

Fume Cupboard Design Standards



MACQUARIE
University

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Name	Position	Approved
Dennis Spicer	Engineering Project Manager	
David Matley	Technical Services Manager	



Table of Content

1. Purpose	1
2. Scope	2
3. Glossary of Terms	3
4. Authorities & Responsibilities	4
5. Technical Requirements	5
5.1. INTRODUCTION	5
5.2. Standards	5
5.3. DESIGN AND DOCUMENTATION	5
5.3.1. DESIGN APPROACH	5
5.3.1.1 Fume Cupboards:	5
5.3.1.2 Fume Cupboard Exhaust System - Individual:	6
5.3.1.3 Fume Cupboard Exhaust – Manifolded	6
5.3.1.4 Laboratory Make-Up Air:	6
5.3.2. DESIGN INPUTS AND PROCESS	7
5.3.3. ENGINEERING FUNCTIONS REQUIRED FROM DESIGN CONSULTANTS	7
5.3.4. EQUIPMENT SELECTION AND SIZING	7
5.4. TECHNICAL COMPONENTS	7
5.4.1. FUME CUPBOARDS	7
5.4.2. PREFERRED SUPPLIERS	7
5.4.3. Outer Construction	8
5.4.4. Inner Chamber	8
5.4.5. Front Fascia	8
5.4.6. Base	8
5.4.7. Worktop	8
5.4.8. Sash	8
5.4.9. Baffle	8
5.4.10. Lighting	8
5.4.11. Services (project specific)	9
5.3.1.5 Typical Fume Cupboards	9
5.3.1.6 Other Requirements	9
5.4.12.	9
5.4.13. Fume Cupboard Electrical and Gas Isolation Equipment	9
5.4.14. Energy Saving sash system	10
5.4.15. High sash alarm	10
5.4.16. Additional items	10
5.4.17. Support units- optional	11
5.4.18. Extraction fan	11
5.4.19. Documentation	11
5.4.20. Equipment Labelling	11
5.4.21. Fume Cupboard Installation and Exhaust Ducting	11
5.4.22. Fan Stand and Support Brackets	12
5.4.23. Commissioning	12
5.4.24. Warranty	12



1. PURPOSE

This Mechanical services standard sets out Macquarie University's minimum requirements for the design, construction and maintenance of Mechanical systems. The objective of this standard is to provide guidance and minimum standards of compliance to ensure that systems are designed, constructed, commissioned, and maintained to achieve energy efficiency, fitness for purpose, quality and durability, design performance in operation, maintainability and safety for access and operation, low environmental impact, and low life cycle cost.

Applicable requirements documented in Work Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, Natural Construction Codes (NCC), Macquarie University Design Guides and Australian Standards (AS) are the minimum and mandatory compliance requirements. British Standards shall be used where no Australian Standard exists.

Reference is also made to CIBSE commissioning codes, ASHRAE and their associated standards and references.

Where any ambiguity exists between this standard and the aforementioned mandatory requirements then:

- a. The highest performance requirements must apply
- b. Applicable requirements must follow this order of precedence
 - i. Work Health and Safety legislation
 - ii. Disability Discrimination legislation
 - iii. State Environmental Planning and Assessment legislation
 - iv. All other Commonwealth and State legislation
 - v. This Standard and Macquarie University Design Guides
 - vi. NCC and BCA
 - vii. AS/NZS



2. SCOPE

These Standards describe the minimum, requirements for the design, construction and maintenance of all mechanical services throughout all buildings owned, operated and managed by Macquarie University Property.

The Standard applies to planners, project managers, consultants, contractors, sub-contractors, tenants, managing agents and University staff involved in the design, construction, commissioning and maintenance of existing, new and proposed University buildings and facilities.

The Mechanical Services Standard provides:

- A reference document to enable consistency with the design and engineering objectives;
- Guidance on design considerations;
- Details of the minimum performance requirements;
- Details of the minimum quality requirements;
- Guidance in regards to provisions for maintenance and access;
- Commissioning requirements for acceptance by the University.

3. GLOSSARY OF TERMS

Unless the context otherwise requires, the following definitions apply:

AS	Australian Standard
BCA	Building Code of Australia
Consultant	The mechanical design consultant/engineer
D&C	Design and Construct
HVAC	Heating Ventilation Air Conditioning
LCD/LED	Liquid Crystal Display/Light Emitting Diode
LHS	Left Hand Side
MUP	Macquarie University Property
NATA	National Association of Testing Authorities
NCC	National Construction Code
PVC	Polyvinyl Chloride
RHS	Right Hand Side
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association



4. AUTHORITIES & RESPONSIBILITIES

This standard is owned by MUP. MUP is responsible for maintaining the standard and keeping it up to date. Always check to see if there has been an update to this standard before committing to its use for any particular project. It is the responsibility of the user to ensure they are using the latest version.

5. TECHNICAL REQUIREMENTS

5.1. INTRODUCTION

The aim of this manual is to assist consultants, Project managers, D & C Contractors and Builders. Generally, the relevant Australian standards are to be complied with unless the University requires that a higher standard be met. Variations from the standard are to be approved by MUP.

It should also be noted that the University is a long term owner of the property and so appropriate considerations are to be made in terms of quality of installation, efficiency in operation, ease of maintenance and safety, long term reliability, and flexibility for change of use (where feasible).

The Technical Services Manager shall be consulted if any confusion arises before applying this Standard Guide. Approved variations must always be in writing or they will not be accepted.

5.2. STANDARDS

The following standards apply:

- ABCB- Building code of Australia, National Construction Code
- AS/NZS 2982-2010 Laboratory Design and Construction
- AS/NZS 2243.1-2005 Safety in laboratories – Planning and operational aspects
- AS/NZS 2243.2-2006 Safety in laboratories – Chemical aspects
- AS/NZS 2243.6-2010 Safety in laboratories – Plant and equipment aspects
- AS/NZS 2243.8-2014 Safety in laboratories – Fume cupboards
- AS 4809 - Copper pipe and fittings-installation and commissioning
- AS/NZS 1677.2 - Refrigeration systems:
- AS 2107: 2000 Noise levels:
- AS 4254-2002 Sheet metal ductwork: Ductwork for air handling system in buildings
- AS/NZS 3000 - Electrical: unless otherwise documented.
- Electrical installation and cable selection: To AS/NZS 3008.1.1 and SAA HB 301.
- Degrees of protection (IP code): To AS/NZS 60529.
- AS/NZS 4296 - Cable trunking systems:.
- Conduits and fittings for electrical installations: AS/NZS 2053 Parts 1, 2, 3, 4, 5, 6, 7 and 8.
- Plumbing and drainage: To AS/NZS 3500.0, AS/NZS 3500.1, AS/NZS 3500.2,
- AS/NZS 3500.3 and AS/NZS 3500.4 and the Plumbing Code of Australia.

5.3. DESIGN AND DOCUMENTATION

5.3.1. DESIGN APPROACH

The University expects consultants and designers to provide designs that meet the project brief. The following are priorities that consultants and designers must be aware of and consider in their design:

5.3.1.1 Fume Cupboards:

Fume cupboards shall be variable flow units equipped with project-specific Laboratory services as defined in the User Brief for that project.

Units shall be selected in lengths suitable for the specific project and requirements, from the selection of “standard” lengths offered by Fume Cupboard manufacturers without the requirement for bespoke manufacture of chassis.

Units shall be specified with a standard suite of finishes and services provisions, or as specifically required for the laboratory installation. In addition, all Fume Cupboards to be supplied complete with indicators on the fascia (in form of an arrow) to indicate working height of sash.

Fume hoods to be supplied separate power from the main labs power. Emergency shutdown is to be provided to each fume hood individually.

All fume cupboards are to be fitted with a scrubber unless deemed unnecessary by end users.

The final fume cupboard identification (numbering) system is to be nominated by the University as per University guidelines.

5.3.1.2 Fume Cupboard Exhaust System - Individual:

All fume cupboard exhaust fans (individual fan per hood) shall be mounted externally on the roof, with stacks to extend vertically and discharge in an approved manner.

Fume cupboard exhaust fans shall be designated the number corresponding to their associated fume cupboard.

If it is a sprinklered building, install a sprinkler head approximately 1m in front of the face of the fume cupboard. Refer to Clause 2.14 in AS 2243.8-2014.

If it is a non-sprinklered building, the university requires that a addressable smoke or thermal detector (depending on the rest of the building and application) be installed as close to the fume cupboard. Refer to Page 29 of AS 2243.8-2014 for spacing as well as AS 1670.1.2015 regarding spacing of detectors.

All new exhaust fans shall be supported on existing roof mounted steel frame with additional frames provided by the builder if required.

Fume cupboard exhaust systems will not require the inclusion of filtration.

5.3.1.3 Fume Cupboard Exhaust – Manifolded

Manifolding of multiple fume cupboards into one discharge may be considered by MUP on submission from the design consultant justifying this selection.

When considering this type of arrangement, the consultant shall review the following as a minimum:

- Installation costs – compared with individual fan system
- System redundancy
- Spatial and architectural considerations
- Individual Fume Cupboard isolation/removal
- Additional fume cupboards/“future-proofing” of the installation

5.3.1.4 Laboratory Make-Up Air:

- Make up air shall be provided to ensure appropriate relative negative pressures are maintained in the space.
- Make up air systems shall modulate in volume depending on pressure readings within the space from 2 separate sensors (averaged).
- The provision shall be made for diversity factor based on percentage of fume cupboards operating air flow such that 20% are at maximum airflow, 20% are at minimum air flow and 60% are at operating (working) airflow.
- Refer to MUP Mechanical Design Standard for further Make Up Air design requirements and considerations

5.3.2. DESIGN INPUTS AND PROCESS

The University expects consultants and designers to proactively inform, advise and contribute to the design process. In particular the following aspects:

- a) System configuration & fan types
- b) Installation and running costs
- c) Energy efficiency and potential for heat recovery (in coordination with mechanical services)
- d) Building physics and aesthetics
- e) Operator safety and Laboratory code compliance – provide advice assisting other designers in relation to fume cupboard operation and final certification (clearances, orientation, air flow considerations)
- f) Planning and architecture – Provide advice on the appropriate location of plant rooms and reticulation strategy, including maintenance and other access requirements, to assist in both the planning of the building and the facilitation of better maintenance in the future. Such advice must be provided in the early stage of the design and planning process so that this can be taken into consideration by the architect.

The consultant or designer is expected to advise, contribute and if necessary lead such processes.

5.3.3. ENGINEERING FUNCTIONS REQUIRED FROM DESIGN CONSULTANTS

The university expects consultants and designers to be fully qualified, experienced and capable of carrying out all engineering design, calculations, equipment selection, construction quality checks, overview and verification of commissioning.

5.3.4. EQUIPMENT SELECTION AND SIZING

In selecting equipment, the consultant shall select products of proven and reliable quality, with reputable support and after sales service. A design basis shall be nominated in the design documentation, with any alternatives to be of an equivalent standard and requiring the approval of MUP and the consultant prior to tender acceptance.

5.4. TECHNICAL COMPONENTS

The following sections contain technical requirements on equipment, materials and installations. Consultants and designers are required to adhere to these. In the preparation of consultants' specifications, they are required to ensure that those project specifications do not contain any conflicting requirements or information with this document, unless approved by MUP.

5.4.1. FUME CUPBOARDS

The Fume cupboard(s) shall be of aerodynamic bench type and shall be constructed in accordance with this specification

All fume cupboards and the associated installation must be in accordance with AS2243.8:2006 and Sydney University requirements. Preference will be given to fume cupboards with Third Party Product Certification for compliance to Australian Standards as a 'QAS Certified Product'.

The fume cupboard(s) shall be manufactured and installed by a Quality Management AS/NZS ISO 9001:2000 Accredited Company.

5.4.2. PREFERRED SUPPLIERS

The following manufacturers are the preferred suppliers of fume cupboards:

- Dynaflow

5.4.3. Outer Construction

Fume cupboard shall be manufactured from fire retarded glass reinforced plastic (GRP) and should comply with Australian Standard AS 1530 Part 3 (1973). The GRP shall be contact moulded to ensure an unbroken gel coat containing no excess or unreacted hardener.

5.4.4. Inner Chamber

The inner chamber shall be a one piece moulded design manufactured from chemical resistant GRP with large radius corners, crevice free and a smooth finished interior. The roof shall be aerodynamically shaped on three sides towards a flanged rectangular outlet at the rear of the chamber which shall not be less than 45% of the width of the inner chamber and containing no exposed fixing bolts.

(A FLAT NON-AERODYNAMIC TYPE ROOF WILL NOT BE ACCEPTABLE.)

5.4.5. Front Fascia

The front fascia shall be of the picture frame type, manufactured in one piece from chemical resistant GRP and shall extend to the full height of the fume cupboard. The aerofoil shaped sides and bottom of the fascia shall have a minimum width of 100 mm at a minimum of 45 degree to the opening.

5.4.6. Base

The base of the chamber shall contain a full width sump moulded in one piece from GRP and fitted with a waste outlet. The front shall contain a shaped section inclined towards the sump to assist in the retention of any spillage. (N.B. A VERTICAL RAISED LIP WILL NOT BE ACCEPTABLE DUE TO THE TURBULENCE AND OBSTRUCTION IT CREATES).

5.4.7. Worktop

The worktop shall be of the removable type, suspended above the full width of the sump and manufactured from ceramics or corrosion resistant product suitable for laboratory use, such as "TRESPA TopLab Plus" or similar, and to be no less than 12mm thick. Drainage from the worktop to the sump shall be achieved via a slot around the removable worktop into the full width sump below.

5.4.8. Sash

The sash shall be of the vertical type, glazed with 6mm armour plate glass and counter balanced by a one-piece counter balance weight supported by stainless steel cables running on four ball bearing pulleys. (2 separate weights will not be acceptable). The bottom of the sash is to have a full-length aerofoil section and two (2) moulded handles fixed approximately 100mm from the bottom of the sash. The sash runners and channels shall have nylon seals to ensure they are completely airtight to ensure no leakage.

A minimum opening of 50mm should remain when the sash is fully lowered.

5.4.9. Baffle

The fume cupboard chamber shall be fitted with a specially designed one piece back baffle, manufactured from chemical resistant GRP. The baffle should ensure the whole of the chamber is scavenged, whether heavy or light corrosive fumes are present and assist in obtaining an even, average, face velocity across the sash.

5.4.10. Lighting

The fume cupboard lighting shall be by a fluorescent light mounted in a purpose made moulded cover and shall provide illumination at the work surface through a sealed armour plate glass panel recessed in the roof of the chamber to avoid disturbing the airflow within the fume cupboard. (A CLEAR PVC PANEL WILL NOT BE ACCEPTABLE.)

A lighting level of 600 LUX average is to be provided within the working space.

5.4.11. Services (project specific)

Each fume cupboard shall be supplied with the following remotely controlled services:

5.3.1.5 Typical Fume Cupboards

- 2 x Cold water service (1 x LHS + 1 x RHS) (Broen Brand)
- 2 x Nitrogen service (1 x LHS + 1 x RHS) (Broen Brand)
- 2 x Vacuum service (1 x LHS + 1 x RHS)
- 2 x Chilled water service (1 x LHS + 1 x RHS) (Broen Brand)
- 2 x DGPO (3 x LHS + 3 x RHS) To be mounted minimum 300mm above the worktop level
- 100mm Pass through port on front fascia (1 x LHS + 1 x RHS)
- Fully scrubbed where possible/non-scrubbed
- Maintenance of fully scrubbed FC's is managed by MQP
- 50mm Pass through conduit from underneath to allow vacuum pipes to enter from below without passing through sash (1 x LHS + 1 x RHS)
- Socket outlets within the fume cupboard to be protected by 20A MCB with RCD protection.

5.3.1.6 Other Requirements

- The service outlets shall be mounted internally on the side walls of the fume cupboard chamber to preserve the uncluttered work surface.
- The outlets shall be finished in electrostatically applied epoxy finish.
- The remote control valves and outlets shall be colour coded to the DIN 12920 international standard.
- The remote control valves are to be mounted on the sides of the front fascia.
- The remote control fittings shall be "BROEN" range with flow regulating facility.
- The fume cupboard shall be totally factory pre-plumbed and pressure tested to ensure no leaks are encountered on site. (No site plumbing other than the connection of service tails to the main supply shall be carried out on site.).
- All fume cupboards to include pass through spigot in the fascia directly underneath the lower GPO.

5.4.12.

5.4.13. Fume Cupboard Electrical and Gas Isolation Equipment

The fume cupboard(s) shall be supplied with an integrated Control System. This Control System shall be an electronic, programmable P.C.B. module containing a liquid crystal back lit display (LCD) allowing full status display without abbreviation, and all switches, timers and relays to enable the fume cupboard to comply with the Australian Standards, Nos. AS 2243.8, AS 3000 and AS 2430.3.

Scrubbers to be placed above units where FL-CL \geq 2.9m, therefore will have roof mounted tank, filters and pumps.

The System is to be complete with a special adjustable airflow monitoring device which allows (in the event of an extraction rate failure) the control system to activate a 75 DB alarm and graphic warning display on the LCD, and will turn off power and gas supplies via a contactor and solenoid valve. The module shall also incorporate a self-charging internal battery back-up supply to ensure the alarm and graphic indication operates when the power supply is lost either by circuit failure or power failure. The capacity of the battery must be sufficient to run the alarm for a minimum of 20 mins in the event of a power failure, as required for compliance with AS 2243.8

The Control System shall be easily upgradable if required via USB or similar.

The Control System shall be complete with pre-purge, and post purge timers, all graphic indication giving status of fan, light, pre-purge, post-purge, power/gas availability, alarm, and alarm mute. (It shall also contain controls for spray bar, Energy Saving Sash System and heat sensor when these are installed).

Fitted on the control module shall be a "Fume Cupboard Emergency Isolator" which when activated will isolate power/gas supplies and give graphic indication, but will allow the fan to continue running as required by the Australian Standards.

Any external exhaust ducting is to be constructed of spiral stainless steel.

5.4.14. Energy Saving sash system

The fume cupboard(s) shall be complete with Energy Saving Sash System to control the fume cupboard extraction fan rpm with the Variable Speed Drive located in the Fume cupboard Electrical enclosure.

The system shall be capable of giving an infinitely variable air volume in relation to the sash position whilst maintaining a constant capture velocity of 0.5 m/s across the open sash. When the sash is at its minimum opening of 50 mm the extraction rate shall be automatically set to give a minimum of five fume cupboard chamber air changes per minute as required for compliance with AS 2243.8. The system must be capable of giving immediate response to any movement of the sash. Note: Pre-set multi speeds operated by switches or a motorized damper by-pass system will not be acceptable.)

An auto/boost switch shall be incorporated in the fume cupboard control module. When the boost switch is activated it shall override the automatic mode of the controller and instantly provide maximum air quantity from the extraction fan, irrespective of the position of the sash. When the auto-switch is activated the fume cupboard should immediately return to its normal synchronised mode.

An outlet terminal shall be supplied in the discharge duct which acts as a non-return valve which will seal the exhaust system to ensure no fume re-enters the laboratory when the fume cupboard is idle, and to maintain a minimum discharge velocity of 10 m/s.

5.4.15. High sash alarm

A high sash alarm shall be provided such that an audible alarm sounds once the sash has been at a position greater than normal working height (50%) for more than 10 minutes.

The fume cupboard mute button shall cancel this alarm.

Prewiring of fume cupboard

All internal wiring to electrical components shall be supplied and factory tested before delivery; including lights, solenoids, GPO's, fan control and overload protection.

Terminals shall be provided for others to connect the electrical supply to the fume cupboard(s) and for wiring to the fan motor. The prewiring shall be complete with BMS output signals (0-10V signal, ON/OFF Status and Fault Alarm signals)

Terminals shall be provided for others to connect a Volt free signal cable which when asserted will activate the "Fume Cupboard Emergency Isolator" function.

Refer to MUP Electrical Services design Guideline for further details.

5.4.16. Additional items

In addition to the above, Each Fume cupboard must be provided with:

- A Scaffold Grid manufactured from minimum #304 grade 12mm Stainless Steel Bar located at the back of the fume cupboard.
- A #304 Stainless steel mesh 170mm high located at low level below the back baffle to prevent tissues/gloves etc being sucked up during fume cupboard operation.
- Mobile blast shield

5.4.17. Support units- optional

The open support unit shall be designed to support the fume cupboard and be manufactured from a metal epoxy coated white powdercoat finish. It shall include:

- 32x32mm mild steel frame – epoxy coated (white) with 4 x adjustable feet.
- 1 x perforated cable tray fixed to the back of the support unit for the support of the piping services.

5.4.18. Extraction fan

The Chemical Fume Extraction Fan shall be expressly made for the purpose of corrosive fume extraction. The casing should be moulded in one piece with no seams or joints from chemical resistant reinforced plastic or PP.

The fan must be capable of providing a velocity rate of not less than 0.5 m/s across the open face of the fume cupboard, after taking into consideration the pressure losses throughout the extract system.

The fan motor shall be located outside the airstream and be suitable for connection to a 415 volt 3 phase (Delta) power supply.

The fan housing shall have a drain to allow drainage of any rainwater entering the system.

The Extraction Fan must have:

- GRP or PP fan casing
- Pp impeller dynamically balanced
- High efficiency TEFC motors, 3 phase 4 pole, IP55 compliant to MEPS 2 requirements and suitable for variable speed operation.
- Stainless steel motor shaft and stainless steel fasteners.

5.4.19. Documentation

Operator's and service manual – 3 hard bound copies and 1 electronic copy are required.

5.4.20. Equipment Labelling

All fume cupboards fans must be labelled in accordance with the requirements of AS2243.8.

Labels shall be suitably affixed to remain on the equipment even when exposed to external weather conditions. Refer to Fume Cupboard Signage (see attached Appendix 1) for required labelling

5.4.21. Fume Cupboard Installation and Exhaust Ducting

The Fume cupboard system shall be installed by the manufacturer or his approved installer to ensure compliance to AS 2243.8: 2006 and Sydney University Requirements

Fume cupboard exhaust ductwork shall be:

- Minimum 300 mm Diameter White UPVC --- between the fume cupboard and Riser location
- Minimum 300 mm Diameter Stainless steel --- Above roof level

Any wiring external to fans in accordance to electrical specifications:

- Rigid conduit
- Armour flex

UPVC Ductwork:

- Extruded thin wall circular ventilation ductwork should be used where possible with the minimum number of joins.

- Duct is to be joined via spigots or sockets with an approved hot air welding system. (Glue and sealants not acceptable). All joints are to be airtight, where multiple ducts and fans are provided they may be supported together and braced in order to improve stability and strength.
- Bends are to be of moulded radius construction for 300 mm diameter and 350 mm diameter bends.
- Lobster segmented type bends will be acceptable for 400 mm diameter bends.
- The construction and installation is to be strictly in accordance with AS 2243.8.
- Thermal detector probes are to be included within the ductwork for all fume cupboards as a factory manufactured inclusion.

5.4.22. Fan Stand and Support Brackets

- The Fan Stand shall be constructed to support the chemical exhaust fan and its exhaust duct.
- Fan stand and its metal components shall be hot dipped galvanised.
- Engineering on the support stand shall be the responsibility of the installer.
- All guy wires and fittings shall be manufactured from 304 Stainless Steel.
- Fan Stand construction to be approved by the client.
- All support brackets shall be hot dipped galvanised with suitable fixings to support the ducting.

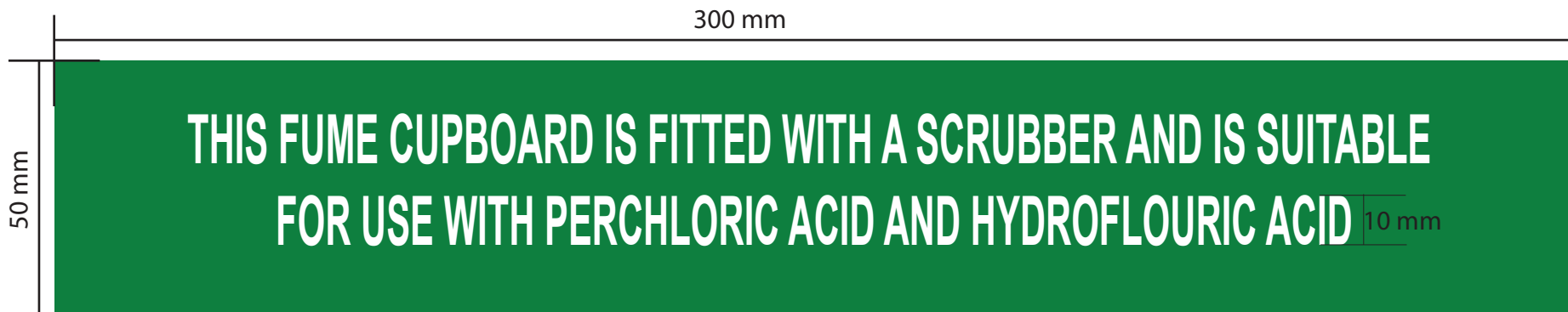
5.4.23. Commissioning

On completion of the installation the University shall be provided a certificate of compliance, in accordance with the Australian Standard 2243.8 Appendix. "A" Smoke Test "B" Velocity Test and "F" Compliance report. This report shall be carried out by a NATA Certified Testing Organisation accredited to provide such a report.

Testing and Commissioning shall be witnessed by authorised representative of the University.

5.4.24. Warranty

All equipment shall be covered by the supplier 12 months from practical completion as agreed by the client. The supplier shall conduct a six monthly and at the end of the 12 month warranty period conduct a full Velocity, Smoke and Compliance test. They shall be conducted in accordance with AS/NZS 2243.8 2000 and provide NATA report.



Label Ref: SCR1
 Label size: 300mm wide x 50mm High
 GREEN background, Wording : 10mm High WHITE lettering
 Qty: 100(supply in sheet - 4 per sheet)
 Digitally printed on 5 years poly SAV with contour cut, square corners



Label Ref: SCR2
 Label size: 300mm wide x 50mm High
 RED background, Wording : 10mm High WHITE lettering
 Qty: 200 (supply in sheet - 4 per sheet)
 Digitally printed on 5 years poly SAV with contour cut, square corners

APPENDIX 1

** Reduced Size

Job No.: XXXX	File Location: X:\Data\DynaFlow\03042019
Order Date: 03-04-2019	
Date: 03-04-2019	Company: Dynaflow
Salesperson: NM	
	E-mail: roy@dynaflow.com.au
	Fax: XXXX

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 Trading as

 **SIGNMAKER SOLUTIONS**
 Unit 13,160 Gilba Road, Girraween, NSW 2145
 Email: artwork@signmaker.com.au Tel: (02) 9896 1099 (02) 9896 4158