



Fair  
Trading

Report to the NSW Product Safety  
Committee into potential hazards  
relating to LPG Cabinet Heaters

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## Executive Summary

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The LPG Cabinet Heater Appliance Type is currently withheld from sale in NSW under an interim ban which has been in effect since August 2010 by The Minister for Fair Trading. As the term of the interim ban spans 3 months, the Energy Utilities Unit of NSW Fair Trading at Parramatta has undertaken a detail re-appraisal of the appliance ahead of the expiry date of the ban. The findings of the department support the continuation of the current ban on the appliance in its present configuration which is deemed inherently unsafe. The recommendation of the Energy Utilities Unit is that the ban should remain in force indefinitely or until such time as the supplier/s of the appliance submits a make & model for approval by an appliance certification body and that the findings and recommendations of the certification body be adopted to deem the appliance compliant to the relevant Australian Standard for indoor use.



## Forward

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The appliance referred to as a Cabinet Heater can be described as a domestic radiant space heater with integral 9kg LPG fuel supply within the appliance shell. It is an appliance type or configuration for which there is no specific Australian Standard. This appliance type of which there are more than one make has been identified as the point of ignition of numerous house fires over a period spanning 10 years. Ref. NSW Fire Brigades Fire Research Paper *LPG Fuelled Cabinet Heaters*.

This brief report examines the possible failure mode conditions of the Cabinet Heater appliance and how these could be compound by various mechanisms into an incident.

To understand the various mechanisms by which an incident could occur, the appliance was analysed first according to individual component modes of failure and their likely effect.

These failures were then examined in context of the appliance configuration and its likely uses in practice.





## Conditions attributing to hazard potential

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### Component Fault Conditions:

- Cylinder valve gland leakage. Not uncommon, normally occurs due to o-ring wear or deformation over time. In this condition leakage of gas (est.5-10MJ/h) commences when the valve is turned anti-clockwise to open. To mitigate the leak, the cylinder valve must be accessed and shut.
- Regulator failure, open condition. Not rare, the result is that full bottle pressure appears at the low pressure burner manifold. All system components downstream of the appliance regulator which are normally rated to 7kPa working pressure become subject to 600kPa vapour pressure (depending on ambient conditions). Major leaks will normally develop at this pressure at the control valve, which tends to lift to discharge gas whether it is in either the open or closed position.

*In the event that the control valve is open at the time of failure, and the appliance operating, then the gas rate through the burner will increase to 300MJ/h (based on the pressure increase at the injector). This should as a result produce a flame of approximate length 1m outside of the appliance.*

### Untested Conditions:

#### AS 4553/AG103 Flueless Radiant Convection Heaters

The following conditions are presumed untested to the requirements of this code and are considered relevant to when the outdoor appliance, the Cabinet Heater is taken indoors. Following are clauses which could relate to the establishment of localised fires or carbon monoxide poisoning in the absence of test data for this appliance.

- 5.8 Temperature Hazards
- 5.9 Heat Resistance
- 5.11 Vitiation & Emission Tests. 5.11.2 ... A heater that has safety shut-down prior to the oxygen concentration decreasing to 15% complies with this requirement. 5.11.6 The CO/CO<sub>2</sub> ratio for indoor Flueless space heaters shall

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not exceed 0.004 when operating on available gas at the manufacturer's specified test point pressure.

- 5.14 Linting Tests

### AS 4565 Radiant Gas Heaters for Outdoor & Non-Residential Use

The following conditions are presumed untested to the requirements of this code and are considered relevant to when the outdoor appliance, the Cabinet Heater is used outdoors and also used indoors. Following are clauses which could relate to the establishment of localised fires in the absence of test data for this appliance.

- 2.12 Instructions 2.12.1.1 (g) ... "NOT TO BE CONNECTED TO AN LPG CYLINDER LOCATED INDOORS".
- 2.6.2 Positioning of Regulators. Regulators shall be placed such that (b) overheating and the possibility of ignition of gas leaking from the breather holes are minimised.
- 5.6.2 Surrounding Surfaces – Temperature Limits. *The radiant & convective heat from the appliance must not allow hazardous temperature concentrations to develop at surfaces which are likely to be adjacent the appliance, such as carpeted flooring.*
- 5.7.3 Heat Resistance – Lit back condition. *In the lit-back condition, a burner discharges flame into an internal burner space which is designed to operate at a relatively cool temperature. This can result in over-temperature conditions occurring within the appliance, leading to early deterioration and compounding consequences.*
- 5.9.1 Rain Resistance - Operation after and during a simulated storm. *Rain damage can cause temperature shock deterioration of parts, such as cracks in a burner tile. The possible consequences include improper burner operation such as lit-back condition and elevated CO emission.*

5.8.4 Tip Over Switch – A tip over switch shall be fitted to all appliances ..., so that in the event of the appliance being knocked over or tipped in any direction to an angle of 45 deg from vertical, all gas to the burner(s) shall be shut off. *This switch was found not to be fitted on at least one Cabinet Heater model. In the event of a heater being tipped*

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*over and where there is no installed automatic gas cut-off switch, the appliance can continue to operate when tipped over causing overheating to itself and to external surroundings. In this tipped over condition the pressure relief valve of the LPG bottle becomes positioned to discharge liquid LPG rather than gas discharge in an overheating event. This prevents the contents to cool by vaporisation, and results in a much greater rate of fuel discharge in such event.***AS 2658 LPG mobile and Portable appliances**

The following tests are mandated by the standard for an appliance to be considered safe:

2.2.1 Shall not weigh more than 20kg with cylinder attached

2.2.2 Adequate support for cylinder

2.3.1 Individual certification of all safety components

2.3.2 Limitation of gas flow to less than 1kg/hr

2.3.4 Metal to metal joint with or without O' ring on all joints designed to be tightened and un-tightened for maintenance.

### **Compounding Conditions:**

*Conditions of service for the Cabinet Heaters are likely to include the following practices in use.*

- **LPG Cylinder multiple re-fills & exchanges**, multiple connection & disconnection cycles. At 9kg per fill, each full cylinder (450MJ) will operate the appliance (~20MJ/h) approximately 23hours. Winter use of the appliance would involve no less than ten re-fills or exchanges of the LPG Cylinder. The probability for an unsound connection between the cylinder outlet and appliance connection POL fitting increases with the frequency of connection.
- **Connection to gas by untrained persons.** Cylinder connection is performed typically by untrained persons, whom are unlikely to conduct a leakage test at each instance of gas connection. This can lead to leakage and localised fire owing to the proximity of the main burner, source of ignition.



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- **The appliance is certified to a European standard (CE) for outdoor use.**  
Being portable and resembling an indoor appliance, there would invariably be instances of this appliance being taken indoors. The requirements for indoor appliances differ markedly in particular with respect to air quality. Asphyxiation by the concentration of flue gases in a sealed room environment or poisoning by carbon monoxide is a distinct possibility in the use of these heaters indoors.

### Gap Analysis between design requirements of AS 4553, AS 4565, AS 2568 and RANA brand Cabinet Heater

The following table presents the relevant design criteria required by the Australian Standards that the heater may possibly be certified against for Safety performance.

The Testing required by these Standards for temperature hazards and emissions has not been included in this analysis, as the objective of this analysis is to visually rate the design of cabinet heaters to the physical design requirements of the Standards.

AS 4553	Gas Space Heating appliances	
Clause	Requirement	Comment
2.1.3	Individual certification of safety components	
2.1.5	Manual shut off valve certified to AS 4617 Type 1 or 2	
2.1.6	Safety shut off valve certified per classification in table 2.1	
2.1.9	Appliance not to incorporate fuel storage cylinder	
2.1.14	Handles & knobs designed to minimise accidental touching of hot surface	
2.6.1	Regulator certified to be fitted within appliance	
2.6.2	Positioning of regulator to minimise risk of ignition from breather vent	



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2.7.5	Provision of flame safeguard system	
2.7.6	Provision of incomplete combustion shutoff system	
2.7.7	Provision of tilt shutoff system	
2.9.2	Visual ignition of pilot while operating controls	
2.9.6	Means to isolate pilot burner	
2.9.10	Support of pilot and flame sensing device	
2.9.17	Non adjustable primary burner aeration for LPG appliances	
2.11.1	Clear markings for control positions	
2.11.10	Markings on appliance ie. Certificate holder/model/date of manufacturer/gas type/gas consumption in MJ/hr/minimum room size	
2.12.2.1	Installation instructions (g) not to be connected to LPG cylinder indoors	
3.3.1	Primary guard/grill capable of withstanding 20 N pull	
3.3.2	Grill design to prevent finger entrapment - opening <6mm & >12mm to max of 35mm x 150mm (vertical)	

AS 4565	Radiant gas heaters for outdoor and non-residential indoor use	
Clause	Requirement	Comment
2.1.3	Individual certification of safety components	

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2.1.5	Manual shut off valve certified to AS 4617 Type 1 or 2	
2.1.6	Safety shut off valve certified per classification in table 2.1	
2.1.14	Pressure test point	
2.1.17	Certification of hose assembly to AS1869	
2.1.22	Guard design to prevent finger entrapment – opening <6mm & >12mm to a max of 53mm (vertical) x 20mm or 126mm (vertical) x 12mm	
2.2.1	Exterior to be weatherproof & protected against corrosion	
2.4.6	Heat damage to cylinder, fittings hoses and electrical components to be prevented	
2.4.7	Excess flow device to be fitted	
2.4.8	Flame safe guard system to be fitted	
2.8.1	Appliances where the burner is less than 1.8m from the ground shall not have an integral cylinder fitted	
2.8.2	Manufacturer to provide means to mount integral cylinder	
2.8.3	Integral cylinder to be restrained to prevent less than 25mm movement	
2.8.4	Mounting of cylinder shall not impede the operation of the cylinder valve	
2.8.5	Connection between integral cylinder and appliance shall be by certified flexible hose, semi rigid hose or limited flexible hose	
2.9.11	High and low ventilation shall be provides to	

## Potential Hazards of LPG Cabinet Heaters



	the integral cylinder compartment	
2.9.12	Vent openings to cylinder compartment shall not be less than 25% of sidewall area, and minimum of 10000mm <sup>2</sup> high and 6000mm <sup>2</sup> low ventilation	
2.9.3	Shall be 50mm clearance between base of cylinder and ground	
2.9.4	Cylinder connections must be accessible for leak test when cylinder fitted	
2.11.7	Pilot burner, igniter and flame sensing device to be supported	
2.13.4.14	Instructions for LPG appliances with integral cylinder to include instructions warning to use only outdoors and reference to indoor storage requirements of AS 1596	

AS2568	LP Gas- Portable and mobile appliances	
2.2.1	Shall not weigh more than 20kg when combined with full cylinder	
2.2.2	Adequate support of cylinder	
2.3.1	Individual certification of safety components	
2.3.2	Gas flow limited to < 1 kg/hr	
2.3.4	Metal to metal joints where connection required to be broken and remade for maintenance	
2.3.7	Flame supervision device to be certified, Flame safeguard system to isolate all gas to burner	
2.4.1	Appliance to be stable on 15° slope	

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2.4.3	Flexible hose to be certified	
2.4.8.1	Temperature of cylinder in gas compartment not to exceed ambient temperature	
2.7.9	Wheels must be able to be locked to prevent accidental movement of heater	
4.2	Must not store more than 250g of gas in compartment	
4.4	Shall have flame safeguard fitted	
4.6.2	Guard to withstand force of 20 N pull	
4.6.3	Guard grill opening to be <6mm & > 12mm to max of 35mm	
4.9.1	Over pressure cut off switch	
4.9.2	Shall incorporate tip over switch	





## Conclusion

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The type of appliance known as a Cabinet Heater primarily comprising a 9kg LPG cylinder fitted into a radiant convective heater has not been proven to be safe through the normal testing and scrutiny afforded to domestic gas room heaters by the Department of Fair Trading. The appliance configuration is not compliant to the Australian Standards for Space heaters. The basic design places inherent potential sources of gas leakage within proximity of to a source of ignition, the appliance main burner. This together with the inherent attractiveness and ease with which to bring such appliance indoors could only be expected to lead to an increase in the potential for domestic house fires.

The conclusion of the Department of Fair Trading is supported by the NSW Fire Brigades Fire Research Paper *LPG Fuel Fuelled Cabinet Heaters*.

The noted absence of an Australian Standard specific to the Cabinet Heater appliance type, and a specific exclusion of LPG bottles from being placed indoors to fuel an appliance add support the findings of the department.



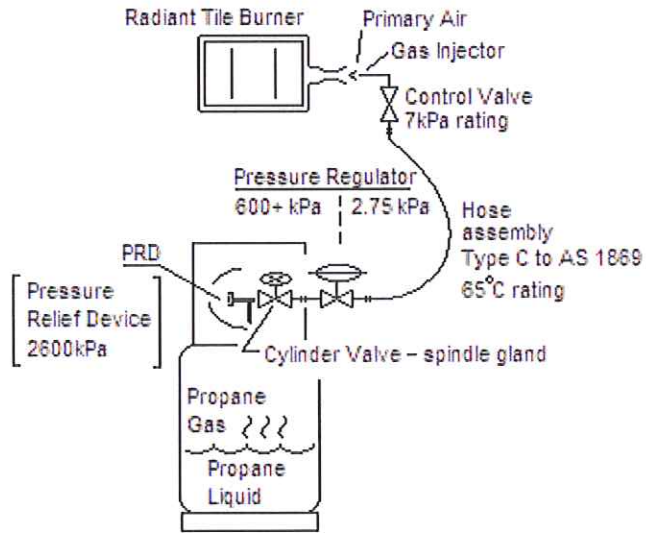
**APPENDIX**

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### Cabinet Heater, Typical Gas System Arrangement

Shown not to scale



- Bullet 1
  - Bullet 2

<b>Table Title</b>			
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