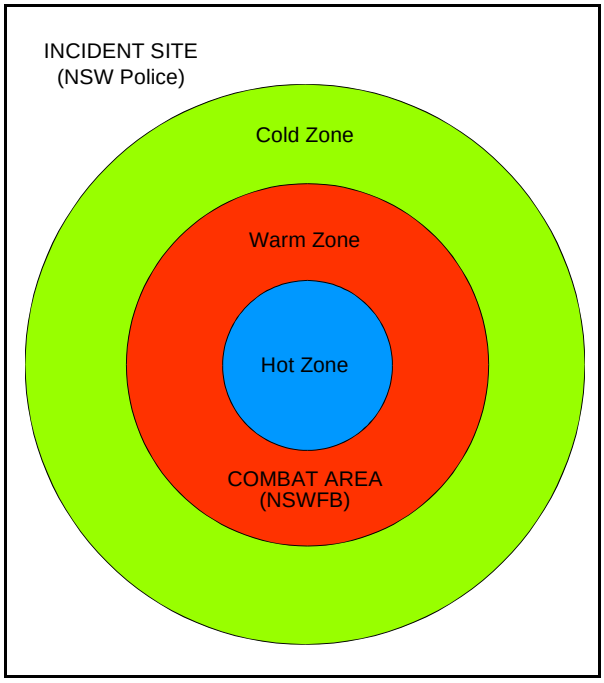

Fig 2.2 Three Zone System

2.5 Identifying Hazardous Materials

Correct identification of hazardous materials at an incident is crucial to the safe cleaning and disposal of substances, and allows levels of protection afforded to personnel to be confirmed or altered accordingly.

Identification of a hazardous material ideally involves obtaining the following information:

- chemical name;
- UN Number; and
- hazard class.

In the first instance, attempt identification by using binoculars, from a position external to the **Hot Zone**.

If identification of the hazardous material(s) and information on the position and volume of the escape requires close inspection, or personal contact, utilise two firefighters in gas tight suits to carry out this work.

Ensure a back-up crew, dressed in the minimum protection of a splash suit and BA, is on hand to effect the rescue of any affected personnel working in the **Hot Zone**. The back-up rescue crew is to consist of a minimum of two persons.

2.5.1 Correct Identification Procedure

HazMat Action Guide

The HazMat Action Guide (HAG) is a form carried on all appliances to facilitate the necessary information being relayed to the Communications Centre. The back of the form has a facility to mark off the HAG numbers given by the Communications Centre to the IC. This information can then be used to initiate the incident procedures as seen fit. An example of a HAG form is detailed at Fig 2.3.

SIDE 1 GREEN

AUSTRALIAN FIRE SERVICES
HAZMAT ACTION GUIDE

STEP 1: Obtain if possible, the product name and/or chemical name and/or UN Number and list below.

PRODUCT NAME

CHEMICAL NAME

UN NUMBER

If you are unable to obtain all information, do not delay transmission. Even part of the chemical name may assist in identification.

PHONETIC ALPHABET

Juliet	Whiskey
Alpha	November
Bravo	Oscar
Charlie	Papa
Delta	Quebec
Echo	Romeo
Foxtrot	Sierra
Golf	Tango
Hotel	Uniform
India	Victor
Kilo	X-Ray
Lima	Yankee
Mike	Zulu

STEP 2: Transfer information to your Communication Centre using the Phonetic Alphabet for chemical and product names.

State Communication Centre Telephone Numbers

008 422281 or 02 3197000

FAX [redacted] 02 6992084

STEP 3: While waiting for reply, attempt to discover the following information -

A. FORM OF SUBSTANCE
- ☐ Solid
- ☐ Liquid
- ☐ Gas
- ☐ Powder
- ☐ Granules

B. NUMBER OF CONTAINERS

C. TYPE OF CONTAINERS

D. SIZE OF CONTAINERS Kilos Litres Gallons

E. TOTAL QUANTITY INVOLVED Kilos Litres Gallons

F. MANUFACTURER'S NAME

G. SPECIALIST ADVICE REFERENCE

H. CLASS LABEL / EMERGENCY ACTION CODE (from container markings)

CLASS SUBSIDIARY RISK(S) HAZCHEM OTHER

3720-0200 (Rev. 4/91)

SIDE 2

HAZMAT ACTION GUIDE

GREEN

SUBSTANCE NAME:_____

UN No ☐☐☐☐ HAZCHEM CODE ☐☐☐ APP CODE ☐

PERSONAL PROTECTION EQUIPMENT

1 ☐ Gloves, boots (chemical resistant)
2 ☐ Breathing apparatus - high vapour/dust levels only
3 ☐ Breathing apparatus (BA)
4 ☐ Chemical splash suit
5 ☐ Gas tight chemical resistant suit
6 ☐ Limit exposure duration to 1 BA set (30 min)
7 ☐ For protection, seek specialist advice

FORM

8 ☐ Solid
9 ☐ Liquid
10 ☐ Gas

HAZARDS

11 ☐ Explosive
12 ☐ Unstable
13 ☐ Can ignite due to impact/friction
14 ☐ Highly flammable
15 ☐ Flammable
16 ☐ Can form explosive mixture in air
17 ☐ Vapours/gas heavier than air
18 ☐ Combustible
19 ☐ Toxic smoke/fumes in a fire
20 ☐ Heat increases risk of bursting/explosion
21 ☐ Attacks metals to liberate hydrogen
22 ☐ Liable to spontaneous ignition
23 ☐ Fire risk in contact with moisture
24 ☐ Oxidising
25 ☐ Increases fire risk
26 ☐ Can ignite combustibles
27 ☐ Very toxic perhaps fatal on contact
28 ☐ Toxic/poisonous
29 ☐ Toxic or noxious vapour/gas
30 ☐ Toxic fumes/gas released with acids
31 ☐ Harmful
32 ☐ Can be absorbed through skin
33 ☐ Danger of cumulative effects
34 ☐ Carcinogen or suspected carcinogen
35 ☐ Infectious
36 ☐ Radioactive
37 ☐ Corrosive
38 ☐ Acid
39 ☐ Alkaline
40 ☐ Irritant
41 ☐ Vapours may cause dizziness or suffocation
42 ☐ Causes severe damage to eyes and skin
43 ☐ May be transported as hot liquid
44 ☐ Spilled liquid has low temperature and evaporates quickly
45 ☐ Pollutant

EFFECT WITH WATER

50 ☐ Mixes/soluble
51 ☐ Does not mix/insoluble
52 ☐ Floats on water
53 ☐ Sinks in water
54 ☐ Reacts
55 ☐ Reacts violently
56 ☐ Gives off flammable fumes/gas

ACTION

60 ☐ Eliminate ignition sources
61 ☐ Consider evacuation
62 ☐ Avoid personal/skin contact
63 ☐ Keep upwind
64 ☐ Avoid dust
65 ☐ Prevent from entering drains
66 ☐ Contain spillage by any means
67 ☐ Do not absorb spillage in combustibles
68 ☐ Control vapour with water spray/fog
69 ☐ Disperse vapours
70 ☐ Allow to evaporate
71 ☐ Absorb with dry agent
72 ☐ Sweep/shovel to a safe place
73 ☐ Dilute with water
74 ☐ Keep containers cool
75 ☐ Neutralize with soda ash/lime
76 ☐ Never spray with water
77 ☐ Stop leak if safe to do so
78 ☐ Seek specialist advice

FIRE FIGHTING

80 ☐ Does not burn
81 ☐ Water jets
82 ☐ Water spray/fog
83 ☐ Foam
84 ☐ Foam - alcohol type
85 ☐ Dry agent
86 ☐ Do not extinguish unless essential
87 ☐ Isolate source of supply
88 ☐ Flood with water

PERSONNEL DECONTAMINATION

90 ☐ Wash with water
91 ☐ Wash with water and detergent
92 ☐ Dry decontamination
93 ☐ Seek specialist advice

FIRST AID: _____

_____

_____

NOTE: THIS IS PRELIMINARY INFORMATION AND MAY NOT BE COMPLETE OR SUFFICIENT, FURTHER ADVICE MAY BE NECESSARY

SPECIALIST ADVICE FROM: _____ **AGENCY:** _____

_____

_____

Fig 2.3 HAG Form

The information obtained is to be written down for relay to the Communication Centre. Ensure correct spelling as one letter misspelt could change the identification, resulting in wrong advice for the precautions being given. To complete the HAG form carry out the following:

- the member reading the name of the substance is to spell it out letter by letter (using the phonetic alphabet) to the member writing it down for confirmation;
- the confirmed information is to be written onto the HAG form;
- once the Chemical name, UN No, hazard class and all other relevant information has been entered onto the HAG sheet. Contact State or Regional Communications;
- the Communications Centre will read back the product name phonetically. Have another member check the spelling;
- once this is confirmed State communications will transmit a series of numbers. These numbers relate to procedures and are to be ticked off *on the back of the HAG sheet*.

⚠ NOTE

TX at the end of the numbers in the transmission means there is also text. This TX or text usually relates to Additional Personal Protection (APP).

Product Identification

The ideal identification of a contaminate includes a chemical name, however, if this cannot be obtained in the first instance, the following items will help:

- trade name;
- manufacturer;
- consignee;
- UN No;
- Emergency Procedure Guides (EPG);
- dangerous goods class label;
- dangerous goods placard;
- HazChem code; and
- Packing Group.

⚠ NOTE

As DATACHEM is updated the forms are also updated. Ensure that the Communications Centre is notified of the colour of the form being used.

2.5.2 United Nations Number

The United Nations Number (UN No) is a four digit number allocated to individual chemicals or groups of chemicals exhibiting similar properties. The number is written in Arabic numbers throughout the world and by law, must be with the dangerous goods class label, displayed on all containers holding dangerous goods.

2.5.3 Emergency Procedure Guides

An Emergency Procedure Guide (EPG) is a guide outlining procedures to be taken in the event of an emergency involving dangerous goods.

When a vehicle carries dangerous goods in bulk, or in packages in quantities for which markings are required, EPG's must be carried. The EPG's will be carried in a holder of suitable size and construction.

The holder should be securely attached to a door of the drivers cabin, or in a conspicuously marked location adjacent to the drivers door (see Fig 2.4).

Fig 2.4 Location of EPG

2.5.4 Hazard Classes

Dangerous substances are classified as belonging to one of nine hazard classes plus sub-classes. Hazard diamonds are assigned to each class and sub-class as shown in Fig 2.5.

1	EXPLOSIVES (Gelatine Dynamite)	EXPLOSIVE ★ 1
2.1	FLAMMABLE GASES (LP Gas)	FLAMMABLE GAS 2
2.2	COMPRESSED GASSES NEITHER FLAMMABLE NOR POISONOUS (Nitrogen Compressed)	NON-FLAMMABLE COMPRESSED GAS 2
2.3	POISON GASES (Chlorine)	POISON GAS 2
3	FLAMMABLE LIQUIDS (Petrol)	FLAMMABLE LIQUID 3
4.1	FLAMMABLE SOLIDS (Nitrocellulose)	FLAMMABLE SOLID 4
4.2	SPONTANEOUSLY FLAMMABLE SUBSTANCES (Phosphorous White)	SPONTANEOUSLY COMBUSTIBLE 4
4.3	SUBSTANCES FLAMMABLE IF WET (Calcium Carbide)	DANGEROUS WHEN WET 4
5.1	OXIDISING SUBSTANCES (Nitrates)	OXIDIZING AGENT 5.1
5.2	ORGANIC PEROXIDES (M.E.K.P.)	ORGANIC PEROXIDE 5.2
6	POISONOUS SUBSTANCES (Cyanides)	POISON 6
6	HARMFUL STOW AWAY FROM FOODSTUFFS (Arsenic Compound)	HARMFUL STOW AWAY FROM FOODSTUFFS 6
6	INFECTIOUS SUBSTANCES (Pathology Samples)	INFECTIOUS SUBSTANCE 6
7	RADIOACTIVE SUBSTANCES (Prescribed by Radioactive Substances Act 1967)	RADIOACTIVE 7
8	CORROSIVE SUBSTANCES (Sulphuric Acid)	CORROSIVE 8
9	MIXED CLASS LABEL	DANGEROUS GOODS

Fig 2.5 Hazard Classes

2.5.5 Emergency Information Panel

A requirement of the *Australian Code for Transport of Dangerous Goods by Road or Rail (A.D.G. Code)* is that a composite emergency information panel be displayed on all vehicles carrying more than specified quantities of dangerous substance(s).

In Fig 2.6 an emergency information panel is shown with typical examples of the following:

- chemical name, item (a) in Fig 2.6. The chemical or technical name of the substance.
- dangerous goods class label, item (b). This diamond-shaped symbol signifies the principal danger of the load carried;
- UN number, item (c). The entire range of UN numbers allocated for substances classified as dangerous is updated each year. If only the UN number of a substance is known, its chemical name and other information is available from the Emergency Response Guide Book or the DATACHEM information system;
- HazChem Code, item (d). This two or three position alpha-numeric code indicates the initial action required in the event of a dangerous substance incident;
- Emergency Services telephone number, item (e). This is a direction to the public to summon assistance.
- specialist advice, item (f). Here the name of the manufacturer or carrier and a telephone number for specialist assistance is indicated.

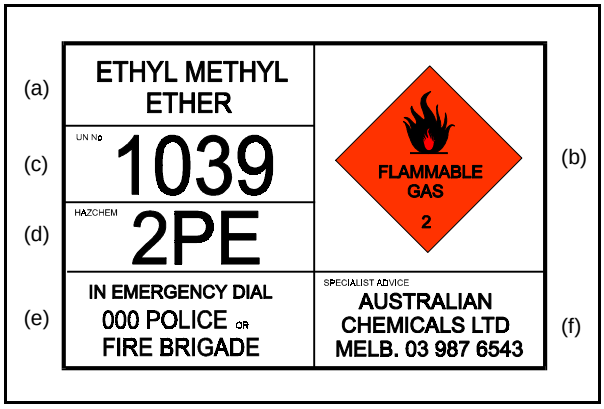

Fig 2.6 Emergency Information Panel

2.5.6 Location of Emergency Information Panel

Emergency information panels are to be fixed to the rear and both sides of road vehicles and to both sides of rail cars. In the event of an accident at least one panel should be visible to firefighters (see Fig 2.7).

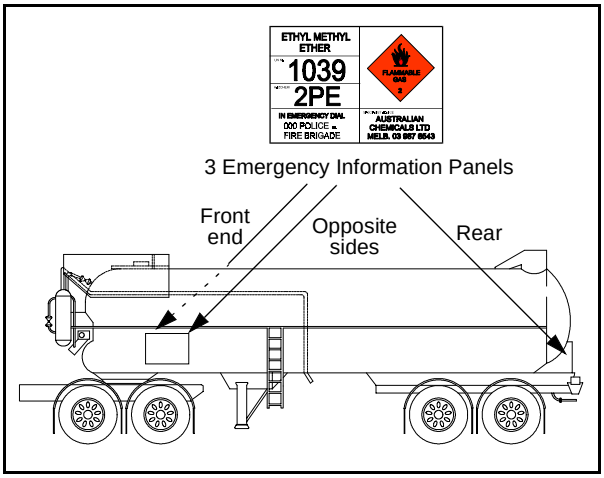

Fig 2.7 Location of Emergency Information Panel

2.5.7 Packing Groups

Under Dangerous Goods legislation, packages containing dangerous goods must be labelled in accordance with *Section 3* of the *Australian Code for the Transport of Dangerous Goods by Road and Rail*. Dangerous Goods of Classes 3, 4, 5, 6.1, 8 and 9 have been divided into 3

packing groups indicating the degree of danger presented by the substance as detailed in Table 2A.

GROUP	DEGREE OF DANGER
Packing Group I	Great Danger
Packing Group II	Medium Danger
Packing Group III	Minor Danger

Table 2A Packing Groups

The substance and the package or receptacle will be labelled accordingly. What you will see on the label is the following: PG I, PG II or PG III (see Fig 2.8).

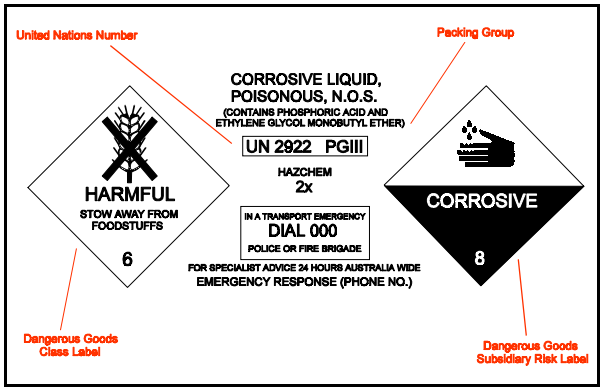

Fig 2.8 Identification of Packing Group

2.5.8 HazChem Code

During the initial stages of a spill or other dangerous substance incident, including fire, the HazChem Code points to the emergency action required. It is de-coded with the aid of the HazChem Scale, a card which is issued to all firefighters as well as being carried on all fire appliances (see Fig 2.9).

HAZCHEM SCALE FOR FIRE OR SPILLAGE

1 JETS
2 FOG
3 FOAM
4 DRY AGENT

P	v	FULL	DILUTE
R			
S	v	BA	
S		BA for FIRE only	
T		BA	
T		BA for FIRE only	
W	v	FULL	CONTAIN
X			
Y	v	BA	
Y		BA for FIRE only	
Z		BA	
Z		BA for FIRE only	
E		CONSIDER EVACUATION	

Fig 2.9 HazChem Scale

The HazChem Code has three positions. In Fig 2.6 the first position is **2**, the second **P**, the third **E**. Each position is de-coded separately.

The First Position

Codes **1**, **2**, **3** and **4** are the only codes used in this position. Each refers to one of the four fire fighting media.

1. De-code: **JETS** - The emergency will require water in the form of jets.
2. De-code: **FOG** - Water in the form of fog or gentle spray is to be applied if water in a form other than jets is needed.
3. De-code: **FOAM** - When the HazChem Code was devised foam generally meant Protein Foam, however, AFFF fluoro-protein and high expansion foams are now included in what was intended.
4. De-code: **DRY AGENT** - Dry agent generally means dry chemical powder or dry sand. Many substances particularly metals are difficult or impossible to extinguish without special agents and, according to the results obtained from dry chemical powder or dry sand, HazChem

Code **4** can mean **protect the surrounding risk and let the substance burn out**. The IC has to make such a decision when all the factors are known.

The no water warning is the important point of Code **4**. Carbon Dioxide and halons (BCF etc) are not suitable dry agents for some substances coded **4**. Carbon Dioxide reacts with some metals and the burning continues. The use of halon agents on fires produces halon acid gas and carbonyl halicides, which add greatly to the toxicity of the original halon.

⚠ NOTE

Where there is fire, a medium with a higher numerical code may be used instead of the one given, but never the reverse e.g. a fire involving a substance coded 2WE may be extinguished by fog, foam or dry agent, but never by jets.

The Second Position

One of the eight letters appears in the second position. De-coded, it will answer one or more of three important questions.

(1) Codes **P**, **S**, **W** or **Y** indicates that a violent reaction is possible because the substance has one or more of the following characteristics:

- it will explode when subjected to heat or shock because the substance is intrinsically unstable;
- it has a flash point below 61° C;
- it has the ability to cause an explosion, or greatly contribute to the intensity of a fire, when in contact with organic or other combustible material (powerful oxidisers come within this category);
- it will react violently with water e.g. the application of water to fuming sulphuric acid causes a violent reaction producing a large amount of heat;
- it will react with water to give off a flammable gas; and
- there is a danger of dust explosion.

⚠ NOTE

Chemicals coded 4 (Dry Agent) are not just coded P, S, W or Y just to warn of a violent reaction they react violently with water. Chemicals code 4W or 4Y can have one or more of the above reactions as well as a dangerous reaction with water.

(2) What personal protection is required? Some protective equipment is required for all hazardous materials incidents. The code indicates the kind to be used for a particular substance. The HazChem Scale lists three categories as follows:

- FULL - Code **P**, **R**, **W** or **X** calls for full protective clothing with BA:

  - to prevent toxic substance being absorbed through the skin;

  - to prevent a corrosive substance attacking the skin;

  - to prevent cold burns from cryogenic or rapidly vaporising liquids.

- to prevent heat burns from substances normally kept above the ambient temperature.

- BA - Code **S**, **T**, **Y** or **Z** (printed on white background) means that BA and protective gloves are to be worn. All personnel attending chemical incidents are to wear gloves to avoid traces of chemicals picked up by NSWFB equipment adhering to hands or under fingernails and likely to be ingested later.

- BA for FIRE only - Code **S**, **T**, **Y** or **Z** (printed on black background) calls for BA only when fire is involved. Protective gloves are worn if there is fire or not.

(3) Is spillage to be diluted or contained?

- DILUTE - Code **P**, **R**, **S**, or **T** means that the substance may be washed away. Only after consulting with the *EPA* or *Water Authority.*

- CONTAIN - Code **W**, **X**, **Y** or **Z** means that the spillage must be prevented from entering drains or water courses.

⚠ NOTE

All spills must initially be contained until more information on dilution or containment is known

The Third Position

Code **E** means **Consider Evacuation**. It appears in this position only if:

- toxic, asphyxiant or flammable gases or vapours are likely to spread outside the area of a possible incident;

- a violent explosion may occur and affect an area outside that of the incident; and

- the flash point of the substance is below 23° C.

The extent of the evacuation depends upon the nature of the chemical, wind condition, the size of the incident, the amount of material and the environment. The general view taken by organisations concerned with dangerous goods is that 200 m is a minimum safe distance. An evacuation can take a long time to effect and may be overtaken if it is delayed. The decision to evacuate and to what extent rests entirely with the IC.

2.5.9 Mixed Load Codes

A load with a mixture of dangerous substances needs a HazChem Code for the combined load. It must be derived from the two or more different HazChem Codes available before the appropriate emergency action is known.

The emergency information panel on a mixed load will normally contain two or more HazChem Codes (see Fig 2.10).

2PE,3S,2Z

Fig 2.10 HazChem Code

First Position. The highest of all the code numbers being considered is the code for the first position of the **mixed** code. As you can see from Fig 2.10 the highest code in this example is **3**.

Second Position. In Fig 2.11, look down the left column and find the letter which corresponds to the second position of one of the HazChem Codes found in the mixed load.

From the example in Fig 2.10 you can see that you could use **P**, **S** or **Z** to start with. Lets start with the letter **P**, so look down the left column till you find the letter **P** and then look along the top horizontal line to the letter which corresponds with the second position of the next code found in the load. In our example the next letter is **S**, so where the horizontal and vertical lines from these two letters intersect is the second position of the **mixed** code.

The letter you end up with from looking at the codes in Fig 2.11 is **P**.

⚠ NOTE

If more than two codes are being considered, take the result from the second positions of the first two codes and apply it, as above, with that of a third HazChem Code for a new result.

	P	R	S	S	T	T	W	X	Y	Y	Z	Z
P	P	P	P	P	P	P	W	W	W	W	W	W
R	P	R	P	P	R	R	W	X	W	W	X	X
S	P	P	S	S	S	S	W	W	Y	Y	Y	Y
S	P	P	S	S	S	S	W	W	Y	Y	Y	Y
T	P	R	S	S	T	T	W	X	Y	Y	Z	Z
T	P	R	S	S	T	T	W	X	Y	Y	Z	Z
W	W	W	W	W	W	W	W	W	W	W	W	W
X	W	X	W	W	X	X	W	X	W	W	X	X
Y	W	W	Y	Y	Y	Y	W	W	Y	Y	Y	Y
Y	W	W	Y	Y	Y	Y	W	W	Y	Y	Y	Y
Z	W	X	Y	Y	Z	Z	W	X	Y	Y	Z	Z
Z	W	X	Y	Y	Z	Z	W	X	Y	Y	Z	Z

Fig 2.11 Mixed Load Codes

From our example in Fig 2.10, the next letter is **Z**, so you would look down the left column until you find the letter **P**, then look along the top horizontal line to the letter which corresponds with the second position of the next code found in the load. In our example as the next letter was **Z**, where the horizontal and vertical lines from these two letters intersect is the final position of the mixed code.

The letter you end up with from looking at the codes in Fig 2.11 is **W**.

Repeat this procedure until all the HazChem Codes are incorporated and you have the second position of the HazChem code to represent the combined load.

Third Position. If any code found in a mixed load has code **E** in the third position then the code for the mixed load shall also have **E**. So from our example for a mixed load code, **2PE**, **3S** and **2Z** we get the HazChem Code **3WE**.

In situations where the Hazardous Material(s) has not yet been identified or where no means of identification are available, the Hazardous Material(s) is to be considered as requiring the highest level of protective clothing, i.e. treat the unidentified substance as having a HazChem code of **4WE**.

2.6 Assess Potential Harm

Assess the potential harmful properties of the material by careful consideration of the following items:

- physical properties;
- flammability;
- reactivity;
- corrosion;
- radioactivity;

- health hazards; and
- environmental hazards.

The most effective method of assessing the potential for a substance to threaten life or the environment is to seek advice from specialist present at the scene e.g. Chemists at a chemical plant incident. However, if no one is available, the NSWFB has other methods at its disposal that can be used. These include:

- HazChem Code;
- Emergency Response Guidebook (CANUTEC);
- HAG form;
- DATACHEM;
- Stored Chemical Information Data System (SCIDS); and
- Materials Safety Data Sheets (MSDS).

The Emergency Response Guidebook is issued to all appliances in the NSWFB and used at dangerous substance incidents in conjunction with the HazChem Code and the Initial Emergency Response Guidebook. They are only intended as interim measures until further information can be obtained from the State or Regional Communications Centres' DATACHEM.

2.6.1 CANUTEC - Initial Emergency Response Guidebook

The CANUTEC book is simple to use and is set out in the following manner:

- the first section (orange pages) lists alphabetically, the names of materials and is referenced to appropriate guide numbers, and product identification number PIN/UN Number;
- the second section (green pages), lists UN numbers (referred to as PIN - product identification number) and NA numbers - a generic code to North American products, in numerical order. Each PIN is referenced with the appropriate guide number and the name (shipping name) of the material; and
- the third section (yellow pages), is the guide section. Numbered from 01 to 52, these guides contain information relating to a product, or products with similar characteristics and properties, and are divided into three sections. The first section is *Potential Hazards* and gives information on fire or explosion, and health. The second section is titled *Emergency Response* which contains information on combating the problem (Fire/spill or leak) and first aid.

⚠ NOTE

Each guide covers two pages (facing).

The guide book reference to CANUTEC, is to be taken to mean State or Regional Communications Centres DATACHEM.

⚠ NOTE

When the CANUTEC book states wear SCBA and chemical protective clothing, it means fully encapsulated suits and positive pressure BA. Structural firefighter's protective clothing includes the wearing of chemical resistant rubber gloves.

The grey coloured pages in the book contain information as well and should not be overlooked. On the inside front cover, and facing pages is a listing of dangerous goods placards and a relevant guide. In both instances, if the shipping name or PIN is unavailable, and in the case of the bulk container the placarding is unavailable, a guide can be referenced initially.

A glossary is included for definition of terms used at hazardous materials incidents.

Members are to become familiar with the Emergency Response Guidebook to anticipate its need during an emergency

Any quantity of a dangerous substance less than that requiring the display of a composite emergency information panel (which displays the HazChem Code), must still display the relevant Dangerous Goods Diamond, and UN Number, additionally shipping papers should state the dangerous substance's name, classification and UN Number. Even if the HazChem Code is not available, initial emergency response guidance is at hand in the Guidebook by using the name or the UN Number.

2.6.2 DATACHEM

DATACHEM is a national computerised data base for safety precautions for each of more than 60 000 dangerous substances on record.

In NSW the system can be accessed by operators at State and Regional Communications Centres (02) 93197000, the Hazmat Response Unit (02) 97427320.

The information supplied to the DATACHEM program is supported by Chemsafe (*ICI* Australia) a member of the *Plastics and Chemicals Industry Association* (*PACIA*).

ICI encourage other chemical companies to contribute to their Chemsafe program as a cost effective way of meeting product stewardship obligations.

There are two instances in Australian legislation where companies provide a 24 hr emergency contact telephone numbers.

(a) Companies consigning bulk dangerous goods are:

- effectively required to provide a 24 hr telephone service so that in the event of an emergency technical advice can be given.
- required to provide when requested by emergency services a trained and competent person at the scene of the incident and special equipment needed for recovering the dangerous goods (*State and Territory Regulations for the transportation of Dangerous Goods*).

(b) If the chemical identity of a hazardous ingredient of a chemical product is not disclosed on an MSDS or label, then the company is obliged to provide that information at any time at the request of a medical practitioner.

A hard copy can also be sent by teleprinter or fax through State and Regional Communications Centres or by fax through the HazMat Response Unit in Sydney.

2.6.3 Protective Clothing and Equipment

Three categories of DATACHEM information require the following clarification about protective clothing used by the NSWFB.

Protection

In addition to BA, the three main types of protective clothing which may be specified on a DATACHEM print out under (protection) have the following meanings for firefighters:

- gas-tight chemical protection - the minimum protection required is a fully encapsulating gas suit, or other NSWFB gas-tight suit;
- chemical protection suit - the minimum protection required is a spillage suit; and

- protective gloves and boots - the minimum protection required is chemical and chemically resistant rubber boots plus normal turnout clothing.

HazChem Code

The HazChem Code does not differentiate between gas-tight or spillage suits. Seek further information under *APP Code* in DATACHEM.

Decontamination

If DATACHEM specifies **neutralise with soda ash**, and soda ash is not readily available, builders' lime may be used.

The DATACHEM refers to decontamination of personnel and equipment that have been exposed to hazardous materials. It does not refer to the requirements for handling a spill.

2.6.4 Explanation of Codes and Abbreviations

doc no refers to document number and any numbers following refer to a specific record in the DATACHEM data bank

EAC stands for Emergency Action Code which is better known as HazChem Code. Refer to the HazChem Code explanation earlier in this topic.

APP Code stands for Additional Person Protection Code. If the protection of personnel requires protective clothing in addition to that suggested by the HazChem Code, and APP Code letter or letters will appear here. Decode each letter as follows:

- **Code A** - This substance attacks protective clothing. Exposure to high concentrations should be limited to the duration of one BA cylinder.
- **Code B** - A gas-tight chemical protection suit capable of giving complete protection from the environment should be worn.
- **Code C** - Positive-pressure BA should be worn because of the highly toxic properties of the gases.
- **Code F** - No type of protective clothing affords adequate protection and special operational procedures are necessary.
- **Product name** will be followed by either the chemical name or the trade name.
- **SI Number** stands for Substance Identification Number and refers to the UN number. The four digit number that follows will be either for a specific substance or generic i.e. for a group of similar substances.
- **UN hazard class** dangerous substances are classified into hazard classes and sub-classes. See the specially designed UN hazard diamonds assigned to each class and sub-class earlier in this topic. DATACHEM does not sub-divide classes 2 and 3 but presents them as 2.0 and 3.0.
- **ADR/RID code** stands for a hazard description code found in EEC countries. It is not applicable in Australia
- **TREMCARD** stands for Transport Emergency Cards for commonly transported dangerous substances plus group tremcards to cover other chemicals. The cards are designed to be carried in the cab of the truck or with train crews. The information is designed specifically for handling of transportation incidents.

- **IMDG Code** stands for International Maritime Dangerous Goods Code. It is used by Port Authorities such as the *Maritime Services Board.*

- **NFPA Code** stands for National Fire Protection Association Code. The three digits code given here is a guide to the degree of hazard using three categories; Health, Flammability and Reactivity. An abbreviated decode is shown in Fig 2.12.

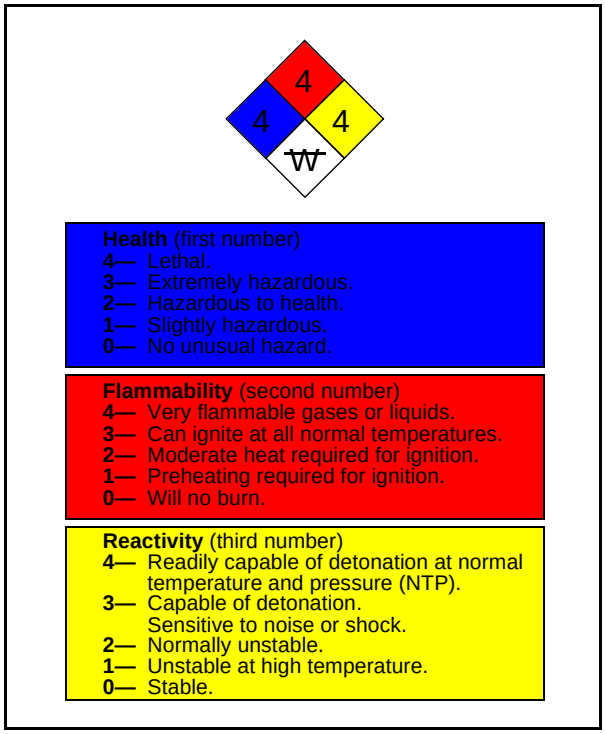

Fig 2.12 NFPA Code

F-pt - The numbers following this heading indicate flash point in degrees Celsius. The symbol > means greater than the following number. The symbol < means less than the following number.

The information provided under the following six headings is in plain language and no decoding is required.

- Hazard;
- Form;
- Precaution;
- Fire;
- Decontamination; and
- First Aid/Medical.

It should be noted that DATACHEM and the Emergency Response Guidebook only supply information regarding initial actions to achieve a safe working environment. For information regarding the most effective clean-up method, specialist advice should be sought.

2.7 Stored Chemical Information Data System

2.7.1 Introduction

Stored Chemical Information Data System (SCIDS) is an inventory of what dangerous goods are kept at different sites. The information database has been developed by the *WorkCover Authority* in conjunction with the NSWFB.

The information given is mandatory for businesses licensed with WorkCover. The database can be accessed by the NSWFB State Communications Centre, Hazmat Response Unit at Sydney, Newcastle and Wollongong, as well as the Fire Safety Division, Greenacre.

2.7.2 Database Information

The information contained on the database includes:

- a plan of the licensed premises including depot sites;
- the maximum quantity of the class of dangerous goods stored at that particular depot;
- the types of chemicals of that class of dangerous goods normally stored at that depot;

- the fire protection available on the site, and
- their hazards and control procedures (MSDS).

2.8 Materials Safety Data Sheet

2.8.1 Introduction

Manufacturers, suppliers and importers are required in legislation (*Occupational Health and Safety Act 1983, S. 18 (2) (c)*) to provide information about substances to ensure that they can be used safely and without risks to health. This information is supplied in the form of a MSDS.

MSDS contain the following information:

- UN No;
- Dangerous Goods class; and
- Packing group.

2.8.2 Information Contained

MSDS also contain the properties and characteristics of the product:

- Specific gravity;
- Vapour density;
- Auto ignition;
- Flash point;
- Explosive limits; and
- Water solubility.

Health Hazard Information: This section of the MSDS sheet contains specific First Aid procedures.

Precautions for use relates to exposure standards and level that are measured using gas detection equipment as outlined in *Section 3*.

The terminology used in conjunction with gas detection equipment i.e. *TWA, STEL, PEAK, LD50* etc are also referred to in *Section 3*.

Exposure standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept as low a level as workable. Exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals.

MSDS sheets may also be included with a transport vehicle consignment documents.

2.9 Additional Resources

As at large fires it is in no way expected that the first responders to a hazardous material incident must handle the emergency without assistance. Indeed, the NSWFB role is only to render safe, not to arrange for final clean up operations. Even a very simple incident may take several hours to achieve a satisfactory outcome and so it is expected that resources both internal and external assistance will be required, and include both personnel and equipment.

Having assessed the danger to life and the environment, decisions should be made relating to the most efficient strategy for rendering safe the involved substance and area. A list of authorities which may be able to contribute to a smooth operation is detailed below:

Essential

- additional NSWFB Units especially Hazardous Materials Response personnel and equipment;
- *EPA*. Whilst the *EPA* may not necessarily attend they are available for advice;
- Police for evacuations, crowd/traffic control and overall authority of safe area;

- owner of materials; and
- material specialists to help plan the best method of rendering safe.

Non-Essential

- medical teams;
- local council representatives;
- local council sand or earth supplies;
- media groups to inform public of areas to avoid; and
- Water Authorities.

Country Areas

It should be remembered that where a serious incident arises, personnel and equipment from Sydney and other areas may be flown by helicopter or fixed wing aircraft to assist if required.

2.10 Monitoring Information

Having initiated an appropriate response to the emergency faced, it is important that an on-going review of new and existing information is made. Particular attention should be paid to:

- safety - Is everyone operating safely in all three zones?;
- strategy - Is the operation accomplishing what it is supposed to?;
- size of operation - Are too many or not enough units working on the scene?; and
- support - Are there enough support personnel available if something goes wrong?

Adequate Resources

Is there enough equipment e.g. absorbents remaining to last for the duration of the incident?

Legal Considerations

Is there complete documentation of all data collection and decisions made?

2.11 Decontamination and Render Safe

At some point, after the operation has begun the IC will decide that the hazard has been rendered safe. This may have included:

- dyking to prevent spread;
- absorbing in sand, chemisorb pillows, sawdust etc;
- neutralising the material;
- reducing flammability with foam etc; and
- containing in a suitable drum, such as a Recovery Bin.

At this point decontamination of all equipment and the making up of the zone can take place.

The NSWFB role then becomes one of support only, and responsibility for final clean up must be handed over to the owner of the material.

If the owner or *EPA* is not present and cannot be contacted, the NSWFB **must not** transport materials themselves. Responsibility for disposal lies with the:

- manufacturer;
- agent; and
- importer.

Disposal may be carried out by the appropriate authority:

- *RTA*; and
- local councils or shires.

The cost of disposal is recovered from industry.

2.12 Medical Management of Firefighters Exposed to Chemicals

Arrangements for the medical management of firefighters who may come into contact with chemical/toxic substances in the course of their duties are as follows:

2.12.1 Member's Actions

Members who have attended an incident at which they have reason to believe that they were exposed to chemicals or toxic fumes which may lead to impairment of their health should contact the NSWFB Occupational Physician, on (02) 265 2800 or, if they consider the matter to be urgent, by ringing State Fire Command on (02) 699 7000.

2.12.2 OIC Actions

Officers-in-Charge of incidents/fires involving chemical/toxic substances are to advise State Fire Command in order to ensure that the Occupational Physician is immediately notified of the situation.

The Senior Supervisor at State Fire Command is to take appropriate action to notify the Occupational Physician either by telephone or pager unit, immediately State Fire Command is advised that NSWFB personnel are involved with chemical/toxic substances.

2.12.3 Senior Supervisor Actions

The Senior Supervisor at State Fire Command will ensure that the following are also notified:

- Regional Commander when incident/ fire occurs in the Greater Sydney Area (GSA) (0800 - 1600 hours Monday to Friday).
- Duty Zone Commander when incident/fire occurs in the GSA at times outside the above times.
- Country Zone Commander when incident/fire occurs in country areas.
- Operational Commander for *all* such incidents.

2.12.4 Occupational Physician Actions

The Occupational Physician will liaise with the appropriate authorities and with hospitals, as necessary, for advice and for such medical treatment, tests, etc as might be required as a result of such incidents.

Recovery of information following the testing of personnel exposed to chemical/toxic substances is important to their future medical management. The Occupational Physician recommends that the following protocol be observed in that regard:

Each firefighter taken to hospital for tests should complete an *Authority* form requesting the hospital to forward results of the tests under confidential cover to:

Occupational Physician
NSW Fire Brigades
PO Box A249
SYDNEY
NSW 2000

This protocol will allow a complete medical history of possible exposures to be maintained by the Occupational Physician for the assurance of each member or the fire fighting staff.

SECTION THREE - HAZMAT EQUIPMENT

CONTENTS

3 HAZMAT EQUIPMENT

3.1 30 L Storage Bins

These reusable black plastic bins are fitted with screw on lids, and can be used for the storage of substances, absorbents, pillows or booms.

3.2 200 L and 60 L HazMat Recovery Bins

These robust orange plastic bins are fitted with screw on lids and an **O**-ring to provide liquid and gas tightness. They can be used for the recovery of a dangerous substance or for placing containers holding hazardous material in. The 200 L bins have the capacity to hold large objects (see Fig 3.1).

Heavy objects, such as a half full 200 L drum, are best placed in a recovery bin by using the following procedures:

- place the lid of the recovery bin upside-down on the ground;
- manoeuvre the drum or package etc, on to the lid;
- place the body of the recovery bin over the contaminate and screw down on the lid; and
- the recovery bin may then be inverted.

⚠ NOTE

All bins given to external agencies have to be entered into the HazMat Recovery Bin Receipt Book.

Fig 3.1 HazMat Recovery Bin

3.3 Recovery Bin Sealing Tape

Once the lid is sealed on the recovery bin, sealing tape is placed around the join between the lid of the bin and the body, as a visual and physical warning that the bin contains contaminated materials (see Fig 3.2).

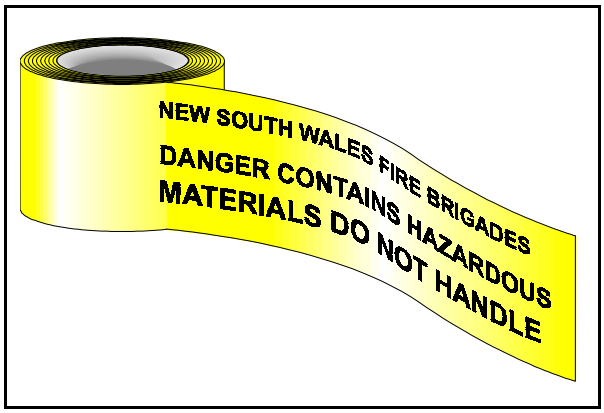

Fig 3.2 Recovery Bin Sealing Tape

3.4 pH Indicating Paper

The pH scale is the measure of the acidity or alkalinity of a substance. It is based on the concentration of H+ (Hydrogen) ions in

solution. Most substances fall in the normal pH range of 0 to 14. The characteristics are as follows:

- a neutral solution has a pH of 7;
- an acidic solution has a pH less than 7; and
- an alkaline solution has a pH greater than 7-14.

The pH paper enables a reading to be over the 0 - 14 pH range of a sample. This knowledge allows the correct method to be employed to neutralise the contaminate. pH readings also indicate the effectiveness of neutralisation of a contaminate, the closer the pH reading is to seven the closer to neutral is the contaminate.

The pH scale is logarithmic. This means that a change of one pH number indicates a ten-fold change in concentration i.e. an acid with a pH of 1 is ten times more concentrated than an acid with a pH of 2.

The pH paper is dipped into the substance and the coloured strip compared to those on the packet (see Fig 3.3) to determine the pH value.

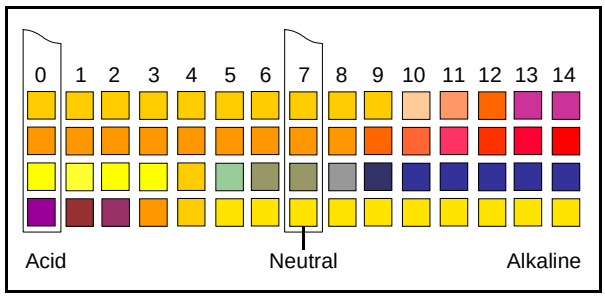

Fig 3.3 pH Indicator Chart

3.5 Spillage Gloves and Boots

Heavy duty rubber gloves and boots are supplied to each station for use as protection from contamination at HazMat incidents. These gloves and boots are to be worn any time a risk of contamination is present.

⚠ NOTE

Fire fighting gloves and boots are not sufficient protection as they will allow contaminates to pass through to the skin.

These gloves and boots are not designed to give long term protection against immersion in aggressive substances i.e. strong acids and alkalis.

3.6 Thermal Imaging Camera

The NSWFB uses two types of Thermal Imaging Camera (TIC), the *EEV* P4428 Miniature TIC and the *ARGUS* type P4438 vision system.

The TIC's are maintained at the BA/HazMat Section, Greenacre.

The TIC is designed to aid firefighters in fire and rescue operations where smoke and darkness obscure normal vision. The TIC converts infra-red radiation into a visible form. This allows the user of the camera to view temperature variations as a black and white image through the in-built monitor.

By detecting the relative temperature of objects within the incident ground it can assist the firefighters in locating casualties, or in assessing the seat and spread of the fire.

⚠ NOTE

The TIC is a specialised piece of equipment that requires a trained operator who is familiar with this specific type of equipment. For this reason, if an incident occurs where a TIC is required, the BA/HazMat section at Greenacre should be contacted immediately.

3.6.1 P4428 Thermal Imaging Camera

The P4428 (see Fig 3.4) is a small TIC used to detect infra-red radiation.

Fig 3.4 P4428 Thermal Imaging Camera

The P4428 is a self-contained battery operated TIC incorporating a miniature display monitor. It is primarily intended for use at incident grounds involving fire, and gives good quality thermal pictures through dense smoke, where normal vision is impossible.

Advantages In Use

- provides clear vision through smoke;
- instantly shows location of fire source;
- substantially increases firefighter mobility in smoke-filled areas; and
- improves firefighter safety by making obstacles and hazards visible.

Special Features

- self-contained, compact and portable for hand-held use;
- integral viewfinder/monitor gives the operator a clear image;
- flicker suppressor gives very steady pictures in the *chopped* mode;
- lightweight 4 kg total;
- removable pistol-grip handle; and
- wide angle germanium lens.

Operating Procedures

The image displayed on the P4428 TIC, is a result of infra-red radiation being given off by the objects in the field of view, and it is necessary for the operator to interpret the visual information being displayed.

To operate the TIC, proceed as follows:

- check that the battery pack contains ten AA alkaline batteries;
- the battery pack should be inserted into the voltage stabiliser unit (see Fig 3.5);
- switch on the TIC; and
- a black and white image will be displayed on the screen.

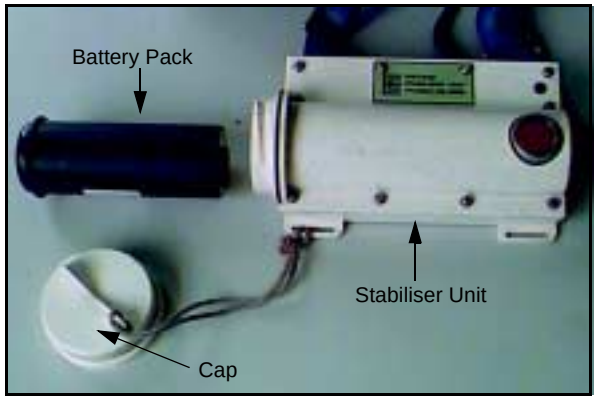

Fig 3.5 P4428 TIC Stabiliser Unit

The TIC may be operated in two modes, *panned* or *chopped*. In the panned mode, the image on the monitor represents changes in the temperature differences in the field of view, and the picture will disappear if the camera steadily views a constant temperature distribution in the scene. In this mode the camera must be oscillated slightly by the user in order to maintain the image.

In the chopped mode a rotating shutter in the camera chops the incoming radiation, and the image effectively represents the scene temperature distribution when the viewer is stationary.

The temperature discrimination in the chopped mode is approximately half that in the panned mode, but the need to move the camera in the panned mode is often an unacceptable inconvenience.

A selector (see Fig 3.6) on the camera provides chopped or panned operation as required.

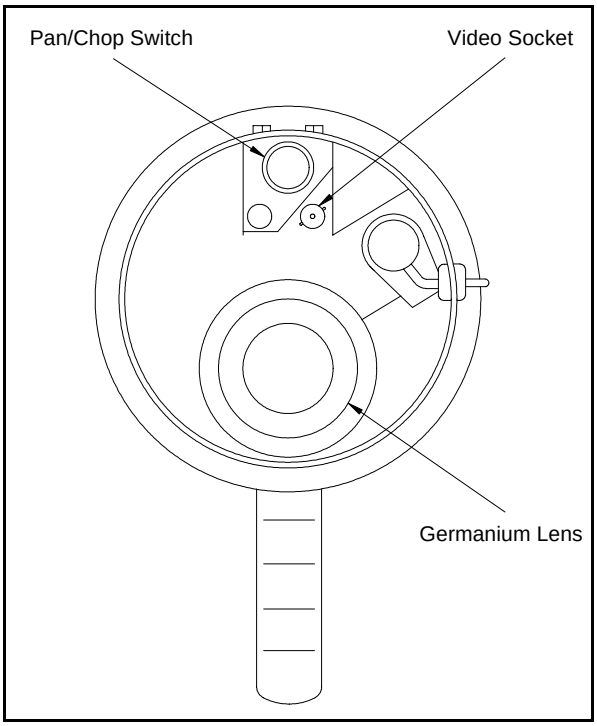

Fig 3.6 P4428 TIC Controls

External Controls and Connections

The voltage stabiliser unit containing the battery cartridge is provided with an on-off switch.

Thermal Environment

The sealed camera container is enclosed in a waterproof outer jacket with good thermal insulating properties. It is designed to operate at 60° C during a run of 1 hr, representing a typical maximum tolerance for an operator in a fire fighting situation.

Specifications

The specifications for the P4428 TIC are detailed in Table 3A.

ITEM	SPECIFICATION
Overall dimensions (excluding handle)	160 mm dia x 270 mm approx
Net weight (excluding batteries)	3.8 kg approx
Visor	Neoprene
Power consumption	4 W approx
Voltage	9.3 to 15 V dc at 0.4 A regulated to 8.7 V dc
Battery quantity, type and duration	10 size AA alkaline disposable cells - 1.5 hrs approx

Table 3A P4428 TIC Specifications

Cleaning Procedure

When the TIC is used at an incident ground, the lens can become contaminated with soot. oil and moisture. To remove this contamination, the lens should be cleaned by wiping it with a clean cloth.

Battery Replacement

To replace the batteries (see Fig 3.7) in the TIC, proceed as follows:

- unscrew battery compartment cap on the end of the voltage stabiliser unit;
- slide out the battery cartridge;
- remove the screw from the top of the battery cartridge to release the cover from the battery carrier;
- replace the batteries;
- mount the outer cover on the battery carrier and tighten the retaining screw; and
- insert the battery carrier into the voltage stabiliser unit.

Fig 3.7 P4428 TIC Battery Carrier

Maintenance

After use and prior to stowing, the TIC should be cleaned using a cloth soaked in warm soapy water.

3.6.2 ARGUS Type P4438 Vision System

The *ARGUS* type P4438 vision system TIC is shown in its carrying case at Fig 3.8.

Fig 3.8 ARGUS P4438 Vision System

Specifications

The specifications for the *ARGUS* P4438 Vision System TIC are detailed in Table 3B.

P4438 Operating Procedures

When using the TIC the image displayed is a result of infra-red radiation being given off by the objects in the field of view. It is therefore necessary for the operator to interpret the visual information being displayed.

To operate the TIC, proceed as follows:

- remove the TIC from its carrying case;
- check that the battery pack (see Fig 3.9) contains eight AA batteries;
- the battery pack should be inserted into the handle of the TIC. Open the battery compartment door and insert the battery pack using the correct orientation;

Fig 3.9 P4438 TIC and Battery Pack

- turn on the TIC by pressing the switch (see Fig 3.10) located at the rear. The switch will latch and illuminate a red light in its centre;

ITEM	SPECIFICATION
Dimensions	30 x 29 x 12 cm (W x H x D) nominal
Weight	2.6 kg nominal (including batteries)
Power supply	8 primary batteries type LR6 or NICAD rechargeable pack
Battery life	60 to 90 mins continuous operation

Table 3B ARGUS P4438 Specifications

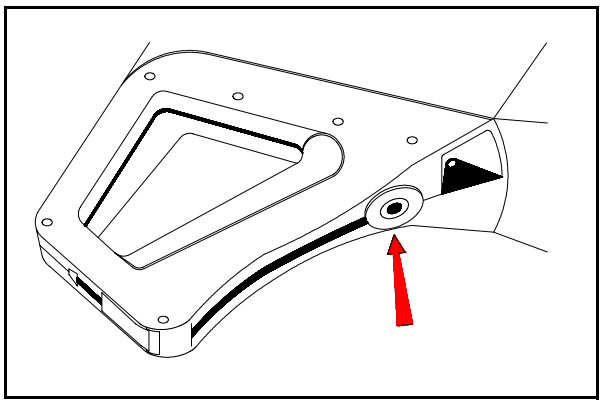

Fig 3.10 P4438 TIC On/Off Switch

- wait for 15 secs. During this time the TIC goes through an automatic set-up procedure;

- 5 secs into this set-up procedure, the TIC will display a battery status bar (see Fig 3.11) and a blanked circle; and

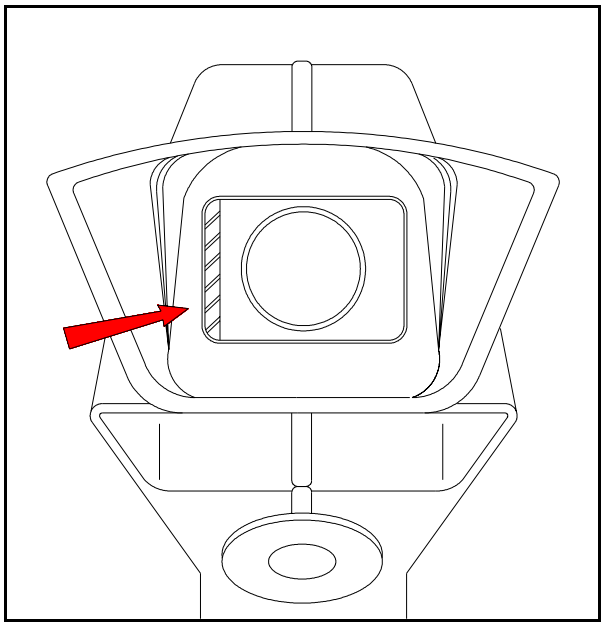

Fig 3.11 P4438 TIC Battery Status Bar Indicator

- after the full 15 secs a black and white thermal image (see Fig 3.12) of the scene is displayed.

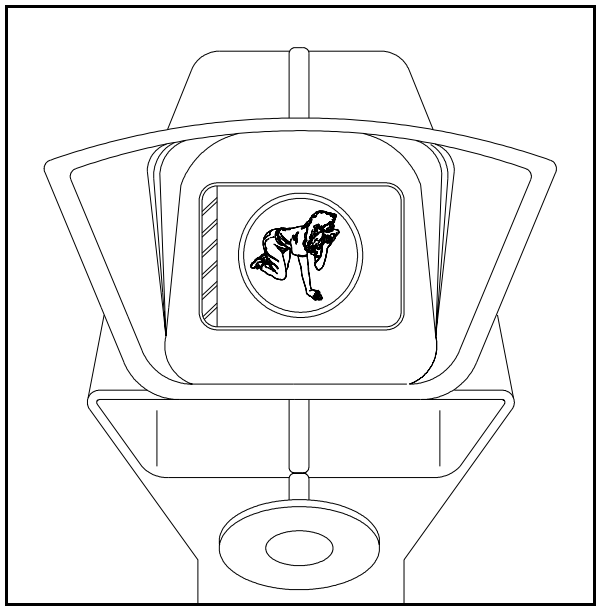

Fig 3.12 P4438 TIC Display

Relative Temperatures

The image displayed is simply a black and white picture of the infra-red energy entering the lens. The TIC displays relative temperature differences between individual objects and their surroundings, irrespective of overall ambient temperature.

The TIC is set up to display objects as various shades between black for cooler items to white for hotter bodies. In a room at 20° C a cold drink would appear black whilst a hot radiator would appear white. If the room was at 250° C, it is possible that the same hot radiator may appear darker than burning materials.

Fires and Hotspots

The TIC will represent zones of very high temperatures as white zones within the picture. Very small fires or smouldering materials will cause the automatic iris to close down slightly, but the image of surrounding objects will remain clearly visible. Large or extremely hot fires will cause the camera iris to close down fully to prevent overload of the image sensor. This is entirely normal and the TIC will not sustain damage. By moving the TIC such that

the fire is *out of picture,* or occupying as little of the picture as possible, the iris will re-open to enable the image to be restored.

Hidden Fires

A fire may be burning or smouldering behind doors or in ducting, and it could be hidden in floor or wall cavities. Under these circumstances, the operator should look for areas which appear whiter when compared to the surroundings. A white area on an otherwise dark wall would normally indicate fire behind that section of masonry.

Image Clarity

The sharpness and clarity of the image provided is related to the temperature of the scene and objects in view. A cold room provides little infra-red energy and less detail is detected than in a warm environment where objects give off significant energy. In general, the warmer the scene the more thermal contrast and the greater the detail in the picture.

Heat Layers

In a major fire, a layer of hot gases may build up in the upper region of a closed space. Attempting to use the TIC in this hot layer will cause the image to become featureless and totally white. The TIC should be aimed below this level of hot gases to obtain a clearer picture of the scene.

Windows and Polished Surfaces

Glass is not transparent to long wavelength infra-red energy and it is not possible for the TIC to look through a window. A white window would indicate that the window itself is relatively warm and may be being heated by a fire behind it. Just as we see reflections in glass under normal circumstances, it is possible that the TIC will detect infra-red reflections in glass, mirrors and polished or painted surfaces. Ensure the image that you are looking at is not a reflection.

Smoke

The TIC will provide vision through all types of smoke and steam.

Cleaning Procedure

When the TIC is used at an incident ground, the lens can become contaminated with soot, oil and moisture. To remove this contamination, the lens should be cleaned by wiping it with a clean cloth.

Battery Replacement

The battery pack will power the TIC for a minimum of 60 mins. To replace the batteries (see Fig 3.13), remove the battery pack from the handle of the TIC and use the following procedure:

- open the battery cartridge by pressing down on the contact end while holding the outer case;
- the contact end will slip out of the sleeve;
- remove the old batteries;
- insert eight new AA batteries in the orientation shown on the inner carrier;
- insert the battery pack into the handle of the TIC; and
- operate TIC to check that it is operating correctly.

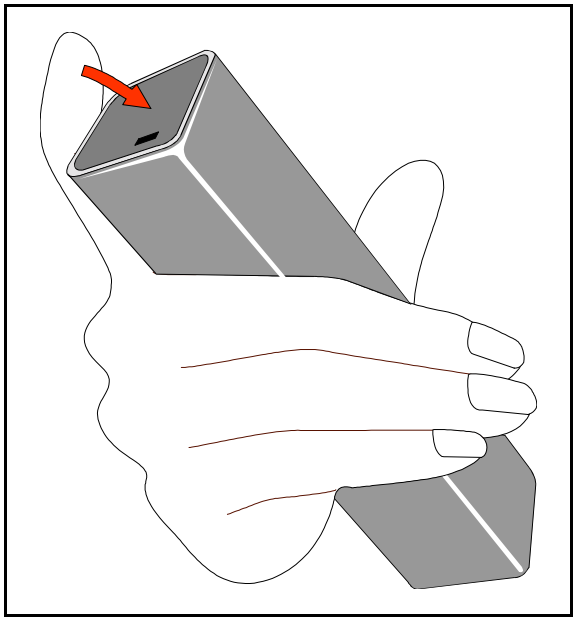

Fig 3.13 Battery Cartridge

Maintenance

After use and prior to stowing, the TIC should be cleaned using a cloth soaked in warm soapy water.

3.7 Radiation Meters

The BA/HazMat Section have a variety of meters for the detection of radiation such as:

- contamination;
- personal dosimeters; and
- source detection meters.

⚠ NOTE

The detection of radiation involves the use of specialised equipment that requires a trained operator who is familiar with this specific type of equipment. For this reason, if an incident occurs where radioactive material is involved, the BA/HazMat Section at Greenacre should be contacted immediately.

An incident involving radioactive substances should be reported to the NSWFB Communications Centre.

3.7.1 Decontamination Meter

The *Mini Instruments* series 900 Mini Monitor is used by the NSWFB. The meter is used to measure contaminates on combat crews during the decontamination process. The meter (see Fig 3.14) is equipped with a probe that is connected to the unit via a flexible cable.

Fig 3.14 Series 900 Mini Monitor Decontamination Meter

Operating Procedure

There are two external controls:

- a four position rotary switch labelled with symbols **OFF**, **BAT**, **ON**, **SPEAKER OFF**; and
- a screwdriver control to set alarm level.

The state of the battery is indicated on the meter when the switch is turned to the position marked **BAT**. In this position the battery is subjected to a current drain in excess of that used in normal use. In order to ensure that the

battery is satisfactory, the pointer should be observed for about 10 secs to see if it falls below the green sector. If so, the battery should be changed.

Alarm Level Adjustment

The alarm level is variable from zero to beyond the limit of the scale. It is set by using a test source to give the desired level and adjusting the front panel control with a small screwdriver. The alarm resets when the radiation level falls below the trip level. If the control is turned fully clockwise the alarm is disabled for all levels on the scale. The alarm is not disabled for overload conditions providing this adjustment is correctly made. In addition, the alarm is not switched off by the *speaker off* position.

Precautions in Using Contamination Monitors

It is essential that firefighters using decontamination monitors should be able to interpret the results and are aware of the instrument's limitations.

When using the decontamination monitor, the following points should be observed:

- make sure that the battery is in good order. Do not perform the battery check too hastily or it will not give a true indication of battery condition;
- ensure that the monitor is working by noting if it is responding to background radiation. It is sensible to check the monitor with a radioactive source to see if it is giving the expected reading and audible signal;
- some x-ray machines and particle accelerators produce radiation in short pulses. If the intensity of the radiation in these pulses is sufficient to cause a response at a rate exceeding an order of magnitude less than the pulse repetition frequency then non-linearity of response will occur. At the limit the monitor indicates pulse repetition frequency and not the radiation intensity;
- the monitor is **not** intrinsically safe and must **not** be used in potentially explosive atmospheres;
- all probes are fragile. If you drop the probe it may not work again; and
- the monitor is not of robust construction and will not withstand rough handling.

Maintenance

The meter must be recalibrated annually. It is essential that the meter is operating correctly and has been calibrated as its operation could be questioned at a coronial inquiry. The meter should have a valid calibration sticker attached to it (see Fig 3.15).

All radiation meters must be returned to the HazMat Section at Greenacre for calibration annually. If the equipment does not have a sticker or the instrument is past its calibration date, it must be returned to the HazMat Section at Greenacre.

RADIATION METER

CALIBRATED / /
Unit N° .....
Type .....
Serviced by .....
Due for Calibration / /

Fig 3.15 Radiation Meter Calibration Label

3.7.2 Personal Meter

The NSWFB uses the Bleeper Sv which is manufactured by *Radiation Components Limited* for personal radiation monitoring. The Bleeper Sv (see Fig 3.16) is a pocket sized

instrument that gives an audible warning of radiation dose rate, and a continuous display of the accumulated dose.

Operating Procedure

To operate the Bleeper Sv, unscrew the lid of the battery compartment and insert three AAA alkaline batteries. The orientation of the batteries must be correct. Reposition the battery cover and tighten the screw. The liquid crystal display (LCD) will read **0** and the unit will emit a series of clicks.

To reset the display, it is necessary to remove the batteries from the Bleeper Sv for 20 secs. The battery life should be approx 1 yr.

Specifications

The specifications for the Bleeper Sv are detailed in Table 3C.

3.7.3 Source Detection Meter

The RAM GAM-1, is used by the NSWFB as a source detection meter. The meter is a microprocessor-based instrument (see Fig 3.17). It is designed for high stability and accurate measurements of dose rate and integrated dose rate gamma radiation. The meter covers a measuring range of 0.1 µSv/h up to 10000 µSv/h.

RAM GAM-1 is a portable one-hand-operated instrument, that is lightweight and compact. Only three push-buttons are needed for operation, **ON/OFF** and **RESET** for accurate measurement of low level count rate, and a **SPEAKER** push-button which controls the audible indicators volume. The meter is provided with a large four digit 7-segment LCD, an audible click whose rate varies directly with count rate, and a LED indicator that flashes with each incident radiation pulse.

A wide dynamic range from background up to 10000 µS/h, is obtained by the automatic dead time correction, according to the preset calibration. A special averaging function softens the readout and maintains fast response time, while keeping the standard deviation at a minimum.

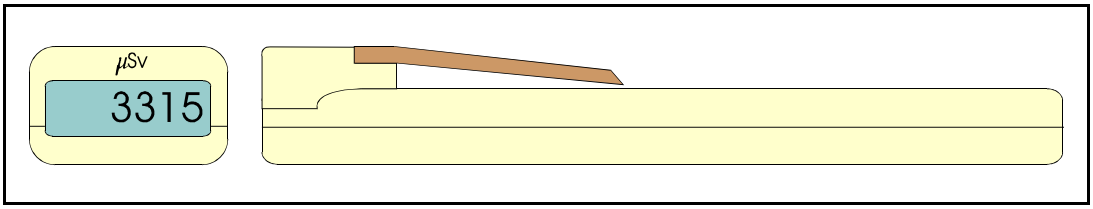

Fig 3.16 Bleeper Sv Personal Meter

ITEM	SPECIFICATION
Bleep Rate for Background radiation	1 bleep every 15 mins
Bleep Rate for 10 µSv/h	1 bleep every 20 Secs
Bleep Rate for 1 mSv/h and above	continuous beep
Length	152 mm
Width	35 mm
Weight	106 g

Table 3C Bleeper Sv Specifications

An automatic self-diagnostic procedure continuously checks both meter and detector, and reports any case of detector failure. The meter also alarms in any case of reading exceeding threshold value, reading overflow or low battery. When the meter is turned off, the last threshold value, the accumulated dose measurement, and the calibration factor are kept in memory.

The RAM GAM-1 is equipped with a recessed internal energy compensated GM tube.

Fig 3.17 RAM GAM-1 Source Detection Meter

Specifications

The specifications for the RAM GAM-1 are detailed in Table 3D.

Operating Instructions

Starting-up

Press the **ON/OFF** push-button. When the meter is turned on, it carries out a short self test procedure indicated by displaying all the segments on the display, and emitting a beep for a short period. The meter is then ready for use.

Readout

The measuring units are µSv/h for dose rate and µSv for accumulated dose. Values through 9999 are expressed in 1 to 4 digits.

To display the accumulated dose measurement, press the **RESET** and **SPEAKER** push-buttons simultaneously. A blinking display for 10 secs indicates that the reading is the accumulated dose measurement. After the 10 secs, the meter returns to display the dose rate. To reset the accumulated dose press the **RESET** push-button while the accumulated dose measurement is displayed.

LED

A LED indicator, located above the LCD, flashes with each incident radiation pulse.

ITEM	SPECIFICATION
Measuring unit	µSv/h and µSv
Power source	One 9 V cell battery 50 hrs minimum continuous operation, using an alkaline battery (speaker off). Automatic battery check under full load
Dimensions	13 cm x 7.2 cm x 3.4 cm
Weight	280 g

Table 3D RAM GAM -1 Specifications

Reading Reset

To reset the reading press the **RESET** push-button. The reset function provides a rapid means of discharging the display reading and enables accurate measurement of low level count rate.

Audible Indication

When the meter is turned on, the audible indication is activated as its high volume, so that the rate and trend of measurement are noticed. This volume control is specially activated at low rates of measurement. To turn it off press the **SPEAKER** push-button.

Detector Alarm

If the detector is defective or disconnected, the **Err.** segment blinks on the display and an audible alarm is activated. To mute the audible alarm press the **SPEAKER** push-button.

Battery Alarm

If battery voltage decreases below 6.2 V, the **bAt.** segment blinks on the display, and an audible alarm is activated.

To display the measured readings and mute the audible alarm, press the **SPEAKER** push-button. After the **SPEAKER** push-button is pressed, the **bAt.** segment will reappear every 5 mins for 2 secs, and every 30 mins accompanied by an audible beep to remind of low battery condition.

Push-button Functions

The functions associated with each push-button are detailed in Table 3E.

PUSH-BUTTON	PRESSING MODE	FUNCTION
ON/OFF		Meter on/off
RESET		Momentary reading reset
SPEAKER		Speaker volume modification
RESET	Long press	In/out threshold mode
SPEAKER (within threshold mode)		Displays/advances threshold
RESET (within threshold mode)	Long press	Out of threshold mode saving new threshold
RESET (within threshold mode)	Short press	Out of threshold mode resuming old threshold
RESET + SPEAKER	Simultaneously	Display accumulated dose
RESET (within accumulated dose)		Resets accumulated dose
RESET (within calibration mode)	Short press Long press	Display/decrease calibration factor Decrease calibration factor
SPEAKER (within calibration mode)	Short press Long press	Display/increase calibration factor Increase calibration factor

Table 3E RAM GAM-1 Push-button Functions

Battery Replacement

The battery compartment is located at the back of the instrument. To replace the battery, slide out the battery compartment cover carefully. Use one 9 V alkaline battery, and be sure to connect it with the right polarity.

Maintenance

The meter must be recalibrated annually. It is essential that the meter is operating correctly and has been calibrated as its operation could be questioned at a coronial inquiry. The meter should have a valid calibration sticker attached to it (see Fig 3.15).

All radiation meters must be returned to the HazMat Section at Greenacre for calibration annually. If the equipment does not have a sticker or the instrument is past it's calibration date, it must be returned to the HazMat Section at Greenacre.

3.8 HazMat Boat

The HazMat Response boat named *Otter* is a 5.3 m Rigid Hulled Inflatable Boat (RHIB) powered by a 115 hp outboard motor (see Fig 3.18).

It is designed primarily for use in waterborne HazMat operations e.g. deploying spill containment booms or underwater HazMat teams as well as command control .

It is stationed at the BA/HazMat Section, Greenacre and may be used at any incident where access by water is necessary.

Fig 3.18 HazMat RHIB

3.9 Waterborne Containment Boom

A floating boom can be used to contain an oil spill on a waterway. The NSWFB currently use a curtain type boom (see Fig 3.19) with a combined ballast and tension chain fitted in an integral pocket.

A floating boom is composed basically of a vertical barrier floating so that it extends above and below the water surface. Buoyancy is provided by separate floats, or a buoyancy section made as an integral part of the boom.

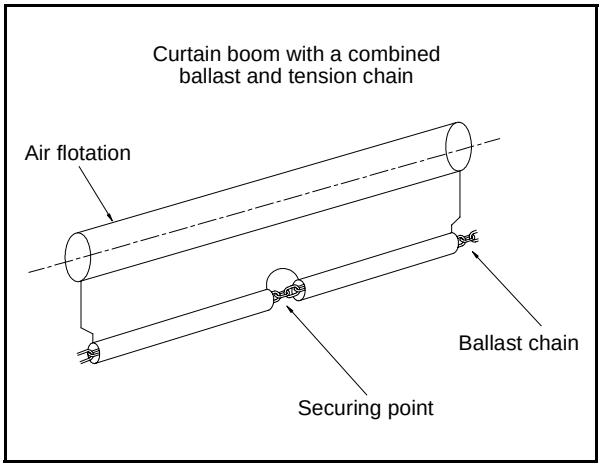

Fig 3.19 Curtain Boom

The NSWFB uses its RHIB to deploy curtain booms to contain and/or divert spills of hydrocarbons on waterways.

They are a non-absorbent, semi-rigid booms, provided in sections which can be joined together, dependant on the length or number of booms required.

The booms are held in place by ballast chains, anchors and securing lines. Floating booms are effective in currents up to 1.2 m/sec.

3.10 Exposure Report Form

To date there has been limited recorded information on firefighters or civilians who have been exposed or suspected of exposure to a hazardous material, nor has there been any form of identification given to these persons indicating possible contamination.

The NSWFB has developed an Exposure Report Form (ERF) for detailed information to be gathered on persons who have been or are suspected of being exposed to a contaminate.

The Decontamination Sector Commander (DSC) at a HazMat incident will have the responsibility of ensuring all details on the ERF are collected and correct. The DSC will also ensure that any person who has entered the **Hot Zone** even when wearing protective clothing, is registered on the ERF and issued a wrist band.

The ERF is a colour coded triplicate proforma report. The green page remaining in the book, the yellow page is detached and forwarded to the HazMat Duty Officer, and the white page is detached and forwarded to the NSWFB Medical Officer.

3.11 Identification Wrist Bands

In conjunction with the ERF, a Health Identification Wrist Band (HIWB) will be issued for the safety of the wearer. The wrist band must be worn for a minimum of 24 hrs after the incident.

If a medical problem occurs to the firefighter/ civilian; medical staff will be alerted by the wrist band that the patient may be suffering as a result of a contaminate exposure.

All HazMat response units including support stations and rural HazMat appliances are to carry ERF's and HIWB's. They are to be utilised as directed in SOG's.

3.12 Temco Earspike

The *Temco* Earspike (see Fig 3.20) is a communications device for use in general fire fighting or when wearing a fully encapsulated suit. The unit consists of:

- an adjustable earpiece with insert;
- a voiceducer; and
- a transceiver connection.

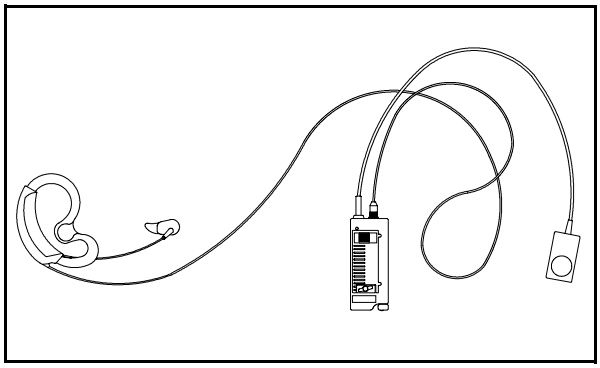

Fig 3.20 Temco Earspike

Method of Operation

The correct method of operation is as follows:

- a protective insert is placed onto the earspike;
- the earspike is placed gently into ear, and earpiece set into place around ear;
- the earspike is connected to a NSWFB transceiver and both units placed onto a belt; and
- the voiceducer can then be set either to press to talk (PTT) or voice activated (VOX).

In the VOX mode the unit operates automatically upon speaking (vibrations from the ear bone). In PTT mode the operator must depress a button on the voiceducer itself.

After Use Actions

The following actions should be taken with the Earspike after use:

- turn **OFF** by switching to PTT mode;
- disconnect unit from transceiver; and
- remove protective insert from earspike and clean as for BA face mask. Leave for 10 mins, rinse and dry.

3.13 Adsorbents and Absorbents

The NSWFB uses various types of materials to retrieve liquid substances involved in HazMat incidents or emergencies. The sorbent properties of these materials can be divided into two categories:

- adsorbents; and
- absorbents.

Adsorbents

The definition of an adsorbent material is one that collects fluid by surface wetting. Adsorbents can be rubberising materials. Oil blotters are used for heavier, more viscous oils.

Absorbents

The definition of an absorbent material is one that collects fluid by capillary action. Absorbents such as recycled paper and sphagnum moss are used for lighter oils.

To further understand the action of **adsorbents** as opposed to **absorbents**. you need to think about what happens if you place a piece of hardwood in a container of oil and then remove it, the surface of the wood will be covered in oil due to absorption or wetting of the surface area of the wood. The oil however is only on the surface of the wood, it does not penetrate its surface.

If you then place a stick of chalk in the same oil container and then remove it, you will find that the surface area of the chalk is also wet with oil, but if you snap the chalk in half, you will find that the oil has penetrated into the chalk, and this action is called absorption. The absorbent qualities of the chalk have caused a capillary action to take place and the oil saturates the chalk.

Adsorbents and absorbents both have a use in the removal of substances from the environment into safe areas such as recovery bins, for later disposal. The sorbents come in different forms to allow for different situations as detailed in Table 3F and illustrated in Fig 3.21.

Fig 3.21 Assorted Booms, Pillows and Pads

TYPE	FORM
Type I	loose
Type II	pad, pillow, sheet
Type III	booms

Table 3F Sorbents

Some sorbents are designed for use on water, others for use on land.

Those designed for water may be used on land but are not as effective and should not be used where the appropriate type can be obtained.

Those designed for use on land may not float, and if used in water scenarios may prove difficult to recover. Absorbent booms and pillows are also divided into two categories:

- for use with Hydrocarbons; and
- for use on Chemicals.

In some circumstances cross use may be moderately effective, however the most appropriate material should be used.

Excessive use of sorbents will contribute to the amount to be disposed. This can be minimised by re-use of booms and pillows after wringing out, or restricting the use of sorbents to cleaning up the residue left after removal by other means.

Absorbent booms are a sausage shape varying in length and diameter. Designed to float across waterways as a dam and absorbent combined, they are often used downstream of floating rigid booms or weirs to collect any residue (see Fig 3.22).

Even after having absorbed to capacity, these booms will continue to dam the spill. They generally have snap hooks attached at either end to allow several booms to be joined together, with an overlap to prevent leakage at the joins.

Fig 3.22 An Example of Absorbent Booms

3.14 Water Contamination

The liquid extraction method allows for a quick determination of contaminants in water. It readily identifies volatile contaminants in water such as chlorinated hydrocarbons, ammonia, petrol hydrocarbons, benzene and toluene.

The method is carried out using the Liquid Extraction Kit (see Fig 3.23) and is based on the extraction of the contaminant that has to be determined with air out of an aqueous solution. Due to its high volatility and low solubility, the contaminant concentrates in the air flow that is bubbling through. This extraction process takes place in a special gas washing bottle. Each bottle is characterised by a calibration constant A. This constant is determined individually for each gas washing bottle and indicated on the bottle insert. The extraction efficiency is dependent on the bottle porous diaphragm insert, and only these specially calibrated bottle inserts can be utilised for measurement.

Fig 3.23 Liquid Extraction Kit

The extraction is carried out using a Gas Detection Device (see Fig 3.24). This comprises a gas detection pump and an appropriate gas tube for the contaminant component to be determined. During air extraction the volatile contaminant is drawn

through the gas tube by means of the bellows pump, and this causes a discolouration with a length corresponding to the amount of contaminants in the airflow.

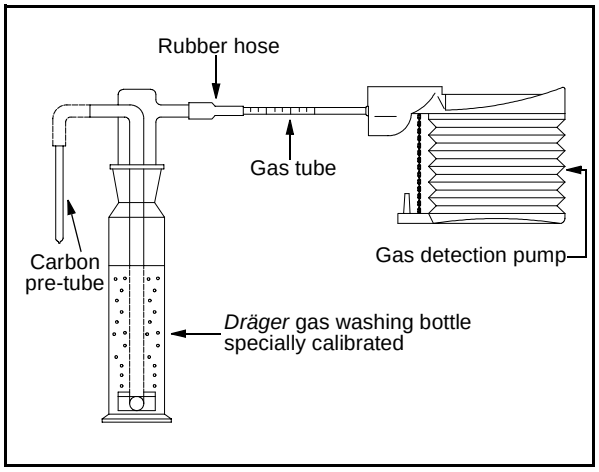

Fig 3.24 Water Contamination Gas Detection Device

Operating Procedure

It is necessary to fill the water sample to be examined (200 mL) in to the gas washing bottle and up to the marking ring. To determine the water thermometer, close the bottle tight with the bottle insert, connect the bottle outlet with the gas tube, and draw the air (quantity mentioned in the measurement specification) through the *Dräger* gas washing bottle and gas tube by means of a gas detection pump. To exclude interfering components possibly present in the ambient air, a carbon pre-tube can be connected to the inlet nozzle of the gas washing bottle for cleaning the extraction gas at each measurement.

The length of the occurring discolouration (in ppm) shows the appearing concentration of the contaminant in the airflow. To indicate the contaminant concentration in the water sample, the reading gained for air has to be corrected. The user may find a detailed description concerning the calculation of the contaminant concentration in the water sample, the measurement accuracy, the concentration range that can be detected and the influence of interfering substances in the measurement specification attached to every Liquid Extraction measurement case.

3.15 Gas Detection Equipment

3.15.1 Introduction

HazMat and confined space incidents may involve atmospheres that are dangerous to humans.

Human life is constantly threatened in working areas where combustible or toxic gases can accumulate or oxygen becomes depleted/ enriched. Gas detection equipment has been developed to preserve human life under these dangerous conditions.

The NSWFB currently uses the following gas detection equipment at incident grounds:

- Gastech 1314SMPN;
- TMX412;
- *Industrial Scientific* model MX251;
- *MSA* Minder; and
- *MSA* Detector Tube Kit.

Definitions for Exposure Limits

Table 3G provides detailed information about exposure limits.

ABBREVIATION	NAME	DEFINITION
TWA (PEL) (TLV)	Time Weighted Average (Permissible Exposure Limit) (Threshold Limit Value)	The 8 hr day, 40 hr week limit. If not otherwise stated, PEL and TLV's are for an 8 hr exposure period
STEL	Short Term Exposure Limit	This concentration is safe for a 15 min exposure period (4 such exposures are permitted per day if they are separated by 1 hr intervals, and the overall TWA exposure is not exceeded for that day).
C	Ceiling	This concentration should never be exceeded
IDLH	Immediately Dangerous To Life And Health	It is recommended that personnel avoid all exposure to IDLH levels of chemicals, and that all persons without adequate protective equipment be immediately evacuated from affected areas.
LD50	LD50	The amount of a chemical administered orally or through skin contact which is estimated to cause death to 50% of a population of test animals. It is expressed as mg/kg of body weight. The lower the value the higher the toxicity.
LC50	LC50	Is the concentration of a chemical in a medium like air or water which is estimated to cause death to 50% of a population of test animals. It is expressed as mg/m3 of air or mg/L of water. The lower LC50 value the higher the toxicity.
TCL0	TCL0	The lowest inhaled concentration expected to cause toxic affects
LOC	Level Of Concern	Concentrations that are cause for concern (these levels are derived by dividing the IDLH level by 10).

Table 3G Definitions and Abbreviations for Exposure Limits

Air and Gases

Air is a mixture of gases. Clean dry air consists of 78.08 volume percent nitrogen, 20.95 volume percent oxygen, and 0.87 volume percent other gases. Life, combustion and various chemical reactions are supported by oxygen.

Human beings can tolerate moderate variations in the amounts of oxygen in the air. Breathing becomes laboured when the air contains only 16% oxygen. Oxygen deficiency can be the result of the displacement of oxygen by other gases, aerobic bacterial activity, combustion and the oxidisation of metal. Depending on the gas detector being used, the O_2 Sensors will alarm when the O_2 level falls below 19% or 19.5%. The O_2 sensor will also alarm when the O_2 rises above 23%.

Flammable Range

A mixture of air and a combustible gas or vapour will be referred to as a *gas*. Gas will support the propagation of a flame only when the concentration of the volume of the mixture is within the flammable range of that specific gas or combination of gases.

An air/gas mixture in which the concentration of gas is below the flammable range will be too lean to support combustion. Alternatively if the air/gas mixture in which the concentration of gas is above the flammable range the

mixture will be too rich to support combustion. The flammable range has a lower limit and an upper limit referred to as:

- the *Lower Explosive Limit* (LEL) and is to lean to support combustion; and
- *Upper Explosive Limit* which is to rich to support combustion.

Lower Explosive Limit

The mixture containing the leanest amount of flammable gases which will explode gas is called the LEL (see Fig 3.25). All gas detectors in the NSWFB are fitted with LEL sensors. The LEL sensor samples the air/gas mixture by burning the gas on a catalytic combustion sensor that is part of a *Wheatstone bridge*. The LEL Sensor will alarm at 20% of the LEL

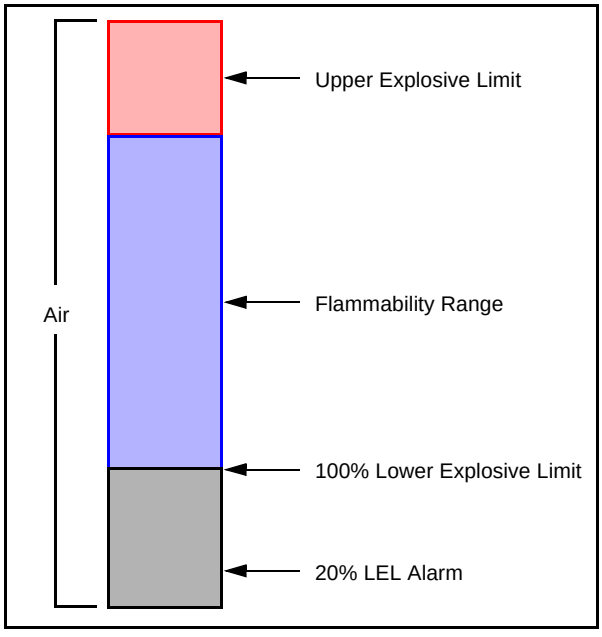

Fig 3.25 Explosive Limits

3.15.2 GASTECH Model 1314SMPN

The *GASTECH* Model 1314SMPN (see Fig 3.26) is a portable gas detection unit for measuring PPM / LEL Combustible Gas and Oxygen. The 1314SMPN has the following features:

- three range continuous monitoring;
- simplified PPM calibration;
- sample draw pump;
- multi-function microprocessor control;
- self-illuminating digital display;
- peak exposure readout (LEL, O_2);
- low flow alarm; and
- RF resistant.

Fig 3.26 GASTECH Model 1314SMPN Gas Detector

Specifications

The specifications for the 1314SMPN are detailed in Table 3H.

ITEM	SPECIFICATION
Power source	8 cell NiCad battery pack 9.5 V, 4.0 AH, encapsulated
Battery life	Full charge - over 8 hrs
Dimensions	305 mm L x 96 mm W x 140 mm H
Weight	4 kg

Table 3H 1314SMPN Specifications

Operating Procedure

With only three controls, this microprocessor based instrument is easy to use. Field calibration of the PPM range is eliminated with the 1314SMPN. Calibration of the LEL range automatically sets PPM calibration. The 1314SMPN is designed for detection of gas and oxygen deficiency in confined work spaces, such as organic vapour residues, or depleted oxygen in a process or storage vessel. Audible alarms sound for high LEL or PPM, and oxygen deficient or rich atmospheres.

Automatic PPM calibration is possible because the relationship between LEL and PPM sensitivities has been precalculated. A self-illuminating LCD gives a large, easy-to-read numeric readout of concentrations. The peak reading function displays the highest LEL and lowest oxygen concentration since the instrument was last turned on. A low flow alarm triggers when the flow to the sample system becomes impeded at an inlet or outlet.

The principle of operation is based on electrically heated catalytic elements in a *Wheatstone bridge* circuit reacting to a combustible gas. The oxygen sensor operates by the electrochemical principle. When exposed to changing atmospheric samples, both sensors give fast response and accurate repeatable concentration readouts, even in PPM concentrations.

Maintenance

The gas detector must be recalibrated every 30 days. It is essential that the gas detector is operating correctly and has been calibrated as its operation could be questioned at a coronial inquiry.

The detector should have a valid calibration sticker attached to it (see Fig 3.30).

All gas detectors must be returned to the HazMat Section at Greenacre for calibration every 30 days. If the equipment does not have a sticker or the instrument is past it's calibration date, it must be returned to the HazMat Section at Greenacre.

⚠ NOTE

The 1314 uses a thermocatalysis method (i.e. it needs to perform catalytic combustion in the sensor), therefore in oxygen deficient environments (below approximately 14%), the LEL readings are completely unreliable as the detector is unable to perform combustion in the sensor.

Ambient temperatures have a strong bearing on LEL readings. This needs to be considered in light of whatever you are trying to detect e.g. substances with high vapour points may, at low temperatures, not be giving off enough vapour to support combustion (despite your being able to smell them).

Ambient temperature for testing of gas detectors in the laboratory is 21° C with 21% oxygen.

If using gas detection equipment within refiners ensure that they are certified for use with Class 1 Dangerous Goods or you could cause an explosion.

The 1314 use a platinum sensor, the temperature of which is maintained at 650° C. This ensures that carbon and sulphur deposits that may be left by some sensor poisons are burnt off. Detectors that

do not use platinum sensors are operated at 450° C and are more prone to sensor poisoning because this temperature is insufficient to burn off carbon and sulphur deposits.

Silicone compounds destroy ALL sensors. Therefore *WD40* and *Mr Sheen* type products should be avoided at all times with the 1314. This problem can be of particular importance if required to operate at paint factories, deodorant factories, or places that pressurised cans are filled at.

The design standards for gas detectors allow 0 - 20% higher reading than actually present but do not allow a reading to be less than actual concentration when calibrating.

3.15.3 TMX412 Gas Detector

The TMX412 gas detector (see Fig 3.27) is used to monitor up to four gases simultaneously. It continuously monitors combustible gases (LEL or CH_4), oxygen and any one or two of the followig five toxic gases:

- carbon monoxide;
- chlorine;
- hydrogen sulphide;
- nitrogen dioxide; and
- sulphur dioxide.

Fig 3.27 TMX412 Gas Detector

The TMX412 is configured for the NSWFB with O_2 Oxygen, H_2S Hydrogen Sulphide, CO Carbon Monoxide and LEL sensors. The features of the TMX412 gas detector are:

- a data logging system calculates STEL and TWA;
- nickel cadmium battery pack operates for 10 hrs;
- removable battery pack. The battery can be charged in or out of the instrument;
- stores the last calibration date;
- classified intrinsically safe;

- real time clock;
- storage of peak readings for retrieval after exit of hazardous areas;
- low and high alarms; and
- single button control for **ON/OFF**.

The LEL/CH4 sensor is protected by an over range circuit to protect the sensor from possible damage. If the unit detects combustible gases in excess of 100% of LEL or 5% of CH4 by volume, a high alarm condition is automatically latched and internal circuitry protects the sensor.

Operating Procedures

To operate the TMX412, proceed as follows:

- switch TMX412 **ON** by depressing the mode button and holding it for 5 beeps;
- the TMX412 takes approximately 90 secs to run through it's diagnostics, during this period **do not** depress any switches.
- the warm up procedure consists of Sensor identification, Code screen and Reset;
- once the warm up procedure has concluded the TMX412 will emit a short beep. The monitor is now operating as a real time gas monitor;
- ensure that the battery is fully charged, all points on the *eight point* bar should be lit;
- always ensure that the peak screen has been cleared. This is done by depressing the mode button 3 times. The peak screen will appear. This screen records the worst possible scenario the monitor was exposed to. Should there be figures that do not appear normal, press the mode button then the **E** button to clear the peaks. Keep pressing the mode button to advance to the real time gas monitor screen;
- always zero the TMX412 before use. This must be done as close to the operational environment as possible;
- ensure that the atmosphere is clean fresh air;
- to zero the TMX412 press the mode button 2 times. The zero screen appears;
- press **E** to start, zeroing will appear on the screen, this function will take 30 secs; and
- the TMX412 will beep and return to a real time gas monitor.

Maintenance

The gas detector must be recalibrated every 30 days. It is essential that the gas detector is operating correctly and has been calibrated as its operation could be questioned at a coronial inquiry. The detector should have a valid calibration sticker attached to it (see Fig 3.30).

All gas detectors must be returned to the HazMat Section at Greenacre for calibration every 30 days. If the equipment does not have a sticker or the instrument is past it's calibration date, it must be returned to the HazMat Section at Greenacre.

3.15.4 MX251 Gas Detector

The MX251 Gas detector (see Fig 3.28) continuously and simultaneously monitors ambient levels of oxygen, hydrogen sulphide and combustible gases. All three gases are monitored simultaneously but only one is displayed on the instruments LCD.

When one of the three switches (located immediately below the LCD) is touched, the respective gas readout will appear on the display. A small triangular pointer also appears on the display, just above the switch that was pressed, to indicate which gas is being displayed. The last gas selected will remain on display until a different switch is pressed.

Fig 3.28 MX251 Gas detector

The readout for the three gases may be selected in any sequence that the user desires. When the instrument is first turned on it will automatically display the oxygen readout.

Although only one gas can be displayed at a time, all of the alarm circuits are active and continuously monitoring for unsafe conditions. If any of the gases reaches a preset safety limit, the audible and visual alarms are activated immediately.

The audible alarm is a high pitched tone. A rectangular LCD enunciator appears near the top of the display panel to indicate which gas or gases caused the alarm activation. The LCD will continue to display the readout of the gas range last selected by touching one of the switches.

Batteries

The MX251 Unit is powered by 4 disposable size AAA alkaline batteries. A set of new batteries will deliver power for at least 8 hrs of continuous monitoring at normal room temperature. Actual run time will vary between battery makes. When the temperature is near or below freezing, the operating time will be reduced significantly. This is a characteristic of alkaline batteries.

The battery cover is held in place with a quarter turn fastener. Remove the battery cover by inserting flat blade screwdriver in the fastener slot and turn the fastener one-quarter of a turn in the counter clockwise direction. First, remove batteries from positions 2 and 3. Then, move the batteries from positions 1 and 4 to positions 2 and 3 for removal.

To insert new batteries, the instrument should be positioned face down. Insert the battery for position 1 into the instrument at position 2. Then, move it to position 1. Insert the position 2 battery. Insert the battery for position 4 into the instrument at position 3. Then, move it to position 4. Insert the position 3 battery. Check the exposed battery terminals against the battery cover markings for proper alignment before installing the battery cover. Press the battery cover into position and secure by turning the fastener one-quarter of a turn in the clockwise direction.

When the battery pack is almost fully discharged, (approximately 30 mins remaining) the monitor will start to emit short audible tone bursts to warn of a low battery pack condition. The duration increases in length until the batteries are no longer capable of supplying sufficient power. Then, the monitor will go into the battery failure mode, which is indicated by all of the display digits being blanked accept for the number 1 at the far left position; and the word **LOBAT** appears in the upper left corner of the display; and the audible alarm sounds a continuous tone.

The MX251 is also equipped with circuitry that detects LEL sensor faults. If a fault condition should occur, the monitor will go into a failure mode similar to the low battery failure mode, and the word **FAULT** will appear in the lower

left corner of the display. When the oxygen sensor is missing, audible and visual alarms are activated.

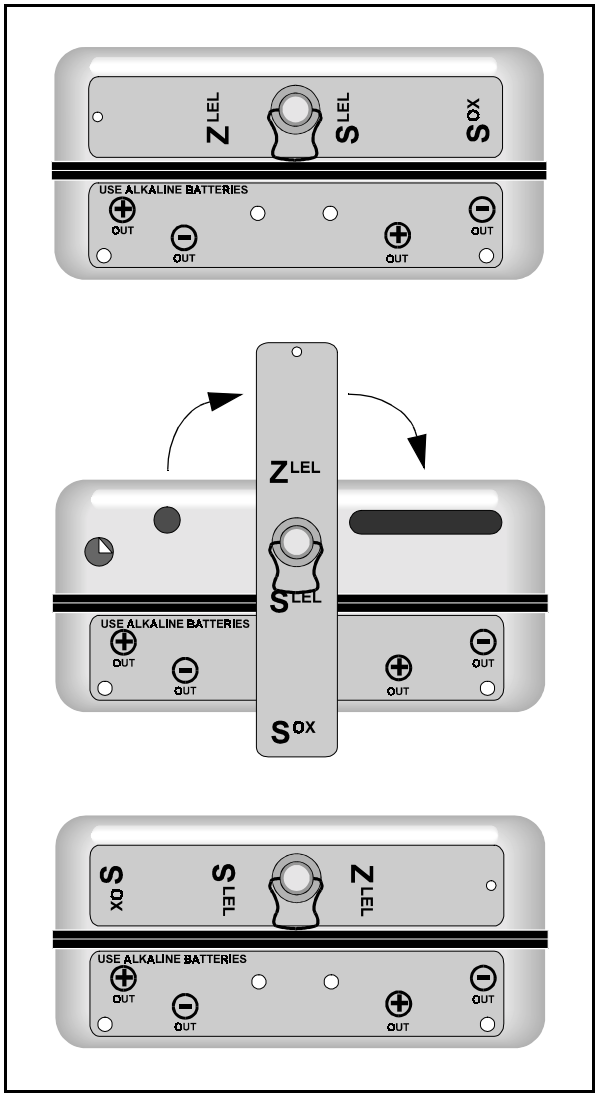

Fig 3.29 MX251 ON/OFF Control

Specifications

The specifications for the MX251 gas detector are detailed in Table 3I.

ITEM	SPECIFICATION
Dimensions	121 mm x 70 mm x 38 mm
Weight	560 g
Power source	Alkaline - 4 AAA alkaline batteries
Battery life	Minimum 8 hrs at normal room temperature

Table 3I MX251 Specifications

Operating Procedures

To operate the MX251, proceed as follows:

- switch **ON** the instrument (see Fig 3.29);
- back off knurled nut that holds the calibration cover in place;
- rotate the cover so that the metal button is inserted in the oval shaped hole;
- tighten the nut until the calibration cover is flush with the case. Do not overtighten; and
- the monitor is ready for use.

To switch **OFF** the MX251 proceed as follows:

- back off the knurled nut that holds the calibration cover in place;
- rotate the cover so that the metal button is in the unmarked round hole; and
- tighten the nut until the calibration cover is flush with the case. Do not overtighten.

Maintenance

The gas detector must be recalibrated every 30 days. It is essential that the gas detector is operating correctly and has been calibrated as

its operation could be questioned at a coronial inquiry. The detector should have a valid calibration sticker attached to it (see Fig 3.30).

All gas detectors must be returned to the HazMat Section at Greenacre for calibration every 30 days. If the equipment does not have a sticker or the instrument is past it's calibration date, it must be returned to the HazMat Section at Greenacre.

Gas Detector

Battery Cycled / /
Calibrated / /
Unit N° .....
Type .....
Serviced by .....
Due for Calibration / /

Fig 3.30 Gas Detector Calibration Sticker

3.15.5 MSA MINDER

The *MSA* combustible gas detector Model Minder (see Fig 3.31), is used by the NSWFB to detect combustible gases at incident grounds.

Fig 3.31 MSA Minder Gas Detector

Operating Procedures

Apart from the battery **ON/OFF** switch, operation of the *MSA* Minder is achieved via 4 keypad switches.

CAUTION

Push keypads with the pad of a finger; the use of fingernails or foreign objects to activate the keypads may damage the membrane switch.

The functions of each keypad is detailed in Table 3J.

KEYPAD	FUNCTION	NOTES
RESET	Permits operator to reset audible and visual alarms when the gas concentration is within a predetermined safe level	*
SELECT	Permits operator to display the monitored concentration of either gas (when applicable). Note that both gases are continuously monitored, regardless of which gas concentration is displayed	*
BATT VOLTS	Permits operator to display battery pack voltage	**
LIGHT	Back-lights the display for the use in low-light applications	**

NOTE

*** Press firmly and release; do not hold these keypads down.**
**** Press continuously for operation; the switch will automatically reset after pressing.**

Table 3J Membrane Switch Keypad Functions

Calibration Controls

Controls for adjusting the zero and span (upscale) reading of the combustible sensor (% LEL or % CH4), and the span (fresh air) reading of the oxygen sensor (where fitted) are found by loosening the two screws on the cover plate on the side of the instrument. The Oxygen span is always marked **OXY:S**. The combustible sensor controls are marked **S** or **SPAN** and **Z** or **ZERO** and identified by LEL or CH4.

Other Controls

All other controls are accessible only by opening the instrument case. They are **not** for operator adjustment.

Normal Operation

Either sensor may be monitored by the display merely by using the **SELECT** keypad.

The alarms on both sensors are fully active, all the time, irrespective of which sensor output is displayed.

The most important aspects of this detector are summarised as follows:

- do not operate in oxygen-enriched atmospheres;
- avoid contaminating the instrument or accessories with liquid or condensed vapours;
- avoid blockage of the sensor protection devices;
- monitor frequently if temperatures are rising or sludges are being disturbed;
- the combustibles (%LEL) sensor will not work properly in less than 10% oxygen;
- the combustibles (%LEL) sensor will not respond to dusts or condensed vapours;
- the combustibles (%LEL) sensor is poisoned by silicones, silanes, silicates, phosphate esters, leaded petrol and acid gases;
- the combustibles (%LEL) sensor will latch up on signals over full scale and will require resetting; and
- the combustibles (%LEL) sensor will show different sensitivities to different substances.

Battery

At any time the state of the battery can be checked by using the **BATT. VOLTS** keypad. A freshly charged battery will typically show a value above 2.50 V. Initially the voltage will fall a little and then will remain within the approximate range 2.40 to 2.25 for much of the battery capacity. The voltage then falls fairly rapidly, when the battery is nearly flat.

A fully charged and properly maintained battery should keep the MSA Minder operational for 8-10 hrs of continuous use.

When the voltage of the battery pack reaches a level where the remaining time of accurate sampling is limited, a **BAT** indication appears on the display. This occurs at approximately 2.20 V on the instrument display. When battery pack voltage is no longer sufficient to provide accurate readings:

- the audible alarm latches **ON**, and does not beep; and
- the display blanks to prevent erroneous readings due to low-battery voltages.

Maintenance

The gas detector must be recalibrated every 30 days. It is essential that the gas detector is operating correctly and has been calibrated as its operation could be questioned at a coronial inquiry. The detector should have a valid calibration sticker attached to it (see Fig 3.30).

All gas detectors must be returned to the HazMat Section at Greenacre for calibration every 30 days. If the equipment does not have a sticker or the instrument is past it's calibration date, it must be returned to the HazMat Section at Greenacre.

3.15.6 Gas Detector Tube Kit

The gas detector tube system for air analysis provides a simple, fast and reliable method for determining the presence of gases and vapours at an incident ground.

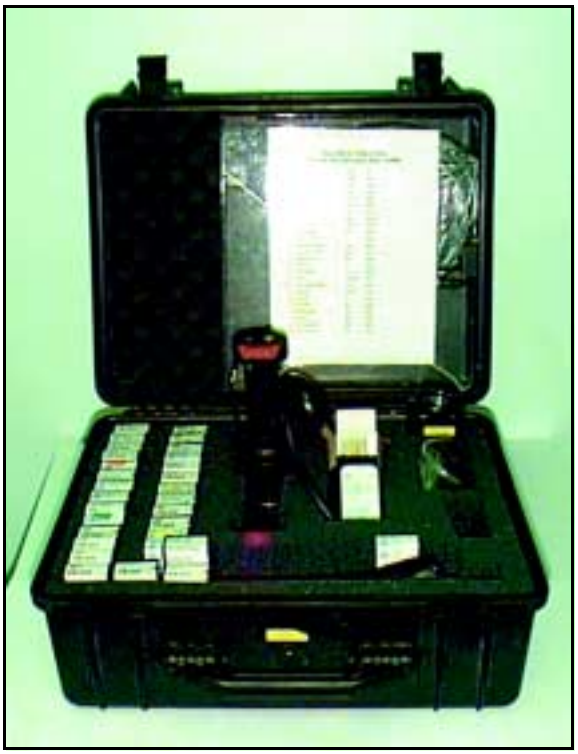

Fig 3.32 Gas Detector Tube Kit (MSA)

The detector tube kit (see Fig 3.32) consists of a sealed glass tube that has been impregnated with a chemical reagent onto a substrate of silica gel, activated alumina, silica glass or silica sand. The detector tube has a calibrated scale and the reading of the gas or vapour concentration is determined by a colour change within the tube (see Fig 3.33).

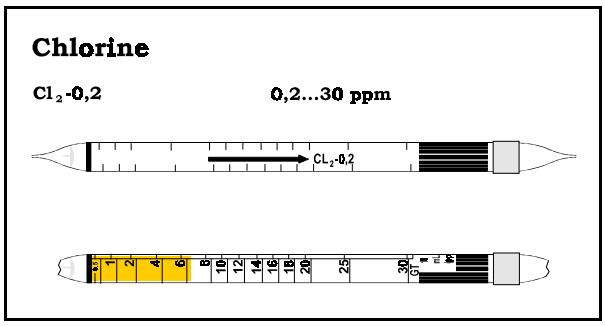

Fig 3.33 Gas Detector Tube (Chlorine)

Operating Procedure

To make a measurement using gas detection apparatus (see Fig 3.34), proceed as follows:

- check the bellows pump for leaks;
- insert an unopened gas tube and squeeze the pump completely. After releasing, the position of the pump should not change within 1 min;
- choose the detector tube that best suits the expected gas and measuring range;
- break off both tips of the tube using the tube opener;
- insert the tube tightly into the pump. The arrow on the tube points towards the pump;
- depress the bellows, this will draw an air or gas sample through the tube, the number of pump strokes is printed on the tube; and
- read the length of the discolouration as in Fig 3.33.

Fig 3.34 Gas Detection Apparatus

3.16 Hazardous Materials Clean Up

The HazMat section of the NSWFB is called upon to deal with the clean up of all types of hazardous material spills. Certain situations such as the release of oil onto water, or the spillage of various types of powdery substances (see Fig 3.35) requires special equipment to remove the substance.

Fig 3.35 An Example of a Powdery Substance Spillage

3.16.1 Safe-T-Vac

The NSWFB uses the Safe-T-Vac industrial vacuum cleaner for hazardous clean up. The specifications for this item are detailed in Table 3K.

ITEM	SPECIFICATION
Power	2 x 1000 W
Voltage	240 V 50 Hz
Net weight	50 kg

Table 3K Safe-T-Vac Specifications

Features

The Safe-T-Vac (see Fig 3.36) has the following features:

- bag removal system prevents accidental release of hazardous material during bag removal. Excess air is sucked out of the bag which is then sealed and slipped off the filler tube;
- tough 200 micron disposable polyethylene bags collect all vacuumed material including filtered dust. Easier to seal and less expensive than paper bags, their non-porous surface prevents dust seepage and allows pick-up of wet materials;
- auto shut-off when the Safe-T-Vac collection bag is full, the unit automatically shuts down, preventing overfilling;
- the filter cleaning system helps maintain maximum suction and reduces costly filter replacements and down-time. The filter cleaning system automatic sends a blast of reverse air through the filters to dislodge virtually all dust particles, and deposit them in the collection bag. No compressed air source is required;
- High Efficiency Particulate Air (HEPA) filtration system is used in the Safe-T-Vac. These large-area filters remove 99.997% of all particles as small as 0.3 microns before they can pass through the motor and into the atmosphere; and
- all collected material, including dust from the filters, deposits in a 200 micron polyethylene bag. During removal, excess air is sucked out of the bag while its being tied off at the neck. Only then is it slipped off the filler tube, eliminating the chance of the operator coming in contact with any hazardous dust or material.

Fig 3.36 Safe-T-Vac

3.16.2 Air Operated Skimmer

When oil or pollutants are spilt into water following a fire or vehicle accident, it is necessary to remove the oil from the surface of the water as it creates a pollution hazard and there is also the risk of the oil igniting.

The Hazmat Unit at Greenacre has an air operated Skimmer (see Fig 3.37) which can be used at incident grounds to remove oil from water surfaces.

The skimmer which is manufactured by *HOLAUST Pty Ltd*, is a lightweight, stainless steel skimmer that can be used for the recovery of pollutants at temperatures up to 100° C.

The skimmer weighs only 8.2 kg and can be handled by one person. Most incidents involve a very thin surface layer, and for optimum efficiency the pumping rate should be approximately 50 L/min.

A higher pumping rate merely results in more water being taken without any significant increase in the rate of surface layer removal.

Fig 3.37 Air Operated Skimmer

3.16.3 ARO Diaphragm Pump

The *ARO* diaphragm pump (see Fig 3.38) offers high volume delivery even at low air presures, and is self-priming with the ability to pump high viscosity materials.

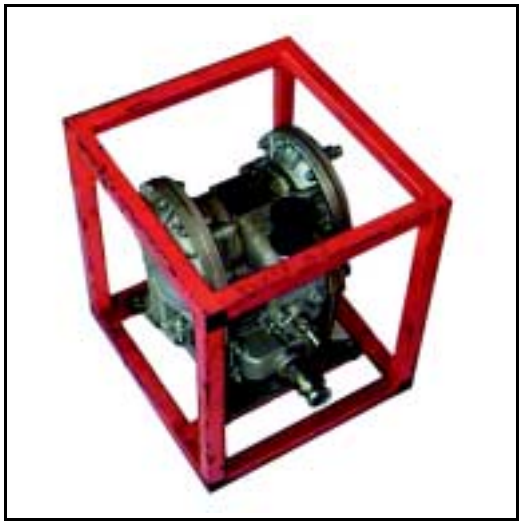

Fig 3.38 ARO Diaphragm Pump

Operation

The pump is a diaphragm type and is operated by compressed air at a maximum pressure of 8 bar.

3.17 PCB

PCB is the abbreviation for polychlorinated biphenyl and is classified as a chlorinated hydrocarbon. This substance was primarily developed as an electrical insulating fluid for use in power control devices such as power transformers, capacitors and high voltage switching units. It has a heavy oil like consistency, and is a stable insulator with a very high heat capacity.

The *EPA* has determined that PCB poses a health risk to humans because of its uncommonly stable molecular structure. Once it is introduced into the environment the PCB will not break down with time and therefore allows any potential health hazards to persist for an indefinite period of time. The most immediate health hazards to humans occur

when PCB is burned at low temperatures and is believed to create the highly toxic chemical dioxin, which may cause carcinogenic changes in humans. If body contact occurs with PCB's there is the potential for developing a skin disease called chloracne. Animal research suggests the probability of reproductive disorders and the formation of tumours.

To enable the detection of PCB's in oil, the *DEXSIL Corporation* has developed a test kit called CLOR-N-OIL (see Fig 3.39) which provides an indication of PCB contamination within 5 mins.

The kit can be used by the HazMat Response Unit to quickly and accurately detect the presence of PCB's.

Fig 3.39 CLOR-N-OIL PCB Test Kit

3.18 Weather Monitoring

When the HazMat Section of the NSWFB responds to an incident ground where toxic substances are being released into the atmosphere, it is important for firefighters to be informed about the local prevailing weather conditions so that the possible spread of the released substance can be determined.

To obtain this information, the HazMat Response Unit has a portable weather station (see Fig 3.40) which is manufactured by *Davis Instruments* and is called the Weather Monitor II.

Fig 3.40 Weather Monitor II

The Weather Monitor II is a portable computerised weather station that has the following features:

- it measures temperature, and has alarms for high and low temperatures which are preset by the operator;
- there is a 12 hr and 24 hr clock with alarm;
- there is a date display;
- wind direction and wind speed with high wind speed alarm;
- wind chill with low wind chill alarm;
- barometric pressure with trend arrows;

- humidity; and
- dew point

3.19 Noncontact Thermometer

The Raynger Noncontact Thermometer is manufactured by *Raytek* (see Fig 3.41) and is used by the NSWFB to measure the temperature of objects from a distance. The Raynger is a portable hand held device that can give accurate temperature readings of objects and substances. The Noncontact Thermometer is equipped with a laser beam for sighting the object to be measured.

Fig 3.41 Noncontact Thermometer

The specifications for the Noncontact Thermometer are detailed in Table 3L

Operating Procedure

All objects having temperatures above absolute zero radiate infra-red energy. This energy travels in all directions, at the speed of light.

When pointed at a target, the infra-red thermometer's lens collects and focuses the energy onto an infra-red detector. The detector responds by producing a voltage signal which is directly proportional to the amount of energy received, and therefore to the temperature of the target. By sampling and manipulating the output of the detector, the unit's microprocessor based electronics can display the temperature, and related computed values, such as maximum temperature seen during the measurement, minimum, average, and difference.

Some objects reflect infra-red energy as well as emit it. Shiny or highly polished surfaces tend to reflect energy, whereas dull ones do not. A factor called emissivity, which can have a value anywhere from 0.1 to 1.0, accounts for the actual energy being emitted. It may be adjusted using the arrows on the unit's touch-sensitive membrane switch. For almost all applications, the emissivity is left at 0.95, which describes a target having a small amount of reflection (5%).

Ambient Temperature Compensation allows for compensation of reflected energy whenever the surrounding ambient temperature is higher than the object and the object has an emissivity less than 1.0.

Power is provided by a 9V battery located inside the compartment in the front of the unit.

ITEM	SPECIFICATION
Power	9 V DC alkaline battery
Weight	0.6 kg
Dimensions (L x W x H)	140 mm x 44 mm x 178 mm
Temperature Display	°C 4 digit backlit LCD
Accuracy	± 1% of reading, or ± 1.0° C whichever is greater, at 23 ± 5° C ambient operating temperature and a known blackbody emissivity

Table 3L Noncontact Thermometer Specifications

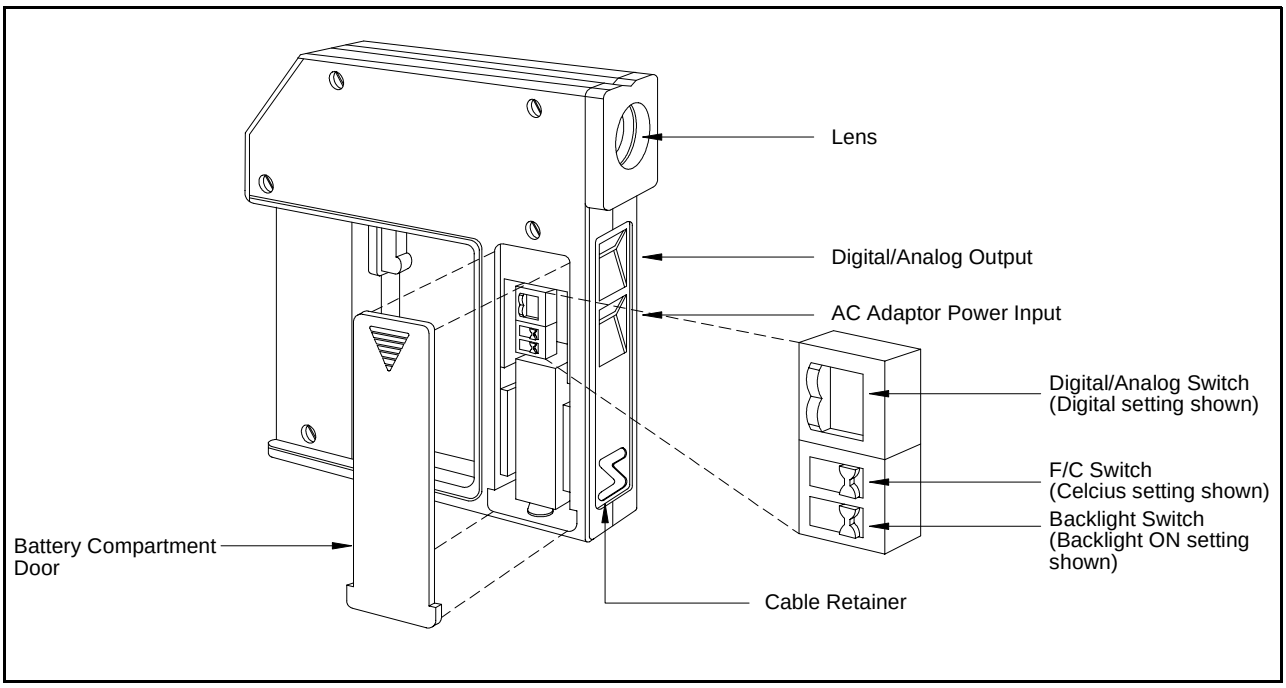

Fig 3.42 Noncontact Thermometer Controls

The unit is activated by pulling and holding the trigger and pointing at the target to be measured. The trigger can be locked **ON** if desired. For more distant targets, hold the unit at arms length and use the sighting groove for aiming (see Fig 3.42). This will give a parallel and offset sighting.

To operate the noncontact thermometer, proceed as follows:

- aim the unit at the object; pull and hold the trigger;
- both the current and maximum temperature will be displayed and updated 4 times per second;
- set emissivity, if necessary. The emissivity is set by pressing either arrow;
- to stop measuring, release the trigger; and
- each operation of the trigger erases the previous readings and starts a new measurement.

3.20 Sealing Bandages

There are many incident grounds where the NSWFB are involved with sealing leaks from pipes that have been damaged. To effectively seal a hole in a pipe, a *Vetter* leak sealing bag is used to stop the flow of liquid (see Fig 3.43).

Fig 3.43 Vetter Bandage

The bandage is designed to contour to irregular surfaces, and will fit in confined spaces. Operating at 1.5 Bar the bandage can be wrapped around a pipe and inflated from any compressed air source. The synthetic rubber material from which the bandage is made, has nylon reinforcing which increase its strength, and the bandage is chemical resistant.

3.21 Infra-red Thermometer

The effects of heat stress on a firefighter can range from discomfort through to heat stroke. To help determine the amount of heat stress a firefighter is suffering from, the NSWFB is using the *DIATEK* 9000 INSTA-TEMP which is an infra-red thermometer that is designed to take a temperature measurement at the ear using a probe with a disposable cover. The body core temperature of the firefighter is indicated on the illuminated display (see Fig 3.44).

Fig 3.44 Infra-red Thermometer

Specifications

The specifications for the infra-red thermometer are detailed in Table 3M.

ITEM	SPECIFICATION
Power	4 x AAA Batteries
Weight	285 g
Dimensions (L x W x H)	15.38 mm x 18.38 mm x 5.12 mm
Temperature Display:	23.9° C to 42.2 ° C
Accuracy	± 0.1° C at 37° C

Table 3M Infra-red Thermometer Specifications

SECTION FOUR - DECONTAMINATION

CONTENTS

4 DECONTAMINATION

4.1 General

Decontamination involves the removal of any contaminates from persons or equipment, which have been exposed to the contaminate in the course of a HazMat incident.

Any personnel and equipment in use in the **Hot Zone** and any persons present in the **Hot Zone** upon the arrival of the NSWFB are to be considered as having been exposed to the hazardous material and will require decontamination.

The form of decontamination to be used i.e. wet or dry, is dependant upon the situation and the hazardous material involved.

Successful decontamination depends on strict adherence to a disciplined process within defined zones.

4.2 Types of Decontamination

There are two types of decontamination used within the NSWFB. These are:

- **Initial** - carried out at the scene to enable the safe removal of personnel from protective suits and to prevent the further spread of contaminates.
- **Final** - carried out under controlled conditions at the HazMat Response Unit in order that contaminated equipment be returned to service.

4.3 Decontamination Team

A full decontamination team consists of five members. They are:

- Decontamination Sector Commander (DSC);
- Wash Operator (WO);
- Wash Assistant (WA);
- Disrobe Assistant (DA); and
- Pump Operator (PO).

Each member is directly responsible to the DSC and will follow his/her instructions as well as assisting with the setting up of the Decontamination Zone. Each member is responsible to see that the clothing and equipment required for their task is arranged and also has the specific duties listed below.

4.3.1 Decontamination Sector Commander

The responsibilities of the DSC are as follows:

- liaise with the IC (HazMat);
- ensure all persons who may have been exposed are decontaminated;
- brief the Decontamination Team regarding their duties, type and method of decontamination to be carried out;
- debrief decontaminated Combat Crew on exit from **Hot Zone**. Endeavour to obtain the information needed to complete an exposure report, seek to establish the physical well being of the crew from the **Hot Zone** (in conjunction with medical personnel if available), and find out if the crew have information which may assist the IC;
- ensure any equipment which has lost its integrity is removed from service immediately;
- determine if the crew from the **Hot Zone** is fit to continue operating;
- establish a record of all personnel exposed to the contaminate and follow the NSWFB policy on reporting of exposed persons;

- arrange for the labelling, safe collection and removal of contaminated clothing and equipment;
- arrange for the make-up of equipment in the **Decontamination Zone** at the conclusion of the incident; and
- ensure each member carries out personal hygiene measures i.e. washing hands prior to leaving the incident site.

4.3.2 Wash Operator

The responsibilities of the WO are as follows:

- wear a minimum protection of a spillage suit and BA;
- attach airlines to BA auxiliary air line fittings where necessary;
- remain in the **Wash Area**;
- ensure the appropriate decontamination measures are thoroughly carried out for exiting crews; and
- carry out a final inspection of the decontaminated personnel to ensure effective cleaning has been achieved.

4.3.3 Wash Assistant

The responsibilities of the WA are as follows:

- wear a minimum protection of a splash suit to allow for relief of the WO;
- as required, operate a BA in the area to provide air to personnel undergoing decontamination;
- prevent entry of unauthorised personnel into the **Wash Area**; and
- assist decontaminated personnel to move to the **Disrobing/Rest Area**.

4.3.4 Disrobe Assistant

The responsibilities of the DA are as follows:

- wear a minimum protection of spillage boots and gloves;
- assist in the partial removal of clothing and equipment from decontaminated personnel, where further wearing is required;
- where decontaminated crews are not returning to the **Hot Zone**, assist in the complete removal of protective clothing. Place the clothing in plastic bags before labelling and sealing the bags. Ensure cylinders are changed on BA where necessary; and
- ensure liquid refreshment is provided to personnel.

4.3.5 Pump Operator

The responsibilities of the PO are as follows:

- remain by the pump;
- ensure sufficient water and pressure is supplied for the decontamination of personnel; and
- ensure the pump is used **only** for decontamination purposes.

4.4 Forms of Decontamination

Determine the appropriate type of decontamination to be used. There are two forms of decontamination to consider, wet using water, and dry, without water. Which method to use will be determined by what information is available on the contaminate.

It may be determined when more information is available that other methods of decontamination are appropriate. The different methods are:

- washing with water;
- washing with water and detergent;
- neutralising;
- brushing off dust particles; and
- scrubbing with a brush

4.4.1 Wet Dilution Decontamination

The majority of HazMat incidents will involve Wet Dilution decontamination, used when the level of toxicity of the contaminate can be sufficiently reduced by dilution with water as to pose no environmental hazard.

In this situation the decontamination run-off is allowed to enter storm water drains. Wet Dilution is done initially and a decision on Wet Containment where large amounts of run-off are undesirable can be taken later.

Wash Area

- use a portable decontamination shower where available (see Fig 4.1); and
- position over or near a drain.

Disrobing/Rest Area

- isolate from non-involved personnel and mark the area with barrier tape; and
- equip with a salvage sheet, heavy duty plastic bags, ties and labels, seating, *Oxy-Viva* resuscitator, liquid refreshment, and disposable overalls where available.

Fig 4.1 Portable Decontamination Shower

4.4.2 Wet Containment Decontamination

Used when the run-off from decontamination must be contained to prevent its spread to the environment. The run-off from this decontamination **must not** be allowed to enter storm water drains and some form of containment dam must be used (see Fig 4.2 and Fig 4.3).

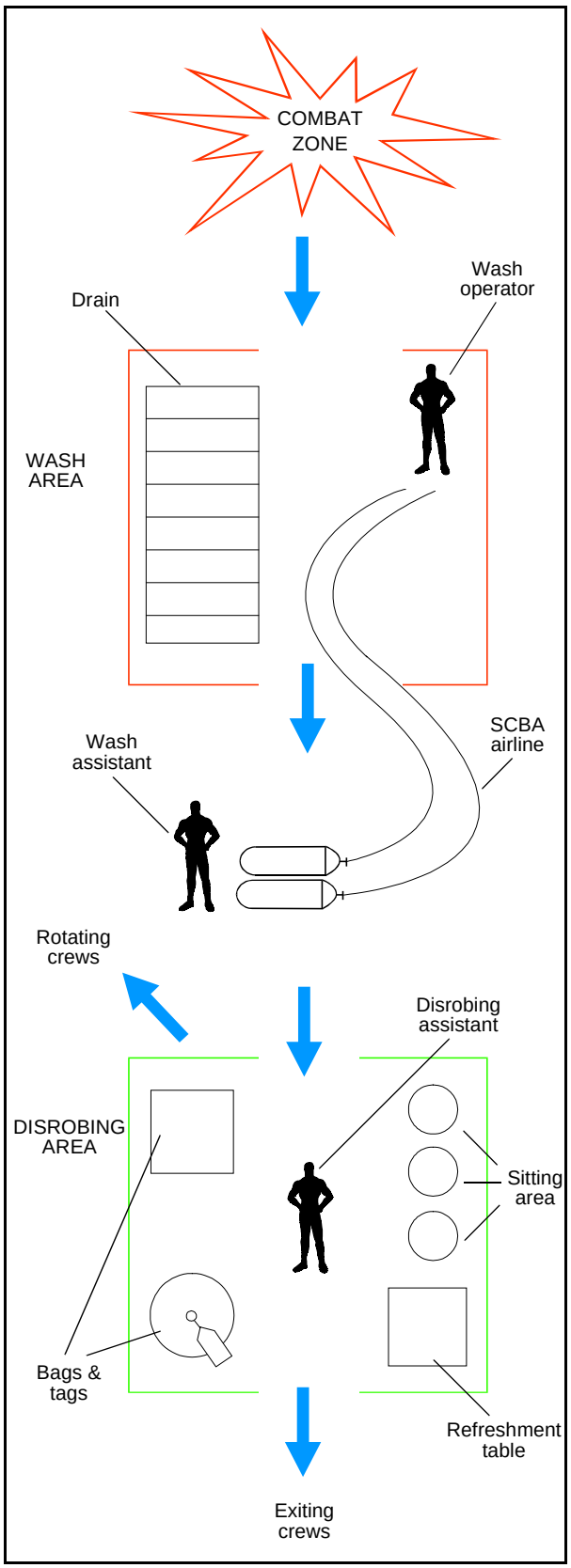

Fig 4.2 Dilution or Containment Decontamination

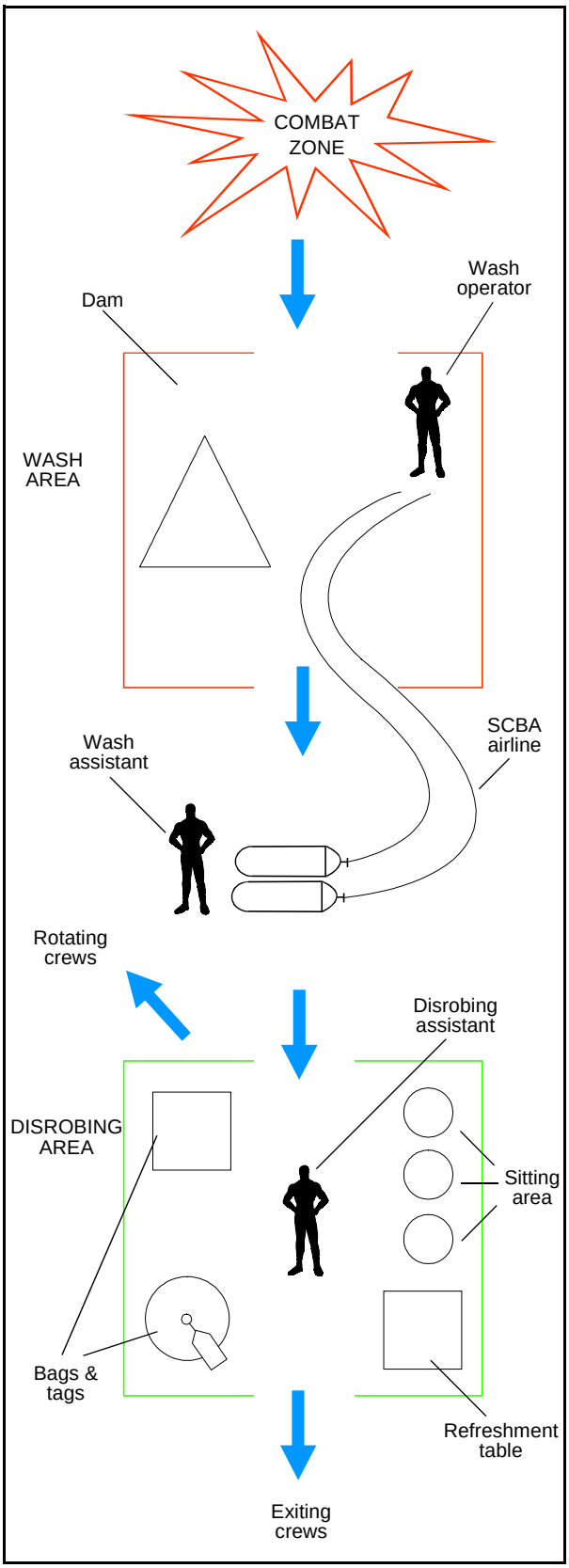

Fig 4.3 Containment Decontamination

4.4.3 Decontamination Zone

Wash Area

- same as for Wet Dilution with a dam to contain the run-off. A drain is not required Existing drain to be blocked off; and
- consideration must be given to the amount of water required to properly decontaminate and the containment of all run-off.

Disrobe Area

- same as for Wet Dilution Decontamination (see Fig 4.2).

4.4.4 Dry Decontamination

Used where an adverse reaction may result from the contaminate coming into contact with water.

Wash Area

- ensure no hoselines or other sources of water are present;
- equip with handbrooms, cloths etc for brushing or wiping; and
- place disposable sheet on ground to contain contaminate.

Disrobe Area

- equip as for Wet Decontamination.

4.4.5 Preliminary Decontamination Zone

In the initial stages of an incident when decontamination may be required quickly, a preliminary decontamination may be established, be it wet or dry.

An area is designated for the **Wash Area** and **Disrobe Area**. It has a WO and DA respectively.

Wash Area

The **Wash Area** consist of a hose reel and BA extension airline for WO and to provide a supplementary air supply to crew members as necessary.

Disrobing/Rest Area

This area requires the following equipment:

- salvage sheet;
- heavy duty plastic bags;
- ties and labels, seating;
- *Oxy-Viva* resuscitator; and
- liquid refreshment, and disposable overalls where available.

Preliminary decontamination is to be considered only as an interim measure and a more formal decontamination zone should be established as resources become available.

4.5 On Site Decontamination of Fire Fighting Uniform

Occasionally a call to a fire will turn out to be a HazMat incident and firefighters may have been contaminated whilst wearing only their fire fighting uniform and BA. In this instance the WO is to apply the following decontamination procedure:

- when the contaminate is of a dry nature, lightly wet down the wearer with the hose reel. This is only to be done when a non reactive material is involved e.g. Asbestos;
- connect firefighters to a supplementary air supply;
- instruct firefighters to remove their BA set without displacing the face mask (assistance may be required);

- remove the wearers external clothing i.e. helmet, turnout coat, boots and overtrousers, and place the helmet and boots in a separate bag to the tunic and overtrousers;
- thoroughly wash the wearers head;
- instruct the wearer to remove the BA face mask and wash their hands and face with soap and water; and
- carry out a final inspection of the wearer and when satisfied, instruct the wearer to proceed to the **Disrobing/ Rest Area**.

The wearer is to:

- consider the tunic and overtrousers unserviceable until they are have been decontaminated in an appropriate manner;
- thoroughly wash and scrub the helmet, boots and BA on return to the station, unless advised to return them to the HazMat Response Unit for final decontamination; and
- shower, with cold water, immediately on return to the station.

4.6 Emergency Decontamination of Casualties

Where the rescue or removal of affected persons has occurred, and decontamination procedures are necessary before handling the casualties over to medical personnel, adopt the following procedures:

- lay out a charged hose reel and blankets at a suitable place on the edge of the **Hot Zone**;
- move the contaminated casualties to that point;
- remove such contaminate as is possible by removing casualties clothing. **Do not** brush contaminate off exposed skin as this can force contaminate into the pores of the skin;
- thoroughly flush the casualties on the affected portions of their bodies with copious amounts of clean water. Ensure all traces of contaminate are removed and if necessary, remove their clothing to achieve effective removal of contaminates;
- provide privacy for casualties who are to have their clothing removed;
- move the casualties to an isolated area for medical attention. Where no medical crews are in attendance, monitor the casualties until medical services arrive; and
- the rescue crew is to report for decontamination.

4.7 Decontamination Procedure

To provide the maximum effectiveness in decontaminating firefighters exiting the **Hot Zone**, the WO is to adopt the following procedure for decontaminating personnel wearing protective clothing:

⚠ NOTE

Determine whether a wet or dry decontamination is to be adopted.

- decontaminate the person with the lowest air supply first;
- rinse the wearer undergoing decontamination. Where a portable decontamination shower is available wash the operator for a minimum of 2 mins;
- the wearers undergoing decontamination are to stand with arms outstretched and legs apart;

- using a brush or cloth, starting at the wearers head, completely clean the wearer giving attention to the BA (on non-encapsulating suits), gloves, folds in suits and zip fastenings;
- instruct the wearer to lift each foot in turn and clean the sole of each boot;
- carry out a further rinsing of operators to remove remaining material(s);
- prior to dispatching to the **Disrobing/ Rest Area** for removal of the suit and BA, inspect the wearer, to ensure effective decontamination has been achieved. Where satisfactory decontamination is not achieved, carry out further decontamination; and
- contain all materials used for dry decontamination in a heavy duty plastic bag, or recovery bin where available.

4.7.1 Decontamination Zone

The boundaries of the zone should be clearly defined using barrier tape, rope or hose lines.

In large open (rural) areas where this may not be practical, a position should be selected that is isolated by distance.

The physical size of the zone must allow for sufficient distance between the **Wash Area** and the **Disrobing Area** to prevent contamination of firefighters being undressed or firefighters working in the vicinity of the **Decontamination Zone** (see Fig 4.2 and Fig 4.3).

Position the **Decontamination Zone** on solid ground, upwind of the incident, be aware of the slope of the ground. The **Decontamination Zone** is divided into two main areas:

Wash Area

- position on the edge of the **Hot Zone**, over or in close proximity to a drain;
- tape off to isolate, large enough to contain spray or wind-borne particles; and
- treat **Wash Area** as a contaminated area.

Disrobing/Rest Area

- position in a shade covered area, sufficiently distant from the **Wash Area** to prevent cross contamination; and
- where the incident is of a size requiring the use of the three zone system, position the **Disrobing/Rest Area** on the edge of the **Restricted Access Zone**, close to the **Support Zone**.

4.7.2 Guidelines

A one way flow of personnel must be maintained.

The WO is to be connected to BA via an extension line to alleviate weight and allow greater movement.

Once personnel have moved from the **Wash Area** into the **Disrobe Area**, they must not step back into **Wash Area**.

The DA assists in partial removal (to the waist) of protective clothing, for rotating crews, who then rest and take in cool liquid refreshments.

SCBA cylinders must be changed if required.

When rested crews prepare for re-entry, the DA helps to redress personnel, who then proceed to staging area.

For crews not returning to the **Combat Zone**, the DA completely removes protective clothing, places it in bags, seals and tags the bags. Personnel then move to the **Support Zone** or beyond as required.

4.8 Making up of Decontamination Zone

All items of equipment within the zone that have come into contact with the contaminate or decontamination residue are to be thoroughly washed down, placed in plastic bags, sealed, labelled and sent to the HazMat Response Unit for final decontamination.

Where Wet Containment decontamination has been used, arrangements with the appropriate authority are to be made regarding disposal of contained decontaminated water. The WO flushes himself/herself down.

The WA will hose down the WO and himself/herself if required, then proceed together to the DA to have their protective clothing removed, bagged, tagged and sent for final decontamination.

⚠ NOTE

The DA's gloves shall also be dispatched for final decontamination.

4.9 Decontamination Tags

These tags are to be attached to bags containing equipment being sent for final decontamination. All details on the tag must be completed.

These tags (see Fig 4.4) are important because, they provide details of the wearer of the protective clothing should it be found to be damaged and the wearer requires contacting.

The tag details inform the personnel at the HazMat Response Unit to be aware of the contaminate they are dealing with and take appropriate measures. They serve as a warning that the bags contain contaminated equipment.

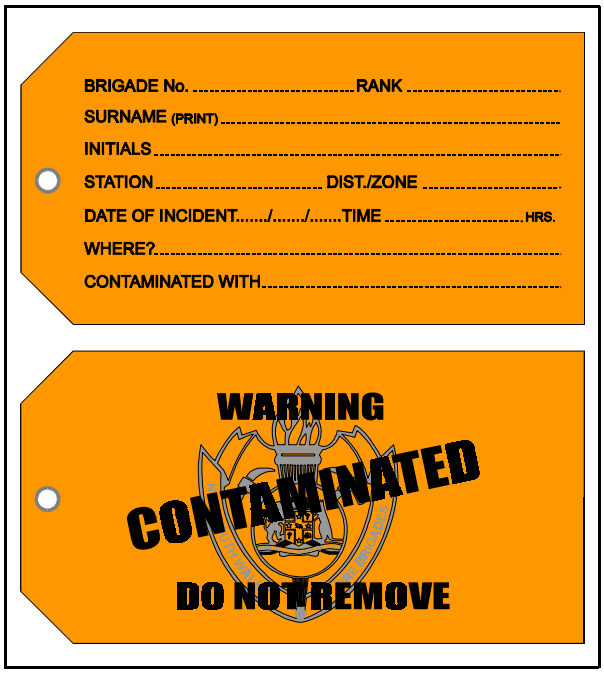

Fig 4.4 Decontamination Tag

SECTION FIVE - PROTECTIVE CLOTHING

CONTENTS

5 PROTECTIVE CLOTHING

5.1 General

At any HazMat incident, it is essential that special protective clothing is available to allow firefighters to work in hazardous situations where various types of toxic substances are present. To cope with these situations, various materials have been developed that offer the wearer various levels of protection.

There are three types of material from which protective clothing is made, these are:

- Poly Vinyl Chloride (PVC);
- Viton; and
- Composite.

5.2 Materials

Due to the many varying types of hazardous substances and the different properties they each possess (see Fig 5.1) it is important that a range of materials be available to provide maximum protection to firefighters in different situations.

Poly Vinyl Chloride (PVC)

The most common of the materials used within the NSWFB for protective clothing is PVC reinforced with a terylene fabric. It provides protection from a wide range of substances.

Viton

Viton is used in the manufacture of fully encapsulating gas tight suits only. Viton (chemical name - hexafluoropropylene/ vinylidene fluoride random copolymer) provides a greater degree of protection than PVC and is carried on HazMat vehicles only.

Composite

This synthetic, non-woven, laminated material is used in the manufacture of fully encapsulating gas tight suits. The composite suit provides a high level of protection, depending on the materials (*contaminates*) involved.

⚠ NOTE

Because no single type of suit will afford protection against all known types of contaminates, the NSWFB use different types of fully encapsulating suits,

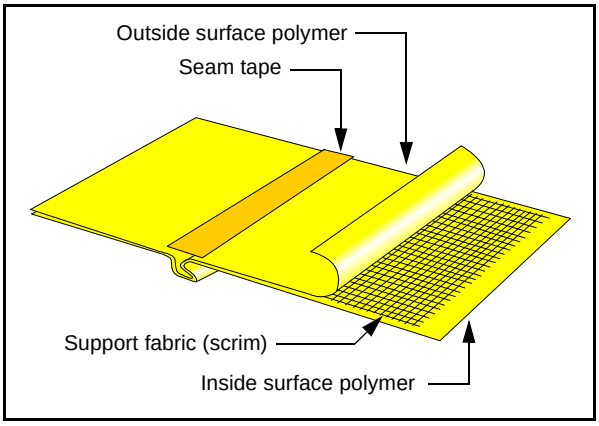

Fig 5.1 Material Structure

5.2.1 Resistance

You will be familiar with the fact that some materials such as rubber and some plastics will not let liquids to pass through them under normal circumstances. On the other hand, fabrics and paper will absorb a liquid and eventually, if saturation occurs, the liquid is able to soak through.

There are three ways in which a liquid could penetrate the material from which protective clothing is made.

- degradation;
- penetration; and
- permeation.

Degradation

Degradation (see Fig 5.2) is the physical destruction or decomposition of a clothing material due to exposure to chemicals, continued use, or ambient conditions e.g. storage in sunlight.

Degradation is noted by visible signs such as charring, shrinking, dissolving or by testing the clothing material for weight changes, loss of fabric tensile strength, etc.

Traditionally, most chemical compatibility charts have been based upon degradation. This data has been gathered from laboratory tests conducted with pure, normally undiluted test chemicals on clean, uncontaminated swatches of material over a pre-established time period (often 2 to 6 hrs). You can see how important it is for the right clothing to be worn depending on the chemical substance that has to be dealt with.

The IC is responsible for the protection and safety of all firefighters during the size up stage at chemical incidents, before initiating first strike action. Additional advice on personal protection is obtainable on most chemicals from the Communications Centre.

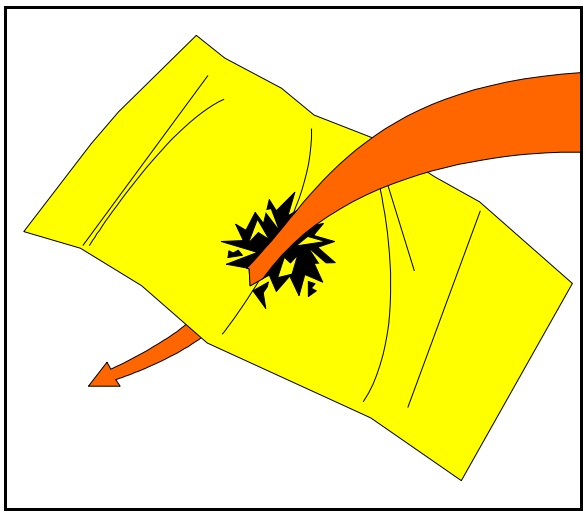

Fig 5.2 Degradation

Penetration

Penetration (see Fig 5.3) is the flow of a hazardous material through zippers, stitched seams, pinholes or other imperfections in the material. The potential for penetration generally increases at excessively hot or cold temperatures e.g. cryogenics.

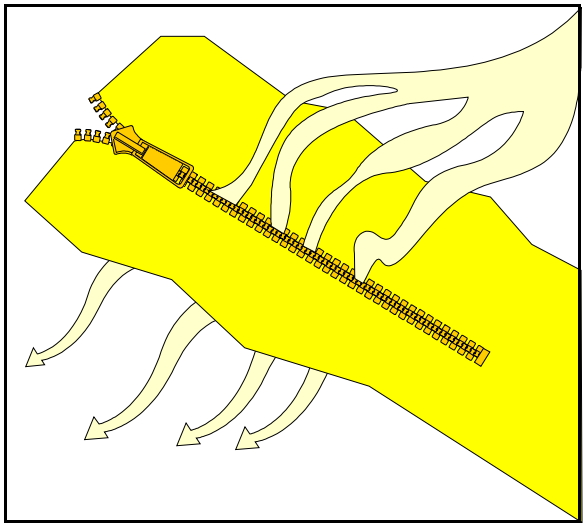

Fig 5.3 Penetration

Permeation

Permeation (see Fig 5.4) is the process by which a hazardous liquid could move through a given material on a molecular level.

The process of chemical permeation through an impervious barrier is a three-step process consisting of:

- absorption of the chemical into the outer surfaces of the material, generally not detectable by the wearer;
- diffusion of the chemical through the material; and
- leakage of the chemical from the inner surface of the material (towards the wearer), is usually the first time that the user will detect the chemical inside the protective clothing.

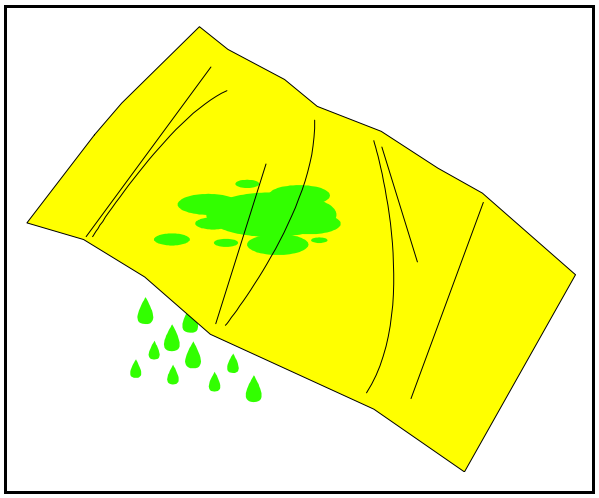

Fig 5.4 Permeation

5.3 Suit Types

The suits used by the NSWFB can be divided into two types, these are:

- non-encapsulating; and
- fully encapsulating - gas tight.

5.3.1 Non-Encapsulating

A Non-Encapsulating suit is capable of providing skin and body protection, but does not provide **total body protection** from gases, air-borne dust particles or vapours.

There is one type of non-encapsulating protection suit within the NSWFB, and this is refered to as *spillage clothing* (see Fig 5.5).

Spillage Clothing

Made of PVC, this one piece suit consists of trousers/jacket with a hood and storm cuffs. It is worn in conjunction with chemical spillage boots and gloves. BA can also be worn with this suit.

Fig 5.5 Spillage Clothing

5.3.2 Spillage Clothing Dressing Procedure

The procedure for putting on the spillage clothing is detailed in Table 5A.

STAGE	STEPS	KEY POINTS	FIGURE
1. Layout Spillage Suit			
2. Remove Helmet		2.1.1 Helmet to be worn at Hazmat Controller's discretion. If it is to be worn the inner band will need to be extended.	
3. Remove fire tunic		3.1.1 Reduces the heat factor making wearing of the suit more comfortable.	
4. Remove boots			
5. Put on pants			Fig 5.6
6. Put on spillage boots		6.1.1 Ensure pants are tucked into boots.	Fig 5.7
7. Fit gloves			Fig 5.8
8. Put on coat	8.1 Bunch fingers up and force through elasticised cuff. 8.2 Pull sleeves down over elasticised cuffs 8.3 Do up press studs	8.1.1 Assistant enlarges elasticised cuff for easy fitting. 8.2.1 Ensures total seal 8.3.1 At this stage ensure hood is outside coat	Fig 5.9
9. Secure Coat	9.1 Do up zip 9.2 Fasten neck band		Fig 5.10
10. Fit SCBA in acordance with NSWFB Procedures	10.1 Fit facemask		
11. Pull hood over head	11.1 Tuck any excess straps etc. inside e.g. neck strap	11.1.1 Hood should cover sealing edge of the face mask.	
12. Fasten hood flap			

Table 5A Spillage Clothing Dressing Procedure

Fig 5.6 Spillage Clothing Dressing (Stage 5)

Fig 5.8 Spillage Clothing Dressing (Stage 7)

Fig 5.7 Spillage Clothing Dressing (Stage 6)

Fig 5.9 Spillage Clothing Dressing (Stage 8)

Fig 5.10 Spillage Clothing Dressing (Stage 9)

5.3.3 Spillage Suit Undressing Procedure

The undressing procedure for the spillage suit is detailed in Table 5B.

STAGE	STEPS	KEY POINTS
1. Remove coat	1.1 Pull hood back 1.2 Remove SCBA 1.3 Undo zip 1.4 Undo studs 1.5 Take off coat	
2. Remove trousers		2.1.1 Remove protective trousers half way and be seated to allow easy removal of complete trousers
3. Remove boots		
4. Remove gloves		
5. Ensure all protective clothing is placed in plastic bags and labelled with a yellow decontamination tag.		
NOTE **All procedures are to be carried out with the aid of an assistant.**		

Table 5B Spillage Suit Undressing Procedure

5.3.4 Operational Instructions

The IC will make the decision regarding the wearing of Spillage Clothing based on the following information:

- observing the incident;
- a knowledge of the substance(s) involved;
- information from informed persons at the incident; and
- information available from the Communication Centre.

CAUTION

Should any doubt exist regarding the suitability of the Spillage Clothing to provide adequate protection from a toxic substance then the gas tight suits are to be worn.

The State Fire Command is to be immediately notified when Spillage Clothing is being worn, together with all other relevant information concerning the incident.

The following procedures are to be followed when operating with Spillage Clothing:

- a dressing station (Staging Area) is to be established upwind of the incident where the air is fresh and not affected by contaminates;

- no firefighter who has been exposed to a toxic substance at the incident, is to be dressed in the Spillage Suit unless rescue of persons is paramount. When this occurs the crew members with the least degree of exposure are to be used;

- under no circumstances is a wearer of the clothing to enter contaminates alone. A minimum of two members are to be used; and

- should, during the operation, the clothing be damaged in any way or the wearer experience distress, the distress alarm is to be sounded. The wearer is to immediately withdraw from the contaminated atmosphere.

CAUTION

As radiated body heat is, for the most part, trapped within the clothing, the wearer must be alert for signs that would indicate heat exhaustion is occurring and which if ignored would lead to collapse. These signs include: dizziness, headache, blurred vision, excess thirst, mental confusion and nausea.

The chemical resistance of the clothing decreases with an increase in temperature. It is recommended that the clothing not be used in operations where the temperature exceeds 60° C.

CAUTION

Rapid deterioration of the suit fabric will occur if the suit comes into contact with heated materials, including steam pipes, any other heated surfaces, or materials which have been exposed to fire.

The clothing is not to be exposed to extremely cold surfaces, or discharging gases which may rapidly freeze the clothing fabric, as this will cause the fabric to crack.

Immediately following withdrawal from the contaminated area the wearer is to report to a designated area, where initial decontamination of the clothing can be undertaken. No attempt to remove the clothing is to be made until the initial decontamination procedure has occurred.

5.3.5 Service Checks

After Use

On return to the station, the clothing is to be washed with BA disinfectant, dried, folded and restowed. Should any item/s of clothing be damaged, the items are to be replaced.

Weekly

Each set of clothing is to be removed and laid out on a salvage sheet. All items of clothing are to be examined inside and out for cuts or defects. Particular attention is to be given to gloves and spillage boots. Examine the palm of the gloves and between the fingers for cuts or cracking. Spillage boots are to be inspected by feeling inside the boot to ensure no damage is apparent.

Replacement of Clothing

Replacement Spillage Clothing is to be ordered through the Hazardous Materials Response Unit. An Initial Supply Transaction Voucher (ISTV) is to be completed and forwarded to the Section through normal NSWFB channels. When ordering replacement Spillage Clothing by telephone, the ISTV number is to be quoted. Following inspection, the clothing is to be refolded using **different** folds than before and replaced in the appliance.

5.3.6 Fully Encapsulating

A gas tight suit offers total body protection from vapours, gases, splashes or air-borne dusts, and includes a respiratory device within the suit (SCBA). The NSWFB has two types of Fully Encapsulating protective suits:

- PVC or Viton suit (see Fig 5.11); and
- Composite Material suit (see Fig 5.12).

PVC/Viton Suit

Table 5C details the suits of this type found in the NSWFB.

SUIT	MANUFACTURER	MATERIAL
Respirex	*FFE*	PVC
Trellechem	*Trellborg*	Viton
Respirex V	*FFE*	Viton

Table 5C PVC/Viton Suits

Fig 5.11 PVC/Viton Suit

This suit consists of a one piece garment with integral boots, gloves, hood with moulded visor, body exhaust valves and auxiliary air line for attachment to SCBA. The visor which is sealed into the hood provides up to 180° peripheral vision.

The PVC suits are carried on all Salvage/ Rescue appliances and many pumping appliances throughout the State. The Viton gas suits are only carried on HazMat vehicles.

Fig 5.12 Composite Material Suit

⚠ NOTE

At all times the auxiliary air line fitting should be attached to the extension face mask connection. This enables air to be supplied to the wearer from an external supply if required.

5.3.7 Gas Tight Fully Encapsulating Suit Dressing Procedure

The dressing procedure for the Gas Tight Fully Encapsulating suit is detailed in Table 5D.

STAGE	STEPS	KEY POINTS	FIGURE
1. Layout suit and visually check - place on undergarment	1.1 Remove helmet, tunic and boots		Fig 5.13
2. Check BA	2.1 Check contents 2.2 Close cylinder valve, release pressure	2.1.1 Release pressure to enable disconnection of supply line coupling.	Fig 5.14
3. Dress in lower half of suit normal fashion	3.1 Pull on right trouser and boot 3.2 Pull on left trouser and boot 3.3 Fasten body belt		Fig 5.15
4. Fit SCBA		4.1.1 Place neck strap around neck.	Fig 5.16
5. Connect air supply to suit	5.1 Attach auxiliary air line to extension mask fitting 5.2 Open cylinder valve		Fig 5.17
6. Put on BA face mask		6.1.1 Conduct a low pressure test. 6.1.2 Positive mode engaged manually or automatically. 6.1.3 Remove set tally with cylinder pressure.	Fig 5.18
7. Have assistant pull hood and visor over head	Fold arms		Fig 5.19
8. Close zip and zip cover			Fig 5.20

NOTE

Dressing shall be carried out with the aid of an assistant.

Table 5D Gas Tight Fully Encapsulating Suit (Dressing Procedure)

Fig 5.13 Gas Tight Suit Dressing (Stage 1)

Fig 5.14 Gas Tight Suit Dressing (Stage 2)

Fig 5.15 Gas Tight Suit Dressing (Stage 3)

Fig 5.16 Gas Tight Suit Dressing (Stage 4)

Fig 5.17 Gas Tight Suit Dressing (Stage 5)

Fig 5.18 Gas Tight Suit Dressing (Stage 6)

Fig 5.19 Gas Tight Suit Dressing (Stage 7)

Fig 5.20 Gas Tight Suit Dressing (Stage 8)

External Air Connection

The Gas Tight suit has a connection for an external air supply (see Fig 5.21).

Fig 5.21 Connection for External Air Supply

Safety Line

The Gas Tight suit is provided with an attachment point for a safety line (see Fig 5.22).

Fig 5.22 Safety Line Attachment Point

5.3.8 Gas Tight Fully Encapsulating Suit Undressing Procedure

The undressing procedure for the Gas Tight Fully Encapsulating suit is detailed in Table 5E.

Due to the *Bat-wing* design of the sleeves in all fully encapsulating gas-tight suits, the arms can be removed from the sleeves during wearing for the purpose of:

- pressure gauge checks;
- PDU operation;
- note taking; and
- transceiver operation.

5.3.9 Operational Instructions Gas Tight Fully Encapsulating Suit

The IC will make the decision regarding the wearing of gas suits based on the following information:

- observing the incident;
- a knowledge of the substance(s) involved; and
- information from informed persons at the incident.

STAGE	STEPS	KEY POINTS
1. Open zip cover and unzip.		
2. Pull hood and visor off head.	2.1 Left hand on top of hood, right hand across front and on left side of visor. 2.2 Pull up and across.	
3. Remove left arm from suit.		
4. Remove right arm from suit.		
5. Remove BA face mask.	5.1 Ensure demand valve is in park mode.	5.1.1 Neck strap to remain around neck.
6. Disconnect air supply.	6.1 Close cylinder valve. 6.2 Release pressure. 6.3 Break connections into manifold of suit.	6.3.1 Air pressure in the supply line must be released to allow breaking of couplings.
7. Remove lower half of suit.	7.1 Release body belt. 7.2 Pull off trousers and boots	7.1.1 Suit to be placed in plastic bag. Bag to be sealed and labelled.
8. Remove SCBA		
⚠ **NOTE** **Undressing shall be carried out with the aid of an assistant.**		

Table 5E Gas Tight Fully Encapsulating Suit (Undressing Procedure)

CAUTION

Should there be any doubt regarding the toxicity of the substance, the suit should be worn.

The State Fire Command is to be immediately notified when gas suits are being worn, together with all other relevant information concerning the incident.

The following procedures are to be followed when operating with the gas suit:

- a staging area is to be established upwind of the incident where the air is fresh and not contaminated by hazardous materials;
- no firefighter who has been exposed to a toxic substance at the incident is to be dressed in the gas tight suit unless rescue of persons is paramount. If this should occur, the crew members with the least degree of exposure are to be used;
- under no circumstances is a wearer of the suit to enter contaminates alone. A minimum of two members are to be used.
- should during the operation, the suit be damaged in any way or the wearer experiences distress, the member shall operate the distress unit and with another wearer they are to immediately withdraw from the contaminated atmosphere. Exhalation from SCBA will provide a positive pressure in the suit, thereby preventing entry of toxic gases or vapours; and
- without any undue exertion the maximum wearing time is not to exceed 20 mins. However, the actual wearing time will be dependent upon the physical exertion of the wearer in carrying out a task, and the ambient temperature. In most cases this will average between 10 to 15 mins.

CAUTION

As radiated body heat is for the most part trapped within the suit the wearer must be alert for signs that would indicate heat exhaustion is occurring and which if ignored would lead to collapse.

The signs of heat exhaustion include:

- dizziness;
- headache;
- blurred vision;
- excess thirst;
- mental confusion; and
- nausea.

The chemical resistance of the suit decreases with an increase in temperature, it is recommended that the suit not be used in operations where the temperature exceeds 60° C.

CAUTION

Rapid deterioration of the suit fabric will occur if the suit comes into contact with heated materials, including steam pipes, any other heated surface, or material which has been exposed to fire.

The suit is not to be exposed to extremely cold surfaces or discharging gases which may rapidly freeze the suit fabric, as this will cause the fabric to crack.

Immediately following withdrawal from the contaminated area the wearer is to report to a designated area where initial decontamination of the suit can be undertaken. No attempt to

remove the suit is to be made until the initial decontamination procedure laid down has occurred.

5.3.10 Service Checks

Following Use

After initial decontamination at the incident the suit is to be placed in a plastic bag which is to be sealed and forwarded to the Hazardous Material Response Unit for final decontamination.

NOTE

So that effective final decontamination can be assured, it is essential that accurate information regarding the substance involved in the incident, together with the manufacturers or suppliers name and address can be supplied. This information is to be written on a tag, together with any note of damage to the suit and tied to the plastic bag containing the suit being returned for final decontamination.

Weekly

Each suit is to be removed from its carrying case, laid out on a clean salvage sheet and examined to ensure all fittings are intact. During this inspection particular attention is to be given to the examination of the fabric and all seams of the suit. The visor is to be examined for cracks to see that no damage is apparent.

Following examination, the suit is to be refolded using **different** folds than previous and replaced in the carrying bag.

Every Two Years

The Hazardous Materials Response Unit conducts an inspection and service of gas suits every 2 yrs. At this time, a thorough examination, plus cleaning and pressure testing of the suit is undertaken.

5.3.11 Composite Material Suit

While being similar in design to other forms of fully encapsulating clothing, there are some differences with the composite suit. Not only is the material more chemically resistant than the PVC and Viton suits, but the design of the suit has been changed.

The suit consists of a one piece garment with integral body valves, auxiliary air line and head. A collapsible visor is sealed into the head and allows full peripheral vision. Replaceable gauntlet-type corrosive chemical gloves are incorporated and the legs of the gas suit end in gas tight socks with a splash cuff. A pair of chemical spillage boots are required to be worn with this suit.

CAUTION

While wearing this suit, if the wearer stands up quickly from a squatting position, a substantial vacuum may be created within the suit, permitting an inward leakage of contaminates. This condition must be prevented by avoiding sudden gross vertical body movements.

All operational and running service checks remain the same for this suit as for other fully encapsulating gas tight suits.