شرکت ملی گاز ایران

مدیریت پژوهش وفناوری

مقررات

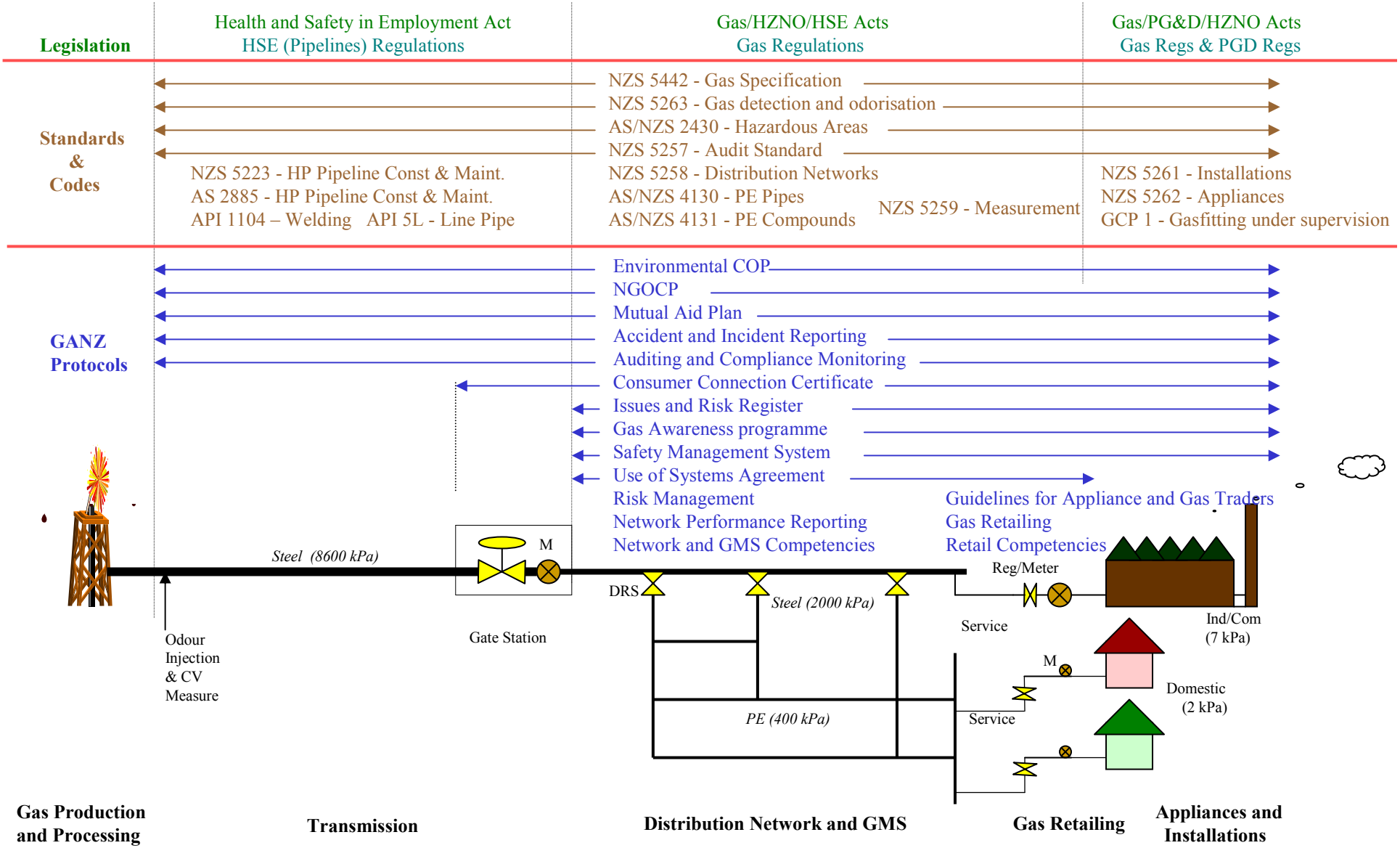
صنعت گازنیوزلند

مجموعه مقررات مربوط به صنعت گازطبیعی درکشورنیوزلند

امورتدوین استاندارد

اردیبهشت ۱۳۸٤

GAS INDUSTRY DOCUMENTATION



June 2004

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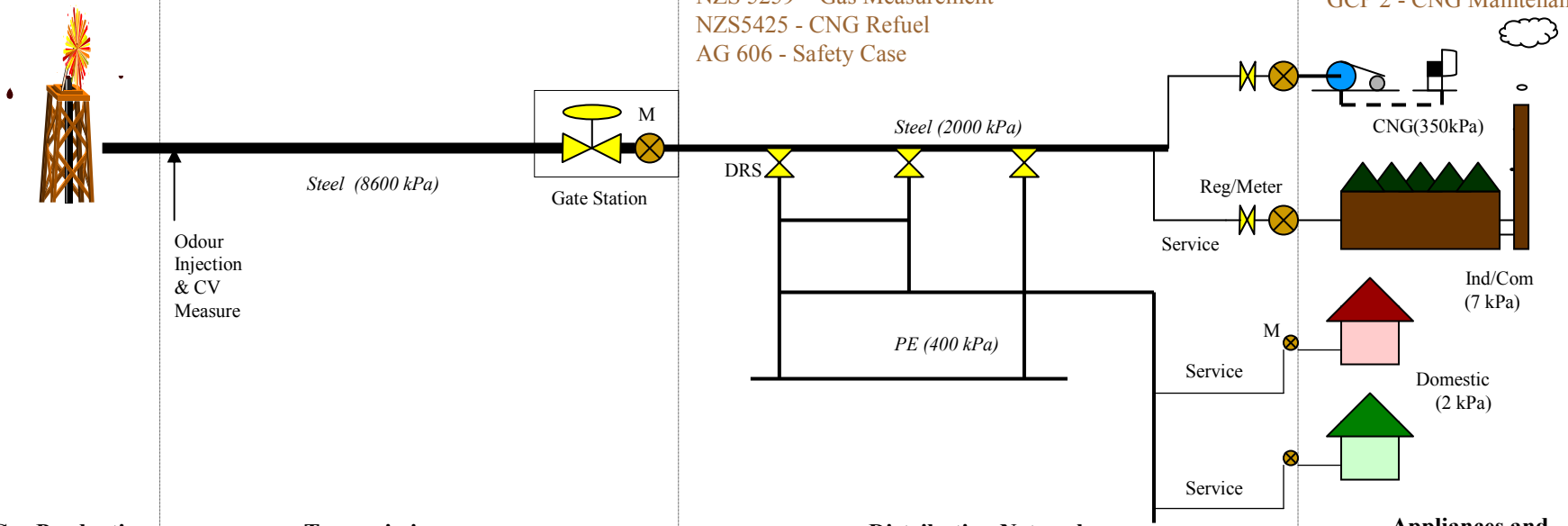
LEGISLATION

Principal Acts	Health and Safety in Employment Act	Gas Act	Gas Act and PG&D Act
Govt Dept	Dept of Labour	Min of Consumer Affairs	MCA and Min. of Health
Regulations	HSE (Pipelines) Regulations	Gas Regulations	Gas Regs & PGD Regs
Standards & Codes		NZS 5442 - Gas specification NZS 5263 – Gas detection and odorisation AS 2430 - Hazardous Areas	
	NZS 5223 - HP Pipeline Const & Maint. AS 2885 - HP Pipeline Const & Maint. API 1104 - Welding API 5L - Line Pipe	NZS 4130 - PE Pipes NZS 4131 - PE Compounds NZS 4442 - Welding (Steel) NZS 5258 – Distribution networks NZS 5259 – Gas Measurement NZS5425 - CNG Refuel AG 606 - Safety Case	NZS 5261 - Installations NZS 5262 – Appliance safety NZS 5422 - CNG Vehicles GCP 1 - Gasfitting under supervision GCP 2 - CNG Maintenance



Gas Production and Processing | **Transmission** | **Distribution Network** | **Appliances and Installations**

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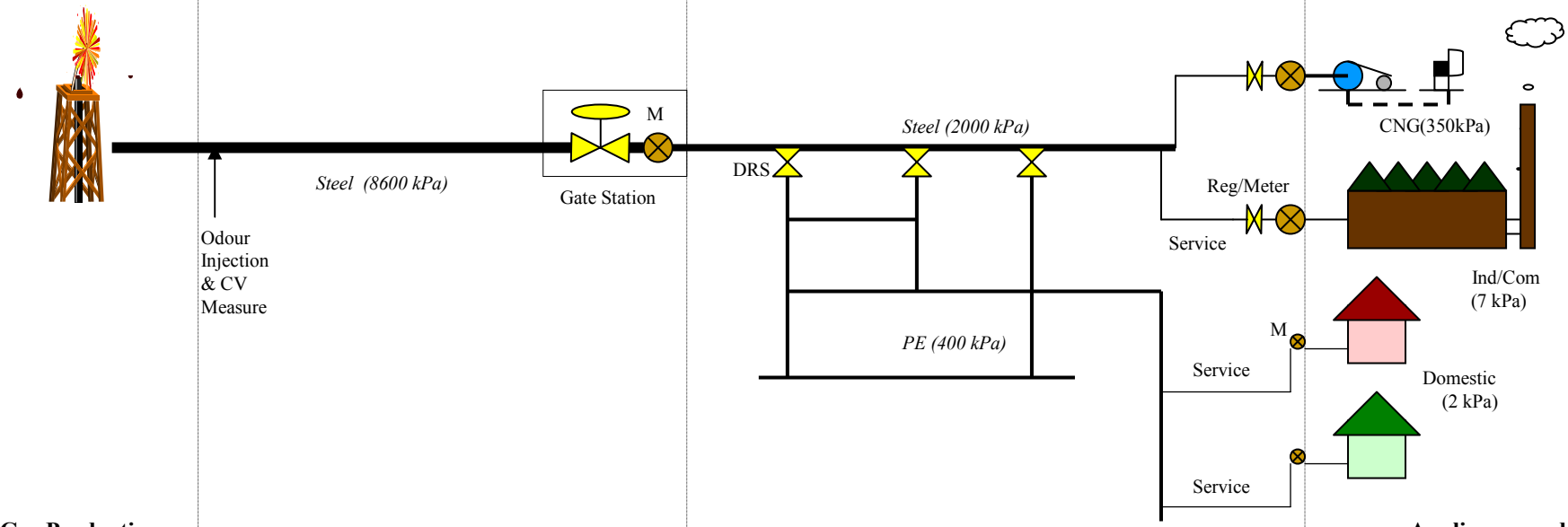
ASSET OWNERSHIP

Processing	Transmission	Network		Consumers
Shell	Maui	GasNet (Wanganui)	NGC	CNG
Maui	NGC	Nova Gas	Otago Citigas	Industrial
NGC	Shell Todd	Powerco	Vector Networks	Commercial
Shell Todd				Domestic

COMMERCIAL/GAS SUPPLY CONTRACTS

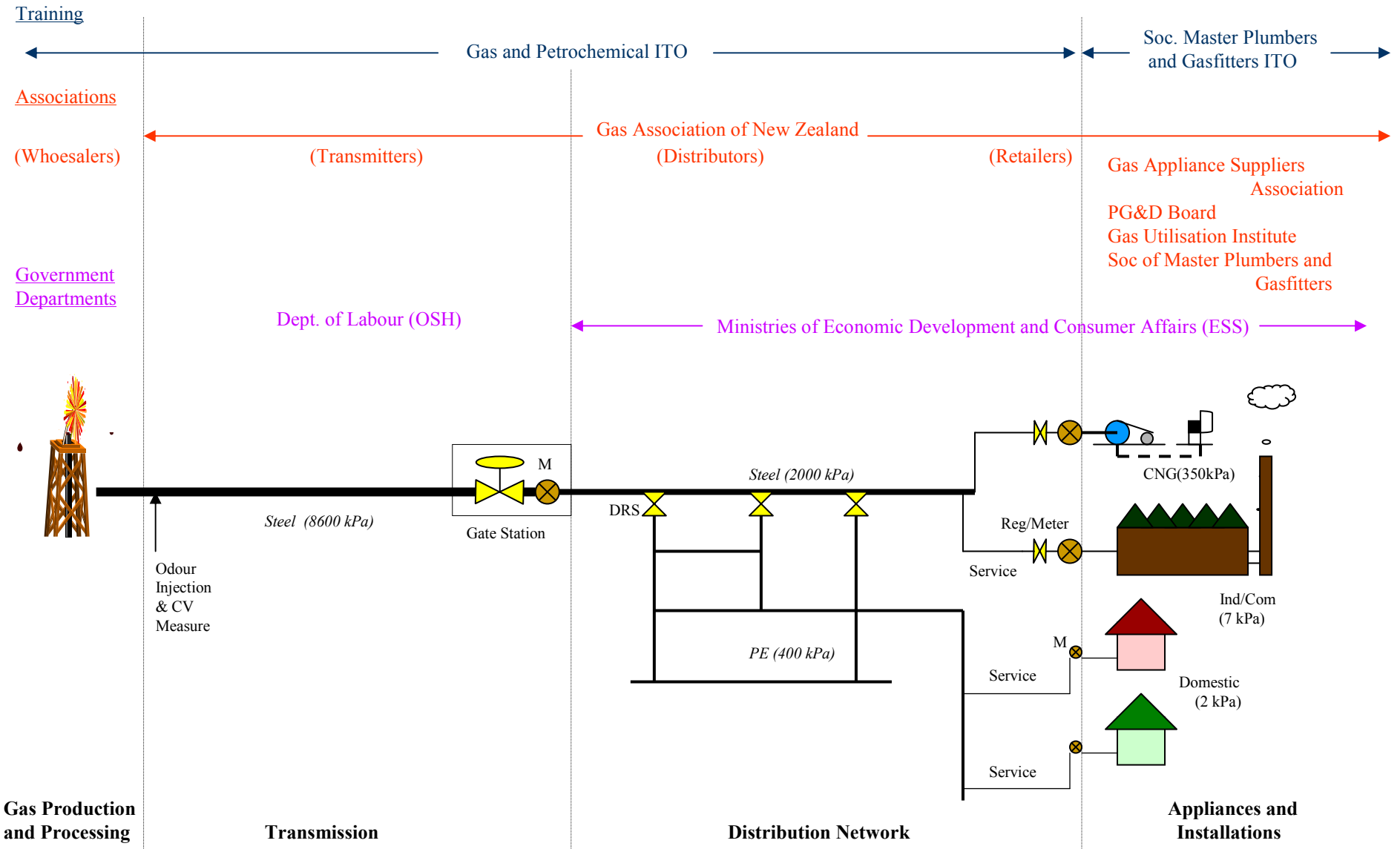
Wholesalers ⟷ Retailers ⟶ Consumers

Wholesalers	Retailers		
Contact Energy	Contact	Genesis	
NGC	NGC	Nova Gas	
Shell Todd	Otago Citigas	Wanganui	



Gas Production and Processing | **Transmission** | **Distribution Network** | **Appliances and Installations**

ORGANISATIONS



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CONTENTS

SECTION 1 - SAFETY

SECTION 2 - EMERGENCY PROCEDURES

SECTION 3 - INSTALLATION OF STEEL SYSTEMS UP TO 2000 KPA

SECTION 4 - INSTALLATION OF POLYETHYLENE SYSTEMS UP TO 420KPA

SECTION 5 - PURGING AND COMMISSIONING

SECTION 6 - CATHODIC PROTECTION

SECTION 7 - LEAKAGE

SECTION 8 - BARHOLING

SECTION 9 - TESTING

SECTION 10 - PIPE DIVERSION AND PROTECTION

SECTION 11 - ODORISATION

1. SAFETY

1.1 WORKING WITH LIVE GAS

1.1.1 SCOPE

This Section deals with the procedure to be followed during live gas operations on a distribution network.
"Live gas operation in a distribution system" is defined as follows: "Work where gas may be present in, or may be released into, the atmosphere or where air may enter a system containing gas."

1.1.2 HAZARDS WHEN WORKING WITH LIVE GAS

(1) Asphyxiation is a hazard with natural gas. Natural gas can create a false sense of security caused by the absence of carbon monoxide but asphyxiation can occur.

(2) Explosion is a hazard with natural gas.

(3) Fire is a hazard with natural gas.

1.1.3 GENERAL

Where any work is being carried out on plant or equipment carrying gas, breathing apparatus must be available. Where live gas is encountered or may be released to the atmosphere during an operation, breathing apparatus must be used by all persons within the area of risk or potential risk. The following recommendations are intended to reduce this risk, but every precaution must be taken to deal with unforeseen difficulties:

(1) Reduce the incidence of live gas operations by using underpressure equipment wherever possible.

(2) Work must not be carried out under live gas conditions if it is practicable to isolate the section of pipe, or plant involved and work in a gas free atmosphere.

(3) Under no circumstances may an operative work alone under live gas conditions, and at all times at least one man must be located outside the gas area, ready to give assistance if required.

(4) Each operator must have been trained in the use of breathing apparatus and CPR technique before being permitted to take part in the operation.

(5) The use of naked lights or smoking is not permitted in an area of possible risk. Members of the public must be diverted away from areas of possible risk.

(6) Warning lamps, mechanical and electrical plant if required, must be placed in a safe location.

(7) In excavations in excess of 1.5m, underground chambers, cellars or similar enclosed spaces, safety harness and lifeline must be worn and approved breathing apparatus used.

(8) The excavation should be wide enough to give adequate space for working.

1.1.4 BREATHING APPARATUS

The standard distance breathing apparatus with 9 metres hose is normally adequate for most distribution operations at low pressure. Where a length of hose greater than 9 metres is required or where escaping gas is at a pressure greater than 35 kPa COMPRESSED AIR BREATHING APPARATUS MUST BE USED.

1.1.4.1 Distance Breathing Apparatus

(a)Before Putting On The Apparatus The Wearer Must Ensure: -

(1) The eye piece and visor are free from cracks.

(2) Check the head harness straps and replace any strap found to be faulty or that has lost its elasticity.

(3) Any unworkable adjusting device must be replaced.

(4) Check to ensure an approved type washer in the union if required.

(5) Lay out the distance breathing tube to ensure an adequate supply of fresh air is available at filter.

(6) Connect distance breathing tube to belt and fasten belt waist.

(7) Clean the inside of face piece and apply anti-dim to visor or eye pieces.

(8) Ease out head straps to fullest extent and place face piece in position.

(9) Adjust head straps by pulling on each pair to ensure comfortable tight fit.

(b) Immediately after fitting the apparatus correctly it must be tested in the following manner:

(1) Double up the short hose and breathe in. Immediate collapse of the face piece on to the face shows that the face piece is fitting correctly.

(2) Remove filter from end of distance breathing tube, cover end and breathe in. The whole system is sound when there is no ingress of air. Replace the filter.

The belt must always be fastened around the waist to ensure no strain on the bottom of the face piece.

(3) The face mask must not be worn continuously for more than 20 minutes. Where work is of an arduous nature this period should be reduced accordingly.

(4) On completion of operation, face mask should be checked, cleaned, disinfected and ready for future use.

1.1.5 COMPRESSED AIR BREATHING APPARATUS

1.1.5.1 Description

Compressed air breathing apparatus is a portable air line breathing unit designed for rapid transportation. Two options are available. The standing cylinder unit carries an air supply of 1800 litres per cylinder giving two operators a breathing period of unlimited duration by systematic replacement of exhausted cylinders. The hose reel will accommodate up to 30m of supply hose and if required, two reels can be used in series. Air is supplied through the axis of the reel from a compressed air cylinder mounted beneath the reel. The back pack unit consists of one compressed air cylinder (1800 litres) carried on the back of the operator. Exhausted cylinders can be systematically replaced to ensure supply of air. (Operator retreating to safe area to carry out replacement.)

1.1.5.2 Pre Operational Checks

(1) Connect up required hose lengths, masks, harness, etc.

(2) Check constant flow valve shut.

(3) Open one cylinder valve. The warning whistle, if fitted, will be momentarily heard as pressure rises. Check cylinder is fully charged by noting high pressure gauge.

4) Close cylinder valve and observe pressure gauge. Pressure should not fall more than 60 atmospheres in five minutes. If it falls in less than five minutes check whole system for leaks.

5) Depress diaphragm by inserting finger through the hole in the outer casing of the regulator to clear circuit air. This should be carried out in a controlled manner and the pressure at which the warning whistle sounds noted.

1.1.5.3 Preparation For Use

(1) Demist mask visor with anti-dim solution.

(2) Don harness and adjust for comfortable fit. On standing cylinder unit check that supply hose is clipped in place and passing through the 'D' ring at the back of the harness. (This prevents any sudden pull being felt on the mask). A life line may also be connected if required.

(3) Open one cylinder valve, put on mask and adjust to fit by pulling first the two side straps in a backward direction, then repeat with the lower ones.

(4) Inhale deeply two or three times to ensure that air is flowing freely from the demand valve and that the exhalation valve is functioning correctly.

(5) Close cylinder valve and inhale until air in the apparatus is exhausted.

(6) Inhale deeply. The mask should squeeze on to the face indicating an air tight fit of both mask and exhale valve.

(7) Re-open one cylinder valve.

(8) Careful observation of the HP gauge will give an indication when to change over cylinders. if a warning whistle is fitted it will give an audible warning at 44 atmospheres.

Empty cylinders should be removed, labelled "EMPTY' and replaced by fully charged cylinders, thus maintaining a constant air supply.

1.1.5.4 Maintenance After Use

After use, the equipment must be maintained in accordance with manufacturers instructions, and the face mask cleaned and disinfected.

1.1.6 WORKING IN LIVE GAS

When using the standard type of breathing apparatus, the end of the breathing tube must be:

(1) Suspended above ground.

(2) Placed up wind of the work area.

(3) In a gas free area.

(4) Free from other contaminants eg. exhaust fumes -

(5) Sufficient slack in hose to allow wearer to make rapid exit from risk area.

In particularly high concentrations of gas and/or 'no wind' conditions, the distance breathing apparatus may be unsuitable due to escaping gas not dispersing and drifting into the end of the breathing tube. In such conditions compressed air breathing apparatus must be brought to the site.

Where excavation is carried out, spark resistant tools should be used when available.

Where excavation is carried out without spark resistant tools the work area and tools used should be thoroughly dampened with water.

1.2 TREATMENT OF PERSONS AFFECTED BY LIVE GAS

1.2.1. SCOPE

This section details the procedure for treating persons affected by non-toxic gases. Any person working on a gas supply system must have undertaken a suitable first aid course which will include training in artificial resuscitation.

1.2.2 SIGNS AND SYMPTOMS

(1) NON TOXIC GAS (eg. Natural Gas) - There are no reliable symptoms but the person affected may-be unconscious.

1.2.3 TREATMENT

(1) Remove the person affected from the gaseous atmosphere.

(2) Loosen tight clothing around the neck and waist.

(3) Check if the person is breathing. (In order to find out whether a casualty is breathing, look, listen, feel. Place your ear above the casualty's mouth and look along the casualty's chest and abdomen. If the casualty is breathing you will hear and feel any breaths and see movement along the chest and abdomen. A casualty who has stopped breathing will almost certainly be unconscious: it is not always easy to discern the exact moment that a casualty stops breathing).

(4) If breathing is present, put the person in the recovery position. (See Figure 1)

(5) If breathing is absent or feeble, artificial respiration by "Mouth to Mouth" breathing as detailed in Figure 2 must be started immediately.

(6) Oxygen, if available, should be given.

(7) The person affected should be kept warm and quiet. UNDER NO CIRCUMSTANCES SHOULD THE PERSON BE ALLOWED TO WALK.

(8) The decision to call an ambulance must be taken by the most responsible person on site, but every employee shall be prepared to take action when necessary. An ambulance must be called when the person is, or has been unconscious. In all cases where on a person has been overcome by gas they should be examined by a Doctor.

(9) Treatment must be continued until the person affected is breathing properly or until a doctor or qualified help i.e. Ambulance arrives on site to continue treatment.

(10) UNDER NO CIRCUMSTANCES SHOULD A CASUALTY BE GIVEN ANYTHING BY MOUTH WHEN UNCONSCIOUS.

(11) A person mildly affected by gas and not taken to hospital must have some rest and the undernoted factors should be considered:

(a) Older persons take longer to recover from the effect of gas.
(b) The persons state of health affects recovery and anyone suffering from a chest complaint is likely to be more seriously affected and will take longer to recover.
(c) The person should be referred to a doctor.

FIGURE 1 - RECOVERY POSITION

This position ensures that a casualty maintains an open airway, that the tongue cannot fall to the back of the throat, that the head and neck will remain in the extended position so that the air passage is widened, and that any vomit or other fluid in the casualty's mouth will drain freely. The position of the casualty's limbs provides the necessary stability to keep the body propped in a safe and comfortable position.

THE CASUALTY SHOULD NOT BE LEFT ALONE WHILST IN THIS POSITION

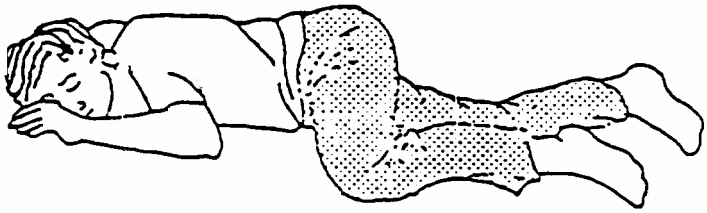
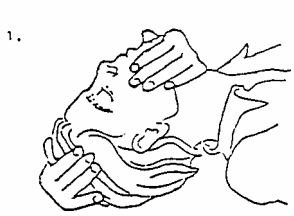
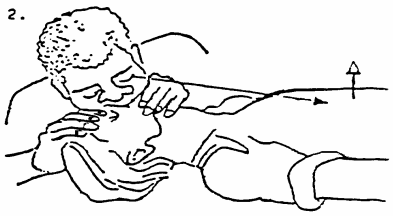


FIGURE 2 MOUTH TO MOUTH BREATHING-

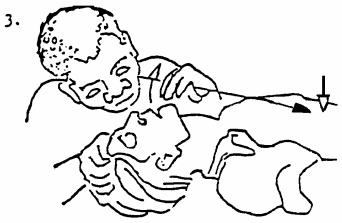
Lay casualty on back on firm surface. Kneel or stand by head. Press head fully back with one hand and pull up chin with ether hand. Loosen clothing around neck chest and waist, and ensure air passage (mouth and throat) is clear.



Breathe in deeply. Bend down lips apart and cover casualty's mouth with your own mouth. Pinch his nostrils with one hand. Breath out steadily into casualty's lungs. Watch chest rise.



Remove mouth, turn your head away, casualty's chest will fall. Breathe in again and repeat procedure once every 5 seconds.



Treatment must be continued until patient shows signs of recovery.

WHEN PATIENT BEGINS TO BREATHE NORMALLY, TURN PATIENT INTO THE RECOVERY POSITION (See Figure 1).

1.3 SAFE WORKING PROCEDURES

1.3.1 SCOPE

This section covers safe working procedures related to natural gas network operations.

1.3.2 GENERAL

All employees engaged on work connected with mains/services containing gas under pressure have certain preliminary duties to observe to ensure the safety of themselves and others. Correct precautions must be taken to ensure that any escaping gas is not ignited by the use of smoking materials or by other means.

1.3.2.1 Toxicity

Natural gas is non-toxic. The only danger in this respect is when all the surrounding atmosphere (e.g. in a deep pit or trench) is replaced with natural gas. This will produce an atmosphere which could lead to suffocation.

1.3.3 FIRE PRECAUTIONS

1.3.3.1 Avoiding The Formation Of A Flammable Mixture

The only practical way of minimising the risk of forming a flammable mixture is to reduce to a minimum the amount of uncontrolled gas discharged to atmosphere. Full use should be made of "no-gas" working techniques and equipment.

During all operations where there could be an escape of gas, regular checks should be made with an approved gas detection instrument, to safeguard operators and the general public. Suitable notices shall be used to warn the public of the presence of gas.

1.3.3.2 Elimination Of Sources Of Ignition

(1) Tools

Impact between steel tools can cause a spark which can ignite a gas/air mixture. Sparks can also be produced by steel tools such as forks, picks, shovels etc. when rock, stones, concrete etc. are hit. "Spark reducing" tools may be used, but they do not provide a guaranteed spark-free operation.

With all tools the use of water will reduce the likelihood of sparks occurring. In the presence of leaking gas, water should be poured onto the ground before a pick or any other tool is used.

When a cast iron pipe is being broken out with a hammer, the pipe should first be thoroughly purged and the pipe and hammer shall both be wet in areas where impact is likely to take place. This can be achieved by wrapping the pipe with a wet cloth.

(2) Stray Electric Currents

Metallic pipework acts as a carrier for stray electric currents. These currents can cause sparking during cut out and disconnection operations.

Temporary continuity bonds shall be installed before any connection or disconnection work. They shall be positioned so that they are not disturbed during the progress of the work. After selecting the positions where bonds are to be connected, the pipe wrapping, paint or other protective coating shall be removed and the area thoroughly cleaned with a wire brush. The ends of the bonds shall .be attached to the pipe so that they make good electrical contact. The bonds shall be removed only when all connection or disconnection work has been completed and when the area is free of gas.

(3) Naked Flames/Smoking

Equipment on site employing a naked flame shall be placed at least 5m from any possible source of escaping gas, and preferably be placed upwind.

It is essential that there is no smoking in or near to any excavation where live gas working is to be carried out. Suitable warning signs and barriers shall be erected to prevent the public entering any area where gas is being, or will be, discharged to atmosphere.

(4) Electrical Equipment

All electrical equipment which is likely to be used in a gas/air mixture shall be of the intrinsically safe type. Non-certified electrical equipment shall be placed at least 5m from any possible source of escaping gas. The ignition system on a petrol engine is electrical and shall be considered when siting equipment.

Immovable and non-certified electrical equipment such as, street lighting, traffic lights etc, are occasionally in danger of igniting escaping gas. If this situation arises, the people responsible for the equipment shall be informed and where necessary appropriate action taken.

(5) Polyethylene Pipe

Sufficient static charge to cause a spark that can ignite gas can be built up on polyethylene pipe by handling and cleaning.

When there is a risk of escaping gas, the pipe shall be covered with a cloth dampened with water and make good contact with earth. This will allow the static charge to be safely discharged to earth.

Due to the ability of polyethylene pipes to build up static charge, they shall not be used as vent pipes.

(6) Electrical Cables

Care shall be taken to avoid striking electrical cables when excavating and barholing.

The position of electrical cables should be established from plans whenever possible. A cable locator shall be used prior to and during all excavation and barholing work.

(7) Welding Operations

When it is necessary to weld onto or adjacent to operational gas plant, the welding shall only be undertaken in accordance with a written routine procedure or a valid Permit to Work, and a welding procedure.

1.3.3.3 Fire Protection For Personnel And Plant

(1) Protective Clothing

During all Distribution Operations where there is a risk of escaping gas, overalls made from flame retardant materials shall be worn together with suitable hand protection.

(2) Fire Extinguishers

At every site where work is being carried out and there is a risk of the release of gas, there shall be at least two fire extinguishers conveniently placed for use in an emergency. Each extinguisher shall be kept in good order and regularly inspected. It should be a dry powder extinguisher with a capacity of at least 3.5kg.

Whenever an extinguisher has been primed, even if no powder or only a small portion of powder has been exhausted, arrangements shall be made to refill and re-charge it without undue delay.

(3) Means of escape

It is essential that there is always a means of rapid escape from areas of work in case of fire. Special precautions shall be taken in deep excavations. Excavations deeper than 1.5m shall be notified to OSH.

Securely fixed ladders or other assistance shall be provided in areas where escape would otherwise be difficult. Ladders shall extend 1m above the level of the excavation or other stepping off point.

Where an excavation is deeper that 1.5m lifelines shall be provided. They shall be placed ready for use or worn as the conditions warrant.

1.3.3.4 Practical Action To Be Taken In The Event Of Fire On Mains And Services

(1) Deciding the Course of Action

If escaping gas catches fire it is necessary to decide which is the greater hazard; the fire or the escaping gas if the fire is extinguished. If the escaping gas would be the greater hazard, it is essential that the fire is allowed to burn under close attention until all materials required for sealing the escape are available or until the gas supply can be turned off.

If the fire is to be allowed to burn and there is a possibility of it getting out of control, or if it is likely to endanger people, buildings, vehicles or other utilities equipment, the Fire Department shall be asked to attend site together with other utilities whose equipment is affected.

(2) Extinguishing a Fire

When it is decided to put out the fire, two options are available:-

(a) If the fire is not too large it may be put out by directing dry powder from a fire extinguisher into its base.

(b) The gas supply may be cut off. In some cases valves may be available, but in the majority of cases it will be necessary to isolate the main either side of the fire. The size of the fire should be reduced by partially shutting off the supply. The fire should then be extinguished with a dry powder fire extinguisher and the gas supply immediately shut off completely.
Care should be taken that the fire does not flash back down the pipe and exposed pipes should be covered with sand to prevent this from happening should the gas supply be reduced or turned off.

APPENDIX NO. I

SAFE WORK ON ASBESTOS PIPE

1. General

Asbestos is not a substance which is poisonous or of immediate danger to health but the inhalation of quantities of asbestos dust could prove harmful to the lungs and must be avoided at all times.

The use of asbestos pipe for gas reticulation is not recommended, but there will be some asbestos pipes in service, and work on them may at times be unavoidable. When this is necessary special care must be taken to avoid the inhalation and spread of the asbestos dust.

The most common types of asbestos encountered are:

(1) Chrysolite, (white asbestos) a white curly white to grey fibre which is difficult to separate into individual fibres.

(2) Amosite (grey asbestos)which consists of colourless to grey to brown straight fibres.

(3) Crocidolite (blue asbestos) which is similar to amosite but has a blue colour.

Much of the asbestos cement pipe used prior to 1970 contains crocidolite and unless testing has proved otherwise it must be assumed that all asbestos cement pipe installed prior to 1970 contains crocidolite.

2. Protection

When it is necessary to carry out any work i.e. drilling, cutting, filing etc) on asbestos pipe that is likely to create asbestos dust, the following precautions are to be taken:

(a) When using hand tools on asbestos cement pipe clearly identified as installed since 1970, no specific cutting precautions need be taken unless cutting will be carried out over 1/2 hour when a light dust mask should be worn. Care should be taken however, to minimise the amount of dust produced. If the generation of a large quantity of dust is unavoidable, it should be caught in a plastic bag sealed and immediately disposed of. Overalls should be sealed in a plastic bag immediately on completion of the work, labelled "contaminated with asbestos" and sent for laundering.

The work area must be thoroughly cleaned up after completion of the work and all traces of asbestos removed.

(b) The use of power tools on asbestos piping is strongly discouraged because of the excessive amount of dust produced.

Where this is unavoidable:

Protective clothing shall be worn. This consists of:

(i) Ori-nasal respirator fitted with suitable cartridge (i.e. Protector RC54) or optional full face, positive pressure air fed respirator
(ii) Disposable overalls.
(iii) Disposable hood (if not supplied integral with the overalls).
(iv) Gumboots - Overalls should be worn outside the gumboots, should be fully zipped with the hood, wrists and ankles closed.

(c) The asbestos pipe and immediate surround should be damped down with water before commencing work and at necessary intervals during the work to reduce the possibility of air contamination with asbestos dust.

(d) Consideration must be given also to keeping onlookers and passersby clear if the work is being done in a public place.

(e) If possible a container should be placed under the work to catch any asbestos dust or particles that may be dropped. Any asbestos collected in this way should then be placed in a plastic bag sealed and disposed of.

(f) On completion of the work, contaminated protective clothing which is not to be cleaned and re used should be treated as asbestos waste and be disposed of accordingly. Where re use of protective clothing is proposed it should be damped, placed in sealed container and clearly marked "asbestos contaminated clothing". The laundry to which the clothing is sent should be made aware that it requires special treatment for the handling of clothing contaminated with asbestos.

(g) Gumboots should be thoroughly washed.

(h) Staff employed on this work should then take a shower as soon as possible the hair being washed at the same time.

3. When any work whatsoever is necessary on asbestos cement pipe containing crocidolite if non power tools are used it may be handled as described in Section 2(2) of this instruction. When the work necessitates the use of power tools on asbestos cement pipe or concerns asbestos insulation in bricks or similar heating appliances or where there is any doubt whatsoever regarding the type or composition of the asbestos prior authority for such work must be obtained jointly from the Departments of Health and Labour.

2. EMERGENCY PROCEDURES

2.1 ADMINISTRATIVE PROCEDURE

2.1.1 SCOPE

This Section of the Manual relates to the minimum practice which must be followed in all incidents involving escapes of natural gas. The main objective of the procedure is to ensure the safety of life and property. This section does not cover the responsibilities of Gas Companys regarding Civil Defence coordinating plans.

2.1.2 CODES AND REGULATIONS

The action recommended in this section of the Manual must comply with the requirements of:

Health and Safety in Employment Act 1992
Health and Safety in Employment (Construction) Regulations 1994
Gas Act 1992
Gas Regulations 1993
NZS 5258 Code of Practice for Gas Distribution

2.1.3 DEFINITION

An emergency shall be deemed to exist in any one of the following circumstances:

It becomes apparent that because of fire, flood or other catastrophe, damage may be caused to the gas company system or a hazardous situation may be created.

Excessive high or low pressure supply occurs in a sector of the distribution system.

Gas is escaping or is likely to escape in such a manner, volume and location to create a hazard to persons and/or property.

Escaping gas has been ignited and the resulting flame could create a hazard to persons, property and/or the gas supply.

Any other situation involving gas considered by the employee, the Fire Service or Police as potentially dangerous to life or property.

2.1.4 EMERGENCY ORGANISATION

Each gas company shall have a well defined emergency plan for handling various types of emergencies, with essential staff available on call to cover all off duty periods. After hours contact phone numbers must be supplied to the Police, the Fire Service and local authorities. All personnel must be instructed at least once a year on the procedures to be adopted in the event of an emergency occurring.

2.1.5 REPORTING AND COMMUNICATION

2.1.5.1 Reporting

Identification and control of an incident can only be achieved through good communication and reporting procedures.

The maximum essential information must be obtained from the person reporting the incident in the minimum of time. This should include:

The nature of the incident, ie. gas escape, explosion, fire, asphyxiation.

The exact location of the incident.

Brief details of injury to persons, numbers affected, damage to property, or any other indication of threat to life or property.

2.1.5.2 Communications

A radio or telephone link must be set up as quickly as possible between the incident site and the Gas Company control centre. The radio channel selected should be kept clear of all other users not concerned in controlling the incident.

It is recommended that all Gas Companys have at least one ex-directory telephone to be made available only to staff involved in the incident.

2.1.5.3 Availability Of Staff

As incidents are not programmed events, the Gas Company will maintain a record of staff movements during the emergency. Personnel should also radio their arrival/departure from the various sites under their control.

2.1.6 SITE ACTIVITY

2.1.6.1 Vehicle Access

Vehicles must not be parked where they could impede the access of other vehicles, such as fire appliances and ambulances. When parking, consideration must be given to the possibility of escaping gas accumulating near the vehicle and leading to an explosion when the vehicle engine is restarted.

2.1.6.2 Gas Escape

The first on-site representative of the gas company must make every endeavour to ascertain the on-site situation by:

observing on-site activity damage etc.
questioning, if possible, the complainant
questioning Police and Fire Services, if present.

From the information received the gas company's on-site representative should take appropriate action as detailed in Section 7.2 of this Manual (Procedures for Dealing with Reported Escapes on Distribution System).

Until the situation is made safe, particular attention should be made with respect to restricting the movement of vehicular traffic and personnel through the hazard area where gas is confirmed within buildings, access to the building must be restricted. The situation must be monitored and gas personnel should enter the building only after work has been carried out to intercept and vent the escaping gas to atmosphere.

As an aid to restrict personnel and vehicular movement through the hazard area, consideration should be given to delineating the area using warning signs and barricades, for example.

The liberal use of water to damp down surfaces will help reduce the possibility of ignition by a spark during excavation work.

2.1.6.3 Gas Supply At Risk

For conditions where gas is not escaping but the gas main is at risk due to severe ground movement or fire, and there is a possibility of large volumes of gas escaping, every reasonable effort must be made to support or protect the gas main. Until the gas main has been secured, or the situation made safe, evacuation of the area should be considered.

2.1.6.4 Supply Incident (Excessive High Or Low Pressure)

Distribution systems are supplied with gas from a high pressure source through pressure reduction systems. These stations and the systems they supply are designed to operate within establish pressure parameters and have safety/supervisory systems incorporated in the design to protect/warn of over or under pressurisation of the system.

Occasions do arise however when over/under pressurisation does occur. These occurances can often by identified at the fault reporting centre when several over/under pressure reports are received from one particular area. It is important that personnel receiving these complaints inform a more senior person at the earliest possible time.

These over/under pressure conditions are generally known as supply incidents.

A decision tree for supply incidents is shown in Appendix A.

2.1.7 CONTROL OF FIRE ON DISTRIBUTION SYSTEMS

Every effort must be made when working on live gas systems to remove all sources of ignition, should there be an escape of gas. Wetting of surfaces prior to and during excavation work can reduce the possibility of sparks.

Fire fighting equipment supplied by the Gas Company must be placed ready for use upwind of all work involving live gas mains or services. Approved breathing apparatus should also be inspected and set out ready for use.

In all incidents where gas has ignited, whether the distribution team are on site when ignition occurs or not, the following action should be adopted.

The team leader or supervisor will assess the situation by considering the following:

safety of the public and property
steps to be taken to control the situation
the need for assistance from other staff of the Gas Company and/or emergency services.

Once this assessment has been completed, arrangements will be made to have any additional equipment required delivered to the worksite.

It is difficult to lay down set rules to cover all incidents. In all cases common sense must prevail. If the flame is extinguished, gas will continue to escape and it could be out of control. Re-ignition can then occur at any time and the results could be more serious than if the gas was left burning. The application of a water fog to the flame area without extinguishing the gas flame, together with the application of cooling water to areas affected by radiant heat, may reduce the danger until such time as the supply is cut off.

Dry powder and BCF extinguishers are the most effective for extinguishing gas fires. It is recommended that a minimum of two be carried on vehicles. After use, regardless of the quantity expelled, all extinguishers used must be replaced or recharged. All extinguishers should be checked annually in accordance with the NZ Fire Service recommendations.

Caution must be taken when using water to prevent flooding of the mains or the cracking of cast iron mains due to sudden quenching. A layer of soil thrown over the main before water is applied can prevent both of these problems from occurring.

After a fire has been extinguished, the surrounding area must be damped down to prevent re-ignition.

It is important that Fire Service personnel attending such fires are made aware of all the circumstances surrounding the fire that could affect the type of firefighting action to be taken.

When a medium or intermediate pressure main or a transmission supply is on fire, every effort must be made to control the supply of gas before the fire is extinguished. In certain circumstances a temporary by-pass may have to be installed around the area of the fire.

The insertion of stopping off equipment into the supply to control the pressure should be carried out in separate excavations clear of the damaged area.

2.1.8 RECORDS

Records of mains, services, valve and regulator locations should be readily available at all times for reference.

Lists of large volume consumers in each area should also be available with details of phone numbers and contact names for use during and outside of normal working hours. A detailed log of events should be maintained by the senior person on site for all incidents.

2.1.9 PRESS RELATIONS AND PUBLICITY

All statements are to be made by the designated officer of the Gas Company. All enquires should be referred to that officer.

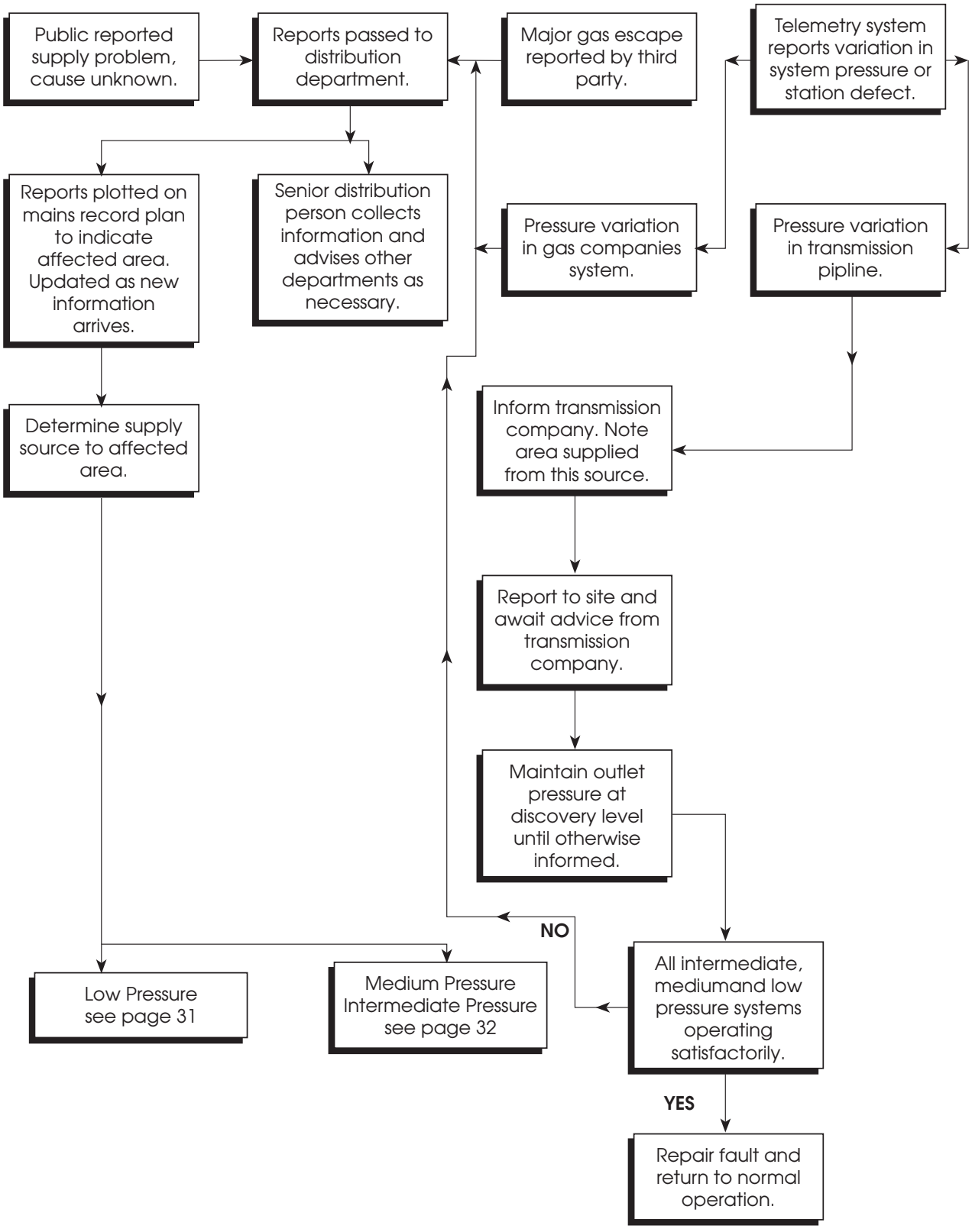
2.1.10 FOLLOW UP ACTION

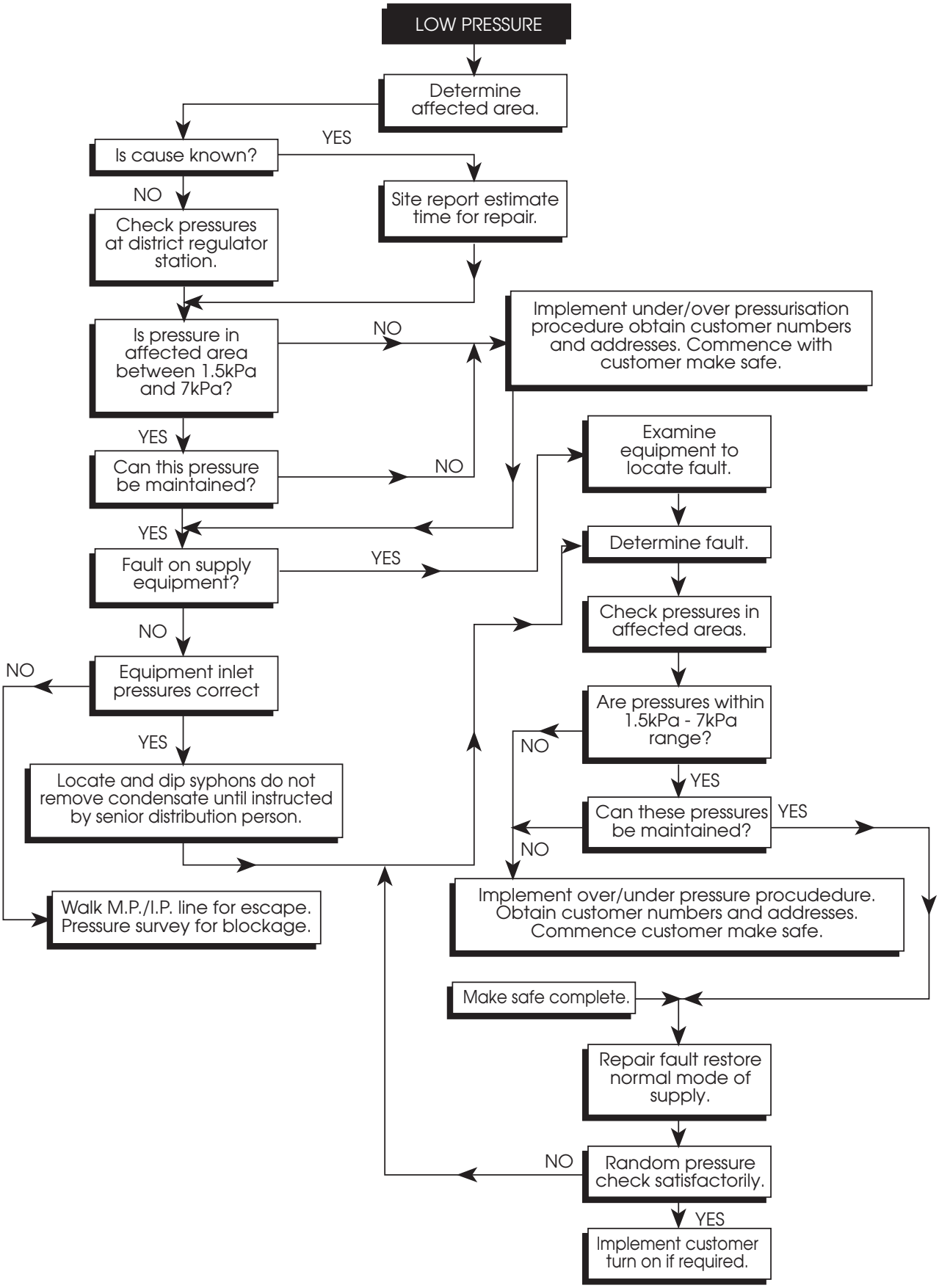
As soon as possible after an emergency has been dealt with, a report should be prepared. Such reports should be prepared by supervisors after consultation with staff involved in the emergency and should be supported by separate reports from individual staff members involved.

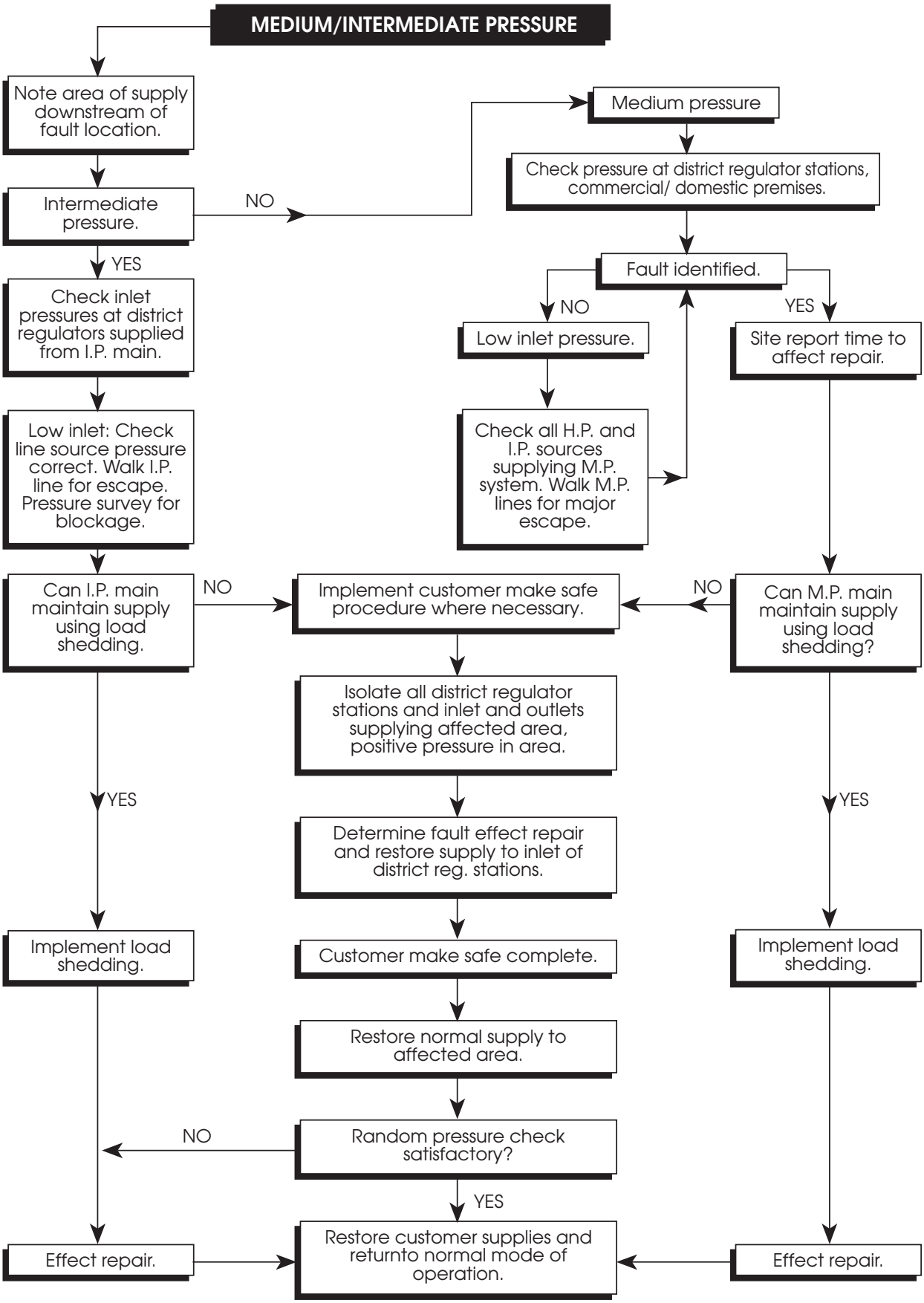
It cannot be too highly stressed that to enable a full and conclusive investigation to be made into any emergency, it is essential that complete and accurate details of all occurrences in chronological order be submitted as early as possible.

The Gas Act 1992 states that when an accident occurs which is caused wholly or partly by gas and which damages a property and affects the gas supply, or which causes serious injury resulting in the likely incapacitation of a victim for 48 hours or more, or the death of any person, it is mandatory for the Gas Company concerned to advise the Chief Inspecting Engineer of the Ministry of Energy immediately. Detailed records of early events in such an accident are of considerable assistance in subsequent investigations into the cause.

APPENDIX A SUPPLY INCIDENT DECISION TREE




LOW PRESSURE
Determine affected area.
Is cause known?
YES
NO
Site report estimate time for repair.
Check pressures at district regulator station.
Is pressure in affected area between 1.5kPa and 7kPa?
NO
Implement under/over pressurisation procedure obtain customer numbers and addresses. Commence with customer make safe.
YES
Can this pressure be maintained?
NO
Examine equipment to locate fault.
YES
Fault on supply equipment?
YES
Determine fault.
NO
Check pressures in affected areas.
NO
Equipment inlet pressures correct
Are pressures within 1.5kPa - 7kPa range?
NO
YES
YES
Locate and dip syphons do not remove condensate until instructed by senior distribution person.
Can these pressures be maintained?
YES
NO
Implement over/under pressure procudedure. Obtain customer numbers and addresses. Commence customer make safe.
Walk M.P./I.P. line for escape. Pressure survey for blockage.
Make safe complete.
Repair fault restore normal mode of supply.
NO
Random pressure check satisfactorily.
YES
Implement customer turn on if required.


MEDIUM/INTERMEDIATE PRESSURE
Note area of supply downstream of fault location.
Intermediate pressure.
NO
YES
Medium pressure
Check pressure at district regulator stations, commercial/ domestic premises.
Fault identified.
NO
YES
Low inlet pressure.
Site report time to affect repair.
Check inlet pressures at district regulators supplied from I.P. main.
Low inlet: Check line source pressure correct. Walk I.P. line for escape. Pressure survey for blockage.
Check all H.P. and I.P. sources supplying M.P. system. Walk M.P. lines for major escape.
Can I.P. main maintain supply using load shedding.
NO
Implement customer make safe procedure where necessary.
NO
Can M.P. main maintain supply using load shedding?
Isolate all district regulator stations and inlet and outlets supplying affected area, positive pressure in area.
YES
YES
Determine fault effect repair and restore supply to inlet of district reg. stations.
Implement load shedding.
Customer make safe complete.
Implement load shedding.
Restore normal supply to affected area.
NO
Random pressure check satisfactory?
YES
Effect repair.
Restore customer supplies and returnto normal mode of operation.
Effect repair.

3. INSTALLATION OF STEEL SYSTEMS UP TO 2000kPa

3.1 SCOPE

This section covers the design and construction associated with the distribution of natural gas at operating pressures between the range 420 kPa and 2000 kPa.

3.2 CODES

All codes are listed in Appendix A of this Manual.

3.3 MATERIALS

All materials and components used in a piping system shall be qualified for the conditions of their use by compliance with the appropriate specifications, standards and special requirements of this manual.

3.4 DESIGN

All design work shall be in accordance with NZS 5258.

3.4.1 DESIGN VELOCITY

In situations where dust particles may be present, arising either from the gas source or from the possibility of the formation of corrosion products within the pipeline, consideration should be given to limiting the gas velocity in any section of the pipeline to avoid abrasion where changes of direction take place.

Velocities of up to 20 m/s are normally acceptable, even if some dust is present, but in situations of severe dust contamination a lower limit may be necessary.

3.4.2 PIPELINE SIZING

The method of determining the required size of pipe for a given application will depend on a number of inter-acting technical and economical criteria. Initial sizing should be based on a simple steady-state concept. A number of formulae have been developed for relating pressure drop to gas flow rate, eg. Weymout, Panhandle, Spitzglass, Oliphant and Unwin, and should be used for this purpose. Convenient disc calculators based on these formulae are available. These give sufficiently accurate results for services and short pipelines.

More complicated and longer pipelines (over 50 km) require greater accuracy and the use of Panhandle “A”, Panhandle “B” or AGA flow formulae is recommended. This is particularly true where recompression stations are required.

3.5 HANDLING OF MATERIALS

3.5.1 DELIVERY

Pipes and associated materials delivered to site shall be carefully unloaded by crane or lowered from the delivery vehicle by means of rope and skids, or, in the case of small diameter pipe, manually lifted from the delivery vehicle. Pipes and fittings shall not be dropped to the ground and shall not be allowed to knock against each other.

3.5.2 INITIAL INSPECTION

All materials delivered to site shall be carefully inspected for obvious physical defects. Any rejected material shall be set aside, clearly marked and the Engineer or his representative notified.

3.5.2 STACKING

Where it is necessary to store pipe and fittings on site, the location shall be on firm level ground free from damaging material and with suitable access for vehicles and cranes etc.

Pipes shall be stacked horizontally, clear of the ground on supports at least 150mm wide, positioned at not more than 2m centres. Wrapped pipe shall not be stacked more than 2m high or, in the case of pipe up to 50 mm diameter, not more than 0.4 m high. Pipe stack shall be restrained by means of vertical supports, or for large diameter pipes, by means of padded wedges. End caps are recommended for each pipe.

3.5.3 STRINGING

Where appropriate, pipes may be strung out along the line of the proposed main or service. Care shall be taken to place pipes so as to cause the minimum possible interference with, or obstruction to, traffic, pedestrians or other Utilities plant. Pipes shall be wedged to prevent accidental movement and where necessary, barricades shall be erected and warning signs and lamps positioned.

3.5.4 SMALL ITEMS AND FITTINGS

Small items of material and fittings shall be kept under cover in a secure store and shall only be taken from store in small quantities as required during the progress of work.

3.5.5 LIFTING EQUIPMENT

Only approved slings, ropes or chain slings and pipe hooks shall be used for lifting. Slings are marked with the maximum safe working load (SWL) tested and shall not be modified for use on site.

Loads shall never be lifted over persons and no one shall be allowed to stand under a load which is being lifted.

3.6 PIPELAYING

3.6.1 GENERAL

3.6.1.1 Inspection of Trench

Prior to the commencement of pipelaying, the trench shall be inspected to ensure that it is safe and that all shoring is secure. He shall also ensure that the bed of the trench is firm, graded to the correct fall if required, and is free of stones or other material which could damage the pipe wrapping.

3.6.2 FINAL INSPECTION OF TRENCH

Immediately before pipes or fittings are positioned in the trench they shall be carefully inspected for damage to the steel or protective coating.

3.6.3 USE OF PULL THROUGHS AND TEMPORARY END CAPS

Before pipes are positioned in the trench, pipe bores shall be checked to ensure that they are free from obstructions and debris. In the case of pipe sizes 80mm and above, a correctly sized pull-through shall be used to verify the internal cleanliness of pipes.

Care shall be taken during pipelaying and jointing that pipe bores are kept clean.

When pipelaying is not in progress, the open end of a pipe shall be capped. A screw expanding stopper may be used for this purpose during temporary cessation of work, but when the site is to remain unattended or when otherwise directed by the Engineer or his representative, the pipe end shall be sealed in a more secure manner.

3.6.4 LOWERING IN AND POSITIONING

Pipes shall be lowered into the trench by means of the necessary and approved lifting equipment. Care shall be taken that no spoil is knocked down onto the bed of the trench.

DURING THIS OPERATION NOBODY SHALL BE ALLOWED TO STAND UNDERNEATH THE SUSPENDED PIPE.

When the pipe has been positioned correctly on the trench bed, the fall if required shall be checked with a graduated spirit level.

3.6.5 LAYING PIPES WITH MECHANICAL JOINTS

When pipes are to be jointed with a mechanical joint, the position of the joint shall be marked on the bed of the trench. Additional ground shall be excavated at joint positions to facilitate assembly of the joint and inspection.

Protective wrapping shall be cut back from the ends of pipes for a distance sufficient to permit the coupling or other joint fitting to be positioned and pipe spigot adequately cleaned to accept the joint. Joint fittings shall be placed over the end of the pipe already in the trench, such that the end of the pipe is clearly visible. When the subsequent pipe has been finally positioned, the fitting shall be drawn over the gap and the joint assembled in accordance with the manufacturer's instructions.

3.6.6 LAYING PIPES WITH WELDED JOINTS

Where pipes are to be jointed by welding, the welding operation shall, wherever possible, be carried out above ground and the corrosion protection applied prior to lowering pipes into the trench. Welding may be carried out alongside or over the trench, with pipes supported on skids. The maximum length of pipes which can be welded in this manner will depend on road traffic conditions and the nature and frequency of ,underground obstructions.

Where 'in ground' welds are required, additional localised excavation will be required at the joint positions.

Sufficient ground shall be excavated to permit the welder to gain access to the full joint circumference.

3.6.7 ANCHORAGE

Anchoring of low pressure mains is not required, unless requested by the Engineer or his representative. However, any sections of exposed pipework shall be temporarily supported during pressure testing.
Where medium pressure mains are being laid in which mechanical compression type joints have been used in any part of the construction, permanent anchorages shall be installed. Anchor blocks shall be constructed as directed by the Engineer or his representative.
Anchorages are not required on mains and services having all welded joints.

3.6.8 PIPE CUTTING

Pipe may be cut using rotating wheel cutters, mechanical rotary cutters, flame cutters or hacksaws. Wheel type cutters should not be used on tubing of nominal size 50mm or less, unless the bore of the pipe is subsequently reamed.

Flame cutters shall not normally be used on mains and services which have contained gas, or in an atmosphere which may contain flammable gas.

Where it is essential that 'flame cutters are used, the main or service shall be prepared and atmosphere monitored continuously during the cutting operation.

3.7 WELDING AND JOINTING

3.7.1 THREADED JOINTS

Threaded joints should not be used on mains where the operating pressure is greater than 200 kPa in sizes above 50mm nominal bore unless directed by the Engineer or his representative. Threads may be taper/taper or taper (male) to parallel (female). All threads shall be cleaned and carefully inspected for damage before use. Joints shall be made with approved jointing material, which shall be applied to the male threads only. Once tightened, joints shall not be turned back for alignment purposes.

Where it is necessary to thread a section of pipe, the pipe end shall be cut square and all burrs removed. Cutting oil shall be applied during the thread cutting operation.

3.7.2 WELDED JOINTS

3.7.2.1 Application Of Section

The welding standards in this section apply to the welding of joints in rolled, forged, and cast materials by arc welding. More specifically they cover butt welds in pipes, valves, flanges and fittings, socket weld fittings etc, as applied in pipelines and connections to apparatus or equipment. When valves or equipment are finished with welding ends suitable for welding directly into a pipeline, the design, composition, welding and stress relief procedures must be such that no significant damage will result from the welding or stress relieving operation. The requirements of this section apply specifically to arc welding; requirements for oxyacetylene welding shall be subject to approval.

This section does not apply to the welding of the seam in the manufacture of pipe.

3.7.2.2 Basis Of Welding Standards

The welding standards of this section require that the following requirements be met:

(1) A welding procedure shall be established and qualified prior to the start of production welding to demonstrate that welds having suitable mechanical properties and soundness can be made by the proposed procedure. The quality of welds shall be established as far as reasonably practicable by destructive testing. The soundness of the weld may be established by non-destructive testing prior to destructive testing, required.

(2) Each welder shall be qualified to determine his ability to make sound welds using the qualified procedures for butt welds or fillet welds.

(3) Each procedure and each welder shall be re-qualified for any departure from the essential variables as required in the Distribution Code.

(4) In addition to the requirements of soundness and compliance with

designated mechanical properties in the welded joint, the welding conditions employed shall be based on compliance with the requirements of the Distribution Code.

*Soundness here refers to absence of unacceptable geometric type imperfections such as cracks, gross porosity, etc.

3.7.2.3 Quality Standards

The standards for quality and acceptability are set out in the Distribution Code.

3.7.2.4 Safety in Welding

(1) New Zealand Standards

All welding operations shall be in accordance with and take account of the relevant NZ standard specifications relating to safety in welding.

(2) Additional Precautions

A thorough check shall be made in and around a structure or area containing gas facilities to determine the possible presence of a combustible gas mixture. Welding shall only begin when safe conditions are indicated.

Where welding operations are being carried out precautions shall be taken to ensure adequate earthing of welding machines.

3.7.2.5 Equipment

(1) General

Welding equipment shall be of a size and type suitable for work and shall be maintained in such a condition as will ensure that sound welds can be produced, that continuity of operation is assured and that safety of personnel is maintained. Any equipment which does not meet these requirements shall be repaired or replaced.

(2) New Zealand Standard

Welding machines and equipment employed for manual metal-arc welding shall comply with the relevant NZ Standards.

3.7.2.6 Fluxes, Filler Rods and Gas Mixtures

(1) Welding Consumables

Welding consumables shall comply with one of the following requirements:-

(a) The relevant NZ Standard
(b) Other recognised standards where there is no relevant NZ Standard.
(c) Welding consumables which produce a welded joint with chemical and mechanical properties which comply with one of the above, even though not classified in accordance with it.

(2) Storage & Handling of Electrodes, Fluxes, Filler Rods, and Gases or Gas Mixtures

(a) Electrodes fluxes and filler rods.

Electrodes, fluxes and filler rods shall be stored and handled in accordance with the manufacturer's recommendations, in such a manner as to avoid damage or deterioration. Those in opened containers shall be protected from deterioration.

Damaged materials shall not be used.

(b) Shielding Gases.

Shielding gases shall be kept in the containers in which they are supplied.

(c) Gases or Gas Mixtures.

Gases or gas mixtures shall comply with the following requirements:

(i) Gas mixtures are permissible provided that procedure tests indicate satisfactory performance. When a gas mixture is used the variation in the constituents shall not exceed 10% of the nominal quantity. The moisture shall correspond to a dewpoint of 30 degrees Celsius or lower.
(ii) Argon gas shall comply with" BS 4365
(iii) Carbon dioxide gas shall comply with the requirements of Type I of BS 4105.

3.7.2.7 Prohibition of Welding

(1) General

Welding shall not be carried out when the quality of the completed weld could possibly be impaired by the prevailing weather conditions including, but not limited to -

(a) when the temperature of the parts to be welded is lower than 5 degrees Celsius;

Note: Preheating may be used to increase temperature.

(b) when rain or snow is falling on the surfaces to be welded or when the surfaces to be welded are subjected to blown sand or dirt.

Gas shielded welding shall be prohibited when the wind velocity exceeds 13km/h except as provided in Clause 3.7.2.7 (2).

(2) Weather Shields

Weather shields or other effective protection may be employed to shield the work in adverse conditions. When such shields are necessary, attention shall also be paid to the provision of internal shields for use with gas shielded welding methods.

3.7.2.8 Definitions and Terms

Definitions and terms used in this standard refer to the standard definitions as given in BS499 except as otherwise defined in the section.

3.7.2.9 General Provisions for Welding

(1) Preparation for Welding

Surfaces and edges to be welded shall be smooth, uniform, and free from fins, tears, cracks and other defects which would otherwise affect the quality or strength of the weld. Surfaces to be welded and surfaces adjacent to a weld shall also be free from loose or thick scale, slag, rust, grease, or other foreign material that will prevent proper welding.

(2) Alignment of parts for Welding

(a) Accuracy of Alignment

Alignment of parts to be welded shall be effected by clamps, stays, tack welds, as accurately as possible having regard to existing commercial tolerances on pipe diameters, pipe wall thickness out-of-roundness, and tolerances on valves and fittings. As specified in this Clause (3.7.2.9(2)), alignment shall provide the most favourable conditions for the deposition of the root runs.

(b) Use of Line up Clamps

These shall be used in accordance with the requirements of the procedure specification. When it is permissible to remove the line-up clamp before completion of the root bead, the completed part of this bead shall be approximately equally spaced around the circumference of the joint. However, when an internal line-up clamp is used and conditions make it difficult to prevent movement of pipe, or if the weld will be unduly stressed, the root bead shall be completed before releasing clamp tension.

Root bead segments used in connection with external clamps shall be uniformly spaced around the circumference of the pipe and shall have an accumulative length of not less than 50% of the pipe circumference before the clamp may be removed.

(c) Use of Tack Welds

Tack welds are- permitted in lieu of line-up clamps only where the use of such clamps is impracticable. Where tack welds are employed full fusion at the root is required. The length of such tack welds shall not be less than 25mm. Tack welds so prepared should, if sound, be incorporated in the body of the weld by fusion provided that the start finish are ground to feather edges to allow proper fusion. Tack welds exhibiting any unsoundness shall be ground out as welding proceeds. Tack welds shall be made by qualified welders only.

(d) Misalignment and Root Gap

The maximum misalignment permitted between butt welds of equal or unequal thickness shall not exceed 1.5mm or 25% of the pipe wall thickness, whichever is the lesser, measured at the internal faces unless otherwise approved. The root gap between fillet welded parts shall be maintained at the lowest figure consistent with the dimensional tolerances of the parts being joined and shall be consistent throughout the joint.

Correction of misalignment by cold hammering shall be held to a minimum using approved tools only. Methods of correction of misalignment shall be approved by the Engineer or his representative.

3.7.2.10 End Preparation for Butt Welding Sections Having Unequal Thickness

(a) General

(1). The wall thickness of the sections to be joined beyond the joint design area shall comply with the design requirements of the Distribution Code.

(2) When the minimum specified yield stress of the pipes to be joined are unequal, the deposited weld metal shall have mechanical properties at least equal to those of the pipes having the higher value.

(3) The transition between ends of unequal thickness may be accomplished by taper or welding as illustrated or by means of a prefabricated transition nipple not less than one half pipe diameter in length.

(4). Sharp notches or grooves at the edge of the weld where it joins a tapered surface shall be avoided.

(5) For joining unequal wall thickness of equal specified yield strengths, the rules given herein apply, except there is no minimum angle limit to the taper.

(b) External Diameters Unequal

(1) Where the external offset does not exceed one half of the wall thickness of the thinner pipe, the transition may be made by welding, provided the angle of rise of the weld surface does not exceed 30 deg. and both bevel edges are

properly fused.

(2) Where there is an external offset exceeding one half the wall thickness of the thinner pipe that portion of the offset over one half of the wall thickness pipe shall be tapered.

2.11 Working Clearance

Where the pipe is welded above-ground, the clearance around the pipe shall not be less than 400mm.

Where the pipe is welded in a trench, the bell hole shall be of sufficient size to provide ready access to the joint.

2.12 Interrun Cleaning

Except where TIG welding is used each run of weld metal shall be cleaned thoroughly by hand or power tools, before a further run is applied.

Cracks shall be removed. Other visible defects which will not be eliminated by the succeeding pass shall be removed.

Attention shall be paid to the cleanliness of the junction between the weld run and the fusion faces, and to the junction of tack welds with weld runs if tack welds are employed.

2.13 Method of Making Preparation

Pipes, valves, or other fittings, for butt welding should be prepared where practicable by machining, or machine thermal cutting. Manual thermal cutting where approved, may be used.

2.14 Stray Arc Strikes

Arcs shall be struck only on fusion faces. Contact of the electrode or of the non-insulated portions of the electrode holder with the surface of the pipe or parts being welded shall be avoided.

Striking plates making good electrical contact with the pipe shall be provided where such are necessary for removal of slag from the electrode tip or as an aid to arc starting.

Stray arc strikes shall be removed by grinding. The extent of grinding and the extent of any repair or the rejection of the part shall be approved by the Inspector. In no case shall the thickness be reduced by more than 10% of the thickness of the pipe.

3.7.2.15 Insert Patching

nsert patching shall not be used.

3.7.2.16 Proximity of Welds

The alignment of the longitudinal joints shall be such that the joints are within the top half of the pipe circumference with the joints offset by approximately 45 degrees but in no case shall the offset be less than six times the pipe wall thickness.

Branches, fittings and other attachments should preferably not be located within a distance of six times the pipe wall thickness from the longitudinal or circumferential joints in the pipe. Where this cannot be avoided special consideration shall be paid to the welding procedure.

3.7.2.17 Welding Procedure

Two consecutive weld runs shall not be started at the same point.

The number of weld runs shall be such that the completed weld shall have a uniform cross-section around the pipe circumference. At no point should the weld be incompletely filled, nor should the reinforcement exceed:

(1) 1.5 mm for pipe wall thickness not greater than 12 mm; or

(2) 3 mm for pipe wall thickness greater than 12 mm.

The width of the completed weld should be approximately 3 mm wider than the width of the weld preparation.

The weld surface shall be thoroughly brushed after completion of welding.

3.7.2.18 Cold Spring

Cold spring of the pipe for the purpose of correcting misalignment should not be used.

Cold spring if specified shall be maintained at all times during welding and postweld heat treatment.

3.7.2.19 Peening

Peening may be carried out during welding where approved by procedure test except that in no case hall peening be carried out on the root run or the capping run or runs.

3.7.2.20 Welding Supervision

All welding shall be carried out under supervision of an approved person who has had training and experience in the welding of the pipes and ancillary equipment.

3.7.2.21 Qualification of Welding Procedure

All qualification of Welding Procedure shall be carried out in accordance with API Std 1104 section 2.

3.7.2.22 Welder Qualification

The purpose of welder qualification is to determine the ability of the welder to make sound welds using a previously qualified procedure.

Welder qualification shall be determined in accordance with API Std. 1104 section 3.

3.7.2.23 Inspection and Testing of Production Welds

The 'Inspection and testing of Production Welds shall be carried out in accordance with API Std 1104 Section 5.

3.7.2.24 Rectification of Welds

(a) General

Where welds fail to comply wholly or in part with the requirements of a non-destructive test all of the unacceptable defects shall be removed.

(b) Methods of Removal

Defects shall be removed by chipping, grinding, machining or thermal gouging. Entire removal of weld involves either cutting through the weld or cutting out a length of pipe containing the weld.

(c) Authority for Repairs

No weld shall be repaired without the agreement of the Engineer or his representative.

(d) Repair Procedure

Repairs shall only be carried out under supervision and shall be in accordance with the following procedure:

(1) The cut out portion shall be sufficiently deep and long to remove the defect. At the ends and sides of the cut there shall be a gradual taper from the base of the cut to the surface of the weld metal. The width and profile of the cut shall be such as will give adequate access for rewelding. When the root of the weld is accessible from the bore of the pipe, a repair to the root may be made from that position.

(2) Where a cut has been made through a weld and there has been no serious loss in pipe length the weld preparation shall be remade in accordance with the requirements of this section.

(3) Where a length of pipe containing a weld has been removed a new length of pipe shall be reinstated and the two joints shall be prepared in accordance with this section. The minimum length of the insert shall be one pipe diameter.

(4) All such repair welds shall be inspected in accordance with the requirements of Clause 3.7.2.23.

(e) Re Welding

When re-welding, the procedure shall be the same as that used in the procedure specification. No further repair shall be made in a specific area.

3.7.3 MECHANICAL COMPRESSION JOINTS

Pipe ends which are to be joined by compression joints shall be square and free from burrs. Pipewrapping shall be cut back and both fitting and pipe cleaned prior to assembling the joint. The joint shall be assembled and made in accordance with the manufacturers' instructions. Electrical continuity shall be maintained across the joint, unless otherwise directed.

3.7.4 Flanged Joints

Flanged joints shall be made using the approved jointing material or gasket. Pipe work shall be so fabricated that mating flanges are aligned and abutted squarely. Bolts in all flanged joints shall be gradually tightened in sequence.

3.8 INSTALLATION OF VALVES

3.8.1 MAINS

Valves shall be checked for internal cleanliness and freedom of operation prior to installation. The number of complete turns of the spindle, between the fully open and fully closed position of the valve shall be recorded.

An approved surface box shall be fitted flush with the ground surface. The top of the valve spindle or false spindle shall terminate at least 100 mm below the underside of the box cover. A marker plate or post shall be installed as an aid to location and identification. Valves, unless otherwise directed, shall be left in the open position.

3.8.2 TESTING

All new and renewed sections of mains shall be subjected to a pressure test to check for soundness, immediately prior to the admission of gas. For information on pressure testing, reference shall be made to section 9 of this Manual.

3.9 CONNECTIONS FOR STEEL MAINS AND SERVICES

3.9.1 MAIN CONNECTIONS

Whenever connections are to be made on mains which necessitate the removal of a section of pipe under pressure, flow stopping equipment shall be used.

Where small branch connections are required, under pressure branch mains drilling equipment shall be used in conjunction with a suitable under pressure mains fitting. Suitable branch connections may be made using saddle or encirclement fittings, which can either be jointed mechanically to a main or preferably welded using a recommended welding procedure.

3.9.2 RECORDING

A complete and up-to-date record must be prepared and maintained of the location of a main/service and of the equipment and materials used in its construction. The record should include:

(1) A dimensional plan (or plans) of where the main has been laid with full details of the depth of cover.

(2) Details of the diameter and type of pipe used.

(3) Where mechanical joints are used, the location should be clearly marked on the plan together with the type of joint.

(4) Full details and exact location of valves fitted to the distribution system, giving the number of turns required to operate the valve and the direction of rotation.

(5) Full details of special crossings and maintenance requirements.

3.9.3 PIPE WRAPPING

3.9.3.1 Application of Wrapping

All sections of mains and services which do not have a corrosion resistant protective coating applied during manufacture shall be wrapped with approved wrapping. Tapes shall be applied to all bare sections of pipe to give a 55% overlap in all cases. Particular attention shall be given to fittings, such as valves, flanged joints, service tees and other items where tapes require moulding to the profile of the fitting during application. Where difficulty is encountered in providing adequate coverage, the Engineer or his representative shall be informed.

3.9.3.2 Checking the Wrapping

On completion of wrapping work and immediately prior to backfilling excavations, all coatings and wrapping shall be carefully inspected for damage. (See Section 6).

3.9.4 ELECTRICAL INSULATION JOINTS

It is essential that all steel mains are electrically insulated from adjoining mains or services of different materials and existing steel mains or services not subject to cathodic protection.

Where a steel main is to be connected to another main which is either of different material or not cathodically protected, insulation joints shall be installed at the connection position.

3.9.5 CATHODIC PROTECTION

All buried sections of steel pipe shall have a system of cathodic protection applied, using sacrificial anodes or impressed current, as detailed in section 6 of this Manual.

3.9.6 TEMPORARY ELECTRICAL CONTINUITY BONDS

In order to ensure that an ignition source will not be created by the discharge of an electrical current good electrical continuity shall be maintained across any connection or disconnection of any part of a metallic main, service, meter or other gas installation.

Temporary electrical continuity bonds shall be fitted before any connection or disconnection work is undertaken on live mains or services. Bonds shall be positioned so that they will not be disturbed during the progress of work. Bonds shall not be removed until the connection or disconnection work has been completed and shall only be fitted or removed in a gas free area.

The following procedure shall be followed when bonds are to be used:

(1) Select the positions on the main, at which the continuity bond is to be connected.
(2) Clean the pipe at this position to provide a sound metal contact. This may involve removing protective coatings and cleaning the area of pipe concerned with a wire brush.
(3) Ensure that the bond is of adequate length and that the connection ends are clean and in.
(4) Attach the two ends of the bond and ensure that both connections are secure.

4. INSTALLATION OF POLYETHYLENE SYSTEMS UP TO 420kPa

4.1 SCOPE

This Section covers the design and construction associated with the distribution of natural gas at operating pressures up to 420 kPa.

4.2 REFERENCES

This section makes reference to the documents listed below. Unless otherwise specified, the latest editions of these documents, including all addenda and revisions, shall apply.

New Zealand Standards
NZS 5258 Code of Practice for Gas Distribution
NZS 7646 Specification for Polyethylene Pipes and Fittings for Gas Reticulation

4.3 CODES

Codes relating to the construction work associated with the laying of polyethylene systems are listed in Appendix A of this manual.

4.4 GENERAL REQUIREMENTS

To facilitate future repair work, mains and services should have a minimum of 150 mm clearance from all other services.

Polyethylene piping shall be installed in such a way that shear, tensile and compressive stresses resulting from construction, backfill, thermal expansion or external loading are minimised.

Where the pipe is at a temperature higher than the normal ground temperature, it shall be allowed to cool and contract before being joined to the piping system.

Polyethylene pipes shall not be used in the following circumstances:-

(1) Where the temperature of the ground surrounding the pipe is likely to exceed 20°C or fall below -20°C.

(2) Where solvent and harmful chemicals are present, even in low concentrations, eg. dry cleaning fluids, photographic or plating solutions.

(3) On infilled demolition sites unless suitable backfill material is available (or imported).

(4) Where the operating pressure is in excess of 420 kPa.

(5) Where another material is more appropriate.

Note, the use of polyethylene above ground is permitted only where it is fully protected and encased.

4.5 METER POSITION

The responsibility for the satisfactory positioning of the meter regulator rests with the Gas Company.

4.6 MATERIALS

Polyethylene systems should be constructed using only materials conforming to recognised Standards. Polyethylene systems shall conform to NZS 7646 Specification for Polyethylene Pipes and Fittings for Gas Reticulation or other recognised standard.

4.7 HANDLING OF MATERIALS

4.7.1 DELIVERY

Pipes and associated materials delivered to the site shall be carefully unloaded. Cranes, ropes and skids may be used for this purpose. Pipes and fittings shall not be dropped to the ground and shall not be allowed to knock against each other.

The team leader or other responsible person shall examine all lifting tackle just before use. Any defective equipment shall be withdrawn and clearly marked “DO NOT USE”. The Engineer or his representative shall be notified of any defective equipment as soon as possible. When a crane is being used, an effective system of communication shall be established between the banksman and the crane driver.

4.7.2 INSPECTION ON DELIVERY

All materials delivered to the site shall be inspected for obvious physical defects. Rejected material shall be clearly marked and reported to the Engineer or his representative who will make the necessary arrangement for its disposal.

4.7.3 STORAGE

Where it is necessary to store pipes and other materials on site, the location shall be on firm level ground free from damaging material with suitable access for vehicles and/or cranes.

Care shall be taken to place pipes and fittings so as to cause the minimum possible interference with or obstruction to traffic, pedestrians or other Utilities' plant. pipes shall be wedged to prevent accidental movement and where necessary barricades shall be erected and warning signs and lamps positioned.

4.7.4 STACKING

Straight pipe up to and including 100mm diameter should be stacked not more than 8 layers high and larger pipe not more than 4 layers high, and the bottom layer should be properly supported on a prepared level surface. When stored in packs as delivered, stacks should not be more than 2 packs high.

Coils of pipe should only be stored flat and stacked not more than 2 coils high.

4.7.5 UNBANDING COILS

Completed coils are secured by both outer and intermediate bands and layers of the coils are independently secured. When the bands are to be released the band securing the outer end of the pipe should be removed first followed by those securing successive layers. Only sufficient bands should be removed to release the length of pipe immediately required.

Care shall be taken when unbending coils to ensure that all banding is undamaged. At least two persons shall be present during unbending, unless the coil has been fitted to a dispenser that has been designed to restrain the outer layer of the coil when the bands are cut.

No bands shall be removed until the material is required for use.

After the pipe has been removed from the coil the end cover shall be replaced on the pipe left on the coil and the banding checked for damage.

Care shall be taken not to damage the pipe during removal of the bands and, if a coil dispenser is used, when pulling the pipe from the coil, to avoid scratching or scoring when the pipe comes into contact with the ground or other objects.

4.8 PIPELAYING

4.8. GENERAL

The normal minimum depth of cover shall be not less than

MINIMUM COVER REQUIREMENTS FOR MAINS

	Consol. rock	Carriageways	Footpaths & berms
	mm	mm	mm
Low & medium pressure	500	600	600
Int. pressure	600	900	900

Where pipes in private property may be subjected to surface loadings comparable with normal roadways (e.g. factories, hospitals) the requirements for roads shall be applied.

Where service pipes change underground from polyethylene to steel before entering buildings, the transition point (polyethylene/steel) shall not be less than one metre (measured along the line of the service) from the service entry point.

A minimum distance of 150mm from obstructions and other services should be maintained. This distance is usually possible when running parallel to other services but not always practicable when crossing other services. A separations distance of 75mm may be allowed for a square crossing if protection is provided.

Where there may be a release of gas in the working area, static charge accumulation shall be minimised by draping water-soaked cloths over all pipes and fittings likely to be handled so that the cloths touch both the polyethylene and the ground.

4.8.2 PREPARATION

All pipes and fittings shall be inspected for cuts, deep scratches or other damage before use. Any defective material shall not be used.

The pipe bore shall be inspected, any foreign matter cleared and the pipe ends temporarily sealed with end caps or stoppers.

Fusion jointing, particularly butt jointing, should be carried out above ground if the road traffic conditions and the type and number of underground obstructions permit.

Pipes shall be jointed by one of the procedures as per 4.9 Pipe Jointing.

4.8.3 LOWERING

When lowering pipe into trenches, care shall be taken to avoid scratching or scoring of the pipe in contact with the sides and bottom of the trench. When straight lengths are lowered, use should be made of the planks and ropes where appropriate, but wire ropes or chains shall not be used. Special care should be taken to avoid damage to the pipes when passing under obstructions in the trench.

4.9 PIPE JOINTING

4.9.1 GENERAL

Fusion jointing for polyethylene piping systems shall be carried out by one of the following methods using approved tools and procedures:

(1) butt
(2) service saddle
(3) socket
(4) electrofusion

Materials from different polymers shall be joined only by electrofusion.

Jointing shall not be carried out when the quality of the completed joint could be impaired by the prevailing weather conditions. Bad weather conditions include, but are not limited to, rain or snow falling on the surfaces to be joined or when the surfaces are subjected to blown sand or dirt. Weather shields or other effective protection may be employed to shield the work in adverse conditions.

The engineer or his representative shall carry out sufficient checks of the fusion procedure and sufficient detailed visual examinations to ensure that all joints produced are satisfactory.

A planned maintenance schedule for tools is necessary and should incorporate maintenance at no more than six monthly intervals.

Regular temperature checks of the heating surfaces of the tools are necessary, particularly after changing the fusion head, to ensure the correct temperature is maintained at the heating surface.

Heating surface temperatures can be checked by using a digital thermometer fitted with an appropriate probe.

Full use should be made of mains records and other records to determine in advance if the existing pipes are imperial or metric so that the team can be provided with the correct metric/imperial fittings and tooling.

Mechanical joints shall be restricted to joining metal to polyethylene, repair situations or other special circumstances defined by the Engineer or his representative. On no account shall polyethylene pipe be threaded and the use of mechanical couplings shall be kept to, a minimum.

Each pipe will be marked -

(a) Manufacturers name/trademark
(b) H.D.P.E. Gas
(c) * S.D.R. Rating of the pipe
(d) Nominal bore of the pipe
(e) The standard to which it complies, ie. N.Z.S 7646

Each fitting will be marked -

(i) Manufacturers name/trademark
(ii) H.D.P.E. Gas
(iii) Nominal bore of the pipe for which the fitting is intended
(iv) * S.D.R. Rating of the fitting
(v) The standard to which it complies, ie. N.Z.S. 7646

Fusion jointing shall only be made with dry pipe, fittings and fusion tools.

A fusion surface which has been cleaned by trimming/scraping should not be touched.

After a successful heating phase, the fusion joint should be made with the minimum delay.

It is essential that the pipe is supported to prevent it being moved during the heating and fusion phases; long pipes should be supported to avoid misalignment due to sagging.

A fitting or an area of pipe that has been through the complete heating cycle shall NEVER be re-heated. If a melt position has to be abandoned the new position shall not be less than 250mm from the abandoned ring bead. The minimum distance permitted between any socket or butt fusion fitting assembly shall be 4 times the diameter of the pipe.

Pressure testing shall not be carried out until the complete system has cooled down.

S.D.R. Standard DimensionRatio = $\frac{\text{Maximum mean outside diameter}}{\text{Minimum specified wall thickness}}$

4.9.2 FUSION TOOLING

Electrically heated tools shall be disconnected from the power source before they are taken into a flammable or potentially flammable atmosphere. Since butt fusion tools have to be connected to the power source at all times, they shall not be used in these conditions. Mechanical fittings/joints are an acceptable alternative.

Gas heated furnaces shall not be placed in a gaseous or potentially gaseous area.

Although electrically heated tools are pre-set, the operating temperature should be checked correct prior to proceeding.

Gas heated tools are not pre-set and should not be allowed to heat up above the correct temperature as the non-stick surface will be damaged. The tools should be allowed to soak' at the correct temperature for 5 minutes before use.

Before using a fusion tool, check that:

(1) The correct size fusion faces are securely fitted.
(2) The fusion faces do not have any gouges or dents.
(3) The non-stick coating is not damaged.
(4) The thermometer is not damaged.
(5) Electrical cables are not damaged and have no loose connections.
(6) Machine guide bars are free from corrosion and the clamps move freely on the bars when the operating lever is moved.
(7) The machine main frame is rigid and is not distorted.

If any of these checks is not satisfactory, the tool should not be used.

Before a pipe/fitting is heated, check that -

(a) The tool is at the correct temperature.
(b) The non-stick fusion faces and the heater plates are clean. (If polyethylene melt sticks to a surface it shall be removed only with a piece of wood. If soot is present on the surface of a gas heated tool it shall only be removed with a clean cotton cloth.)

ner of the checks is unsatisfactory, fusion shall not proceed.

Portable shelters should be used to protect the fusion joint area from rain and high winds. The heat loss from fusion tools should be minimised by using purpose made boxes or heater muffs. If 240 volt equipment **is** used in wet conditions extra care must be taken at all times.

4.9.3 ELECTRO FUSION TOOLS

Electrofusion equipment is electrically operated and as the possibility of ignition is present, the equipment should not be used in a gaseous atmosphere.

The control box should, when in use, be handled with care and when in transit, securely installed.

The installation of fittings should be in accordance with the Manufacturers instructions.

4.9.4 FUSION PROCEDURES

The procedures to be followed for fusion jointing are shown in Figures 2 to 9.

4.9.5 MECHANICAL FITTINGS

All mechanical fittings shall be assembled in accordance with the manufacturer's instructions and shall be protected against corrosion. When tightening or untightening a joint it is essential that movement is not transmitted to the polyethylene pipe; two spanners shall be used to prevent this.

4.9.6 FLANGED JOINTS

Flanged joints shall be made using the appropriate jointing material or gasket and all metallic flanges shall be protected against corrosion.

Polyethylene flanges shall be protected against damage to the sealing faces before assembly.

4.10 SERVICES

4.10.1 METER CONTROL VALVES

All service entries to all buildings shall terminate with a meter control valve. If lever operated, the meter control valve shall be installed in such a way that downward movement of the lever turns the valve to the OFF position.

Where a meter is not to be connected or re-connected at the time a service is laid, the meter control valve shall be closed and plugged/capped immediately following purging. A 'Live Gas' label shall be attached to the meter control valve.

4.10.2 JOINT SERVICES

Where a joint service is laid, a suitable warning label shall be fitted on the services adjacent to the meter position in both premises.

4.11 TESTING

All new and renewed polyethylene systems shall be subjected to a pressure test in accordance with Section 9 of this manual.

4.12 RECORDING

A complete and up-to-date record must be prepared and maintained of the location of main/service and of the equipment and materials used in its construction. The record should include:

(1) A dimensional plan (or plans) of where the main has been laid with full details of the depth of cover.

(2) Details of the diameter and type of pipe used.

(3) Where mechanical joints are used, the location should be clearly marked on the plan together with the type of joint.

(4) Full details and exact location of valves fitted to the distribution system, giving the number of turns required to operate the valve and the direction of rotation.

(5) Full details of special crossings and maintenance requirements.

4.13 LIVE GAS WORKING

4.13.1 MAINS CONNECTIONS AND EXTENSIONS

Connections involving the removal of a section of live pipe shall be made after the pipe has been isolated by the use of squeeze-off equipment. (See 4.14.1.2).

Small branch connections can be made using the method described in 4.13.2.2. or by cutting out a section of the main and inserting a tee.

Large branch connections can be made by cutting out a section of the main and inserting a tee.

Consideration must be given to the use of by-passes when removing a section of live main.

4.13.2 SERVICE CONNECTIONS

4.13.2.1 General

Service pipes shall not be left in tension.

4.13.2.2 Polyethylene Connections from a Polyethylene Main. Saddle Fusion Service Tee.

Fuse the service tee to the main using the saddle fusion or electrofusion procedure.

Cut the service pipe to size allowing sufficient slack to fuse the pipe into the service tee outlet.

Using the socket fusion or electrofusion procedure, fuse the service pipe to the tee.

Test the complete service tee and service and if the service tee fails this test, a new tee shall be fused to the main at least 250mm away from the original position and the failed tee, which has not yet been drilled, should be abandoned by cutting off close to the main.

After a successful test, remove the closure cap on the tee and insert the CORRECT KEY into the cutting head.

Drill the main by turning the key clockwise and stop when the handle contacts the top of the tee.

Return the cutter to the top of the tee by turning the key anticlockwise.

Wet the "O" ring and screw on the cap.

Soap test around the cap and wash off the soap solution with clean water.

4.13.3 Alterations to Services and Service Entries

As in all excavation work, great care should be exercised in order to reduce as far as possible damage to other utilities apparatus.

4.14 SERVICE CUTOFFS/ABANDONMENT

Reference should be made to NZS 5258 Code of Practice for Gas Distribution for abandonment and inactivation of services. In general:

(1) The service shall be disconnected at the main and at the consumer's end, external to the building and the open ends of all abandoned pipes shall be capped, plugged, or otherwise made safe.

(2) In cases where a system including the mains, together with services connected to them, are abandoned, in so far as services are concerned, only the consumer's end of such services need be capped, plugged or otherwise made safe.

(3) All abandoned pipes shall be purged to prevent the development of a potentially hazardous condition.

4.14.1 STOPPING OFF

4.14.1.1 General

The most practical method of stopping off the flow of gas in polyethylene pipes is to use the squeeze-off technique. Care shall be taken to ensure that the correct tool is used for the size of pipe.

4.14.1.2 Cutting Out or Replacing a Section of Pipe Under Pressure

If any possibility exists of damaging the by-pass then the by-pass should be connected to the parent main in separate excavations.

A continuity bond is not required at polyethylene cut-out sites although full provision shall be made to prevent a spark from static electricity by placing damp cloths around the pipe and in contact with the ground on each side of the cut.

A single squeeze-off unit on each live side of the cut may be adequate under normal circumstances, but a second squeeze-off unit and vent should be fitted at the discretion of the Engineer or his representative.

On completion of a squeeze-off operation, the pipe shall be re-rounded and an approved tape marked "SQUEEZE-OFF APPLIED" affixed to the pipe, OR

a recognised tape applied to the main to denote that squeeze-off has been applied to this section of main.

The same squeeze-off position shall not be used again and at least 6 pipe diameters distance shall be allowed between squeeze-off position on the same pipe.

Polyethylene pipe which has been in any way distorted by a squeeze-off operation shall not be used for jointing operations either by fusion or mechanical techniques.

A squeeze-off unit shall not be used as a closed end for test purposes.

TABLE 1: JOINING PRESSURE/TIMES FOR BUTT FUSION. TYPICAL DATA FOR WELDING P.E. PIPE BEAD FORMATION

		BEAD FORMATION		WELDING			
PIPE DAMETER(MM)	S.D.R RATNG	FORCE (NEWTONS)	PRESSURE (KpA)	SOAK TME (SECONDS)	FORCE (NEWTONS)	PRESSURE (KpA)	WELDING TIIME (MINUTES)
50	11	140/160	140/160	60/85	140/160	140/160	15
80	11	320/325	150	80/130	320/325	150	15
80	17	220	150	50/80	220	150	15
100	11	470/535	130/150	100/165	470/535	130/150	15
100	17	360	150	105	360	150	15
100	21	295	150	85	295	150	15

NOTE:

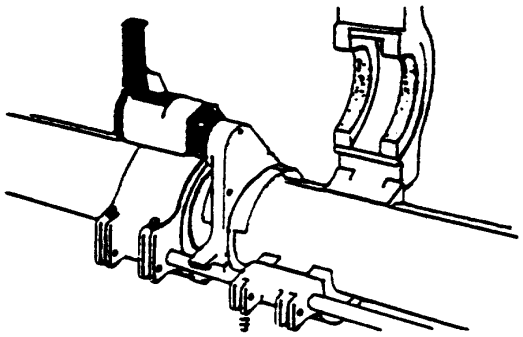
IT IS RECOMMENDED THAT THIS TABLE BE DISPLAYED IN A PROMINENT POSITION ON BUTT FUSION JOINTING MACHINES.

BUTT FUSION PREPARATION & PROCEDURE

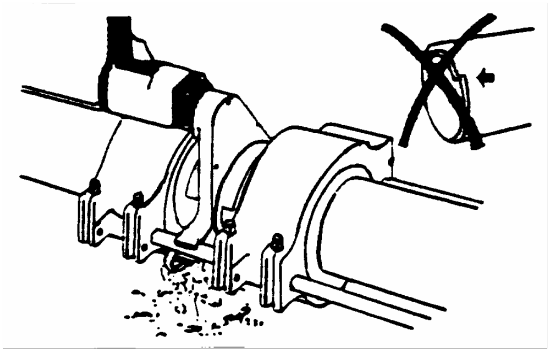
FIGURE 1 - BUTT FUSION JOINTING - PREPARATION

PREPARATION

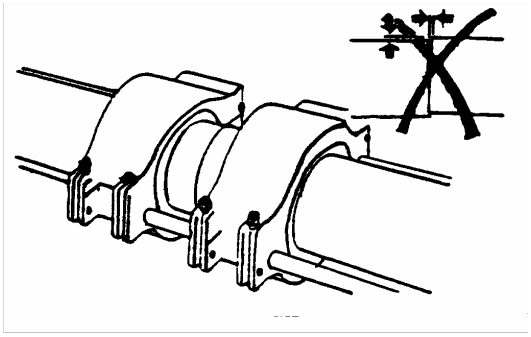
CHECK MACHINE, PLANER AND HEATING PLATE ARE IN WORKING ORDER



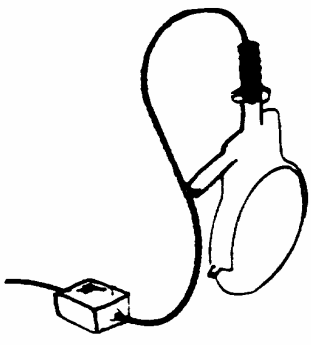
1 Clean pipe ends, inside and outside, with a clean cloth. Lightly scrape away tarry deposits.
Fully open carriage and position planer in machine.
Place pipes in clamps with pipe markings in line (if possible) and ends touching planer.
Align and level pipes using pipe support
Tighten pipe clamps.



2 Close carriage and hold pipe ends lightly against planer until continuous shavings are produced from each end.
Continue planing while reducing pressure to zero to avoid steps on pipe ends.
Remove planer
Remove shavings from machine and inside pipes.
Do not touch pipe ends.



3 CHECK pipe ends are complete planed. Bring pipe ends together.
CHECK there is no visible gap and minimise mismatch.
If necessary adjust pip supports and clamps and then re-plane pipe ends.
When checks are satisfactory ensure shavings have been removed from machine and inside pipes.
Do not touch pipe ends.



4 CHECK heating plate surfaces are clean and undamaged.

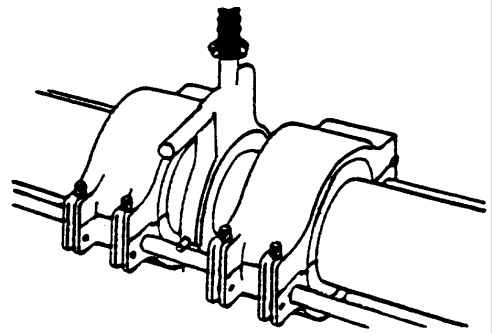
CHECK heating plate is at correct emperature.

BUTT FUSION PREPARATION & PROCEDURE

FIGURE 1 - BUTT FUSION JOINTING - OPERATION

OPERATION

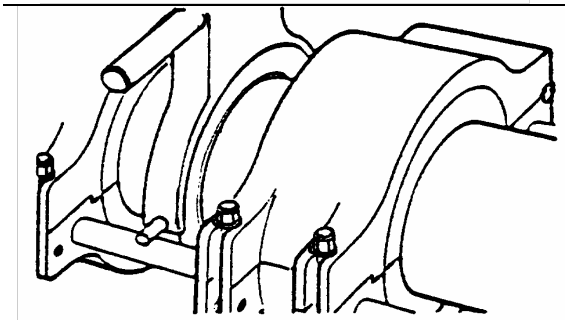
NOTE: HEATING PRESSURE HEATING SOAK TIME FUSION PRESSURE FUSION WELDING TIME)) SEE TABLE 1)))



5 Close carriage and note drag pressure (repeat if necessary).

Position heating plate on supports in machine.

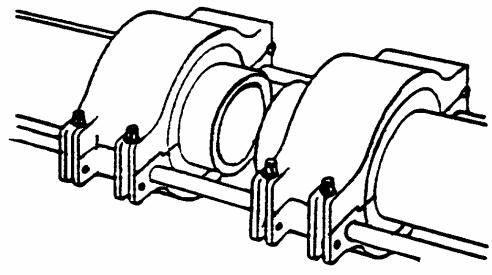
Apply correct pressure (heating pressure + drag pressure)



6 When a 2mm bead forms completely around each pipe end, release pressure completely.

CHECK heating plate is still gripped by pipe ends.

HEATING SOAK TIME STARTS NOW



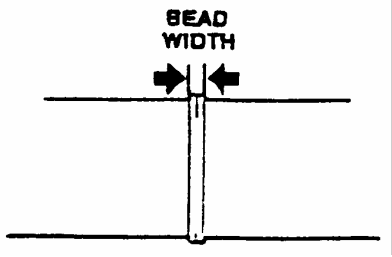
7 After heating soak time, open carriage

By hand, tap heating plate from pip end and carefully remove.

Join pipes and apply correct press (fusion pressure + drag pressure)

Maintain pressure for fusion welding time.

8 Carefully remove pipe from machine.



CHECK complete weld bead for evenness

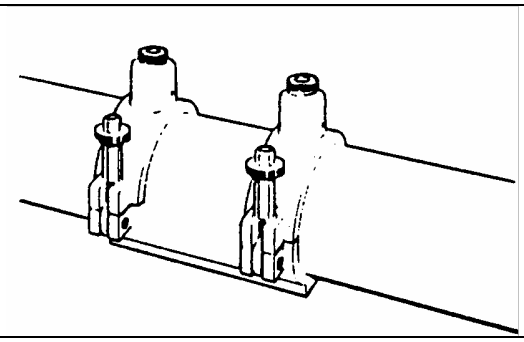
CHECK bead width is 6-10mm

If checks are not satisfactory, cut out a short section containing defective butt joint.

Allow pipe to cool for 10 minutes before site handling.

FIGURE 4 - SADDLE FUSION JOINTING BY HAND - PREPARATION

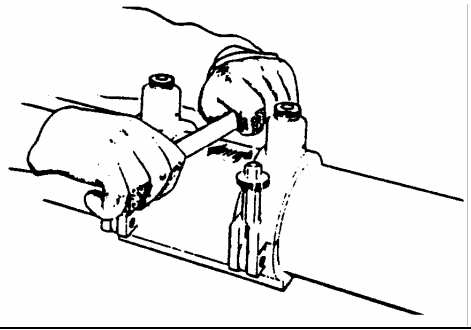
OPERATION SIMPLE SADDLES AND TAPPING TEES



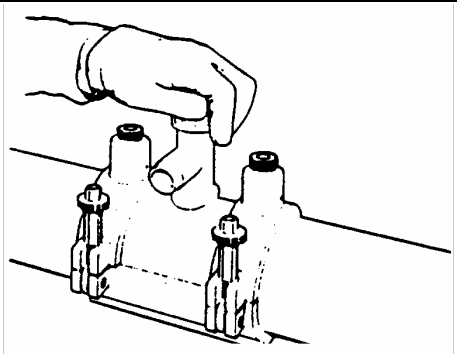
1 CHECK size of pipe.

Clean pipe using clean cloth.

Fit the correct size window clamp around the pipe.

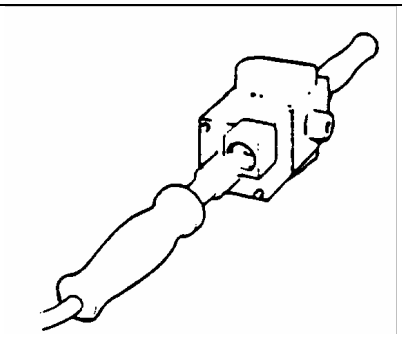


2 Lightly scrape the exposed area of pipe and saddle base with a square edged blade.



3 CHECK the fitting is the correct size

CHECK the fitting fits the pipe.



4 CHECK fusion tool surfaces are clean and undamaged.

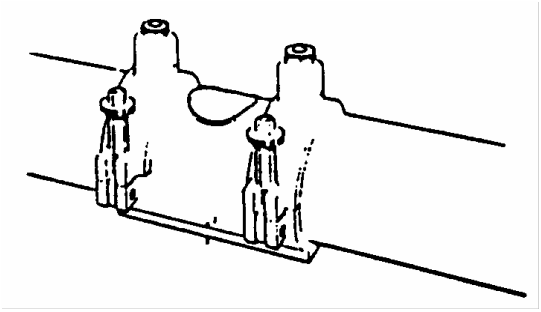
CHECK the heating head is the correct size.

CHECK heating plate is at correct temperature.

FIGURE 5 - SADDLE FUSION JOINTING BY HAND - PREPARATION

OPERATION

BEFORE COMMENCING OPERATION CHECK HEATING TIME REQUIRED



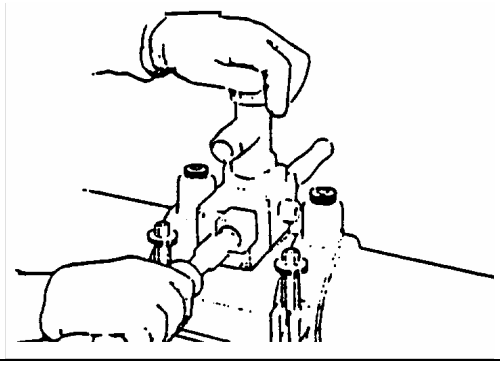
1 Firmly press fusion tool onto pipe for 5-10 seconds then remove.

CHECK completeness of melt bead ring

IF RING IS NOT COMPLETE -

S T 0 P CHECK steps 1, 2, 3 and 4.

Make a new melt bead ring 250mm (10") from abandoned position.



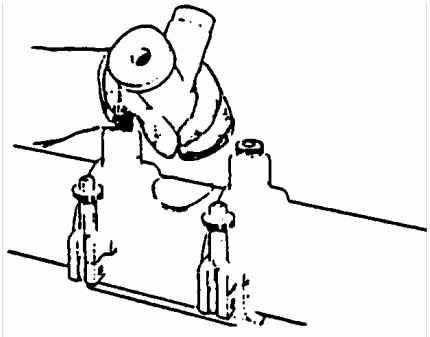
2 IF RING IS COMPLETE

Carefully replace fusion tool on melt pattern. Position fitting on fusion tool.

Apply firm pressure onto fitting.

HEATING TIME STARTS NOW

When small complete melt bead forms around fitting, relax pressure.

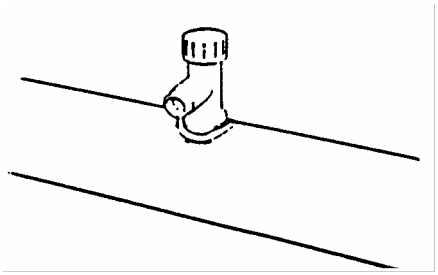


3 At end of heating time, snap fitting off fusion tool.

Snap fusion tool off pipe.

CHECK (quickly) evenness and cleanliness of melt patterns.

Position fitting within pipe melt pattern.

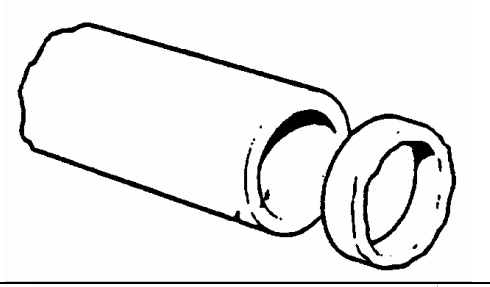


4 Press firmly for 30 seconds.
Relax pressure and hold for a further 30 seconds.
INSPECT JOINT FOR FORMATION OF A CONTINUOUS DOUBLE WELD BEAD.
Allow joint to cool for 5 minutes before making service connection.
Do not re-use the fitting or reheat the same area on the pipe after it has been through the heating cycle

FIGURE 6 - SOCKET FUSION JOINTING BY HAND - PREPARATION

PREPARATION

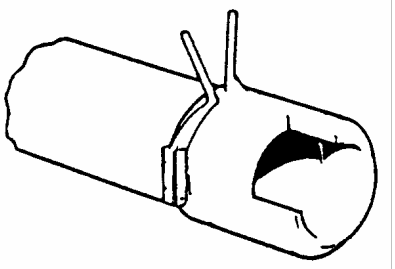
SOCKET JOINTS (COUPLING, TEE, BEND, REDUCER, AND CAP)



1 Cut pipe end square and deburr.

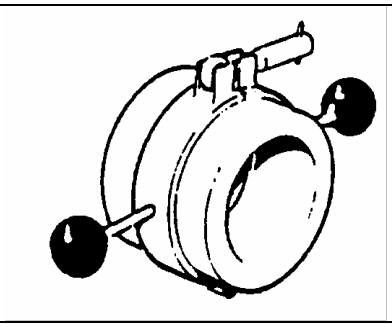
Clean pipe end using a clean cloth.

Lightly scrape away tarry deposits.



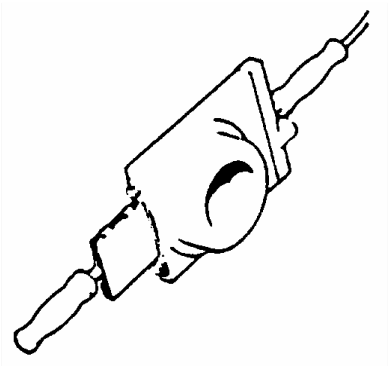
2 Position re-rounding tool on pipe using depth gauge.

CHECK fusion surface is clean.



3 Secure fitting in holder (do not overtighten)

Clean fusion surface using a clean cloth



4 CHECK Fusion Tool Surfaces are undamaged.

CHECK Fusion Tool surfaces are clean.

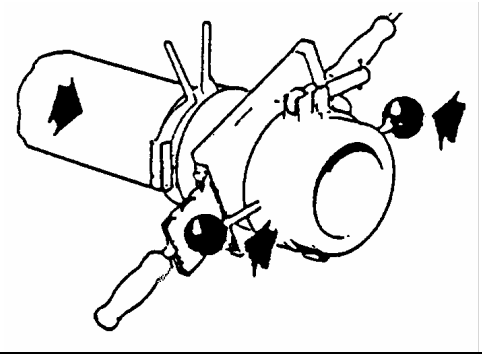
Check Fusion Tool is at correct temperature.

FIGURE 7 - SOCKET FUSION JOINTING BY HAND - OPERATION

OPERATION

BEFORE COMMENCING OPERATION CHECK HEATING TIME REQUIRED

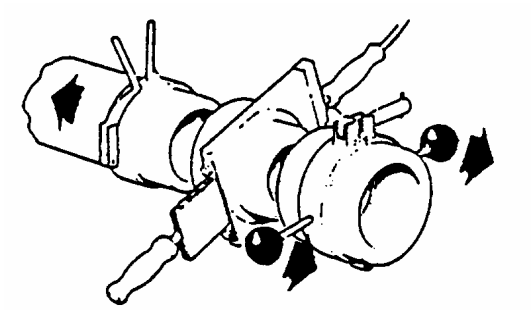
Size (mm)	Heating time (sec)
15	2
20	2
25	5
40	10
50	15



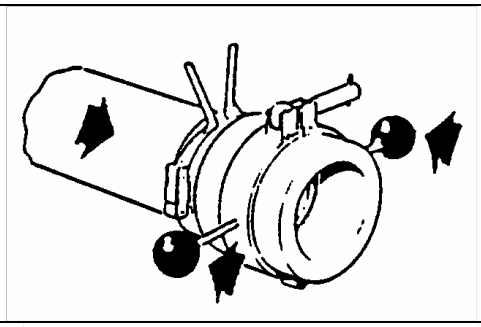
5 Position pipe and fitting an fusion tool.

Apply firm pressure until pipe and fitting are at full depth on fusion tool..

HEATING TIME STARTS NOW.

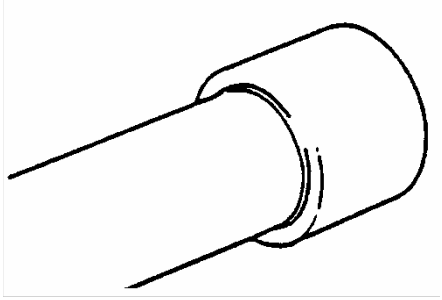


6 Separate fitting and pipe from fusion tool by 'snap' action.



7 Push pipe and fitting together until fitting is hard against re-rounding tool.

Hold using firm, constant pressure for 2 minutes minimum



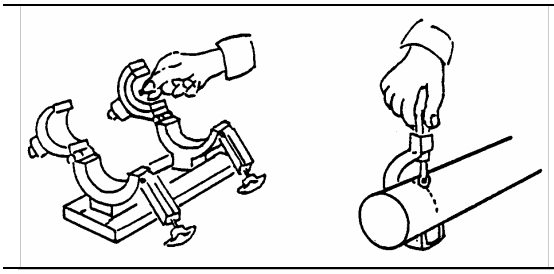
8 Remove re-rounding tool and fitting clamp.

INSPECT J0INT FOR EVENNESS OF MELT PATTERN.

FIGURE 8 - SOCKET FUSION BY ELECTROFUSION - PREPARATION

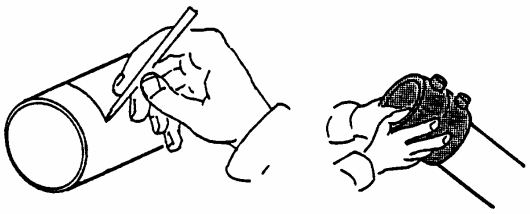
PREPARATION

SOCKET JOINTS (COUPLING, TEE, BEND, REDUCER, AND CAP)



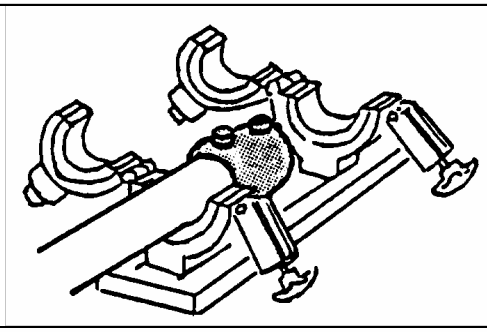
1 Ensure correct liners are secured to multi-clamp and that pipe ends are square cut.

Clean pipe inside and out and light scrape outer surfaces of pipe ends.



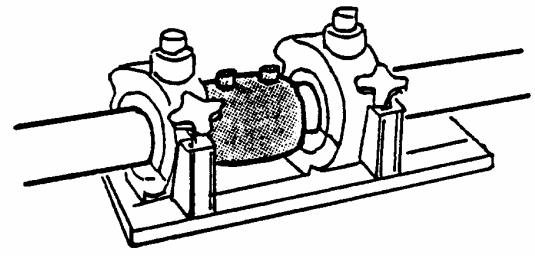
2 Measure and make one half of the Socket length on each end of pipe.

Push socket on to-end of the pipe until p contacts internal stops.



3 Place pipe and socket into multi-clamp keeping socket close to clamp face and depth mark visible.

Close the clamp. Manoeuvre second clamp towards socket and secure

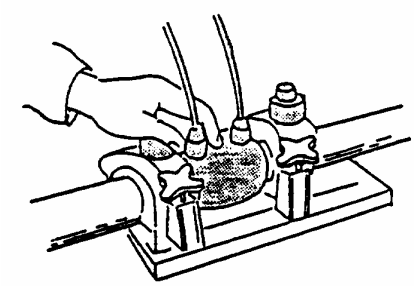


4 Push second pipe into socket until depth mark coincides with socket mouth and pipe contacts internal stops.

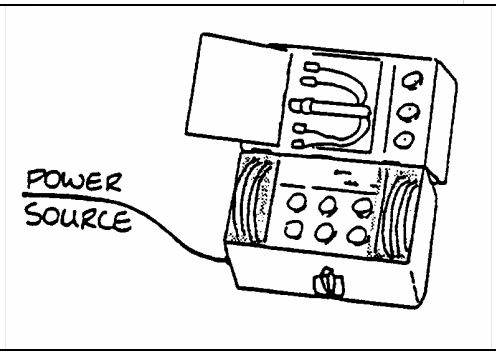
Close second clamp

FIGURE 9 - SOCKET FUSION BY ELECTROFUSION - OPERATION

OPERATION



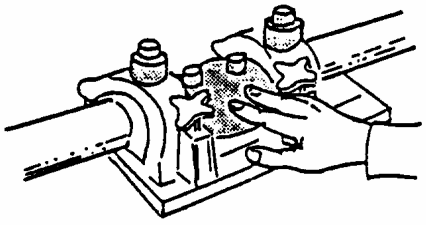
1 Attach leads from Control Box to Socket Terminals



2 Plug in the. Control Box to Power Source and switch on power.

3 Follow manufacturer's instructions for fusion cycle.

These instructions are displayed on the Control Box.



4 On completion of the fusion cycle switch off power source. Disconnect leads and check visual indications, if fitted, to ensure fusion has taken place.

5 The fitting should not be disturbed for 15 minutes.

5. PURGING AND COMMISSIONING

5.1 SCOPE

This section gives detailed guidance on site operations when carrying out purging operations of natural gas distribution systems.

5.2 DEFINITIONS

For the purposes of this section the following definitions apply: -

DIRECT PURGING: The removal of air by natural gas, or the removal of natural gas by air.

INDIRECT PURGING: The removal of air by an inert gas (eg. nitrogen or carbon dioxide) followed by natural gas; or the removal of natural gas by an inert gas followed by air.

SLUG PURGING: The formation of a barrier of inert gas between natural gas and air during purging.

INERT GAS: A gas which will not support combustion.

PURGE RIDER: A pipe through which a gas is put into the main or service.

VENT PIPE: A pipe through which a gas is expelled from the main or service.

5.3 SAFETY

(1) When written procedures for the purging operation are produced they shall be strictly observed unless altered by the Engineer or his representative.

(2) Mains or services to be purged shall first be tested and found sound.

(3) The Engineer or his representative shall provide design details for the purge rider.

(4) The Engineer or his representative shall be present at all purging operations using an inert gas.

(5) A continuity bond shall be maintained across separated metallic pipes during all purging operations.

(6) There shall be no smoking or naked lights present during purging operations.

5.4 GENERAL

5.4.1 SERVICES

(1) Services up to and including 50mm diameter may be directly purged with natural gas.

(2) Services greater than 50mm diameter shall be purged as for mains.

5.4.2 MAINS

(1) Direct purging with either natural gas or air is allowed only for mains without branch extensions. Mains up to 50mm diameter may be purged in this way, irrespective of length. The maximum lengths of mains above 50mm diameter which may be purged in this manner are listed in Table 1.

TABLE I - DIRECT PURGING - MAXIMUM ALLOWED LENGTH OF MAIN

Pipe Nominal Size mm	***Maximum length of direct purge m***
above 50 up to 100	250
above 100 up to 150	120
above 150 up to 200	70
above 200 up to 250	50
above 250 up to 300	30

(2) For mains which are to be abandoned, the above lengths can be directly purged with air.

(3) All other mains operations require the use of an inert gas.

(4) If there is any doubt as to the safety of a direct purge the Engineer or his representative shall be consulted.

5.5 VENT PIPES

(1) Vent pipes shall be fitted at the far end of the main to be purged and should be manned throughout purging operation. Where dead end branch mains are connected to the main to be purged, vent pipes shall be fitted at the far end of each branch.

(2) All vent pipes shall be provided with:-
(a) Control Valves
(b) A sample test point
(c) A flame trap

(3) Flame traps should be checked before use to ensure they **are** undamaged.

(4) The design and construction of all vent pipes shall be in accordance with the following requirements: -

(a) They shall be constructed so as to discharge vertically into the open air at least 2 m above ground level.

(b) They shall be firmly supported.

(c) They shall be positioned, where possible, a distance of at least 10 m downwind of possible sources of ignition **(**eg**.** traffic lights, sub-stations, etc.).

(d) They shall be located where vented gas is unlikely to drift into buildings.

(5) The location in which venting operations are taking place shall be guarded by the erection of barriers.

(6) Warning notices shall be displayed on the barriers.

(7) Venting at night should be avoided wherever possible if it is expected that noise will cause unreasonable inconvenience to the public.

5.6 PURGE RIDERS

Table 2 gives guidance on the size of riders necessary to purge mains satisfactorily with natural gas.

TABLE 2 - PURGE RATES AND RIDER SIZES

Pipe Nominal Size	***Purge Rate***		***Rider Nominal Size***	***Pressure Drop along 6m of rider***
mm	***scfh***	***scmh***	***mm***	***kPa***
80	390	11	25	0.15
100	610	17	25	0.3
150	1370	38	50	0.1

2430● 68● 50● 0.15● ● 250● 3800● 106● 50● 0.25● ● 300● 5480● 163● 80● 0.1●

250● 3800● 10	3800● 106● 50	106 50	0.25	
300	5480	163	80	0.1
400	9730	273	80	0.2
450	12320	345	100	0.1
600	21900	613	150	0.1

5.7 DIRECT PURGING PROCEDURES

5.7.1 SERVICES

(1) Services shall be purged up to and including the meter control valve.

(2) The purge hose shall be connected to the meter control valve and the hose outlet safely positioned away from the building.

(3) A flame trap shall be fitted to the purge hose outlet in all cases.

(4) When gas has been introduced to the service, the meter control valve should be opened to allow a flow of gas through the purge hose.

(5) When gas is present at the outlet of the purge hose the purge should continue for one minute before the meter control valve is closed.

(6) The purge hose shall be removed and if the meter is not to be fitted

immediately the meter control valve shall be closed and sealed off. Where a service valve is fitted it shall be left in the open position.

5.7.2 MAINS

(1) The final connection will have been carried out, but the bag/squeeze off units should remain in position in the live main.

(2) A pressure gauge shall be fitted to the live main and monitored during purging to ensure that the District pressure does not fall below minimum requirements.

(3) A valved purge rider shall be erected between the live main and the main to be purged.

(4) The Engineer or his representative shall be consulted about the design of the purge rider.

(5) The purge rider control valve shall be opened to allow a flow of gas from the live main. At the same time the vent pipe control valve(s) shall be opened.

(6) PURGING OF LOW PRESSURE MAINS BY REMOVAL OF BAGS OR SQUEEZE OFF UNITS IS FORBIDDEN.

(7) Should the District pressure fall to the minimum requirement during gas purging, the purge rider control valve shall immediately be closed, followed by closure of the vent pipe(s) control valve(s). Gas purging shall then only restart at the discretion of the Engineer or his representative.

(8) Gas purging shall proceed continuously until 90% natural gas on the G.I.A. Scale is obtained at the vent pipe test point(s).

(9) When 90% natural gas has been confirmed by two successive tests, the vent pipe(s) shall be disconnected and the main plugged. The new main shall be brought to the correct working pressure.

(10) The bags or squeeze off units, valve, shall then be withdrawn or opened and the purge rider disconnected.

(11) All plugs, caps, etc inserted shall be tested with leak detecting fluid.

5.8 INDIRECT PURGING PROCEDURES

5.8.1 AIR TO INERT GAS TO NATURAL GAS

(1) Reference should be made to Figure 1 for a typical mains layout for this type of purging operation.

(2) The Engineer or his representative shall be consulted on the design of the natural gas purge rider and the inert gas rider.

(3) The natural gas rider including control valve shall be erected with the inlet point of the rider as close as possible to the near end of the main to be purged.

(4) The connection for the inert gas rider pipe shall be made on the main as near as possible to the natural gas rider inlet control valve. A control valve shall be installed in the inert gas rider line.

(5) A pressure gauge shall be fitted to the supply main in a position such that it can be monitored during the purging operation.

(6) A pressure gauge shall be fitted to the new main as close as possible to the inert gas connection and shall be visible from the inlet control valve position.

(7) Vent pipes shall be erected in accordance with Clause 5.5 of this Section.

(8) All control valves installed on riders or vent pipes shall be left in the closed position until instructions are received from the Engineer or his representative to start the purge.

(9) On receiving instructions to commence the purge the inert gas control valve shall be opened to allow a flow of inert gas into the main. At the same time the vent pipe control valve(s) shall be opened. Care shall be taken not to over-pressurise the mains. Purging shall be progressive from the point of supply to the furthest vent pipe position. Any and each branch shall in turn be verified to be completely purged by the Engineer or his representative before inert gas inlet control valve is closed.
This shall be followed immediately by opening the purge rider inlet control valve to admit a flow of natural gas to the main. 'The pressure gauge on the natural gas supply main should be carefully watched to ensure that local pressures are not adversely affected.

(10) Gas purging shall proceed continuously until 90% natural gas on G.I.A scale is obtained at the vent pipe test point(s).

(11) The inert gas assembly shall be disconnected and the main brought to the correct working pressure.

(12) The mains connection shall be made and the squeeze off units shall then be withdrawn or opened and the purge rider disconnected.

(13) All plugs, caps, etc. inserted and joints made shall be tested with leak detecting fluid.

5.8.2 NATURAL GAS TO INERT GAS TO AIR

(1) The main to be purged shall be physically separated from the live main.

(2) After isolation of the main which is to be purged, the following checks shall be made to ensure that no unknown connections remain:-

(a) Reduce the pressure in the isolated main to 1.5 kPa

(b) If the pressure rises it may indicate the presence of a further connection and the Engineer or his representative should be notified.

(c) If there is no increase in pressure and on the advice of the Engineer or his representative the purging preparations can start.

(3). An air supply pipe with inlet control valve shall be installed as close as possible to the near end of the main to be purged.

(4) An inert gas rider pipe with outlet control valve shall be connected as near as possible to the air supply pipe.

(5) A pressure gauge shall be maintained on the main being purged. This gauge shall be visible from the inlet control valves on the air supply pipe and the inert gas rider.

(6) Vent pipes shall be erected in accordance with Clause 5.5 of this section.

(7) All control valves installed on riders or vent pipes shall be left in the closed position until instructions are received from the Engineer or his representative to start the purge.

(8) When instructions are received the vent pipe control valve can be opened, followed immediately by operation of the inert gas control valve to allow a flow of inert gas into the main. Care should be taken not to overpressurise the main.

(9) Purging shall be progressive from the point of supply to the furthest vent pipe position. Any and each branch shall in turn be verified to be completely purged by the Engineer or their representative before closure of the inert gas inlet control valve.

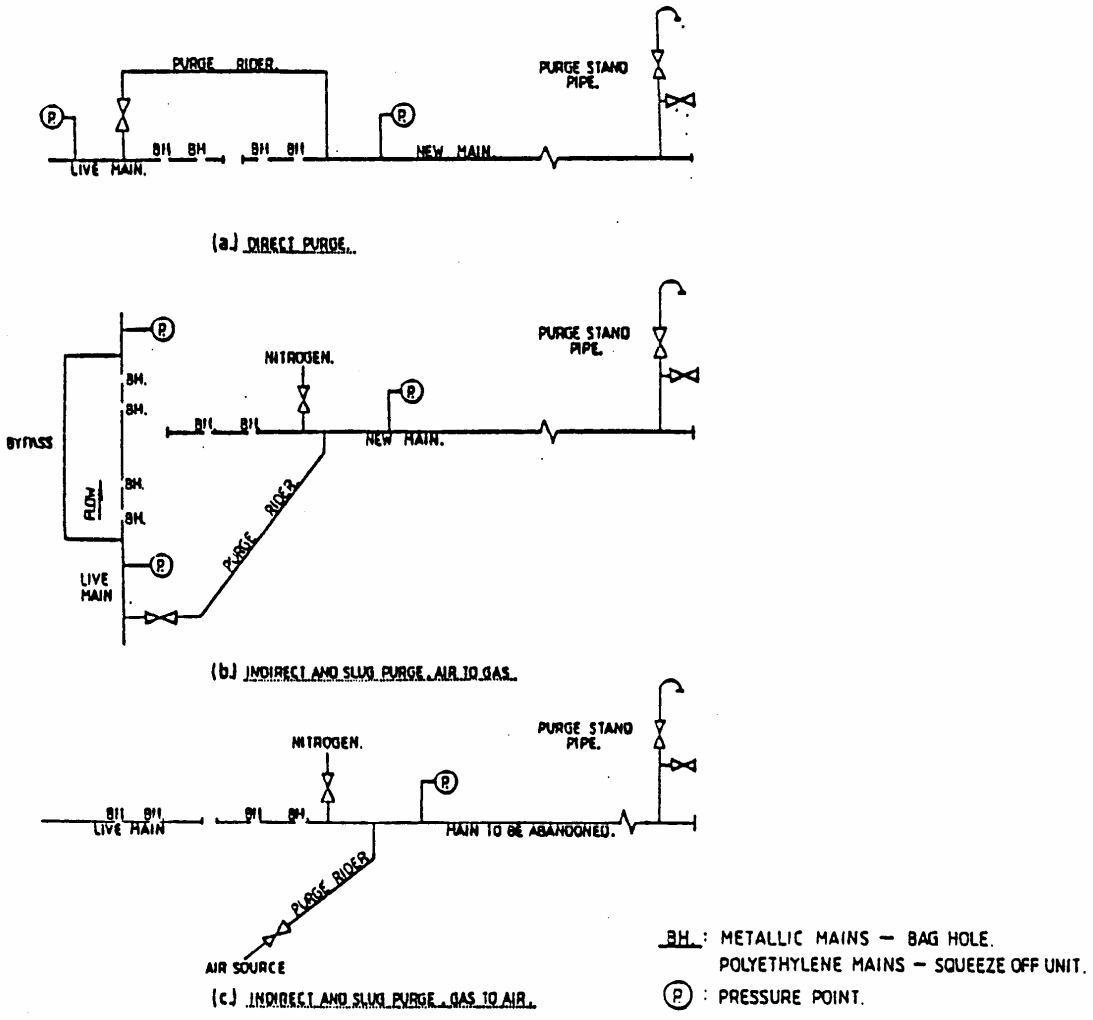
This shall be followed immediately by opening the air supply inlet control valve. The admission of air shall be under close supervision and care shall be taken not to overpressurise the main. Air purging shall proceed continuously until the Engineer or his representative has carried out satisfactory tests at the vent pipe test points and confirmed the completion of the. The inert gas assembly and air supply shall then be disconnected.

5.8.3 SLUG PURGING

All slug purging operations shall be carried out as in 5.8.1 or 5.8.2 except that inert gas purging shall continue only until the Engineer or his representative is satisfied that the required volume of inert gas has been introduced into the main, at which point the inert gas inlet control valve shall be closed.

The slug volume should not be less than 10% of the new main volume

FIGURE 1:



6. CATHODIC PROTECTION

6.1 SCOPE

This section defines the type of corrosion experienced on pipelines, the causes of this corrosion, and the main methods used in preventing or reducing corrosion.

6.2 DEFINITION

Corrosion of a metal can generally be described as the returning of metal to its natural unrefined state. The corrosion process, normally encountered in pipelines is basically electrochemical in nature and the presence of oxygen in some form is necessary.

6.3 TYPES OF CORROSION

Corrosion of a pipeline is generally the result of a corrosion cell being set up, the conditions for which may be listed as follows:

(1) There must be two metal surfaces of differing metals to electrolyte potential.

(2) There must be a metallic path electrically connecting the anode and the cathode. (Normally this will be the pipeline).

(3) The anode and the cathode must be immersed in continuous electrolyte. (Soil or water surrounding buried pipe lines fulfil this condition.)

(4). There must be a cathode depolariser, usually oxygen present

Once these conditions are met, an electric current will flow and metal will be consumed at the anodes. This is apparent visually in the form of corrosion.

The rate of metal loss on a pipe is directly proportional to the amount of current flow and although pipeline corrosion in some cases can be severe, the current to cause this may only be of a minor nature.

There are a number of corrosion cells which cause deterioration of a pipeline. The more important ones are described in the following sections.

6.3.1 DISSIMILAR METAL CORROSION

Such a cell can be established whenever different metals are used in pipeline construction, provided there is an electrical contact between them and provided they are in contact with a common electrolyte (soil or water). Under such conditions, any two dissimilar metals may be expected to have an electrical potential between them. The magnitude of this potential and the determination of which of the two metals will be the anode (ie. the one to corrode) will normally depend on the position of the metals in the practical galvanic series table.

Common metals and their position on this table are:

Typical potentials for materials in a neutral soil referenced to a $Cu/CuSO_4$ electrode.

METAL	ELECTRODE POTENTIAL (VOLTS)
Magnesium (commercially pure)	-1.75
Zinc	-1.10
Aluminium alloy (5% zinc)	-1.05
Aluminium (commercially pure)	-0.08
Mild steel (bright)	-0.50 - -0.80
Mild steel (rusty)	-0.20 - -0.50
Cast iron	-0.50
Lead	-0.50
Copper, Brass, Bronze	-0.20
High silicon cast iron	-0.20
Carbon, Graphite, Coke	-0.30

Figure 1. Galvanic Series

If any two of the metals listed in this table are physically connected and in the same electrolyte the one that is higher on the table will act as the anode and the lower one as the cathode. As an example of this, if an underground pipeline consisted of a mixture of plain steel pipe and galvanised pipe or fittings (ie. hot dipped zinc coated) with no electrical insulation between the two materials, the table shows that zinc, which is higher on the table, would act as an anode and would corrode. In a low resistivity soil, the zinc galvanising would tend to be consumed rapidly and would not give satisfactory protection for the galvanised parts.

If the galvanised pipe or fittings were electrically isolated from the plain steel pipe, the zinc galvanising would still be anodic but any current discharge from it would only flow to steel exposed at defects in the galvanising. As such defects should be only small, the current flow is restricted, therefore increasing the life of the protective zinc coating.

6.3.2 CORROSION RESULTING FROM DISSIMILAR SOILS

In much the same manner that corrosion cells are established with dissimilar metals, a steel pipeline passing through dissimilar soil can set up a corrosion cell.

In some cases where an abrupt change of soil conditions occurs, a small potential difference between the soil types can be measured. The difference in potential causes a current to flow between the soils which is returned by the pipe with corrosion occurring in that section of the pipe which becomes anodic (ie. where the current is returned to the soil from the pipe).

6.3.3 DIFFERENTIAL AERATION CORROSION

This can occur in a pipeline which is buried in a completely uniform soil but with some areas of the pipeline having a free supply of oxygen (well aerated) whereas other sections are oxygen starved. This condition can arise where a pipeline passes under a sealed road-way or under a river.

In these conditions the pipe in the well aerated soil becomes cathodic and the pipe in the poorly aerated soil will become anodic and heavy corrosion may be experienced in the pipe under the road or river.

6.3.4 CORROSION WITH NEW AND OLD PIPE

A condition very closely related to the dissimilar metal corrosion cell arises when new steel pipe is intermixed with old pipe.

This situation can occur when a section of pipe has been badly damaged by corrosion and it is necessary to replace it with new pipe. Although it would seem logical that the new pipe would have a longer service life than the old pipe to which it is connected, the fact that it is higher on the “Practical Galvanic” series table (Figure 1) means that the new pipe becomes the anode (unless it is electrically insulated from the old pipe) and heavy corrosion can occur at these points unless they are correctly treated.

6.3.5 STRAY CURRENT CORROSION

A stray direct current from an external source such as an earth return from an electrical supply installation or an electric transport system can set up an artificial corrosion cell, the stray direct current may jump on and off the pipeline at intervals. Where it leaves, the pipeline becomes anodic and corrosion occurs.

6.4 METHODS OF PROTECTION

The principal methods of controlling corrosion are:

(1) Wrappings and coatings
(2) Insulated joints
(3) Cathodic protection

6.4.1 WRAPPINGS AND COATINGS

Wrappings and coatings are intended to form a continuous film of an electrically insulating material over the metallic surface to be protected. The function of such a coating is to isolate the metal from direct contact with the surrounding electrolyte (soil) and to interpose such a high electrical resistance in the anode-cathode pipeline/soil circuit that there will be no significant current flow.

Unfortunately perfection is difficult to achieve and when wrapped or coated pipes are buried it is economically and almost physically impossible to avoid some 'holidays' or imperfections in the protective coating. Each of these imperfections will become corrosion sites. This corrosion, which occurs in isolated spots, in the absence of any cathodic protection could be worse than for a completely unwrapped pipe as corrosion current may be concentrated.

Close attention must be given to the application of the wrapping as it cannot be too highly emphasised that the corrosion protection provided by this method is only as good as the integrity of the wrapping.

6.4.2 INSULATED JOINTS

Insulated joints are an essential part of cathodically protected pipeline systems. Insulated joints are used to isolate any part of the system that does not require protection, or because of its connection to (either accidentally or be design) earthed structures which would render most cathodic protection systems inoperative.

Insulating joints may also be used when it is necessary to break long electrical lengths of line down to smaller lengths for ease of cathodic protection maintenance.

6.4.3 SYSTEM

6.4.3.1 Sacrificial Anodes

With this method, advantage is taken of the relationship of one metal to another as listed in the 'Practical Galvanic' series table (Figure 1). This is done by using a very strongly anodic metal.

The only corrosion that occurs is at the anode whose life is determined by its surface area, weight and current output. An anode design life is generally calculated to produce a life of 20-25 years. This could be varied by economics of replacement, useful life of the structure being protected.

The most common metals used for sacrificial anodes are magnesium and zinc, the basic difference being that magnesium has a higher solution potential.

Sacrificial anodes are simple to install and can be used where electric power is not available.

They can be used to advantage in areas congested with other metal substructures, because their individual current outputs are small they will be unlikely to have any interference effects. They can also be used to protect areas that may be "shaded" by other structures in a congested area and are suitable for service risers and short lengths of metallic pipe and fittings installed in polyethylene.

6.4.3.2 Impressed Current System

The impressed current system of protection is used mainly on longer pipelines. This direct current may be provided from mains or alternative sources. It is applied with the negative pole connected by cable to the pipeline and the positive pole connected to a ground bed which forms the corroding anode. The ground bed is normally a cheap form of carbon, iron or silicon iron and preferably should be buried in a chemical backfill of low resistivity compared with the surrounding soil. The site for a ground bed should be selected in a permanently damp low resistivity soil, as should a sacrificial anode. The voltage supply should be variable in order that the current impressed into the pipeline may be kept as low as possible, consistent with providing maximum protection.

The length of pipeline that can be protected varies with the pipeline condition and other factors, but with a well coated pipeline, full corrosion protection for between 90 and 100 kilometres may be achieved.

Pipes buried in the ground create a natural potential with the soil and this potential is known as the metal/soil potential. This is measured using a copper/copper sulphate half cell and a high resistance voltmeter, and interpretation of the results gives and indication of the level of protection, accepted criteria for defining the effectiveness of a CP system is well documented.

Advantages of impressed current installations are:

(1) Capital and running costs are low.
(2) The installation may be monitored constantly.
(3) One installation can cover a long length of pipeline. There is no limit in application caused by soil resistance. If pipeline coating deteriorates, the current may be adjusted to compensate.

Disadvantages are:

(1). It is difficult to use in built up areas
(2) Uneconomic for small sections of pipeline
(3). Outside electrical supply is required

6.5 APPLICATION

6.5.1 WRAPPING AND COATING PIPELINES

6.5.1.1 General

It is desirable that all components of the pipeline and associated installations should be factory coated before delivery to site. This will permit proper pre-treatment and application of coatings under controlled conditions. All internal and external coating systems should be in accordance with a specification approved by the gas company.

6.5.1.2 Internal Pipe Coatings

Notwithstanding the non-corrosive nature of dry Natural Gas consideration should be given to internally coating steel pipeline to prevent rusting during transit and storage. The presence of rust should give rise to problems of internal dust and blockage of filters etc. during operation.

A further advantage of internal coating is the reduction of friction losses within the pipeline. The internal coating system should be epoxy based, applied without delay by airless spray onto either a chemically cleaned, phosphate and thoroughly washed surface, or surface which has been blast cleaned to an approved standard and profile.

The coating material thickness should be selected to match the duties required, eg. expected duration of storage and ability to withstand pigging.

6.5.1.3 External Pipe Coatings

6.5.1.3.1. Factory Coated Pipes

The external coating system should be such as to provide long term electrical and mechanical characteristics which are suited to the diameter and operating conditions of the pipe and the nature of the environment. The coating must adhere strongly to the pipe and satisfactorily resist cathodic disbonding at ‘holidays’.

The coating should be applied to a clean dry surface. Grit blasting is the preferred method of cleaning. Where chemical cleaning is used, it should include an approved phosphate process, and subsequent thorough washing. Treatment with an appropriate primer should take place immediately after the cleaning process. The coating material may be coal tar or bitumen incorporating a glass based reinforcement extruded high density polythene or other material of proven performance. High density polythene should not be applied directly on to a pipe.

Where lime wash or similar is applied to the finished coating as a reflective and anti-stick barrier, it should be omitted for a distance of 150mm at each end of the coating.

6.5.1.3.2 Field Applied Pipe Coatings

Field coatings should be selected and applied in accordance with an approved procedure aimed at reproducing as far as possible, the factory application process.

In all cases the pipe should be cleaned (preferably by grit blasting) and without delay treated with an appropriate primer before application of the coating.

Where a tape is employed particular care will be needed to ensure that it is applied in accordance with the manufacturer's instructions without wrinkles, that the overlap is consistent and that a sound seal is made between the tape layers.

diverter/spark/gap/condenser devices. Test leads should also be attached to each side of the joint and consideration be given to facilities for electrical bridging of the joint to allow for future testing of the electrical differential across the joint. Where an insulated joint installed to isolate a section of above ground pipework such as a regulator station, the joint should be installed above ground.

6.5.2 SERVICES

6.5.2.1 Domestic

Insulated joints should be provided on all services that are subject to cathodic protection, the joint being installed between the meter control valve and the meter regulator inlet.

6.5.2.2 Industrial/Commercial

For the larger type of installation, usually installed for this type of consumer, Section 6.5.4.2 should be adopted.

Where steel services are connected to existing Cast Iron or unprotected steel mains, consideration should be given to the installation of a suitable joint at the point of connection.

6.5.3 DESIGN

To obtain optimum performance from a cathodic protection system is necessary to thoroughly check on the potential differences between the pipeline and its environment.

The following points must also be taken into consideration:

(1) Whether the pipeline is bare or coated.
(2) If coated, the electrical strength and quality of the coating. Also the presence of environmental conditions which may cause coating deterioration.
(3) The type of metal used in the pipeline.
(4) The size of the pipeline and its ability to conduct cathodic protection current.

(5) The presence of metallic structures crossing or in close proximity to the pipeline.
(6) Soil structure and resistivity influencing ground bed construction
(7) Areas known to be particularly corrosive from the operators past experience or as determined from others.
(8) The possible presence of stray currents
(9) Availability of electric power.
(10) Economic evaluation of alternative systems.

From the survey carried out, a decision may then be made regarding the type of system to be employed.

Cased crossings are covered in Section 6.5.5.2. of this manual.

6.5.4 ABOVE GROUND PIPEWORK

6.5.4.1 Initial Protection

All exposed pipework and other metallic structures should be prepared and painted in accordance with a specification acceptable to the gas company. this specification should include reference to the following essential features:

(1) All surfaces should be prepared by wire-brushing or shot blasting so that all loose coating is removed and any bare surface is free from rust or corrosion products.
(2) A satisfactory paint system should then be applied, in accordance with the manufacturer's specification.

6.5.4.2 Cathodic Protection

Where cathodic protection is applied to the underground pipework for it to function correctly the following should be adopted on the above ground system:

(1) All incoming and outgoing pipework would be electrically isolated from the installation by insulating joints. Great care must be taken to ensure that any electrical metering or other installed facilities do not electrically by-pass insulating joints thereby rendering them ineffective.
(2) Any earthing of electrical apparatus should be to a station earthing system. Stainless steel , galvanised steel or zinc rods are recommended in preference to copper, to avoid the probably of a higher corrosion rate, as steel would be anodic relative to a copper earth. Under no circumstances should coke or other carbonacious material be used to augment the earthing system.

6.5.5 OTHER BURIED PIPEWORK

6.5.5.1 General

All other metallic fittings that are buried below ground should be afforded protection against corrosion. These fittings will include service risers at the end of polyethylene service pipes, metallic couplings and flanged joints.

In the majority of cases the protection will consist of the application of a suitable hand applied wrapping tape and a sacrificial anode to the specification laid down by the local gas company.

6.5.5.2 Cased Crossings

Cased crossings should be avoided wherever possible.

Where it is necessary for a section of pipe to be cased such as a major road-crossing or rail-crossing, consideration should be given to the protection against corrosion of both the carrier and case pipe.

The carrier pipe will normally be protected by either an impressed current or sacrificial anode system and steps should be taken to ensure that the protected pipe is electrically insulated from the casing pipe. The carrier pipe should be supported centrally within the casing on insulators or similar supports and the ends of the casing fitted with suitable seals to prevent the ingress of water.

Consideration should be given to pressurising the annulus between the carrier and casing pipe with nitrogen and facilities included for the periodic checking and repressurising of the nitrogen. Where it is not possible to pressurise the casing, the casing should be laid to a fall and facilities incorporated at the low point for the removal of water.

Cathodic protection test points should be provided at both ends of the casing both on the carrier and casing pipe.

The casing should also be subjected to corrosion control measures which will normally be by the attachment of a sacrificial anode or bond wires to utilise the carrier pipe system.

6.6 TESTING

6.6.1 WRAPPING AND COATED PIPELINES AND SERVICE CONSTRUCTION

During construction and prior to laying the pipe in a prepared trench the pipe should be subjected to a coating check using a ‘holiday’ detector. Any defects found should be repaired and the check repeated. As this test is the last opportunity to verify coating integrity before backfilling commences the test should be carried out by a competent person.

On completion of the pipeline or service construction, direct current voltage gradient should be carried out to locate any areas of coating damage on the buried pipeline. Any damage so found should be repaired.

6.6.2 INSULATED JOINTS

This type of joint, if possible, be assembled and checked in the workshop. The resistance, where possible, can be checked with a meter prior to installation. Once installed it will normally be possible to check the joints effectively by observing potentials on either side of the flange.

6.6.3. CATHODIC PROTECTION TEST POINTS

An electrical cable(s) should be connected to the buried pipe at pre-determined intervals such as:

(1) Road crossings
(2) River crossings
(3) Rail crossings
(4) Insulated joints
(5) Areas of interference damage (ie. large number of other services).

This cable should terminate in a suitable above ground test box with reasonable access.

6.7 MAINTENANCE

Pipeline corrosion control measures can be highly effective if properly designed and installed but it is also important that consideration should be given to the adoption of a continuous maintenance and monitoring program.

6.7.1 COATING MAINTENANCE

Although most coated pipelines are buried and inaccessible under normal conditions, there are occasions when some maintenance can be performed on these pipes.

There are times when a portion of the pipeline is uncovered for repair work or other reasons. This work may involve damage to the coating or even the removal of portions of the coating.

Repair or replacement of the coating should be as detailed in Section 6.5 and must be at least as good as the original coating. At the time that any pipeline is uncovered for any reason, a close inspection should be made of the condition of the protective coating and by comparison over a period, it should be possible, eventually to determine the approximate life that can be expected from the coating.

If extreme conditions of deterioration are experienced or suspected, special excavations should be arranged for spot checking.

6.8 RECORDS

Records must be kept of all cathodic protection work done.

6.9 SAFETY REQUIREMENTS

6.9.1 GENERAL

Gas pipelines and distribution systems which are cathodically protected present certain safety problems that must be appreciated. Stray currents, corrosion currents and induced currents may still flow in a system even when the cathodically impressed current (from power or galvanic anodes) is switched off. With either type of system the making or breaking of current can be a source of danger, especially in areas containing ignitable vapours (around flanges).

Sparking might occur on pipeline joints and plant in the following circumstances:

(1) Deliberate or accidental disconnection of pipelines, joints, bends, plant or any other associated equipment in the circuit.
(2) Accidental or deliberate short-circuit of insulating flanges.
(3) Connection or disconnection of flexible conductive hoses to tankers, barges and rail car gantry structures and associated pipelines.
(4) Disconnection or accidental breakage of cables from the rectifier or other DC source to the protected structure.

6.9.2 PRECAUTIONS NECESSARY

(1) Before any break is made in the system, a heavy gauge bonding cable must be clamped to each side of the intended break and remain connected until the repair work is completed.
(2) It is advisable when undertaking maintenance or repair of pipelines or associated plant where ignitable vapours or gases may be present, to switch off the source of power to the cathodic protection equipment.
(3) Cathodic protection can cause evolution of Hydrogen which may accumulate in pits. Care should be taken when removing pit covers to avoid sparking.

6.10 INTERFERENCE TESTING

Special care must be taken to notify other authorities with underground services to ensure that interference between systems is kept to a minimum.

7. LEAKAGE

7.1 SCOPE

This section of the Manual relates to the reporting of gas leaks that either require immediate or scheduled repair, the action which should be taken when such leaks are reported, and procedures which should be followed to ensure the prompt detection of leaks.

Leakage from the distribution system is brought to the attention of the appropriate Gas Company via two sources:

(1) Direct reported (non survey)
(2) System surveillance (survey)

This section is, therefore, divided into two corresponding parts.

7.2 MINIMUM STANDARDS FOR HANDLING REPORTED ESCAPES ON DISTRIBUTION SYSTEMS (NON SURVEY ESCAPE)

7.2.1 INITIAL CALL

(1) A telephone must be continuously manned to receive calls reporting escapes. Personnel must be available to deal with emergency calls and procedures established to ensure that personnel arrive on site as quickly as possible.

(2) When calls are received by the Gas Company a competent person will be sent to investigate the report and take precautions to safeguard life and property. This person will remain on site until the situation is clear.

7.2.2 ACTION

(1) In dealing with emergencies, the following sequence of actions must be followed:

a) To safeguard life
b) To safeguard property
c) To find and repair the escape
d) To carry out a final investigation of the site

(2) On site personnel should call for assistance without delay whenever they consider that conditions warrant additional help.

(3) When any of the following situations occur, a senior officer of the gas distributor must be informed and will attend on site:

a) When there has been an explosion, fire or gassing.
b) When it has been necessary to evacuate the public from the site.
c) When there is substantial or escape of gas.
d) Where there is a rapid deterioration of the situation on site.

(4) If an accident occurs which is either wholly or partly caused by gas, depending on the severity, it is mandatory to advise the Chief Inspecting Engineer of the Ministry of Energy immediately. (See section 2.1.10).

(5) Where emergency staff have difficulty in locating a confirmed escape and the source of leakage has not been located within four hours of arrival, further advice must be sought from a senior officer.

(6) If, after the initial site investigations, indications are such that the leak is considered to be not potentially hazardous, a decision may be taken to defer further action. Such a decision will only be taken by a senior officer after careful examination of the situation on site. When deciding to defer further action, arrangements must be made to monitor conditions at the leak at regular intervals until the report has been cleared. This decision must be taken in accordance with Section 7.3.6 and Appendix B of this section of this manual.

(7) Where there has been written notification of a gas leak then action cannot be deferred.

(8) In cases where no trace of gas can be found, a senior officer must be notified, who, after careful consideration of the situation, may decide to defer further action. In this case, a further check may be made within twenty-four hours. If this second check still indicates "no gas' then no further action is necessary. Where practicable, a second check should be carried out by a different distribution team.

(9) On completion of a repair a further check must be made of the site.

7.2.3 RECORDS

Details of all reported escapes must be kept on file and should include the following:

(1) Time and date of report.
(2) Location of report.
(3) Person responsible for making report.
(4) Time and date report completed.

Consideration should be given to retain the following information:

(5) Name of team leader attending report.
(6) Time of arrival on site.
(7) Cause of leak and action taken for repair.
(8) General condition of underground equipment.
(9) Brief sketch of repaired area.
(10) Time escape repaired.

7.3 SURVEILLANCE, CLASSIFICATION AND REPAIR OF LEAKAGE IN THE DISTRIBUTION SYSTEM ARISING FROM SURVEY (SURVEY ESCAPE)

7.3.1 OBJECTIVES

The objectives of leakage survey are to:

(1) Identify leakage which is likely to result in a public report or lead to an emergency.

(2) Identify leakage in priority area.

(3) Monitor the system and identify areas requiring attention.

7.3.2 FREQUENCY OF SURVEYS

The maximum time between surveys for various locations shall not exceed the following periods:

(a) Monthly. All gate stations.

(b) Three monthly. All areas where movement of pipe is anticipated such as mains in places or on structures where expected physical movement or external loading could cause leakage or failure.

(c) Annually. Mains adjacent to public buildings; hospitals and schools; regulator vaults and stations; distribution systems in business districts; distribution valves.
NOTE: The surveys should involve tests of atmosphere, in gas, electric, telephone, sewer and water system manholes, at cracks in pavements and at other locations providing an opportunity for finding gas leaks.

(d) At intervals not exceeding 5 years. All the remaining portions of the distribution system not covered above, including services.

7.3.4 SENSITIVITY LEVELS

The sensitivity level of detection equipment and the speed of survey shall be set by each Gas Company but should not exceed a speed of 30 km/h for instruments with a sensitivity of 500 ppm.

7.3.5 SCHEDULING

(1) Scheduling of indications for action must be carried out as soon as practicable following a survey. This schedule will be determined taking into account the leakage indication and location as defined in Appendix A of this section of the manual.

(2) In the case of walking surveys, the scheduling process may be omitted and leakages classified concurrent with survey.

INDICATION		ACTION
SCHEDULE I:		
(a)	All indications in A locations.	Investigate and classify as soon as practicable after the survey, priority being given to indications associated with mains operating at pressures above 7 kPa.
(b)	All indications of full scale deflections and prolonged or grouped indications in B locations.	
(c)	All indications associated with mains operating at a pressure greater than 7 kPa in any locations.	
(d)	All indications in B locations which are potentially hazardous by virtue of their close proximity to underground cavities, schools, shops or places of public assembly.	
SCHEDULE II:		
(a)	All indications in B locations other than those in Schedule I.	Investigate, pinpoint and classify within four weeks of scheduling as a secondary priority to work in Schedule I.
(b)	Indications of full scale deflections and prolonged or grouped indications in C locations.	
SCHEDULE III		
(a)	All indications other than those in Schedules I and II.	Economically appraise for system treatment and note for comparison with the next survey.

7.3.6

(1) Classification of leakage should be carried out in accordance with the decision chart in Appendix B of this section of the manual, using a combustible gas indicator.

(2) Although this system of classification is intended to cover all eventualities, there may be situations where, in the light of local circumstances and knowledge, a leakage indication warrants a more urgent classification ranking than that obtained by the decision process (as in Appendix B).

(3) Barholing shall be used both to pinpoint and determine the spread of leakage.

(4) This method of classification must be used when deciding to defer action on non-survey escapes. (See section 7.2.2).

7.3.7 REPAIR ACTION

The outcome of classification of a leakage may be an action to repair or apply treatment to the main. However records may indicate that the main should be considered for replacement.

Leakage Classification	**Action**
Class 1	Immediate action to vent ground, ducts or manholes, or isolate the main or service. This initial action shall be followed by appropriate repairs.
Class 2	On mains where treatment has already been applied, consideration should be given to carrying out a second application and the main re-surveyed after allowing time for the treatment to take effect. Alternatively, it may be appropriate to carry out limited repairs to eliminate the indications of leakage.
Class 3	In situations where treatment is not applicable or where a second application has proved unsuccessful, limited repairs should be carried out to eliminate the indications of leakage. Apply internal treatment or other repair methods, but this type of leak shall have a low priority.

7.4 PROCEDURES FOR DEALING WITH REPORTED ESCAPES ON DISTRIBUTION SYSTEMS

7.4.1 SCOPE

The objective on attending all gas escapes is to:-

(1) Safeguard life and property.
(2) Trace where the gas is going.
(3) Intercept and vent the gas to atmosphere.
(4) Locate and repair the escape.

7.4.2 INITIAL ACTION

7.4.2.1 Precautions

The initial action of the first team to arrive at the site is to take the following precautions to safeguard life and property:-

(1) Make contact, where possible, with the complainant. If the complainant is indoors on arrival, knock on the door for access. Do not operate door bells, etc.

(2). Turn off gas supply at the meter

(3) Extinguish all naked flames and enforce NO SMOKING.

(4) Ventilate the property by opening doors and windows.

(5) Do not operate electrical switches, telephones, etc.

(6) Remove all bottled gas containers.

(7) Evacuate all occupants in the following circumstances:-

(a) If, after turning off the gas supply and venting the premises, a reading on a combustible gas detector of 20% L.E.L. or more is obtained.
(b) If there is reason to believe that any person is adversely affected by gas.
(c) If, in your judgement, there is a danger to life.

7.4.2.2 ACTION FOLLOWING INITIAL EVACUATION

In the event of evacuation all premises above, below and connected to on either side should also be evacuated.

Premises adjacent and opposite the affected premise should be checked using a combustible gas indicator to determine the spread of gas.

If gas is detected repeat all previous actions and precautions.

If it is not possible to gain access to a premise where it is suspected that gas is present, or if there is reason to believe that a person's life is in danger, an entrance should be forced immediately. If the police are not available an independent witness such as a neighbour, should witness the entry and the police informed.

It is important that at the first opportunity following completion of the evacuation a more senior person is advised of the situation

7.5 INTERCEPT AND VENT GAS

7.5.1 GENERAL

Where the presence of gas concentrations in occupied premises is confirmed and after such precautions as necessary have been taken the next most important activity is to intercept and vent to atmosphere the gas passing into the building.

As gas frequently travels along the line of gas, water, electricity, telephone and drainage services; one or other of these may be the ingress point.

7.5.2 BARHOLING AND EXCAVATING

Barholing should be carried out in accordance with Section 8 of this manual the frontage of the affected premises to establish the point of highest gas concentration.

Excavations should be made at the barhole location where the highest gas in air readings are noted.

On completion of each excavation, premises should be re-checked and the readings monitored.

These excavations will continue until readings in the affected properties are reduced to less than 20%. L.E.L.

7.5.3 GAS IN CONFINED SPACES

Where gas is found or suspected in confined spaces which cannot be made safe by supply isolation and/or venting then the affected property and all adjacent and opposite premises likely to be affected by an explosion should be evacuated.

When in doubt evacuate.

7.5.4 ACTION IF RISK OF FIRE OR EXPLOSION

If there is a risk of explosion or fire the Fire Service should be asked to attend, and where the diversion of traffic is necessary assistance should be requested from the police.

7.5.5 RETESTING OF PREMISES PREVIOUSLY GAS FREE

Tests for gas should be made at frequent intervals to ensure that premises previously clear from gas are still clear.

7.6 SITE INVESTIGATION

7.6.1 GENERAL

The next priority is to locate the escape and it must be emphasised that, where the presence of gas is detected, continuous attention must be paid to observing the precautions listed in 7.4.2.1. Escaping gas can be readily ignited, particularly during bar-holing and excavation work, and all possible sources of ignition should be kept clear of the affected area.

7.6.2 IGNITION PREVENTION

Lighting equipment used in emergencies must be certified for hazardous area working.

The liberal use of water to damp down excavations will help to reduce the possibility of a spark igniting gas during road surface breaking and subsequent work.

7.6.3 LOCALISING THE ESCAPE

Assistance in localising the escape may be obtained from a survey of the following:

7.6.3.1 Gas in air

(1) Direction of wind
(2). Visible service pipes, service risers, service regulators, meter installation
(3) District regulator installations.
(4) Demolition sites.
(5) Manholes, surface boxes and gullies.

7.6.3.2 Gas locally in the ground

(1) Dead or dying vegetation
(2) Evidence of recent excavation.
(3) Signs of subsidence.
(4) Damage to ground surface by vehicles or plant.
(5) Surface boxes.
(6) Bubbles where water is lying.

7.7 TRACING ESCAPES

7.7.1 BARHOLING

Bar-holing using suitable equipment should be carried out along the line of gas service pipes and other pipes connected to property affected by gas and, where necessary, adjacent property.

If it appears that the escape is from the main, bar-holing may also be carried out along the line of the main. This activity will be carried out after completion of 7.4.3.2.

7.7.2 SEARCHER BARS

Hand-held insulated searcher bars should be used whenever possible. If mechanical equipment, such as rock drills, are used to penetrate road or footpath surfacing, hand-held insulated searcher bars should be used in the soft ground below the surfacing material.

Plant owned by other Utilities is easily damaged by searcher bars and details of underground plant should be obtained when possible from the appropriate Authority.

A survey of inspection manholes and jointing chambers will often reveal information about other Utilities plant and help the barholing team to avoid unnecessary damage.

7.7.3 EXCAVATIONS

Where gas is detected over a length of main, an excavation should be made at the point of greatest concentration of gas or at the centre point of the readings. The excavation should be made to below the bottom of the main to interrupt the passage of gas. Horizontal bar-holes can, if necessary, be made along the main in both directions.

7.7.4 VENTILATING OTHER DUCTING AND PIPEWORK

Where the gas is detected in underground plant carrying telephone or electric cables, joint box and manhole covers should be lifted to ventilate the duct system and the relevant Authority notified.

7.7.5 PROTECTION OF STAFF

Breathing apparatus and life-lines are to be available and should be worn if it is necessary to enter confined spaces, e.g. electricity or telephone manholes, to seal ducts.

7.7.6 FINAL SITE INSPECTION

On locating and repairing a gas escape all bar-holes will be rechecked with a combustible gas detector and if indications of gas persist further venting may be necessary and, should this not be effective, further checks made to ensure that .there is no other escape.

If a service is cut off as the suspected source of leakage, it must be pressure tested to establish whether it leaks.

When service pipes are abandoned, open ends should be properly sealed to prevent the ingress of gas.

7.8 GENERAL

7.8.1 DEFERMENT OF REPAIRS

The results of initial site investigations may indicate that immediate remedial action in respect of leakage is not necessary. In such situations, after careful examination of the situation, it may be decided to defer any required repair action and incorporate this in normal work schedules. Under no circumstances must this procedure be adopted when there is:

(1) A blowing leak (hear, feel or see).
(2) Gas present in or under buildings.
(3) Gas present within 2.0m of a building.
(4) An indication holding greater than 10% G.I.A. within 15m of a building in category A and B locations.

Although a decision may be made to defer repair action in the absence of the above conditions, the leak site must be monitored at regular intervals until the report has been cleared.

In situations where gas is present in ducts or manholes, immediate action must be taken to provide ventilation, as outlined in 7.4.5.4. Subsequent repair activities, however, will depend on the nature of leakage and an assessment of remedial action required. Provided that adequate arrangements for ventilation are made, further action shall be determined by the Gas Company and may be undertaken during normal work schedules.

7.8.2 INFORMATION FOR EMERGENCY TEAMS AND SPECIALIST EQUIPMENT

Personnel in charge of emergency teams should be notified of escapes at the appropriate time and should visit escape locations as necessary during the course of their duties and should arrange for the provision of additional equipment and labour as required.

Records of distribution mains systems should be readily available so that information can be passed to site personnel.

Specialist equipment used, e.g. F.I.M. (flame ionization method) units, pipe locators, etc., should be available and should be used by competent personnel.

Distribution emergency teams and others engaged on escape work should be equipped with dry powder fire extinguishers and be trained in their use.

Non-sparking' tools have limited use in excavation work but such tools shall be readily available for use by emergency teams.

7.8.3 RECORDS

Distribution personnel attending an escape or incident should, if possible, keep a log of action taken with times.

In the event of a major incident, keeping records is an important part of a Gas Company's responsibility.

The Gas Act 1992 states that when an accident occurs which is caused wholly or partly by gas and which damages a property and affects the gas supply, or which causes serious injury resulting in the likely incapacitating of a victim for 48 hours or more, or the death of any person, it is mandatory for the Gas Company concerned to advise the Chief Inspecting Engineer of the Ministry of Commerce (Energy Division) immediately and detailed records of early events in such an incident are of considerable assistance in subsequent investigations into the cause.

7.8.4 COMBUSTIBLE GAS DETECTION EQUIPMENT

7.8.4.1 Introduction

The most commonly used gas detector is the human nose. Although it can identify leaking gas in low concentrations, it has the disadvantages that, as it cannot quantitatively measure gas-in-air mixtures, it is not a reliable means of locating the source of leakage, and that sensitivity varies from person to person. A more serious disadvantage is that of "fatigue" - the sense of smell is rendered insensitive when subjected to prolonged exposure to gas-in-air mixtures. In contrast, the sensing element in gas detecting instruments is calibrated to give quantitative measurement of gas-in-air mixtures.

The indicating of the presence of combustible gases by most of the portable gas detecting instruments currently in use, depends on the gas present changing the physical characteristics of the gas sensing element located within the body of the instrument. The scale ranges of instruments available in Distribution are:

(1) Gas In Air (GIA) 0-100% Gas
(2) 0-100% of Lower Explosive Limit (LEL) (ie. 0-5% Gas In Air)
(3) 0-10% of Lower Explosive Limit (ie. 0-0.5% Gas In Air)

7.8.4.2 Approved Instruments

(1) Gas detection instruments are calibrated for use on Natural Gas, and must only be used on the gas for which they are calibrated. The type of calibration gas is marked on the instrument.

(2) Instruments are also available, calibrated for specific gases or vapours, eg. L.F.G, Petrol fumes, etc., and must not be used for any other purpose. These instruments should be painted red as well as being clearly marked for the specific gas or vapour for which they are- calibrated.

7.8.4.3 Use Of Portable Gas Detectors

Each opertor of a portable gas detector shall receive instruction in its use, and be supplied with a set of written instructions. The instructions shall be strictly followed whenever the indicator is used. Short cuts will give rise to erroneous readings, and could well result in hazardous situations being overlooked.

It is the responsibility of the operator to carry out the stipulated daily checks applicable to the instrument being used. If the user is in doubt about the satisfactory operation of the detector, then the instrument shall NOT be used under any circumstances, but shall be exchanged for another instrument. Procedures for the exchanging of instruments shall be defined.

7.8.4.4 Operation and Routine Maintenance of Equipment

(1) <u>PPM Detector</u>

The user shall be familiar with the operating and routine maintenance instructions provided. Before survey commences, the detector shall be checked to confirm that the filters, probes and gasways are clear. When flame ionisation equipment is used, the pressure in the hydrogen/fuel gas cylinder shall be checked to ensure that there is sufficient for a survey. The cylinder pressure shall not in any circumstances, be allowed to fall below the manufacturer's recommended minimum level.

At lease one spare hydrogen/gas cylinder shall be carried with the equipment.

Refilling of hydrogen/fuel gas cylinders shall only be undertaken in a nominated work area, where approved equipment is installed. This is essential to prevent the over-pressurisation of small cylinders. The state of the battery charge shall be checked, and the battery recharged after each working day, to maintain it in a fully charged condition. The detector shall be checked with gas to ensure that it is operative. Any doubts about its response, or sensitivity, shall be reported to the Officer in Charge who will arrange for a detailed check on the detector.

(2) Combustible Gas Indicator

The user shall be familiar with the operating instructions of the indicator. The instrument shall be checked daily to ensure it responds to gas. The indicator shall be returned to the nominated work area for checking, and re-calibration, if its operation and/or sensitivity is suspect.

7.8.4.5 Periodic Checks of Instruments

A label attached to each instrument will indicate when the instrument was last serviced, and the date for the next service. Instruments shall be returned when the service is due. The probe unit and aspirator shall be returned with the instrument.

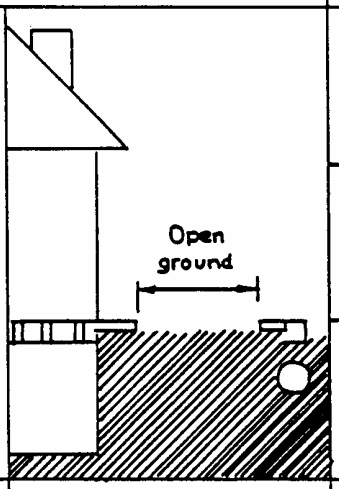
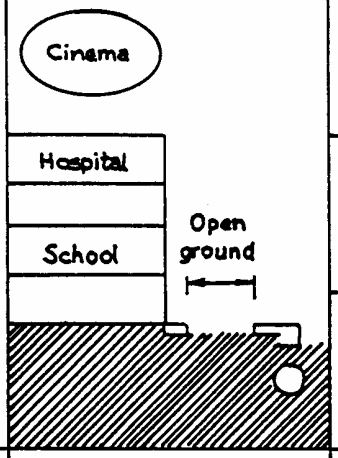
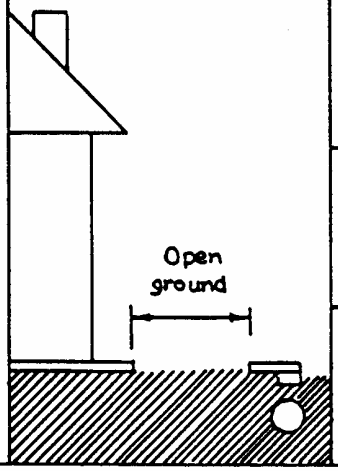
7.9 GAS DETECTION EQUIPMENT USING THE FLAME IONISATION METHOD (FIM)

(1) This specialist equipment, which can only be used by trained operatives, is available to assist in locating the source of gas leaks. It shall be used when doubt exists regarding the presence of low concentrations of gas-in-air mixtures, which cannot be detected by the LEL ranges of portable combustible gas instruments (CGI). FIM instruments are capable of detecting parts per million by volume concentrations of gas-in-air mixtures.

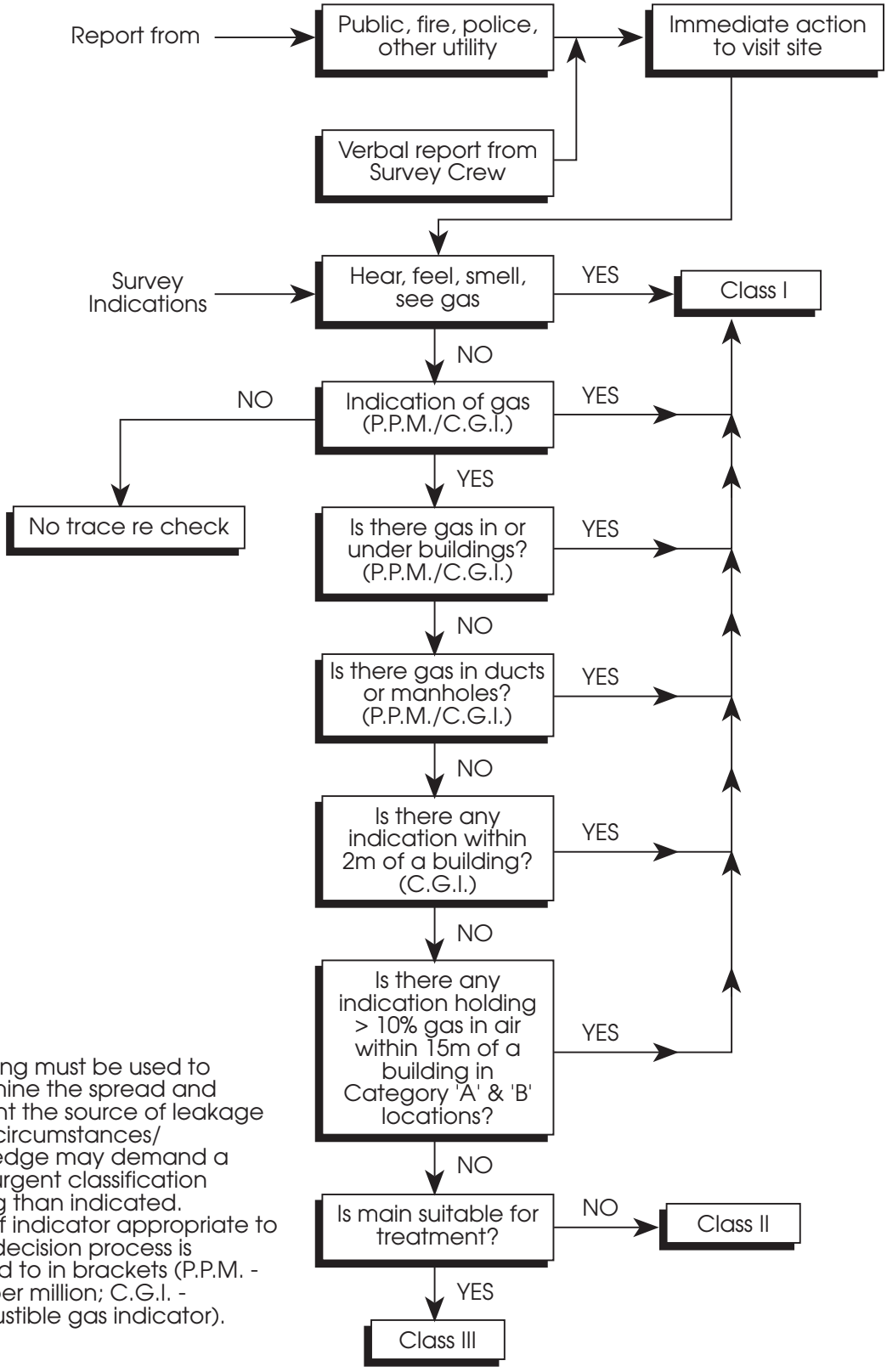
(2) FIM instruments are not intrinsically safe, and shall not be used in locations where gas-in-air mixtures above 60% LEL are present, and shall not be taken into any suspect enclosed space, unless the atmosphere has been proven to be safe using a CGI.

APPENDIX A:

DEFINITION OF LOCATION CATEGORIES

Type of property	Length of open ground	Location category
With underground cavities 	Less Than 2M	A
	2M to 15M	B
	Greater Than 15M	C
Places of public assembly 	Less Than 2M	A
	2M to 15M	B
	Greater Than 15M	C
Any other 	None	A
	Less Than 2M	B
	Greater Than 2M	C

APPENDIX B:



NOTES:

1. Barholing must be used to determine the spread and pinpoint the source of leakage
2. Local circumstances/ knowledge may demand a more urgent classification ranking than indicated.
3. Type of indicator appropriate to each decision process is referred to in brackets (P.P.M. - parts per million; C.G.I. - combustible gas indicator).

8. BARHOLING

8.1 INTRODUCTION

This section deals with the practice of barholing to determine the location of gas escapes from underground systems.

On the one hand there is the possibility that barholing, if not carried out correctly, may, in locations where underground services are highly congested, expose operators to the risk of striking buried electricity cables.

On the other hand, there is a potential danger to the general public that if the leakage is allowed to continue unabated and gas seeps through the ground into premises, ducts and underground voids, a critical mixture with air may build up which, together with an ignition source, could result in an explosion.

Regarding the position of electricity cables, an operative engaged in locating and remedying has a duty to proceed with that task, at the same time exercising all the precautions outlined in this Standard Practice.

8.1.1 GENERAL

Personnel engaged in barholing work shall be properly trained in safe working procedures for the use of rock drills, percussion bars, hand held probes and cable locators.

They shall additionally be equipped with, and use, protective clothing including goggles, gloves and footwear.

8.1.2 PROVISION OF INFORMATION

Information known to the Gas Company about the presence and location of their and other Utilities' plant at the site shall be made available. Additionally, particular effort must be made by the Gas Company to obtain information about the locations of all cables and apparatus by contact with the appropriate Utilities when time and the situation permit.

8.1.3 INITIAL SITE WORK

The Team Leader must attempt to establish the actual locations of cables and other buried plant within the area to be barholed by the actions detailed in (1) to (3) below.

(1) Examination of all information provided.

(2) Lifting, wherever possible, the covers of manholes or joint boxes to determine direction of cable tracks. (Proper equipment should be used for these operations and care taken to avoid sparking or damage to underground plant or covers. Where covers are lifted, a responsible officer of the appropriate utility should be advised at the earliest opportunity).

(3) Survey the area with a cable locator and mark on the surface the line of the cable(s). (See Appendix B).

8.2 BARHOLING

8.2.1 Prevention of Damage to Underground Plant

Whenever barholing operations are taking place the utmost care must be exercised at all times to prevent damage to any underground plant. In no circumstances must undue force be used to drive the searcher bar and if it is suspected that the bar has met some obstruction then the bar hole should immediately be abandoned or an excavation should be made to determine the nature of the obstruction.

8.2.2 Vertical Barholing

Barholing vertically downward from the surface should be carried out in accordance with the following recommendations **as** appropriate, using approved percussion or drilling equipment.

(1) The use of rock drills of approved type is recommended to penetrate the surface of roadways and footpaths where the surface is exceptionally hard. Percussion searcher bars of approved type may be used for barholing work. Details of approved types of rock drills and percussion searcher bars are given in Appendix A.

(2) Rock drills or percussion searcher bars shall not normally be permitted to penetrate below a depth from ground surface of 200mm in footpaths or 380mm in roadways.

(3) Where it is not possible to establish the location of a gas escape with such limited depths of penetration, barholes may be driven to the depth of the main, provided that steps have been taken to locate the position of cables and other Utilities' plant, (see Clauses 8.1.3 and 8.1.4) and that the Electrical Authority, if not previously notified, is so notified and requested to attend the site. This decision should only be taken after consultation with the Supervisor.

(4) Prior to carrying out deep barholing in heavily congested locations, consideration should be given to trial holing to establish the lines of buried cables. Deep bar holes must not be driven within 250mm of the determined lines of buried cables.

8.2.3 Probing in open Excavations

(1) Before any probing in open excavations is undertaken, the area to be probed shall be swept with a cable locator. (see Appendix B)

(2) Taking care to avoid damage to cables and other plant, hand held probes may be used in open excavations to trace gas leakage paths.

(3) Horizontal probing along the line of mains shall be carried out in accordance with (a) or (b) as applicable.

(a) Horizontal probing along the line of exposed small diameter mains shall only be undertaken at the 3 o'clock and 9 o'clock positions.

(b) For partially exposed larger mains probing in an area wider than defined in (a) is permissible. However, probes should not be driven along the top or bottom of the main.

(c) A percussion searcher bar shall not be used for probing in open excavations.

APPENDIX A

APPROVED EQUIPMENT

A.1 ROCK DRILLS

Normally only rock drills which allow for control of the depth of penetration are acceptable. This may be achieved by either:-

(1) Provision of three separate drilling shafts with each rock drill two of the shafts having a fixed stop one with a stop at 200mm and one with a stop of 380mm to limit the depth of penetration and one without a stop for use in the exception cases described in Clause

8.2.2 (3)

OR

(2) Provision of a single drilling shaft incorporating a moveable stop, which can be firmly fixed in one of two predetermined positions on the shaft, so as to limit the depth of penetration to 200mm or 380mm.

The operator shall always wear insulated gloves.

A.2 PERCUSSION SEARCHER BARS

Percussion searcher bars must be fitted with electrically insulated hand grips, designed and tested to resist 22KV.

Each searcher bar should have a unique serial number and be subjected to frequent visual inspections and tested at least once per annum.

The searcher bars shall be provided either:-

(1) In sets of three, two of which incorporate a fixed stop one with a stop at 200mm and one with a stop at 380mm to limit the depth of penetration and one without a stop for use in the exceptional circumstances described in Clause 8.2.2(3)

(2) As a single bar incorporating a moveable stop, which can be firmly fixed in one of two predetermined positions so as to limit the depth of penetration to 200mm or 380mm.

A.3 HAND HELD PROBES

Hand held probes should not exceed 380mn in length (excluding handles) and must either be fitted with electrically insulated hand grips, or designed and tested to resist 22Kv, or be constructed of a non-conducting material.

APPENDIX B

USE OF CABLE LOCATORS

B.1 It is essential that cable locators are maintained in good working order.

B.2 Before commencing excavation the presence of electric cables should be checked for on every occasion by use of a cable locator even when prior consultation with the Electrical Department has taken place and information obtained about the location of cables.

B.3 The use of the cable locator should not be restricted to a single sweep of the area before breaking out the ground surface. The area should be continually monitored as ground is excavated so as to improve the pin-pointing of the position of the cable.

B.4 Before an excavation is extended, its side(s) should be swept with a cable locator using a vertical scanning in addition to any appropriate use at surface level.

9. TESTING

9.1 SCOPE

This section gives guidance for the pressure testing of gas mains and services operating at pressures up to 2000 kPa. Both hydrostatic and pneumatic testing are covered.

9.2 DEFINITIONS

For the purpose of this Section, the following definitions shall apply:

- Low pressure — operating pressures not exceeding 7 kPa;
- Medium pressure — operating pressures above 7 kPa but not exceeding 420 kPa
- Intermediate pressure — operating pressures above 420 kPa but not exceeding 2000 kPa.

9.3 GENERAL REQUIREMENTS FOR PRESSURE TESTING

(1) All new mains and services shall be pressure tested.

(2) Any part of the distribution system which is diverted, altered or renewed shall be pressure tested. Joints which cannot be included in such a pressure test shall be tested at normal operating pressure using a leak detection fluid or L.E.L. Scale on a combustible gas indicator.

(3) A pneumatic test shall be applied to low, medium and intermediate pressure systems. Where it is considered that hazards to persons and/or property are likely to arise in the event of a failure of pneumatic test, then it should be preceded by an appropriate hydrostatic test at a pressure not exceeding 1.6 times the maximum working pressure.

(4) For all pneumatic tests of longer than 2 hours duration, readings shall be corrected for barometric pressure. Barometric readings should preferably be taken at the test site or alternatively at a point within 15 km of the site.

(5) For intermediate pressure mains and services a hydrostatic test should be applied followed by a pneumatic test.

(6) For pneumatic and hydrostatic testing of mains the Engineer in charge of the project shall stipulate the test pressure and duration.

9.4 SAFETY PRECAUTIONS

(1) All caps, plugs, bends, tees and other fittings on mains incorporating flexible joints should be restrained against movement during the test. The trench should be sufficiently backfilled to secure the pipes in position.

(2) Consideration should be given to means of minimising noise during pressurising and depressurising by utilising the maximum diameter stand pipe.

(3) Notices warning that pressure testing is in progress should be prominently displayed where the main is exposed and accessible to the public.

(4) Before pressurisation commences a final visual check should be made that the test section is secure for pressurising.

(5) Whilst the pressure is being raised no person shall remain in the trench.

9.5 PNEUMATIC TESTING (LOW AND MEDIUM PRESSURE)

9.5.1 GENERAL

(1) In the case of the renewal or alteration of a main, a check shall be made that the section to be tested is physically isolated from any live main. For service pipes operating at low pressure acceptable isolation can be achieved by the use of the integral stopper at the service tee. For service pipes operating at medium pressure acceptable isolation can only be achieved by physical disconnection.

(2) Mains to be tested shall generally be isolated into sections of approximately 500 metres and each section tested individually. Following the satisfactory completion of the sectional tests tie in joints shall be tested under operating conditions using leak detection fluid, or L.E.L. Scale on a combustible as indicator.

9.5.2 MAINS TESTING PROCEDURE (INCLUDING SERVICES ABOVE 50mm DIAMETER)

(1) When testing mains, the standpipes should be located at the extremity of the new main and incorporate a relief valve set to lift at a pressure 10% above the specified test pressure.

(2) Where considered necessary, pressure recorders should be installed.

Test instruments shall be fitted so that they can be read and operated without entering the trench or standing in line with the end of the main.

(3) Closed valves shall not be used as end caps. All valves shall be tested in the open position. Where a valve is fitted at the extremities of the main under

test the valve shall be securely blanked and anchored against movement.

(4) Air should be introduced under controlled conditions into the main until the appropriate test pressure is reached as indicated in Table 1. Care shall be taken not to overpressure the pipework.

(5) Whilst the test pressure is being raised no person shall enter the trench.

(6) No work shall be carried out on a main under test other than any necessary soap testing or operation of the valves on the test standpipe.

Any necessary leak detection shall be carried out at a pressure not exceeding 35 kPa.

(7) Before the start of the test period the temperature of the main should be allowed to stabilise for a minimum period of 4 hours. For large diameter short length services the Engineer shall stipulate cooling time.

(8) Following the period of temperature stabilisation, the initial pressure reading shall be taken. A further pressure reading shall be taken at the end of the test duration.

(9) When the test has been completed to the satisfaction of a competent person the air pressure should be released through a suitable vent in a controlled manner.

A check should be made by a gauge or other means to ensure that the pressure has been released.

(10) Test certificates must be completed for all tests, and retained.

9.5.3 SERVICE TESTING PROCEDURE (UP TO AND INCLUDING 50mm DIAMETER)

9.5.3.1 Low Pressure

(1) On services connected into polyethylene mains testing should be carried out prior to cutting into the main and with the cutting head removed.

On services connected into metallic mains it is permissible to test after drilling and against the integral stopper.

(2) The control valve on the meter inlet should be in the open position with the outlet plugged off.

(3) Fit the pressure test manifold to the service tee.

(4) By means of a suitable hand pump slowly pressurise the service to 10 kPa and disconnect pump. No temperature stabilisation period is required.

(5) The pressure test shall be over a 5 minute period and no pressure loss shall be allowed.

(6) Depressurise the service and remove the pressure test manifold.

The service should now be purged and commissioned.

9.5.3.2 Medium Pressure

(1) On services connected into polyethylene mains, testing should be carried out prior to cutting into the main and with the cutting head removed.

On services connected into metallic mains operating at medium pressure it is permissible to test after drilling and against the integral stopper.

(2) The test shall be from the mains connection to the inlet valve of the service regulator/meter installation. This valve should be in the open position and the outlet plugged off.

(3) Fit the pressure test manifold to the service tee. If a pressure relief valve is included in the manifold it should be set at 20% above the test pressure.

(4) Introduce air in a controlled manner and slowly pressurise the service to 350 kPa and allow 5 minutes for the temperature to stabilise.

(5) The pressure test shall be over a 5 minute period and no pressure loss shall be allowed.

(6) Should the operating pressure be in excess of 210 kPa a second five minute air pressure test must be applied to a level of 1.5 times the maximum operational pressure.

(7) This test, after allowing 5 minutes for the temperature to stabilise, shall be over 5 minutes and no pressure loss shall be allowed.

(8) Depressurise the service and remove the pressure test manifold.

(9) The test pressure shall be recorded and retained for record purposes.

The service should now be purged and commissioned. This operation should be carried out in accordance with Section 5.

9.5.3.3 Service Alterations

The procedure for testing service alterations shall be as follows:-

(1) The service pipe shall be physically disconnected from the network and the live end sealed. (If service is metallic, continuity bonds must be fitted prior to disconnection and damp cloths used to remove static electricity from polyethylene pipes).

(2) An appropriate air test shall be applied to the disconnected service and if sound the service alteration may be carried out.

(3) If the pressure test fails then the service should be abandoned and relaid.

(4) On completion of the service alteration, an air test of the whole section shall be carried out in accordance with 9.5.3.1 or 9.5.3.2 as appropriate.

(5) On reconnection of the service all exposed joints not included in a pneumatic tes shall be tested at network operating pressure using leak detection fluid or a combustible gas indicator on L.E.L. Scale.

(6) Following a successful test and reconnection of the altered portion of the service, a test using a combustible gas indicator associated with barhole survey should be made to the existing buried service to ensure the pipe and connections have not been disturbed.

(7) All abandoned services shall be isolated and capped.

9.5.3.4 Service Testing Procedure (Above 50mm Diameter)

Services and service risers above 50 mm diameter shall be tested in accordance with the procedure for mains testing as detailed in 9.5.2.

9.5.3.5 Test Failure

Where the instrument reading (including correction for barometric pressure if appropriate) shows a pressure loss greater than that allowed, investigations shall be carried out to find the leakage. All connections plugs and external fittings shall be re-examined for possible leakage by leak detection fluid. If the leak is not found, further investigations, i.e. sectioning of the main, should be carried out until the leakage is found and repaired. Tracer gas such as Ethyl Mercaptain etc, may be used. The main or service should then be re-tested.

9.5.4 HYDROSTATIC TESTING

9.5.4.1 General

Provision shall be made for an adequate supply of clean water. The necessary consents should be obtained from the authority concerned for the supply of water as well as the times, points and rates at which water may be drawn. Similarly, arrangements should be made for the disposal of water into rivers or drains.

The length to be hydrostatically tested will be governed by ground contours and the need to avoid excessive test pressures at low points due to hydraulic head, taking account of material used for the construction of the main. The appropriate hydrostatic test pressure should be applied to the highest section of the main under test and checked using a Bourdon gauge. The precise test procedure in such cases shall be decided upon by the Engineer.

9.5.4.2 Procedure

(1) An air test of 35 kPa minimum shall be applied prior to the hydrostatic test to ensure soundness of the system.

(2) Air vents should be provided at all high points so ,that trapped air can be vented as the main is filled with water. Provision should be made at low points for the removal of the water.

(3) If necessary, a settling tank should be provided from which the water for the hydrostatic test shall be drawn.

(4) The pumping system used for filling the main should be such as to reduce entrained air to a minimum and the pumps shall be capable of overcoming any hydraulic head due to contour.

(5) Where practical, water should be introduced into the main at the lowest point. Where difficulties exist in the introduction and eventual removal of water from the main, suitable pig despatching and receiving units should be fitted at the ends of the main.

(6) While filling the main with water a continuous and even flow shall be maintained until the main is completely filled. Due regard should be paid to any freezing conditions and necessary precautions should be taken during the filling.

(7) If pigs are to be used they should be suitable swabbing pigs of a type that will ensure that the air is swept out of the main and the pigs should be separated in their travel by a slug of water of adequate length to ensure non-aeration of test water behind the second pig.

(8) Water shall be pumped into the main and pressurised to the prescribed test pressure.

(9) On reaching this test pressure and following an adequate time for pressure to stabilise, there should be no observable pressure loss and the first test reading should be taken.

(10) After a period of at least two hours, a second test reading should be taken. Any loss in pressure shall be made good by providing additional water and the amount of 'make up' water required is an indication of the soundness of the section of main under test.

(11) A hydrostatic pressure test shall be considered satisfactory if over a continuous period of 24 hours, there is no pressure drop that cannot be explained as due to conditions external to the pipeline. For pipelines with a volume of less than $10m^3$, the continuous period of the test may be reduced to 8 hours.

(12) Where the hydrostatic test is successful, a final pneumatic test shall be carried out at a pressure of 700 kPa. A dead weight oil column gauge accurate to 0.01% should be used for this test.

(13) Where the amount of 'make up' water is unacceptable, a check shall be made for any indication of water along the route of the main. In extreme conditions it may be necessary to inject a dye into the water to provide visual indication of leakage. Where visual inspection does not reveal the source of leakage the hydrostatic test shall be abandoned. The water shall be removed prior to carrying out the subsequent tracing for leakage.

9.5.4.3 Water Removal

The procedure for the removal of water shall be approved by the Engineer.

The main shall be emptied of water by using one or more air propelled swabbing pigs discharging the water for disposal.

The air compressors used for emptying the water from the main should have ample capacity, both in volume and pressure, to allow the swabbing pigs to travel continuously and overcome any hydrostatic head in the system.

After initial emptying, the pigs may be run in the reverse direction as a swabbing run and this process shall continue until the main is as dry as practicable as determined by the Engineer.

When natural gas is to be supplied to a C.N.G. installation, every endeavour must be made to reduce the water content to an acceptable level prior to compression and the installation of driers for this purpose may be desirable. A recommended maximum water content for gas supplied for compression is 16 m.g of water per. standard cubic metre of gas which is equivalent to 79 parts of water per million parts of gas, measured on a mole basis.

9.5.4.4 Leak Tracing

Where the hydrostatic test has proved unsatisfactory and abandoned, the following procedures shall be applied:-

(1) The main shall be treated with a tracing agent as detailed in 9.5.3.5 and pressurised to 35 kPa.

(2) Checks shall be carried out along the route of the main using a suitable detecting instrument. If the source of leakage is not located the pressure shall be increased in 100 kPa increments up to the pneumatic test pressure. Following each increase in pressure, leak checks shall be carried out as described above.

(3) When the leak source has been located, the main shall be vented and repaired and the hydrostatic and final pneumatic tests repeated for the whole section under test.

9.5.4.5 Test Records

A record of all tests on mains should be kept together with any relevant pressure recordings.

FIGURE 1 -Typical Test Certificate

PRESSURE TEST FOR MAINS

DATE.....

SITE.....

LENGTH.....

SIZE..... LP/MP/IP

DURATION OF TEST.....

CONTRACTOR..... TEST - Passed/Failed*

	Initial Reading (kPa)	Final Reading (kPa)
Gauge Pressures		
Absolute Pressure (Gauge + Barometric)	A	B
Actual Pressure Loss (A - B)		
Permissible Pressure Loss (see table)		

* delete as appropriate
# indicate which contractor or if direct labour.

Signed .....
Supervisor/Engineer

Table 1 - Pneumatic test pressure and duration (low and medium pressures)

System	Test pressure Pneumatic	Suitable test instrument Pneumatic	Duration of test	Permissible pressure loss
Low pressure services	10 kPa	Single or double limb water column gauge	5 min	nil
Low pressure mains	35 kPa	Single or double limb mercury gauge plus verniers or magnified scale	See table 2	1.0 kPa
Medium pressure services	Minimum test pressure 1.5 x maximum system working pressure	Bourdon tube gauge or equivalent insrument	5 min	Nil
Medium pressure mains	Minimum test pressure 1.5 x maximum working pressure	dead weight tester or equivalent instrument	See table 2	0.3 kPa

Table 2- Duration of pneumatic tests - hours (low and meduim pressure)

Pipe diameter: Polyethylene Ductile / steel	Up to 80 mm			100 mm			150 mm			200 mm			250 mm			300 mm			450 mm		
Working pressure	LP	MP		LP	MP		LP	MP		LP	MP		LP	MP		LP	MP		LP	MP	
(kPa)	–	210	420	–	210	420	–	210	420	–	210	420	–	210	420	–	210	420	–	210	420
Pipe length m																					
50	0.25	0.25	0.5	0.5	0.5	1.0	1.0	1.0	2.0	2.0	2.0	3.0	3.5	2.5	5.0	4.5	3.5	7.0	10.0	7.0	15.0
100	0.5	0.5	1.0	1.0	0.5	1.5	2.0	2.0	3.0	4.0	3.0	6.0	6.75	5.0	10.0	9.0	7.0	14.0	19.0	15.0	29.0
150	0.75	0.5	1.25	1.5	1.0	2.0	3.0	2.0	5.0	6.0	4.0	9.0	10.0	8.0	15.0	13.0	10.0	20.0	29.0	22.0	44.0
200	1.0	0.75	1.75	2.0	1.5	3.0	4.0	3.0	6.0	8.0	6.0	12.0	13.25	10.0	20.0	18.0	14.0	27.0	38.0	29.0	58.0
250	1.0	1.0	2.0	2.5	2.0	3.5	5.0	4.0	8.0	10.0	7.0	14.0	16.75	13.0	25.0	22.0	17.0	34.0	48.0	36.0	73.0
300	1.5	1.0	2.5	3.0	2.0	4.5	6.0	5.0	10.0	11.0	9.0	17.0	20.0	15.0	30.0	26.0	20.0	41.0	51.0	44.0	87.0
350	1.5	1.5	3.0	3.0	2.5	5.0	7.0	6.0	11.0	13.0	10.0	20.0	23.0	18.0	35.0	31.0	23.0	47.0	67.0	51.0	102.0
400	2.0	1.5	3.25	3.5	3.0	6.0	9.0	6.0	13.0	15.0	12.0	23.0	26.5	20.0	40.0	36.0	27.0	54.0	77.0	58.0	116.0
450	2.0	1.5	3.75	4.0	3.0	6.5	10.0	7.0	15.0	17.0	13.0	26.0	30.0	23.0	45.0	40.0	30.0	61.0	86.0	65.0	131.0
500	2.5	2.0	4.0	4.5	3.5	7.0	12.0	8.0	16.0	19.0	14.0	29.0	33.0	25.0	50.0	45.0	34.0	67.0	96.0	73.0	145.0

10. PIPE DIVERSION AND PROTECTION

10.1 SCOPE

This section gives guidance in the assessment of the need to divert or protect Gas Company apparatus irrespective of its operating pressure.

10.2 ELEMENT OF RISK

There are five main elements of risk to apparatus from third party activity; these can alter in priority and, as such, it is necessary to consider each element in turn prior to taking a decision on the need to divert or protect. In most cases these elements arise from road reconstruction, road construction, building works or other utilities operations.

The five main elements are:-

(1) Excessive cover.
(2) Reduced cover and/or change in loading on pipe.
(3) Future access to pipe impaired.
(4) Damage during construction work.
(5) Resultant hazard location.

10.3 DETAILED CONSIDERATION

10.3.1 LIMITS OF COVER

The recommended limits of cover for elements of excessive cover, reduced cover, and future access are indicated on Table 1.

In addition, in relation to future cover the following factors may be of importance:-

(1) Where other plant is placed close to or over gas apparatus.

(2) Where the installation of street furniture prevents future access to pipe.

(3) Where a pipe is being put into a position which would be detrimental to future maintenance e.g. moving from footpath to roadway or to centre of roundabout etc.

(4) Where a road closure is affected and the road is no longer under the control of the Road Authority.

(5) Maximum height of spoil heaps and temporary embankments over buried mains

Where large spoil heaps or embankments are placed over buried pipes it affects the pipes in a manner which is equivalent to burying them deep (See Fig 1). The mounds are assumed to be short lived, and care should be taken to prevent heavy earth-moving plant running over any unprotected pipes whilst the mound is being built or cleared. The use of thick steel plates or timber beams as a temporary road surface over pipes is recommended, especially where the ground may become soft with the passage of site traffic or plant. If the Engineer or his representative considers either the construction or the presence of a proposed spoil heap or embankment poses an unacceptable risk he should prevent its construction or divert the pipe.

To maintain reasonable access to gas apparatus, temporary spoil heaps and embankments should be limited to 2 m above ground level. Where the established main is old, has many offtakes as services or branches or has a history of leakage, the maximum safe height should be reduced to one metre, at the discretion of the Engineer or his representative.

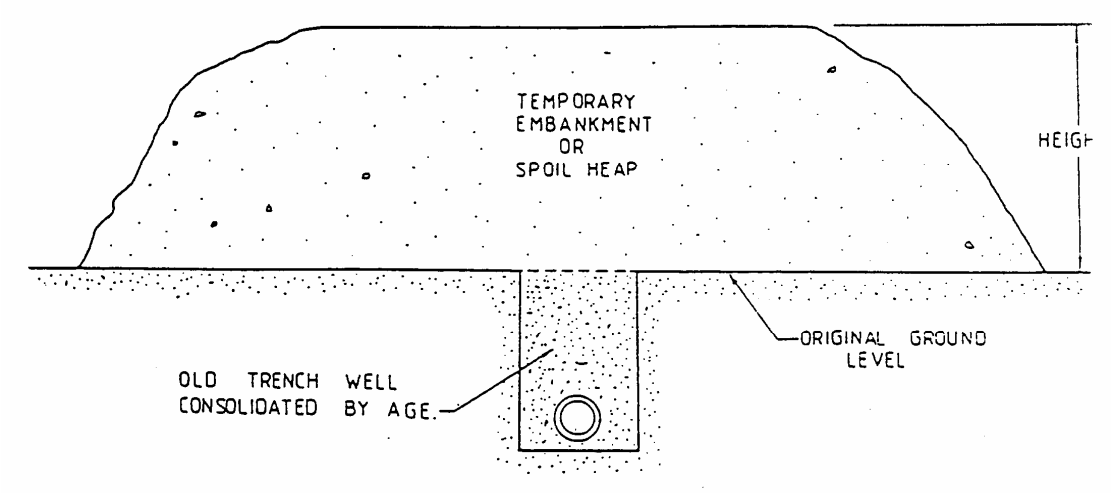


FIGURE I Embankment or spoil heap over line of existing main

10.3.2 POSSIBLE DAMAGE DURING OTHER CONSTRUCTION WORKS

(1) Where heavy plant or machinery would cross pipe giving excess loading.

(2) Where blasting or dynamic compaction will occur in close proximity to pipe.

(3) Where ground movement/slippage is likely or deep excavation close to pipe.

(4) Where there is a possibility of interference damage during the installation of street furniture.

(5) Where there is an excavation and gas pipe is to be exposed.

10.3.3 RESULTANT HAZARD LOCATION

(1) Where buildings are to be constructed over or near to the line of gas apparatus.

(2) Where voids are left in close proximity to gas apparatus.

10.4 PROTECTIVE MEASURES

The alternatives to diversion of gas apparatus, assuming that some course of action is required, range from joint encapsulation to the installation of some measure of protection. (The latter could be the installation of a concrete raft over the pipe).

Each case has to be judged in its own merits and whilst it may be permissible, for example, to allow plant to be operated over a welded steel main with reduced cover, a cast iron pipe in similar circumstances would require to be re-laid. The length of section of pipe affected may well influence the measures required.

Other protective measures may be necessary whether or not a diversion is require, e.g. hand-excavation within 2.0. metres of the gas apparatus, temporary crossing points and specified backfill materials. Consideration should also be given to the alteration of such items as pressure point standpipes, valve spindles, syphon points, mains treatment points and any other apparatus which may be affected by existing road/ground level alterations.

LIMITS OF COVER

Situation	Effect	Limitations	Details of Pipe				
			Cast pipe up to 200m dia and asbestos	Cast pipe over 200mm dia	Steel	P.E.	Ductile
1. EXCESSIVE COVER	Crushing effect on barrel and joints etc	Maximum Cover	1.5m	2m	4.3m	6m	2.4m
2. REDUCED COVER	Increased traffic loading on pipe and possibility of intererence damage	Minimum cover: 2.1 Roads & Berms 2.2 Footpaths 2.3 Significant change of loading (see note 1)	0.75m 0.6m Divert	0.75m 0.6m Divert	Depths in accordance with NZS 7647:1979 Code of Practice for The Installation of Polythene Pipe for Gas Reticulation Divert or project subject to cover and particular site circumstances.		
3. FUTURE ACCESS TO PIPE	Where cover would be increased beyond point where trench supporting is required for future works.	Maximum cover	1.5m	1.5m	1.5m Could be as per element 1 but for short lengths only See 3.2 Spoil Heaps		

Note(1): For example, where main lies in footpath, berm or field subject to normal or nil loading and road now to be constructed over.

11. ODORISATION

11.1 SCOPE OF MANUAL

This Manual applies to the operation of odorising equipment and the handling of odorant used for reticulated natural gas.

11.2 DEFINITIONS

Definitions in the Code of Practice for Odorisation, GCP3, apply to this Manual.

11.3 DESIGN OF ODORISATION INSTALLATIONS

11.3.1 PURPOSE OF SECTION

To describe factors that should be considered when designing odorisation installations.

11.3.2 GENERAL

Odorisation equipment should be designed for the type of odorant and for the odorisation rate required.

Odorisers are of the liquid injection or evaporation type. The former provides the greatest dosage rate control; the latter is the simplest and cheapest to operate.

Odorising systems should be designed and operated so as to minimise variations in odorant levels. Due regard should be given to the effect of variations in gas flow rate, temperature and pressure on the dosage rate.

Odorisers, odorant storage facilities, and odorant transport and transfer systems should be located, designed and operated so as to avoid the creation of undue nuisance odours by minimising the escape of odorant to the atmosphere.

Odoriser installations should be designed so as to allow for the efficient purging and flushing of odorant without vapour lock. The pipework should be configured to allow for recirculation in the event of vapour lock.

With the storage part of the system isolated, the contained volume of odorant should be small enough to be disposed into a part filled drum of hypochlorite neutralizing agent.

Stainless steel (preferably) or mild steel should be used for odorisers, odorant storage tanks and associated pipework and fittings. Copper, copper alloys and aluminium should not be used.

Gaskets and O-rings should be of types which do not swell when in contact with odorant. Fluoroplastic and asbestos impregnated with fluoroplastic may be used for gaskets. PTFE and suitable anaerobic thread sealants may be used for seals. PTFE is recommended for tapes and flexible hoses.

11.3.3 ELECTRICAL EQUIPMENT

Electrical equipment associated with or in the vicinity of odorisers, odorant storage and odorant handling areas should be designed to the Electrical Wiring Regulations for the applicable hazardous zone.

In order to avoid possible electrical ignition or shock, electrical earthing equipment for use in odorisation systems and odorant handling should be installed in accordance with the Electricity Regulations for the applicable hazardous zone. All pumps, tanks, odorant lines and other odorising equipment should be bonded to become electrically continuous and earthed.

11.3.4 ODORANT STORAGE

The underlying surface for all odorant holding areas should be impervious and bunded so as to be able to contain the maximum amount of odorant stored.

11.3.5 ODORANT STORAGE IN TANKS

Storage tanks should be located as near as possible to the odorisation point to minimise transfer piping.

Storage tanks should be either located underground, or placed under a well vetillated canopy or cover or painted with a non-heat absorbing paint to reduce temperature variations in the tank.

11.3.6 BULK ODORANT STORAGE IN TANKS

Storage tanks should be of all welded construction and fabricated in accordance with ASME unfired pressure vessel codes.

The minimum design pressure of storage tanks should be 240 kPa (gauge).

As protection against overpressure a relief valve should be fitted to the storage tank. The relief valve should be installed to a permanently mounted flare.

11.3.7 SECURITY

Operational odorising systems and odorant storage areas should be secured to prevent access by unauthorised persons.

11.4 OPERATION OF ODORISATION INSTALLATIONS

11.4.1 PURPOSE OF SECTION

To describe procedures for operating odorisation systems.

11.4.2 STEADY ODORISATION RATE FOR NORMAL OPERATIONS

For normal operations, as far as practicable, a steady odorisation rate should be maintained.

11.4.3 INCREASE OF ODORISATION RATES TO COMPENSATE FOR ODORANT LOSSES IN PIPELINE

In order to compensate for odorant adsorption and absorption in the pipeline where supplemental odorisers are not used, odorisation rates should be temporarily substantially raised when commencing odorisation or commissioning long pipelines runs .

11.4.4 ELECTRICAL EARTHING

In order to avoid possible electrical shock or ignition, before any pipework is connected for delivery of odorant, an electrical bond should be made between the delivery vessel and the fixed storage system. This bond should remain in place until all other connections have been disconnected on completion of filling.

11.4.5 SECURITY OF INSTALLATION

Operational odorising systems and odorant storage areas should be securely locked to prevent access by unauthorised persons.

11.4.6 RECORD OF ODORISER SETTINGS

Records of odoriser settings should be held at odorising facilities.

11.5 DOCUMENTATION AND SUPPLY OF PROCEDURES

11.5.1 PURPOSE OF SECTION

To ensure that the odorising authority has written procedures for the operation of odorisation equipment and handling of odorant.

The odorising authority should ensure that the information in this Manual is supplied to the relevant personnel.

11.6 HYPOCHLORITE FOR NEUTRALIZING (DEODORIZING) ODORANT

11.6.1 PURPOSE OF SECTION

To specify procedures for selecting, preparing and using hypochlorite neutralizing (deodorizing) agents for treating residual and spilled odorant.

11.6.2 LIMITATIONS OF HYPOCHLORITE TREATMENT

Hypochlorite oxidises odorants to less odorous and less harmful compounds (disulphides). Hypochlorite treatment will not totally eliminate odour or danger.

11.6.3 HYPOCHLORITE STRENGTH AS AVAILABLE CHLORINE

It is common to specify hypochlorite strength as either grams/litre (g/L) available chlorine (or free available chlorine) or % available chlorine. Where the concentration of available chlorine is not given on packaging, manufacturers can this provide information.

11.6.4 AVAILABLE CHLORINE AND STORAGE LIFE

Solid hypochlorite may be stored indefinitely. The storage life of hypochlorite solutions decreases as the concentration and storage temperature increases. The storage life of the solution may determined from the manufacturer's data on half-life at specified temperatures.

The following is a list of readily obtainable hypochlorite neutralizing agents, with guideline information on strength and approximate storage lives (away from heat and sunlight):

(a) Household bleach. Approx. 3 % available chlorine (30 g/L sodium hypochlorite). Long term storage.

(b) Sodium hypochlorite solution (industrial bleach). A range of strengths from 5 % to 16 % available chlorine. Maximum storage life is approximately 15 months and 6 weeks respectively. The strongest industrial bleach solutions (12 - 16 % available chlorine) should only be obtained for use on delivery.

(c) Calcium hypochlorite or HTH. Available as powder, granules or pills. Typically 70 % available chlorine. May be stored indefinitely under dry conditions. Calcium hypochlorite solutions should always be prepared fresh to avoid loss of strength.

11.6.5 SELECTION OF HYPOCHLORITE NEUTRALIZING AGENTS

To avoid storage life problems, fresh solutions can be made by dissolving calcium hypochlorite in water.

If storage life is not a problem, it may be convenient to use industrial sodium hypochlorite solutions.

If only minor quantities of hypochlorite are needed, household bleach may suffice.

11.6.6 DETERMINATION OF RELATIVE STRENGTH OF NEUTRALIZING AGENTS

To convert from % mass calcium hypochlorite to % active chlorine, multiply by 0.7.

By coincidence, 1 % mass sodium hypochlorite (10 g/L) has 1 % available chlorine. Therefore, no conversion factor is required.

Relative strengths of sodium hypochlorite and calcium hypochlorite neutralizing agents may be determined using the above information.

For example, the strongest hypochlorite neutralizing agent specified in this manual is a solution made up by dissolving 1 kg of calcium hypochlorite in 7 to 8 litres of water (an average sized plastic bucket). This could be substituted by 25 litres of household bleach or by 4.5 litres of the strongest available sodium hypochlorite solution.

Various granulated oxidants (available through retail outlets which supply chemicals for pool cleaning) may be substituted for calcium hypochlorite. Packaging information should include the strength in calcium hypochlorite equivalence.

11.6.7 RELATIONSHIP BETWEEN AMOUNT OF HYPOCHLORITE STRENGTH, AMOUNT OF ODORANT AND ODORANT TYPE

Hypochlorite strengths specified in this manual apply to all types of odorant except tetrahydrothiophene (where half the amount of hypochlorite is used).

The volume of a 4 % mass calcium hypochlorite solution should be approximately 40 times the volume of odorant to be neutralized.

11.6.8 SAFETY

The concentration of hypochlorite solutions should be limited to strengths specified in this manual. In no case should hypochlorite with more than 10% available chlorine be added to odorant as the reaction could be violent and the heat of reaction could cause ignition.

Hypochlorite is harmful under the following circumstances: contact with the eyes (contact lenses pose a special hazard) and skin; inhalation of powders or the vapours of strong solutions.

Protective clothing and chemical goggles should be used with solid and liquid hypochlorite and a full face mask should be used with industrial strength solutions.

When handling calcium hypochlorite in powder form (bleaching powder), an SAA approved dust respirator should be used to protect against the danger of inhalation.

Hypochlorite should be handled in well ventilated areas.

Legal requirements apply to the storage, handling and transport of large quantities of concentrated hypochlorite. The storage and handling of hypochlorite above 39% available chlorine must comply with the requirements for Class 5A materials under the Dangerous Goods Act and Regulations. The NZ Standard, NZS 5433: Transport of Hazardous Substances on Land, is also relevant.

It is hazardous to store solid hypochlorite under damp conditions.

11.7 MAINTENANCE AND SERVICING OF ODORISATION INSTALLATIONS

11.7.1 ROUTINE INSPECTION

Active and standby odoriser installations should be inspected at minimum intervals of one month.

Inspections should include:

(a) In the case of active injection odorisers, a check of the odorant injection rate.

(b) A check of the condition of all visible piping and fittings to ensure that the installation is free of leaks and external corrosion.

(c) Where the size of the installation warrants on site storage, a check of material for handling odorant.

(d) Prior to departure, a check for any combustible material and the security of the installation.

A system of inspection for underground active and standby odoriser installations should be implemented to ensure that the installation remains in operational and serviceable condition.

Immediate steps should be taken to rectify all faults found on inspection of odoriser installations.

Maintenance and servicing should be carried out in accordance with manufacturers' recommendations.

Service routines should be implemented and carried out for liquid injection odorisers to maintain the efficiency of mechanical, pneumatic, and electrical systems.

11.7.2 PERIODIC ACTIVATION OF STANDBY ODORISERS

Standby odorisers should be periodically activated to ensure that they are in proper working order and to prevent gumming of odorant in tanks and lines.

The interval between periodic activation should be no more than 6 months in the case of injection odorisers, and one year in the case of by-pass odorisers.

Odoriser filters should be replaced regularly to prevent clogging.

11.7.3 DISPLACEMENT AND DISPOSAL OF ODORANT DURING DISMANTLING

When an odoriser is decommissioned or dismantled for repair, all odorant should be displaced from the system, and action should be taken to prevent nuisance odours.

Odorant should be displaced from the system by introducing an inert gas or kerosene at the highest part in the system and removing odorant from the lowest part of the system.

Odorant displaced from odoriser systems should be disposed of by burning or reaction with hypochlorite.

If the odorant is disposed of by reaction with hypochlorite the following procedures should be followed:

The odorant should be displaced into a drum which is part filled with a 4 % mass calcium hypochlorite (or household bleach).

The volume of hypochlorite in the drum should be approximately 40 times the volume of odorant to be displaced (except for tetrahydrothiophene where 20 times the volume is used). There should be sufficient capacity in the drum to allow adequate agitation of the displaced odorant with the hypochlorite.

Where the volume of odorant and hypochlorite is more than a drum can effectively contain, sealed drums and a flare stack should be used (Procedures are given in section 14.6.2.).

When the empty system is to opened to atmosphere, it should be flushed with an approximately 4 % mass calcium hypochlorite solution or equivalent.

If possible this should be done prior to opening the system.

The volume of hypochlorite solution used should be at least four times the volume at that part of the system which is to be flushed.

All parts of the system removed should be completely immersed in the hypochlorite solution whether or not they are to be transported.

All pipework and parts of the system which have been washed with hypochlorite solution should be immediately flushed with copious quantities of water to prevent hypochlorite corrosion.

11.7.4 RECORD OF MAINTENANCE AND INSPECTION

A written record should be kept of maintenance and inspections of odoriser facilities.

11.8 ODORANT HANDLING

11.8.1 ODORANT TOXICITY

Odorants can reach toxic concentrations in an enclosed area, but are not toxic at concentrations used in commercially available natural gas.

Personnel should not work in atmospheres containing in excess of 8 mg/m^3 of mercaptan unless using breathing apparatus capable of providing an uncontaminated air supply.

Odorant concentrations may be determined using mercaptan detector tubes.

11.8.2 DESENSITIZATION TO SMELL AT HIGH CONCENTRATIONS

With time, the nose becomes desensitized to the smell of high concentrations of odorant. Thus, after prolonged exposure a dangerous concentration of gas may go unnoticed. Exposure to fresh air is required to counter this effect.

11.8.3 PROTECTIVE EQUIPMENT

Breathing apparatus capable of maintaining an uncontaminated air supply should be available when handling odorants in enclosed areas.

Personnel handling liquid odorant should wear eye protection, rubber or PVC gloves, gumboots and PVC overalls.

11.8.4 FIRST AID

If odorant should come in contact with the skin or eyes, the affected area should be flushed immediately and thoroughly with water. A doctor should be contacted if the eye is contacted or if the irritation persists from skin contact.

Should clothing become contaminated, the person affected should wash or shower immediately and change into clean clothing. Exposed areas such as the face and hands should be washed with soap and water. For further treatment, very weak potassium permanganate (Condy's Crystals) may be used and then washed off (a very weak solution will be a strawberry colour).

Personnel who handle odorant should hold a current first aid certificate from the Order of St John or New Zealand Red Cross. On application, these organizations could also provide specialist instruction for dealing with the toxic properties of odorant and hypochlorite.

Personnel should not handle odorant without supporting personnel who are capable of providing assistance should the need arise.

Personnel should not eat or drink when handling odorant.

11.8.5 ODORANT FIRE HAZARDS

Requirements for class 3A dangerous goods apply under the Dangerous Goods Class 3 Flammable Liquids Regulations 1985.

Odorants are classified as "Red Label Flammable Liquids" (as is petrol).

Smoking, the use of naked lights and all other sources of potential ignition (e.g. tools, clothing or electrical equipment which could emit or cause a spark) are prohibited in the vicinity of odorising facilities and odorants.

Tools used in the vicinity of odorant/air atmospheres should be either of the spark proof type or be kept damp to minimise the generation of sparks.

Do not use solid hypochlorite for neutralizing odorant. If solid hypochlorite is reacted with odorant, the resultant strong reaction may cause a fire.

11.8.6 EXPANSION OF LIQUID

Odorants have a high coefficient of thermal expansion. In order to avoid rupture from internal pressure, containers should not be filled above 85 % of their capacity.

11.8.7 ON SITE EQUIPMENT

The following items should be on site when working on odorant facilities or with odorants: A dry powder fire extinguisher, hypochlorite solution, fresh water, detergent and soap. If water is not on tap a 200 litre container of fresh water should be available.

11.9 ODORANT SPILLAGE

11.9.1 MAJOR ODORANT SPILLS

Gas suppliers or companies which handle odorant should have contingency procedures for handling major odorant spillages.

Contingency procedures should include the availability of trained personnel and equipment for cleaning up and disposing spilled odorant, commensurate with the size and risk of potential spillages.

Equipment should include hypochlorite solution, concentrated detergent, water, containers for odorant-soaked and other contaminated items.

Gelling agent, kerosene, bunding materials, air supplied masks and materials for absorbing odorant may also be required depending on the size and nature of potential spillages.

The spillage area should be cleared of all people except those authorised to deal with the spill.

Precautions should be taken to ensure that no sources of ignition occur in the vicinity of the spillage.

The following agencies should be advised of a major spillage as soon as possible: gas supply company emergency contact, police, fire service, regional and local territorial authorities.

In their communication with the fire service, the gas supply company should point out that the spillage area be treated with hypochlorite solution or similar as stated in clause 9.1.12.

Major spills should be confined where possible by bunding.

Where the odorant has been spilled onto a hard surface, the preferred treatment method (subject to the availability of materials) is to use a gelling agent for picking up and neutralising the spilled odorant.

The method uses a liquid which is sprayed under pressure on the spill followed by water fogging of the contaminated area. The water causes the formation of a gel which is flammable at about 77°C and can be burned in place, scraped up and burned in a safe location, or otherwise disposed of.

Where spilled odorant can be ignited, it should be burnt. Kerosene can be added to control the rate of burning and vaporization of the odorant.

The following treatment method is applicable where spilled odorant on a hard surface can not be burnt and where a gelling/neutralising agent is not available:

Solutions of calcium or sodium hypochlorite mixed with some concentrated detergent (which acts as an emulsifier) may be sprayed or flooded on the spill area to oxidise the spilled odorant to relatively low odour compounds.

Dilute hypochlorite solutions are more effective than commercial or concentrated solutions. For example, 100 litres of an 0.5 % solution are more effective than 10 litres of a 5% solution. However, large volumes of water should not be used on uncontained odorant spills as the water will only carry the odorant and enlarge the area of the spill.

Use of hypochlorite solutions above 5% available chlorine should be avoided.

Where the odorant has spilled on a hard surface, commercial absorbent material should be used to absorb remaining neutralized liquid.

If commercial absorbent material is not readily to hand, then dry clay may be used.

Where the odorant has spilled on the earth it may be treated by turning over the earth, covering it with hypochlorite solution and then spraying it with kerosene or some other low vapour pressure hydrocarbon.

Spilled odorant and material which has been used to absorb spilled odorant should be disposed of in accordance with section 9.

An alternative to dumping the contaminated material (if no hazard is present) is to turn over the earth, mix it with more kerosene, spread the dirt out and ignite the mixture.

11.9.2 MINOR ODORANT SPILLS

A drip tray containing a weak solution of fresh calcium or sodium hypochlorite solution (e.g. 2:1 mix of household bleach) mixed with some detergent is effective in dealing with minor spillage.

Masking agents have been developed to obscure odours resulting from minor leaks and spills. The odour of the masking agent mixed with that of the odorant forms a less objectionable odour.

Masking agents do not destroy the odorant and therefore should not be used with dangerous concentrations of odorant.

11.10 AVOIDANCE OF NUISANCE ODOURS

All reasonable precautions should be taken in respect of odorant handling and transportation to minimise spillage.

Odorant contaminated items should be either neutralized with hypochlorite, incinerated, buried or otherwise disposed of in accordance with Sections xxx to xxx inclusive of this Manual so as to avoid giving rise to offensive or nuisance odours.

11.11 ODORANT STORAGE

11.11.1 GENERAL

Odorant should be stored and transported in accordance with procedures which minimise the risk of spillage.

Persons responsible for odorant storage should have a contingency plan covering spillage and odorant escape.

The Dangerous Goods Act contains requirements in respect of the licensing of odorant storage.

Odorant should be stored in areas where any spillage would cause the least possible public nuisance or environmental damage.

The storage area should be bunded to contain any spillage within a confined area.

Odorant storage equipment should be maintained in a vapour tight state at all times.

11.11.2 ODORANT STORAGE IN DRUMS

Where odorant is supplied in drums, equipment should be sized and odorant purchases scheduled so that the entire contents of the drum can be transferred when opened. When this is not practicable, careful attention should be given to retightening the bung and to periodic inspection at the bung gasket for leakage.

Stored odorant drums should be protected from the weather. Drums stored outside should be left in a horizontal position to avoid water accumulating on the drum top.

Odorant drums should be inspected for deterioration at intervals of no more than three months. The contents of substandard drums should be transferred to an odoriser tank or another drum as soon as practicable.

The storage of spent drums should be avoided. If immediate disposal of spent drums is not possible, the drums should be sealed about the bungs, marked and stored in sealed plastic bags.

11.12 ODORANT TRANSPORT

Odorant should be transported by either tanker or drum taking all reasonable precautions against spillage.

The transportation of odorant should be in compliance with the Dangerous Goods Act and Regulations, NZS 5418: Parts 1 (specification for tanks) and 2 (specification for small packages), and NZS 5433: Transport of Hazardous Substances on Land.

Personnel experienced in the handling of odorants and the materials and resources necessary to cope with any spillage should accompany all odorant deliveries.

The routes taken for transporting odorant should be forwarded to the Police and Fire Service.

The route decided upon should take cognisance of the impact of a spill. Centres of population, high traffic density routes, and environmentally sensitive areas should be avoided.

11.13 ODORANT TRANSFER

11.13.1 GENERAL

Odorant should be transferred in accordance with procedures which minimise the risk of spillage and the release of odorant vapour to the atmosphere.

Drip trays containing a 4 % mass calcium hypochlorite solution (or alternatively, household bleach) should be placed under pipe joints where minor odorant leaks might occur.

Transfer lines and fittings containing residual odorant should be blown through with inert gas and/or flushed with hypochlorite solution followed by water.

Odorant handling operations during high temperature periods should be minimised as much as possible.

11.13.2 ODORANT TRANSFER FROM DRUMS

Where possible, prior to opening, odorant drums should be removed from direct summer sunlight.

Before a drum is unbunged in warm conditions or in direct sunlight, it should be sprayed with cool water for a period of 5 minutes to lower the vapour pressure.

A purpose fabricated drum spanner should be used for removing the bung.

The person transferring odorant should take up a position which avoids unnecessary exposure to odorant vapours.

The recommended method for transferring odorant from drums consists of a dip pipe assembly fitted with an odorant-tight bung fitting (Figure 1).

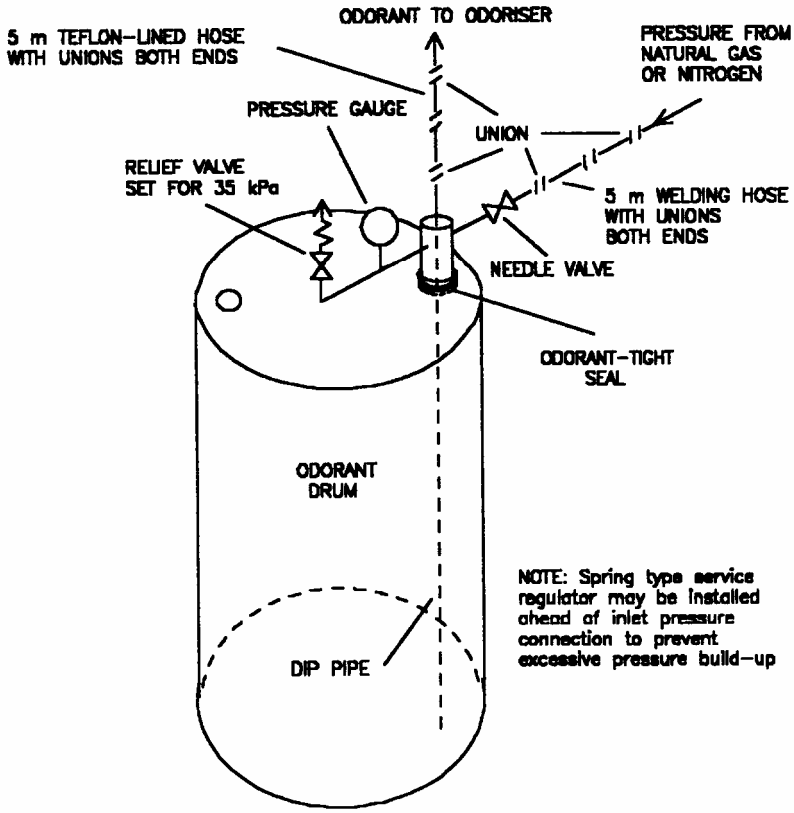


Figure 1 Odorant drum unloading assembly

The dip pipe extends to the bottom of the drum to ensure that the drum is thoroughly emptied when it is tilted.

The device will work with a regulated gas supply of either natural gas or nitrogen by forcing odorant up the dip pipe. The supply pressure should not exceed 30 kPa (gauge). The system should have a relief valve which will open at 35 kPa gauge pressure to avoid rupture of the drum.

Residual odorant in drums should be eliminated in accordance with section 14.

11.13.3 ODORANT TRANSFER FROM TANKERS

Odorant tankers should comply with the Dangerous Goods Act and Regulations.

Odorant should be transferred from tankers so that the pressure of the storage tank into which the odorant is transferred does not exceed 200 kPa (gauge).

The tanker should be earthed in accordance with section 4.4.

11.14 TREATMENT AND DISPOSAL OF CONTAMINATED ITEMS

Odorant in used odorant drums should be neutralized with hypochlorite before disposal.

Non combustible contaminated items should be disposed of in pits or land disposal sites approved by the local territorial authority.

In sparsely populated areas combustible contaminated items should be burned with kerosine. The combustion gives rise to considerable smoke and some odour.

Contaminated liquids or other items should not be disposed of into storm water systems, inland waters or coastal waters.

Odorants and odorant containing items should not be flushed into sewers. Other contaminated liquids should not be flushed into sewers without prior arrangements with the relevant controlling authority.

11.14.1 DRUM EMPTYING

Before any deodorising procedure is started a quick check of the drum should be made to make sure it has been adequately emptied. An easy way to do this is to stand the drum in a flat, level spot, and insert a dip stick through a bung hole until the stick touches the bottom of the drum. The height of the liquid remaining in an unloaded 230 litre drum should not be over 1.5 mm. Ideally, the liquid height should be 0.7 mm.

If the drum contains more than 1/2 litre of liquid odorant it should be either unloaded further or purged and flared from the drum with natural gas.

Purging will be valuable even when less than 1/2 litre of liquid odorant remains in the drum.

If purging the gas is convenient, the procedures in following parts of section 14 may be used for the subsequent elimination of residual odorant.

For the purposes of purging the drum, the dip pipe assembly described in section 13 may be used for flowing natural gas into the drum. Residual odorant is flowed from a pipe inserted near the base of the drum to the flare.

Natural gas is run through the drum for a minimum of five minutes at a time, burning the gas with the flare.

Returnable containers are available from some suppliers in the United States. They are equipped with dip sticks and valved for pressure unloading thereby eliminating the odour problem associated with drums.

11.14.2 DEODORISING DRUMS WITH HYPOCHLORITE

The following deodorising procedure apply to 230 litre drums (but is adaptable for use with smaller drums):

1. Remove the large bung and add 40 litres of clean water to the empty 230 litre drum. Change both bung gaskets.

2. Add 0.25 litres of a concentrated detergent to the water in the drum.

3. Insert the bung. Agitate the contents of the drum thoroughly, wetting all interior surfaces, by up-ending the drum 2 or 3 times and rolling it approximately 3 metres and back.

4. Place 15 litres of clean water in a clean plastic container, and gradually add 2 kilograms of calcium hypochlorite (alternatively, use other hypochlorite of equivalent strength).

5. Mix thoroughly until the calcium hypochlorite is dissolved.

6. Remove the bung. Add the 15 litres of fresh calcium hypochlorite solution to the drum, using a large funnel if desired. Avoid splashing.

7. Insert the bung and agitate the contents of the drum thoroughly by upending and rolling the drum approximately 3 metres and back.

8. Place the drum upright, loosen the bungs and let the drum stand for two hours (or overnight if convenient). Then remove a bung and carefully smell the contents of the drum to determine if odorant odour has been removed. There may be a chlorine smell; however, this will not be too offensive and will normally disappear soon after the next steps.

9. If no odorant odour is present, dump the contents of the drum in accordance with section 13. Then fill the empty drum with water, and dump again.

10. If odorant is still present, the amount of calcium hypochlorite solution used was insufficient to neutralize the odorant remaining in the drum. In this case, first check to make sure that sufficient space is available in the drum for adding more calcium hypochlorite solution. Then dissolve 1 kilogram of calcium hypochlorite in 7 or 8 litres of water, add this solution to the drum, agitate contents of drum as in Step 7 above, and proceed again as in Step 8. Step 10 may be repeated if necessary, adding calcium hypochlorite solution in 7 or 8 litre quantities each time. Never dump contents of drum if an odorant smell is still present.

11.14.3 DEODORISING DRUMS BY BURNING

This method of deodorising drums is recommended for use only in remote areas, since it results in considerable smoke and some odour from the combustion products.

To treat drums:

1. Remove the entire head of the drum with a commercial drum-cutting device. Odorants are flammable, and care should be taken not to create any sparks in removing the head.

2. Add 1/2 litre or more of kerosene to the drum.

3. Ignite and burn out the contents.

4. Torch out the seams of the drum.

11.14.4 DEODORISING DRUMS BY PURGING AND HYPOCHLORITE TREATMENT

After the drum is emptied add, kerosene and purge for twenty to thirty minutes. If the drum is then deodorised it may be disposed of. If the odorant smell remains add 2 % mass calcium hypochlorite or equivalent to the level of the flare outlet hole.

Allow the hypochlorite solution to stand for two hours, or if convenient overnight. If a slight odour remains the drum may be left standing in the open for a week for the odour to disappear.

APPENDIX A - REFERENCE STANDARDS AND SPECIFICATIONS

STANDARDS AND SPECIFICATIONS
Standards and specifications nominated for use under this Standard are listed in Appendix A. Some Standards listed in Appendix A are supplemented by specific requirements elsewhere in this Standard. Users of this Standard are advised against attempting direct application of any of these Standards without carefully observing the reference herein to that Standard. All Standards are taken to be the current edition unless otherwise approved or indicated.

NOTE

1. Users of these Standards and Specifications are advised against attempting direct application of any of these Standards or Specifications without carefully observing the reference herein to that Standard or Specification.
2. In each case the latest edition of the Standard or Specification should be used.

DESIGN CODES

ANSI/ASME B31.1	Power piping
ANSI/ASME B31.8	Gas transmission and distribution piping systems
AS 1210	Unfired pressure vessels (known as the SAA Unfired pressure vessels code)
AS 1596	SAA LPG Code
AS 1958	SAA Submarine pipeline code
AS 2018	SAA Liquid petroleum pipeline code
ASME	Boiler and pressure vessel code Section VIII - Pressure vessels: Division 1
BS 5500	Unfired fusion welded pressure vessels

STEEL PIPE

ANSI/ASME B36.10M	Welded and seamless wrought steel pipe
ANSI/ASME B36.19M	Stainless steel pipe
AS 1074	Steel tubes and tubulars for ordinary service
AS 1579	Arc welded steel pipes and fittings for water and waste water
ASTM A53	Specification for pipe, steel, black and hot-dipped zinc-coated welded and seamless
ASTM A106	Specification for seamless carbon steel pipe for high-temperature service
ASTM A135	Specification for electric-resistance-welded steel pipe
ASTM A269	Seamless and welded austenitic stainless steel tubing for general service
ASTM A381	Specification for metal-arc-welded steel pipe for use with high-pressure transmission systems
ASTM A524	Specification for seamless carbon steel pipe for atmospheric and lower temperatures
API 5L	Specification for line pipe
BS 21	Pipe threads for tubes and fittings where pressure-tight joints are made on the threads
BS 1387	Steel tubes and tubulars suitable for screwing to BS 21 pipe threads
BS 3601	Carbon steel pipes and tubes with specified room temperature properties for pressure purposes

BS 3602	Specification for steel pipes and tubes for pressure purposes

STEEL FITTINGS

ANSI/ASME B16.9	Factory-made wrought steel buttwelding fittings
ANSI/ASME B16.11	Forged fittings, socket-welding and threaded
ANSI/ASME B16.25	Buttwelding ends
ANSI/ASME B16.28	Wrought steel buttwelding short radius elbows and returns
ASTM A234	Specification for piping fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM A420	Specification for piping fittings of wrought carbon steel and alloy steel for low-temperature service
BS 1640	Steel butt-welding pipe fittings for the petroleum industry Part 2: Wrought and case austenitic chromium-nickel steel fittings Part 3: Wrought carbon and ferritic alloy steel fittings
BS 1965	Butt-welding pipe fittings for pressure purposes Part 1: Carbon steel (related to fittings for use with pipe made to BS 3601)
BS 3799	Steel pipe fittings, screwed and socket-welding for the petroleum industry
MSS SP-75	Specification for high test wrought butt-welding fittings

STEEL FLANGES

ANSI/ASME B16.5	Steel pipe flanges and flanged fittings, including ratings for class 150, 300, 400, 600, 900, 1500 and 2500
ANSI/ASME B16.25	Buttwelding ends
AS 2129	Flanges for pipes, valves and fittings
ASTM A181	Specification for forgings, carbon steel for general purpose piping
BS 1560	Circular flanges for pipes, valves and fittings (class designated) Part 3; Section 3.1: Steel flanges
BS 3293	Carbon steel pipe flanges (over 24 inches nominal size) for the petroleum industry
ISO 7005	Metallic flanges Part 1: Steel flanges
MSS SP-6	Standard finishes for contact faces of pipe flanges and connecting-end flanges of valves and fittings
MSS SP-44	Steel pipe line flanges

GASKETS

ANSI/ASME B16.20	Metallic gaskets for pipe flanges - Ring joint, spiral wounds and jacketed
ANSI/ASME B16.21	Non-metallic flat gaskets for pipe flanges
BS 1832	Compressed asbestos fibre jointing
BS 3063	Dimensions of gaskets for pipe flanges
BS 3381	Specification for spiral wound gaskets for steel flanges to BS 1560
MSS SP-25	Standard marking system for valves, fittings, flanges and unions

BOLTING

ANSI B18.2.1	Square and hexagon bolts and screws - inch series
ANSI B18.2.2	Square and hexagon nuts
AS 2129	Flanges for pipes, valves and fittings
ASTM A193	Specification for alloy-steel and stainless steel bolting materials for high-temperature service
ASTM A194	Specification for carbon and alloy steel nuts for bolts for high-pressure and high-temperature service
ASTM A307	Specification for carbon steel bolts and studs
ASTM A320	Specification for alloys - Steel bolting materials for low-

	temperature service
ASTM A354	Specification for quenched and tempered alloy steel bolts, studs and other externally threaded fasteners
ASTM A449	Specification for quenched and tempered steel bolts, and otherexternally threaded fasteners
BS 4882	Bolting for flanges and pressure containing purposes

FORGINGS AND CASTINGS

AS 1832	Iron castings - Malleable cast iron

STEEL VALVES

API 6D	Specifications for pipeline valves
ANSI/ASME B16.10	Face-to-face and end-to-end dimensions of valves
ANSI/ASME B16.34	Valves. Flanged, threaded and welding ends
BS 1414	Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 1868	Steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 1873	Steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS 5351	Steel ball valves for the petroleum, petrochemical and allied industries
BS 5352	Specification for steel wedge gate, globe and check valves 50mm and smaller for the petroleum, petrochemical and allied industries
BS 5353	Specification for steel plug valves
MSS SP-25	Standard marking systems for valves, fittings, flanges and unions
MSS SP-61	Hydrostatic testing of steel valves
MSS SP-66	Pressure temperature ratings for steel butt-welding end valves
MSS SP-67	Butterfly valves
MSS SP-82	Valve pressure testing methods

WELDING

ASME	Boiler and Pressure Vessels Code, Section IX, Welding and brazing qualification
BS 1821	Specification for class I oxy-acetylene welding of ferritic steel pipework for carrying fluids
BS 2633	Class I arc welding of ferritic steel pipework for carrying fluids
BS 2910	Methods for radiographic examination of fusion welded circumferential butt joints in steel pipes
AS 1167	Welding and brazing - Filler metals Part 2: Filler metal for welding
AS 1553	Covered electrodes for welding
AS 1966	Electric arc welding power sources
As 2826	Manual metal-arc welding electrode holders

PIPE THREADS

ANSI/ASME B1.1	Unified inch screw threads (UN and UNR thread forms)
ANSI/ASME B1.20.1	Pipe threads
ANSI B1.20.3	Dryseal pipe threads
AS 1722	Pipe threads of Whitworth form Part 1: Sealing pipe threads Part 2: Fastening pipe threads

CAST IRON PIPING

SYSTEMS	
ANSI/ASME B16.1	Cast iron pipe flanges and flanged fittings, Class 25, 125, 250 and 800
ANSI/ASME B16.3	Malleable-iron threaded fittings
ANSI B16.4	Grey iron threaded fittings
ASTM A395	Specification for ferritic ductile iron pressure-retaining castings for use at elevated temperatures
BS 143/1256	Malleable cast iron and cast copper alloy threaded pipe fittings
BS 4622	Grey iron pipes and fittings
BS 4772	Specification for ductile iron pipes and fittings
BSCP 2010	Pipelines Part 2: Design and construction of iron pipelines in land
COPPER AND COPPER ALLOY PIPING SYSTEMS	
ANSI/ASME B16.24	Cast copper alloy pipe flanges and flanged fittings Class 150, 300, 400, 600, 900, 1500 and 2500
BS 143/1256	Malleable cast iron and cast copper alloy threaded pipe fittings
BS 1306	Copper and copper alloy pressure piping systems
NZS 3501	Copper tubes for water, gas and sanitation
POLYETHYLENE PIPING SYSTEMS	
API 15LE	Specification for polyethylene line pipe
AS 1460	Fittings for use with polyethylene pipes Part 2: Electrofusion fittings
AS 1667	Polyethylene pipes and fittings for gas reticulation - Nominal series Parts 1 & 2
AS 2718	Polyethylene pipes and fittings for gas reticulation - Outside diameter series
AS 3723	Installation and maintenance of plastic pipe systems for gas
AS 4130	Polyethylene pipes - Pressure applications
ASTM D2513	Thermoplastic gas pressure pipe tubing and fittings
BS 7281	Polyethylene pipes for the supply of gaseous fuels
BS 7336	Polyethylene fusion fittings with integral heating element(s) for use with polyethylene pipes for the conveyance of gaseous fuels
NZS 7646	Polyethylene pipes and fittings for gas reticulation
POLYAMIDE (NYLON) PIPING SYSTEMS	
AS 2944	Plastic pipes and fittings for gas reticulation - Polyamide Part 1: Pipes Part 2: Fittings
OTHER GAS RELATED STANDARDS AND CODES	
NZS 5223	High pressure gas and petroleum liquids pipelines Part 1: High pressure gas pipelines
NZS 5259	Gas metering
NZS 5261	Code of practice for the installation of gas burning appliances and equipment
NZS 5425	Codes of practice for CNG compressor and refuelling stations, Parts 1-3

NZS 5435	Specification for liquefied petroleum gas
NZS 5442	Specification for reticulated natural gas
NZ GCP3	Code of practice for odorization of gas

CATHODIC PROTECTION

BS 7361	Cathodic protection Part 1: Code of practice for land and marine applications

ELECTRICAL

BS 5345	Selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres Part 3: Installation and maintenance requirements for electrical apparatus with type of protection ‘d’. Flameproof enclosure

HAZARDOUS AREA CLASSIFICATION

NZS 6101	Classification of hazardous areas Part 1: Flammable gas and vapour atmospheres

NEW ZEALAND LEGISLATION

Gas Act 1992
Gas Regulations 1993