

Calor LPG THE COMPLETE ENERGY SOLUTION



LPG in Commercial
and Industrial Applications



now you can

Course Content

- Unit 1 - **LPG Product Knowledge**
- Unit 2 - **Gas Regulations & Standards**
- Unit 3 - **Bulk Tank Installations**
- Unit 4 - **Cylinder Storage**
- Unit 5 - **Pipe Work**
- Unit 6 - **Utilisation**



UNIT 1 : LPG PRODUCT KNOWLEDGE

LPG What is it?



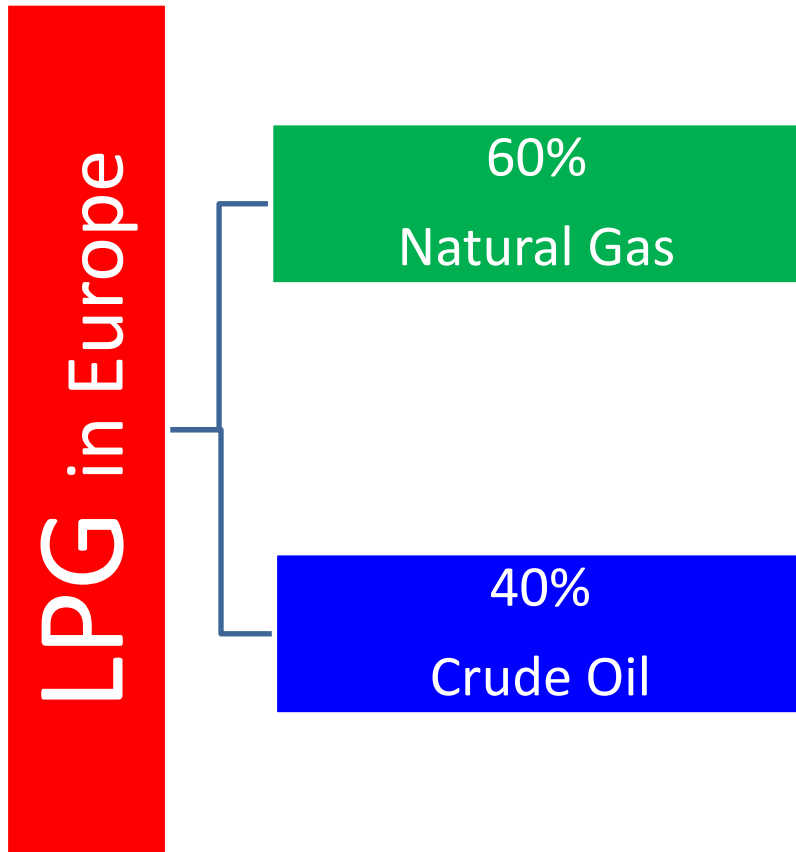
LPG
EXCEPTIONAL
ENERGY



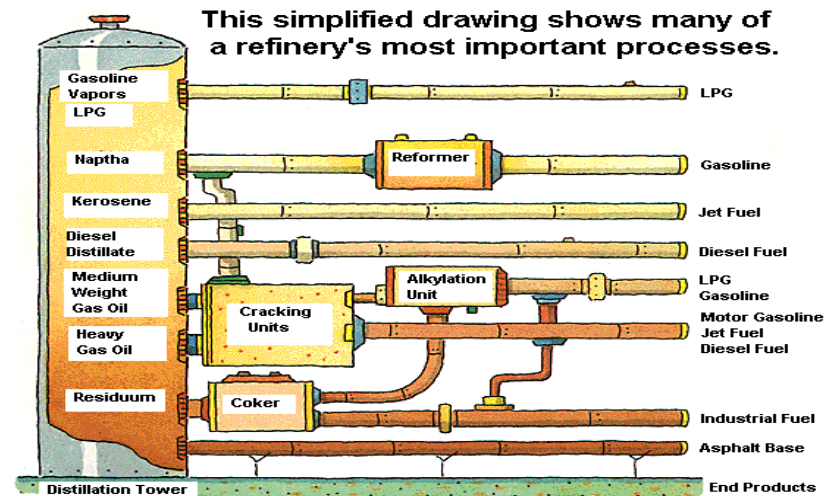
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UNIT 1 : WHERE DOES LPG COME FROM?



LPG is a naturally occurring by-product of natural gas extraction (60%) and crude oil refining (40%) Therefore we either use it or it is wasted.



UNIT 1 : WHAT IS LPG?

LIQUEFIED PETROLEUM GAS AND IT COMES IN TWO FORMS

COMMERCIAL PROPANE

Chemical Makeup: C_3H_8

Boiling Temperature: $-42^{\circ}C$

Storage Conditioners:

Bulk Tanks and Red Cylinders



BUTANE

Chemical Makeup: C_4H_{10}

Boiling Temperature: $-2^{\circ}C$

Storage Conditioners:

Yellow Cylinders



138.tif

UNIT 1 : LPG CHARACTERISTICS

1. Under moderate pressure LPG becomes a liquid.

Easy to store large quantities in specially constructed vessels and cylinders.

2. Heavier than air and natural gas so therefore will search out and accumulate at the lowest levels.

Such as drains, pits, basements – NO LPG appliances in basements.

These 2 key characteristics distinguishes LPG from Natural Gas



UNIT 1 : LPG HAS A HIGH CALORIFIC VALUE

THE GROSS CALORIFIC VALUE

PROPANE_(LPG) **95.0 MJ/m³** **(2500btu's/ft³)**

BUTANE_(LPG) **121.5 MJ/m³** **(3200btu's/ft³)**

METHANE (Nat. Gas) 38.0 MJ/m³ (1040 Btu's/ft³)

MEGAJOULES PER CUBIC METRE (MJ/m³) or BRITISH THERMAL UNITS PER CUBIC FOOT (Btu's/ft³)



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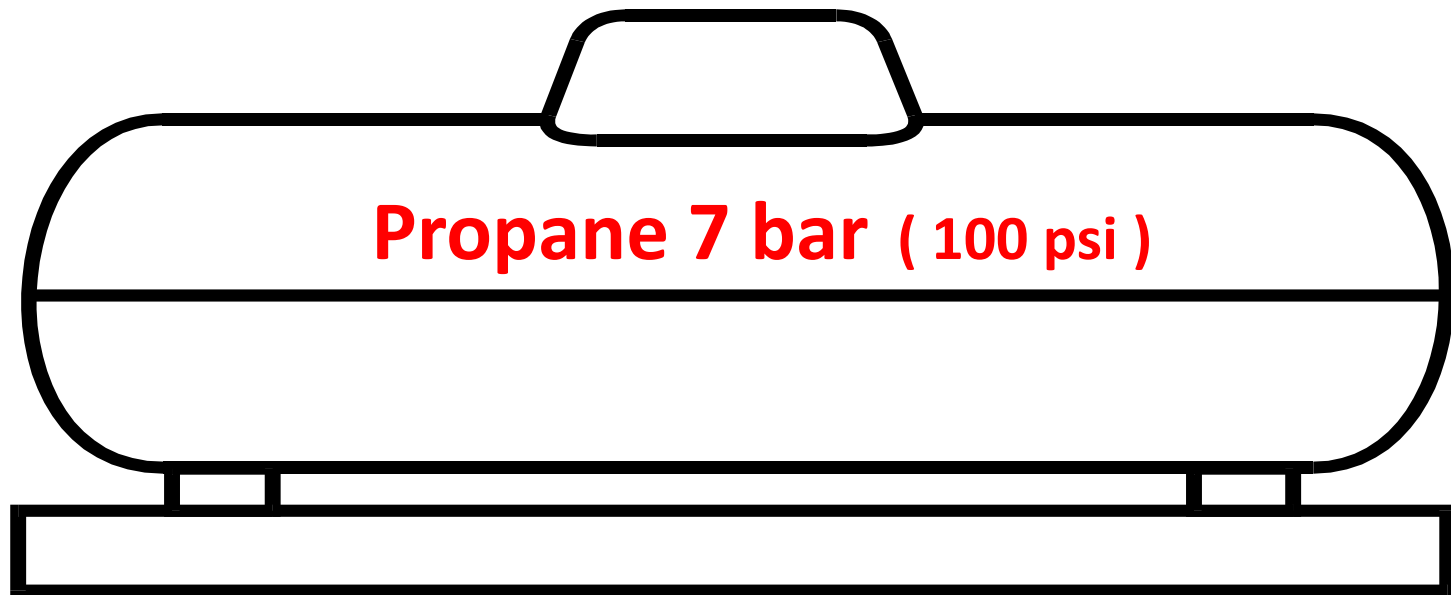
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UNIT 1 : HOW IS LPG STORED?

LPG IS STORED AS A LIQUID IN SPECIALLY DESIGNED PRESSURE VESSELS UNDER MODERATE PRESSURE.

STP @ 15°C & 1013.25 millibar



UNIT 1 : PRESCENCE OF GAS IN AIR?

In its natural form LPG is not readily detectable in air so to enable detection by smell a stenching agent is added

Ethyl Mercaptan or Dimethyl Sulphide

Detectable at 20%
of the Lower Explosive Limit
approximately 0.4% in air



UNIT 1 : DETECTION OTHER THAN BY SMELL?

YES!

LPG LIQUID EVAPORATING WILL CREATE A COOLING EFFECT AND CAUSE THE WATER VAPOUR PRESENT IN THE AIR TO

'FREEZE'

REFRACTORY DIFFERENCES BETWEEN GAS AND AIR WILL CAUSE A LEAK TO

'SHIMMER'



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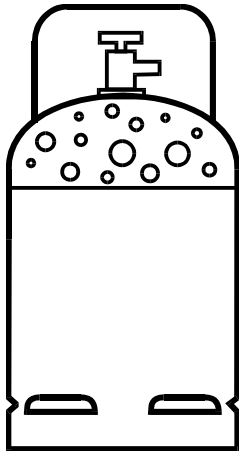
UNIT 1 : HOW IS THE GAS VAPOUR PRODUCED?

THE LIQUID BOILS SIMILAR TO WATER IN A KETTLE EXCEPT THE BOILING TEMPERATURES ARE VERY DIFFERENT

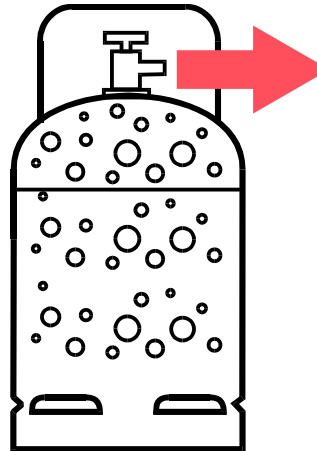
WHEN THE PRESSURE IN THE VESSEL IS REDUCED

THE LIQUID WILL BOIL

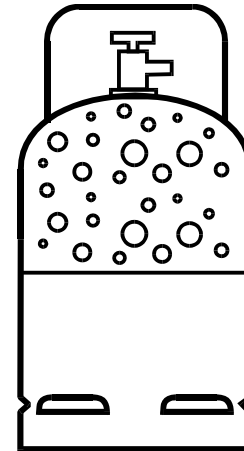
Valve
Closed



Valve
Open

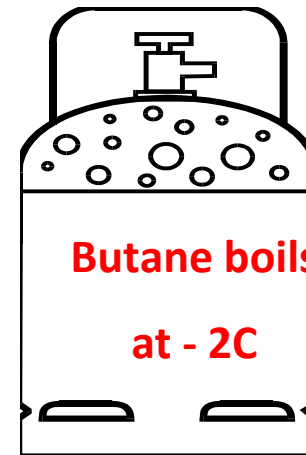
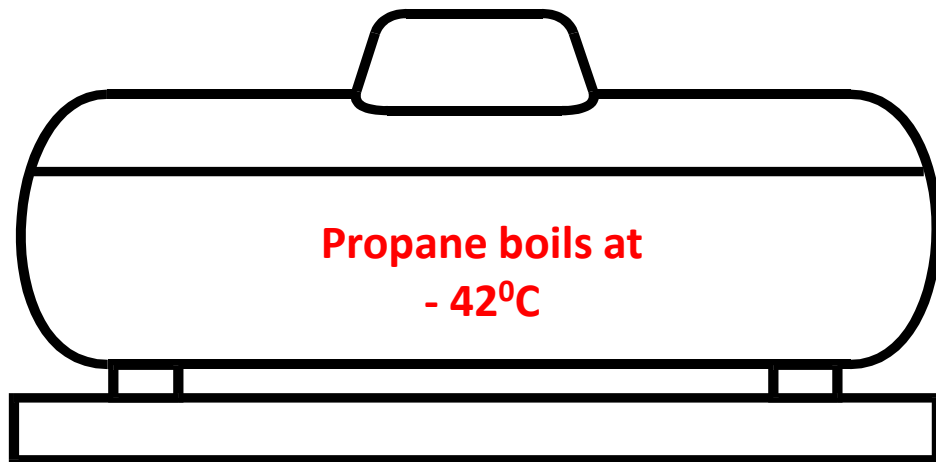


Valve
Closed



UNIT 1: WHAT TEMPERATURE DOES LPG VAPOURISE?

LPG BOILS AT VERY LOW TEMPERATURES



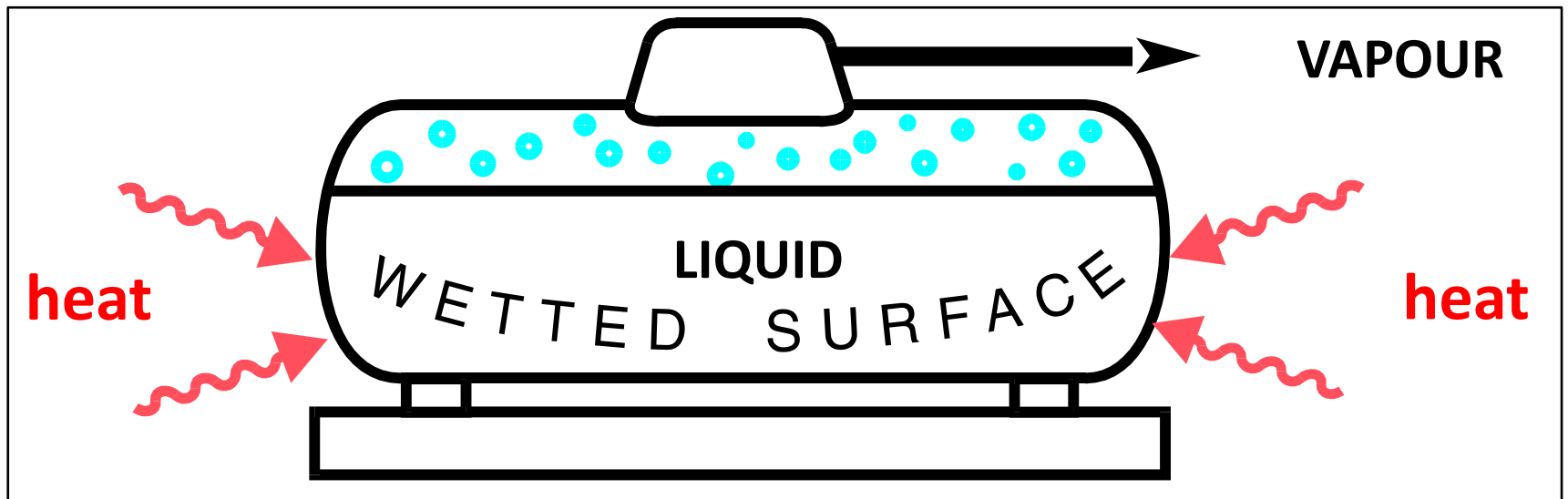
- ✓ Propane in Ireland does not have vaporisation issues.
- ✓ Butane performs well at an ambient temperature of 10°C.
- × Butane will be affected if the air temperature falls below minus 2°C.

UNIT 1 : THE VAPORISATION PROCESS

1. From the Liquid Gas Itself

2. From the Wetted Surface Area

3. From the Ambient Temperature

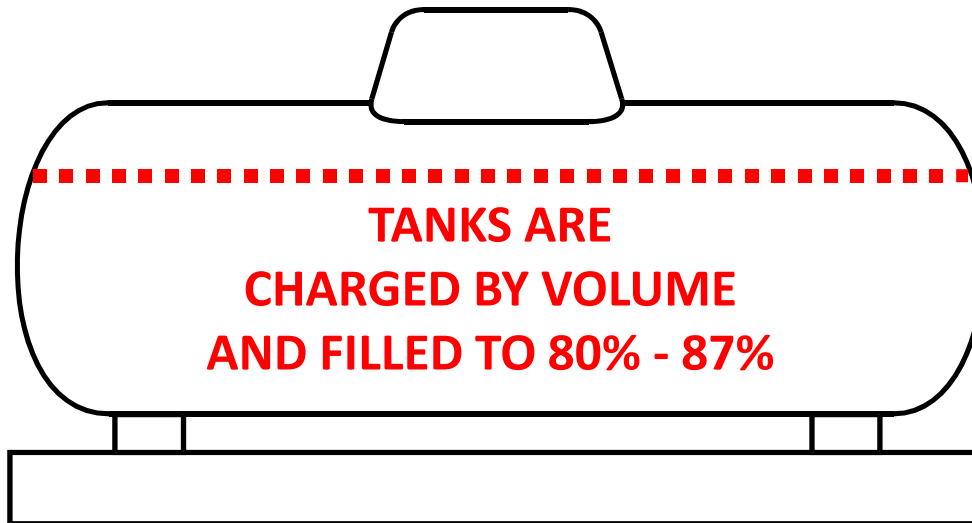


ARE TANKS OR CYLINDERS COMPLETELY FILLED?

NO!

THEY MUST NEVER BE FILLED 'HYDRAULICALLY'

LPG IN ITS LIQUID STATE HAS A HIGH RATE OF THERMAL EXPANSION.
IT IS IMPORTANT TO LEAVE A VAPOUR SPACE ABOVE THE LIQUID LEVEL



UNIT 1 : ESCAPE OF LIQUID PROPANE

The liquid will expand over 274 times when vaporised



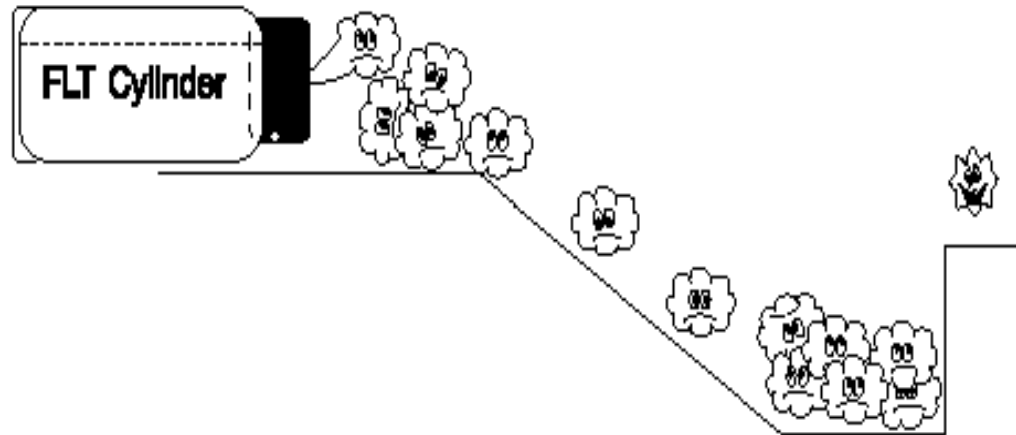
**1 VOLUME
OF LIQUID**

**274 VOLUMES
PROPANE
VAPOUR**

UNIT 1 : SPECIFIC GRAVITY OR RELATIVE DENSITY

LPG is Heavier than Air

◆ Natural Gas	=	0.58	s.g.
◆ Air	=	1	s.g.
◆ Propane	=	1.5	s.g.
◆ Butane	=	2.0	s.g.



UNIT 1 : IS LPG EASILY IGNITED?

YES : LPG IS EXTREMELY FLAMMABLE AND IS READILY IGNITED

IGNITION TEMPERATURES FOR PROPANE IS 460°C - 580°C

MUST HAVE THE CORRECT MIXTURE OF PROPANE AND AIR



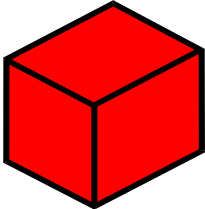
**100% Gas
Vapour**

Propane Gas
% to Air mix
2% - 11%
**FLAMMABLE OR
EXPLOSIVE**

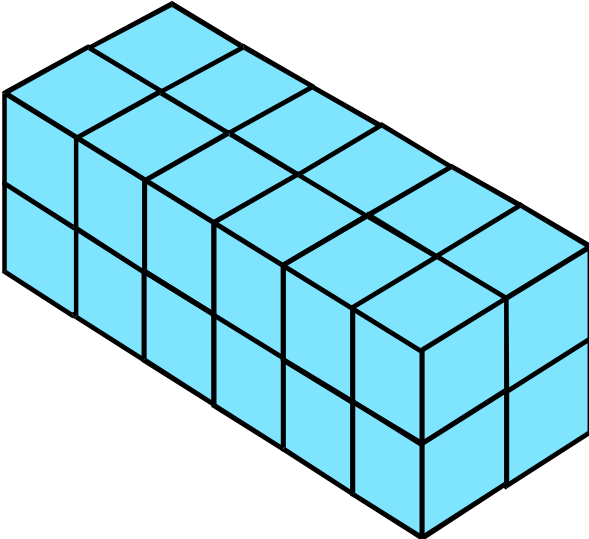
L.E.L. - Lower Explosive Limit
U.E.L. -Upper Explosive Limit

UNIT 1: COMBUSTION AIR REQUIRED FOR PROPANE

1 Volume of Propane



24 Volumes of Air

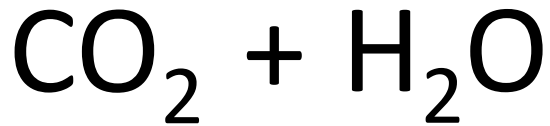


Complete Combustion



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UNIT 1: PRODUCTS OF GOOD COMBUSTION



CARBON
DIOXIDE + WATER
VAPOUR



WHEN LPG IS BURNED COMPLETELY, THE PRODUCTS OF COMBUSTION ARE HARMLESS



HOWEVER INCOMPLETE COMBUSTION CAN RESULT IN THE PRODUCTION OF CARBON MONOXIDE (CO) WHICH IS HARMFUL.

UNIT 1: CO - CARBON MONOXIDE

WHAT IS IT?

- Highly poisonous gas.
- No smell.
- No colour.
- No taste.

HOW DOES IT OCCUR?

- Poorly installed or maintained appliances
- Oil, Solid Fuel, Wood, Gas

WHAT ARE THE SYMPTOMS?

- When you inhale CO it starves the body of O₂
- Symptoms similar to every day illnesses
 - HEADACHES
 - BREATHLESSNESS
 - COLLAPSE
 - NAUSEA
 - DIZZINESS
 - LOSS OF CONSCIOUSNESS

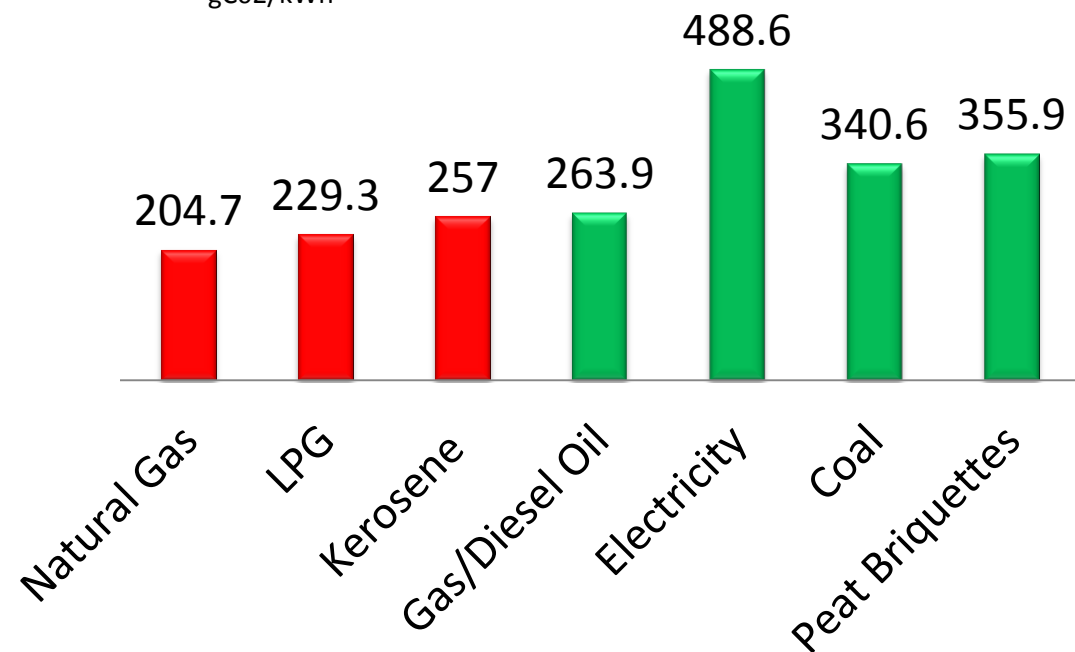
Even low levels of exposure of CO over a long period of time can cause lasting damage to your health, including permanent brain damage. More serious cases can cause death

More Information available at: www.hseni.gov.uk and www.carbonmonoxide.ie

UNIT 1: ENVIRONMENT

Comparison of CO₂ emissions*

gCO₂/kWh



*Source – SEAI 15th October 2013

CO₂ emission factors for electricity vary from year to year depending on the fuel mix used in power generation

LPG IS:

Cleaner Burning

Reduced CO₂ Emissions

Convenient

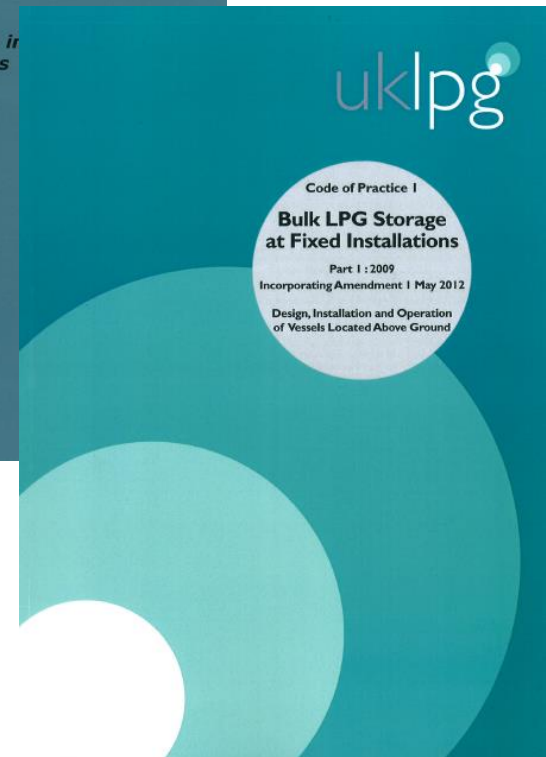
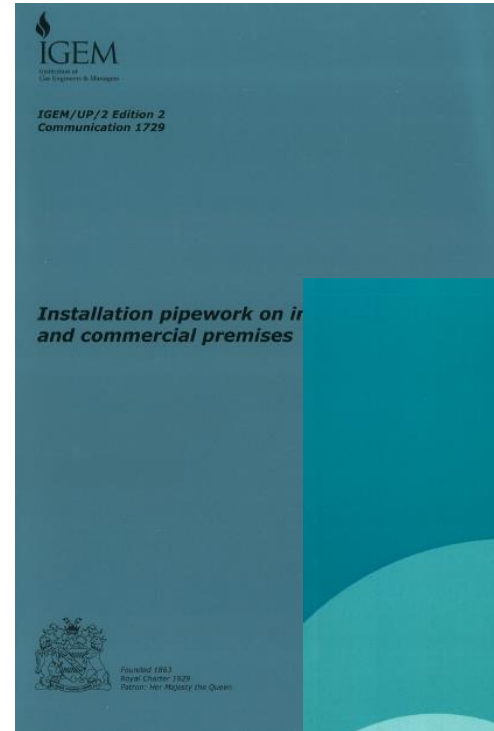
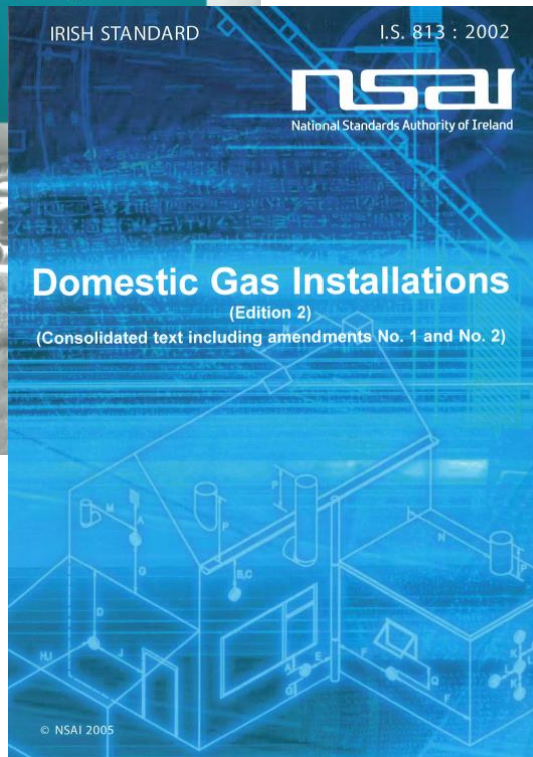
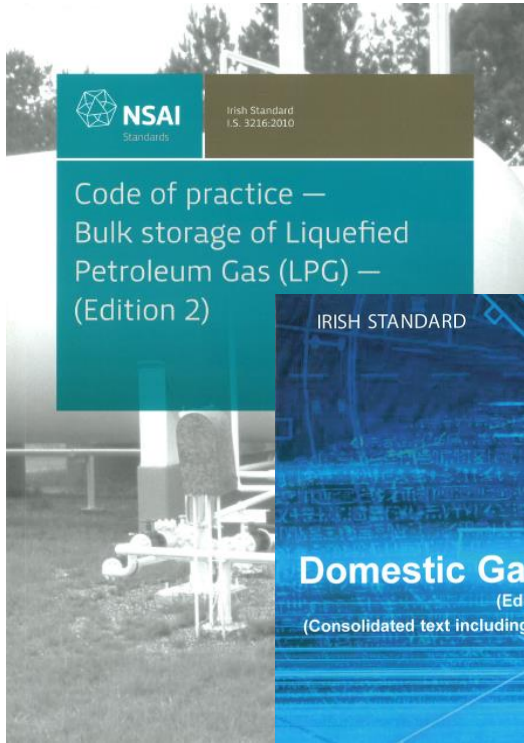
No Soil or Water Pollution

LPG is non-toxic



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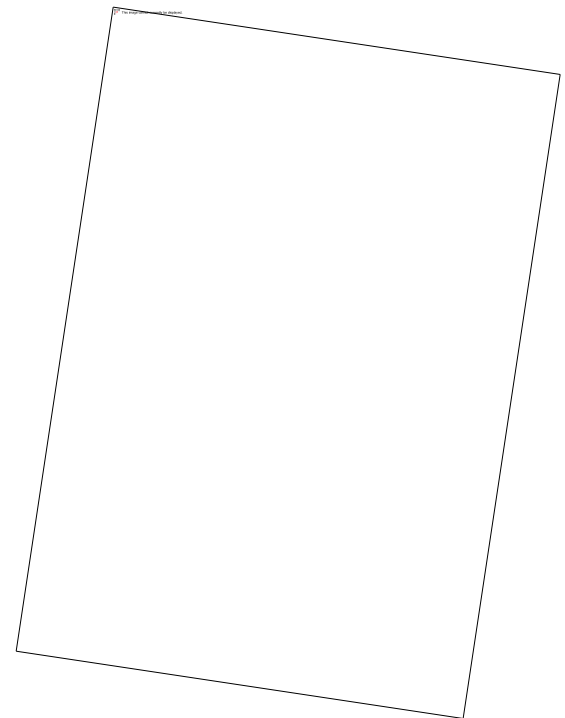
UNIT 2 : GAS REGULATIONS AND STANDARDS



UNIT 2: NATIONAL STANDARD AUTHORITY

Regulations governing the use of LPG in Republic of Ireland for Storage & Installations

- IS 3216:2010 Code of Practice for the Bulk Storage of LPG
Part 1 General Requirements
Amendment No.3 : 2001 –
Installation of underground vessels
- IS 3213 :1987 Storage of LPG Cylinders and Cartridges
- IS 813 : 2002 Domestic Gas Installations
- IS 820 : 2003 Non-Domestic Gas Installations
- IS 329 : 2003 Gas Distribution Mains
- IS 265 : 2000 Installation of Gas Service Pipes
Parts 1 & 2 (Fourth Edition)



UNIT 3 : BULK TANK INSTALLATIONS



UNIT 3 : LPG CONVERSION FACTORS

Volume Conversion

1mTonne = 1000kg

1mTonne = 1968.5 litres of LPG

Energy Conversion

1 kWh = 3412 btu's/hr

1 litre of LPG = 7.09kwh

1 m³ of LPG = 3.72 litres

UNIT 3 : BULK TANK STORAGE AND SIZING

Selecting the appropriate size of Tank/s depends on:

1. Customer Requirements (Application, Aesthetics)

2. Safety Considerations & Physical Constraints (Location requirements, Surrounding Area)

3. Required Off-take and/or Minimum Storage Capacity.

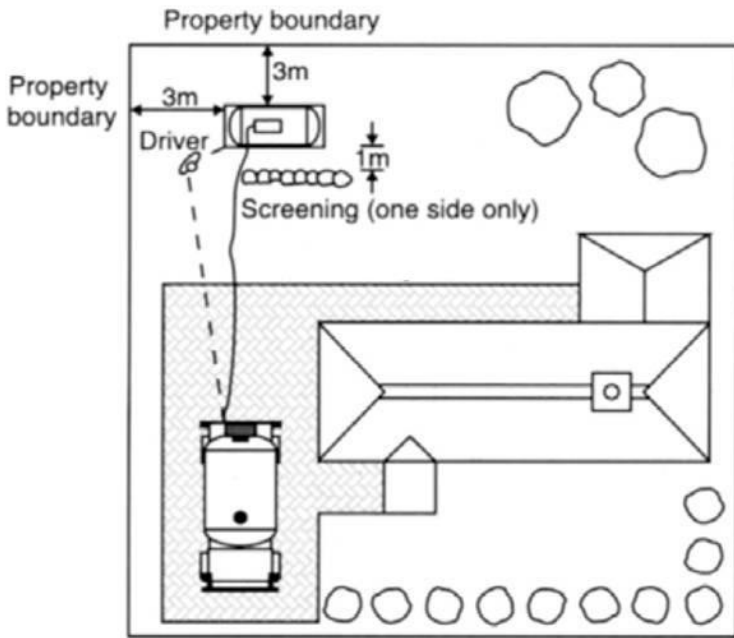
4. Access of Tank and Gas Delivery

UNIT 3 : TANK OFF-TAKES

Off-take = amount of vapour a tank can deliver at any point of time by natural vaporisation

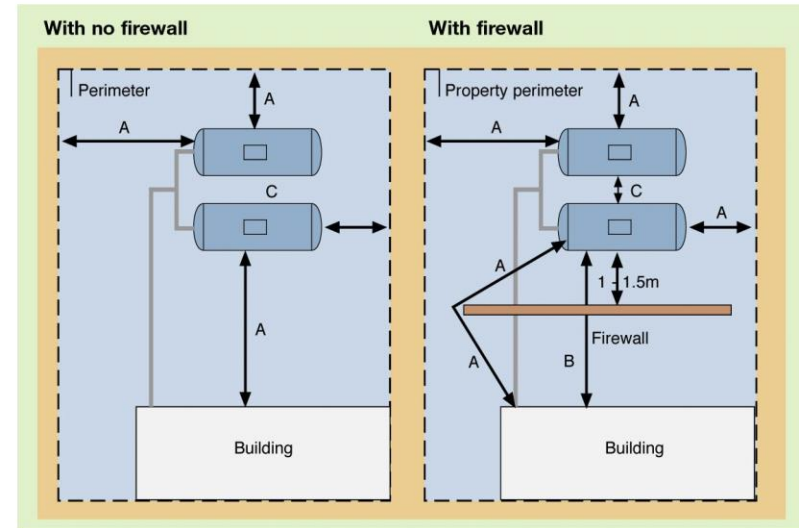
Tank off-take table*	u/g = underground		
Tank capacity (kg propane)	Kw	m ³ /h	Kg/h
200	60	2.3	4.2
600	145	5.7	10.5
1000	187	7.1	13.2
1000 (u/g)	94	3.5	6.8
2000	264	10.2	19
2000 (u/g)	132	5.1	9.5
3000	347	13.4	25
4000	513	19.8	36.9
6500 (u/g)	366	14.2	26.4

UNIT 3 : TANK SITING – ABOVE GROUND



Distance from buildings, boundaries and sources of ignition

LPG capacity (kg)	Max no. of tanks in a group (m)	From buildings boundary, property line or fixed source of ignition (m) A	With a fire wall (m) B	Distance between (m) C
230	3	2.5	0.3	1.0
600	5	3.0	1.5	1.0
1000	3	3.0	1.5	1.0
2000	6	7.5	4.0	1.0
3000	6	7.5	4.0	1.0
4000	3	7.5	4.0	1.0
12000	3	15.0	7.5	1.5



UNIT 3: WIDE RANGE OF AG STORAGE OPTIONS

6 x 1000kg



6x 1000kg
'vertical' tanks



3 x 200kg 'vertical'



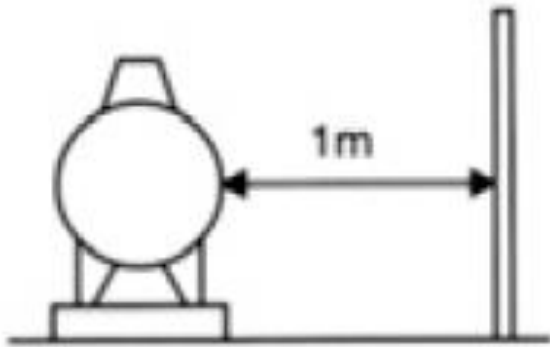
4 x 3100kg



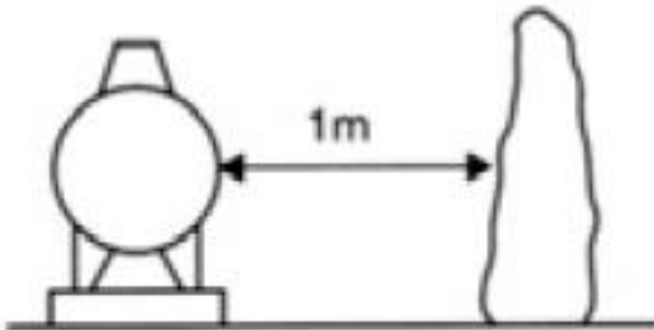
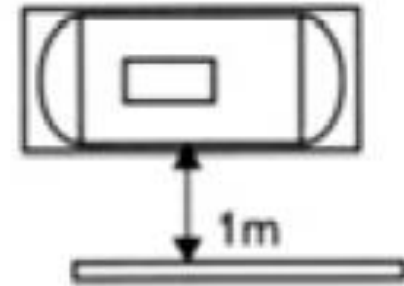
3x 4000kg & 3x 3000kg



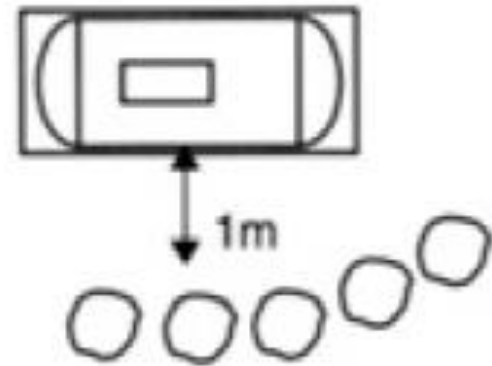
UNIT 3 : SCREENING DISTANCES



Non flammable ranch
type fence



Evergreen shrubs



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UNIT 3: UNDERGROUND TANKS

- Safety Distance observed from Tank Lid
- Incorporation of a Gas Dispersion wall results in a reduced Safety Distance requirement
- No vehicular movement permitted on tank area
- Tanks cannot be located in areas prone to flooding
- No underground services permitted within the Tank Excavation Area

More technical info regarding Underground Tanks is available from
Calor Gas Customer Engineering



UNIT 3: UNDERGROUND TANKS SAFETY DISTANCES

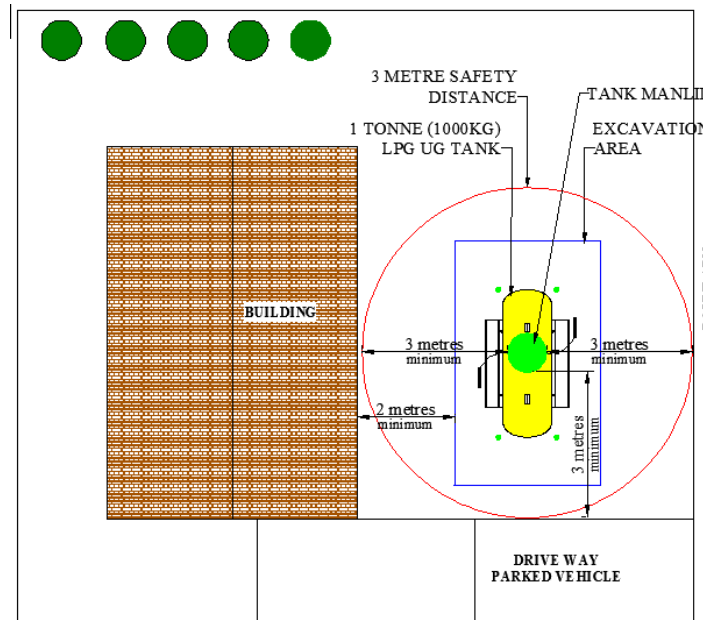
NSAI I.S 3216: 2010 Bulk Storage of Liquefied Petroleum Gas

Tank Size (kg)	To Tank Surface	To Valve Assembly (Man lid)		Distance Between Tanks (m)
		Without gas Dispersion Wall	With gas Dispersion Wall	
1000	1*	3	1.5	1
4000	1*	3	1.5	1
6500	3	7.5	4	**

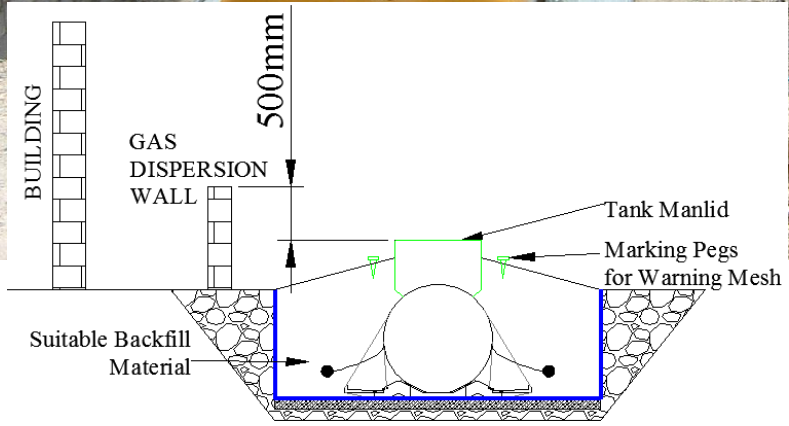
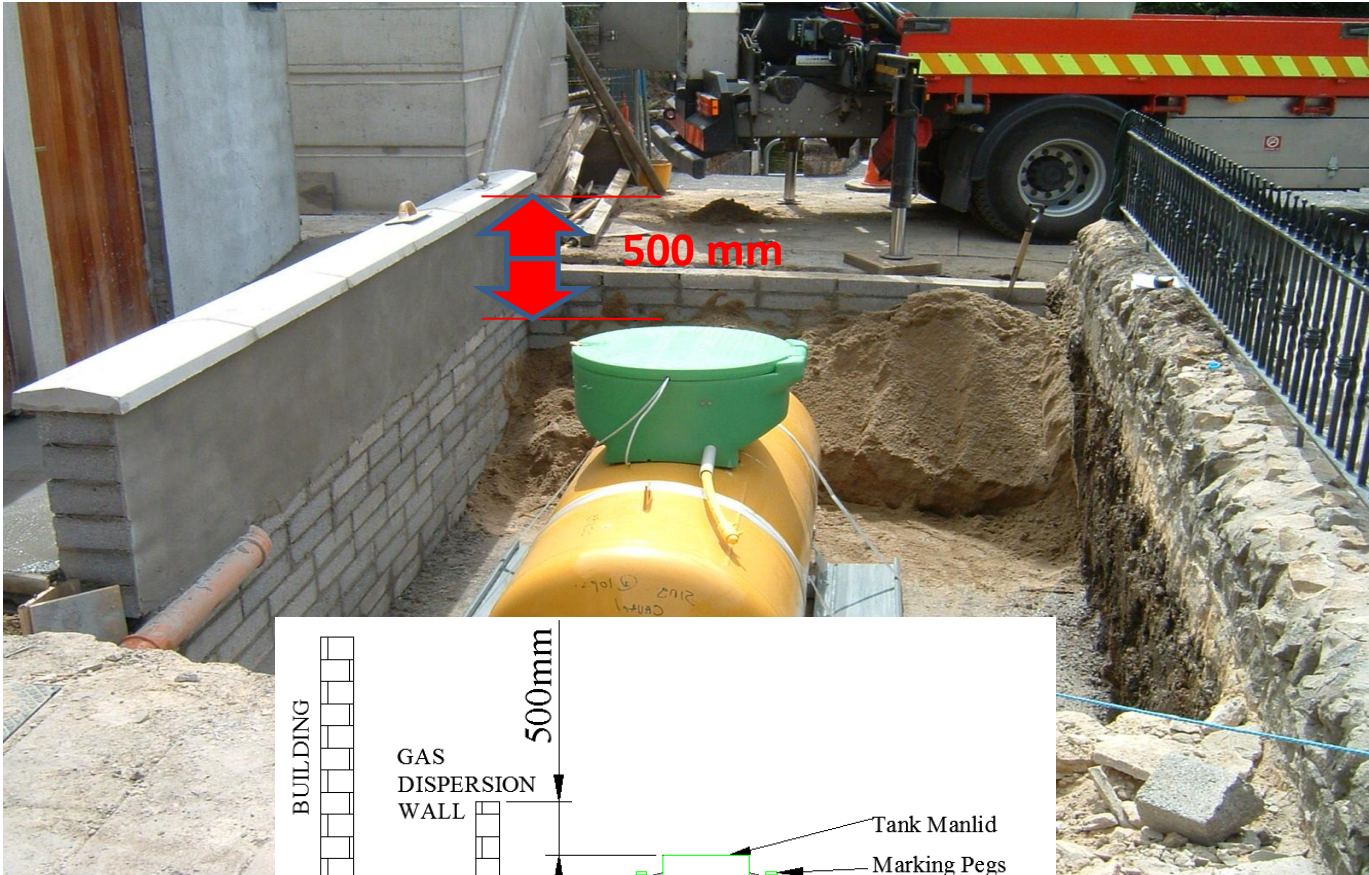
* Recommended to be no less than 2 metres so as to minimise effects on building structure.

** Subject to excavation design. Minimum 1 metre.

ILLUSTRATION OF A 1000KG (1TONNE) UNDERGROUND TANK



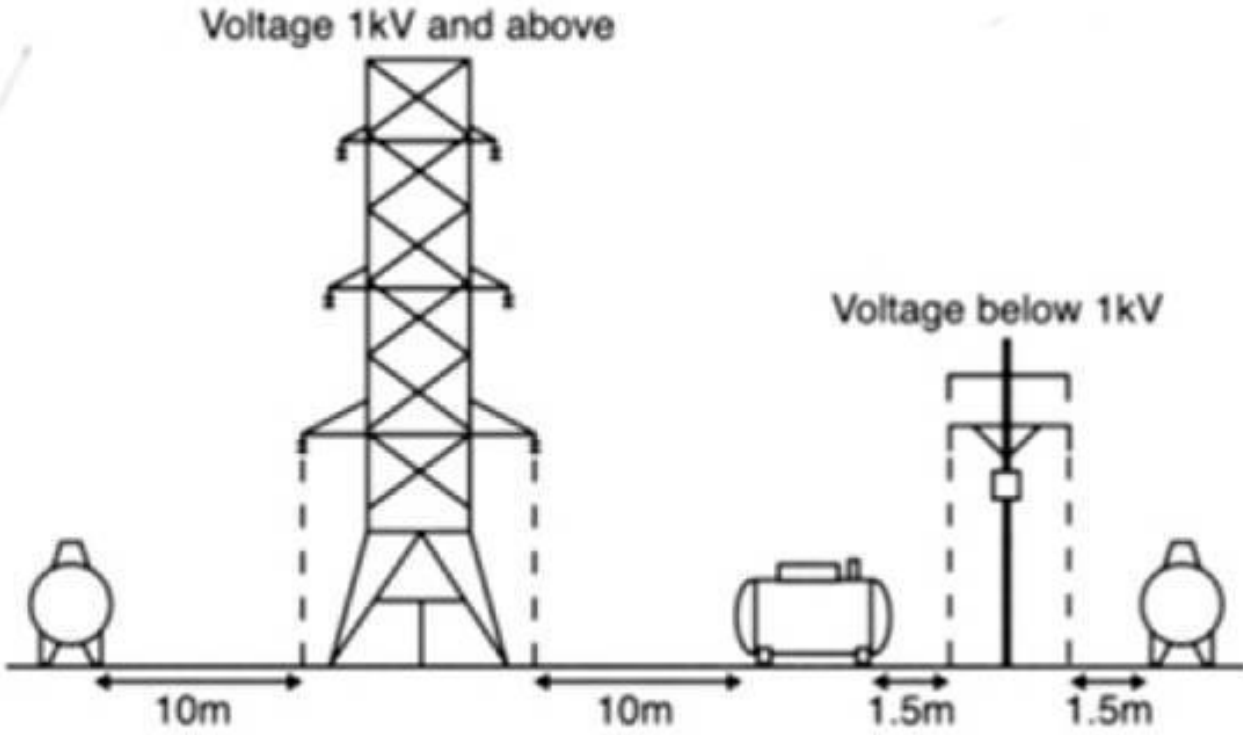
UNIT 3: EFFECTIVE USE OF A 0.5m DISPERSION WALL



UNIT 3: VARIOUS UNDERGROUND INSTALLATIONS

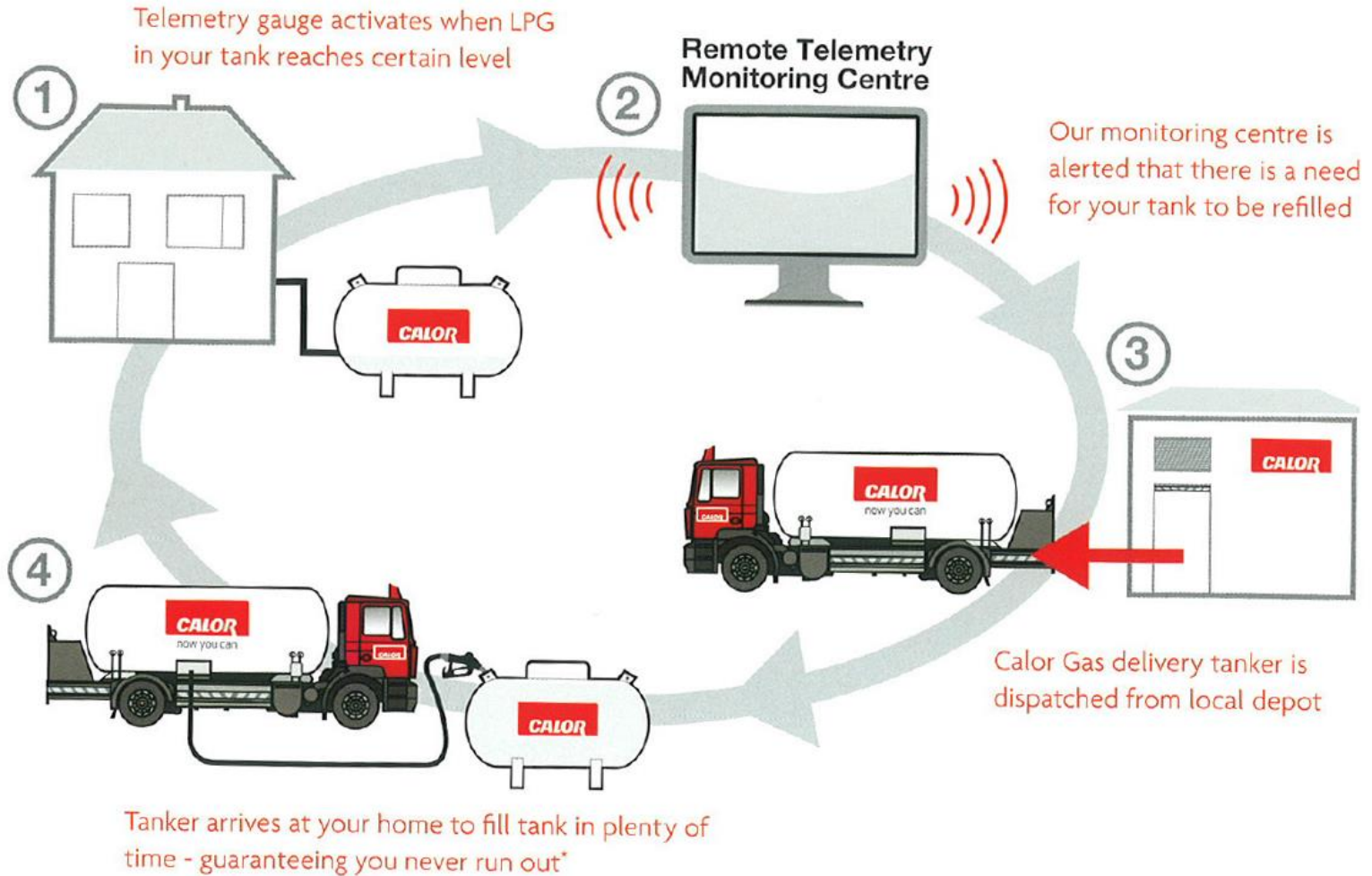


UNIT 3: SAFETY DISTANCE FROM ELECTRICAL CABLES

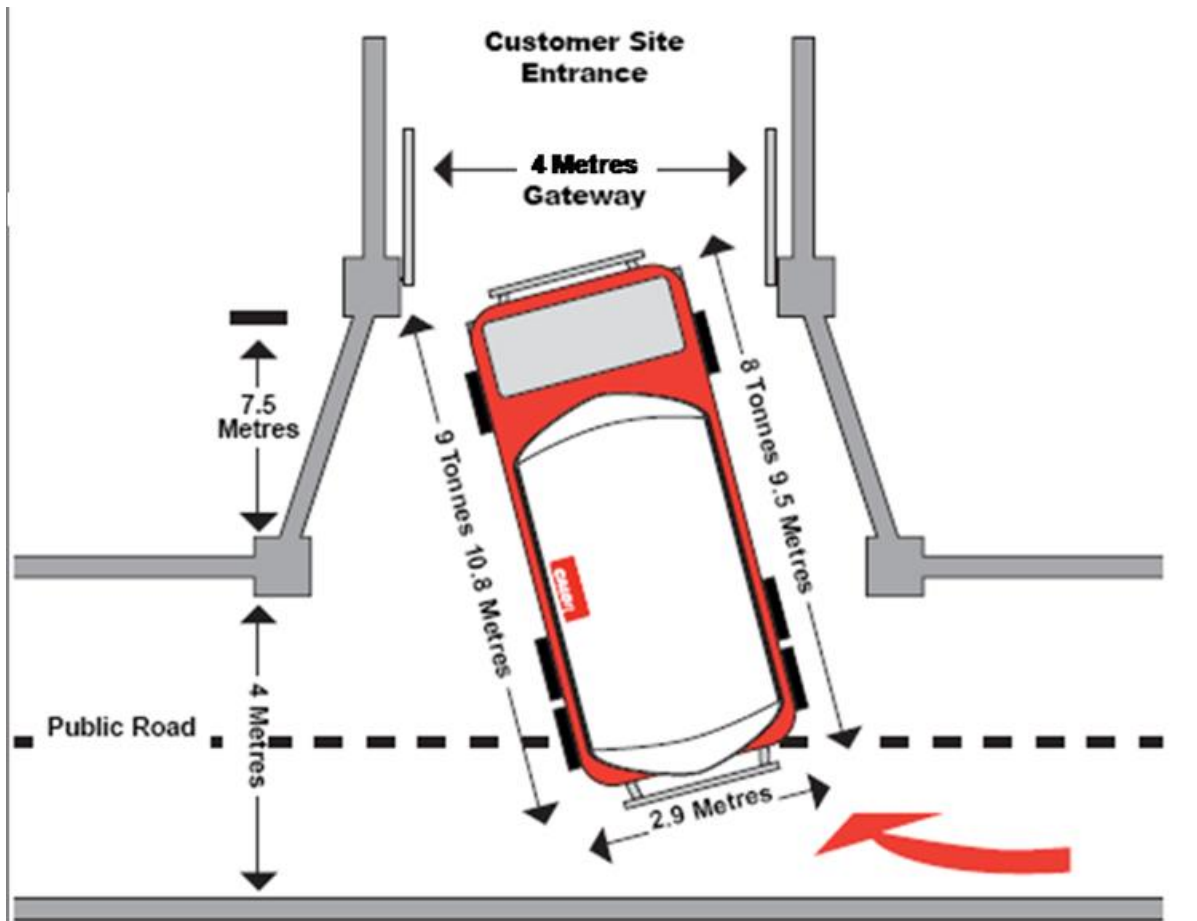


Separation distances from overhead power cables.

UNIT 3: TANK TELEMETRY



UNIT3: LPG DELIVERY TANKER ACCESS



TANKER DETAILS

- Minimum width of entrance 4 Metres
- Minimum height clearance of entrance 4 Metres
- Minimum turning circle 12 Metres
- 8 tonne tanker gross weight 20 tonnes
- 9 tonne tanker gross weight 23 tonnes
- Maximum hose length 30 Metres

UNIT 4: CYLINDER INSTALLATIONS

(IS 3213)



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UNIT 4: LEISURE & DOMESTIC CYLINDERS



Propane



Cooking



Gas Fire



Catering



BBQ



Camping



Patio Heater

Available in: **9kg Lightweight, 11kg, 19kg, 34kg & 47kg**



Butane



Cooking



BBQ



Space Heating



Burning Ring



Patio Heater

Available in: **5kg & 11.34kg**



Patio



BBQ



Patio Heater



Caravan

Available in: **6kg Lightweight & 11kg Patio**



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UNIT 4: COMMERCIAL/INDUSTRIAL CYLINDERS



Butane



Blowtorch DeBudder Catering Space Heating

Available in: **5kg & 11.34kg**



Propane - Fork Lift Truck



FLT

Available in: **12kg & 18kg**



Propane



Blowtorch DeBudder Catering Space Heating

Available in: **9kg Lightweight, 11kg, 19kg, 34kg & 47kg**



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UNIT 4: MULTI CYLINDER INSALLATIONS

Ideal for buildings with limited space

Up to 132kW demand

4,6 or 8 cylinders in interconnected pairs

Un-interrupted supply



UNIT 4: SIZING CYLINDERS

Sizing Gas Cylinder's: 3 Key Questions

1. What is the maximum gas rate of the appliances?

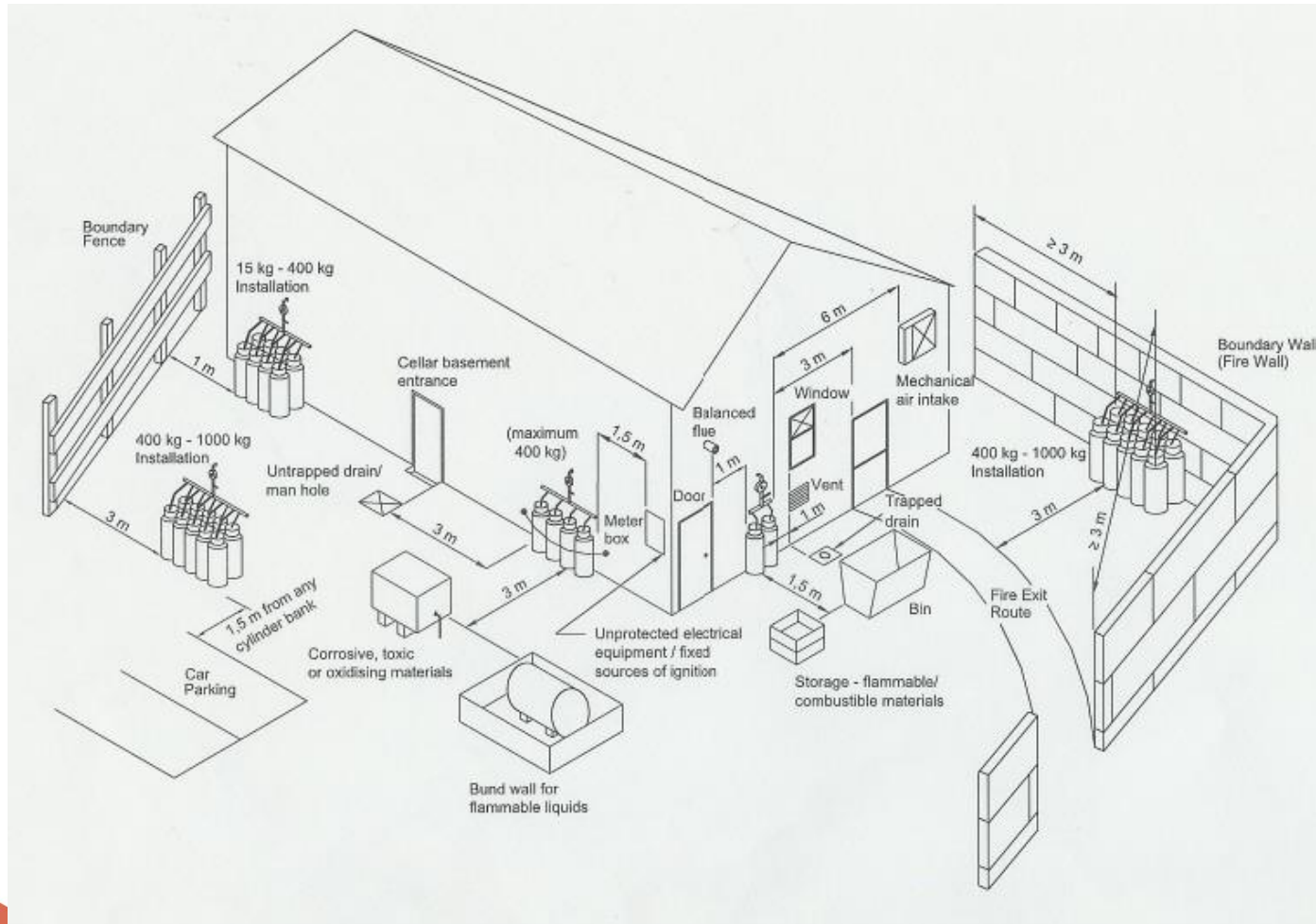
2. Is there more than one appliance?

3. What is the pattern of use?

	Maximum Continuous propane Off-take		
Cylinder Size (Propane kg)	kW	m ³ /h	kg/h
34	24	0.93	1.73
47	34	1.28	2.4

UNIT 4: LPG CYLINDERS SAFETY DISTANCES

Safety distances of LPG cylinders from buildings and other potential sources of ignition.
LPG Gas Association COP 24 Parts 1 to 6



UNIT 5: PIPEWORK

PIPE WORK LOCATION

PIPEWORK SIZING

PIPEWORK INSTALLATION

(IS 329 Gas Distribution Mains)
(IS 265 Installation of Gas Service Pipes)
(IS 813 Domestic Gas Installations)
(IS 820 Non-Domestic Gas Installations)



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UNIT 5: PIPEWORK MATERIALS

Above Ground Pipework Material

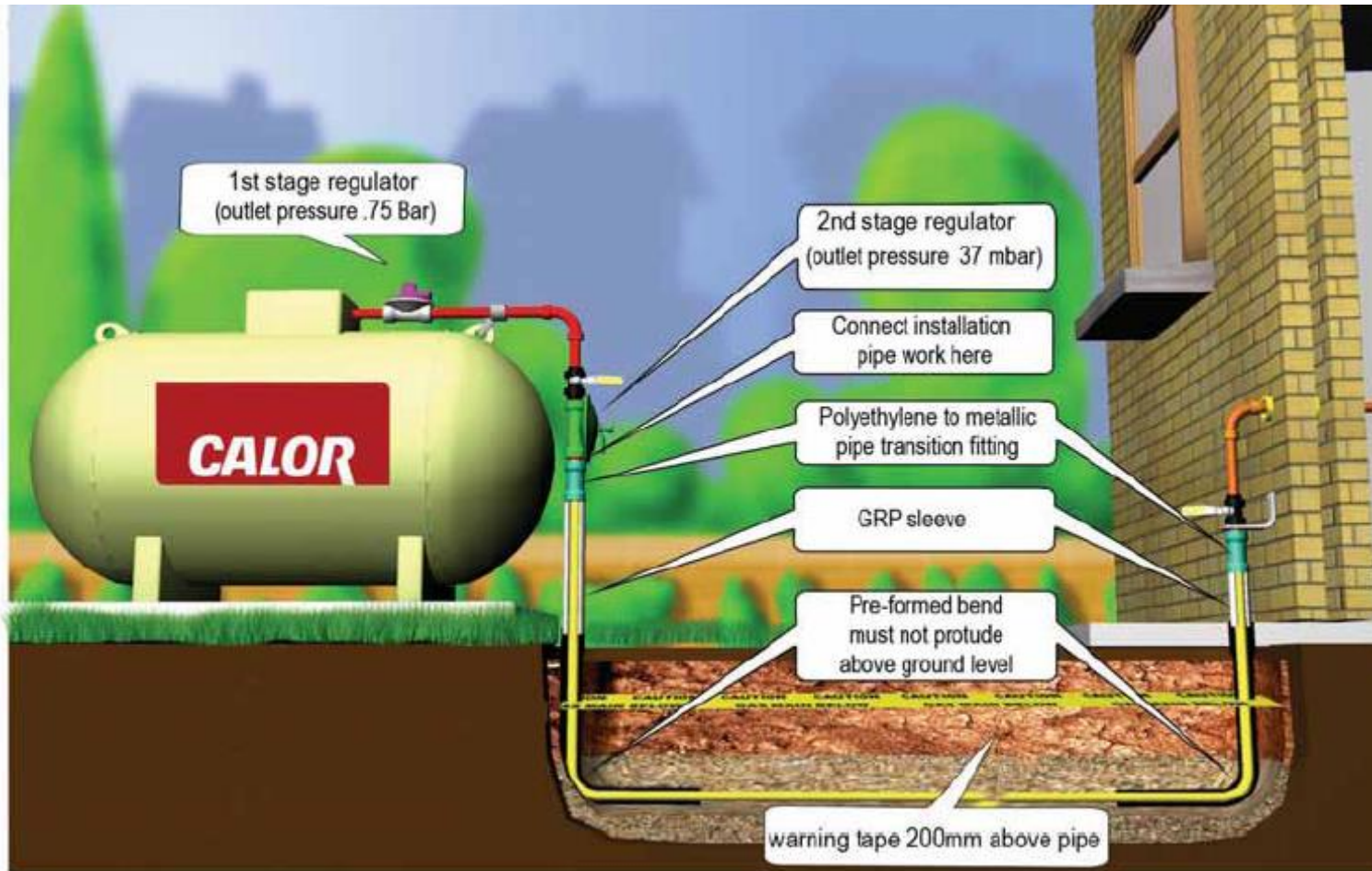
- Steel
- Copper

Under ground Pipework Material

- Polyethylene Plastic SDR11 (PE)



UNIT 5: THE INSTALLATION PIPEWORK



UNIT 5: PIPE SIZING

- LPG has a much larger Calorific Value than Natural Gas, therefore pipe sizes for LPG can be much smaller.
- Contact Calor for assistance with Pipe Sizing
- Tables available in the Installation Guide.

Effective capacity of STEEL pipe for LPG										
Length m	Heat input kW	8mm		15mm		20mm		25mm		
3	9.3									
6	6.3									
9	5.7									
12	4.8									
15	4.4									
18	4.0									
21	3.7									
24	3.5									
NOTE: The maximum pressure drop is 2.5 mbar.										

Effective capacity of COPPER tube for LPG											
Length m	Heat input kW	6mm		10mm		15mm		22mm		28mm	
3	2.20	Heat input kW	m ³ /h	Heat input kW	m ³ /h	Heat input kW	m ³ /h	Heat input kW	m ³ /h	Heat input kW	m ³ /h
6	1.54										
9	1.32										
12	1.10										
15	0.88										
18	0.88										
21	0.66										
24	0.66										
NOTE: The heat input is based upon propane at low pressure of 37mbar and 2.5 mbar maximum pressure drop over the length of the pipe.											

Effective capacity of POLYETHYLENE PIPE (PE) for LPG					
Length m	Heat input kW	Heat Input		Maximum length (25mm OD) m	Maximum length (32mm OD) m
		kW	m ³ /h		
3	2.20	28.6	1,104	72	213
6	1.54	30.8	1,189	62	184
9	1.32	33.0	1,274	54	160
12	1.10	35.2	1,358	47	140
15	0.88	37.4	1,443	42	125
18	0.88	39.6	1,528	37	111
21	0.66	41.8	1,613	33	100
24	0.66	44.0	1,698	30	90
NOTE: The heat input is based upon propane at low pressure of 37mbar and 2.5 mbar maximum pressure drop over the length of the pipe.					

Source: IS 3216:2002 – Irish Standard for Domestic Gas Installations

UNIT 5: REGISTERED INSTALLERS

Northern Ireland



Republic of Ireland



A gas safe registered installer (in Northern Ireland) is responsible for the installation of all gas pipework and appliances and for making the connection to outlet pipework at vessel. An RGI registered installer in the Republic of Ireland is responsible for domestic gas works for LPG installations .

A written GAS SAFE or RGI certificate is required before the gas can be turned on.

The gas supply may only be turned on by Calor approved personnel.

UNIT 6: UTILISATION OF LPG

Commercial

Industrial

Domestic and Metered



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UNIT 5: GENERAL ADVICE ON LPG APPLIANCES

1. Simple, non-complex flue arrangement

2. Ventilation in accordance with Building Regulations
(TGD J) Combustion air and water vapour

3. Consider room sealed appliances where available.

UNIT 5: COMMERCIAL APPLICATIONS

Sectors

- Commercial
- Hospitality & Leisure
- Catering
- Education
- Healthcare
- Government Buildings
- Industrial Processing/Manufacturing
- Agricultural

Applications

- Space Heating
 - Radiators
 - Warm Air
 - Radiant
- Hot Water
 - Stored
 - Instantaneous
- Catering
- Laundry
- Air-Conditioning
- CHP
- Gas Heat Pump

UNIT 5: COMMERCIAL SPACE APPLICATIONS

Radiant Heating

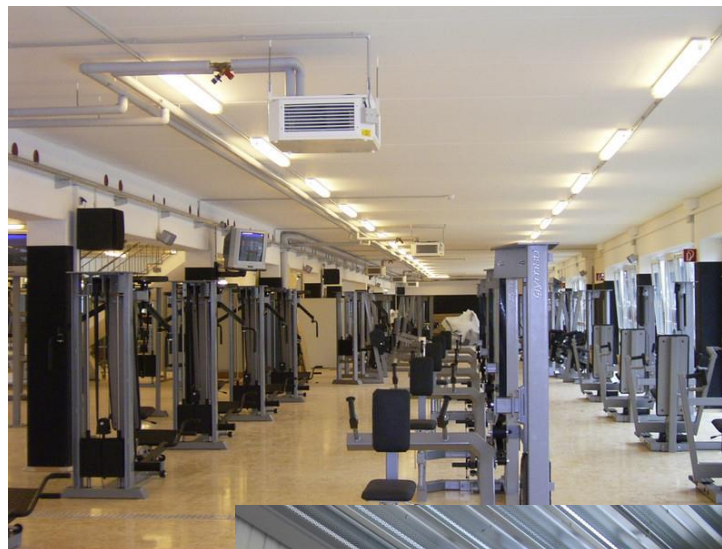
- High Levels of High Efficiency
- Deliver heat precisely and exactly where required
- Rapid Heat up & Cool down time
- Highly controllable
- Easy to Install, manage and maintain
- **Factories, Workshops, Warehouses, Sports & Community Halls, Churches**



UNIT 5: COMMERCIAL SPACE APPLICATIONS

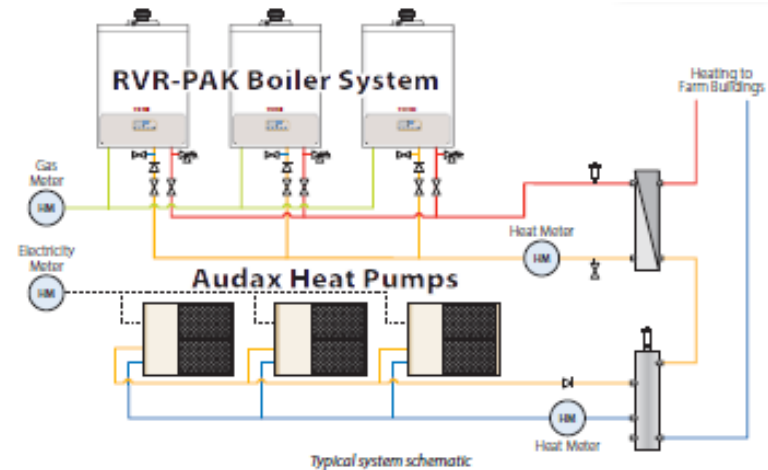
Warm Air Heating

- Direct or Indirect Fired
- Fast response
- Highly Controllable
- Effective Warm Air Distribution
- Can also be used for Cooling
- Easy to Install, manage and maintain
- 90% efficient
- **Offices, Retail Units, Warehouses, Leisure centres**



UNIT 5: COMMERCIAL HYBRID SYSTEM

- Combines benefits of cost effective Air to Water Heat pumps with extremely efficient modulation of gas boilers
- Most economic balance of Heat Source is Supplied
- 50% savings compared to Oil System



Web connected control system which can be accessed remotely

UNIT 5: Boilers

Retrofitting

- Change the burners
- Older boilers not designed to condense, doing so can damage
- No improvement in efficiency, fuel switch only
- Less expensive option (in the short term)
- Consider boiler condition/in test (steam boilers)



LPHW Burner Switch

New Boilers

- Opportunity to greatly improve efficiency
- Modulating to match the load requirement
- Important to review operation of the entire system (lower the temperatures if possible)
- Higher capital but payback can be achieved



Steam Boiler Conversion

UNIT 5: Typical Example

Large Hotel

- 2 x 800kW Boilers (for heating)
- Consuming 300,000 Litres of oil per year
- Assume existing system efficiency of 70%, reasonable assumption, given age, condition and technical set-up
- Replaced with high efficiency modulating LPG boilers, typical rating of 89%
- >20% Primary Energy Saving
- >30% Carbon Savings (263 Tonnes/year)
- Estimated €50k Savings/Year

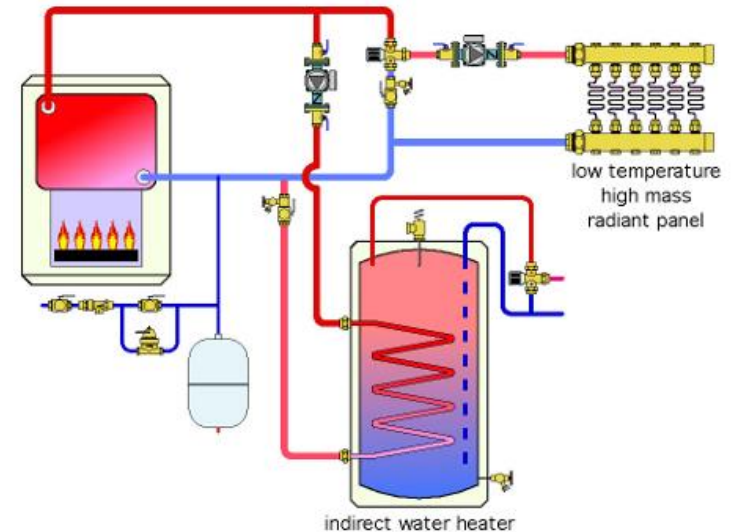


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UNIT 5: Water Heating

Indirect Water Heating

- Boiler system heating a coil in a calorifier
- More losses – pumping, heat loss, thermal efficiency of boiler, coil etc..
- Difficult to achieve condensing at low demand
- Storing hot water » Legionella considerations
- Re-heat times of the storage vessel a consideration
 - Increase in boiler size » Capital Cost
- Boilers required all year round
- Traditional system in Ireland
- Plate Heat Exchangers also an option but expensive and require a lot of control



Indirect Water Heating Schematic

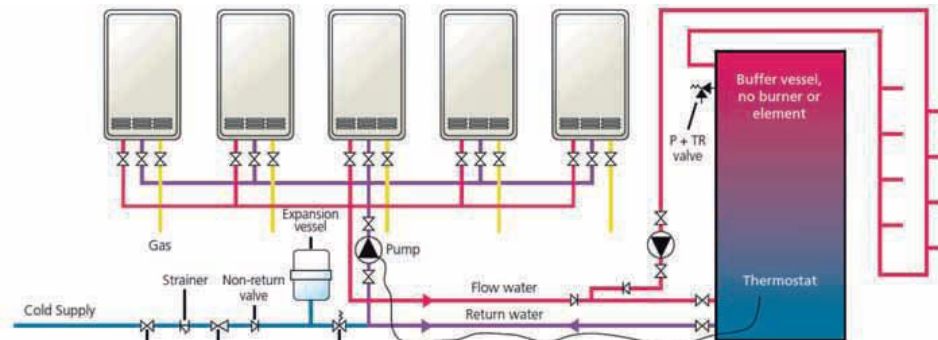
UNIT 5: Water Heating

Continuous Flow

- High efficiency, modulating flame
- Low or zero standing losses
- Good for intermittent use
- Capital cost, reasonable if sized correctly
- Storage/buffer can be incorporated
- Easy incorporation of new technologies



Dairy Farm example – no storage



Multiple heaters, combined with buffer

UNIT 5: COMMERCIAL CATERING



Substantial savings by using LPG compared to electricity.

Hotels

Fast Food Outlets

Nursing Homes

Factory Canteens

Restaurants

Schools + Colleges

UNIT 5: INDUSTRIAL APPLICATIONS

Any Industrial Process requiring Heat

Incineration

Air handling

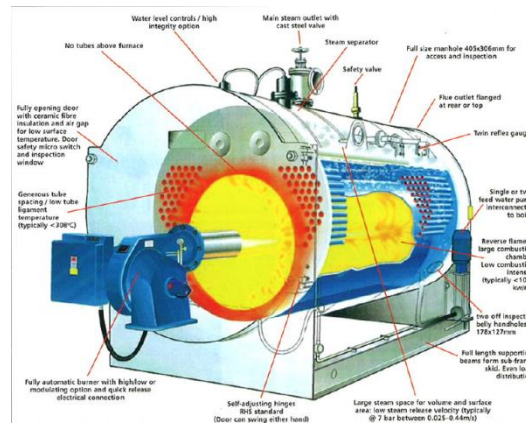
Steam Boilers

Industrial Water Heating

Food Processing

Paint Drying

Laundry



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UNIT 5: FORK LIFT TRUCKS (FLT'S)



Efficient
Lower Emissions
No Battery to recharge
Used Indoor & Outdoor
Reduced engine noise.
On site LPG storage.



UNIT 5: DOMESTIC CENTRAL HEATING

Bulk Tank or Cylinder Storage

Standard Central heating plus the complete energy package

Automatic top-up throughout the year. Telemetry as standard, budget plan available



CONTROLLABLE HEATING



COSY REAL FLAME FIRE



INSTANT HOT WATER



EFFICIENT TUMBLE DRYING



INSTANT, EASY COOKING



UNIT 5: METERED DEVELOPMENTS

COMMERCIAL AND DOMESTIC



Communal LPG storage to serve a number of dwellings or business units.

Each network is designed, installed and maintained by experienced and qualified engineers.

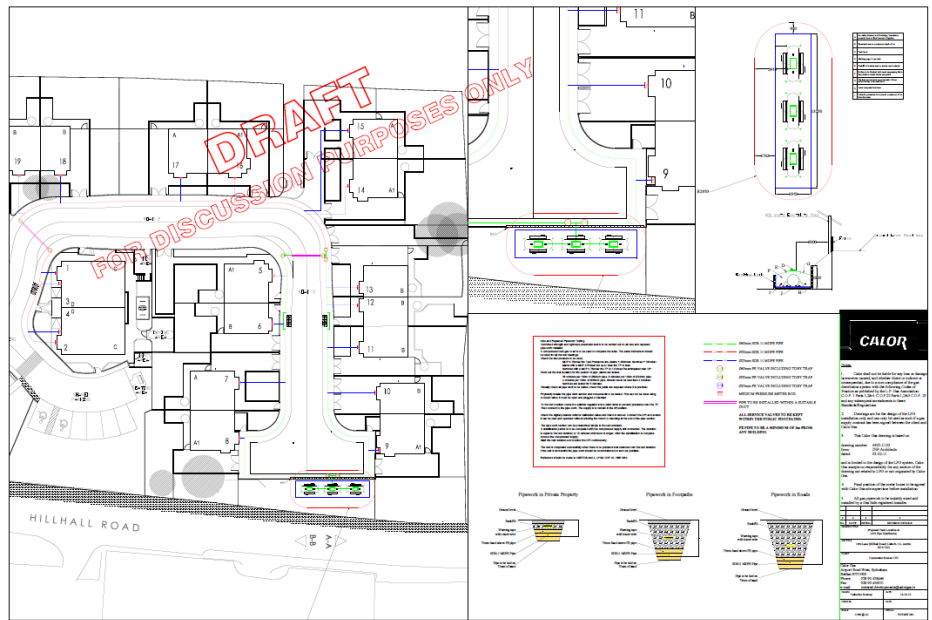
An individual meter box is installed outside each customer dwelling or business unit for billing.

UNIT 5: TYPICAL HOUSING ESTATE LAYOUT

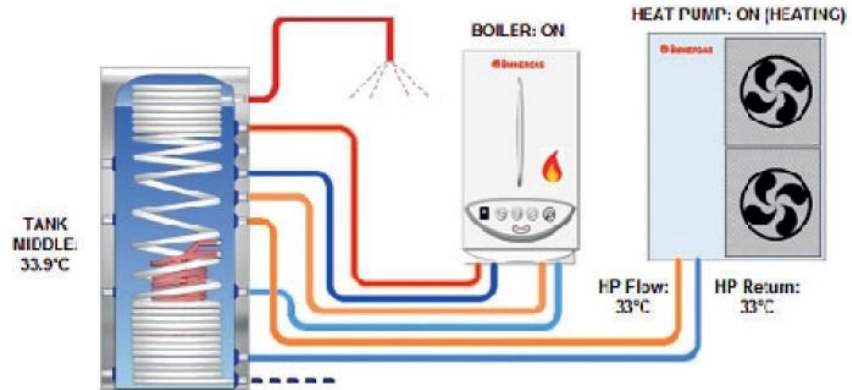
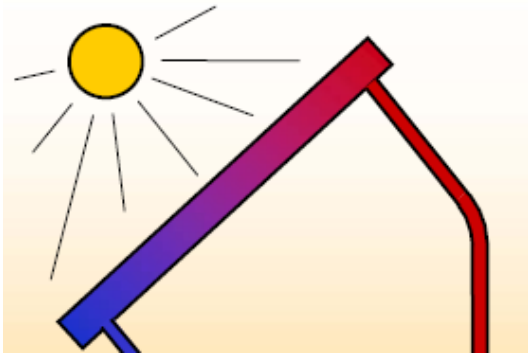
Bulk Tanks are normally located in the communal green area.

Designed and Installed Gas Distribution Infrastructure

Tank Telemetry installed on all sites



UNIT 5: LPG PARTNERS WITH RENEWABLES



Solar Panels

- Condensing, fully Modulating and Weather Compensated Gas Boiler (90+% efficient)
- Solar Panel System with Solar Station Control for Water Heating
- Heat Recovery Mechanical Ventilation System
- Three Zone System Control
- Increased Cavity Wall & Attic Insulation

Air Source Heat Pump

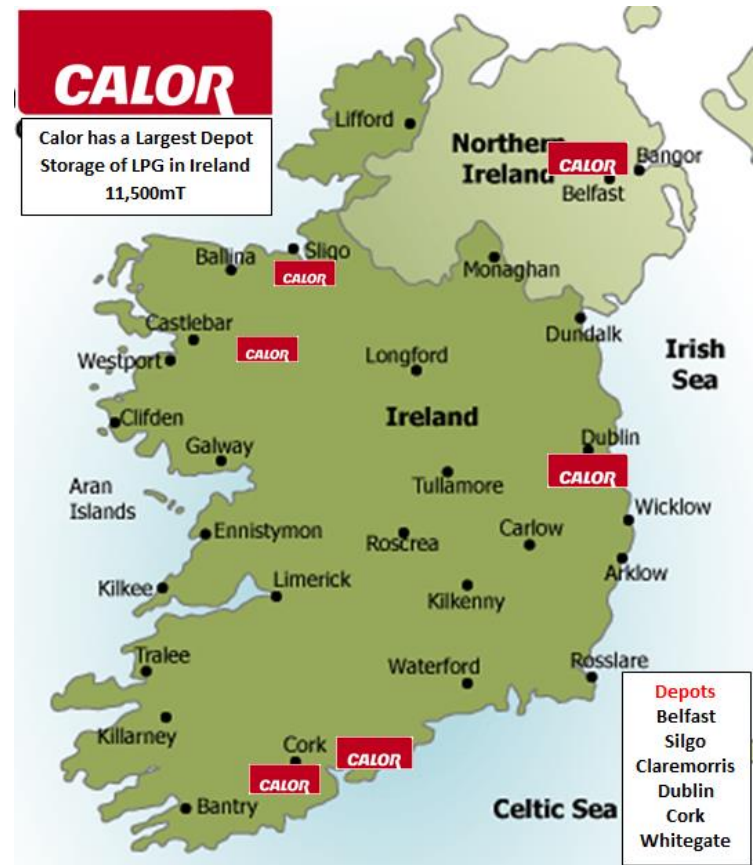
- Integrated Unit comprising of an Electric Heat Pump, a Condensing Boiler and a Hybrid System Manager.
- System manger, selects the most cost effective heat source for the current conditions.
- Works best at temperatures of 45°C.

CALOR – KEY FACTS

Calor is a wholly-owned subsidiary of SHV Gas based in the Netherlands.

SHV is the largest distributor of LPG in the world

Market Leader: Calor has 50% Market Share in the Irish LPG market.



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SUMMARY

- Unit 1 - **LPG Product Knowledge**
- Unit 2 - **Gas Regulations & Standards**
- Unit 3 - **Bulk Tank Installations**
- Unit 4 - **Cylinder Storage**
- Unit 5 - **Pipe Work**
- Unit 6 - **Utilisation**



LPG is a competitive alternative to Oil

Thought you couldn't have Gas?
Now You Can



Questions



Everything is
Possible



Thank you

