THE UNIVERSITY OF SYDNEY

SAFE WORK PROCEDURE

Use this form to document Safe Work Procedures for hazardous activities and processes. The information in your Safe Work Procedure (SWP) should be supported by a risk assessment.

Faculty/School:	School of Physics		**Initial Issue Date: 2026-09-18** **Next Review Date: 2027-09-18**
SWP Reference Number:	SWP-A14-SAIL-methane-sensor-demo	**Version: 1.0**	**Version Issue Date: 2026-09-18**
SWP Title:	Public demonstration of the SAIL fibre optic methane sensor using balloons filled with 1% CH4 / balance N2 calibration gas (103 L disposable cylinder)		
Prepared by:	Chris Betters		
Responsible supervisor/s:	Chris Betters		

List the Hazards and risk controls as per risk assessment		
Associated risk assessment reference:	**Hazards**	**Risk controls**
RA-A14-SAIL-methane-sensor-demo	Compressed gas: 103 L disposable steel cylinder at 70 bar with a C10 brass valve	Only one cylinder taken to the venue; transported upright in a padded box with the valve closed and regulator removed; kept in shade below 50 degrees C, secured at the back of the table; valve closed between fills; NEVER heated, NEVER refilled
RA-A14-SAIL-methane-sensor-demo	Gas mixture: 1% methane in nitrogen (UN1956, Class 2.2 non-flammable, non-toxic); simple asphyxiant only; cannot burn at any dilution in air	Open-air venue only; NEVER run inside a small enclosed room with the door shut; SDS No. 303 and the RA provided to the venue and kept at the table; table sign: Calibration gas, 1% methane in nitrogen, non-flammable, Class 2.2
RA-A14-SAIL-methane-sensor-demo	Balloon filling: gas jet from the outlet, balloon burst, latex fragments	Filled by trained demonstrators only, wearing safety glasses, using a C10 fixed-flow regulator (nominal 1 L/min); filled to no more than 15 cm diameter (1.5 to 2 L); regulator thread checked by hand before opening the valve
RA-A14-SAIL-methane-sensor-demo	Public interaction: inhalation of oxygen-free balloon gas, latex allergy, choking hazard for young children, balloon litter	Every balloon handed over by a demonstrator, released within arm's reach and taken straight back; balloons NEVER given away, left on the table or inhaled from; sign: Do not inhale balloon gas; latex-free balloons where practicable or Contains latex notice; children under 12 only with a parent or carer present; fragments binned immediately; balloons counted out and back
RA-A14-SAIL-methane-sensor-demo	Electrical equipment outdoors: interrogator, laptop, sample pump, cables	Battery power where possible; any mains lead tested and tagged and run through a portable RCD with the connection under cover; cables along the wall or under a cable cover, never across the walkway; stop and cover if rain reaches the table

RA-A14-SAIL-methane-sensor-demo	Optical source: fibre-enclosed infrared source (1600 to 1700 nm) inside the interrogator	No fibre connector opened while the source is on; fibre run taped down out of public reach; source switched off if any fibre is damaged
RA-A14-SAIL-methane-sensor-demo	Public crowd environment: trips, table tipping, heritage venue; weather (heat, rain, wind)	Table against the cloister wall, weighted if lightweight; cylinder and pump behind the table; clear 1.5 m walkway; two demonstrators on the stand at all times; cylinder and demonstrators in shade; event marshal directions followed

List resources required including personal protective clothing, chemicals and equipment needed

PPE: safety glasses (AS/NZS 1337.1) for the demonstrator filling balloons; closed-toe shoes for all demonstrators; hat and sunscreen if the display is unshaded

One 103 L disposable cylinder of 1% CH4 / balance N2, CAC Gas part 103DS1VCH4N (SDS No. 303), in a padded transport box

C10-thread fixed-flow regulator for 103 L disposable cylinders (nominal 1 L/min) with on/off lever, short length of 6 mm tubing and balloon nozzle

30 to 50 balloons, 23 cm (9 inch) size, latex-free (chloroprene) preferred; spare balloons in a sealed bag

SAIL fibre optic methane sensor: interrogator unit, gas cell with sample intake tube, small diaphragm sample pump, laptop with sensor software, charged batteries or power bank

Portable RCD and one tested and tagged extension lead (only if mains is required); cable cover or gaffer tape

Table (weighted if lightweight), table cover, lidded bin, balloon count sheet

Printed signs: Calibration gas, 1% methane in nitrogen, non-flammable, Class 2.2; Do not inhale balloon gas; Contains latex (if applicable)

Printed copies of SDS No. 303 and the risk assessment

Small first aid kit, bottle of clean water or saline for eye rinse, emergency contact card (000, Security 9351 3333, supervisor mobile, event coordinator, first aid post), charged mobile phone on each demonstrator

List step by step instructions or order for undertaking the task

BEFORE STARTING - CRITICAL SAFETY REQUIREMENTS:
- You must have completed the SAIL General Local Induction and been briefed on this RA and SWP by the supervisor
- You must be listed as a rostered demonstrator for this event
- You must NEVER let anyone inhale from a balloon, and you must NEVER give a balloon away
- You must NEVER leave the cylinder with the regulator fitted and the valve open while unattended
- You must NEVER expose the cylinder to heat, direct sun or a parked vehicle
- You must NEVER open a fibre connector while the interrogator is switched on

PRE-EVENT PREPARATION (in the laboratory, the day before):

Check the cylinder:
- Confirm the label reads 1% CH4 / Bal. N2, part 103DS1VCH4N, SDS 303, Class 2.2
- Check the cylinder body for dents, corrosion or damage to the C10 valve outlet thread
- Check the shelf-life date on the label has not passed
- If ANY check fails: DO NOT USE, tag the cylinder and report to the supervisor

Test-fit the regulator:
- With the cylinder upright, screw the C10 regulator onto the valve outlet by hand until fully seated; the thread must engage smoothly without force
- Open the cylinder valve slowly (anticlockwise, one full turn); the regulator gauge should read approximately 70 bar (lower if partly used)
- Close the valve and listen for leaks at the joint; if hissing is heard, close the valve, remove and re-seat the regulator
- Operate the flow lever and confirm gas flows from the nozzle, then close it
- Close the cylinder valve, bleed the regulator until the gauge reads zero, and remove the regulator for transport

Trial-fill two balloons to approximately 15 cm diameter (about 1.5 to 2 minutes each at 1 L/min). Tie off and confirm they hold gas for at least an hour. Note how many seconds gives the right size

Check the sensor apparatus:
- Charge the laptop and any battery packs
- Confirm the interrogator label laser class and that all fibre connectors are mated and the fibre run is secured
- Run the sensor software, release a trial balloon at the intake and confirm the reading responds
- Confirm any mains equipment carries a current test and tag label

Pack the kit against the resources list, including signs, SDS, RA, first aid kit and balloon count sheet

Brief all demonstrators (30 minutes): hazards, the balloon hand-over rule, the no-inhalation rule, emergency contacts and the location of the event first aid post

TRANSPORT TO THE VENUE:

Close the cylinder valve and confirm the regulator is removed

Place the cylinder upright in the padded transport box with the valve protected

Carry the box by hand or on a trolley. Do not place it in a backpack, do not throw or roll it, and do not leave it in a vehicle in the sun

On arrival, place the box in a shaded position behind the table

SETTING UP THE DISPLAY (MANDATORY - DO NOT SKIP):

Sign in with the event coordinator and record the start time and demonstrator names on the balloon count sheet

Position the table against the cloister wall (or under the marquee on Eastern Avenue) so the public approach from one side only. Weight the table if it is lightweight. Keep a clear 1.5 m walkway past the display

Set up the sensor:
- Place the interrogator, laptop and pump at the back of the table with the fibre run taped down and out of reach
- Route the sample intake tube to the front edge of the table where the public will release balloons
- Use battery power. If mains is unavoidable, plug the single tested and tagged lead into the portable RCD, press the RCD TEST button and confirm it trips, reset it, and cover the connection. Run the cable along the wall under a cable cover
- Switch on the interrogator and laptop and confirm a stable baseline reading

Set up the cylinder:
- Stand the cylinder upright in its box behind the table, in shade, where it cannot be knocked over
- Touch-check the cylinder is not warm
- Fit the C10 regulator by hand until fully seated
- Open the cylinder valve slowly one full turn, check the gauge, then close the valve again. Leave the valve CLOSED until filling

Display the signs (Non-flammable calibration gas; Do not inhale balloon gas; Contains latex if applicable) and place the SDS and RA in a folder on the table

Confirm emergency arrangements: each demonstrator knows the location of the event first aid post, the nearest exit and assembly point, and has the emergency contact card

Final check before opening:
- Cylinder valve closed, cylinder secured and shaded
- Cables clear of the walkway
- First aid kit and eye rinse at the table
- Lidded bin at the table

- Two demonstrators present
- If ANY check fails: DO NOT OPEN THE DISPLAY; resolve the issue or contact the supervisor

FILLING BALLOONS (demonstrators only):

Put on safety glasses and stand at the back of the table facing away from the public

Stretch a balloon over the regulator nozzle and hold the neck firmly

Open the cylinder valve one full turn

Operate the flow lever for the pre-timed number of seconds to reach approximately 15 cm diameter. NEVER fill beyond 15 cm; a small balloon is enough for the sensor and will not burst

Release the lever, pinch the neck, remove the balloon and tie it off

Repeat for a batch of 10 to 15 balloons, then CLOSE THE CYLINDER VALVE

Inspect each balloon; discard any that are weak, perished or over-stretched into the lidded bin

Store filled balloons in a lidded tub or tied to a weighted string behind the table (the gas does not float, but wind can move them). Record the number filled on the balloon count sheet

Close the cylinder valve at any time the table is unattended or filling stops for more than a few minutes

RUNNING THE DEMONSTRATION (public interaction):

ATTENDANCE REQUIREMENT: two demonstrators MUST be on the stand at all times during opening hours. One runs the sensor and hands balloons over; the other manages the queue and fills balloons

For each participant:
- Hand over one balloon and say: squeeze the neck and let the gas out near this tube, like a fart; please do not breathe it in, there is no oxygen in it
- Stay within arm's reach while they release the gas at the intake tube
- Point out the sensor reading rising on the laptop screen and explain the science
- Take the balloon straight back. Balloons are NEVER given away, left on the table, or handed to a second person unsupervised

For children under 12: only with a parent or carer present. For young children, the demonstrator holds the balloon and lets the child squeeze it

If a balloon bursts: pick up every fragment immediately and bin it. Do not let children pick up fragments

If anyone says they have a latex allergy: offer the demonstrator-operated release, or use a latex-free balloon

If anyone inhales from a balloon: take it away, sit them in fresh air away from the crowd and follow the emergency procedure

Periodic checks every 30 minutes:
- Cylinder valve closed and cylinder not warm
- Balloon count (out and back) matches
- Cables still covered and walkway clear
- No balloon fragments on the ground
- Sensor reading has returned to baseline between participants (if not, move the intake tube into cleaner air for a minute)

If it rains on the table, or wind makes the balloons or equipment unmanageable: close the valve, switch off and cover the equipment and pause the demonstration

PACK-DOWN:

Close the cylinder valve fully (clockwise)

Bleed the regulator by operating the flow lever until the gauge reads zero, then unscrew the regulator

Place the cylinder upright in its padded box

Deflate all remaining balloons (cut the neck) and put all balloon material in the lidded bin. Reconcile the balloon count sheet; leave NO balloon material at the venue

Switch off the interrogator, pump and laptop. Unplug and coil any mains lead and the RCD. Do not open fibre connectors at the venue

Remove all signs, tape and cable covers, leaving the heritage surfaces as found

Sign out with the event coordinator; note any incidents or near misses on the count sheet and report them to the supervisor

Transport the cylinder and equipment back to A31 P2012 in the padded box, and return the cylinder to the gas storage cabinet with the valve closed, regulator removed and label facing out

List emergency shutdown procedures

USE EMERGENCY SHUTDOWN IF: the cylinder is dropped, the valve is damaged, the regulator is ejected or hissing cannot be stopped; any person is faint, unwell or injured at the display; a fire alarm or evacuation instruction is given; rain reaches electrical equipment, or there is lightning or high wind; the crowd cannot be controlled; or any other unsafe condition

CLOSE THE CYLINDER VALVE by turning the C10 valve handwheel fully clockwise. Gas flow stops immediately. There is no emergency stop button; the valve is the shutdown

If the valve cannot be closed (damaged or stuck open), carry the cylinder by the body to the nearest open space away from people and let it vent. A full cylinder empties in a few minutes through the regulator. The gas is non-flammable and non-toxic; keep people 3 m away only because of the pressure, not the gas

Switch off the interrogator and laptop at their power switches; unplug the mains lead from the RCD if used

Assess the situation: injury (first aid), fire elsewhere (evacuate), weather (cover and pause)

Do NOT restart until the emergency is resolved, the equipment is inspected and the supervisor approves. Repeat the setting-up checks before restarting. A dropped cylinder MUST NOT be used again

Report: record the time, date and circumstances; report to the supervisor and via RiskWare

List Emergency procedures for how to deal with fires, spills or exposure to hazardous substances

PERSON INHALED BALLOON GAS OR FEELS FAINT:
- Take the balloon away
- Sit the person down in fresh air away from the crowd; stay with them
- Light-headedness from one breath passes within a minute
- If they faint, lose colour or do not recover within 2 minutes: call 000, then University Security on 9351 3333, and send the second demonstrator to fetch event first aid
- If unresponsive and not breathing normally: start CPR and send for the nearest AED (event first aid post)
- Record the incident and report via RiskWare

CYLINDER DROPPED, VALVE DAMAGED OR REGULATOR EJECTED:
- Move people back at least 3 m
- If the cylinder is venting and stationary, wait for it to empty (a few minutes); do not try to catch a moving cylinder
- When silent, pick it up, mark it DAMAGED and take it out of service
- Treat any injury (first aid) and report to the supervisor and via RiskWare

GAS LEAK (hissing at the regulator or valve):
- Close the cylinder valve
- Remove and re-seat the regulator; if the leak persists, remove the regulator and do not use the cylinder
- There is no fire or health hazard from the leaked gas in the open air; no evacuation is required

BALLOON FRAGMENT IN EYE OR CHOKING:
- Eye: do not rub; rinse with clean water or saline; seek medical attention if pain or vision disturbance persists
- Choking (child with a balloon fragment): call 000 and event first aid immediately; give back blows and chest thrusts as per first aid training

FIRE EMERGENCY (fire elsewhere at the event):
- Close the cylinder valve; carry the cylinder in its box with you if it can be done without delay; the gas does not feed a fire, but a cylinder heated above 50 degrees C could rupture
- Follow the event evacuation procedure and the wardens' directions

- Call 000 if not already done; go to the assembly point; do not re-enter until cleared

SEVERE WEATHER:
- Close the cylinder valve, switch off and cover the electrical equipment
- Move the cylinder, balloons and equipment under cover as directed by event staff
- Resume only when conditions are safe and the supervisor agrees

EQUIPMENT MALFUNCTION:
- Switch off the interrogator, pump and laptop
- Do not open the interrogator or disconnect fibres with the source on; do not attempt repairs at the venue
- If any fibre or cable is damaged, keep the source off for the rest of the event
- Report to the supervisor

EMERGENCY CONTACTS:
- Emergency services: 000
- University of Sydney Security (24 hours, emergency): 9351 3333
- University of Sydney Security (general): 9351 3487
- Event first aid post: TODO: location and contact from event organiser
- Supervisor: Chris Betters, TODO: mobile number
- School of Physics WHS Officer: TODO: name and number
- Event coordinator: TODO: name and number

List Clean up and waste disposal requirements

Display area: pick up all balloon fragments, tape and cable ties; wipe the table and sample intake tube (the gas leaves no residue); remove signs and leave heritage surfaces as found

Sensor apparatus: coil cables, cap the sample intake tube, pack the interrogator and laptop in their cases; do not clean or open fibre connectors at the venue

Balloons and fragments: deflate and place all balloon material in general waste. NEVER release balloons; balloon release is littering under the Protection of the Environment Operations Act 1997 (NSW)

Gas mixture: residual gas may be vented to the open air or a fume cupboard; it is non-flammable and non-toxic and needs no treatment

Empty cylinder: non-refillable, NEVER attempt to refill. To dispose: outdoors or in a fume cupboard, fit the regulator, open the valve and vent until the gauge reads zero and no flow is heard; remove the regulator, mark the cylinder EMPTY, and dispose of it through the University scrap metal or hazardous waste stream in accordance with SDS No. 303. A cylinder with gas remaining is returned to the gas storage cabinet in A31 P2012

Maintenance: inspect the regulator O-ring and nozzle tubing before each event and replace perished parts; check the cylinder shelf-life date before each event; record cylinder use (date, event, balloons filled, approximate remaining pressure) on the cylinder log

List references used in the development of this SWP, e.g. codes of practice

Work Health and Safety Act 2011 (NSW)

Work Health and Safety Regulation 2017 (NSW), Chapter 7 Hazardous Chemicals

Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), edition 7.9

AS 4332-2004 The storage and handling of gases in cylinders

AS/NZS 60079.10.1:2022 Explosive atmospheres, Classification of areas

AS/NZS 2243.1:2021 and AS/NZS 2243.2:2021 Safety in laboratories

AS/NZS 3760:2022 In-service safety inspection and testing of electrical equipment

AS/NZS 1337.1:2010 Personal eye protection

Safe Work Australia Code of Practice: Managing risks of hazardous chemicals in the workplace

CAC Gas and Instrumentation quotation SQ1070 and Safety Data Sheet No. 303 (1% CH4 in N2)

Protection of the Environment Operations Act 1997 (NSW)

SAIL General Laboratory Risk Assessment and Safe Work Procedure (general-lab-safety)

University of Sydney WHS Policy 2016 and event risk management requirements

List competency required – qualifications, certificates, licensing, training - e.g. course or instruction:

SAIL General Local Induction completed (laboratory hazards, emergency procedures and reporting)

Demonstration-specific briefing delivered by the supervisor before each event: properties of the 1% CH4 / N2 mixture (non-flammable at any dilution, simple asphyxiant, Class 2.2); cylinder handling (transport, shade, valve closed between fills, never heat, never refill); regulator fitting, leak check and balloon filling to 15 cm; the balloon hand-over rule and the no-inhalation rule; sensor setup, battery and RCD use, fibre connector rule; emergency procedures, contacts, first aid post and assembly point

Working with the public: supervising children with a parent or carer present; latex allergy and choking hazard awareness; crowd management and event marshal directions

First aid awareness: response to a person who feels faint; when to call 000 and Security; location of the first aid kit, eye rinse and event AED

Theory assessment (oral questioning by the supervisor): why the gas cannot burn and why it is Class 2.2; what to do if someone inhales from a balloon; when the cylinder valve must be closed; the balloon hand-over rule; emergency contacts. All safety-critical questions must be answered correctly

Practical assessment (supervised): fitting the regulator, leak check and closing the valve; filling and tying off a balloon to 15 cm; handing a balloon to a participant, supervising the release and taking it back; emergency shutdown (closing the valve, switching off equipment). Any safety-critical error requires re-briefing and reassessment

Ongoing: briefing repeated before every event; retraining after any incident or near miss, when this SWP or the RA is updated, or if unsafe practice is observed. Briefing attendance and sign-off recorded by the supervisor; balloon count sheets and cylinder log retained

Staff approved to assess competence for this SWP

Chris Betters (Senior Research Fellow, SAIL)

SWP Sign off sheet	
SWP name and version:	**Public demonstration of the SAIL fibre optic methane sensor using balloons filled with 1% CH4 / balance N2 calibration gas (103 L disposable cylinder) (Version 1.0)**

In signing this section the assessor agrees that the following persons are competent in following this SWP.

Name	Signature	Date Competent	Name of Assessor/Authoriser	Assessor/Authoriser signature

Risk Matrix

			Potential Consequences				
			Class 3	Class 2	Class 2	Class 1b/1c	Class 1a
			Minor injuries or physical discomfort. Short-term psychological impact (isolated or one-off event).	Injury or illness requiring medical treatment and/or short-term impairment (less than 2 weeks). Psychological impact requiring support.	Injury or illness requiring hospital admission and/or temporary impairment (less than 6 months). Psychological impact requiring medical treatment.	Injury or illness (physical or psychological) resulting in long-term or permanent impairment (more than 6 months). Injury or illness resulting in temporary impairment to multiple people.	One or more fatalities. Injury or illness resulting in long-term or permanent impairment to multiple people.
			Insignificant	**Minor**	**Moderate**	**Major**	**Severe**
Likelihood	Expected to occur regularly under normal circumstances	**Almost Certain**	**Medium**	**High**	**Very High**	**Very High**	**Very High**
	Expected to occur at some time	**Likely**	**Low**	**Medium**	**High**	**Very High**	**Very High**
	May occur at some time	**Possible**	**Low**	**Medium**	**Medium**	**High**	**High**
	Not likely to occur in normal circumstances	**Unlikely**	**Low**	**Low**	**Medium**	**Medium**	**High**
	Could happen, but probably never will	**Rare**	**Low**	**Low**	**Low**	**Medium**	**Medium**