

# **Leisure LPG Cylinder Safety Report**

**May 2018**

This publication has been compiled by the Petroleum and Gas Inspectorate, Department of Natural Resources, Mines and Energy.

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## Executive summary

LPG cylinders and portable butane gas appliances are popular in Queensland homes, for travelling and in workplaces. While there are no reliable figures, it is understood that most people in Queensland will come into contact with a portable gas device.

With LPG cylinder and butane canister imports increasing as a result of limited Australian production, Queensland's Petroleum and Gas Inspectorate (the Inspectorate), within the Department of Natural Resources, Mines and Energy (DNRME), conducted a study into the current standards of portable gas containers.

Overall, the study found no evidence of declining standards in imported products and found that importers have processes in place to check that products meet regulatory requirements.

Based on the study's findings, this report outlines recommendations to minimise the risks Queenslanders face when using these products, including strategies for the Petroleum and Gas Inspectorate to:

- undertake a targeted audit and inspection of gas suppliers and LPG cylinder retailers to ensure cylinders are being purchased to the required standards
- conduct a program of inspection and verification, by a suitably qualified technical body, on a sample of leisure LPG cylinders sold into Queensland for public use and those in the cylinder exchange business supplied by various gas suppliers. The inspection and verification program will determine if these cylinders comply with the requirements of Australian Standard *AS2030.1 Gas Cylinders. Part 1 General Requirements* and *AS2469 Steel cylinders for compressed gases - Welded two-piece construction - 0.1 kg to 150 kg*
- inspect to ensure LPG cylinder design registration obligations for gas suppliers and retailers are being met
- continue—and possibly enhance—the level of gas safety campaigns and stakeholder engagement.

In addition to the recommendations stemming from the risk assessment, it is recommended that the Inspectorate:

- continue to work with industry and other jurisdictions to monitor national statistics on safety incidents
- further examine whether regulations governing LPG cylinder valves should reflect a preference for those outlined in the Gas Energy Australia (GEA), August 2017 Safe+Connect Project.

## Introduction

The use of LPG cylinders and butane fuelled portable appliances is widespread throughout Queensland. While the actual number in use is not known, it is believed that most people in Queensland will come in contact with an appliance fuelled by LPG or butane, in either a private or commercial setting.

With limited Australian manufacturing of LPG cylinders and butane canisters, an increasing number of cylinders, canisters and associated valves and fittings are being imported into the country.

Queensland's Petroleum and Gas Inspectorate works with industry and the public to maintain and improve safety and health in the petroleum and gas industry. It determined that a study of the current state of LPG cylinders and butane canisters would provide valuable intelligence to inform its ongoing efforts to protect the safety of Queenslanders.

Given there are no restrictions on the movement of portable gas containers throughout Australia, the study looked at the issue across Australia and in New Zealand. The Inspectorate acknowledges the assistance of a range of gas industry and regulatory bodies who were consulted in the development of this report and also notes that there was some difficulty in gaining information from commercial suppliers due to the commercial confidence classification of some information.

## Objective and scope

The objective of this report is to:

- Identify the level of risk, both current and future, to the people of Queensland from the use of portable gas containers.
- Outline the current standards for imported portable gas containers, valves and fittings.
- Determine whether the standards are being robustly applied (and by whom).
- Identify any evidence that butane cooker fires can be linked back to different brands.

The scope of the report includes:

- The identification of the relevant standards and guidelines for leisure LPG cylinders, cylinder valves, butane canisters and associated fittings.
- The standards and guidelines covering the storage and handling, transportation, installation, use and care of LPG cylinders and butane canisters.
- Evidence of reported safety incidents.

This report is specific to the 'leisure market' and therefore does not include any container greater than 9kgs.

## Setting

Reliable figures on how many LPG cylinders and butane canisters are in use across Queensland are not available. Gas Energy Australia (GEA) estimates there are 9 million 9kg LPG cylinders with a Type 21 valve and cylinder connection in circulation in Australia<sup>1</sup>. Advice from gas suppliers puts the estimate of

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<sup>1</sup> Gas Energy Australia (GEA), August 2017. Safe+Connect Project LPG Leisure cylinder safety review: incidents, cylinder valves, regulations, operational impacts and conclusions. Pp.9-10.

LPG cylinders in Queensland at around 3 million. The cylinders are mostly used to operate barbecues and patio heaters.

Butane canisters are widely used in portable (camping) stoves and heaters. There is no accurate data available on the quantities of their sales and use in Queensland.

The lack of definitive numbers in Queensland should not impact on the report. Anecdotal evidence suggests that most Queensland households have at least one LPG cylinder or butane canister which suggests a strong regulatory focus must be maintained on safe use and handling.

## **Bodies involved in the monitoring and safety of portable gas containers**

The Gas Technical Regulators Committee (GTRC) is an association of government departments responsible for the safe use of gas. The committee includes representatives from every state and territory in Australia and New Zealand. Queensland is represented by the Inspectorate.

GEA is the national peak industry body that represents the bulk of the downstream gaseous fuels industries that cover liquified petroleum gas (LPG), liquefied natural gas (LNG) and compressed natural gas (CNG).

Australian Gas Association (AGA) provides accredited product certification services with respect to the gas, electrical and plumbing sectors within Australia. It also provides additional certification services that are accepted by the relevant government/industry regulators.

## **National experience**

### **Victoria**

The dangerous goods section of Worksafe Victoria was contacted<sup>2</sup> regarding leisure LPG cylinder safety. The manager advised that approximately 8 years ago they observed a marked increase in incidents involving cylinder valves. These incidents involved:

- non-captivated bleed screws (falling out of the valve causing an uncontrolled leak)
- broken fixed ullage tubes (allowing overfill of cylinders)
- non-captivated valve bonnets (no locating pins/screws allowing the bonnet to unscrew from the body of the valve).

Worksafe Victoria believes that the standard of imported valves has fallen, following the relaxation of requirements of *AS 2473.1: Valves for compressed gas cylinders*. (This is unconfirmed and is the opinion of Worksafe Victoria.) Worksafe Victoria receives reports of between 8 to 10 incidents involving cylinder valves each year but believes many incidents go unreported. Worksafe Victoria advised that they have not had any reports of cylinder manufacturing faults causing leaks.

### **Tasmania**

The Gas Standards and Safety Consumer, Building & Occupational Service section of the Tasmanian Government's Department of Justice advised that they had not had any reported issues with cylinder manufacturing faults<sup>3</sup>.

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<sup>2</sup> A. O'Connor (31 October 2017) phone & email conversation

<sup>3</sup> A. O'Connor (31 October 2017) phone conversation

## New Zealand

The Serious Gas Accident Data Report by the New Zealand Government's Worksafe Department<sup>4</sup> contains accident data collected by GTRC members from 2010 to 2016. The report covers LPG and NG accidents and gas related injuries from Australia and New Zealand.

The report states that in one year, 2015-16, there were 62 LPG accidents that caused injuries to 68 people and included 5 fatalities. Of these accidents, 71% occurred in a domestic or recreational environment and barbeques were involved in 40% of these accidents.

## Western Australia

Western Australia's Department of Commerce found that the most common types of equipment found in gas utilisation incidents were water heaters (hot water systems) accounting for 24% of the incidents. This was followed by LPG (storage) cylinders at 16% and recreational equipment (which includes gas barbeques) at 15%. It also stated that component failure was the cause of the majority of LPG storage incidents and recreational equipment (like barbeques)<sup>5</sup>.

## Queensland

LPG cylinder/portable appliance and butane appliance statistics from the Inspectorate's database were compiled and reviewed for the years 2012 to 2017. The statistics show that there were 159 reported incidents in that five-year period. The following is a list of where the leaks occurred:

Cylinder valves:	13
Connections:	44
Regulator:	12
Hose:	18
Appliance:	9
Unknown/Other:	63

It should be noted that of all the incidents reported, only two incidents involved the LPG cylinder itself (i.e. holes in welds, cracks in foot ring or valve guard, etc).

During the same period, there were 27 incidents involving portable butane cookers and canisters. The incidents mainly involved operators not following the manufacturer's instructions (e.g. inverted trivets, incorrectly inserted canister, oversized pot/pan and using/storing butane cookers on top of LPG barbeques). A full breakdown of the incidents is included in Appendix A of this report.

## Key findings 1:

- There is no uniform approach to data collection and assessment of safety incidents.
- There is no overwhelming evidence of cylinder or canister manufacturing faults leading to safety incidents.

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<sup>4</sup> WORKSAFE New Zealand, n.d. *Draft Serious Gas Accident Data Report 2010-2016*

<sup>5</sup> Department of Commerce, Government of Western Australia, n.d. *Gas Incident Safety Report 2014-15*.

## Industry experience

The issue of incidents and faults with leisure LPG cylinders was discussed at a meeting between GEA Queensland and the Inspectorate in September 2017. The feedback from GEA members was that they were aware of some issues with LPG cylinder valves and leaking cylinders but could not give any firm numbers to quantify this belief. GEA members were asked to check their incident/testing records for the past 5 years and provide the details to the inspectorate specifically regarding:

- faults with the LPG cylinder itself
- faults with LPG cylinder valves.

GEA Members were also asked to advise the Inspectorate what requirements gas suppliers stipulate to cylinder suppliers when purchasing cylinders (i.e. what standards, test procedures, documentation, design registration etc).

Approximately 80,000 new cylinders were introduced into the Queensland market in 2017. GEA members advised that they purchase their cylinders through importers who source them mainly from Thailand and China. The specification for cylinders purchased by gas suppliers for use in the leisure market is:

- 9kg & 4kg LPG cylinders with a code 4 finish (painted)
- cylinders supplied with Presto-Lite (POL) valve
- manufactured to AS2469 & Australian test station inspected & stamped.

LPG cylinder retailers advised that they purchase their cylinders through importers and stipulate that the cylinders and valves conform to all applicable standards and they specify a code 4 finish (painted).

One retailer advised that during the cylinder manufacture of every batch/order, a representative of the AGA attends and witnesses the production process. A test report is produced and provided to the AGA confirming that all the appropriate testings were conducted before the cylinders were shipped to Australia. AGA Monitoring Inspection Reports supplied to the retailers confirms that the cylinders were tested to, and meet, the respective Australian Standards.

### Key findings 2:

- All leisure LPG cylinder purchasers that were consulted require cylinder suppliers to provide cylinders that comply with Australian Standards.
- GEA Queensland members advised that they were aware of some issues with LPG in the past with cylinder valves and leaking cylinders but could not give any firm numbers or description of issues.

## Literature review

### LPG cylinders

Following concerns raised by the GTRC in 2016, GEA undertook the 'Safe+Connect' project to collect and review data pertaining to leisure LPG cylinder safety. The Safe+Connect preliminary report was released in August 2017.

Incident data was collected from GEA members as well as Energy Safety Victoria (ESV). Technical and commercial working groups reviewed the data and found that the majority of incidents were related to the

LPG leaking from the cylinder valve. It should be noted that the safety incident data used in the report was from GEA members and ESV only and therefore does not include other State regulators and non-GEA members.

The preliminary report included an analysis of 74 leisure LPG cylinder safety that occurred between July 2013 and February 2017. It was discovered that 40% of the safety incidents related directly to the cylinder valve, with the remaining incidents being attributed to fat fires, hose failures and other unknown causes. The preliminary report did not identify any issues with the integrity of LPG cylinders and did not reference cylinder manufacturing standards.

The working groups also reviewed incident data provided by ESV. ESV recorded 592 safety incidents with leisure LPG cylinders between July 2012 and March 2016 in Victoria. The report breaks the incidents down to unknown cause, connection issue, incorrect usage, cylinder valve open etc. The data indicates that among the incidents where the cause could be determined, 69% of them were caused by the cylinder valve connection.

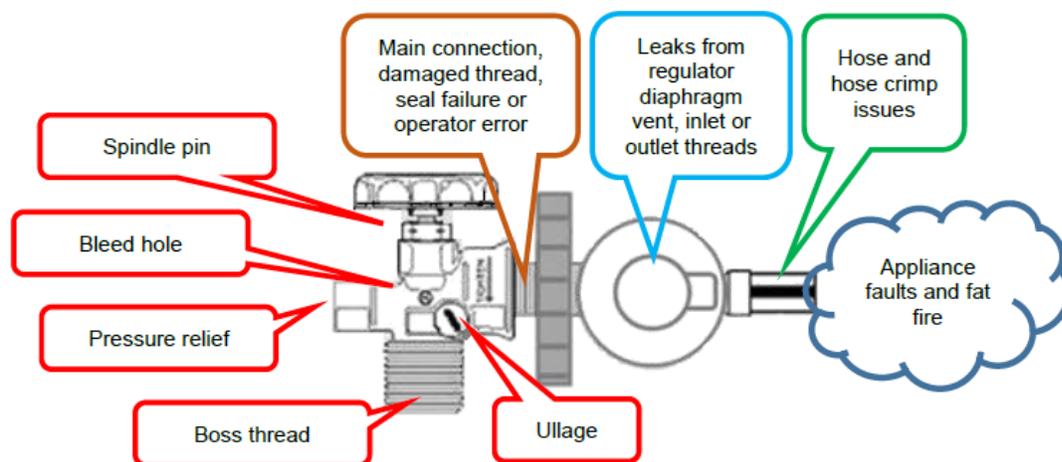


Figure 1: Possible leakage points

(image courtesy of Gas Energy Australia, August 2017, Safe+Connect Project. *LPG Leisure cylinder safety review: incidents, cylinder valves, regulations, operational impacts and conclusions*. p.7)

The preliminary report canvassed seven different styles of valves that could be used to enhance safety. These were:

- The current Type 21 threaded connection with a gastight plug for transport.
- Reverting back to brass connections for appliances while retaining the current Type 21 specification.
- Adding a back-check valve to the Type 21 connection specification.
- Reverting back to brass connections for appliances in addition to a back-check valve included in the Type 21 specification.
- Adopting the 'quick connect coupling' (QCC) which has an external ACME/internal Type 21 thread connection.
- Introducing a modified 'quick connect coupling' (QCC) (external ACME thread only, with no internal Type 21 thread) connection.

- Adopting a Kosan connection (no isolation/control valve on connection).



POL/Type 21/ CGA510 valve



POL with back-check valve and brass male fitting



QCC



Modified QCC



Kosan style valve

(Image courtesy of Gas Energy Australia, August 2017, Safe+Connect Project. *LPG Leisure cylinder safety review: incidents, cylinder valves, regulations, operational impacts and conclusions*. Table 6, p.14.

The GEA Safe+Connect project preliminary report evaluated the seven valve types against the criteria of providing stakeholders with:

- an easy to make a gas tight connection
- limited mechanical force required to achieve a gas tight seal
- eliminated chance of misalignment during connection
- a positive connection to cylinder before gas can flow to the appliance
- safe and efficient filling
- international approval.

The GEA Board further concluded that the POL (Type 21) valve with back-check, the QCC with Type 21 internal threaded valve, and the modified QCC all possess the above attributes, and has directed the working groups to investigate how the recommendations/conclusions can be implemented.

### Key findings 3:

- The majority of safety incidents relate to LPG leaking from the cylinder valve.
- No issues with the LPG cylinders and cylinder manufacturing standards were identified.
- There is merit in considering changing cylinder design specifications to meet the criteria suggested by the GEA Safe+Connect report.

### Butane canisters

The following points are taken from the GTRC Butane Canister Cooker Safety Issue Summary<sup>6</sup>.

Due to specific safety concerns as a result of testing conducted by the Australian Gas Association (AGA) regarding the reliability of the safety devices, regulatory authorities required verification testing of samples of all portable butane cookers on the market for compliance with relevant overpressure protection requirements.

Verification testing identified that a substantial proportion of the tested appliances **did not** comply with standard requirements as the overpressure protection activated at a higher pressure than permitted by the standard or failed to activate at all. A number of appliances also did not comply with requirements relating to the protection of the overpressure and canister retention mechanisms however they had previously been accepted by the certification body.

The non-compliances have the potential to result in the over-pressure safety device failing to activate in an overpressure situation which can result of the butane canister rupturing and resulting in injury and damage.

As a result of the non-compliances a majority of the product certifications were suspended, and the non-compliant products were withdrawn from sale.

SAI Global disputed suspension of certain products on the basis that compliant test reports have been provided and the standard requirements are unclear.

Addressing any concerns in relation to products that have already been sold, certificate holders were requested to respond with the actions they had undertaken as a result of the adverse findings, or alternatively, provide evidence that their appliances are safe.

For further reference an extract from *GTRC Test Results Summary – Butane Canister Cooker* is attached in Appendix C.

Queensland Petroleum and Gas inspectors have attended portable butane cooker incidents where the overpressure safety device has failed, causing the butane cylinder to rupture. The incidents involved different models of overpressure safety devices and no consistent cause has been identified. The available information gathered from other regulators and industry bodies does not highlight the butane canister, itself, as a factor in the ongoing incidents with these devices but rather a failure of the overpressure safety devices.

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<sup>6</sup> Jason Treseder (GTRC), March 2015. *Butane Canister Cooker Safety Issue Summary*. pp.1.

DNRME issued Safety Alert No 54 in 2013<sup>7</sup>, advising the public of the safety hazards of butane cookers. In 2015, DNRME issued Safety Instruction No 68, informing the public of several non-compliant butane cooker approval certificate numbers. The public was advised to return any butane cookers to the retailer if their butane cooker matched any of the non-compliant numbers. DNRME was able to act in the public's interest due to information supplied by other Australian regulators through the GTRC. In September 2017 Kmart Australia recalled 'Active & Co' and 'Jackeroo' portable butane cookers.

The European Standard EN 417 Type 200:1996 is effectively the governing standard worldwide for the safety requirements of pressurised canisters. The butane canisters are available in several formats and require the correct one for the particular cooker. The different formats cannot be swapped between stove types (with one exception).

The (French) Gaz Bleu puncture-type C206 canister is the oldest butane canister commonly found. It is cheap and still widely available, however, it has a narrow base which can be easy to tip over. Once installed, the canister cannot be removed from the burner until it is empty.



Figure 2: Gaz Bleu puncture-type C206 canister connection



The screw-thread or Epigas canister was founded by the UK firm Epigas and is now possibly the most common type in the world. Epigas is now owned by Coleman of America. The canister comes in a 100 gram, 220 gram or 450 gram size, and can be removed from the burner after each use.

Figure 3: Screw-thread or Epigas canister connection



The Easy-Clic CV series of CampingGaz canisters look almost identical to the screw-thread ones but they have no thread. They are suitable only for the French made CampingGaz range of stoves. CampingGaz is now also owned by Coleman.

Figure 4: Easy-Clic CV series canister connection



The Coleman liquid gas PowerMax canisters look like a small Sigg brand water bottle with a Lindal valve which is similar to the CampingGaz valve. They are designed to feed the liquid gas mix to a Coleman Xtreme stove.

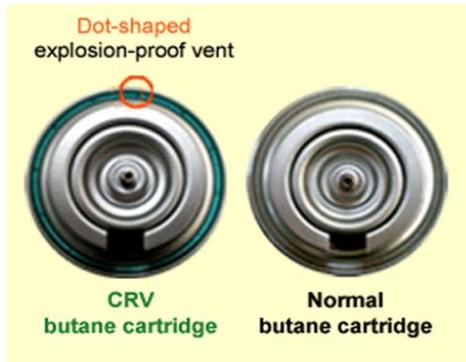
Figure 5: PowerMax canisters connection

<sup>7</sup> Petroleum & Gas Inspectorate, Department of Natural Resources and Mines, 2013. *Petroleum & Gas safety alert no. 54* | 22 January 2013 | Version 1

<sup>8</sup> Petroleum & Gas Inspectorate, Department of Natural Resources and Mines, 2015. *Petroleum and gas safety instruction no. 6* | 05 September 2015 | Version 3



Finally, there are also canisters which look like a standard pressure pack paint spray can. They have a 'bayonet' type connection which looks identical to the top of a spray can without the nozzle. They appear to be popular for some car-camping stoves where the canister clips inside the stove body. The canisters are quite cheap with most brands appearing to contain only 'butane' as the fuel.



The latest design in butane canisters for portable butane cookers includes a safety device called a countersink release vent (CRV). The CRV safety device allows gas to vent through the perforations in the can rim when the canister heat or pressure is too much. The CRV approved cans are identified by their certification marked on the can and packaging (certification and compliance of either EN417 or UL147B) they also have a light blue colour rim.

#### Key findings 4:

- There is a diverse range of canisters available on the Queensland market.
- The inspectorate should maintain ongoing surveillance of Butane Cookers including monitoring the effectiveness of the canisters fitted with a countersink release vent (CRV) in preventing serious incidents.
- The available information gathered from other regulators and industry bodies does not highlight the butane canister, itself, as a factor in ongoing incidents with these devices.

## Regulations by jurisdiction

Currently each jurisdiction has similar legislative requirements for leisure LPG cylinders that cover design registration, manufacturing, inspection and maintenance standards. They also all reference the same standard (AS2030 Part 1). For a thorough comparison across the jurisdictions, see Appendix D.

Acts and standards are constantly revised and improved, following incidents involving gas devices and associated equipment. While Queensland can influence changes to standards through its involvement on committees such as GTRC, it is harder to influence other jurisdictions to change their legislation. This creates the risk of having different legislative frameworks governing a product that can be moved freely across the jurisdictions.

More work is required with other state regulators, standards committees and industry associations to ascertain the effectiveness of the enforcement of the existing requirements.

## LPG cylinder certification and approval requirements

Most states and territories have health and safety laws that are based on the Work Health and Safety (Model Work Health and Safety Laws) legislation ([www.safeworkaustralia.gov.au/law-and-regulation/model-whs-laws](http://www.safeworkaustralia.gov.au/law-and-regulation/model-whs-laws)). The model legislation hold that gas cylinders covered by Section 1 of AS2030.1:2009 (*Gas cylinders – General Requirements*) are pieces of high risk plant and therefore their design requires registration.

The Inspectorate consulted the Engineering Unit in Workplace Health and Safety Queensland (WHSQ) on issues such as design registration, manufacturing standards and audit/inspection processes. Below are the findings which are based on the requirements of the Queensland Work Health and Safety Act and Regulation 2011 (WHS legislation).

Under the WHS legislation there are no approval or authorization requirements to import leisure use LPG cylinders (9kg or under). There is, however, a requirement for the cylinders to be 'design registered', either with WHSQ or a corresponding jurisdiction before they can be sold or used in Queensland.

In administering the design registration process, WHSQ checks:

- Whether the item of plant has been designed to a standard published by a reputable standard publishing organisation (e.g. Australian Standard, American Standard, American Society Mechanical Engineers, European Standard etc.)
- The design has been verified by a Registered Professional Engineer Qld (RPEQ).

The design registration application must include a statement from the designer stating the published technical standards and engineering principles used in the design of the cylinder. The design registration requirement ensures the design of the cylinder is compliant with the nominated technical standard, it does not encompass the manufacturing process of the cylinder. There is no requirement under the WHS legislation for importers or suppliers to provide evidence that the LPG cylinder is manufactured to a particular standard. WHS legislation does not mandate compliance with a particular technical standard nor does it have a list of standards that are acceptable. It is WHSQ's position that the cylinder should comply with the published technical standard that it is designed to, in its entirety, including any manufacturing, inspection, testing and marking requirements in that standard.

The *Petroleum and Gas (Production and Safety) Act 2004* contains a list of mandatory and preferred standards for safety requirements in relation to petroleum and gas (including for cylinders).

WHSQ Inspectors conduct workplace assessments on suppliers (e.g. service stations) of leisure LPG cylinders but this does not include assessments on the LPG cylinders themselves. WHSQ Inspectors would typically look at general workplace health and safety matters such as confirmation of design registration, storage and handling, inspection, notification of manifest quantities etc.

The WHSQ Engineering Unit does not conduct inspections or audits on importers or retailers of leisure LPG cylinders. The unit has advised that if there are issues relating to gas cylinders it may become involved to provide technical support, depending on the nature of the issue.

The AGA's Cylinder Certification Scheme 'AS2030.1/ Welded and Brazed Cylinders' has issued 32 approvals to date. These certifications are for LPG cylinders ranging from 1.25 to 45 kg and are certified to Australian Standards AS2030.1, AS2469 and AS2470.

The cylinder manufacturing companies are from China and the cylinders are marketed under popular brand names such as Gasmate, Barbecues Galore, Super Cheap Auto and Campmaster.

## **Butane canister certification and approval requirements**

Under Queensland legislation, butane cookers are defined as Type A devices that are required to be approved for use by the Chief Inspector or by a body approved by the Chief Inspector. These devices are approved with the butane canister as an integral part of the approval. The approval of these cookers requires that overpressure protection is part of the design. This protection is required if the temperature of the canister increases to the point where it could rupture and release a large amount of liquid butane causing significant damage and serious injury.

Following ongoing safety concerns with portable butane stoves incorporating enclosed gas cartridges, the GTRC released *Technical Guidance Bulletin No. 010 in January 2017*<sup>9</sup>. This bulletin, when read in addition to AS2658, specifies the minimum safety requirements for portable butane stoves incorporating enclosed gas cartridges (also known as 'lunchbox cookers').

The bulletin outlined the changes to AS2658 LP gas—Portable and mobile appliances. The changes required:

- Certifiers to ensure cartridge temperature and pressure settings did not exceed set new limits.
- The appliances to be fitted with two forms of independent overpressure protection.
- That changes in appliance cartridge compartments be devoid of any openings.
- The appliance pan support (Trivet) be permanently attached and not be reversible.

The AGA also certify disposable gas cartridges to *AGA301 Butane gas cartridges*. These canisters are marketed as Gasmate, Gasmaster, Buyright, Jumbuck and Jackeroo Butane gas cartridges and cover models G3210 (3 pack), G4210 (4 pack) and G6210 (6 pack).

## **Conclusion**

This report has found that the states and territories of Australia have similar legislation and safety requirements to manage the safe use of LPG cylinders and butane canisters. The legislation governing the design registration of cylinders is based on the Work Health and Safety (National Uniform Legislation) Regulation and is the model for most state legislation. The standards listed in this report are also common across the country. Gas suppliers and other retailers of LPG cylinders have confirmed that they require the cylinders to be manufactured to the relevant Australian standards.

Information found in the most recent literature on LPG cylinder safety, and from discussions with other state and territory regulators, indicates that the majority of incidents involving LPG cylinders involved the cylinder valve and connection. The GEA report provides some direction in proposing safe cylinder valve designs. Reports of faults with the imported gas cylinders was minimal but still provides a risk.

Following the number of incidents with portable butane cookers, research and regulatory input have resulted in product recall and recertification of these cookers. Some canister designs now include a safety device called a countersink release vent (CRV). No statistics are available on whether this has reduced overpressure-related safety incidents. The available information gathered from other regulators and

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<sup>9</sup> Gas Technical Regulators Committee (GTRC). January 2017. *Technical Guidance Bulletin No 010*

industry bodies does not highlight the butane canister, itself, as a factor in the ongoing incidents with these devices.

The report found no evidence of declining standards of imported LPG cylinders, butane canisters, valves and fittings in use in Queensland.

There is a lack of uniform and comprehensive reporting of safety incidents both across the jurisdictions and industry. This makes monitoring and assessment of incidents difficult.

## Recommendations

In response to the research findings, the Inspectorate conducted a risk assessment, identifying the risks to public safety and to the reputation of the Government regarding the use of imported leisure LPG cylinders in Queensland.

The risks identified were:

- risk to public safety related to faults with imported LPG cylinders and valves.
- risk of adverse public perception of the Queensland Government's ability to safely manage the LPG industry in Queensland.
- risk to the viability of the leisure LPG cylinder industry in Queensland due to safety concerns.

The risks were assessed against the current controls and rated comparing consequence and likelihood. The current rating for the identified risks is considered medium to high. A copy of the risk register is included in Appendix E.

The Inspectorate has identified strategies that it recommends will help to minimise the safety risk posed by imported LPG cylinders and how the implementation of these will reduce the risk level to medium and low. The strategies are to:

- undertake a targeted audit and inspection of gas suppliers and LPG cylinder retailers to ensure cylinders are being purchased to the required standards.
- conduct a program of inspection and verification, by a suitably qualified body (SIMTARS), on a sample of leisure LPG cylinders sold into Queensland for public use and those in the cylinder exchange business supplied by various gas suppliers. The inspection and verification program will ascertain if these cylinders comply with the requirements of *AS2030.1 Gas Cylinders. Part 1 General Requirements* and *AS2469 Steel cylinders for compressed gases: welded two-piece construction - 0.1 kg to 150 kg*.
- inspect to ensure LPG cylinder design registration obligations for gas suppliers and retailers are being met.
- Continue, and possibly enhance, the level of gas safety campaigns and stakeholder engagement.

These responses will be tracked to ensure implementation and effectiveness.

In addition to the recommendations stemming from the risk assessment, it is recommended that the Inspectorate:

- continue to work with industry and other jurisdictions to monitor national statistics on safety incidents

- further examine whether regulations governing LPG cylinder valves should reflect a preference for those outlined in the GEA report.

## Appendix A - Queensland leisure LPG cylinder incidents 2012 – 2017

Year	Valve	Connection	Cylinder	Regulator/hose	BBQ/Appliance Fault	Unknown/Other
2012		<p>Leak at connection between LPG cylinder and the regulator hose</p> <p>Loose connection at cylinder</p> <p>LPG cylinder not connected to BBQ properly</p> <p>POL fitting not tightened properly</p> <p>Fire occurred at the LPG cylinder connection</p> <p>Damaged seal on POL male fitting at inlet to pressure regulator</p> <p>Gas connection between LPG cylinder and lamp was loose.</p> <p>Loose POL connection</p>	Gas leak at cylinder	<p>Final regulator connection not correctly tightened before use</p> <p>Loose fitting or dog has chewed the hose</p> <p>Regulator missing rubber seal</p> <p>Leak at regulator fitting, owner forgot it was a left handed thread and undid the fitting instead of tightening it.</p>	<p>alteration of appliance from original specifications</p> <p>Fire started at final LPG connection to gas rail inside the LPG cylinder cabinet.</p> <p>Ignition of leaking gas at or on the appliance regulator</p> <p>Manufacturer has altered the design of the Portable Outdoor LPG "Area Heater</p>	<p>BBQ fire. Unknown cause.</p> <p>BBQ fire in cylinder storage area.</p> <p>BBQ Fire. Unknown cause. Could have been from loose POL connection, absence of soft seat washer or disturbance of the joint from cleaning to cooking.</p> <p>BBQ fire. Unknown cause.</p> <p>Hose and regulator assembly too badly damaged to determine point of gas leak.</p> <p>BBQ fire caused by butane canister sitting next to BBQ. Canister exposed to more than 70 degrees.</p> <p>BBQ fire. Unknown cause</p>
2013	Gas leak from faulty isolation valve	<p>connection between regulator and BBQ not fully tight</p> <p>gas leak from POL connection</p> <p>Loose POL connection</p> <p>Leak at POL connection into cylinder valve</p> <p>Rubber seal missing from POL fitting</p> <p>Loose POL connection</p>		<p>regulator hose caught fire</p> <p>gas leak from regulator not being sealed into the LPG cylinder</p> <p>Origin of fire appeared to be at hose connection</p>	<p>small gas leak a right side of gas cock on BBQ</p> <p>Fire caused by use of homemade unapproved appliance- pig spit.</p>	<p>Smell of gas.</p> <p>Fire at unit affected BBQ gas cylinder</p> <p>BBQ fire. Unknown cause</p> <p>BBQ fire. Unknown cause</p> <p>BBQ fire. Unknown cause</p> <p>House fire believed to be caused by LPG Cylinder.</p> <p>BBQ fire. Unknown cause</p> <p>BBQ fire. Unknown cause</p> <p>BBQ fire. Unknown cause</p>

Year	Valve	Connection	Cylinder	Regulator/hose	BBQ/Appliance Fault	Unknown/Other
		Loose POL connection POL connection not tightened correctly before use Possible loose connection at LPG cylinder POL connection loose Seal missing on the male POL fitting on pressure regulator inlet		Owner 'fiddled' with hose in an attempt to adjust cooking temp. Loose hose fitting Possible loose connection Gas leak at LPG regulator		BBQ fire. Unknown cause BBQ fire. Unknown cause BBQ fire. Unknown cause BBQ fire caused by use of an outdoor approved BBQ/fryer in a confined space
2014	Gas leak from cylinder valve Leak from ullage screw Leak from loose ullage valve	Loose POL connection Loose POL connection Loose connection between LPG cylinder and BBQ Loose cylinder connection Leak between valve and connection on BBQ regulator Fire appeared to have started at POL connection and cylinder outlet valve Leak was at the connection to the cylinder outlet valve and POL fitting Loose POL Connection POL seal missing resulting in gas leak		Loose LPG regulator connection Fire started at connection of the regulator to the LPG cylinder Cylinder hose had caught fire Fire started where regulator connected to cylinder BBQ hose caught fire Leak from middle of hose which ignited the outdoor burner	Faulty BBQ	Owner delayed lighting the BBQ. Owner delayed lighting the BBQ. Faulty camera provided ignition source. BBQ fire. Unknown cause BBQ fire. Unknown cause BBQ fire caused by butane gas stove sitting next to BBQ, in use. Owner delayed lighting the BBQ. BBQ fire. Unknown cause BBQ fire. Unknown cause BBQ fire. Unknown cause LPG cylinder casualty of shipping container fire stored beside. Leaking cylinder. Unknown cause BBQ fire. Unknown cause BBQ with explosive ignition. Unknown cause BBQ fire. Unknown cause
2015	Cylinder unable to be isolated due to fault with the valve Gas leak at cylinder valve	Loose POL connection O ring not fitted correctly	Leak from a pinhole in the weld Leak from a pinhole in the weld	Leak between flex hose and cylinder Leak at hose connection crimp at	Faulty appliance Odour identified as a failed portable BBQ regulator hose assembly	Owner left butane fuelled torch in operation, unattended on top of a BBQ.

Year	Valve	Connection	Cylinder	Regulator/hose	BBQ/Appliance Fault	Unknown/Other
	Gas leak from bleed screw not being fully sealed Gas leak from seized valve in the open position	Fire from connection between cylinder and pressure regulator valve. Seal missing Leak at POL Connection Gas leak coming out of connection to BBQ Loose connection, not tightened properly Fire started at cylinder connection Cylinder ignited at POL connection		the outlet of the regulator BBQ hose attachment was loose at cylinder connection Appears gas hose had ruptured Leak on BBQ hose Poor connection of LPG hose and cylinder Leak from a crack in the flex hose assembly up near the connection point on the appliance		Owner delayed lighting the BBQ. BBQ fire. Unknown cause BBQ fire. Unknown cause Leaking exchange cylinder. Unknown cause
2016	leak near cylinder valve extreme heat to cylinder valve handle from a live match being dropped onto valve faulty valve	Fire started from connection to cylinder. Leak at POL connection Loose fitting POL Connection loosened by owner accidentally		Gas leak on hose seal Believe gas hose melted resulting in released gas igniting		BBQ fire in cylinder storage area. BBQ fire. Unknown cause BBQ fire. Unknown cause
2017	Gas leak from faulty valve. Owner not able to turn off. Leak from the thread where the valve screws into the cylinder			Leak at regulator fitting, owner attempted to tighten it. Loosened it instead Fire occurred at the regulator		Owner forgot BBQ was on and went out, leaving BBQ unattended, causing a fire. BBQ fire. Unknown cause. Gas starting leaking from cylinder end. BBQ fire. Unknown cause BBQ fire. Unknown cause BBQ explosion caused by butane canister sitting on 3 burner BBQ shelf, too close to burner.

## Appendix B - Butane cooker canister incidents 2012-2017

Year	Reason
2012	BBQ fire caused by butane canister sitting next to BBQ. Canister exposed to more than 70 degrees. Butane canister explosion. Appliance was not correctly set up as designed.
2013	Butane cooker explosion due to heat shield being fitted upside down. Butane canister explosion. Used with trivet in the inverted position
2014	BBQ fire caused by butane gas stove sitting next to BBQ, in use. Butane cooker fire caused by canister being inserted into appliance the wrong way around Butane cooker exploded. Used with trivets facing upward Butane cooker explosion. Cooker was placed on top of an upright cooker that was in use at the time. Butane cooker explosion. Cooker not used as per manufacturer's instructions. Saucepan was wider than cooker trivet causing heat to reflect back down onto the canister. Butane cooker fire. Unknown cause Butane cooker fire. Being used on kitchen table at time of incident Double ring burner fire. Used within annexe of caravan.
2015	Owner left butane fuelled torch in operation, unattended on top of a BBQ. Butane canister explosion. Unknown cause Portable Butane cooker explosion. Being used indoor at time of incident Butane canister IED. 5 canisters used to improvise an IED. One canister ignited Butane cooker fire. Being used indoor at the time of incident Butane cooker fire. Unknown cause Butane canister explosion, using a 300mm frying pan at time of incident Butane cooker explosion. Not used in accordance with manufacturer's instructions Butane cooker fire. Being used indoor at time of incident
2016	Butane cooker explosion. Canister leaked until the gas came into contact with citronella candle under the table Portable Butane cooker fire. Being used indoor at time of incident Butane cooker fire. Not used in accordance with manufacturer's instructions
2017	BBQ explosion caused by butane canister sitting on 3 burner BBQ shelf, too close to burner. Butane canister explosion caused by owner placing 5 canisters inside an electric oven, forgetting about them and preheating the oven to cook a meal. Butane cooker fire. Unknown cause Portable Butane cooker explosion. Being used indoor at time of incident Lunchbox cooker explosion. Unknown cause

## Appendix C - Test results summary: Butane canister cooker

As a result, concerns tabled by AGA at the November GTRC Meeting, the certification bodies were instructed to obtain 6 appliances and assess compliance against clauses 3.7.1 Overpressure protection and Clause 3.7.9 Protection of cartridge retention and overpressure safety system mechanisms.

AGA provided information on 8 certificates covering 10 models.

- One model did not have samples available and is still pending.
- SAI Global provided results a total of 3 certificates covering 3 models.
- IAPMO advised they had not certified canister cookers

The results of the testing are summarised below

#	Certificate Holder	Model	Cert Number	Report	Tested units	Total tests	Critical failures (no release)	Average Release Pressure (kPa)	Max Release Pressure (kPa)	Number Passing Tests <500kPa	Number Failing Tests >500kPa	3.7.9 protect comply	Comment
1	AHM	CM2200S	5907	R15012901	6	30	0	407	489	30	0	Fail	
2	AHM	CM2250	6810	R15012901+1	6x2	60	1	493	700	36	19	Fail	1 unit failed to release 1st attempt
3	AHM	OZ2160	6810	R15012901+1	6	30	0	552	738	11	21	Fail	
4	AHM	CM2270	6834	R15012901+2	6	30	0	414	455	30	0	Fail	
5	Austcrown	AD-90	5241	R15012902	9	45	0	543	982	27	18	Fail	3 units were made in 2013, 6 in 2014. The 3 older models performed significantly worse
6	Sitro	PC2080	7920	R15012906	14x2	140	14*	529	713	43	83	Fail	2 units failed 5 times, 3 other units failed intermittently on tests 1, 2, 3 and 3.
7	Sitro	PC1070	7920	R15012906	6	30	0	484	565	19	11	Fail	Cartridge retention change from approved design
8	Chen Bros	BDZ-168	7378	R15012903	6	30	6	484	644	17	8	Fail	1 unit failed 5 times, a 2nd unit failed on test 1.
9	Illusion	U-Bute	7633	R15012904	6x2	60	10	656	812	0	50	Fail	2 units failed 5 times. Small change to lock level found
10	MIT	MS-2000	7437	R15012905	6	30	0	398	426	30	0	Fail	
11	Primus	2282	GSC-S20210	R2658004	3x2	36	0	481	609	24	12	Pass*	*photos show apparent non-compliance

#	Certificate Holder	Model	Cert Number	Report	Tested units	Total tests	Critical failures (no release)	Average Release Pressure (kPa)	Max Release Pressure (kPa)	Number Passing Tests <500kPa	Number Failing Tests >500kPa	3.7.9 protect comply	Comment
1 2	Primus	2271	GSCS-20063	R2658005	6	36	0	471	570	31	5	Pass*	*photos show apparent non-compliance Additional test on one sample in 50°C oven (pass)
1 3	Powerlite	PL-121	GAS-40077	R2658006	6	36	0	353	513	35	1	Pass*	*photos show apparent non-compliance

## Appendix D - Rules, standards and guidelines by jurisdictions

State / Territory	Legislation	Referenced Standard	Guideline
Queensland	<i>Petroleum and Gas (Production and Safety) Act/Regulation</i> Work Health Safety Act 2011 and Regulation	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	Safe Storage and Handling of LPG Gas Cylinders
New South Wales	<i>Gas Supply Act 1996</i> <i>Gas Supply (Consumer Safety) Act 2017</i> Gas Supply (Consumer Safety) Regulation 2012 Work Health and Safety Regulation 2011	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	NSW Government Fair Trading Gas safety Fire & Rescue NSW - LPG Cylinder Safety Check List
Victoria	Gas Safety (Gas Quality) Regulation Occupational Health and Safety Regulations 2017	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	Guidelines for Gas Safety Code of Practice for the safe use of LP Gas at public events in Victoria
Tasmania	<i>Gas Act 2000</i> Work Health and Safety Regulation 2012	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	Storing and Using LP Gas at Public Events Fact Sheet Nov 14 Butane Cartridge cookers
South Australia	<i>Gas Act 1997</i> Gas Regulations 2012 Dangerous Substances (General) Regulations 2017 Work Health and Safety Regulations 2012	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	LPG cylinders and fittings
Western Australia	Gas Standards (Gas Supply and System Safety) Regulations Occupational Safety and Health Regulations 1996	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	Important points about LP Gas cylinders
Northern Territory	NT Dangerous Goods Regulations Work Health and Safety (National Uniform Legislation) Regulation	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	Handling and storage of gas cylinders
Australian Capital Territory	<i>Gas Safety Act 2000</i> Gas Safety Regulations 2001	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases'	

	Work Health and Safety Regulation 2011 (ACT)	Part 1 'Cylinders for compressed gases other than acetylene' (2009)	
Norfolk Island	Gas Safety Act 2000 (ACT) Gas Safety Regulations 2001 (ACT)	AS2030 'The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases' Part 1 'Cylinders for compressed gases other than acetylene' (2009)	
New Zealand	Health and Safety at Work (Hazardous Substances) Regulations 2017 Gas Act 1992 Gas (Safety & Measurement) Regulation)	AS2469—2005 (R2016) Steel cylinders for compressed gases—Welded two-piece construction—0.1 kg to 150 kg 29 AS2470—2005 (R2016) Steel cylinders for compressed gases—Welded three-piece construction with longitudinal joint—11 kg to 150 kg AS2030. The verification, filling, inspection, testing and cylinders	Guide to Gas Cylinders LPG for suppliers

Table 1. State rules and regulations

Standard	Scope
AS2030.1 Gas Cylinders. Part 1 General Requirements	This Standard specifies requirements for the design, verification and manufacture of all gas cylinders for the storage and transport of compressed, dissolved and liquefied gases, of water capacity ranging from 0.1 kg to 3000 kg. References AS2469 Steel cylinders for compressed gases - Welded two-piece construction - 0.1 kg to 150 kg
AS1596 The Storage and handling of LP Gas	Specifies AS2030.1 as being the reference standards for LP Gas cylinders
AS2473.1: Valves for compressed gas cylinders	This Standard specifies requirements for valve design, construction and manufacturing, type testing and marking. This Standard applies to valves intended to be fitted to gas cylinders which convey compressed, liquefied or dissolved gases.
AS2469 Steel cylinders for compressed gases - Welded two-piece construction - 0.1 kg to 150 kg	This Standard specifies requirements for welded carbon and stainless steel cylinders with no longitudinal joint and one circumferential joint, of water capacity not less than 0.1 kg nor more than 150 kg, which have test pressures from 1750 kPa to 7000 kPa and are intended for the storage and transport of compressed gases in accordance with AS2030.1.

Standard	Scope
AS2337 Gas cylinder test stations	This Standard sets out requirements and procedures for a gas cylinder test station to carry out initial and periodic inspection of gas cylinders covered by AS 2030.1. It also specifies requirements for test stations to obtain a certificate of conformity.
<b>Butane Equipment</b>	<b>Scope</b>
AS2658 LP Gas—Portable and mobile appliances	This Standard applies to various types of portable appliances supplied from a separate gas container with vaporized LP Gas including Butane

*Table 2. Adopted Australian standards*

## Appendix E - Risk assessment

### Petroleum and Gas Inspectorate Leisure LPG Cylinder Risk Register

Risk Description (Clearly describe the risk - include information on the source of risk)	Business Unit most affected (Select from the drop down menu provided)	Risk Impact Area (Select from the drop down menu provided)	Date Registered / reviewed	Potential Consequences	Current Controls (What is in place at present to control the risk)	Control Effectiveness Rating (Select from the drop down menu provided)	Current Risk Level (Considering current controls in place and their effectiveness)			Current Risk Rating #	Risk Controls (Actions to be taken)	Timing (Date)	Action Owner	Status	Residual Risk Level (After controls in place and all response actions completed)			Residual Risk Rating #
							Consequence	Likelihood	Risk Rating						Consequence	Likelihood	Risk Rating	
Risk to public safety related to faults with imported LPG cylinders and valves	Petroleum and Gas	Regulatory	1/09/2017	Members of the public seriously injured or killed from a fire or explosion	Legislation requiring LPG cylinder be manufactured and maintained to recognised standards.	Adequate	Major	Possible	High	12	Audit and inspection of LPG gas suppliers	June 30 2018	Tony O'Connor	Under development	Major	Unlikely	Medium	8
					Gas suppliers require importers to supply LPG cylinders with cylinders manufactured to relevant standards	Adequate	Major	Possible	High	12	Audit and inspect cylinder suppliers / importers to ensure legislative obligations are being fulfilled	June 30 2018	Tony O'Connor	Under development	Major	Unlikely	Medium	8
					Legislative requirement for LPG cylinders design to be registered ( Work Health and Safety (National Uniform Legislation) Regulation	Adequate	Major	Possible	High	12	Review the current status of design registration for LPG cylinders supplied into Queensland	March 30 2018	Tony O'Connor	Under development	Major	Unlikely	Medium	8
Risk of adverse public perception of the governments (P&G Inspectorate) ability to safely manage the LPG industry in Queensland	Petroleum and Gas	Reputational	1/09/2017	Complaints from public resulting in ministerial enquiry's  Media articles regarding the safety of leisure LPG cylinders and the inspectorates ability to manage the risk	P&G inspectorates Compliance Assurance Program involving audit and inspection of gas suppliers, installations and appliances	Adequate	Moderate	Likely	High	12	Gas safety campaigns  Regular stakeholder engagements  Regular Gas industry body engagements	2nd, 3rd,4th Qtr 2017/18	All inspectorate staff	On track	Moderate	Rare	Low	3

Risk Description (Clearly describe the risk - include information on the source of risk)	Business Unit most affected (Select from the drop down menu provided)	Risk Impact Area (Select from the drop down menu provided)	Date Registered / reviewed	Potential Consequences	Current Controls (What is in place at present to control the risk)	Control Effectiveness Rating (Select from the drop down menu provided)	Current Risk Level (Considering current controls in place and their effectiveness)			Current Risk Rating #	Risk Controls (Actions to be taken)	Timing (Date)	Action Owner	Status	Residual Risk Level (After controls in place and all response actions completed)			Residual Risk Rating #
							Consequence	Likelihood	Risk Rating						Consequence	Likelihood	Risk Rating	
Risk to the viability of the Leisure LPG cylinder industry in Queensland due to safety risks	Petroleum and Gas	Business Continuity	1/09/2017	Leisure industry moving to alternate energy sources  Change in lifestyle choices for public .i.e. less outdoor activities etc.	Gas suppliers require importers to supply LPG cylinders with cylinders manufactured to relevant standards  LPG cylinders testing, filling and inspection practices	Strong	Moderate	Possible	Medium	9	Gas safety campaigns  Regular stakeholder engagements  Regular Gas industry body engagements	2nd, 3rd, 4th Qtr 2017/18	All inspectorate staff	On track	Moderate	Rare	Low	3

