



Register of Gas Installers of Ireland
Unit 9, KCR Industrial Estate,
Ravensdale Park, Kimmage,
Dublin 1
T. 01 4997998
F. 01 4929983
Email: info@rgii.ie

Technical Bulletin

CO risk from appliances burning incorrect fuel or incorrectly converted appliances

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BACKGROUND:

RGII has become aware of several occurrences where appliances have been found to be on a Liquefied Petroleum Gas (LPG) supply but have been put into service set up for Natural Gas. The appliances had not been converted for use with LPG or were incorrectly converted. This resulted in the appliances producing very high and dangerous levels of carbon monoxide. This in turn created a very hazardous condition which can result in death.

Natural Gas / LPG - Physical, Chemical Properties and differences

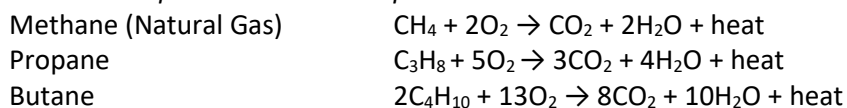
Table A.1 of IS813 details the various differences in the basic characteristics of each fuel. Most notably, Propane and Butane have a higher calorific value than Natural Gas and require more than twice the amount of air for complete combustion.

Most appliances on the market today are by design suitable for use with either Natural Gas or LPG. All must be adjusted /converted to suit the particular gas in use. When procuring an appliance, it is important to specify the gas type. **It is always the responsibility of the person commissioning the appliance, to check that the appliance is set up for the correct gas type and operating pressure, before putting the appliance in to service.**

Incomplete or inefficient combustion

All fossil fuels contain carbon and hydrogen. During complete combustion the carbon and hydrogen combine with oxygen to produce carbon dioxide and water vapour. The following formulae are the ideal burning conditions for each fuel. Note that Propane and Butane require a significantly higher amount of oxygen to produce complete combustion (see also table above – Volume of air required to burn one unit of gas).

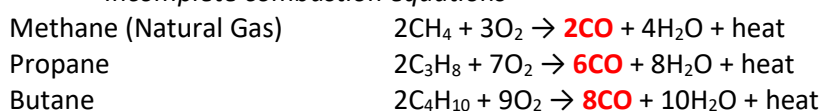
Complete combustion equations



In general, for complete combustion on natural gas appliances, more fuel is required to mix with air in order to burn properly. For complete combustion on LPG appliances, less fuel (than natural gas) and much more air is required.

Therefore, if Propane or Butane is connected to a Natural gas designed appliance, more fuel will be supplied to the burner with less air for the fuel/air mixture to be sufficient and incomplete combustion will occur. The rich fuel to air mix and the extra carbon which has not been burned completely during the combustion process will create Carbon Monoxide. (See photos 1 and 2 for examples of incomplete combustion)

Incomplete combustion equations



SAFETY ACTIONS:

Action required

Where a Registered Gas Installer (RGI) normally working in the Natural Gas environment encounters an LPG installation or is asked to carry out an LPG installation, they are asked to be extra vigilant in ensuring that appliances are either purchased for or converted for LPG use. RGIs should carefully follow Manufacturer's instructions if attempting a conversion from one fuel to another. If an RGI is not confident or has any doubts about converting appliances they should seek assistance from the appliance manufacturer trained technician, their local inspector or contact the RGII offices.

If it is identified, or an RGI becomes aware of any appliance which has not been converted for LPG use, is not properly converted or is set up and using the incorrect fuel, the appliance should be isolated (disconnect and capping off pipework), and a Notice of Hazard issued until such time as the appliance is converted.

Hazards

Due to the fundamental differences in the gases and their requirements for complete combustion, if an appliance is manufactured for and set up for use with Natural Gas but is connected to an LPG supply, the fuel will not be burned properly, and Carbon Monoxide (CO) will be produced. If there are issues with the flue of the appliance or the appliance is open flued, this can lead to CO entering occupied spaces of dwellings which could lead to injury or death. Annex I of IS813 details the requirements of carbon monoxide detectors to be installed in a new installation. RGII would always recommend that RGIs use a CO personal alarm for their own safety and protection from CO.

Conversion of appliances from Natural Gas to LPG

Most domestic appliances imported into the Republic of Ireland are manufactured to use Natural Gas. If your customer is using LPG to fuel their appliance, a conversion kit will be required. The conversion kit to be used should be recommended by the manufacturer and must be installed in accordance with manufacturer's instructions. Conversion kits may vary from one model to another, RGIs should ensure they have the correct conversion kit for the appliance before attempting a conversion. After a conversion is completed, the appliance must be commissioned in accordance with the manufacturer's instructions and where applicable Flue Gas Analysis carried out. With development of new technologies, manufacturer's instructions have a critical importance in setting up the appliance (eg. Fan speeds) and must be followed thoroughly.

As part of the conversion it is important to also mark up the data plate on the appliance (see photo 4) to show the correct gas type and to record details of the conversion on Declaration of Conformance and commissioning documentation.

Signs of incorrect conversion and incomplete combustion

If an appliance is not set up or has not been converted to suit the gas type, the appliance must always be isolated (disconnect and capping off pipework) from the gas supply and a DO NOT USE notice fixed to the appliance until such time as conversion is completed.

Warning signs of incorrect fuel use and/or incomplete combustion include (not an exhaustive list);

- High levels of CO in boiler Flue Gas Analysis readings
- Heavy staining soot deposits or discolouration around the appliance

- Blackening and/or soot deposits on kitchen equipment (pots, pans etc)
- Bad (orange or yellow) flame picture (see photos 1 and 2 below)
- Flame lifting on cookers/hobs
- Excessive condensation
- Incorrect family gas on data badge of appliance



Photo 1. Bad flame picture and flame lifting from hob (Nat Gas set-up with LPG in use)



Photo 2. Bad Flame picture in oven (Nat Gas set-up with LPG in use)



Photo 3. Typical good flame picture



Photo 4. Updated data badge after conversion (from Nat Gas to LPG)

Annex C (Servicing) and Annex E (Safety of Installation) of IS 813 detail the methods by which RGIs should carry out servicing and safety checks of gas installations.