Health and Safety Information

For Calor
Bulk Gas Users (Northern Ireland)

CALOR

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SECTION 1

INTRODUCTION

1.1 Liquefied Petroleum Gases

1.2 The ranges of gases marketed by Calor are all members of the same family of liquefied petroleum gases (LPG). They are usually produced during the refining processes of Crude Oil, but also occur as free gases in the gas fields associated with North Sea Oil.

1.3 They have the important physical characteristics of existing as liquids at atmospheric temperature if subjected to moderate compression and reverting to the gaseous phase when the pressure is sufficiently reduced. The practical significance of this is large quantities of high energy fuel may be readily transported and stored as a liquid, and subsequently become available for use as a gaseous fuel. The expansion in volume that takes place with the change from liquid to gaseous phase is approximately 250 times.

1.4 Calor's product range of Calor Propane, Calor Butane and Calor Autogas conform to the general specifications laid down in BS 4250: Specification for commercial butane and commercial propane (Current Edition).

1.5 All LPG is extremely flammable and is normally stored under moderate pressure. Consequently a small leakage in any liquid LPG system can allow large volumes of highly flammable gas to escape.

1.6 All commercial grades of LPG have a distinctive odour added at source to aid detection in the event of any escape of gas.

SECTION 2

TYPICAL PROPERTIES OF BUTANE AND PROPANE

2.1 Table of Properties

The following tables show typical physical properties for commercial grades of Calor Butane and Calor Propane. All metric units relate to Standard Temperature and Pressure Conditions at 15°C and 1013 mbar (dry). Imperial units relate to Normal Temperature and Pressure Conditions of 60 °F and 30 ins Hg (saturated).

TABLE 1. Butane Properties and Characteristics.

CALOR BUTANE	METRIC UNITS	IMPERIAL UNITS
Freezing Point at Atmospheric Pressure	-140°C	-220°F
Boiling Point at Atmospheric Pressure	-2°C	28°F
Specific Gravity of Gas (Air = 1)	2.0	2.0
Specific Gravity of Liquid (Water = 1)	0.575	0.575
Calorific Value (Vapourised)	121.5MJ/m^3 49.2 MJ/kg 28.2 MJ/litre	3200 Btu/ft^3 21150 Btu/1b 121610 Btu/gal
Latent Heat of Vapourisation at Boiling Point	0.39 MJ/kg	166 Btu/lb
Specific Heat of Gas	1.61 kJ/kg/°C	0.385 Btu/lb/°F
Specific Heat of Liquid	2.34 kJ/kg/°C	0.56 Btu/lb/°F
Density of Gas	2.45 kg/m^3	0.153 lb/ft^3
Density of Liquid	575 kg/m^3	36 lb/ft^3
Volume of Gas Produced per Mass of Liquid	0.41 m^3/kg	6.6 ft^3/lb
Volume of Gas Produced per Unit Volume of Liquid	233	233
Volume occupied per mass of Liquid	1743 litres/tonne	390 gal/ton
Volume of Air to burn Unit Volume of Gas	30	30
Volume of Oxygen to burn Unit Volume of Gas	6.25	6.25
Ignition Temperature	410-550°C	770-1022°F
Maximum Flame Temperature	1996°C	3625°F

TABLE 2. Propane Properties and Characteristics.

CALOR PROPANE	METRIC UNITS	IMPERIAL UNITS
Freezing Point at Atmospheric Pressure	-186˚C	-303˚F
Boiling Point at Atmospheric Pressure	-42˚C	-44˚F
Specific Gravity of Gas (Air = 1)	1.5	1.5
Specific Gravity of Liquid (Water = 1)	0.512	0.512
Calorific Value (Vapourised)	95 MJ/m^3 50 MJ/kg 25.5 MJ/litre	2500 Btu/ft^3 21500 Btu/lb 110080 Btu/gal
Latent Heat of Vapourisation at Boiling Point	0.43 MJ/kg	185 Btu/lb
Specific Heat of Gas	1.55 kJ/kg/˚C	0.37 Btu/lb/˚F
Specific Heat of Liquid	2.43 kJ/kg/˚C	0.58 Btu/lb/˚F
Density of Gas	1.85 kg/m^3	0.115 lb/ft^3
Density of Liquid	512 kg/m^3	32 lb/ft3
Volume of Gas Produced per Mass of Liquid	0.54 m^3/kg	8.6 ft^3/lb
Volume of Gas Produced per Unit Volume of Liquid	274	274
Volume occupied per mass of Liquid	1957 litres/tonne	437 gal/ton
Volume of Air to burn Unit Volume of Gas	23	23
Volume of Oxygen to burn Unit Volume of Gas	4.8	4.8
Ignition Temperature	460-580˚C	860-1076˚F
Maximum Flame Temperature	1980˚C	3600˚F

2.2 Combustion of LPG

2.2.1 LPG can only be ignited and subsequently burn when certain criteria are fulfilled. Firstly, gas must be mixed with air to make a flammable mixture. The proportions must lie within well defined limits, known as the Limits of Flammability and these are % Gas by volume in gas/air mixture:

	Lower Limit	Upper Limit
Commercial Butane	1.9	8.5
Commercial Propane	2.0	11.0

2.2.2 Secondly, this mixture should be presented with a source of ignition, or a part of it must be heated to a certain temperature known as the auto-ignition temperature. This temperature may vary according to the composition of the gas and the environmental conditions, but the range in air is:

Commercial Butane 410 - 550°C
Commercial Propane 460 - 580°C

2.2.3 To sustain combustion the above criteria must be maintained and also the products of combustion must be removed from the vicinity of the flame.

2.3 Density of LPG

2.3.1 LPG Vapour is heavier than air and thus in the event of escape of unignited gas, it will sink to the lowest possible point. Unless it is dispersed, the accumulation may remain for a considerable time.

2.3.2 Conversely, LPG liquid is lighter than water, so it may lie on top of water, similar to other oil products such as petrol and lubricating oil. However it must be remembered that water will always be at a temperature higher than the boiling point of LPG and propane will evaporate extremely rapidly if spilt on water, but butane could so remain on water appreciably longer.

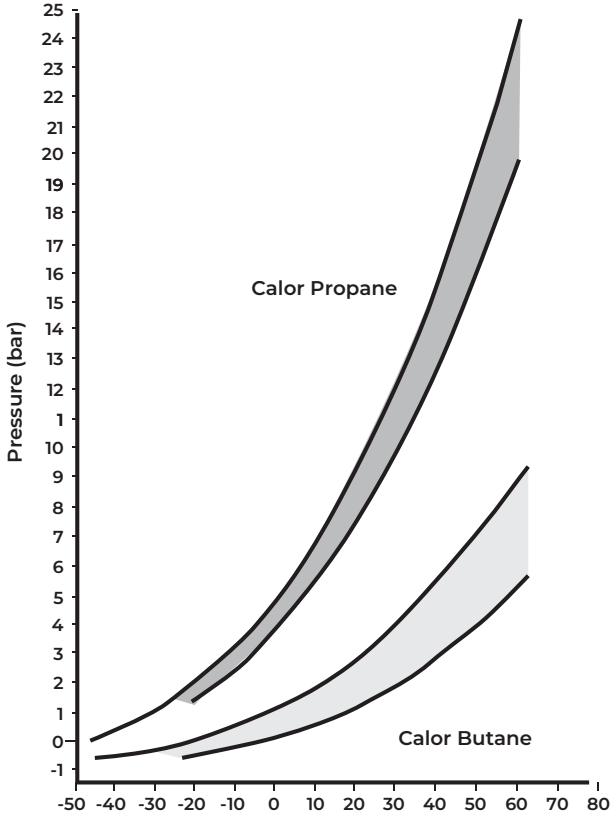
2.4 Vapour Pressure of LPG

2.4.1 The pressure that LPG exerts within the storage tanks varies with temperature. The higher the temperature the higher the pressure generated. The chart overleaf illustrates the variation in vapour pressure that occurs with change in temperature. It should be noted that, for butane at very low temperatures the pressure could fall below normal atmospheric pressure.

2.5 Coefficient of Expansion

2.5.1 Liquid LPG has a high coefficient of expansion i.e. the volume substantially increases when the temperature rises. For this reason, LPG storage tanks are never filled completely with liquid. A free space (or ullage) must always be left above the liquid level in the storage tank to allow for this expansion. Where small tanks are charged at customers' premises, they must never be filled beyond the fixed liquid level indicator.

2.6 Vapour Pressure Chart



Temperature

Vapour Pressures of Calor Butane and Calor Propane

SECTION 3

STORAGE, HANDLING AND MAINTENANCE

3.1 Storage

3.1.1 The Liquefied Petroleum Gas Association publication Code of Practice No.1 (Pt 1) covers siting of LPG storage tanks above ground and Code of Practice 1 (Pt 4) covers siting of mounded or buried LPG storage tank.

All users of LPG must be familiar with the detailed recommendations given in these publications and some of the more important aspects are detailed below for storage tanks above ground. For more detailed information on mounded or buried tanks with regard to underground services and installations, flooding and protection from damage by vehicles consult COP1 Pt 4.

3.1.2 Storage tanks must be located in accordance with 3.1.8 Table 3 based upon the capacity of storage concerned.

3.1.3 The separation distances given in Table 3 must be maintained at all times and no building extensions, fixed ignition sources etc must ever be allowed to encroach within.

3.1.4 Within the distances stated of the following sized vessels: 2,5 metres from tanks up to 500 litres water capacity or 3 metres from tanks between 500 and 2,500 litres water capacity or 6 metres of all larger vessels the whole of the area must be maintained at ALL times free from weeds, long grass or any combustible materials. Tanks must not be sited adjacent to pits, depressions or drains.

3.1.5 Tanks must be enclosed with industrial type fencing at locations where the public may have uncontrolled access or in all cases where the risk of trespass is high.

At industrial sites where there is adequate surveillance of the installation the site perimeter fence may be acceptable for security.

The requirement for a fence may be relaxed for vessels of less than 9000 litres water capacity provided that access to the valves and fittings is denied for example a substantial lockable cover or other appropriate means.

This relaxation is not permitted where the public have uncontrolled access.

3.1.6 Where damage to LPG installations from vehicular traffic is a possibility, precautions against such damage must be taken. The degree of protection required will depend on the actual site conditions, including the density or nature of the traffic and the overhang or reach of any vehicle. Strategically located motorway type crash barriers, concrete or steel bollards will be suitable for most installations.

3.1.7 An earth point that is provided for the discharge of static electricity will be suitably marked and readily accessible at all times.

3.1.8 **TABLE 3.** Distances from Buildings, Boundaries and Sources of Ignition

Maximum Propane Capacity			**Minimum Separation Distances**		
Of any single vessel in a group		**Of all vessels in a group up to a max. of 6**			
LPG Capacity (a)	**Typical Water Capacity (b)**	**LPG Capacity (c)**	From buildings, boundary, property line or fixed source of ignition - **without a radiation wall (d)**	From buildings, boundary, property line or fixed source of ignition - **with a radiation wall (e)**	**Spacing between vessels (f)**
Tonnes	**Litres**	**Tonnes**	**metres**	**metres**	**metres**
0,05 to 0,25	150 to 500	0,8	2,5	0,3	1
>0,25 to 1,1	>500 to 2 500	3,5	3	1,5	1
>1,1 to 4	>2 500 to 9 000	12,5	7,5	4	1
>4 to 60	>9 000 to 135 000	200	15	7,5	1,5
>60 to 150	>135 000 to 337 500	460	22,5	11	¼ of sum of the diameter of 2 adjacent vessels
>150	>337 500	1 000	30 (see 2.3.1.4)	15 (see 2.3.1.5)	As above

More detailed guidance on minimum separation distances and the use of fire and dispersion walls can be obtained in LGUK Code of Practice 1.
Distances from underground tanks to buildings / walls may need to be increased to prevent adverse effects on the structures' foundations.
*The person responsible for the design must consider site conditions when determining the distance between large underground tanks.
For any assistance in assessing the location of a gas tank please contact Calor Gas.

3.1.9 Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) (Northern Ireland) 2003

(DSEAR) requires employers to identify and classify areas of the workplace where explosive atmospheres may occur and avoid ignition sources (from unprotected equipment, for example) in those areas. The 'Ex' sign described in DSEAR need not be displayed if suitable warning signs are in place to warn people of the flammable nature of any release from the tank or fittings.

LGUK Code of Practice 1 Part 1 'Bulk LPG Storage at Fixed Installations - Design, Installation and Operation of Vessels Located Above Ground' lists hazardous zones for LPG. DSEAR defines areas in which there is a need to install 'protected' electrical equipment as follows:

TABLE 4. Area Classification - Above Ground Tank

Factor	Extent of Classified Area	Area Classification
Discharge orifice of liquid level detection devices (e.g. fixed liquid level gauges or rotary or slip gauges).	Within 0.5m of the point of discharge.	Zone 1
Vessel Relief Valve.	Within direct path of discharge. Note: The circumstances under which a relief valve opens to give full discharge is considered an abnormal event, so above a relief valve is classified as a nonhazardous area.	Fixed electrical equipment should not be installed, to avoid damage or ignition in the unlikely event of a full discharge.
Hydrostatic (thermal) Relief Valve.	Within 0.5m of the point of discharge*. *Distance and zone from IP15	Zone 2
Tank Vehicle Loading / Unloading Connections.	Within 0.5m in all directions from a point where connections are made or disconnected for product transfer.	Zone 1
Vessel Flanges.	Within 0.5m in all directions.	Zone 2
Pumps.	Within 0.5m in all directions around any wetted external pump shaft.	Zone 1
Vaporiser (excluding direct fired).	Within 0.5m in all directions.	Zone 2
Liquid Meter	Within 0.5m in all directions unless a specific DSEAR risk assessment determines a different value.	Zone 2

For liquid offtake installations such as Fork Lift Truck refuelling and Autogas an additional Temporary Zone 1 exists 0.5m in all directions of the filling nozzle at the end of a dispensing hose. The reach of hose will be a determining factor.

Additionally: only equipment suitable for use in zoned areas and constructed to a recognised standard shall be installed within:

- 0.5m of any point on the vessel surface;
- The area beneath the vessel;
- The area above ground level measured at the vessel surface and decreasing to zero at the safety distance for the size of tank (see Table 3 above).

LGUK Code of Practice 1 Part 4 'Bulk LPG Storage at Fixed Installations - Buried/Mounded LPG Storage Vessels' lists hazardous zones for LPG as follows:

TABLE 5. Area Classification - Below Ground Tanks

Factor	Extent of Classified Area	Area Classification
Valve boxes and access chambers.	Entire Volume When carrying out cathodic protection checks with a valve box lid open the valve box may be considered as unzone provided operating procedures require the lid to be opened before the test equipment is unloaded from the vehicle carrying it.	Zone 1
Discharge orifice of liquid level detection devices (e.g. fixed liquid level gauges or rotary or slip gauges.).	Within 1.5m of the point of discharge during operation only.	Zone 1
Tank Vehicle Loading/ Unloading Connections.	Within 1.5m in all directions from a point where connections are made or disconnected for product transfer during operation only.	Zone 1

3.2 Handling

3.2.1 The storage tanks are designed and constructed to relevant British or European Standards and they are equipped with various safety features to protect them. The most important safety feature is the pressure relief valve(s) which is designed to relieve safely any excess pressure caused by fires, abnormally hot weather, accidentally over filling etc.

Every consumer must familiarise themselves with the various fittings and valves fitted on their storage tank(s) including any ancillary systems. In particular they must clearly know the location of all isolation valves fitted to the tank(s) and distribution system.

In the event that a consumer closes any isolation valve, either on the tank(s) or in the distribution system, they must satisfy themselves that all outlet points downstream of the valve concerned are closed before re-opening the isolation valve.

Protective rain or dust caps, which are fitted to certain valves, must be in place at all times, other than when the valve is in use. Where valve hoods are fitted to tanks these must be kept locked with a padlock supplied by Calor and for which delivery drivers have a key. All couplings, which are used by the consumer must be kept clean and properly stowed away, to guard against damage, which could cause leakage to occur. Protective clothing must be worn at all times where the transfer of liquid LPG is involved.

3.2.2 Only authorised and competent persons must be allowed to adjust, modify, extend or service the installation.

In Northern Ireland only a Gas Safe registered business with competent personnel as defined by The Gas Safety (Installation & Use) Regulations (Northern Ireland) current edition must complete gas work. The competent person must carry an ID card showing the work categories that can be undertaken.

3.2.3 The LPG system must be visually examined on a regular basis for signs of leakage, damage or other deterioration. Never search for leaks with naked lights, leak detection fluid must be used. In the event that leakage is detected or suspected, a Gas Safe Engineer must be contacted to undertake the necessary repair works.

3.2.4 In the case of Autogas or Forklift truck cylinder type installations, LPG is used in its liquid form. It is important both for pumping efficiency and for safety reasons that all valves are left open during operation of the pumping system. Liquid LPG is also used for Grain Drying.

3.2.5 **NEVER OVERFILL AUTOGAS OR FORKLIFT TRUCK TANKS OR CYLINDERS**

3.3 Maintenance

3.3.1 LPG storage tanks are subjected to periodic examination requirements that may involve the exchange of the tank, the testing of the tank in situ and the testing or exchange of certain valves and fittings of the tanks.

LPG pumps and dispensing meters also require periodic maintenance and calibration checks.

Storage tanks, pumps and dispensing meters owned by Calor Gas NI Limited are maintained to industry codes of practice. However, in the unusual event that the consumer owns the tank, pump and dispensing meter or any of these then the responsibility for ensuring that adequate maintenance is carried out rests with that consumer. In the case of Grain Drying it is essential that Calor Gas are contacted when and if the tank requires relocating.

3.3.2 The gas distribution of all commercial liquid or vapour service LPG pipework, pressure regulators, isolation valves etc are owned by the consumer. The consumer must ensure appropriate maintenance provisions are in place.

Whilst the specific requirements will vary from consumer to consumer it is recommended that the whole of the gas distribution system be visually examined once per annum and subject to operational test at least once every five years. These examinations and tests must be recorded.

If underground metallic gas pipe exists it must be replaced. It must be subject to a strict documented inspection regime until such time as it is replaced.

The operating and safe working life of the distribution system including pipework, regulators and valves will vary with a number of factors such as conditions of duty, environment and standard of maintenance.

The consumer must give specific consideration to their own set of conditions and decide upon an appropriate maintenance and or replacement programme. The manufacturers usually recommend that regulators are replaced after ten years in service.

3.3.3 In most cases Calor owns the flexible hoses used for liquid LPG service. The exception is Grain Drying installations where the hose belongs to the consumer and is therefore their responsibility for the condition and the maintenance of the hose. However all consumers must visually examine the condition of the hoses daily and report any defects to Calor.

3.3.4 If the gas appliances or other gas burning equipment is owned by the customer, they must make appropriate maintenance provision based on the recommendations of the manufacturers instructions. The consumer must only use suitably qualified and experienced, competent personnel.

3.3.5 Failure to maintain any part of the LPG installation could lead to risk of serious hazard, leakage, fire and or explosion.

3.3.6 Every consumer must satisfy themselves of the appropriate responsibilities for the whole of their LPG installation. Calor recommend that any installation used with LPG is regularly checked and serviced by competent persons. In Northern Ireland the business must be Gas Safe registered.

Please contact Calor for further guidance.

SECTION 4

FIRE PROTECTION

4.1 It is recommended that the Fire Authority be consulted on the provision of fire protection facilities in the planning stages of the installation and from time to time thereafter.

4.2 There must be an adequate supply of water for fire protection for use in an emergency at all installations.

For domestic and those small commercial or industrial installations with vessels not exceeding 2500 litres a water supply from hydrants, ponds, canals or rivers within a distance of 100 metres should suffice.

There must be sufficient and suitable portable fire fighting equipment on the premises. This equipment must be selected and located to enable fires adjacent to the vessel to be extinguished and so prevent fire spreading to or jeopardising the LPG installation. Fire extinguishers or hose reels or an equivalent combination of the two types of equipment must be provided.

Installations having a capacity greater than 2500 litres but less than 56250 litres (25 tonnes) with only vapour off-take will require a water supply for Fire Brigade use including a 19mm hose reel.

At bulk installations with inventories greater than 25 tonnes but less than 50 tonnes, means must be provided to apply cooling water to the vessels again by fixed or mobile monitors or other means.

At bulk installations with inventories of more than 50 tonnes, vessels must be provided with fixed, fully automatic water spray systems capable of detecting a fire threatening the vessels and operating the sprays without manual intervention.

4.3 An adequate number of 9KG Dry Powder Fire Extinguishers as suitable to use on LPG fires, must be located at strategic points adjacent to the installation.

Consult LGUK Code of Practice 1: Bulk LPG Storage at Fixed Installations, for more details.

4.4 Hazard warning notices must be displayed in prominent positions around all bulk tank installations. All safety signs and notices must conform to current Health and Safety (Safety Signs and Signals) Regulations (Northern Ireland) 1996.

SECTION 5

EMERGENCY ACTION

5.1 In any emergency situation the first priority must be to avoid endangering human life and the destruction of property. It is the responsibility of the consumer to have a clearly defined 'Emergency Procedure' in place. However the following course of action is considered appropriate:

(a) Always summon help and the fire fighting services.

(b) Wherever possible turn off all 'Emergency Valves' and all distribution and appliance isolation valves necessary to cut off or reduce the source of escaping gas.

(c) Evacuate all persons from any area, which is in the path of any gas accumulation except those necessary to deal with the emergency.

5.2 Always approach a fire or gas cloud from upwind. Fires should be controlled but not extinguished until the source of the gas escape can be cut off.

5.3 When any incident occurs whether it involves fire or not; Calor must be contacted as soon as possible. If the incident occurs outside normal office hours the appropriate Calor Emergency Service Number must be contacted as stated below.

NORTHERN IRELAND
CALOR EMERGENCY SERVICE

0845 075 5588

SECTION 6

PERSONNEL WELFARE

6.1 Ventilation

6.1.1 Whenever LPG is burnt the fuel and oxygen from the air are consumed to produce what are known as 'products of combustion'. These products are normally harmless but must be properly dispersed by means of a flue and adequate ventilation and not allowed to accumulate in or around the vicinity of an appliance. The area must be adequately ventilated. If the ventilation is restricted combustion can be 'incomplete' and the formation of carbon monoxide is a real possibility. Carbon monoxide (CO) is highly toxic and will endanger the lives of humans and animals if inhaled.

Carbon Monoxide is tasteless and odourless.
Carbon Monoxide will kill.

6.1.2 In all cases ventilation requirements as per the manufacturer instructions shall be adhered to.

6.1.3 **BS 5440-1:** Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) Specification for installation of gas appliances to chimneys and for maintenance of chimneys

BS 5440-2: Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) Specification for the installation and maintenance of ventilation provision for gas appliances

BS 6644: Specification for the installation and maintenance of gas-fired hot water boilers of rated inputs between 70 kw (net) and 1.8 Mw (net) (2nd and 3rd family gases)

BS 6896: Specification for installation and maintenance of gas-fired overhead radiant heaters for industrial and commercial heating (2nd and 3rd family gases)

6.2 LPG Inhalation

6.2.1 LPG inhalation may cause irritation to the nose and throat, headache, nausea, vomiting, dizziness, euphoria, drowsiness. In poorly ventilated or confined spaces, unconsciousness and asphyxiation may result.

6.2.2 The first aid measure for inhalation is to move the person to fresh air, keeping them warm and at rest. Where there is loss of consciousness give oxygen or if breathing ceases or shows signs of failing commence artificial respiration. Summon expert medical attention immediately.

6.3 Skin contact

6.3.1 A strong refrigerant effect is produced when liquid LPG comes into contact with the skin. This is created by the rapid evaporation of the liquid and it can cause severe frostbite depending on the level of exposure.

First aid treatment must be carried out immediately by placing the affected part gently under slow running cool water or by immersing in cool water keeping it there for at least ten minutes or until the pain ceases. If this is not done then in severe cases tissue damage will take place before medical aid can be obtained.

6.3.2 In all but minor cases, professional medical treatment must be sought.

6.4 Personal Protective Equipment (PPE)

6.4.1 Personal protective equipment must be worn at all times when handling LPG liquid.
Wear the following items of clothing:
Gauntlet type neoprene gloves, goggles or face visor, long sleeved cotton Antistatic and Flame Retardant (ASFR) overalls including Hi-vis protection and safety boots or shoes.

6.4.2 When handling cylinders cotton overalls, safety shoes or boots and gloves must be worn.

NOTES:

Printed on environment-friendly paper

Calor contact:

For information, advice and support on all Calor products and services, contact our Customer Support Team.

NI: 028 9045 5588

Email: customerengineering@calorgas.ie

Calor Gas Northern Ireland Limited
Airport Road West
Sydenham
BT3 9EE

In the event of an emergency outside office hours, please dial:

NI: 0845 075 5588

www.calorgas.ie

CALOR