

# FIRE SERVICES EXAMINATIONS BOARD

## STUDY NOTE

EXAMINATION

LEADING FIREFIGHTERS EXAMINATION

PAPER

OPERATIONS

SUBJECT

FIREFIGHTING & RESCUE INCIDENTS

ITEM

THE IDENTIFICATION OF DANGEROUS SUBSTANCES

STUDY NOTE No.

1111

### ***INTRODUCTION TO THE STUDY NOTE***

***This study note has been prepared as the basis of study in connection with the qualifying examinations for promotion.***

***Candidates will be expected to demonstrate knowledge of the information contained in the study note and understand how it should be applied:***

***The 'References' made at the end of the Study Note are included for information only and candidates will not be expected to study these as part of the bibliography.***

## THE IDENTIFICATION OF DANGEROUS SUBSTANCES

### 1. Introduction

This Study Note relates to the identification of dangerous substances being conveyed by road and describes how firefighters can use action codes to deal with incidents involving them.

### 2. The Nature of the Problem

The number of dangerous substances, which might face firefighters at an incident, is immense.

For firefighters to cope safely and efficiently with such an incident, they must be able to quickly, and without difficulty, discover the nature of the danger and how they should respond.

Sometimes the substances will be at fixed sites, such as factories and laboratories. Here it is essential that firefighters take active steps in advance to familiarise themselves with the dangers and how to cope with them. Section 1.1(d) inspections provide a good opportunity for this.

While many incidents do involve goods being kept in one place, a greater problem could arise with goods in transit, particularly those in bulk tankers. Clearly it would be difficult for firefighters to know in advance the details of all the dangerous substances being transported within their areas. They must therefore be able to obtain the information they require at the time and to rely on it.

This is generally achieved by regulations requiring vehicles carrying hazardous substances to be marked with appropriate warning signs.

### 3. Types of Dangerous Substances

The United Nations classifies nine types of hazard relating to the transport of dangerous goods. These are as follows:

- (a) Class 1: explosives;
- (b) Class 2: gases;
- (c) Class 3: flammable liquids;
- (d) Class 4: flammable solids;
- (e) Class 5: oxidising substances and organic peroxides;
- (f) Class 6: poisonous and infectious substances;
- (g) Class 7: radioactive substances;
- (h) Class 8: corrosives;
- (i) Class 9: the transportation of miscellaneous dangerous substances in a class not covered by the previous eight classes.

#### 4. The Labelling of Dangerous Substance Containers

The number of dangerous substances covered by the nine classes is very great and their physical characteristics - colour, smell, etc, even if apparent, are not necessarily such as to distinguish clearly one from another. This is particularly so for non-experts.

When goods are in transit information regarding the substances being transported may be available from:

- (a) the driver of the vehicle;
- (b) the consigner's documents; or
- (c) the vehicle may carry special instructions on the action necessary in the event of an incident.

In some accidents, however, firefighters would not be able to consult these. In such circumstances, unless they have obtained information in advance, they must rely on the labelling of the vehicle, the tank, the tank compartment or the container.

#### 5. Hazard Warning Panels

The Carriage of Dangerous Goods by Road Regulations 1996 relates to the identification of dangerous substances being conveyed by road or any other substance offering a comparable risk.

The Regulations require that each vehicle should display composite Hazard-Warning Panels. The panel has an orange background with black lettering, except for one of the sections, which shows a variously coloured hazard warning diamond symbol on a white background.

Hazard Warning Panels shall be so mounted as to be clearly visible and will generally be sited:

- ( i ) at the vehicles rear; and
- ( ii ) on both sides towards the front.

The Hazard Warning Panel is divided into five sections as shown below.

|                                           |                                   |
|-------------------------------------------|-----------------------------------|
| EMERGENCY ACTION CODE<br>(d)              | HAZARD WARNING<br>DIAMOND<br>(a)  |
| SUBSTANCE IDENTIFICATION NUMBER<br>(b)    |                                   |
| SPECIALIST ADVICE TELEPHONE NUMBER<br>(c) | MANUFACTURERS<br>NAME/LOGO<br>(c) |



Fig 1 - Example of a Hazard Warning Panel

The Regulations also make provision for the simultaneous conveyance, in separate compartments of the same tanker, substances of the **same class**, namely multi-loads.

The Hazard Warning Panel under these circumstances will vary from the one above in that the Substance Identification Number will be replaced with the words 'MULTI-LOAD'.

(a) Hazard Warning Diamond

As can be seen from the above examples, the right hand section of the Hazard Warning Panel contains a symbol in the shape of a diamond. This indicates that the contents of the vehicle are dangerous and shows the broad nature of the principal hazard they present. The symbols are internationally agreed and relate to the classes listed in the 'Types of Dangerous Substances' in Section 3.

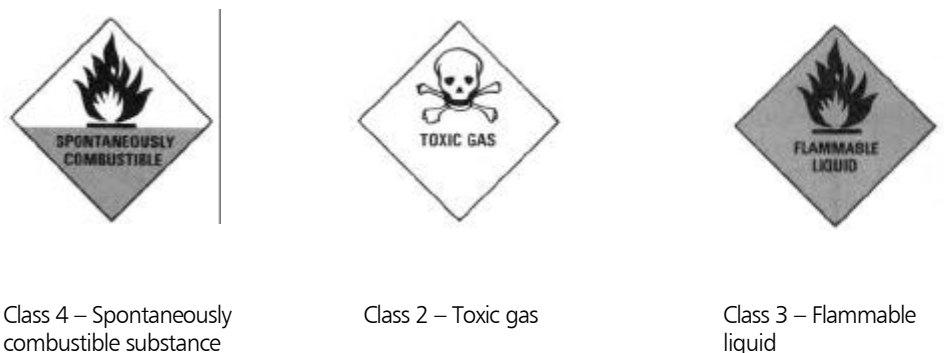


Fig 2 - Examples of Hazard Warning Diamonds

Where multi loads are in **different classes** the Hazard Warning Diamond will register an Exclamation Mark ! as shown below.



Fig 3 - Example of Hazard Warning Diamond – Multi-Load

In these circumstances each compartment will also be labelled with the Substance Identification Number to identify the hazard presented by the separate load. (see (b) below).

(b) Substance Identification Number

The middle section of the Hazard Warning Panel contains a Substance Identification Number produced by The United Nations. This is an international list of the most commonly transported dangerous substances that The United Nations has assigned a separate number to, commonly known as the UN number. Member states of the UN have agreed to use these numbers on their transport vehicles, so that the contents can be identified by reference to an index.

Sometimes the name of the chemical appears under the number.

Firefighters should be aware that the number does not necessarily give a precise identification: it may indicate only a general class. As mentioned earlier where a tanker is conveying a multi-load, the word 'multi-load' should appear instead of a number; each compartment will however also be separately labelled and **this label will carry the Substance Identification Number**.

(c) Specialist Advice Telephone Number

In the bottom two sections of the Hazard Warning Panel, there will be a telephone number in the left hand side and possibly in the right hand side (which otherwise remains blank) a manufacturer's name or symbol.

Contact with the telephone number brings into operation the Chemsafe scheme organised by the Chemical Industries' Association (see Section 10).

(d) Emergency Action Code (EAC)

At the top left of the panel appears the Emergency Action Code, commonly known as the Hazchem code.

The codes are designed to be used in conjunction with the Emergency Action Scale Cards, which should be carried by emergency service personnel. The cards indicate the action that may be necessary (except additional personal protection (APP)) **DURING THE FIRST FEW MINUTES** of an incident.

The codes allocated apply to the transport in bulk (ie 3,000 litres or more) of a substance by road or rail. These codes will not necessarily apply in cases where loads are carried in quantities below 3,000 litres or for non-transport incidents, although they may be used to provide some indication of the action that may be necessary.

Substances in Class 7, ie radioactive substances, although included in the list have not been allocated emergency action codes.

## 6. Interpretation of Emergency Action Code

The code consists of a number from 1 to 4 and one of the letters P, R, S, T, W, X, Y, Z, sometimes followed by the letter E.

The code does not identify the contents of a vehicle. Its purpose is to indicate the basic method of dealing with an incident.

Set out below is the detail found on an Emergency Action Scale Card followed by a description of the meaning of the different numbers and letters.

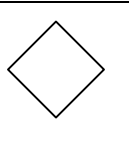
| HAZCHEM SCALE        |                      |                                                                                     |         |
|----------------------|----------------------|-------------------------------------------------------------------------------------|---------|
| EAC                  |                      |  |         |
| UN No                |                      |                                                                                     |         |
| FOR FIRE OR SPILLAGE |                      |                                                                                     |         |
| 1                    | COURSE SPRAY         |                                                                                     |         |
| 2                    | FINE SPRAY           |                                                                                     |         |
| 3                    | FOAM                 |                                                                                     |         |
| 4                    | DRY AGENT            |                                                                                     |         |
| P                    | V                    | CPC                                                                                 | DILUTE  |
| R                    |                      |                                                                                     |         |
| S                    | V                    | BA & FIRE KIT                                                                       |         |
| T                    |                      |                                                                                     | CONTAIN |
| W                    | V                    | CPC                                                                                 |         |
| X                    |                      |                                                                                     |         |
| Y                    | V                    | BA & FIRE KIT                                                                       |         |
| Z                    |                      |                                                                                     |         |
| E                    | PUBLIC SAFETY HAZARD |                                                                                     |         |

Fig 4 - Layout of Emergency Action Scale Card

(a) Extinguishing Media

The firefighting extinguishing media is determined by reference to the first character of the Emergency Action Code as follows:

- 1 denotes COARSE SPRAY;
- 2 denotes FINE SPRAY;
- 3 denotes NORMAL FOAM ie protein type foam that is not alcohol resistant; and
- 4 denotes DRY AGENT - water MUST NOT be allowed to come into contact with substance.

NOTE: ANY HIGHER NUMBER THAN THE ONE SHOWN CAN BE USED BUT A LOWER NUMBER MUST NOT BE USED.

(b) Personal Protection

Where the second character of the Emergency Action Code is S, T, Y or Z, self-contained open circuit positive pressure compressed-air breathing apparatus should be worn in combination with fire kit consisting of tunic, over trousers and firefighters' gloves. The fire kit shall conform to the appropriate British Standard.

Where the second character of an Emergency Action Code is P, R, W or X, liquid-tight Chemical Protective Clothing (CPC) conforming to the appropriate British Standard in combination with the breathing apparatus as specified above should be used.

(c) Violent Reaction

Where the second character of the Emergency Action Code is a P, S, W or Y, there is a danger that the substance can be violently or explosively reactive. This danger exists for all flammable gases and flammable liquids with a flash point below 61°C as well as for many other reactive substances.

(d) Contain

Where the second character of an Emergency Action Code is W, X, Y or Z, spillages should be prevented from entering drains and watercourses.

(e) Dilute

Where the second character of the code is P, R, S or T, spillages may be washed to drains with large quantities of water. Due care must however still be exercised to avoid unnecessary pollution of watercourses.

NOTE: In order to mitigate the effects of environmental pollution by fire service operations and to improve liaison between the fire service and the environment agency, a consistent set of arrangements and standards for dealing with incidents has been established.

Ideally all contamination and decontamination run-off should be contained. However, the environment agency accepts that this will not always be practical for normal fire service operations and that life saving operational procedures must take precedence over other considerations at the scene of an incident. Nevertheless, all steps that are reasonably practicable should be taken to contain contaminants and the fire service should always inform the environment agency as soon as possible so that appropriate advice can be given.

(f) 'E' - Public Safety Hazard

An 'E' following the first two characters of an Emergency Action Code indicates that there may be a public safety hazard and that the following actions should be taken:

- (i) People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be eliminated and any ventilation stopped.
- (ii) Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250 metres away from the incident.
- (iii) Police and Fire Service incident commanders should consult each other and with a product expert, or with a source of product expertise.
- (iv) The possible need for subsequent evacuation should be considered, but it should be remembered that in most cases it would be safer to remain in a building than to evacuate.

**7. Additional Personal Protection (APP)**

As mentioned above, the Emergency Action Codes are only intended to provide advice during the initial stages of an incident. In all cases, further information on the hazards likely to be encountered from the substance or substances and the additional protection required of firefighters should be obtained from fire control as a matter of urgency.

This particularly applies to protective clothing requirements as some substances can be dealt with using Liquid-tight Chemical Protective Clothing (CPC) but in other circumstances Gas-tight Chemical Protective Clothing should be worn.

**8. International Operations - ADR Hazardous Identification Number (HIN)**

The transport of dangerous goods between most European countries is governed by an agreement commonly known as ADR.

The purpose of the agreement is to ensure that dangerous goods transported by road across European frontiers comply with certain conditions, amongst them being the marking of vehicles carrying such loads.

These vehicles must display two forms of hazard identification:

- (a) the Hazard Warning Diamond of the type described in Section 5(a); and
- (b) an ADR Warning Panel.

The ADR Warning Panel is an orange coloured plate (40cm wide by 30 cm high) with black lettering.

The panels shall be so mounted as to be clearly visible and will generally be sited:

- (a) at the vehicles front; and
- (b) its rear.

The plate shall contain the following information:

|                                    |
|------------------------------------|
| HAZARD IDENTIFICATION CODE         |
| SUBSTANCE IDENTIFICATION<br>NUMBER |

Fig 5 - Layout of ADR Warning Panel

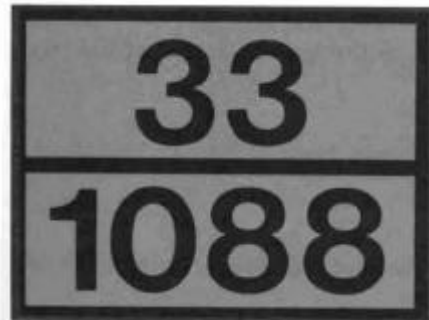


Fig 6 - Example of ADR Warning Panel

The Hazard Identification Code consists of two or three figures and in general, the figures indicate the following hazards:

- 1 = Not used.
- 2 = Emissions of gas due to pressure or to chemical reaction.
- 3 = Flammability of liquids (vapours) and gases or self-heating liquids.
- 4 = Flammability of solids or self-heating solids.

- 5 = Oxidizing (fire-intensifying) effect.
- 6 = Toxicity (or risk of infection).
- 7 = Radioactivity.
- 8 = Corrosivity.
- 9 = Risk of spontaneous, violent reaction.

Doubling of a figure (eg '33') indicates an intensification of that particular hazard.

Where the hazard associated with a substance can be adequately indicated by a single figure, this is followed by a zero. (eg '30').

If the letter 'X' prefixes a hazard identification number, this indicates that the substance will react dangerously with water. For these substances, water may only be used with the approval of experts.

As in the Regulations for the UK, the ADR code also makes provision for the marking of vehicles simultaneously by conveying in separate compartments of the same tanker, substances of the same class or of different classes, namely multi-loads.

Under these circumstance the Orange ADR Warning Panel at the front and rear of the vehicle will be left blank and individual Compartment Labels, together with Hazard Warning Diamonds to identify the hazard presented by the separate loads in each compartment, are required to be provided.

## 9. Obtaining Further Information

Some of the information available at an incident, for example from the Tremcards or by the Emergency Action Code, will enable firefighters to know at once the basic action they should take. If, however, this information is missing or more details are required then further enquiries must be made. The officer-in-charge must contact Fire Control who will have further resources available, such as computer based information systems or access to specialist officers.

## 10. Obtaining Assistance in the Identification of Hazardous Substances

### (a) Chemsafe (Chemical Industries' Scheme for Assistance in Freight Emergencies)

The scheme requires that vehicles should carry effective markings plus written instructions on the action to take in an emergency.

More than this, however, it recognises that the emergency services may require quickly more detailed advice or help either by telephone or at the scene. The main aim of the scheme is to ensure that this advice and help are constantly available. The scheme is, by intention, comprehensive amongst members of the Association, to which most firms do belong.

(b) The standard procedure

Under the standard procedure, each company ensures that its vehicles are clearly labelled with an emergency telephone number. By calling this number the Fire Service should be able to obtain advice and help at any time.

(c) Long-stop procedure

Contact with the emergency number should be the first course of action. In some circumstances, however, the number may be missing or obscured or the arrangements may break down. In this case, there is a longstop procedure for obtaining assistance, even though the manufacturer or trader is unknown or unobtainable, or the product is unidentified.

The principal element of this longstop procedure is an emergency centre that has a continuously manned telephone through which the public emergency authorities can ask for advice on the chemical hazards of a product involved in an incident.

In order to readily identify hazards and the emergency action that should be taken for the numerous different products being marketed, the Centre has established a computerised chemical data bank and duty officers, who are scientifically qualified and experienced in handling hazardous materials, have access to this.

If assistance is needed at the scene, the Centre will turn out its own qualified staff or, if it is more convenient, request a particular company to send help. The manufacturer or trading company actually involved should take over as soon as its identity is known. The other assistance provided will, however, remain until no longer required.

(d) Tremcards (Transport Emergency Cards)

Many companies, in meeting their obligation to provide each vehicle conveying a dangerous chemical written instructions on the action to take in case of emergency, provide a Tremcard. This is a standard A4 size card in red and black issued for each of a number of common hazardous chemicals. The card gives:

- (i) the chemical name of the substance;
- (ii) its appearance and chemical properties;
- (iii) its hazards and the precautions against them;
- (iv) the action necessary in the event of fire or spillage;
- (v) the appropriate first-aid treatment; and
- (vi) possibly, an emergency telephone number.

## 11. Other Labels and Means of Identification

Firefighters will occasionally encounter dangerous substances other than chemicals. The most serious danger of contamination will come from radioactive and biological hazards. Where the labelling arrangements referred to above do not apply, the symbols shown below are often used for identification purposes.

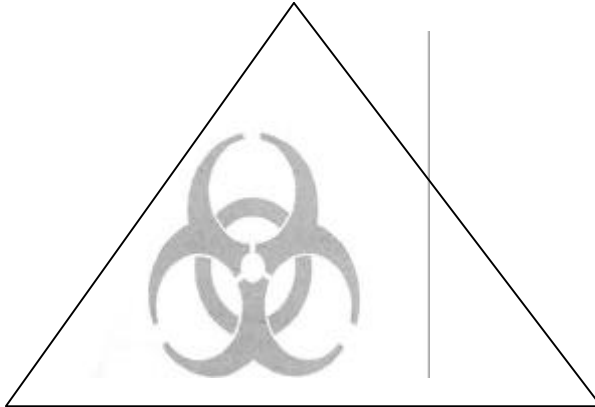


Fig 7 - Symbol used to denote Biological Hazard  
Black symbol inside yellow triangle.

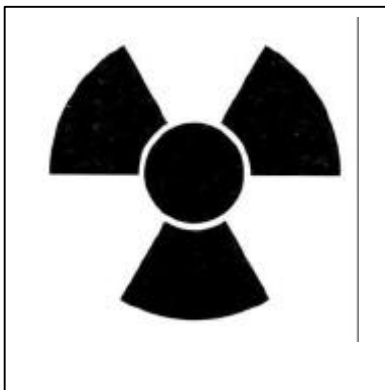


Fig 8 - Symbol used to denote Radioactive Hazard  
Black symbol inside yellow box.

## References

Manual of Firemanship Book 12  
HMFSI - Hazchem List 10