ASSIST INFORMATION SHEET:

Portable Bunsen burners

Portable Bunsen burners are sometimes used in school science areas where reticulated LPG or Natural Gas is not available; however, they lack the safeguards that reticulated services offer. This information sheet outlines design features of portable Bunsen burners and explores the safety issues that schools should consider (in conjunction with a detailed risk assessment) if they choose to purchase and use portable Bunsen burners.

Note: Some school jurisdictions do not permit the use of portable Bunsen burners.

Science ASSIST advises that a compliant reticulated gas supply MUST be used, where it is available, with traditional Bunsen burners. Science ASSIST discourages the use of portable Bunsen burners.

Gas Regulatory Authorities:

Communication with the Gas Technical Regulators Committee (GTRC) identified the following significant safety concerns with using portable Bunsen burners:

1. The lack of a central emergency shut off facility.
2. The requirement for proper storage and handling of the canisters.
3. The requirement for adequate safety training in their correct use.
4. The requirement for adequate adult supervision at all times whilst in use.
5. The requirement for users to be able to identify faults with individual units and manage the risks if a fault is identified.

GRTC advised that the use of a compliant reticulated supply must be used where it is available and recommended that in the absence of a reticulated gas supply an alternative **low risk**-heating source, such as using electrical heat, should be sought.

Science ASSIST:

- **advises that a compliant reticulated gas supply MUST be used, where it is available, with traditional Bunsen burners**
- **recommends** that in the absence of a reticulated service, schools use alternate heating options such as electric hotplates or hot water baths
- **recommends** that portable Bunsen burners should not be seen as a convenient alternative or a cost saving measure in schools with an existing reticulated gas service, or in a new or refurbished area where a reticulated service can be installed
- **recommends** that portable Bunsen burners should only be considered as a last resort for use as a heating source in demonstrations, subject to a risk assessment, in school science laboratories in situations where reticulated LPG or Natural Gas is not available and other forms of heating such as electric hotplates are not suitable for use.
- **recommends** that if portable Bunsen burners are deemed necessary, careful consideration be given to the type purchased and used. These should be of squat form for increased stability of

the burner with screw threaded valve resealing type gas canisters. They should be marked as compliant with Australian Standard 2278 or European Standard EN 417 and **designed specifically for use in science laboratories**
- **strongly advises against** the use of the puncture/pierceable style and spray/aerosol style canisters, due to several safety concerns
- considers that a compliant reticulated gas supply used with traditional Bunsen burners is not only safer, but in the long term also more economical than portable Bunsen burners.

Portable burners and gas canisters

There are a wide range of small portable gas cylinder burners available on the market. **Portable camping burners are designed for OUTDOOR USE ONLY and therefore indoor use of portable camping burners is prohibited.**

Portable burners use various types of disposable liquefied gas canisters, commonly a mixture of butane (80%) and propane (20%). All portable non-refillable gas canisters sold in Australia should comply with the Australian Standard 2278 (AS 2278), the European Standard EN 417, or both. This compliance should be marked on the canister. Do not purchase a canister that does not display this compliance.

There are three common types of non-refillable (disposable) gas canisters available in Australia.

1. **Screw thread and self-sealing canisters:** The top of the canister has a screw thread with a valve in the centre. The valve is commonly known as a 'Lindal' valve. The burner attachment can be removed with no escape of gas or risk of explosion, and the canister can be stored separate from the burner attachment. **It is recommended that only screw thread self-sealing canisters are used for portable Bunsen burners in schools**, and only in conjunction with burner attachments designed for science laboratory use. Canisters used for this purpose should be of low profile/ squat form so as to maximise stability.
2. **Puncture or pierceable gas canisters (C206):** The burner assembly is clamped on top of the canister and is used to puncture it. The potential for gas leakage is high with this type of canister, sometimes occurring when the puncture procedure is faulty or not performed correctly, or if the burner assembly is removed before the canister is empty. **As the pierceable canister has no valve or sealing mechanism, the canister cannot be safely removed from the burner until empty.** Removal prior to this has the potential risk of a fireball or explosion if the burner is in operation. Also, the cooling caused by the rapid loss of gas could cause 'cold' burns if the canister is being handled. These are **not recommended for school science use**.
3. **Spray can or aerosol canisters**: This type of canister uses the same principle as an aerosol spray paint or fly spray can. The burner assembly is used to depress the valve at the top of the can to release the gas. They are also not considered to offer the level of safety of the screw thread type canisters and are **not recommended for school science use**.

Other heat sources

Electric hot plates and water baths.

These are recommended as a lower risk source of heat for conducting activities.

Alcohol or spirit burners

These are NOT recommended as a general heat source for school science use. They comprise a clear glass bottle containing an alcohol fuel such as methylated spirits, and a screw fitted wick holder and wick. These pose some safety concerns. The screw fittings are usually not

spill proof if the burner is knocked over, and the flame of the burning alcohol is very pale and difficult to see. If they are not filled to more than half full they may become an explosion risk with the air/alcohol vapour they produce in the burner. They are occasionally used for comparing the 'heats of combustion' of different alcohols in calorimetry but are subject to a risk assessment.

Electric 'Bunsen burners'

These are not actually Bunsen burners, but electrically heated mantles, which radiate heat towards a central focal point. While they are designed as a safer alternative to Bunsen burners, they are very expensive, and generally not affordable by schools. See the link below for an example: http://www.labfriend.com.au/burners-1397

Considerations for the use of portable Bunsen burners

Although there is no legal requirement preventing the use of portable Bunsen burners in school science laboratories, Science ASSIST **strongly recommends that they be considered only as a last resort** in certain circumstances, preferably for demonstration purposes only and subject to a risk assessment. If portable Bunsen burners have been determined to be necessary, ensure that they are designed specifically for use in science laboratories and safe operating procedures and emergency response procedures are established prior to their purchase and use.

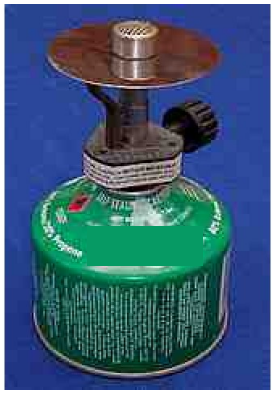
Safety concerns when using portable Bunsen burners in a school science laboratory

- **There is no 'single central' emergency cut off facility.** Each individual Bunsen is equipped with an on/off regulatory device.
- **There is no indication for 'on' or 'off' on the unit.** A threaded needle type valve fitting is utilised with a knob to turn it on, off or to control the gas flow. The gas flow can generally be heard when the unit is on.
- **The height of the portable Bunsen burner** requires a tall tripod, which can be unstable, to allow the item being heated to be at a suitable height above the flame of the burner.
- **Leaking of gas** from the canisters has occurred when using the puncture style canisters.
- **Safe storage** of the gas canisters is required.

Note: In contrast, in compliant reticulated gas installations, the following safety features apply:

- There is a master emergency gas shut off that can stop the gas to all appliances in the laboratory in the event of an emergency.
- Gas fittings usually have a turret with a lever, which clearly indicates when the gas is on.
- The height of the standard Bunsen burner uses a standard tripod, which offers more stability.

Design features to consider in a portable Bunsen burner



Portable Bunsen burners produce a single flame through mixing a flammable gas (LPG) with air and combusting it. They use a burner head with a control valve and an air intake control (collar) that attaches to a pressurised liquefied gas canister.

Design features to consider in a portable Bunsen burner for school science use should include the following features:

- A **gas control valve** that can be adjusted to regulate gas flow and flame intensity.
- An **air hole and mechanism to adjust air intake to obtain a yellow safety flame** like a standard gas plumbed Bunsen burner.

- A **reflective heat shield** mounted above the controls and the top of the barrel, to prevent undue heating of the controls and the gas canister. This safety feature not only improves performance but also prevents the burner heating the gas cylinder.
- The **ability to be lit with standard lighting procedures** using a match, a flint spark lighter or a gas flame lighter.
- The **canister is of squat form, with a screw thread fitting**, and a valve that seals the canister when it is disconnected from the burner.

Risk Assessment

The risk assessment should consider the maturity and skills of the class, the experience of the teacher, the degree of supervision, the place of use—teaching laboratory, preparation room, classroom, the number required and the frequency of use. Safety training in their correct use must be provided prior to handling.

Safety notes

- **Documented guidelines** should be established and carefully followed including; pre-use inspection, safe use procedures, student briefing process, maintenance, storage and disposal as per the manufacturer's instructions and local and jurisdictional requirements. **Adult supervision** must be provided at all times during use.
- Never leave the unit unattended under any circumstances.
- Burners and cartridges that are damaged should never be used.
- **Only teachers or technicians** should attach burners to cartridges. Users must be able to identify faults with individual units and manage the risks if a fault is identified.
- Care should be taken that the tripod and gauze supporting the item being heated is at a suitable height above the flame of the burner. The top of the burner should be greater than 10mm below the item being heated or below the gauze. It should also be easily removed from beneath the tripod.
- It is important to ensure ready access to the tap controlling the flame when the burner is under a tripod.
- As with other burner types, portable Bunsen burners should be used only in well-ventilated areas and away from flammable materials, using safe procedures.
- Never attempt to light a burner with another lit burner.
- Do not turn unit on its side or upside down.
- Ensure that the Bunsen burners are turned off after use.

Faults to look for to determine if an individual gas canister is unsafe to use

- Corrosion, dents, damaged seals.
- Leaks. Check with soapy water or look for frosting around suspect areas.
- Incorrectly fitted Bunsen burner.

Disposal of leaking or empty canisters

In the event of a leak, it is recommended that the leaking canister be moved safely to a fume cupboard or a safe area out of doors to allow the gas to dissipate completely away from any naked flames. The empty canister should then be disposed of according to local regulations.

Handling cold canisters

Canisters may 'ice up' in instances where there is prolonged use of the device.

Care should be taken when handling a canister in this condition. To reduce the risk of 'Cold burns', handle the canister wearing gloves designed for use at high or low temperatures.

Storage of Canisters when not in use:

- Total gas storage **must** comply with jurisdictional and local storage regulations.
- Canisters **must** be stored in a locked, cool, dark, separate, and well-ventilated area. Never store canisters in the sun. This may require the purchase of a suitable storage cage.
- Canisters **must not** be stored in damp areas, with or near corrosive materials, or with other flammable or combustible materials or near escape routes.
- Canisters must be stored in an upright position with the valve/cap closed.
- Monitor the canister for leaks after each use by checking the valve, cap, any seals and each part of the canister. Checking of leaks can be done with a soapy water mix, or looking for areas of frosting.
- Consideration needs to be given to the transportation of these units from the storage area to the lab and back.
- Spare cartridges should be stored away from those in use.

Further information on Bunsen burner safety

For more information on using Bunsen burners safely refer to the following websites:

- 'Standard Operating Procedure Using Bunsen burners', University of Sydney website, http://sydney.edu.au/science/molecular_bioscience/ohs/documents/sop/SOP%20SMB_006.2_Using%20Bunsen%20burners%20SK%20NC%200614.pdf (June 2014)
- 'Bunsen burner safety guidelines', Worcester Polytechnic Institute website, https://www.wpi.edu/offices/environmental-health-safety/laboratory/bunsen (Accessed January 2017)
- 'Laboratory Techniques: Using a Bunsen Burner', Mr-damon webpage, http://www.mr-damon.com/experiments/bunsen/ (Accessed January 2017)

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