ROAD VEHICLE EMERGENCY AND RECOVERY

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1 Introduction and Summary

This document has been written by experts from the Gases Industry to help minimise the effects of serious road vehicle incidents involving Gases Industry products by providing recommended guidance, training and procedures to be followed.

Road vehicle incidents involving Gases Industry products can be extremely serious. The dangers can be at their worst during the recovery operation, particularly, if the recovery is not managed in a safe and professional manner by those at the scene.

Due to the unplanned nature of any Trans Em event, safety MUST be given the highest priority.

This document provides information about transported products, identification of the products and major design features of gases industry road transport equipment. The document also provides advice on product handling, vehicle recovery, preparing transport emergency plans, safety aspects and training.

2 Scope and Purpose

2.1 Scope

This document is intended for all persons within and outside the Gases Industry who may become involved in a Gases Industry Road Vehicle Emergency or Recovery operation. This may include Hauliers under contract, Emergency Service personnel, vehicle recovery operators and members of other organisations (e.g. Environmental Agency).

This document provides guidance on Road Vehicle Recovery, and on the following:

- product safety information;
- incidents where there is product release or potential product release;
- damage to pressure vessels/receptacles (e.g. Cylinders, Tubes and Bundles) and manifolds;
- prevention of fire; and,
- actual fires which may have occurred.

Road transport equipment included are Road Tankers (vacuum insulated), Road Tankers (insulated), Tank Containers, Multiple-element gas containers (MEGCs) and Battery Vehicles manufactured for the products covered in Section 4.0 when full, part full and nominally empty.

Other equipment, cylinder vehicles and vehicles owned by customers and used to carry transportable receptacles are not included, but some of the principles and guidelines may be applicable. Gases Industry railway wagons are not included in the scope of this document, but the principles involved are generally similar.

The products of ADR Class 2 which are listed in section 4.0 of this document are included (compressed, refrigerated liquefied and dissolved gases). LPG products and other liquefied gases are not included within the scope of this document.

2.2 Purpose

The purpose is:

- to provide information to Gases Industry vehicle operators, hauliers under contract, Emergency Service personnel, vehicle recovery operators and members of other organisations (Eg:- Environmental Agency)

- to provide guidance, training material and procedures to be followed in order to minimise the effects of a TransEm event. This will include guidance relating to emergency incident planning, the procedures and actions to be followed during any such TransEm event;
- to provide specific Gases Industry product and vehicle/equipment information to promote maximum co-operation from all those involved in an incident, particularly the Emergency Services;
- to provide guidance on the follow up actions required to ensure that any lessons learned are considered, and incorporated into future emergency planning to avoid repetition of the TransEm event.
- repetition of the TransEm event.

3 Definitions

Road Vehicle Incident:

An unplanned event, involving a Gases Industry road vehicle, which may have resulted in product release, or may result in product release, during recovery.

Road Vehicle Accident:

An unplanned event involving a Gases Industry road vehicle (and / or its equipment) where injury has occurred to persons or animals and / or the vehicle has been damaged, and / or has left the road.

Road Vehicle Emergency:

An unplanned event where a Gases Industry vehicle (and / or its equipment) has been damaged, or is liable to be damaged and there is product release or potential product release during recovery.

TransEm Event:

For the purposes of this document, any one of the above (road transport incident / accident / emergency).

Emergency Services:

Members of the Police, Fire and Ambulance services.

Duty Officer:

The “on -duty” gases industry person assigned the task of initiating the response to a road vehicle incident or accident or an emergency.

Transport Emergency (TransEm) Team Leader:

The gases industry person responsible, at the scene, for the management of the gas industry involvement in a Road Vehicle Transport event.

Transport Emergency (TransEm) Co-ordinator:

The gases industry person responsible “at base” for assisting and co-ordinating the work of the Transport Emergency Team Leader.

Vehicle Recovery:

The operation of restoring a vehicle to its normal transport position, or to a position where it can be otherwise removed from the scene, following an incident, an accident or an emergency.

Vehicle Recovery Operator:

A vehicle recovery operator who operates under hire and reward system who has specialist heavy lifting, towing and recovery equipment.

Vehicle:

Road transport equipment used to carry pressure vessels / receptacles or pull pressure vessels / receptacles mounted on wheels. These are known as Road Tankers, Tank Containers, MEGCs and Battery Vehicles.

Road Tanker:

A vehicle to which is permanently attached a vacuum insulated or insulated pressure vessel designed to carry liquefied or refrigerated gases products. This may be self-propelled or pulled by a motor vehicle.

Tank Container:

An article of transport equipment with an internal volume greater than 450 litres designed to carry liquefied or refrigerated gases products and fitted with devices permitting ready handling, particularly from one mode of transport to another.

Multiple-element gas containers (MEGCs):

MEGCs are multimodal assemblies of cylinders, tubes and bundles of cylinders which are inter connected by a manifold and which are assembled within a framework. The MEGC includes service equipment and structural equipment necessary for the transport of gases.

Battery-vehicle:

An assembly of cylinders, tubes, or bundles connected to a manifold and permanently mounted on a vehicle chassis such that the assembly is filled, transported and emptied as a single unit.

Cylinders:

Transportable pressure receptacles of a capacity not exceeding 150 litres.

Tubes:

Seamless transportable pressure receptacles of a capacity exceeding 150 litres and of not more than 5000 litres.

Bundles (also known as frames):

Transportable assemblies of cylinders which are inter-connected by a manifold and held permanently and firmly together in a frame.

Cryogenic Liquid:

Refrigerated liquefied gases.

Cryogenic receptacles:

Transportable thermally insulated pressure receptacles for deeply refrigerated liquefied gases of a capacity of not more than 1000 litres.

Transport Emergency Card (TREMCARD):

A written document carried with the road transport equipment detailing product hazards and general information for the driver, and other persons to use, in a TransEm event.

EIGA:

The European Industrial Gases Association.

ADR:

The European Agreement concerning the international carriage of Dangerous Goods by Road.

4 Products included and other information

4.1 List of products

The following products of ADR Class 2 with classification codes starting with 1, 3 and 4 are included within the scope of this document.

Gases with a classification code of 1A (Asphyxiant gases {or gases presenting no subsidiary risk})

1046

1066

1956

Gases with a classification code of 1O (Oxidising gases)

1072 OXYGEN, COMPRESSED

3156 COMPRESSED GAS, OXIDIZING, N.O.S.

Gases with a classification code of 1F (Flammable gases)

1049 HYDROGEN, COMPRESSED

1962 ETHYLENE, COMPRESSED

1971 METHANE, COMPRESSED

1971 NATURAL GAS, COMPRESSED, with high methane content

1954 COMPRESSED GAS, FLAMMABLE, N.O.S.

Gases with a classification code of 1T (Toxic, gases)

1955 COMPRESSED GAS, TOXIC, N.O.S.

Gases with a classification code of 1TF (Toxic, Flammable gases)

1016 CARBON MONOXIDE, COMPRESSED

1953 COMPRESSED GAS, TOXIC, FLAMMABLE, N.O.S.

Gases with a classification code of 3A (Asphyxiant gases)

1951 ARGON, REFRIGERATED LIQUID

1963 HELIUM, REFRIGERATED LIQUID

1977 NITROGEN, REFRIGERATED LIQUID

2187 CARBON DIOXIDE, REFRIGERATED LIQUID

3158 GAS, REFRIGERATED LIQUID, N.O.S.

Gases with a classification code of 3O (Oxidising gases)

1003 AIR, REFRIGERATED LIQUID

1073 OXYGEN, REFRIGERATED LIQUID

2201 NITROUS OXIDE, REFRIGERATED LIQUID

3311 GAS, REFRIGERATED LIQUID, OXIDIZING, N.O.S.

Gases with a classification code of 3F (Flammable gases)

1038 ETHYLENE, REFRIGERATED LIQUID

1961 ETHANE, REFRIGERATED LIQUID

1966 HYDROGEN, REFRIGERATED LIQUID

1972 METHANE, REFRIGERATED LIQUID

1972 NATURAL GAS, REFRIGERATED LIQUID, with high methane content

3312 GAS, REFRIGERATED LIQUID, FLAMMABLE, N.O.S.

Gases with a classification code of 4F (Flammable gases)

1001 ACETYLENE, DISSOLVED

4.2 Types of Gases

In the United Nations Model Regulations for the Transport of Dangerous Goods (Orange Book) Class 2 Gases are assigned to one of three divisions based on the primary hazard of the gas during as follows:

(a) Division 2.1 *Flammable gases*

Gases which at 20°C and a standard pressure of 101.3 kPa:

- are ignitable when in a mixture of 13 per cent or less by volume with air; or
- have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Flammability shall be determined by tests or by calculation in accordance with methods adopted by ISO.

(b) Division 2.2 *Non-flammable, non-toxic gases*

Gases which are transported at a pressure not less than 280 kPa at 20 °C, or as refrigerated liquids, and which:

- are asphyxiant - gases which dilute or replace the oxygen normally in the atmosphere; or
- are oxidizing - gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does; or
- do not come under the other divisions;

(c) Division 2.3 *Toxic gases*

Gases which:

- are known to be so toxic or corrosive to humans as to pose a hazard to health; or
- are presumed to be toxic or corrosive to humans because they have an LC_{50} value equal to or less than 5,000 ml/m^3 (ppm).

Gases and gas mixtures with hazards associated with more than one division take the following hazard precedence:

(a) Division 2.3 (Toxic Gases) takes precedence over all other divisions:

(b) Division 2.1 (Flammable Gases) takes precedence over Division 2.2

(Non-Flammable, Non-Toxic Gases).

The International Maritime Organisation (IMO) in their International Maritime Dangerous Goods Code (IMDG) have accepted the UN divisions and classifications as detailed above.

ADR accepts the UN principles for road transport and subdivides Class 2 Gases (substances and articles) as follows: -

1 Compressed gases: gases having a critical temperature below 20° C.

2 Liquefied gases: gases having a critical temperature of 20° or above.

3 Refrigerated liquefied gases: gases which when carried are partially liquid because of their low temperature.

4 Gases dissolved under pressure: gases which when carried are dissolved in a solvent.

5 Aerosol dispensers and receptacles, small, containing gas (gas cartridges).

6 Other articles containing gas under pressure.

7 Non-pressurised gases subject to special requirements (gas samples).

Substances and articles, classified as above are assigned to one of the following groups according to their hazardous properties:

A asphyxiant

O oxidising

F flammable

T toxic

TF toxic, flammable

TC toxic, corrosive

TO toxic, oxidizing

TFC toxic, flammable, corrosive

TOC toxic, oxidising, corrosive.

Where there are hazardous properties associated with more than one group, the groups designated with the letter T take precedence over all other groups. The groups designated by the letter F takes precedence over the groups designated A and O.

Note: Corrosive is considered toxic and is therefore assigned to the group TC, TFC and TOC.

4.3 Substance Hazard communication

To ensure that the potential risks and hazards of substances and articles offered for transport are adequately communicated to all who may become involved or in contact with the goods in the course of transport, special labelling and placarding of the transport units (within the scope of this document) is applied.

4.3.1 Danger Labels

The labelling system is based on the classification of the substance or article (dangerous goods) and with the following in mind: -

To make dangerous goods recognizable from a distance using colour, symbol and shape.

To make the nature of the risk identifiable by means of main symbols.

To make, by colour, a useful first guide for handling, stowage and segregation.

For UN Class 2 three primary labels are allocated, one for flammable gases, one for non-flammable non-toxic gases and one for toxic gases as indicated below. Labels indicating the primary hazard MAY BE marked with the class number in the bottom corner (as indicated below).

Gases with more than one hazard may have a subsidiary hazard label allocated, however, this MUST NOT bear the class number in the bottom corner.

ADR Labels Class 2 (UN Primary Labels)

Flammable
(UN Division 2.1)

Non-flammable
Non-toxic
(UN Division 2.2)

2

Toxic
(UN Division 2.3)

Subsidiary Labels

Flammable

Oxidising

Corrosive

4.3.2 Vehicle Placarding (Orange Plates)

Road Transport units and tankers / tank containers / battery vehicles carrying dangerous goods must display rectangular reflectorized Orange-coloured plates set in a vertical plane. These may be plain or carry the identification of the dangerous goods, the class number and the main hazards.

Examples as follows:

Fig 1

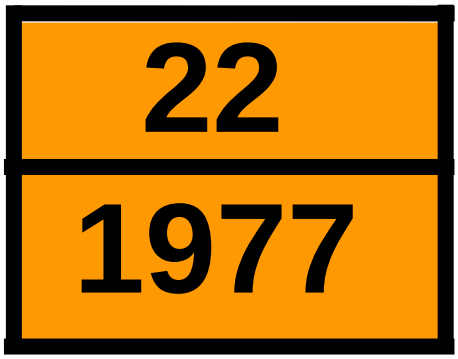


Fig 2

(1977 Nitrogen, Refrigerated Liquid)

Fig 1 shows the placarding normally associated with the vehicle.
In the upper part of Fig 2 is the Hazard identification number.
In the lower part of Fig 2 is the substance identification number (in accordance with the UN designation).

The Hazard identification number consists of two or three figures. In general the figures indicate the following hazards: -

2 Emission of gas due to pressure or chemical reaction.
3 Flammability of liquids (vapours) and gas or self-heating liquid.
4 Flammability of solids or self-heating solids.
5 Oxidising (fire intensifying) effect.
6 Toxicity or risk of infection.
7 Radioactivity.
8 Corrosivity.
9 Risk of violent spontaneous reaction.
0 No other risk.

Doubling of the figure 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.

Examples for Class 2 substances:

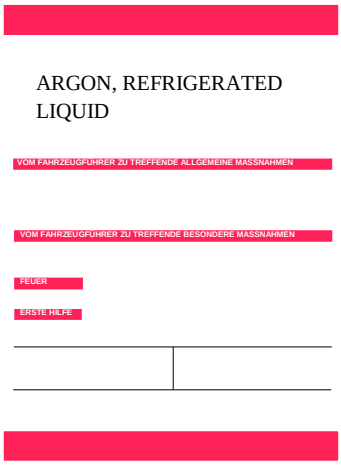
20 asphyxiant gas or gas with no subsidiary risk
(e.g. 1066 NITROGEN, COMPRESSED).
22 refrigerated liquefied gas, asphyxiant.
(e.g. 1951 ARGON, REFRIGERATED LIQUID)
223 refrigerated liquefied gas, flammable
(e.g. 1966 HYDROGEN, REFRIGERATED LIQUID)

225 refrigerated liquefied gas, oxidising (fire intensifying)
(e.g. 1073 OXYGEN, REFRIGERATED LIQUID)
23 flammable gas (e.g. 1049 HYDROGEN, COMPRESSED)
24 oxidising (fire intensifying) gas
(e.g. 1072 OXYGEN, COMPRESSED)
263 toxic gas, flammable.
(e.g. 1016 CARBON MONOXIDE, COMPRESSED)

In the United Kingdom a derogation allows national hazard placarding to be used as an alternative.

4.3.3 Trem Cards

Information in writing about the dangerous goods being transported, sometimes known as a Tremcard, is given to the driver and is available for the emergency services for use at a TransEm event. (see technical note ”Transport Emergency Instructions” IGC Document)



Example of typical TREMCARD format.

The information contained within this format is:

- **Load:** information about the substance(s) being carried e.g. physical state.
- **Nature of the load:** main danger, behaviour under fire etc.
- **Basic personal protection:** recommended for the driver e.g. suitable gloves.
- **Immediate action by Driver:** action to take (e.g. notify police and fire brigade, etc.)
- **Spillage:** what action to take (e.g. prevent escalation if safe to do so).
- **Fire:** what action to take and general information e.g. reacts with water.
- **First Aid:** in case of contact with the substances being carried.
- **Additional information:** any other useful information, for example, contact telephone number for further specialist advice, emergency services, fire brigade, police, hospitals, etc.

5 Vehicles / Equipment

All personnel involved in dealing with a TransEm event should be familiar with the vehicles/equipment involved. This includes a working knowledge of the following:

5.1 Types of Vehicles

5.1.1 Tank vehicles (Road Tankers and Tank Containers)

Tank vehicles (road tankers and tank containers) are generally:

- Low pressure with working pressures of 5 bar or less generally used for refrigerated liquefied gases known as “air gases” (e.g. Nitrogen).

- Medium pressure with working pressures above 5 bar up to 25 bar generally used for refrigerated liquefied gases (e.g. Carbon Dioxide or air gases) being transferred by differential pressure rather than by pump.
- Special case refrigerated liquefied gas tank containers (5 bar up to 25 bar) used on long international journeys.

These can be either vacuum insulated comprising of an inner vessel surrounded by a vacuum jacket or an inner vessel surrounded by a thin outer jacket in which is positioned insulating material.

All these tanks are equipped with a discharge system that works either by using a pump or by using a pressure build up system for discharge by differential pressure.

The appropriate Process & Instrumentation Diagram (P & ID) is displayed on each vehicle. (See appendix A.)

5.1.1.1 Vacuum Insulated Tank / Tanker

Vacuum insulated transport tanks are double walled. They consist of an inner vessel and an outer vacuum jacket. The space between the jacket and the inner vessel (inter space) contains special insulating material, and is evacuated of air. The inner vessel is the actual pressure vessel, which contains the gas to be transported. The outer vacuum jacket is designed for an external pressure of 1 bar and connects the whole to the vehicle chassis by means of external sub-assemblies. The inner vessel is connected to the jacket by a support system with a heat reducing path and is fitted with baffle plates to reduce dynamic loads during transport. It is designed to fulfil all the loading requirements of ADR. If the vacuum is lost, e.g. due to a failed jacket, the insulating material itself is adequate to limit the pressure rise (known as boil off) due to normal ambient temperature and abnormal (fire engulfment) such it can be vented by the Tank safety valves.

In general the following main connections are made to the inner vessel:

- a bottom line for liquid filling and withdrawal (in some cases this may be a dip tube),
- a top fill line,
- a vent line and
- a line from the safety devices to the top of the tank.

Other connections are made for gauging and artificial pressure raising**.**

The first valve immediately after the tank on the filling /withdrawal line may be a remote controlled emergency valve that can be pneumatically or hydraulically operated. Normally the design of these valves allows the valves to be opened mechanically in emergencies.

Depending on the position of an overturned tank it is possible that gas lines may be submerged in the liquid phase and liquid lines may be in the gas phase. Additionally gauging is likely to be inaccurate.

The inner vessel is protected against over pressure by safety valves (or in older tankers or special tankers rupture discs or both). These may be set to open at the maximum working pressure of the tank or the test pressure of the tank in the case of rupture discs. In addition to the safety devices for the tank all pipework where liquid gas can be trapped is fitted with relief devices.

A blow off plate, disc or a similar device that opens if the vacuum is lost, or if the space between the jacket and the inner vessel becomes pressurised, protects the outer jacket.

5.1.1.2 Insulated Tank / Tanker

Insulated tanks are not normally used to transport refrigerated liquefied gas products with temperatures less than –100 °C. An insulated transport tank consists of an inner pressure vessel, enclosed by an outer jacket. The space between the inner vessel and the outer jacket is filled with insulating material, usually closed cell polyurethane foam.

The outer jacket is normally made of thin plates of stainless steel or aluminium or fibre glass reinforced plastic. This protects the insulation against the environment and minor damage but does not form a gas tight seal.

The inner vessel is connected to the chassis by a low thermal conductivity support system and is usually fitted with baffle plates to reduce dynamic loads during transport. It is designed to fulfil all the loading requirements of ADR. If the outer jacket and parts of the insulation are damaged, the insulating material itself is adequate to limit the pressure rise (known as boil off) due to normal ambient temperature and abnormal conditions (e.g. fire engulfment). Excess gas pressure can be relieved by the tank safety valves and rupture discs.

In general the following main connections are made to the inner vessel:

- a bottom line for liquid filling and withdrawal with a bottom valve (in some cases this may be a dip tube),
- a top fill line,
- a vent line and,
- a line from the safety devices to the top of the tank.

Additional connections are made for pressure gauging, level indication and other purposes.

The first valve immediately after the tank on the filling / withdrawal line may be a remote controlled emergency valve or a bottom valve that can be pneumatically or hydraulically operated. Normally the designs of these valves allow the valves to be opened mechanically in emergencies.

Depending on the position of an overturned tank it is possible that gas lines may be submerged in the liquid phase and liquid lines may be in the gas phase. Additionally gauging is likely to be inaccurate or obscured.

The inner vessel is protected against over pressure by safety valves (or in older tankers or special tankers rupture discs or both). These may be set to open at, or below, the maximum working pressure of the tank.
In addition to the safety devices for the tank all pipework where liquid gas can be trapped is fitted with a relief device. A blow off plate, disc or a similar device is not required to protect the outer jacket since these jackets are not gas tight.

5.1.2 Battery vehicles

Battery vehicles are normally used for the transport of compressed gas in high pressure cylinders, tubes or bundles up to 300 bar at 15°C.

It is typical for this type of equipment for the mass / weight of the transported product to be low in comparison with the total mass of the battery vehicle. The weight of the vehicle cannot, therefore, be substantially reduced by product removal. The discharge system of battery vehicles is simple and uses the pressure difference between the contents of cylinders / tubes and that of the static vessels / installation. The discharge coupling is normally situated at the rear of the vehicle.

Battery vehicles are normally equipped with a manifold valve for each assembly of receptacles, a main valve and a pressure indicator. In the case of toxic and / or flammable products there may also be a spring actuated emergency valve, which is normally closed during transport.

Note:

MEGCs are constructed in a similar manner to battery vehicles. The receptacles are assembled and permanently fastened within a frame, which is secured to a vehicle (or trailer) in a similar manner to a tank container.

They should therefore be treated in the same way as the equivalent type of battery vehicle.

5.1.2.1 Battery vehicles constructed from cylinders

Battery vehicles manufactured from cylinders are assemblies of cylinders, up to 150 litre capacity, permanently fastened together by mechanical means (known as packs).Each cylinder is connected to the other by a piping arrangement (known as a manifold) and each pack may be connected to a gallery manifold which leads to the outlet fill / discharge coupling via a main shut-off valve. In some cases there are separate couplings for filling and discharge.

The packs are permanently attached to the chassis by mechanical means such that the whole is filled, transported and emptied as a single unit.

Each cylinder is manufactured and approved according to the requirements for cylinders.

The cylinders are combined into groups of not more than 5000 litres. Each group can be isolated by a shut-off valve.

For toxic gases each cylinder is also fitted with a valve.

The mechanical means used to attach the cylinders together and to the chassis is designed to withstand the “g” load requirements of ADR and to avoid local stress concentration on the cylinder wall.

Battery vehicles of this type do not normally have safety relief devices.

The manifold system is designed to the test pressure of the cylinders.

5.1.2.2 Battery vehicles constructed from tubes

Battery vehicles manufactured from tubes are assemblies of seamless tubes, each more than 150 litres but not more than 5000 litres capacity, permanently fastened together by mechanical means. The tubes are combined into groups of not more than 5000 litres, although it may be possible for this to be an individual tube.

Each tube is connected to the others by a piping arrangement (known as a manifold) and each pack, if more than one, may be connected to a gallery manifold (which leads to the outlet / discharge coupling) via a shut off valve. The pack(s) are permanently attached to the chassis by mechanical means such that the whole is filled, transported and emptied as a single unit.

Each tube is manufactured and approved according to the requirements for cylinders / tubes.

Each group or individual tube can be isolated by a shut-off valve.

For toxic gases each cylinder is also fitted with a valve.

The mechanical means used to attach the cylinders together and to the chassis is designed to withstand the “g” load requirements of ADR and to avoid local stress concentration on the cylinder wall.

Battery vehicles of this type do not normally have safety relief devices.

The manifold system is designed to the test pressure of the tubes.

5.1.2.3 Battery vehicles constructed from bundles

Battery vehicles manufactured from bundles are assemblies of bundles permanently connected to a manifold external to the bundle and permanently mounted on a chassis such that all the assemblies are filled, transported and emptied as a single unit.

The bundles and the cylinders in a bundle are manufactured and approved according the requirements for bundles / cylinders for individual use.

Each bundle is fitted with a shut off valve and can be isolated.

For toxic gases each cylinder of the bundle is fitted with a shut off valve.

The mounting system is designed to withstand the “g” load requirements of ADR. The Mechanical means employed to permanently secure the bundle to the chassis is such that movement in relation to the chassis is avoided.

Battery vehicles of this type do not normally have safety relief devices.

The manifold system is designed to the test pressure of the cylinders.

5.1.2.4 Special cases resembling battery vehicles

Acetylene may be transported on vehicles which resemble battery vehicles with bundles which are **not** permanently fixed to the chassis but secured for the purpose of transport.
In this case the bundles are taken off the chassis for filling and connected to the manifold for product withdrawal at the customer site.

The bundle fastening system of these trailers is designed to withstand the "g" load requirements of ADR. The mechanical means employed to secure the bundles to the chassis also allows for the bundles to be easily removed.

Battery vehicles for acetylene are normally not fitted with safety valves but the piping system is designed to withstand an explosion in the system.

There may be other products transported in this way (e.g. Carbon Dioxide). However, they **should not** be confused with vehicles transporting single packages of cylinders or bundles.

In these cases it may be appropriate to remove the bundles to lighten the load for recovery.

5.2 Weight of the vehicle / equipment and product

Maximum gross vehicle weights will vary according to the regulations of each particular country. The actual vehicle weight (including equipment) will depend on the design and construction of the vehicle and the product carried.

Maximum gross vehicle weights are shown on plate(s) attached to the vehicle.

The weight of the product carried will depend on:

- How full the vehicle is
- What the product is
- Whether the product is being contained as a compressed gas (relatively light in comparison to the weight of the containment) or liquid (often much heavier than the weight of the containment).
- Vehicle size.

5.3 Design and construction and general arrangement drawings

This will depend on the individual gas company requirements and manufacturer of the Vehicle. These may vary in the way they are constructed, but, the principles are normally the same. A typical illustration of a tanker cross section is given in Appendix B. Photographs of typical road transport equipment are shown in Appendix C, and a typical Process and Instrumentation Diagram (P&ID) is shown in Appendix A.

5.4 Design and construction details of pipework / manifolding arrangement

Refrigerated liquid product road transport equipment usually has pipework constructed from either stainless steel or high purity copper. The thickness of the pipework will depend on the

maximum working pressure of the tanker and the maximum delivery pressure of the product discharge system.

Compressed gas product road transport equipment will usually have pipework constructed from stainless steel, high purity copper or copper alloy. The thickness of the pipework will depend on the maximum fill/settled pressure of the product and on the maximum working pressure of the receptacles.

Fittings used to connect lengths of pipework together are soldered, welded or mechanical joints with or without “o” ring back up.

All pipework is designed for the temperature ranges expected from the product and atmospheric conditions.

5.5 Contents and pressure gauges

Gauges on gases industry road transport equipment are used for information purposes. Pressure gauges are used to advise on the vessel pressure. In the case of compressed gas road transport equipment the pressure gauge indicates the quantity of gas carried. In the case of liquid vehicles a special contents gauge indicates the amount of product. Other gauges are used for the discharge system.

Note:

Following a TransEm event all gauges should be considered as being suspect and must not therefore be relied upon to provide accurate information as to the pressure and / or contents. Whilst pressure gauges may provide some indication as to pressure, contents gauges will never operate properly unless the tank is in an upright, or near upright, position.

5.6 Safety Devices

5.6.1 Safety Relief Valves

These devices protect the vessel and / or pipework from excessive pressure which could cause rupture.

These valves are spring loaded and will normally release pressure to the atmosphere.

Vessel relief valves will start to open at their set pressure and be fully open at 110% of this set pressure. When the pressure reduces to below 90% the valves will re-seat.

During vehicle emergencies particular care must be taken to avoid injury or equipment damage due to escaping product when these valves open unexpectedly.

Note:

When the vehicle is in a non-upright position the risk is greater since there is a likelihood that these relief devices may vent liquid and the discharge may be directed towards personnel working in the area.

5.6.2 Rupture (bursting) Discs

They also protect the vessel and / or pipework from excessive pressure.

The safety advice given in the last paragraph of 5.6.1 relates equally to rupture discs.

Rupture discs are similar to safety relief valves but have the following significant differences:

- They are specially manufactured single operation metal foil discs designed to rupture at a set pressure.
- When rupture discs fail the sudden noise generated may startle individuals in the vicinity.
- They do not re-set following rupture and cannot be replaced whilst venting is taking place.
- Many installations may be fitted with a change-over system which will allow isolation of the failed disc.(This will allow emergency replacement of the failed disc).

5.6.3 Emergency Valves and Emergency Shut-off Controls

Emergency valves are designed to prevent unintended loss of product in case of failure of other pipework components, or in case of an incident during filling or discharge. They normally require pressure (pneumatic or hydraulic) to open but are closed by spring pressure. During transport they are normally closed.

If required, and depending on the design, they can be opened using one of the following techniques:

- Application of air / hydraulics from the vehicle in the incident
- Application of air / hydraulics from another vehicle
- Application of air from a foot pump
- Application of hydraulic fluid using a pump and reservoir
- Application of an inert gas from a cylinder through a pressure regulator
- Using the mechanical wind-off device incorporated within the valve, if fitted.

Note:

Care should be taken not to exceed the design pressure of the valve actuator.

In normal operation these valves are opened and closed by controls at the road transport equipment control cabinet. There are additional remote controls mounted on the sides of the road transport equipment which allow emergency shut-off operation of the valve(s). These remote controls must be re-set to allow the valve(s) to be re-opened normally.

5.6.4 Vacuum Safety Devices

In case of a product leak into the interspace a vacuum safety device is fitted to protect the outer jacket from bursting and / or the inner vessel from collapse.

These devices can take one of the following forms:

- A blow-off plate secured on the jacket (e.g. by springs)
- A blow-out plug positioned in the vacuum line.
- A bursting disc.

In all cases there is no significant hazard from their operation. (Plates and plugs are captive).

5.6.5 Anti Tow-away

Many gases companies fit an automatic safety device which prevents movement of the vehicle when one or more of the following occur:

- A product transfer and / or vent hose is connected to the road transport equipment pipework coupling.
- The road transport equipment control cabinet doors are open.

These devices normally operate by preventing the brakes from being released. (Document 63/99 “Prevention of tow away accidents” gives further information.)
In addition, some vehicles are equipped with a warning system (e.g. light and / or buzzer) located in the driver’s cab.

5.7 Couplings (Vehicle and Product)

5.7.1 Vehicle Couplings

Gases industry vehicle couplings are standard within the general transport industry. This may be country specific and so may have to be changed if a local replacement vehicle is to be coupled to a trailer from another country.

5.7.2 Product Couplings

All gases company vehicles to which this document refers use flexible hoses.
A few of these vehicles are fitted with hoses which are permanently connected by means of bolted flange joints. However, most vehicles have hoses which are removed during transport. In these cases the hose is only connected during product transfer or safety vent stacks.

Product couplings are product specific to minimise the risk of incorrect product being transferred. They are normally company specific.

Special tools may be required to connect and disconnect these couplings. (Spark proof tools are necessary for flammable products.) These tools are normally carried with the driver on the vehicle.

Special coupling components may be provided by some gases companies and carried with their Transport Emergency Equipment for the specific purpose of controlled emergency product transfer at the scene of an incident.

If such product transfer has been necessary then care must be taken to ensure that:

- the receiving tanker is returned to required purity before re-use
- any special coupling components are returned to the emergency team
- no unauthorised adapters become available for general use.

6 Priorities

When preparing transport emergency plans and when dealing with any TransEm event there are a number of aspects to be considered, some of which are of greater or lesser importance to the emergency services than to the gases industry.
These aspects include:

6.1 Safety of Individuals

- Those living in the local area
- The driver(s) involved
- Any passers by
- Any other individual(s) involved
- Those attending to assist

6.2 Animals

- Domestic
- Wild
- On farmland

6.3 Prevention of escalation of the TransEm event

- Preservation of tanker or battery vehicle integrity
- Prevention of product release
- Prevention of fire
- Product handling
  - Retain
  - Disposal
  - Transfer

6.4 Prevention of environmental damage

- Reopening of the road, if closed
- Minimising disruption to others
- Inconvenience to other road users
- Other services (e.g. trains, electricity)
- People in proximity

6.5 Publicity unfavorable to the Industry

- All reports must be factual
- Professionalism when dealing with the media. (See Appendix D)

6.6 Legal aspects

- Potential claims
- Prosecution

6.7 Cost of the TransEm event

- Human cost
  - Fatality
  - Injury
  - Compensation

- Damage to industry vehicle
- Damage to third party vehicle(s)/property
- Claims
- Customer supply failure
- Investigation and report

7 Transport Emergency Plan

A TransEm event can occur anywhere, and at any time.

It is the responsibility of every company that transports gases to have emergency plan arrangements in place, which can cater for an emergency at any time. All these companies must also ensure that there are Transport Emergency Plans in place which can cater for all appropriate products and geographical areas. These may include plans for assistance to or from other companies.
The purpose of any transport emergency plan is to ensure that all employees responsible for transport of gases understand their responsibilities and actions to be taken with respect to TransEm event.

The Plan should include all TransEm events involving vehicles within the scope of this document owned by, or transporting gas products on behalf of a gases company, regardless of location, type of vehicle or product carried.

All managers responsible for transport and other personnel who may be required to assist following a TransEm event are therefore included.

Each company must have procedures in place for the personnel responsible for dealing with any road transport incident and clear action plans for these personnel to follow.

Failure to provide such a plan in advance will result in procedures having to be developed by personnel who, due to the on-going emergency, will be under considerable stress and pressure. They may therefore not be able to think as logically and coherently as they would otherwise, and this may lead to decisions and actions which are less than ideal.

The plan should cover the following aspects:

- TransEm event personnel
- TransEm event equipment
- Communication
  - Internal
  - External
  - Media
- Responsibilities
- Training

- Practical exercises and tests of the plan and people involved.

- Ongoing contact with:
  - Other internal personnel
  - Personnel from other gas companies
  - Commercial vehicle recovery operators
  - Emergency services
- Authority levels

8 Contact list

Each company which transports gases should ensure that sufficient competent personnel are always readily available to deal with any TransEm event.

It is critical to the success of any TransEm event response that the correct persons / organisations are contacted whenever required. It is therefore important that a specific “first contact” information form is provided to accurately and consistently record the incoming information. (See Appendix E for typical example).

Each company should ensure that sufficient and appropriate personnel who may be required to attend or assist remotely in a TransEm event are contactable. They must also ensure that these personnel can always adequately respond.

One or more persons, depending on geographical area or specific product, should be nominated at all times as being the “Duty Officer”. He/she may be responsible for being the focal point for all communications and actions during any TransEm event during their “duty period” or until relieved by another nominated employee. Duty periods may start at for, example, 9.00 am on a Thursday and last for a period of one week. This minimises problems of cover requirements during holiday periods.

Personnel responsible for transport at each gas industry location should carefully consider which personnel could be Duty Officer, TransEm Team Leaders, TransEm Co-ordinators, and which personnel should be on their TransEm event Contact List.
The contact list may include the following:

- All gases industry and haulier personnel who may be involved
  - Their cover requirements
  - Their responsibilities
- Other contact telephone numbers required
  - Emergency services general numbers
  - Hospitals
  - Commercial vehicle recovery operators
  - Commercial vehicle service agents
  - Crane hire companies
  - Any air transport or ferry companies who may be used to transport “expert” personnel in an emergency.
  - Appropriate regulatory agencies
- All appropriate gases industry offices, head office for the particular geography and all other Gases industry offices/ branches, and all the personnel on their “TransEm event Contact Lists”.
  - These include management teams, transport staff, media experts, vehicle engineering teams, safety staff, etc.
- All appropriate “Mutual Aid” contact lists.

- A TransEm event response vehicle recovery and product specialist matrix.

- The responsible person(s) of the haulier(s).

The personnel responsible for transport at each location should ensure that these contact lists are kept up to date and controlled. This should include all persons/organisations involved in the Communications Flow Chart (see appendix F for example of such a flow chart) and the following:

- Internal gas company contacts
- Emergency services
- Mutual aid contacts
- Heavy vehicle recovery contractors.

9 TransEm event equipment

The following should be made available:

- Equipment to enable the driver to provide immediate first line response at the scene of a TransEm event. This also enables specialists who arrive at the scene of a TransEm event prior to the gases industry TransEm event team and associated equipment to undertake minor rectification work to product related equipment.
- Appropriate Personal Protection Equipment to drivers as specified in the Transport Emergency document as being required by the driver or vehicle crew in an emergency.
- Equipment to enable the TransEm event team to carry out rectification work and off load /dispose of the product. This may be carried in a TransEm event trailer.

For a list of suggested equipment and an example of a typical TransEm event trailer see Appendix G.

10 Communication Flow chart

In any TransEm event good communication is essential.

A carefully prepared communication flow chart will minimise the possibility of any errors or omissions.

This flow chart should indicate the chronological order of communication with all appropriate personnel / agencies. (See Appendix F for example of such a flow chart).

11 Concerns / Actions by TransEm Team Leader

11.1 Prior to arrival at the TransEm event

Prior to leaving for the TransEm event the TransEm Team Leader should consider what is likely to be required on arrival.
The following points should be considered:-

- PPE availability.
- Ensure all appropriate tools are available.

- Arrange police escort if necessary.

- Ensure other actions required of the TransEm plan are being addressed.
- Notify TransEm co-ordinator that he is leaving for the scene, giving his contact number.
  - The TransEm co-ordinator should advise the emergency services “Officer in Charge” of his estimated time of arrival, contact number and vehicle registration.

11.2 On arrival at the TransEm event

The TransEm Team Leader is the main representative of the gas Company at the scene of the TransEm event.

The actions required following any TransEm event will vary considerably depending on the individual circumstances of the TransEm event. The following list is a generic summary of the main aspects to be considered (in recommended order) by the TransEm Team Leader at the scene of the TransEm event.

1 Identify himself to the “Officer in Charge” at the scene of the TransEm event.
2 Check that appropriate personal protective equipment is used by all concerned.
3 Check that any injured persons have been cared for.
4 Liaise with Officer in charge to ensure safety of all persons in proximity of the TransEm event.
5 Asses the situation, for example:-
  - Product(s) involved
  - Quantity
  - Pressure
  - Condition of road transport equipment, etc.
6 Provide guidance to ensure no further escalation of the TransEm event.
7 Recommend the preferred method of recovery.
8 Communicate and agree proposed plan with Emergency services “Officer in Charge” at TransEm event scene.
9 Arrange appropriate resources. (Define and arrange assistance.)
10 Communicate with and advise Vehicle Recovery team leader of the situation and proposals.
11 Arrange for continuity of attendance by gases industry personnel at TransEm event scene.
12 Advise on environmental protection.
13 Risk assessment (see section 13.0).

Throughout the above, the gases industry TransEm Team Leader at the scene of the TransEm event, must ensure that all his team, including the gases industry TransEm Co-ordinator (who will not be at the scene), are kept fully updated on all actions, proposed actions and changes in circumstances at all times.

The TransEm Co-ordinator must, in turn, ensure that all appropriate personnel not at the scene are also kept fully up to date with the circumstances as they change.
In addition, he should contact and notify a trained representative from the Company to be responsible for all communication with the media (See Appendix D).

12 Recovery Methods

12.1 Choice of recovery method

Depending on the circumstances of the TransEm event, the vehicle type and severity of any damage many different solutions may be available.

Where possible the recovery method selected should minimise the forces exerted on the vehicle to be recovered in order to reduce/prevent any additional damage and the risk of product release. By ensuring that the vehicle to be recovered always maintains reasonably firm contact with the ground (e.g. a pivot point – see appendix H) this may be achievable.

It should be possible to reduce the capacity of the recovery equipment if the forces exerted during recovery are kept to a minimum. This will generally provide the dual advantage of ease / speed of availability and lower cost of the equipment.

Where tanker vehicles are concerned, the forces can be minimised if the product is removed from the vehicle (see 12.4.Product Handling).

12.2 Use of cranes or recovery vehicles

The choice of whether to use cranes or recovery vehicles (with or without airbags) will be determined by several factors.

12.2.1 Availability of equipment / resource

- Acceptability of delays
  - There may be situations where the preferred equipment for recovery is not available without an unacceptable delay. The emergency team leader must liaise with the “Officer in Charge” to consider whether second choice equipment is acceptable for the TransEm event.
- Local geography / ground strength
- The emergency team leader should decide whether there is sufficient space/area and condition of the ground surface (e.g. Ice, Mud etc.) for the method of recovery selected (Cranes require firm surfaces for stability).

12.2.2 Type of Vehicle involved

- Recovery vehicles, preferably, with airbags, are generally the most suitable for tank/tanker recovery.
- Cranes are usually preferable when dealing with battery vehicles or MEGCs.

12.3 Where to fix slings / chains / airbags / straps

In order to minimise the damage to any road equipment it is necessary to obtain the maximum leverage. Utilising the maximum surface area of the tank / tanker barrel (jacket) or equivalent for battery vehicles achieves this. This serves to minimise the pressure/force on any individual part of the vehicle and provides the longest lever.

The strongest points on any road tank / tanker or battery vehicle are at the positions of maximum stress during normal road operation. These are associated with:

- the running gear;
- the landing legs;
- the upper coupler / king pin.

Any slings / chains / airbags used for recovery should therefore be positioned / attached carefully in these areas. In some cases these areas may be indicated on the vehicle or vessel.

Lashing lugs fitted for the purposes of lashing down during sea journeys are not lifting eyes and should therefore not be used as anchorage points for lifting.

Safety considerations:-

a) In the case of flammable and / or oxidising products consideration should be given to conducting atmospheric tests before any other actions are undertaken. The tanks / tanker / battery vehicle should be earthed during recovery. Consideration should be given to the use of spark-proof tools and other equipment.

b) In the case of toxic products there is a need for toxic gas monitors to be used to identify any leakage of toxic gas. Breathing Apparatus may be required should any toxic gas leakage be detected.
A thorough understanding of the nature of the danger and hazards of the product is essential, as is competence in the use of the monitor and Breathing Apparatus.

c) Where uncontrolled product release may cause escalation of the TransEm event and is considered a possibility the product must be removed in a controlled manner. Product transfer and / or controlled release / venting may accomplish this.

In the case of flammable products, purging of the road transport equipment with nitrogen, preferably dry, is essential to ensure that the atmosphere within the vehicle is below the lower flammability limit of the product.

d) Emergency Services should be advised to avoid spraying water on to refrigerated liquid tanker vehicles during recovery as this may freeze safety devices or other essential equipment. In addition, the ground surface may become difficult for recovery.

e) Steel wire cables, rope or chains should not be used for tank recovery unless the load is spread across the tanker surface using wooden timbers.

f) If the vehicle is severely damaged the recommended recovery method may not be practicable the best alternative recovery method should be selected.

12.3.1 Vacuum Insulated Tank / Tanker

Due to the nature of the construction these tankers have particularly strong outer barrels (jackets). The straps / airbags can therefore be positioned as above with the minimum risk of damage. Ideally wide webbing straps (at least 250 mm) should be used with airbags. Where it is not possible to use airbags because of the non-availability or because of the nature of the ground at the TransEm event area then recovery by rolling the vehicle using webbing straps is preferred. Only when neither of these options is suitable for the TransEm event should alternatives be considered.

The following points should also be considered:

- Contents gauges for this type of tank/tanker are usually of the differential pressure type and will therefore not operate correctly if the tank/tanker is on its side or overturned.
- Pressure and / or contents gauges may be isolated during road transport.
- Pressure and contents gauges may be damaged during a TransEm event.
- During a TransEm event safety devices may have become damaged or their outlets may have become blocked.

12.3.2 Insulated Tank / Tanker

These tanks/tankers are not vacuum insulated, but all the main recovery aspects concerning vacuum insulated tanks/tankers in 12.3.1. remain appropriate. However, there are a number of differences with these tanks/tankers, the major differences being:

- The outer jacket is only a weather covering to protect the insulation. It has therefore very little structural rigidity.
- The insulation can be easily damaged if the protective jacket becomes ruptured or deformed. This deformation may take the form of compression of the jacket and insulation.
- Generally transporting products at higher pressures than vacuum insulated tanks / tankers. This higher-pressure gives rise to additional hazards should there be any product leakage during recovery.
- Many contents gauges on these tankers are mechanical and therefore their operation must be considered suspect following a TransEm event.
- During a TransEm event safety devices may have become damaged or their outlets may have become blocked.

12.3.3 Battery Vehicles Constructed from Tubes

All the main recovery aspects concerning vacuum insulated tanks/tankers in 12.3.1. remain appropriate except that the vehicle is constructed with a number of large tubes rather than a single double walled tank. Additionally, the following points need to be considered:

- The nature of the product. (see section 4)
- The products will be compressed gases.
- The tubes are secured together either by strapping to the chassis or held between bulkheads. In both cases the assembly of tubes should be used as the tank of a tanker, but care must be taken to ensure that the tubes are secure prior to and during recovery. If there is any sign of movement of the tubes then these must be secured or removed before the recovery operation.
- The Tubes themselves must not be used as recovery anchorage points.
- The individual tubes are manifolded together usually at the rear of the vehicle and protected within a cabinet or frame. Regardless of protection this manifold area is the most vulnerable area during recovery.
- The pressure can be considerably higher than for tanks/tankers (up to 300bar at 15°C)
- Except for toxic products the individual tube valves will normally be open during road transportation.
- The manifold valves will be closed during road transportation.
- The manifold may be under full trailer pressure.
- The pressure gauge may or may not be under manifold pressure.

Before recovery:

- where fitted, individual tube valves should be closed;
- manifolding should be de-pressurised;
- all manifold valves should be closed.

12.3.4 Battery Vehicles constructed from Cylinders

These vehicles pose a different recovery problem from battery vehicles constructed from tubes. The cylinders are manifolded together in individual packs (or banks), and these packs generally do not contribute as much structural rigidity as do tanks / tankers or the tubes of battery vehicles constructed from tubes.

These vehicles generally carry significantly more individual receptacles (cylinders) than the tube carrying vehicles. Because there are significantly more receptacles (cylinders) and packs there is considerably more manifolding.

The following points should also be considered:

- Care must be taken when positioning straps or chains to avoid damage to the manifolds as these areas are the most vulnerable on the vehicle.

- As these manifolds are generally the most vulnerable areas, particular care must be taken during recovery operations and if straps move or when there is sudden movement.
- The chassis of the battery vehicle and its main automotive components (e.g. spring hanger brackets) should be considered to be the preferred positions for securing chains or straps.

- The cylinders themselves must not be used as recovery anchorage points.

Before recovery:

- where fitted, individual cylinder valves should be closed;
- manifolding should be de-pressurised;
- all manifold valves should be closed.

12.3.5 Battery Vehicles Constructed from Bundles

These vehicles should be treated in a similar manner to battery vehicles constructed from cylinders (see 12.3.4.), but, the following differences must be understood:

- the method of securing the cylinders within the bundles is likely to be the weakest of the securing mechanisms and so the cylinders may have moved within the bundles;
- the bundles themselves may have moved from their original position;
- the bundles may have been weakened by deformation;
- the manifolding arrangement may have distorted or broken;
- the bundles themselves must not be used as recovery anchorage points, except when they are being removed from the vehicle.

Before recovery:

- where fitted, individual cylinder valves should be closed;
- manifolding should be de-pressurised;
- all manifold valves should be closed.

12.3.6 Special cases resembling Battery Vehicles

These vehicles should be treated in a similar manner to battery vehicles constructed from bundles (see 12.3.5.), but, the following differences must be understood*:*

- the bundles are not permanently secured to the chassis of the vehicle and some may have moved from their original position during the TransEm event.
- in extreme cases one or more bundles may have been completely dislodged from the vehicle.
- consideration should be given to removal of individual bundles remaining on the vehicle prior to vehicle recovery.
- if the product is Acetylene then additional care must be taken due to the special nature of the hazards (See end of Appendix K).

Before recovery:

- where fitted, individual cylinder valves should be closed;
- manifolding should be de-pressurised;
- all manifold valves should be closed.

In the case of Acetylene special consideration should be given due to the solvent.

12.4 Product Handling

Before product handling, any hoses, or other equipment used (e.g. pumps) must be clean and compatible with the product. If hoses are to be connected together they must be connected in a manner which prevents separation and leakage. Hoses connected together should also be secured so that inadvertent movement of the hoses is reduced.

There may be alternative methods of dealing with the product in the vehicle.

These are:

- Retain
- Dispose
- Transfer.

There are specific hazards (e.g. vapour clouds, toxicity and fire) associated with product handling which need to be understood. These are described in appendices K, L and M.
The following outlines possible options and their respective advantages and disadvantages.

12.4.1 Product Retention

This is the simplest, and often the safest, method of product handling. Where the weight of the product is minimal in comparison to the overall vehicle weight **AND** there is no damage to the product containment equipment this should be the preferred method.

It has the advantages of:

- Speed
- Safety (by not requiring to handle the product in an “non-standard” manner)
- Complete recovery of the product from the accident/TransEm event scene to the Gases Industry location where it can be safely managed.

However, the following problems may be encountered:

- the condition of the vehicle and its associated equipment (e.g. tank, cylinders, tubes, manifolding, etc.)
- higher weight of the vehicle to be recovered, which may result in the necessity to use higher capacity recovery equipment;
- possible instability due to sudden movement of the load during recovery; particularly movement of liquid through surge plates (baffles)
- possibility of pressure increase which may cause product venting through rupture discs or safety valves during recovery; and,
- possibility of unexpected product release.

If the tanker is on a slope such that all of its outlet connections are in the gas phase there may be no option other than to **initially** retain the product. In this case, it may be possible to plan the recovery in stages.

During certain of these planned stages some product may be removed from the vehicle. For example, part- recovery may be possible using air-bags, after which it may be possible to remove some product, before full recovery using cranes.

Never attempt, or allow, liquid to be transferred during a lifting or recovery operation.

12.4.2 Product disposal

The majority of the volume of gases industry products (e.g. “air gases”) transported by road do not cause environmental damage. These products therefore have the advantage that they can generally be released to the atmosphere without risk of environmental damage.

If the product, or at least a significant proportion of the product, must be removed before vehicle recovery then there are two remaining options – product disposal and product transfer.

Product disposal is often the safest method of product handling, particularly if the tanker involved has been damaged.

Product disposal has the following advantages over product transfer:

Speed

- No delay whilst second tanker is organised.
- Product disposal rates can be much greater than product transfer rates but will vary depending on whether it is decided to release gaseous or liquid product.
- Releasing liquid product is usually the faster of the two options. However, this may create other problems such as pools of cryogenic liquid, serious lack of visibility due to vapour clouds, and local atmospheres which may be seriously oxygen enriched or oxygen deficient, flammable, toxic, or a combination of two or more of the above.

Simplicity of operation

- There is no requirement to raise pressure in the tanker to be recovered, nor to lower pressure in the receiving tanker.
- A second tanker is not required to be parked close to the first tanker to enable product transfer to be undertaken.

Safety

By disposal, rather than transferring, any dangers associated with mixing products can be reduced. This may, however, cause other localised problems such as the following:

- extreme cold, which may be sufficient to cause personal injury and / or damage to property, equipment or even surrounding ground surface;
- reduced visibility due to vapour clouds (see appendix J);
- the risk of fire (see appendix K)
  - oxygen and asphalt or hydrogen and electrostatic charges, etc.
- the atmosphere in the local area may become oxygen enriched;
  - this will give rise to a significantly higher fire risk.
- the atmosphere in the local area may become oxygen deficient
  - this may be such that asphyxiation becomes a risk.

Other gases within scope of this document may have different hazards associated with them. These hazards may be one, or more, of the following:

- toxicity, possibly with a corrosive subsidiary risk(see Appendix L);
- flammability.

When dealing with these products other factors must be considered. These include the following:

- can controlled release be undertaken safely?
- will the released product disperse safely?
- is Breathing Apparatus required for all personnel in the local area?
- is specific equipment necessary and available (e.g. vent or flare stack?)

In all cases, the probable path(s) of any released products must be considered:

- what area will be affected?
- will the released product gather in an area which might give rise to a problem? (e.g. pits or hollows)
- what effect(s) will the released product create? (e.g. extreme cold, vapour clouds, etc.)

- are there any potential ignition sources? (e.g. contact with a hot point, an electrical spark or an electrostatic discharge)

Venting flammable gases should be done using specific and specially designed venting equipment. For some gases or in some circumstances a specially designed burning system may be required.

The need to stop, or pause, any product disposal before complete discharge must be considered.

- Can this controlled release be safely stopped?
  - If not, should it be started?

The method(s) of product disposal will vary depending on the product and type of equipment involved, but the following safety considerations must always be assessed.

- Which vessel outlet valve(s) are currently open to the vessel's vapour phase?
- Which vessel outlet valve(s) are currently open to the vessel's liquid phase?
- Do I require to use a hose for disposal?
  - If so is it securely attached to the tanker coupling?
  - If more than one hose is required are they securely connected to each other?
  - Have I taken precautions to prevent hose whip?

- Do I require to use a portable vent stack?
  - What is the wind direction?
  - In the case of flammable gases heavier than air should I consider igniting the escaping gas to prevent it collecting in pits and hollows?
- Am I under a time constraint?
  - What is the best method of disposal given the above time constraint?
- What is the indicated pressure of the product to be disposed of?
  - Is this indicated pressure reliable?
  - If not, should I make alternative arrangements?
- Will my decisions, actions and recommendations adversely effect:
  - Any people?
  - Any property or equipment?
- Has anything changed since I last considered the above?

12.4.3 Product Transfer

Product transfer to another tanker has a few advantages over product dumping. The most important of these are:

- Little, or no, escape of product to the atmosphere.
  - This has the advantage of reducing any risks posed when product is deliberately released to the atmosphere. (e.g. asphyxiant or flammable vapour in the environment)
- Minimal product loss.
  - The retained product, however, may have lost purity and so, for commercial reasons, may have to be disposed of in a controlled manner elsewhere.

One important, though easily overlooked, factor which must be considered when transferring liquid oxygen or other oxidising gases is the condition of the receiving tanker.

- As a general principle, the “empty” tanker (vessel) and its transfer equipment which is to receive the product from the vehicle to be recovered must be in service carrying the same product. If this is not possible then dumping the product from the vehicle to be recovered may be the best option.
- Ensure that the tanker (and transfer equipment) into which the oxidising gas is to be transferred is clean and prepared for service with that product.

Note:

A tanker (vessel) and its transfer equipment in oxidising gas use should not be used for receiving non oxidising products in case these have become contaminated with hydrocarbons.

Additionally, the safe working pressure of both tanks/tankers must be considered. Tanks / tankers may have vastly differing working pressures. Great care must be taken when transferring (either by pressure decant or pump) product at high pressure into a lower pressure tank / tanker.

Product transfer can be undertaken by utilising one of the following methods:

- Pressure decanting
- On-board pump transfer
- External pump transfer

12.4.3.1 Pressure Decanting

The pressure decant technique is the simplest and most practical of all possible product transfer techniques. (It is also the only practical technique possible if the product is a compressed gas, but in this case it must be very clearly understood that only a balancing of pressures can be achieved.)

For liquid gases this technique may require a number of hoses to be connected together and one end connected to a connection which is in the liquid phase of the tanker to be recovered, and the other to the standard tanker filling connection on the receiving tanker.

- The total length of hose used should be as short as possible.
- The hose(s) used should have the largest internal diameter possible.

The pressure in the tanker to be recovered should be raised, if possible, by use of the normal pressure raising coil. If this is not possible then an alternative pressure raising system may be used (e.g. a hose connected at one end to a connection in the liquid phase and the other end to one in the gas phase).

The operation of this alternative pressure raising device may require to be “batch operation” if there is only one connection in the liquid phase. This will occur if the gas which must be added to the tanker which is to be recovered is through the same coupling which is used for product transfer.
It may also be possible to use pressure from another tanker, but to facilitate a reasonable rate of transfer the receiving tanker pressure should be kept (by top filling and / or venting) to the practical minimum. This tanker will not, therefore, have sufficient pressure to assist in raising, or maintaining, pressure in the first tanker.

The operation of this second tanker as an alternative pressure raising device will require to be “batch operated”. Where the pressure in both tankers needs to be raised using the pressure raising facility of the receiving tanker, then the receiving tanker will need to be de-pressurised in order to transfer liquid from the tanker to be recovered.

Where the tanker to be recovered is at a significantly lower level than the receiving tanker it may not be possible to raise sufficient pressure (by any method) to utilise this technique.

12.4.3.2 On-board Pump Transfer

It may be possible to use the pump transfer system on the tanker to be recovered to transfer product to the receiving tanker, but, there may be a number of possible problems; which will prevent its use.

Such problems and possible solutions are detailed below:

Problem	Possible Practical Solution
Pump suction not in liquid phase	No practical solution (unless the tanker can be turned)
Power to pump motor not available	Use power from another vehicle
Pump will not prime	Raise pressure in tanker
Gas lock	Use vent valve(s) to release gas lock

This method of product transfer is really only practical in situations where the tanker to be recovered is in a predominantly upright orientation, and the product system equipment is mechanically undamaged.

12.4.3.3 External Pump Transfer

It may be possible to use an external pump (e.g. on the receiving tanker) to withdraw product out of the tanker to be recovered.
Where it is possible to utilise this technique there are a number of advantages, but there are many cases where it will be impossible to use this technique. For example, it will not be possible to use this technique if:

- the suction line of the pump to be used cannot be connected to the transfer hose;
- the transfer hose cannot be connected to a connection in the liquid phase of the tanker to be recovered; or,
- the total length of the hose feeding the pump is such that the heat in-leak lead to gas locks in the hose or cavitation of the pump.
- sufficient pressure cannot be provided in the tanker to be recovered to produce adequate pressure at the pump inlet.

In general, this technique has very limited availability in situations involving cryogenic liquids.

13 Dynamic Risk Assessment

By their very nature TransEm events are unplanned and are outside the scope of normal vehicle / equipment operation.
They are therefore potentially the most hazardous operations that may be encountered.

Carrying out regular risk assessments should ensure that no unexpected hazards arise during the recovery operation.

Ideally, though not necessarily, written notes should be kept of these on-going risk assessments throughout the recovery.

These risk assessments must be dynamic (i.e. frequently repeated) and updated every time circumstances change. They should cover all the aspects detailed above and the following additional items:

- Appropriate personal protective equipment.
- Potential damage to surrounding areas by product spillage (e.g. metal embrittlement, permafrost damage to sewers, watercourses, drains, and underground services).
- Potential damage to underground and / or overhead services by recovery equipment employed.
- Potential damage to roadways and / or buildings / structures.
- Possible sudden unexpected movement of the vehicle being recovered caused by product shift (see also 12.4.1).
- Possible slippage of recovery equipment during recovery, particularly, when conditions are below zero degrees °C (cold climatic conditions or liquid spillage).
- Potential catastrophic damage to recovery equipment (chains or straps) due to extreme cold temperature
- Potential failure of safety relief devices (e.g. damaged, blocked, frozen)
- Potential escape of product through safety relief devices (see also 5.6 and 12.3.1). **Remember:** In normal operation the tail pipe outlets from the safety devices are orientated to ensure that escaping product does not cause injury or damage. In a TransEm event these tail pipe outlets may be orientated such that escaping product (which may be in liquid form) may be directed towards personnel or critical equipment.
- If undamaged during the TransEm event the relevant pressure gauge(s) on the gases industry equipment covered by the scope of this document should provide a good indication of the approximate pressure in the road transport equipment. The risk assessments should take due account of the pressure, and any pressure change as knowledge of this information may be invaluable during, and immediately after, the recovery operation. (Contents gauges on tankers only operate when the vehicle is in the normal orientation.) (see also 12.3.1)
- Consideration must be given to reducing the contents of the vehicle to minimise;
    - ☐ the overall weight of the vehicle to be recovered;
    - ☐ the dangers associated with product movement;
    - ☐ the dangers associated with product leakage (particularly with toxic and flammable gases)
- Methods of transporting the damaged vehicle to a suitable location where it can be inspected, emptied, purged risk free, and eventually repaired or disposed of.
- Has anything changed since I last considered the above?

14 Post TransEm event actions

Document 54/95 “Road Vehicle Safety Programme” gives additional information which supplements this section.

14.1 Post TransEm event checks

Post TransEm event checks may be required by:

- Police
- Local government transport agency
- Local authority
- The gases company which operated and / or owns the vehicle.

- Any contractor involved
- Insurance companies with a vested interest

14.2 Return of Vehicle to Base

Arrangements must be made to return the vehicle to its home base or location selected by the gas company involved. If the location selected is not a gases company site then particular care should be taken to ensure that no unauthorised persons are allowed near the vehicle. Due to the likelihood that any remaining product may have lost purity it should be disposed of according to local procedures.

Note:

The local authorities may require the vehicle to be quarantined pending an enquiry. In such a case the vehicle will be directed to a designated location. The authorities must be informed in writing of all risks associated with the product and equipment, and the precautions to be taken.

14.3 Driver Interviews

The driver of the vehicle (and any other available witnesses) should be interviewed as soon as possible following the incident (i.e. a “hot” interview”.). He should be subsequently interviewed again, as soon as practical, but after the initial shock of the incident has receded. (i.e. a “cold” interview.) In both cases the timing and location of these interviews, or de-briefs, may be dependant on any injuries sustained by the driver.

The following points should be considered when conducting an interview:

- Introduce yourself fully (name, job title, etc)
- Explain the intention of the interview
- Stress that you want to prevent another accident
- Record the person’s name and address
- Explain what questions you are going to ask
- Emphasise that you are trying to determine the cause of the accident, **not** to find a scapegoat
- Start with general questions, before gradually asking more specific and detailed questions
- Base any questions on known facts and observation, do not make quick conclusions
- Do not force the witness into making “yes/no” answers
- Do not use difficult or foreign terms
- Do not refer to statements made by other witnesses

In all interviews ensure that the questions asked are relevant to the aim of the investigation. Full details should be obtained which should cover the period immediately prior to the incident and the events for the previous 7 days.

“Hot” interviews should only be conducted if driver capable of being interviewed. Cold” interviews may need to be repeated.

14.4 Post TransEm event review

A person should be appointed who shall be responsible for conducting a post incident review to ensure that any learning points are highlighted:

- To prevent recurrence of such an event
- To use in a critical review of the Transport Emergency Plan.

In relation to the cause(s) of the TransEm event there may be changes required concerning:

- the procedures used in the driver’s work activity
- the driver training
- the working conditions of the driver;
- the behaviour of the driver during his working activity
- the techniques, and equipment used;
- any other element which may have contributed to the accident.

With regard to the Transport Emergency Plan the following should be considered:

- the communication network
- the actions taken
- the techniques employed
- the equipment available and / or required
- the behaviour of the personnel involved.

14.5 Training

All personnel who may be required to become involved with serious road transport incidents/accidents/emergencies must be suitably trained, and retrained as appropriate, and have proved their competence through practical and theoretical tests. Records of such training and tests should be kept.

This document should be used as a guideline for those involved.

14.6 Safety

Due to the unplanned nature of any TransEm event safety MUST be given the highest priority.

Regardless of the type of TransEm event all personnel must be made aware of the dangers of passing traffic. Particular consideration should be given when working on or near the hard shoulder of a motorway.

Use the information which can be found on the appropriate TREMCARD(S).(see also 4.3.3)

Such information relates to:

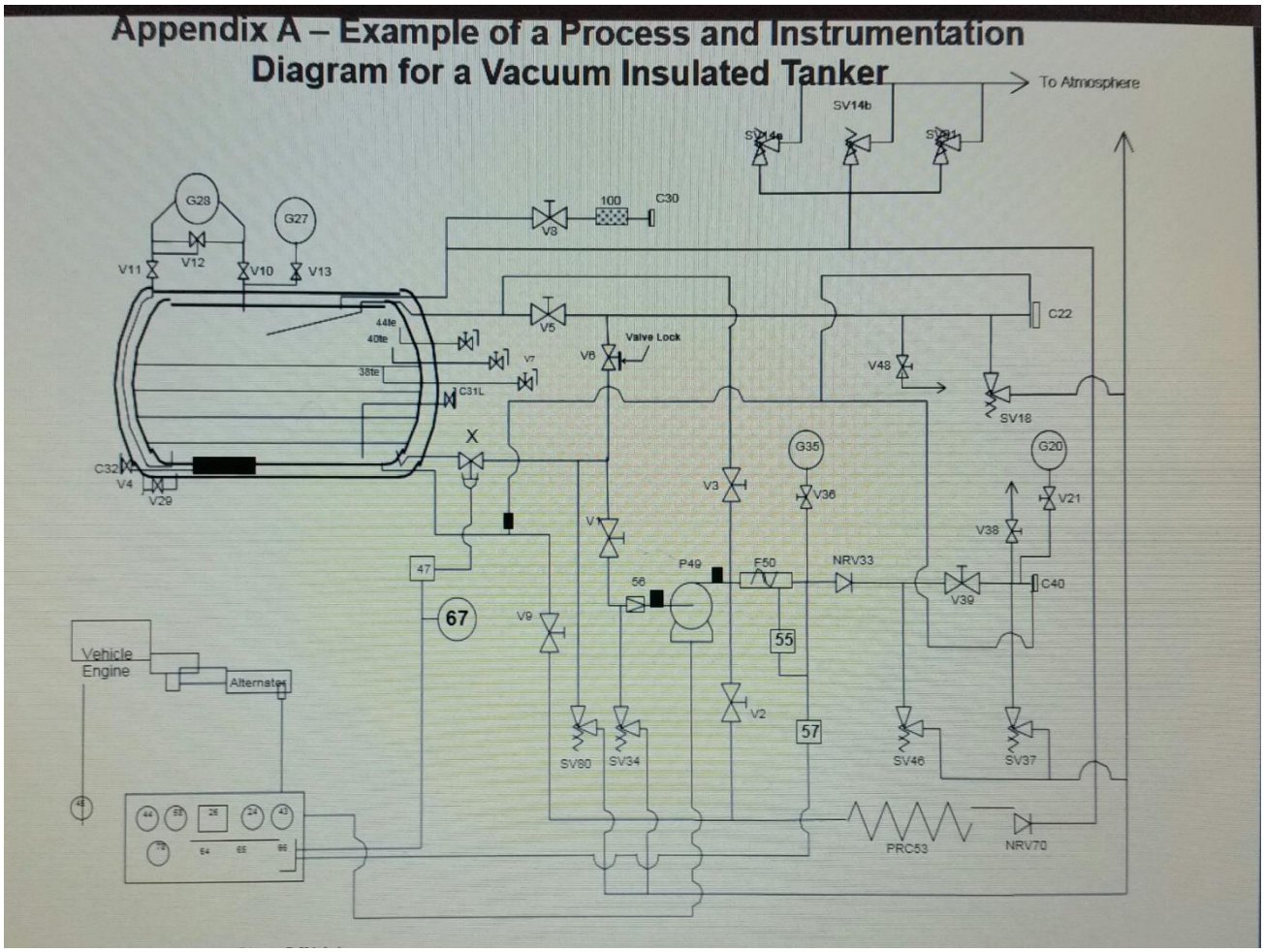
- the nature and characteristics of the product
- the nature of the hazard(s)
- PPE for the vehicle crew
- Emergency Actions (“Do’s” and “Do Not’s”)
- advice on :
  - First Aid
  - Fire
  - Spillage
- the Emergency Contact Telephone Number.

In particular, the dangers associated with working in or near vapour clouds must be fully understood.
The procedure to be followed in the event of any individual receiving cold burns or exposure to toxic gas must also be fully understood.

15 Conclusion

The information given in this document is intended to ensure that all personnel involved in transport emergencies are well informed about the necessary elements of safe management of TransEms. Training, close co-operation and using a predetermined plan are all required for safe and successful recovery of vehicles.

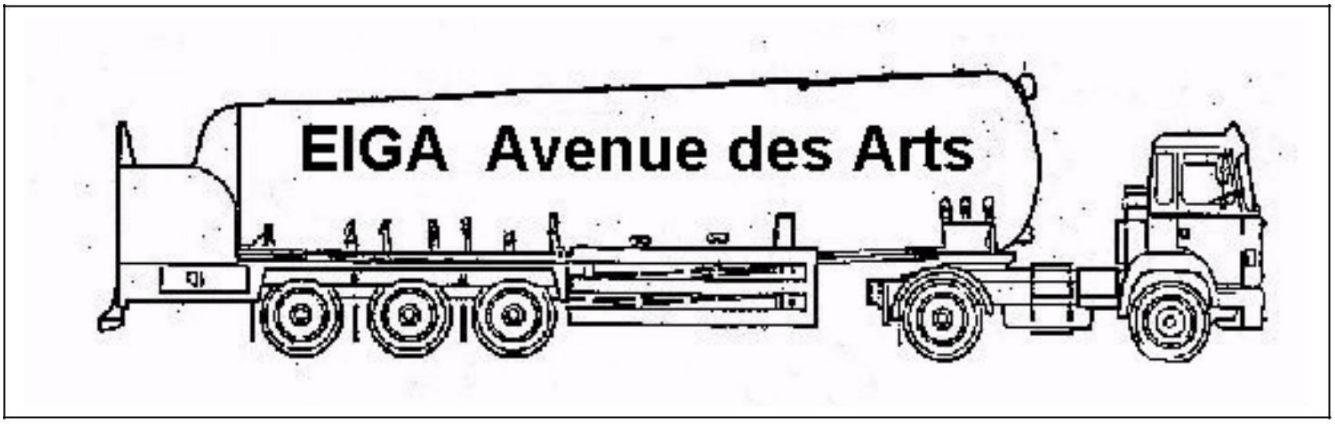
APPENDIX A -Typical Process and Instrumentation Diagram

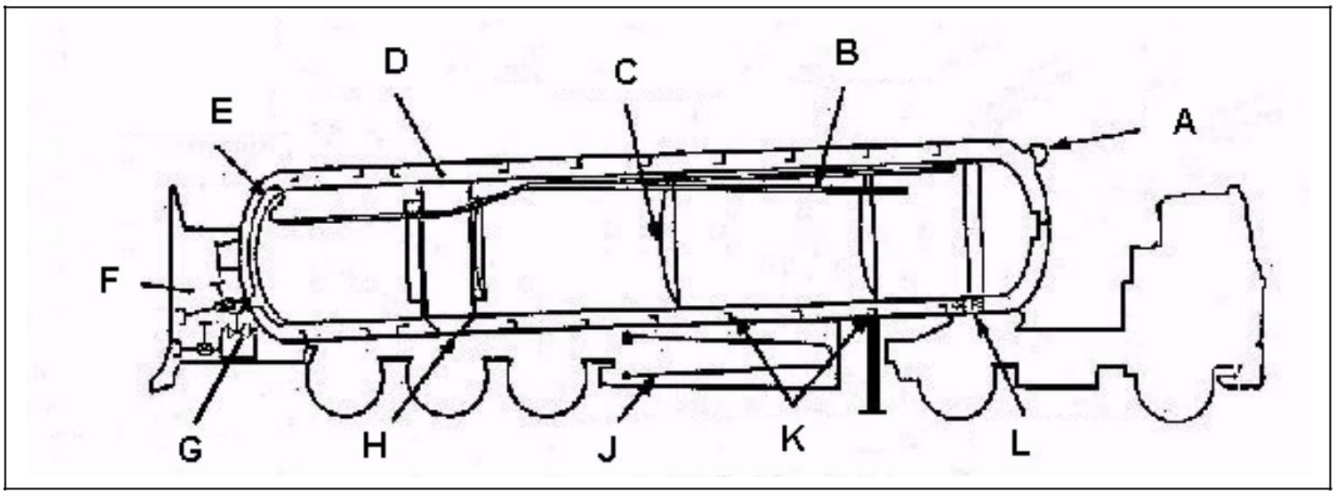


X Emergency Shut-Off Valve

1	Pump Suction Valve	35	Pump Delivery Pressure Gauge
2	Pump Feed to Pressure Raising Coil	36	Pump Delivery Gauge Isolating Valve
3	Recycle Valve	37	Delivery Hose Relief Valve
4	Vacuum Valve	38	Delivery Hose Vent Valve
5	Top Fill Valve	39	Pump Delivery Valve
6	Bottom Fill / Decant Valve	40	Delivery Line Coupling
7	Trycock Valve(s)	43	Canopy Light / Working Light Switch
8	Main Vent Valve	44	Ammeter
9	Pressure Raising Valve	45	Engine Speed Tachometer
10	Contents Gauge Isolating Valve (Gas)	46	Delivery Line Relief Valve
11	Contents Gauge Isolating Valve (Liquid)	47	Emergency Valve Actuator
12	Contents Gauge Equalising Valve	48	Top Fill / Decant Hose Vent Valve
13	Vessel Pressure Gauge Isolating Valve	49	Pump and Motor
14	Vessel Relief Valve	50	Flowmeter
18	Top Fill / Decant Hose Relief Valve	53	Pressure Raising Coil
20	Back Pressure Gauge	55	Metering Pressure Switch
21	Back Pressure Gauge Isolating Valve	56	Pump Suction Filter
22	Top Fill / Decant Line Coupling	57	Off-Prime Pressure Switch
24	Earth Leakage Protection Trip Button	58	Hours Run Meter
26	Pump Start / Stop Unit	64	Emergency Shut-Off Button
27	Vessel Pressure Gauge	65	Emergency Shut-Off Valve Operating Button
28	Liquid Level Contents Gauge	66	Emergency Shut-Off Valve “Open” Indicator
29	Vacuum Gauge Head Isolating Valve	67	Remote Emergency Shut-Off Buttons (2)
30	Main Vent Coupling	70	Pressure Raising Coil Gas Phase Non-Return Valve
31	Analysis Valve	78	Earth Leakage Protection Warning Light
32	Vacuum Gauge Head	80	Closed Circuit Relief Valve
33	Non-Return Valve	91	Vessel Secondary Relief Valve
34	Pump Suction Relief Valve	100	Main Vent Silencer

Appendix B – Cross Section of Road Tanker





Cross Section Through Typical Tanker

1	KEY:-
A	Blow off Plate
B	Top Fill Sparge Pipe
C	Dished Baffle
D	Vacuum Interspace and Insulation
E	Vapour Traps
F	Canopy and Pipework
G	Emergency Valve
H	Rear Fixed Supports
J	Pressure Raising Coil
K	Outer Jacket Vacuum Rings
L	Front Sliding Supports

APPENDIX C – Photographs of Typical Road Transport Equipment

Typical Road Tankers

MEGC

Battery Vehicles (using tubes and cylinders)

Appendix D – Communications during TransEm events

The following slides are intended for the guidance of TransEm team members who may be approached by the press during, or following a TransEm event.

Training Slide 1

When a crisis occurs...

We – as Gases Industry managers – need to take control.
To know what is happening
To know *what* to say, *when* – and *to whom*
If we are slow (or unable) to respond – or appear to be ignorant, uncaring or evasive – our company's reputation is likely to be damaged

Training Slide 2

The press

Normally an 'interested audience' in their own right – and a useful channel for communicating good news about the Gases Industry
BUT...
When we are involved in an incident, they can be *powerful purveyors of negative (or inaccurate) information*

FAST!!!

Training Slide 3

Communications priorities...

- Implement internal communications process
- 'Own' the incident
- Manage the media

Training Slide 4

Interfacing with the media

- Preferably handled by Media Relations team – either at scene or remotely...

…but not always possible with transport emergencies – especially during early stages

- Emergency services at the scene are most likely to be in dominant position with respect to the media
- Important for one Gases Industry person to 'own the incident' and *work with* the emergency services in interfacing with the media.

Slide 5

‘Owning’ the incident (1)

Know the facts - and be prepared to work with them...

- WHAT has occurred; WHEN and WHERE (But *do not* speculate about the cause.)
  - *Obvious* casualties (if any). (But *not in detail –do not* identify individuals and *do not* report any fatality until a medical practitioner has certified the death.)
- *Ditto* property damage or leakage
- Product characteristics – *especially reassuring and positive aspects*

Slide 6

Owning the incident (2)

Media awareness of the incident will be almost immediate and – if serious or spectacular – extensive…

- Phone calls from other drivers
- Monitoring emergency services’ airwaves
- Broadcast traffic reports (including ‘eye-in-the-sky’)

Slide 7

Owning the incident (3)

The emergency services will be first to arrive - and have instant credibility

- Establish rapport with their controller or PR person; position yourself as a credible Gases Industry expert and (possibly) spokesperson
- Share the facts and co-operate with them in preparing and issuing press information.

Be sensitive to emerging opportunities or threats (e.g. press conferences/interviews)

Slide 8

Owning the incident (4)

Be on front foot when the press do arrive

Initial summary of facts ready for use
Gases Industry and emergency services singing from same song sheet
Reporters, photographers and camera teams ‘marked’ and contacted on arrival
Ground rules established (interview points, ‘no go’ areas etc.)

Slide 9

Owning the incident (5)

"Tell it straight, tell it fast - and keep it simple!"

- The media want a story. They have space or a time-slot to fill… and often tight deadlines.
- Any facts and statements released and impressions created early on in the 'life' of an incident tend to be repeated and recycled over a surprisingly long period
- So get it right first time

Slide 10

Central media relations support

- Attend if possible
- Help draft/approve initial statement + updates
- Issue ditto electronically or face-to-face
- Field press calls
- Act as 'official spokesman'- if only by telephone
- Help prevent 'on-the-spot' overload

Slide 11

Typical press statement

At (time) today a tanker carrying liquid nitrogen was involved in a collision with a van on the (name or number of road) at (location).

The emergency services are in attendance and two people have been taken to (name) Hospital.
The van has been seriously damaged and the articulated tanker has jack-knifed across both carriageways, causing traffic to be diverted. A team of specialist Gases Industry engineers is on its way from (location) to expedite recovery of the tanker.

Some liquid nitrogen is leaking, but the Gases Organisation confirms that the gas is non-flammable, non-toxic and harmless to the environment. Extracted from the air around us and valued for its very low temperatures and inert properties, liquid nitrogen has a range of uses, from food freezing to extinguishing fires in coal mines.
(ends)
For further information please contact (Gases Organisation central media relations contact name and phone number)

Appendix E – Typical Check List For Person Receiving Emergency Telephone Call

General Information

CALLERS NAME: …… TEL.NO. :

DATE: ..…… TIME OF CALL:

IS CALLER:	DRIVER	POLICEMAN	FIREMAN	AMBULANCE MAN	MEMBER	PUBLIC

IF CALLER IS NOT FROM EMERGENCY SERVICES

HAVE POLICE BEEN INFORMED

YES/NO

HAVE FIRE BRIGADE BEEN INFORMED

YES/NO

TELEPHONE NUMBER FOR CONTACT AT SCENE:

NATURE OF EMERGENCY

WHAT IS THE SITUATION (AT TIME OF CALL):

…….

WHAT HAPPENED: ……

……

WHEN DID INCIDENT OCCUR:

……..……..……

WHERE DID INCIDENT OCCUR:
ROAD: ……

TOWN: ……. COUNTRY: ……

IF MOTORWAY – NEAREST EXIT: ……..……..

MARKER NO. : ……

IS DRIVER INJURED: YES/NO INJURIES:
……

ARE OTHERS INJURED: YES/NO INJURIES:

…….
NO. INJURED: ……..

TYPE OF VEHICLE AND NATURE OF PRODUCT

WHICH TYPE OF VEHICLE IS INVOLVED:	TANKER TUBE TRAILER CYL. VEHICLE DRUMS

WHICH TYPE OF PRODUCT IS INVOLVED: ……

IS PRODUCT LEAKING OR SPILLED:	YES/NO	IF YES, WHY

……..……

……

……

FLEET NO. OF VEHICLE AND TRAILER: ……IS ROAD CLOSED: YES / NO

ANY OTHER VEHICLES OR PRODUCT INVOLVED IN EMERGENCY:	YES/NO
ANY OTHER PUBLIC DISRUPTION:	YES/NO

IF YES, DESCRIBE:

……

……..

ACTION

INITIATE THE TRANSEM PROCEDURE

- If relevant, request caller to stay by telephone to await a call from a company representative.
- Immediately contact appropriate person and read off all the above information.

Name of person receiving call:

……

Name of person accepting responsibility:

……

Time and Date of transmission of details from this document:

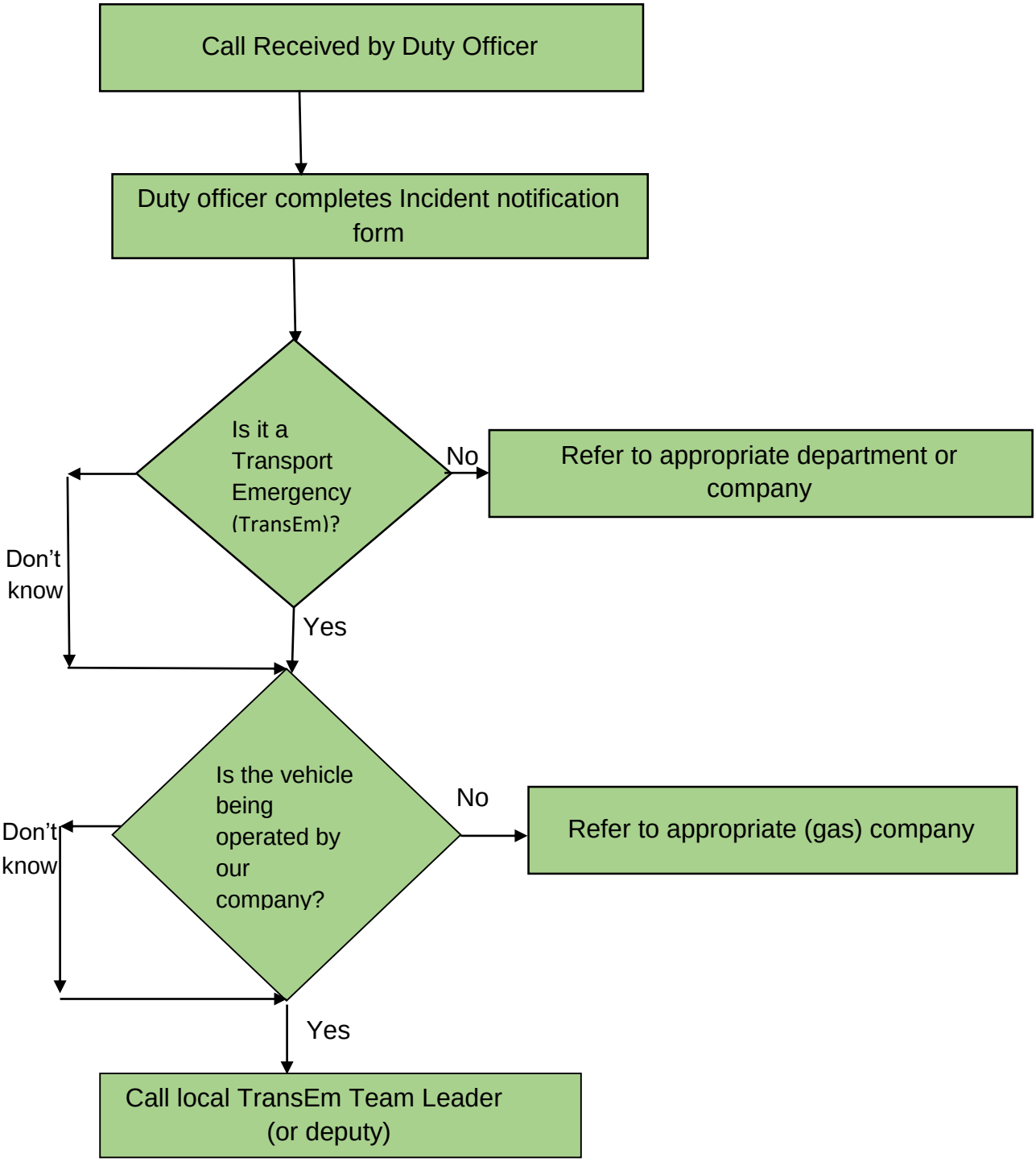
……

Signature/Location of Initial Contact:

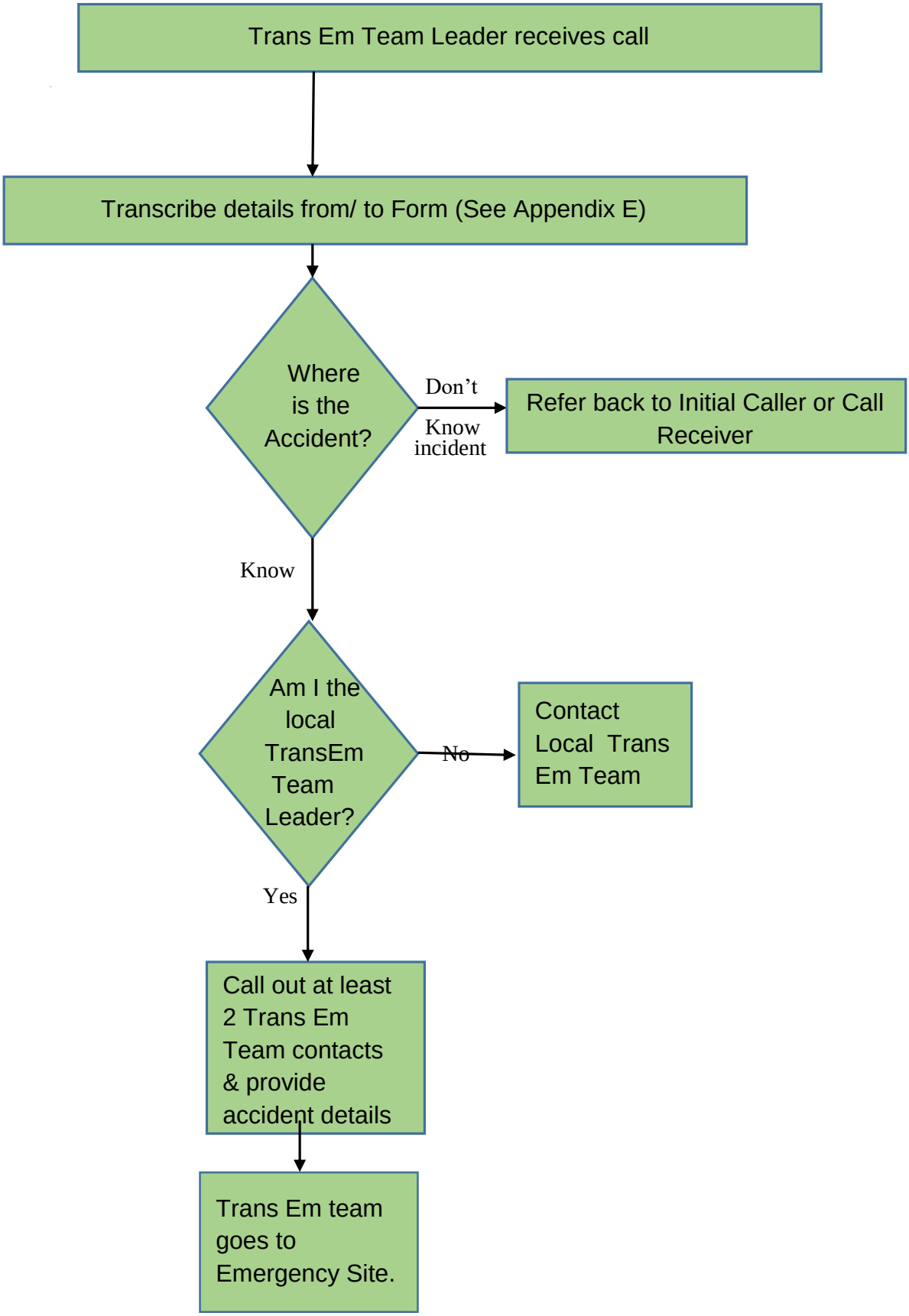
……..……

Send this form to your Supervisor as soon as practical.

Appendix F – Example of a Transport Emergency Communications Flow Chart

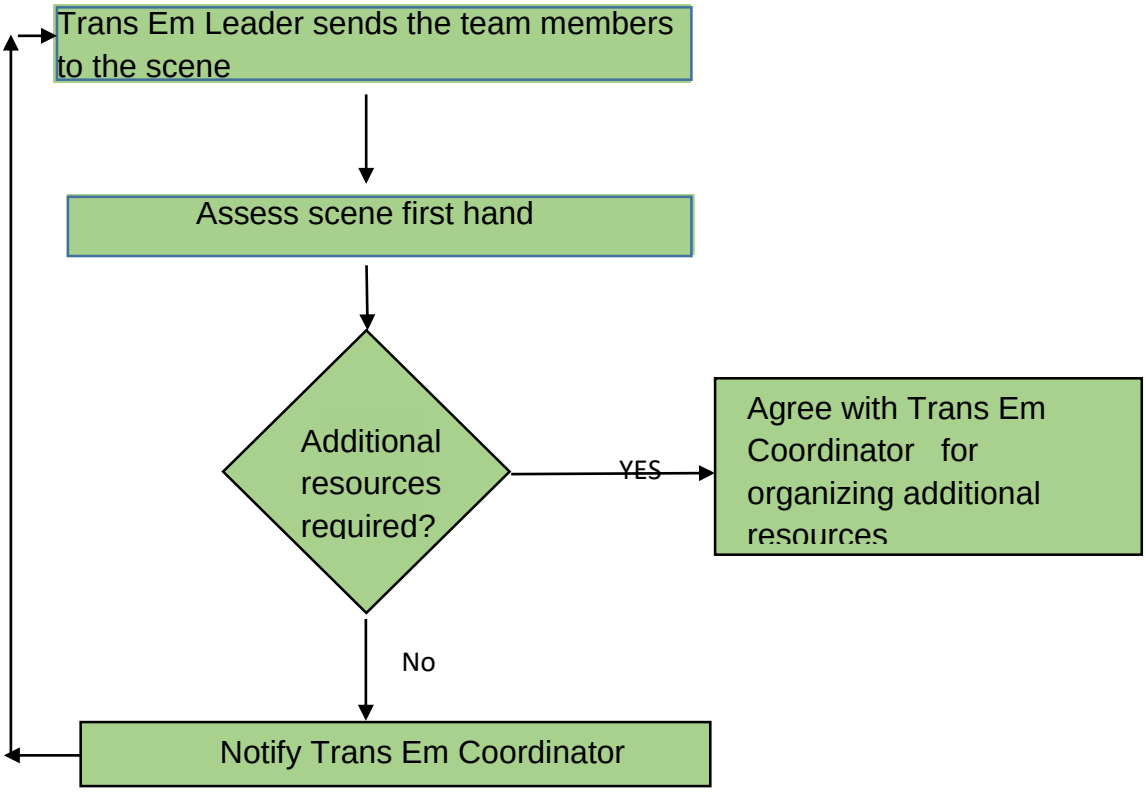


Example of a Transport Emergency Communications Flow Chart Sheet (2)



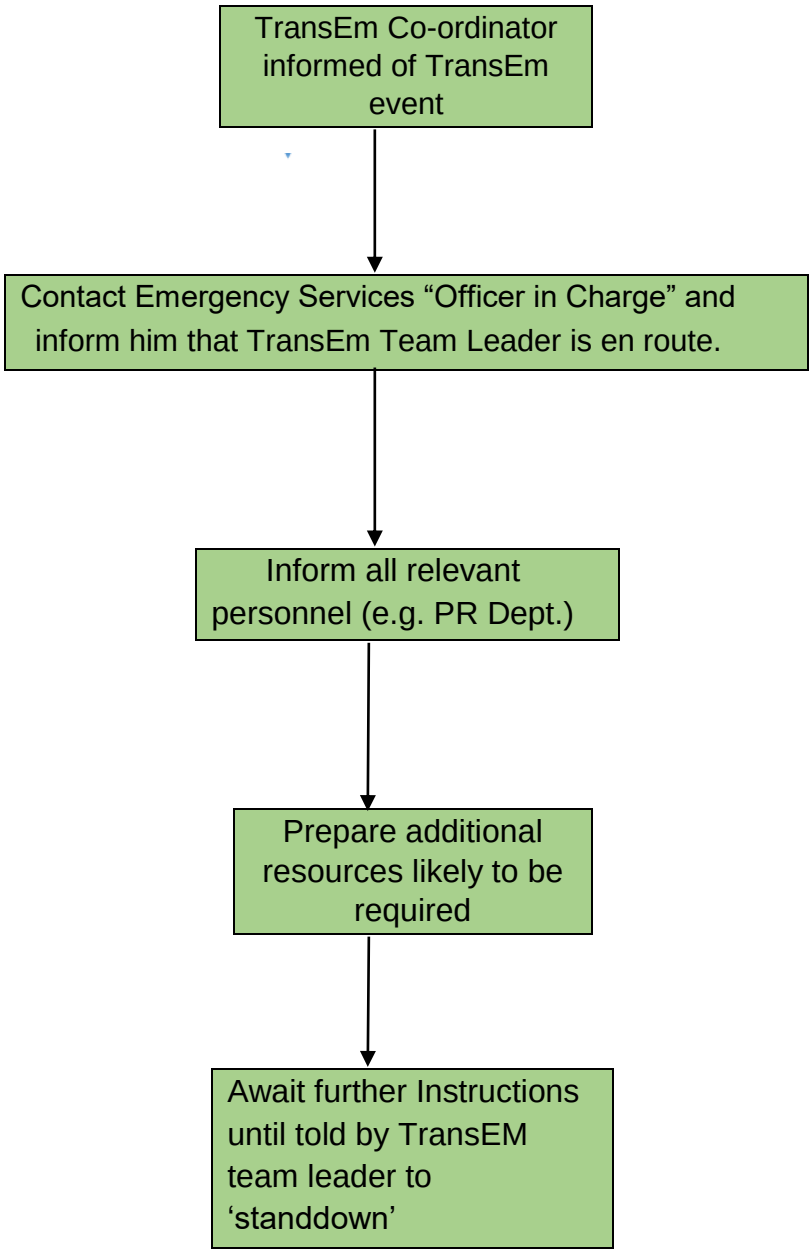
Example of a Transport Emergency Communications Flowchart

Sheet (3)



Example of a Transport Emergency Communications Flow Chart

Sheet (4)



Appendix G – Example of Typical Transport Emergency Equipment

Typical Transport emergency requirements

Each geography must provide a sufficient transport emergency response capability. This will include provision of appropriate Transport Emergency Teams and equipment to deal with transport emergencies. The equipment must be readily available for transport to the scene of any incident and may be specific to the vehicle and product. It may be held in a 'Transport Emergency Trailer'. The contents must be regularly checked and maintained for immediate use.
Whenever a transport emergency occurs, professional assistance will almost always be available at the scene from the local emergency services. These services generally provide a good range of emergency equipment and the necessary skills, for example Fire and Rescue services have first aid and cutting equipment capabilities. As a result, It is not recommended to carry any of these specialised equipment.

Example of an Emergency Trailer.

Example of Transport Emergency equipment which has been refined with experience and may vary according to the product (e.g. non sparking tools). The following provides a good guide.

Small Hand Tools / Equipment Checklist

- Mobile/Cell Phone
- 1 x Hacksaw Blade
- 1 x large Hammer
- 1 x Set Spanners for Flange Nuts(4)
- 1 x Large Adjustable Spanner
- 1 Medium Adjustable Spanner
- 1 x Small Adjustable Spanner
- 2 Safety Torches
- 1 Roll PTFE Tape
- 1 x Small Pliers
- 1 x Set Screw Drivers (8)
- 10 litre Plastic water container
- Digital and/or Disposable Camera
- 1 Large Wrench
- 1 Foot Pump
- 1 Set Files (4)
- 1 Copper Mallet
- 1 Large Pliers
- 1 Pair Side Cutters
- 1 x Sharp knife

Larger Equipment Items

- First Aid Box
- Shovel & Broom
- Earthing spike
- Plastic Bags
- Rope
- Chisel Large
- Bolt Cutters
- Vent stack

Personal Protection Equipment (PPE)

- Overalls (fire retardant)
- Hard hats
- Cryogenic Gloves
- Waterproof overclothes
- Waterproof Boots
- Warning vests
- Large Plastic Sheet

Warning Devices

- Warning Triangles
- 1x 500 Metres Barrier Tape
- Warning Lights

Specific Product equipment

- 1 x Cylinder Valve Key
- 2 x Bursting Discs for relevant products
- Various adapters and seal rings
- Various product transfer hoses

Example of Contents

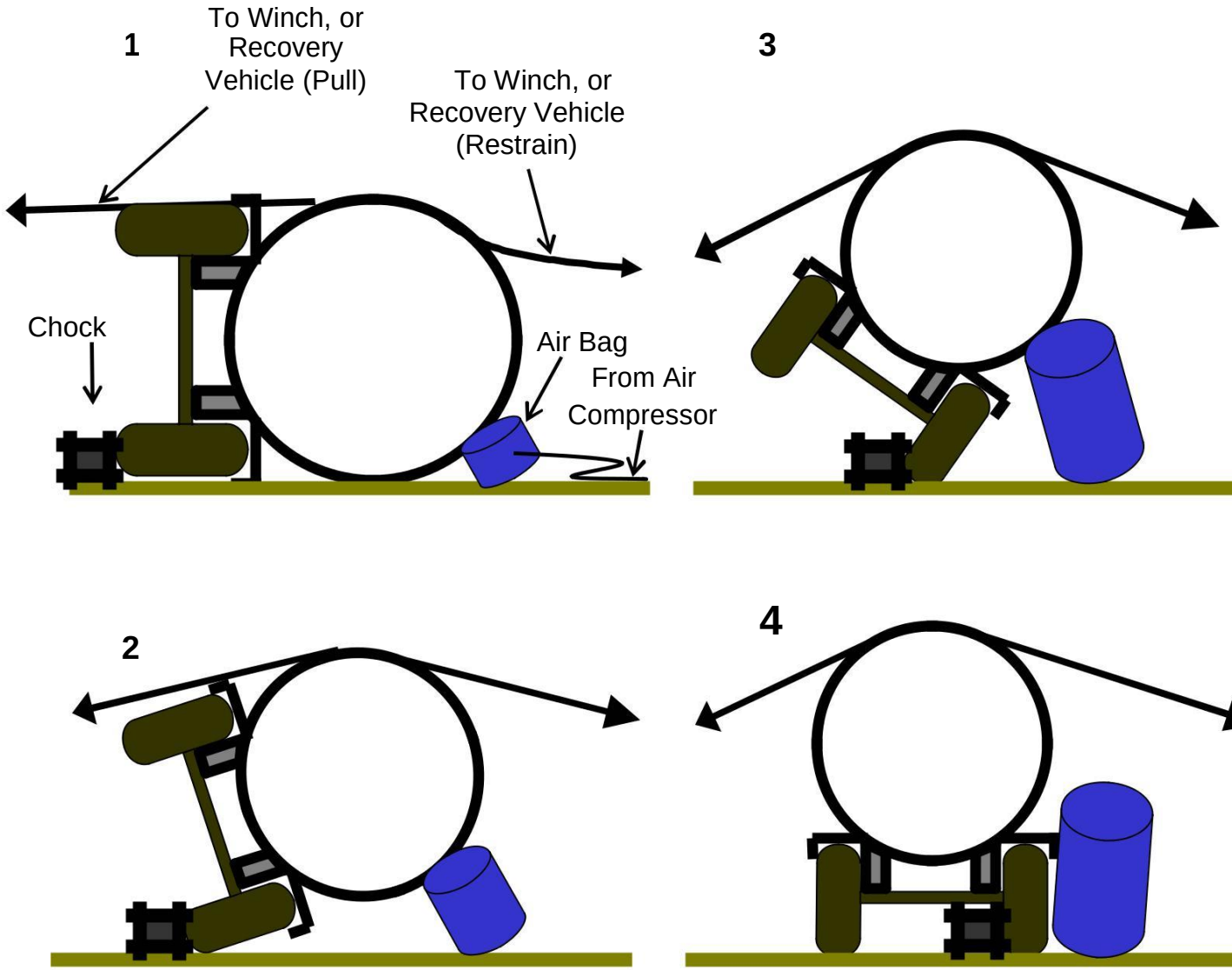
BOX 1

BOX 2

BOX 3

BOX 3A

Appendix H – Tanker Recovery Using Air Bags and Two Recovery Vehicles



"**Notes:**

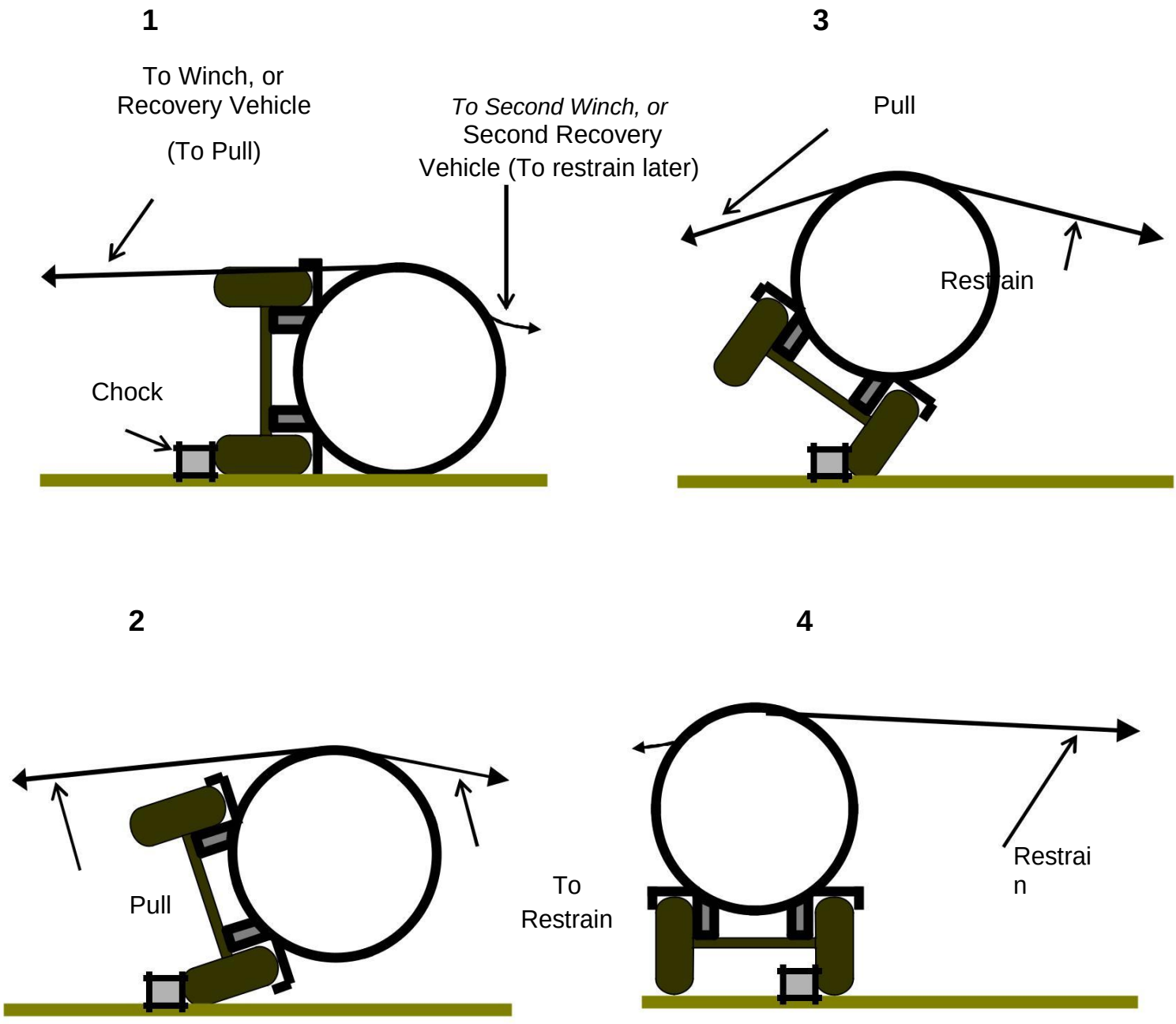
1 For manifolded cylinder trailers, tube trailers and MEGCs, the guidance given for conventional cryogenic tankers remains generally true.

Specific care, however, must also be taken with regard to the following fundamental differences:

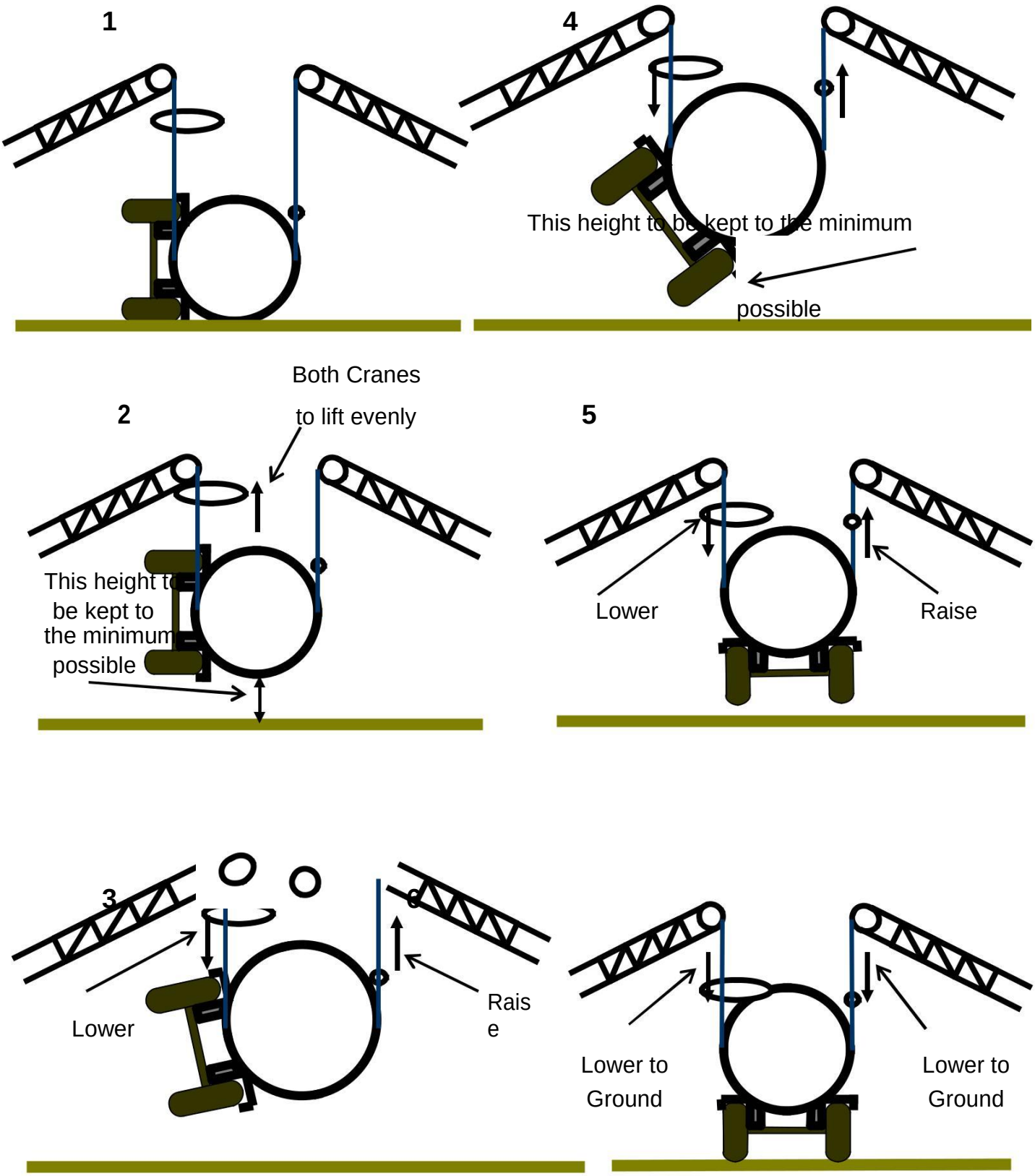
- there are many additional sharp edges on these trailers which may create high stresses in the lifting equipment or puncture Air Bags. These edges must be covered by suitable protective material, but the use of Air Bags may not be practicable.
- some individual cylinder or tube supports may have become broken or distorted. The cylinders, or tubes, must therefore be secured (usually by webbing straps) prior to lifting the trailer.

2 For tank containers and MEGCs the corner supports provide the most suitable lifting point(s)."

Tanker Recovery Using Two Recovery Vehicles



Tanker Recovery Using Two Cranes



Appendix J – Safety aspects concerning Vapour Clouds

Vapour Clouds are produced by condensation of water in air by contact with cold gas.

There are many hazards involving gas vapour clouds, the main ones being:

- Reduced visibility for individuals working in or others entering such a cloud. This means that tripping is more likely and vehicle movement is extremely hazardous for all parties. Clouds will change shape and position depending on wind condition.
- As many clouds form because of spilled cryogenic liquid, the pool of liquid itself is an extremely serious hazard which will usually be invisible due to the vapour cloud.
- Dependent on the product type, Oxygen enrichment or Oxygen deficiency may occur within dense clouds.
- Extreme cold, which can cause cold burns, frostbite and hypothermia.
- The properties of materials can be adversely affected which can lead to their catastrophic failure.
- Where the original product is a flammable substance, for example liquid hydrogen, the gas cloud will be flammable

NOTE:
Be very careful when there is a leak of flammable gas especially if the gas is heavier than air that may happen easily with cold gases (eg. The majority of hydrocarbon gases). Such a gas may form a layer on ground level which can extend to a long distance from the origin of the leak and ignite in catastrophic way, in contact with a hot point, an electrical contact an electrostatic discharge
Never enter in a cloud of flammable gas.
See document 44/90 (Hazards of Inert Gases) for further details on prevention of accidents arising from enrichment or deficiency of the oxygen in the atmosphere.

Entry into Vapour Clouds

Individuals may only enter a gas vapour cloud if all of the following requirements are satisfied:

- The cloud is neither flammable nor toxic gas
- the individual has been trained in the hazards of Cryogenics procedures / work instructions.
- this training should have been logged in the individual's training log.
- A second trained person, suitably equipped, is available to provide assistance if necessary.
- The individual is wearing appropriate personal protective equipment (see appropriate
  TREMCARD)
- If a vapour cloud is being deliberately generated then the person operating the equipment or process should be competent.

Prior to entering the cloud, the individual must know:

- the product type.
- where and how the cloud is being generated.
- the ground conditions (no liquid, tripping hazards, trenches).
- How the cloud has been generated

Note: Entry into a flammable gas vapour cloud should be avoided.

Safety with Vapour Clouds.

Never enter a cloud unless the guidance given above is followed.

Be particularly careful where:

- it rolls into low lying land i.e. below the ground level of the vessel which is generating the cloud
- there is cryogenic liquid on the ground, that is where injury may occur.
- a pipe discharges into low lying areas.
- the area may become a confined space.
- there are depressions in the ground where cryogenic liquid can accumulate.
- where the cloud covers a roadway where vehicles of any type may travel

Discharge of liquid

Discharge of liquid must only occur when either:

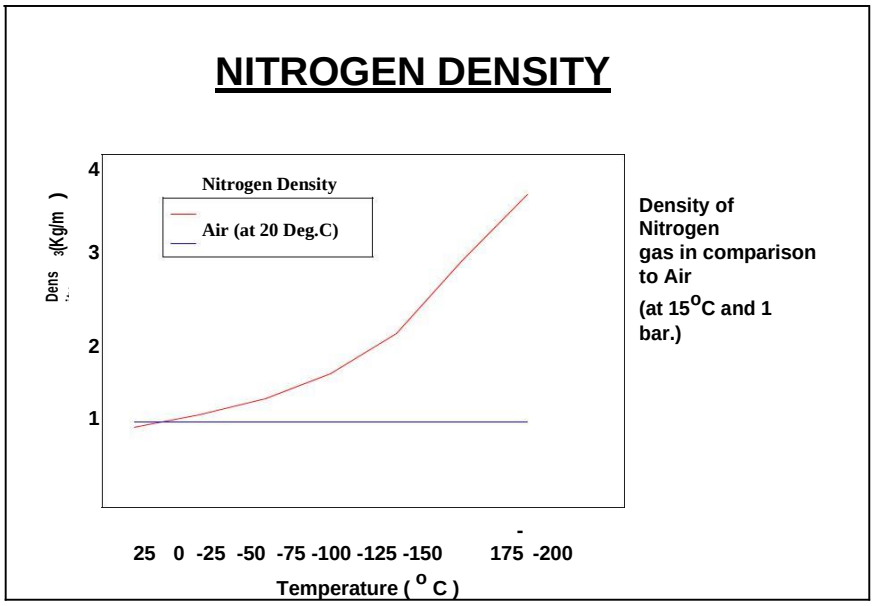
- off loading a tanker into an approved vessel or through an approved engineered system; or
- quantities of cryogenic liquid, or gas, are to be disposed of into an designated area.

Any individuals who may be affected by a cryogenic cloud have been notified, and the area suitably secured against entry.

Example:

Several gases are at normal temperatures and pressures, lighter than air. However, gas vapours arising from cryogenic liquids are always very cold and this changes the behaviour of the gas in that it always increases its relative density.

A good example of a cold gas is nitrogen where at normal temperatures and pressures, this gas is considered lighter than air, but below approximately 7°C, the gas is heavier than air and will collect in pits, hollows and trenches.



Appendix K – Safety aspects concerning Fire

Fires are normally caused by:

- Tyres
- Leak of flammable substance (vehicle or gas being transported)
- Third party collision.
- Vehicle Mechanical or Electrical defects.

As such, any fires which involve vehicles being loaded with, carrying, or unloading product must be considered as being extremely serious. In the case of a vehicle accident, a fire could be the cause of ruptured vessels or receptacles, damage to the vehicle or vehicle equipment and even other vehicles. Safely extinguishing most of these fires could well be beyond the capability of the vehicle driver(s) and the following paragraphs give guidelines as to what may be the most appropriate action to take in specific circumstances after calling the Fire Service.

The safety of all personnel must be the first priority.

If a fire is to be extinguished the safest time to tackle it is as early as possible and certainly before it escalates into a situation where it is “out of control”.
The instructions given in the TREMCARD(S) must be followed and examples of the information required is given below.

The general actions to be followed by the driver are:

- Stop the engine.
- No naked lights. No smoking.
- Notify police and fire brigade as soon as possible.
- Mark roads and warn other road users or passers-by.
- Inform the public about the hazards and give advice to keep upwind.

Drivers should be instructed during training to deal with minor vehicle fires. They shall not attempt to deal with any fire involving the load.

When acting on a fire the fire fighter(s) must at all times, carefully consider their actions and proposed actions, taking into account the following priority list:

- Safeguard all persons
- Avoid escalation of the incident
- Minimise any environmental damage

They must be competent in the use of their vehicle fire extinguishers.

Loading and unloading sites

Drivers should comply with local/customer site emergency procedures.

Tyre Fires

Tyre fires can generate extremely high pressures within the tyre which may result in the tyre bursting violently. This can lead to severe injury, even fatality, to any persons in close proximity to the tyre if it explodes.

One other danger of a tyre fire is that it can lead to a vehicle and/or product fire.

Tyre fires, when they occur, often look comparatively minor while in reality the fire may be burning internally and could lead to under estimation of the dangers. After a tyre fire has been apparently extinguished, there may still be very hot components or tyre parts, hot enough to lead to re-ignition of the tyre.

The first action if signs of overheating are detected or if flames break out
should always be immediately to call, or get someone else to call, the fire service who can spray down the tyre, wheel and surrounding area with water from fire hose(s) until all the heated parts have been completely cooled.

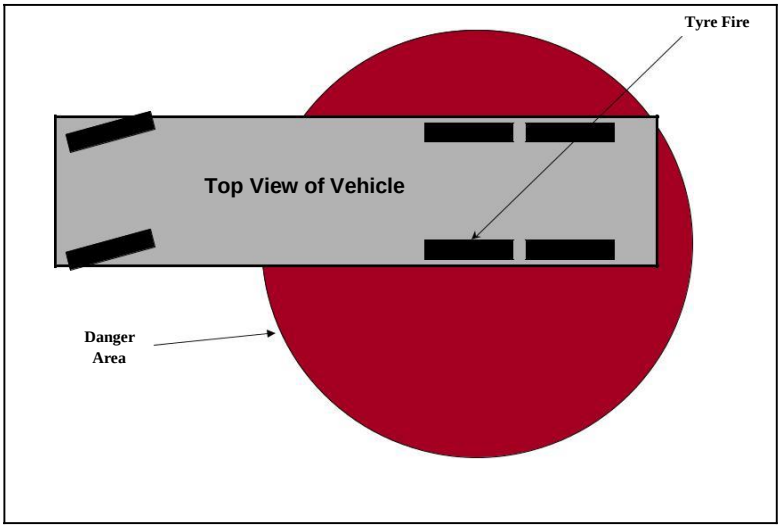
The use of dry powder extinguishers may be ineffective, as it does not provide an adequate source of cooling. Consequently, the risk of bursting should be considered before using a fire extinguisher.

Note:
Particular caution is necessary in the case of twin tyres as one tyre may have heated the other to a sufficiently high temperature, which could result in ignition or even bursting of this other tyre.

Never use a fire extinguisher whilst under a vehicle.

The driver should:

- stay clear of the maximum danger area (4 metre radius),
- keep other people away,
- not work on, or allow others to work on, the vehicle until the area has completely cooled.



The red area designates the area of maximum danger. All persons must stay away from that area. If a tyre explodes pieces of tyre may be projected in unexpected directions.

The area beyond the red circle must not be considered as safe because it is still possible for tyre fragments or other components to be projected into this area and cause injury.

Cylinders and Tubes in fire situations

Compressed gas cylinders and tubes have the following attributes:

- May have filling pressures of up to 300 bar at 15°C.
- Internal pressure increases with heat.
- High temperature and uneven heating affect the strength of the material(s) of manufacture.
- Most do not have a pressure relief device for protection against excess pressure.
- Failure (leak or rupture) may be without warning

Liquefied gas cylinders/tubes may have the following additional attributes:

- When the temperature rises, the pressure rises rapidly.
- These may contain a pressure relief device, fitted to the valve or any pipework for protection against excess pressure.

Acetylene Cylinders differ from other gas cylinders in that their interiors are packed with a porous filler material (porous mass). Liquid solvent in a carefully determined amount saturates this filler and acts as an absorbent for the acetylene. When the valve on a charged cylinder is opened, the acetylene comes out of the solution and passes out in gaseous form. Like other Flammable Gases, Acetylene can form explosive mixtures with air and may react violently with oxidants.

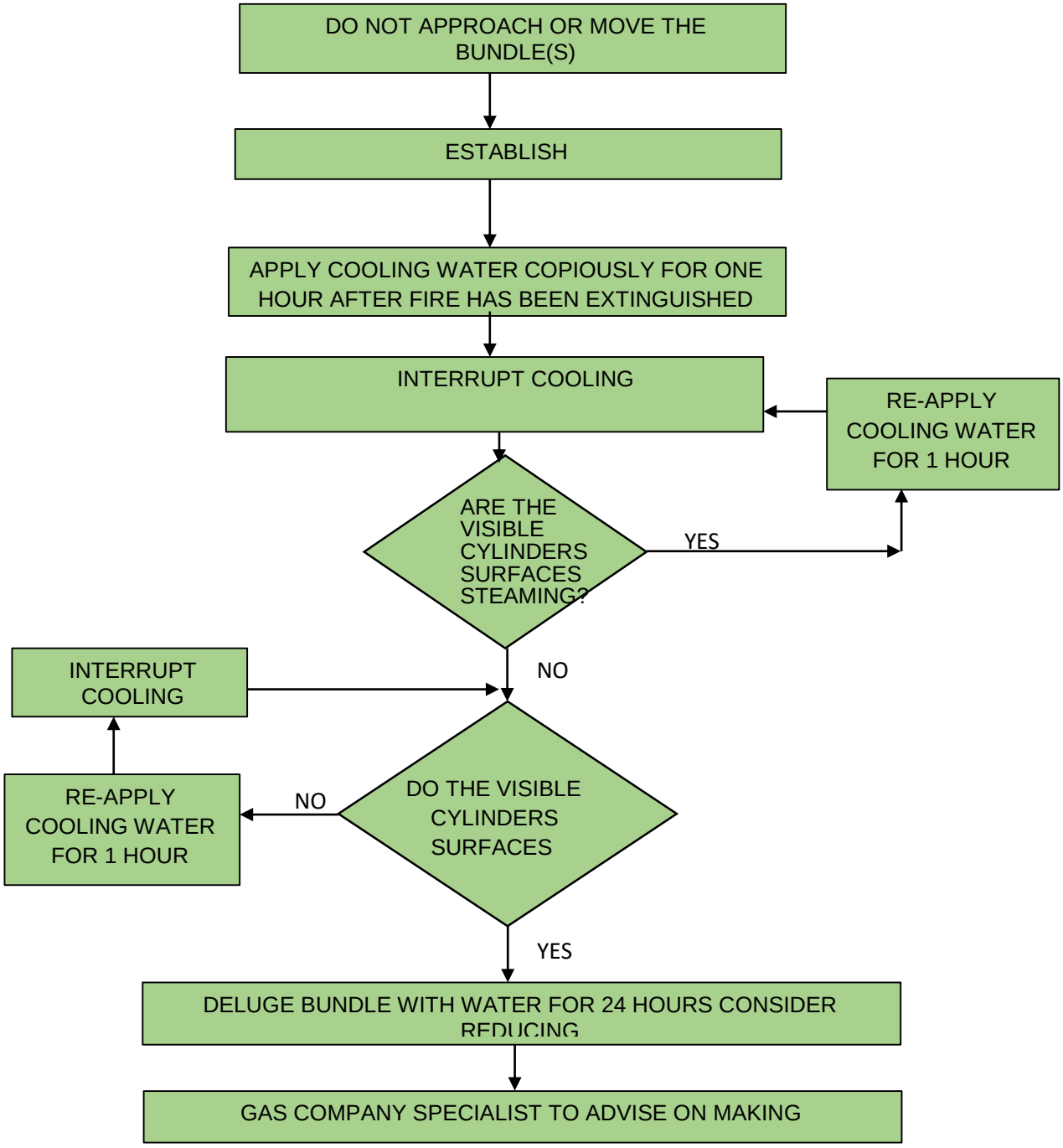
Acetylene cylinders may be fitted with a fusible metal plug(s) threaded through a hole in the base or shoulder of the cylinder or in the valve. As the temperature rises the plug melts, allowing release of acetylene gas into the atmosphere, relieving the pressure. Nevertheless, fusible plugs will not prevent cylinders from bursting. They may only delay such bursting.

A dissolved acetylene cylinder, which has been subjected to even moderate heating through being involved in a back fire, or adjacent to a fire, should be considered as being extremely dangerous.

Progressive decomposition of the acetylene contained in the cylinder takes place raising the temperature and the pressure of the cylinder and is likely to continue unless the cylinder is effectively cooled. This decomposition can continue for many hours if the cylinder has been exposed to heat resulting in a potential cylinder rupture.

It is essential that certain precautions are taken, as given in the accompanying flow diagram below to avoid injuries and fatalities to personnel and fire fighting services. This document covers bulk transport vehicles only, so the advice below is restricted to acetylene bundles.

Key Actions for dealing with Acetylene Bundles in Fires



Note:

- Advice should be given not to approach such fire affected bundles and to maintain the cooling and surveillance for at least 24 hours after the fire has been extinguished and it has been confirmed that the cylinder has remained cool. The steaming/drying of the cylinders should be observed from a safe location.

- Rough handling of fire affected cylinders can also initiate decomposition, so acetylene bundles which have been in fires **must not** be moved.

Vehicles in Fire

It is rare for a vehicle to be totally engulfed. Normally only a part of it is involved. The advice given by the information in writing, which may be in the form of a TREMCARD, should be followed.

Should a vehicle become involved in a fire situation the following must be considered:

- The outer jacket and any insulation material of a tanker will provide some protection for a short period. If this is made from Aluminium or some other materials then this will be a significantly shorter period than steel.
- In the case of a vacuum insulated tanker with powder insulation the protection will be more than other types.
- Heat in-leak will cause liquid gases to expand and pressure rise will be evident leading to safety devices opening or bursting which may be accompanied by a loud noise.

Note: - tanker safety devices are designed to cope with Fire engulfment situations and so discharge pipework should not be blocked.

- Some gases will increase the fire intensity while others will have a partial reducing effect.
- In the case of compressed and certain other liquid flammable gases a leak which has ignited is not always visible to the naked eye, but a loud noise may be heard.
- Spraying safety devices venting gas with water may cause the safety device to clog and escalate the incident (especially in the case of refrigerated liquid gases).
- In the case of battery vehicles the cylinders should be sprayed with water to keep them cool.
- Cylinders should continue to be sprayed in order to ensure that they are cool before recovery is attempted.
- The products of combustion may be harmful e.g. paint, some insulating and cladding materials.
- A quarantine period should be set before and after the vehicle is moved to a safe place depending on the severity of the incident and the gas being transported.

Appendix L – Safety aspects concerning Toxic gases

There are special hazards when Toxic products are involved. The following is general guidance, however;-

- always consult the driver's transport emergency instructions (Tremcard),
- **always obtain advice from an expert practitioner before dealing with toxic gases**:

Nature of the risks when toxic gases are involved

There is a fundamental difference in the process by which Toxic gases harm to people compared to asphyxiant gases. With asphyxiants, the person may lose consciousness, and may ultimately die, because of oxygen deficiency in the atmosphere which he is breathing.

Toxic gases harm, and may kill, people by a chemical process which poisons the person's body – irrespective of the amount of oxygen in the atmosphere. It will only take very small quantities of toxic gas in the atmosphere (usually <0.5%) to cause death within one hour.

Points to note are:-

- In an emergency, the risks of flammable gases are reduced by avoiding ignition sources and the risks of non-flammable non-toxic gases are reduced by using an oxygen monitor. These typical approaches to an emergency are not valid for toxic gases.
- Toxic gases may possess other hazardous properties (e.g. flammable, pyrophoric, corrosive, oxidant etc.)
- Toxic gases may be odourless & colourless.
- Gas may be either toxic by inhalation or by absorption through skin even from very small quantities.
- Appropriate gas detection devices are required to confirm safety of local atmosphere, (oxygen monitors cannot be used for this task)
- Unless it can be confirmed that the local atmosphere is safe, it should be considered as being toxic

Additional Information:

- Be aware that valves may start leaking when heated, therefore:
  - Use proper protective equipment (see appropriate TREMCARD).
  - Check for leakage with suitable leak detection method.
  - Where appropriate, advise Emergency Services to erect barriers and warning notices to keep affected area clear.
- In certain circumstances, it may be advisable to recover a leaking toxic gas cylinder in a "cylinder recovery vessel" (often known as a "cylinder coffin").

Clearly mark any damaged or heat-affected cylinders / tubes and inform the gas supplier before further handling or transport.