

Monash Centre for Electron Microscopy (MCEM)

User Manual

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INTRODUCTION

This Manual is a convenient reference giving information about the **Monash Centre for Electron Microscopy (MCEM)**, its staff and facilities, operating procedures and occupational health and safety matters. For additional information please see the website:

https://www.monash.edu/researchinfrastructure/mcem

If you have any questions or comments regarding the Manual or MCEM, please contact the General Manager, Dr Flame Burgmann (see contact details below).

ABOUT MCEM

The Monash Centre for Electron Microscopy (MCEM) is a centrally-funded Monash University Research Platform (MRP). It provides a world-class capability in electron microscopy to enable researchers to solve major scientific challenges. MCEM conducts innovative research in electron microscopy, and provides advanced instrumentation, expertise and training to researchers from across the university, government and industry sectors. MCEM's primary role is to enable an increase in the quality and quantity of research at Monash university.

Monash Research Platforms report to Professor Jacek Jasieniak (Pro Vice-Chancellor (Research Infrastructure), *Office of the Pro-Vice Chancellor (Research Infrastructure)*

In 2019 MCEM, together with the Monash Ramaciotti Centre for Cryo-Electron Microscopy, joined as the Victorian node of Microscopy Australia, see <u>https://micro.org.au/</u>. Microscopy Australia is a consortium of university-based microscopy facilities united by values of collaboration, accessibility, excellence and innovation and is funded by federal (NCRIS) and state governments and participating institutions.

MCEM Platform Vision

To be at the forefront of research in electron microscopy, providing a leading-edge capability that will enable researchers to solve major scientific challenges.

MCEM Platform Mission

To enable and advance research excellence at Monash University and beyond through the provision of world-class electron microscopy for the determination of the structure of matter down to the atomic scale.

MCEM achieves this via its dual academic and research support role, namely:

- 1. execution of world class research in the field of electron microscopy, and
- 2. provision of advanced instrumentation, expertise and training in electron microscopy to researchers across all fields of science and engineering (except biology).

MCEM is the largest electron microscope facility in Victoria, serving several hundred registered researchers from Monash, other universities, government research agencies, as well as providing consultancy services to industry. It plays an important role in educating and supporting students in electron microscopy and materials characterisation and is a key complementary facility to the Australian Synchrotron and the Melbourne Centre for Nanofabrication (MCN), the Australian National Fabrication Facility's (ANFF) central node in Victoria.

MCEM works closely with the Monash Ramaciotti Centre for Cryo-Electron Microscopy (see <u>https://www.monash.edu/research/infrastructure/platforms-pages/cryo-em</u>) and Monash Micro Imaging (MMI, see <u>https://www.monash.edu/research/infrastructure/platforms-pages/mmi</u>) which provide electron microscopy and optical microscopy capabilities respectively for the biological sciences.



Capabilities

MCEM commenced operation in its current location in November 2007. This dedicated building provides exceptional acoustic, mechanical, thermal and electromagnetic stability as well as high quality water, gas and power services needed to ensure optimum instrument performance. This is one of the most stable electron microscopy buildings worldwide.

MCEM maintains nine electron microscopes: four transmission electron microscopes (TEM); three scanning electron microscopes (SEM) and two focused ion beam/ scanning electron microscope (FIB/SEM).

Three major new instruments were commissioned in 2008/2009, including Australia's first "aberration-corrected" transmission electron microscope, the FEI Titan³ 80-300 field emission gun transmission electron microscope (FEGTEM). The other two instruments are the JEOL 7001F FEGSEM and FEI Quanta 3D focussed ion beam/scanning electron microscope (FIB/SEM).

A further four instruments were installed in 2012: FEI Nova NanoSEM 450 FEGSEM; FEI Magellan 400 FEGSEM; FEI Tecnai G2 T20 TWIN TEM and FEI Tecnai G2 F20 S-TWIN FEGTEM.

A Thermo Fisher Scientific Spectra ϕ FEGTEM was delivered in March 2021. This doubleaberration corrected and monochromated FEGTEM is the first of its type in the world.

MCEM received LIEF funding in 2020 to purchase a new FIB/SEM. In 2022 MCEM took delivery of a Thermo Fisher Scientific Helios 5 UX FIBSEM and a Thermo Fisher Scientific Verios 5 UC FEGSEM.

Please see the MCEM website <u>https://www.monash.edu/researchinfrastructure/mcem/home</u> for further information on MCEM's electron microscopes, computer software, sample preparation and support equipment and names of staff responsible for this equipment.

Brief History of MCEM

- Originally the Electron Microscopy and Microanalysis Facility (EMMF) based in the Department of Materials Science and Engineering. The Department had provided a materials-based TEM and SEM capability for over 30 years.
- 2005: Monash University decided to establish a centrally-funded capability in materialsbased electron microscopy. The Victorian state government contributed \$5million towards establishment of the facility.
- 2006: Construction of the purpose-designed building started.
- Late 2007: MCEM commenced operation in the new building with increased number of staff using existing instruments: two SEMs and two TEMs with average age >15 years and one atom probe. A 25-year old TEM was decommissioned at that time.
- 2008/2009: FEI Titan FEGTEM, FEI Quanta FIB/SEM, JEOL 7001F FEGSEM and JEOL 2100F FEGTEM installed.
- 2012: FEI Tecnai T20, FEI Tecnai F20, FEI Nova FEGSEM, FEI Magellan FEGSEM installed replacing four obsolete microscopes.
- 2014: Atom probes removed from service.
- 2019: MCEM and the Ramaciotti Centre for Cryo-EM joined Microscopy Australia.
- 2020: JEOL 2100F FEGTEM removed from service.
- 2021: Thermo Fisher Scientific Spectra φ FEGTEM installed.
- 2021: FEI Magellan FEGSEM removed from service.



• 2022: Thermo Fisher Scientific Helios 5 UX FIBSEM and Verios 5 UC FEGSEM installed.

What MCEM delivers (2022 data)

- 1. MCEM was used by 12 Monash Schools, Departments and Centres and enabled the research of 337 Instrument Users (~75% PhD students) and 117 Supervisors (plus their collaborators), involved in 344 research projects.
- 2. Total annual microscope usage >14,000 hr excluding service and downtime (average of >1,750 hr/microscope).
- 3. MCEM usage resulted in 181 publications (so far) with ~20% of publications in the top 10 citation percentile.
- 4. MCEM supported the research of ~200 PhD students and provided more than 2,000 hours of expert training in electron microscopy.
- 5. 116 researchers received individual tuition in specialist topics.
- 6. 40 researchers successfully completed accredited PhD courses CEM6881/CEM6882 given by MCEM.
- 7. 53 people were granted after-hours licenses.
- 8. 196 licences for independent use of microscopes were granted.
- MCEM supported the research of over \$85million of competitive project grants (ARC DP, LP, FL, FT, DE, NHMRC) and over \$292million of centres and hubs (ARC CoE, ITRH, ITTC).



STAFF ROLES AND CONTACT DETAILS

General Office

Ms Viki Pan General Office Coordinator/Executive Assistant Tel.: 990 55563 Office: 10 Innovation Walk Room G03 <u>viki.pan@monash.edu</u>

Ms Catherine Brown

Tel.: 990 55563 Office: 10 Innovation Walk Room G03 <u>catherine.brown@monash.edu</u>

Ms Katherine O'Rourke

Tel.: 990 55563 Office: 10 Innovation Walk Room G03 <u>katherine.orourke@monash.edu</u>

Director

Professor Joanne Etheridge

Director Tel.: 990 51836 Office: 10 Innovation Walk Room G05 joanne.etheridge@monash.edu

General Manager

Dr Flame Burgmann

General Manager Tel.: 990 50336 Mobile: 0423 217 462 Office: 10 Innovation Walk Room G06 <u>flame.burgmann@monash.edu</u>

MCEM Web Page

https://www.monash.edu/researchinfrastructure/mcem

MCEM Email mcem@monash.edu



Academic Staff

Academic Staff members conduct their own research programmes, usually in the development of advanced methods of electron microscopy and their application to the study of materials. They may collaborate with Users on projects of mutual interest requiring advanced electron microscopy. Academic Staff are responsible for leading the development of new methods and instrumentation to maintain and extend the MCEM's advanced capabilities. Academic Staff members also perform the role of Microscope and Equipment Manager (see below).

Professor Joanne Etheridge

Director Professor, Department of Materials Science and Engineering Tel.: 990 51836 Office: 10 Innovation Walk Room G05 joanne.etheridge@monash.edu

Associate Professor Laure Bourgeois

FEI Titan FEGTEM Manager Associate Professor, Department of Materials Science and Engineering Tel.: 990 55368 Office: 10 Innovation Walk Room 105 <u>laure.bourgeois@monash.edu</u>

Associate Professor Matthew Weyland

Spectra φ FEGTEM Manager Associate Professor, Department of Materials Science and EngineeringTel.: 990 59026 Office: 10 Innovation Walk Room 108 <u>matthew.weyland@monash.edu</u>

Dr Tim Petersen

Research Fellow, Monash Centre for Electron Microscopy Tel.: 990 20747 Office: 10 Innovation Walk Room 110 timothy.petersen@monash.edu

Dr Bryan Esser

Research Fellow, Microscopy Australia Tel.: 990 24036 Office: 10 Innovation Walk Room 110 bryan.esser@monash.edu

Dr Sergey Gorelick

Research Fellow, Monash Centre for Electron Microscopy Tel.: 990 55347 Office: 10 Innovation Walk Room 110 sergey.gorelick@monash.edu



Microscope Managers

The Microscope Manager is responsible for:

- overall management of a microscope, its performance and maintenance;
- preparation of operating, training and OHS documents;
- management of training, client work (internal and external) and issuing licences;
- setting and enforcing training procedures, operating and safety procedures, access rules and booking regimes;
- instrument and technique development;
- provision of expert advice to assist with equipment purchase.

The Microscope Manager provides training, advice and assistance to Users, particularly where advanced techniques are needed. The Microscope Manager may collaborate with Users on projects of mutual interest and may carry out Client work.

Microscope Managers work closely with Microscopists to ensure the efficient operation of the laboratory.

Dr Xi-Ya Fang

Microscope Scientist SEM Manager (TFS Verios 5 UC FEGSEM, FEI Nova NanoSEM 450 FEGSEM and JEOL 7001F FEGSEM) and SEM Sample Preparation Specialist Tel.: 990 20821 Office: 10 Innovation Walk Room 107 <u>xi-ya.fang@monash.edu</u>

Dr Yang Liu

Microscope Scientist FIB Manager (TFS Helios 5 UX FIB FEGSEM, FEI Quanta 3D FIB FEGSEM) Tel.: 990 53781 Office: 10 Innovation Walk Room 106 <u>yang.liu3@monash.edu</u>

Dr Tim Williams

Microscope Scientist TEM Manager (FEI Tecnai G2 T20 TWIN TEM and FEI Tecnai G2 F20 S-TWIN FEGTEM) Tel.: 990 20721 Office: 10 Innovation Walk Room 103 timothy.williams@monash.edu



Microscopists

Microscopists work closely with Microscope Managers to support the efficient operation of the laboratory. They assist with the development of training and operating procedures and with development of new microscope capabilities and techniques. Microscopists provide training and assistance to microscope Users, may collaborate with Users on projects of mutual interest and carry out Client work.

Dr Emily Chen

Microscope Scientist and TEM Sample Preparation Specialist Tel.: 990 55348 Office: 10 Innovation Walk Room 104 <u>yu.chen@monash.edu</u>

Dr Zhou Xu

Microscope Scientist and Cathodoluminescence Specialist Tel.: 990 56211 Office: 10 Innovation Walk Room 104 <u>zhou.xu@monash.edu</u>

Mr Nick McDougall

Microscope Scientist Tel.: 990 53435 Office: 10 Innovation Walk Room G29 <u>nick.mcdougall@monash.edu</u>

Casual Microscopists

David Vowles (visiting) Tel.: 990 53435 Office: 10 Innovation Walk Room G29 david.vowles@monash.edu



Microscope Engineers

Microscope Engineers play a pivotal role in the day-to-day running of the laboratories. They undertake maintenance on specific equipment and associated infrastructure, see MCEM website

https://www.monash.edu/researchinfrastructure/mcem/facilities/staff-responsibilities

Microscope Engineers may be involved in the further development of this equipment to optimise and extend performance. They also provide training and assistance to microscope Users and may carry out Client work.

Dr Russell King

Electron Microscope Engineer and Safety Officer Tel.: 990 53804 Office: 10 Innovation Walk Room G34 russell.king@monash.edu

Equipment Managers, Engineers and Trainers

Equipment within MCEM is supported by Equipment Managers, Engineers and Trainers with the following responsibilities, see MCEM website

https://www.monash.edu/researchinfrastructure/mcem/facilities/staff-responsibilities

The role of the **Equipment Manager** similar to that of the Microscope Manager but with responsibility for particular equipment.

The **Equipment Engineer** is the staff member with primary responsibility for the day-to-day operation and routine maintenance of the equipment.

An **Equipment Trainer** provides training in use of the equipment.

Microscopes are equipment so a Microscope Manager/Engineer is also an Equipment Manager/Engineer.



Affiliated Monash Academic and Research Staff

Affiliates typically hold a joint appointment with MCEM and a School or Department. They conduct their own programmes of research, usually in the development of methods of microscopy and their application to the study of materials. They may be available to collaborate with Users on projects of mutual interest requiring advanced microscopy. They are not routinely involved in microscope management, training or service.

The following Monash academic and research staff have specialist research programmes in the development of electron microscopy methods.

Dr Wei Chao	Research Fellow Department of Materials Science and Engineering
Dr Heidi Cheng	CSIRO Manufacturing
Dr Scott Findlay	Senior Lecturer, School of Physics and Astronomy
Dr Weilun Li	Research Fellow Department of Materials Science and Engineering
Dr Amelia Liu	School of Physics and Astronomy
A/Prof. Philip Nakashima	Department of Materials Science and Engineering
Dr Huyen Pham	Department of Materials Science and Engineering



LOCATION

The Monash Centre for Electron Microscopy is located at 10 Innovation Walk (formerly Building 81) on the Monash University Clayton campus, (Figure 1 and

https://www.monash.edu/ data/assets/pdf file/0010/71686/3-Claytoncolour.pdf).

The main entrance is at the North-West corner.

For general information about the Monash Clayton campus see: <u>https://www.monash.edu/about/our-locations/clayton-campus</u>

For information on travelling to the Clayton campus and parking advice see:

https://www.monash.edu/people/transport-parking



Figure 1 The Monash Centre for Electron Microscopy is located at 10 Innovation Walk on the Monash University Clayton campus.

DELIVERIES

The Clayton campus is a pedestrianised environment. Vehicle access to the centre of campus is restricted. For further information please see: <u>https://www.monash.edu/people/transport-parking/delivery-access-guidelines</u>

Deliveries at the Clayton campus can be completed in two ways.



Small deliveries - to be walked from loading bays

For deliveries that can be carried by hand or trolley you can park in any available perimeter loading bay on campus. The delivery can take place at any time and does not require prior notification or authorisation from Monash Security.

Large deliveries - requiring road access

If an item can only be delivered by a vehicle accessing the centre of campus - due to its size or sensitivity - the vehicle will need access past one of the bollard entry points. Please inform MCEM of the delivery at least one business day prior to the delivery date. MCEM must submit a form to Monash Security to arrange access past the bollards. Monash Security may not authorise access if adequate prior notification was not provided.

- 1. When the delivery vehicle arrives at a bollard location, the driver is to use the intercom provided to call Monash Security, identifying their company or delivery. If an intercom is not available, they are to call Monash Security on 9902 7777. The driver will also need to contact MCEM on 9905 5563 to arrange for an MCEM staff member at act as a spotter.
- 2. Security will visually confirm a spotter is present to escort the vehicle at a walking pace and guide any vehicle reversing or turning movements.
- 3. Security will lower the bollards to allow access.
- 4. On departure, the spotter will walk the vehicle back through to the bollards. The bollards will lower automatically when exiting.

Contractors

See Parking and Permits - Buildings and Property Contractors (monash.edu)



BUILDING

Plans of the ground floor and mezzanine level are shown in Figure 2 and Figure 3 respectively. The Centre's room directory and telephone list is given in Table 1.



Figure 2. MCEM, 10 Innovation Walk (Building 81) ground level.





Figure 3. MCEM, 10 Innovation Walk (Building 81) mezzanine level.

Toilets

Male, unisex and female toilets are located in the administration area at the North end of the building (top of the plan), Rooms G07, G08 and G09 respectively. The unisex toilet located on the mezzanine level, Room 109 is for MCEM staff use only.



Table 1. MCEM Room Directory and Telephone List.

Room Number	Description	Telephone	Comments/Access Restrictions
G02	Monash Centre for Electron Microscopy	990 58774	Main entrance
G03/G04	MCEM General Office	990 55563	MCEM staff only
	Ms Viki Pan Ms Catherine Brown General Office Coordinator/ Executive Assistant		
G05	Prof. Joanne Etheridge MCEM Director	990 51836	Office
G06	Dr Flame Burgmann MCEM Manager	990 50336	Office
G07	Male Toilet		
G08	Unisex Toilet and Shower		
G09	Female Toilet		
G10	Tea Room	990 58781	
G11	Meeting Room	990 58782	
G15	TEM Laboratory Lobby FEI Tecnai T20 FEI Tecnai F20	990 58783	Licensed users only
G16	Utility Room (Laboratory G17)		MCEM staff only
G17	FEI Tecnai G2 F20 S-TWIN FEGTEM	990 51834	Licensed users only
G18	FEI Tecnai G2 T20 TWIN TEM	990 59891	Licensed users only
G19	Utility Room (Laboratory G18)		MCEM staff only
G20	FEGTEM Operators' Room FEI Titan FEGTEM Thermo Fisher Scientific Spectra φ FEGTEM	990 58784	FEGTEM licensed users only
G21	FEI Titan FEGTEM	990 58785	Licensed users only
G21A	Utility Room (Laboratory G21)		MCEM staff only
G22	Utility Room (FEGTEMs)		MCEM staff only
G23	Thermo Fisher Scientific Spectra φ FEGTEM		Spectra φ FEGTEM licensed users only
G24	Cleaner's cupboard		Cleaner only
G25	Focused Ion Beam Microscope Lobby		Licensed users only
G26	Thermo Fisher Scientific Helios 5 UX FIBSEM	990 58786	Licensed users only
G27	Specimen Preparation Laboratory B	990 58788	MCEM staff and licensed users only
G28A	Utility Room (Laboratory G26)		MCEM staff only
G29	Nicholas McDougall	990 53435	Office
G30	Microtome Laboratory	990 58790 990 20822	Licensed users only



Room Number	Description	Telephone	Comments/Access Restrictions
G31	TEM Support Laboratory	990 58777	TEM licensed users only
G32	Polishing Room	990 20717	TEM licensed users only
G33	Clean Workroom	990 20718	MCEM staff only
G34	Dr Russell King Microscope Engineer Safety Officer	990 53804	Office
G35	Specimen Preparation Laboratory A	990 54905	All licensed users
G36	JEOL 7001F FEGSEM	990 20702	Licensed users only
G37	Electropolishing Laboratory	990 20701	Electropolisher licensed users only
G38	Liquid Nitrogen and Gas Store		All licensed users
G41	FEI Nova NanoSEM 450 FEGSEM	990 20704	Licensed users only
G42	Thermo Fisher Scientific Verios 5 UC FEGSEM	990 20703	Licensed users only
G43	FEI Quanta 3D FEG FIBSEM	990 58787	Licensed users only
G44	Utility Room (Laboratory G43)		MCEM staff only
G45	Utility Room (Laboratory G42)		MCEM staff only
G46	Utility Room (Laboratory G41)		MCEM staff only
G47	Utility Room (Laboratory G36)		MCEM staff only
102	Computer Room	990 20723	All licensed users
103	Dr Tim Williams Microscope Scientist Tecnai TEM Manager	990 20721	Office
104	Dr Emily Chen Microscope Scientist	990 55348	Office
	Dr Zhou (Ben) Xu Microscope Scientist	990 56211	
105	Assoc. Prof. Laure Bourgeois Titan Manager	990 55368	Office
106	Dr Yang Liu Microscope Scientist FIB Manager	990 58789	Office
107	Dr Xi-Ya Fang Microscope Scientist SEM Manager	990 20821	Office
108	Assoc. Prof. Matthew Weyland Spectra φ Manager	990 59026	Office
109	Unisex Toilet		MCEM staff only
110	Research Fellows Office		Office



BUILDING ACCESS

The main entrance to MCEM is open from 8:45am to 5:30pm on normal University business days. This gives access to the General Office, Director's Office, Manager's Office, Toilets and the Meeting Room. Access to the main laboratory area is restricted.

COVID19

All people entering MCEM must comply with Monash University's Covid Safe Plan, see

https://www.monash.edu/ data/assets/pdf file/0010/2406790/COVID-Safe-Plan.pdf

Users will be advised of any additional procedures required by the special circumstances of the MCEM building by email and on the website.

Business-Hours Access

MCEM Users with business-hours access can use their Monash ID card to enter the Laboratory Area via the door in Reception from 8:45am to 5:30pm on normal university business days.

Business Hours bookings on equipment can be made between 9:00am and 5:00pm on normal university working days.

Only authorised personnel may enter rooms in the Laboratory Area unsupervised. Room access rights are summarised in Table 2.

Room	Authorised personnel
Microscope Laboratories	Trained ¹ microscope users.
Specimen Preparation Laboratory A	All trained users.
Gas Store	Must have completed the cryogenics induction.
Computer Room	All inducted users.
TEM Support Laboratory	All trained TEM users.
Polishing Room	People trained to use saws, grinding or polishing equipment.
Ultramicrotome Laboratory	Trained ultramicrotome users.
Electropolishing Laboratory	Proximity card access. Trained electropolishing users only.
Specimen Preparation Laboratory B	People trained to use equipment in this room.
All Utility Rooms	MCEM staff only.
Clean Workroom	MCEM staff only.

Table 2. Summary of room access rights.

¹Trained means the User has a current Supervised Use, Business-Hours or After-Hours licence for the equipment.



After-Hours Access

If you would like to work in the building outside normal business hours you can request afterhours access. With after-hours access you will have 24/7 access to the MCEM building except when Monash is closed during the end-of-year period.

For further information on After-Hours access please see page 61.

Visitors

A Visitor to MCEM must sign in and out using the book in Reception and must wear a Visitor Badge.

Visitors entering the Laboratory Area must be under the supervision of an authorised MCEM User at all times. On arrival the Visitor must contact the authorised MCEM User and wait to be picked up from Reception.

Visitors are not permitted to use any MCEM equipment. If you allow a Visitor to use MCEM equipment your access to MCEM will be revoked.

Use of Monash ID Cards

Please contact the General Office if you change your ID card so that we can ask Monash Security to activate your new card.

Monash Staff and students **must not** allow any other person to use their Monash University ID card. To do so is an extremely serious matter which could amount to conduct capable of disciplinary action. Staff and students who become aware of such misuse must immediately report the matter.

An MCEM User is **not permitted** to let anyone else into the Laboratory Area except for visitors under their direct supervision. This includes another MCEM User who didn't bring their ID card or someone who sneaks in behind while the door is open. Anyone without an ID card must contact an MCEM staff member who will check that they are a current User before letting them enter the Laboratory Area. In some special cases such as when a card is lost or damaged a fob may be provided for temporary use.

Tours

MCEM is a key research capability within Monash University and there are frequent requests for tours. Tours of MCEM are important and we try to accommodate these while minimising any disruption to Users. If you would like to arrange a tour of MCEM, please send a request to the MCEM role account <u>mcem@monash.edu</u>, preferably at least one week in advance. Please note that microscopes are heavily booked and that microscope doors are kept closed. Microscope operators have limited time to get their work done and cannot be interrupted. The earlier that MCEM is notified of a tour, the greater the chance that the tour will be able to include a visit to the major instruments.



ACCESSING MCEM

Enquiries regarding use of MCEM facilities can be directed to the MCEM role account <u>mcem@monash.edu</u>. Information can also be found on the MCEM website:

https://www.monash.edu/researchinfrastructure/mcem

iLab booking system

Monash uses the Agilent iLab booking system to manage access requests, equipment and service bookings:

https://monash.ilab.agilent.com/landing/63

How to access MCEM using iLab

Summary of access steps

Access steps are summarised below and are described in more detail following.

- 1. Register with iLab and select your Principal Investigator/Group (your supervisor);
- 2. Submit a New Project Request Form;
- 3. Attend a New Project Meeting to determine your microscopy and training needs (if you are a PhD student your supervisor must also attend).

How to register with iLab and request access to MCEM

An overview of the iLab registration process for PIs and Lab Members is given here: <u>https://www.monash.edu/__data/assets/pdf_file/0011/2069408/Monash-iLab-Registration-for-PIs-and-Lab-Members-2020-01-06.pdf</u>.

Principal Investigator (PI) Registration:

Each Principal Investigator (PI, Supervisor in the Monash context) must create a Laboratory/Research Group in iLab.

The Supervisor of a Project is responsible for authorising the work and for payment of any costs incurred such as for training, consumables, equipment use or the cost of repairing equipment damaged as a result of incorrect operation by the User.

It is best if the Laboratory/Research Group has been set up before laboratory members try to register with iLab. When a laboratory member registers with a Laboratory/Research Group the PI will receive a notification email from iLab requesting approval of the request. The email will provide instructions on how to approve the request, see:

https://www.monash.edu/__data/assets/pdf_file/0004/2069419/PI-Accepts-a-New-Lab-Member-2020-01-06.pdf

and how to assign Funds, see

https://www.monash.edu/ data/assets/pdf file/0006/2069430/PI-Assigns-a-Monash-Fund-Source-2020-01-06.pdf

- 2. Monash iLab administrator creates the Laboratory/Research Group and assigns the PI.
- 3. PI requests access to their fund(s) (this will be approved by the Monash iLab administrator).



Lab Member Registration

Lab Members must register with their PI's Laboratory/Research Group.

- 2. PI approves the Lab Member's access to their Laboratory/Research Group, see:

https://www.monash.edu/__data/assets/pdf_file/0004/2069419/PI-Accepts-a-New-Lab-Member-2020-01-06.pdf

3. PI assigns Fund(s) to be used by the Lab Member, see:

https://www.monash.edu/ data/assets/pdf file/0006/2069430/PI-Assigns-a-Monash-Fund-Source-2020-01-06.pdf

You can be a member of more than one laboratory.

Submit New Project Request Form

Using the "New User and Service Requests" tab, select "initiate request" next to "New Project Request - (NPR)" to start the New Project Request process. Complete and submit this request.

New Project Meetings are normally held on the second Tuesday of the month. Applications must be received 10 days prior to the meeting date to allow sufficient time for processing. Applications received after this time will be scheduled for the following month's meetings.

Your request will be processed and if necessary, a New Project Meeting will be arranged (your PhD supervisor must also attend).

It may become apparent during the New Project Meeting or after a subsequent feasibility study that MCEM equipment is not suitable for your work. In this situation we will try to refer you to another facility with more appropriate capabilities.

Access Steps for External Users

The procedure to be followed by someone external to Monash wanting to gain access to MCEM is essentially the same as detailed above but with two changes:

- Assignment of the Fund source by the PI is different, see: <u>https://www.monash.edu/__data/assets/pdf_file/0020/2070470/External-PI-Instructions.pdf</u>

Existing User: request new or additional Project

- 1. Login to MCEM on iLab.
- 2. Select the New User and Service requests tab.
- 3. Fill in and submit a New Project Request (NPR)
- 4. You will be contacted to discuss your new work.

In most cases an existing User requesting a new Project to undertake similar work to their previous Project will not need to attend a New Project Meeting. The User will need to discuss their new work with the relevant Equipment Managers and it may be necessary to arrange additional or refresher training.



For general iLab Help see <u>https://help.ilab.agilent.com/35322-getting-started/299372-welcome-to-ilab-help</u>

If you have any questions about iLab please contact the iLab Monash Institution Administrator:

mtrp-booking@monash.edu

After your Project Request has been accepted

Once your Project Request has been accepted you will be advised of your Project number and the relevant Equipment Manager(s) will arrange your training and/or Client work.

You will also be advised of any induction procedures that you must complete before being able to access MCEM.

Users are normally trained to do their own work, unless the amount of work involved is relatively small, or if the work is too complex. In this case it is more efficient for an MCEM staff member or another trained User to perform the work. This is called a Client work (see below).

Occasionally, an initial feasibility study may be carried out where there is some uncertainty in the Project. For example, to determine if it is possible to prepare a sample or to obtain useful information about a sample using MCEM equipment, or to find out more about the sample in order to determine the best microscopy method. Depending on the results the Project may: 1) proceed and arrangements will be made for the User to be trained; 2) may continue as Client work or 3) may not proceed.

Please also note that you will only be trained if you can make regular use of the equipment over at least several months following completion of your training. This is essential to consolidate your skills in operating the microscope following training.

The Equipment Manager(s) will contact you to arrange training or Client work as determined at the New Project Meeting.

Client work

Sometimes it is more efficient for an MCEM staff member or another trained User to carry out your microscopy work rather than for you to be trained to do the work. This is called Client work.

The Client User is expected to be present while their samples are being examined.

The need to carry out Client work may be identified at your New Project Meeting or during the course of your research using MCEM.

If the Client work is to be carried out by an MCEM staff member, the staff member can make a booking against your Project number.

If the Client work is to be carried out by someone else, for example, another member of your research group, then this person will not be able to book equipment against your Project number. In this case the person doing your Client work will need an additional Project that can be used to record work done on your behalf. In many cases Client work can be arranged without a formal New Project meeting.

Client work by MCEM staff must be appropriately acknowledged.

Projects

When you start using MCEM you will be allocated a **Project** number for your work. This Project number is used to track your use of MCEM facilities, for example microscope bookings.

Project records are needed for charging, OHS, to prepare usage reports and statistics (required by Monash and by various federal, state and other bodies as well as for grant applications for new equipment) and for other administrative functions.



Please note: Your equipment licence only entitles you to carry out your work as described, and on the materials specified, in your Project Request. You must notify MCEM of any significant changes to your work, for example, a need to look at different materials. The relevant Microscope Manager(s) will be able to provide advice on the safest and best ways to study your new materials and can arrange additional training if necessary.

The Project record includes the following information:

- Title
- User details
- Supervisor details (the person who has authorised the work including payment)
- Research goals/purpose
- Description of the work
- Funding sources and collaborators
- Sample details number, type, form, size, composition, hazards etc.

The purpose of the work and sample details help determine your initial microscope and sample preparation training needs. In addition, some materials may be hazardous to people or equipment, or may become hazardous when samples are prepared, so it is essential that appropriate MCEM staff members know what materials you are studying.

Project Rules

- 1. The Project number is needed when making a booking and when filling in equipment logbooks.
- 2. The iLab booking system only allows one person per Project but you can have more than one Project.
- 3. The Project must be closed and a new Project may be created if there is any significant change in the Project's information. Please report any changes promptly.
- 4. You cannot have more than one Project for the same purpose.
- 5. If you wish to undertake microscopy or other work on another person's materials the other person must have an active Project and you must submit a New Project Request for this Client work.
- 6. The Project's affiliation is that of the Supervisor.



TRAINING

MCEM instruments can only be used by trained and licensed Users. Your initial training needs will have been identified at your New Project Meeting and you may need additional or refresher training as your work progresses. A range of licence types are available, depending on your skills and needs (see below).

Training sessions will start with standard samples and are not intended to yield scientific results. Towards the end of training your samples will be examined so that you can be given advice on sample preparation and suitable initial microscope operating conditions.

Electron microscopy encompasses a number of difficult and complex techniques, each of which requires sustained and dedicated learning to master. Depending on the technique, this can take months or years. After you have completed your initial training you must then make regular use of the microscope over a period of some months to reinforce the training. Your training will not commence until you are able to commit the time necessary to reach a basic level of proficiency with the microscope and you have samples ready for examination.

By completing training to business hours level, you will attain a standard of skill necessary to undertake basic microscope operations safely and effectively during normal business hours when assistance is available from MCEM staff.

After you have been using the microscope for some time, typically at least several months, you may request training for an After-Hours licence.

Initial Electron Microscopy Training

Initial training on electron microscopes is as follows:

- 1. Read the microscope's User Guide and other training materials;
- 2. Attend microscopy lectures;
- 3. Complete training in basic microscope operation as detailed in the microscope's Training Checklist.

There are a number of assessment steps throughout the training procedure:

- 1. Open book 15-minute test on the microscope Users Guide.
- 2. Closed book test on material covered in microscopy lectures and training materials.
- 3. Practical test. The Microscope Manager will assess your competence to operate the microscope safely and effectively by observing your use of the microscope and considering feedback from trainers.
- 4. Licence ratification. You must make at least four bookings in the 3 months from the date of the Business Hours licence and must provide a short report to the Microscope Manager showing some of their microscopy results. Independent use of the microscope shortly after completion of training is essential to consolidate your skills. The short report also provides an opportunity to review the new User's ability and provide additional advice and/or training if required.

Advanced TEM Training

Experienced TEM users needing the advanced capabilities available on the aberration-corrected FEGTEMs should contact Dr Laure Bourgeois or Dr Matthew Weyland to discuss their microscopy needs.

Specimen Preparation and Support Equipment Training

MCEM has a wide range of equipment used to prepare samples for scanning electron microscopy and transmission electron microscopy. The initial specimen preparation techniques needed for your work will have been identified during your New Project Meeting.



Specimen preparation for microscopy can be a very complex and time-consuming process. The number of training sessions required may range from one or two for the simpler techniques such as using a punch to eight or more for the more difficult techniques such as electropolishing, ultramicrotomy and ion beam techniques. In some cases, you may need to contact other groups within the University to arrange access to specimen preparation equipment not available within MCEM.

Additional Training

After you have completed your initial training and as your work progresses, you may require additional training. This could be in the application of more advanced techniques, in the operation of other microscopes or in the use of additional specimen preparation equipment. To arrange additional training, please contact the relevant Equipment Manager, see MCEM website https://www.monash.edu/researchinfrastructure/mcem/facilities/staff-responsibilities.

Refresher Training

If you do not make regular use of licensed equipment your licence will lapse and you will not be able to make bookings or use the equipment. The period of time after which your licence will lapse varies depending on the complexity of the equipment but is typically 6 months. If your licence has lapsed you will need to take refresher training. Please contact the Equipment Manager (see MCEM website

<u>https://www.monash.edu/researchinfrastructure/mcem/facilities/staff-responsibilities</u>) who will book a session for your refresher training. The refresher training is usually quite quick. The purpose of the refresher training is both to ensure that you know how to correctly operate the equipment and to inform you of any recent changes in operating procedures. Once the refresher training has been completed your licence will be restored and you will be able to make bookings as normal.

Responsibilities

Responsibilities of the Trainer and the Trainee necessary for effective training are as follows.

Trainer's Responsibilities

• To teach the Trainee how to operate the equipment safely, effectively and without damage within a reasonable time.

Trainee's Responsibilities

- To comply with MCEM and University OHS policies and procedures.
- To always seek help if you are unsure of the correct operating procedure and to report any abnormalities with the equipment.
- To always follow the Trainer's instructions on the operation of the equipment.
- To take detailed notes.
- Where appropriate, to consult references to learn more about the techniques being taught. Centre staff members can suggest suitable references.
- To become proficient in operating the equipment.



CEM6881: Introduction to Scanning Electron Microscopy: Theory and Applications in Physical Sciences, and CEM6882: Introduction to Transmission Electron Microscopy: Theory and Applications in Physical Sciences

Introductory courses **CEM6881 and CEM6882** provide the basic theory to understand image formation and interpretation on a scanning electron microscope (SEM) and a transmission electron microscope (TEM) respectively. Practical training provides key competencies in instrument operations with a focus on selecting operating conditions, instrument alignment, image acquisition and qualitative X-ray analysis.

These courses are only available to Engineering students whose research Project requires training for independent operation of electron microscope within MCEM. This requirement will be determined by MCEM staff during your New Project Meeting.

The content of courses CEM6881 and CEM6882 is covered in the standard SEM and TEM training whether you are enrolled or not.

UNDERGRADUATE COURSE PRACTICAL CLASSES

At least 3 months' notice is needed prior to commencement of undergraduate course practical classes in order to guarantee availability of equipment and staff. Please contact the Manager to discuss your needs.

HONOURS AND 4TH YEAR PROJECTS

Supervisors proposing an Honours or 4th year project that requires use of MCEM facilities **must** discuss the feasibility of the project with the Manager before the project is offered to a student. There is not sufficient time during an Honours or 4th year project to train the student so the microscopy will need to be done by an MCEM staff member or by another MCEM User as a Client job. Please note that MCEM staff members have limited time available to carry out Client work.



EQUIPMENT LICENCES

MCEM facilities can only be operated by trained and licensed Users. A licence is also needed to make a booking (see Booking Rules). There are a number of different licence types depending on the needs and skills of the User, see below.

Your access to MCEM and your licences expire at the end of each year. You must submit an iLab MCEM Renewal Form at the end of the year to have your access and licences extended into the following year.

As discussed earlier, you must regularly use equipment to maintain your skills.

Experienced Business-Hours operators can apply to the Equipment Manager for an After-Hours licence.

Licence Types (iLab permissions)

Waiting: You are in the queue for training. If you expect to be trained on a particular piece of equipment you should check that you do have a Waiting permission in iLab. If not, please contact the MCEM role account <u>mcem@monash.edu</u> or the Equipment Manager.

Client: An MCEM staff member or another licensed MCEM User will operate the equipment for you. You will be expected to participate in the microscope sessions so that you can identify the features of interest in your sample.

Training: Under the direct supervision of a Trainer.

Supervised-Use: Under the supervision of a Trainer; Trainer will exchange samples, start up and shut down the microscope but you will operate the microscope and record your data (9:00am to 5:00pm on normal university business days).

Business-Hours: Unsupervised use of equipment (9:00am to 5:00pm on normal university business days).

After-Hours: Unsupervised use at any time that the University is open.

Trainer: After-Hours licence plus authorised to train Users.

Manager: Trainer licence plus can grant a new licence.



BOOKING INFORMATION AND RULES

It is essential that you understand and follow the Booking Rules. Failure to follow these rules may result in a reduction or suspension of booking entitlements or loss of licence.

Bookings are made using the iLab booking system. Login to iLab (<u>https://monash.ilab.agilent.com/landing/63</u>), go to the MCEM site and select the "Book Equipment" tab. Over 25 items of specimen preparation equipment can be booked in addition to the electron microscopes.

Electron microscopes and some specimen preparation equipment must be booked and some other equipment may be booked to ensure access at a particular time. Some equipment cannot be booked, either because it is always available or it is for staff use only.

The equipment booking requirements are summarised in Table 3. Items in red can only be used during normal business hours.

Table 7 Equipment beaking requirements Items in red can only be used during bus	
Table 5. Equipment booking requirements, items in red can only be used during bus	siness nours.

Equipment	Booking requirement
All electron microscopes	Must be booked
Atom Probe Tip Polisher	Must be booked
Gatan 691 PIPS 2	Must be booked
Gatan 695 PIPS II	Must be booked
Leica EM FC7 cryo-ultramicrotome	Must be booked
Mbraun Unilab Pro glovebox	Must be booked
Nikon Eclipse Ni optical microscope	Must be booked
Reichert Ultracut S Microtome	Must be booked
Struers Accutom-100 saw	Must be booked
Struers Lectropol	Must be booked
Struers Tegramin-30	Must be booked
Tenupol 3 or 5	Must be booked
Allied Techprep	May be booked to ensure access
Branson Sonifier 450	May be booked to ensure access
Buehler Ecomet 3000 grinder-polisher	May be booked to ensure access
Buehler Isomet low speed saw	May be booked to ensure access
Cryo Fracture	May be booked to ensure access
Gatan 685 PECS	May be booked to ensure access
Gatan Model 656 dimple grinder	May be booked to ensure access
Leica M165 C optical microscope	May be booked to ensure access
Olympus BX51 research microscope	May be booked to ensure access
Olympus SZX16 stereo microscope	May be booked to ensure access
South Bay Technology Model 850 wire saw	May be booked to ensure access
Wire saw	May be booked to ensure access
XEI Evactron Zephyr plasma cleaner	May be booked to ensure access
Fischione Model 1070 Nanoclean	Always available, cannot be booked
Gatan Solarus 950 plasma cleaner	Always available, cannot be booked
Cressington 208HR sputter coater	Staff only
Cressington C coater	Staff only



Booking rules

- 1. Bookings can be made up to 14 days in advance, this is called the "days in advance" period.
- 2. There is a minimum and a maximum booking time and a fixed booking time step. This will limit the available booking times. For example, with minimum 4hr, maximum 8hr and time step 4hr only 4hr and 8hr bookings are possible. Different items of equipment may have different time settings and these times may be varied in response to equipment demand.
- 3. There is a Usage Cap on the total amount of time that you can book within the days in advance period. For example, if the Usage Cap is 4hr, the minimum booking time is 2hr and maximum booking time is 4hr you could have one 4hr booking or two 2hr bookings. Different items of equipment may have different Usage Caps and the Usage Caps may be varied in response to equipment demand.
- 4. There is an "hours in advance" period which limits when you can make a booking. This is currently set to 0hr. If the Usage Cap was 4hr and you had a 4hr booking you could make another booking as soon as the booking time is reached. If the equipment is available you can extend your session but you must book this additional time.
- 5. There is no limit on how much time you can book, access to the equipment is only limited by its availability.
- 6. You must start and finish your session on time so that other Users are not inconvenienced. If you are more than 30 minutes late in starting your session the booking may be reassigned to another User. Persistent failure to make full use of the booked time may result in a reduction or suspension of booking entitlements.
- 7. Equipment can only be used by the person who booked it for the work described in the Project assigned to the booking.
- 8. Equipment bookings are NOT transferable.
- 9. You must fill in the equipment log book at the start and end of your session. Please note any unusual conditions or equipment problems. Please report any serious problems to the Equipment Manager.

There are limitations on the permitted start time for TEM bookings during business hours as shown in Table 4.

Booking length	Permitted start time
2hr	9:00am, 11:00am, 1:00pm or 3:00pm
4hr	9:00am or 1:00pm
8hr	9:00am

Table 4. TEM business hours permitted start times

Your first equipment booking after training must be confirmed by the Equipment Manager. If necessary, the Equipment Manager will arrange for an MCEM staff member to attend your sessions to provide assistance.

Please contact the Equipment Manager if you urgently need extra time or if you need a longer than normal booking for a special purpose, for example, if you are not based on the Clayton campus. At times of high demand, it may not be possible to make extended or additional bookings.

There is very heavy demand for access to MCEM equipment. Please observe these simple rules so that we can optimize access for everyone.



CHARGES

Internal charges

An **internal** university Project is one that only involves Monash staff and/or students, or has external collaborators and the Monash participants will be co-authors on publications.

The internal charge rate applies to:

- 1. Use of microscopes by Monash staff and postgraduate students who are working on **internal** university Projects;
- 2. Collaborative work with an external researcher intended for publication with a Monash coauthor.

There is no charge for undergraduate work (Honours and 4th year projects, prac. classes etc.).

There is a cap on the total annual charge against a Project and a one-off charge of \$500 for new user training.

The internal charge rates and Project caps for 2023 is summarised in Table 5.

Table 5. Internal charge rates and Project caps for 2021-2023

Year	Internal charge/hr	Project Cap
2023	\$46	\$2,800

There is no additional charge for any subsequent training or assistance or for reasonable use of basic specimen preparation equipment and basic consumables.

Consumables

MCEM can supply a range of commonly used consumables such as TEM grids with various support films, TEM storage containers, special-purpose SEM holders and storage containers, tweezers, agate pestle and mortar, diamond lapping film and polishing pads. These items can be ordered using the Consumables service request in iLab.

A basic set of ultramicrotome diamond knives are provided for general use but regular ultramicrotome users may prefer to purchase their own. Users may also need to provide their own diamond saw blades and diamond polishing pads.

There is no charge for a reasonable amount of Client work carried out by an MCEM staff member on behalf of a Monash User (other than for microscope time) but the amount of this type of work that can be undertaken is limited.

This internal charge rate represents a small fraction of the real cost of maintaining and operating these multi-million-dollar instruments, the cost of providing expert staff to train and support users and the on-going cost of replacement equipment. The rate is very heavily subsidised by the University and is comparable or less than that charged by other Go8 universities.

External charges: publicly funded researchers

The charge rate for use of any microscope except the FEI Titan aberration-corrected TEM by an Australian publicly funded researcher is \$150/hr (ex-GST). The charge for use of the Titan TEM is provided on a case by case basis.

There is an additional charge for staff time in accordance with the Monash Consultancy Rates.

External publicly funded research undertaken in collaboration with a Monash partner and intended for publication with a Monash co-author may be charged at the internal rate.



External charges: commercial entities

Monash University must charge full commercial rates for work done by or on behalf of commercial entities under the Competition and Consumer Act administered by the Productivity Commission (PC) (see <u>https://www.pc.gov.au/about/core-functions/competitive-neutrality</u> and https://www.pc.gov.au/competitive-neutrality/research). External commercial work is managed using iLab. External Users should contact the Manager to discuss their microscopy needs.

Please note that negotiations for external work can be very involved and time consuming, particularly when intellectual property rights are involved. Undertaking external work at the internal charge rates may be both a breach of University policy and illegal under the Competition and Consumer Act. Monash Users planning to undertake externally funded research **must** discuss this with the Manager prior to commencing negotiations or submitting a grant application to ensure that MCEM has the capabilities and resources to support the work.

All research projects including grant applications must use the Monash Tiered Pricing Model for costing and pricing, see

https://www.intranet.monash/finance/our-services/research-finance/research-pricing-and-costing



PUBLICATIONS AND ACKNOWLEDGEMENTS

Your use of the MCEM is heavily subsidised by the University and by grants from funding agencies. To comply with internal and external reporting obligations and to apply for new funding, MCEM must report on the number and type of publications produced using the Centre. It is essential that we have this information so that we can continue to provide the advanced instrumentation, staff, training and assistance that you and other researchers require to undertake your work.

It is a condition of use of MCEM that:

- 1. You acknowledge MCEM and any significant assistance provided by MCEM staff members in your publications;
- 2. MCEM staff members who made a significant scholarly contribution should be co-authors on the publication, in accordance with Monash's Research Authorship And Attribution Policy, see

https://www.monash.edu/ data/assets/pdf file/0006/797253/Authorship-Policy.pdf

Please acknowledge MCEM in your publications by including:

"The authors acknowledge the use of instruments and scientific and technical assistance at the Monash Centre for Electron Microscopy (MCEM), Monash University, the Victorian Node of Microscopy Australia."

Or, if the work was carried out with help from MCEM staff (but not enough to justify coauthorship):

"The authors acknowledge the use of instruments and scientific and technical assistance of NAME OF MCEM STAFF MEMBER(S) at the Monash Centre for Electron Microscopy (MCEM), Monash University, the Victorian Node of Microscopy Australia."

In addition, specific instruments funded by the ARC (see Table 6) must be acknowledged as follows:

"This research used equipment funded by Australian Research Council grant(s) (select from table below)."

Table 6. MCEM instruments funded by the ARC

FEI Titan	ARC Funding (LE0454166)
FEI Quanta 3D FIB	ARC Funding (LE0882821)
FEI Tecnai G2 F20 S-TWIN FEGTEM	ARC Funding (LE110100223)
Delmic SPARC Cathodoluminescence system	ARC Funding (LE140100104)
Thermo Fisher Scientific Spectra ϕ FEGTEM	ARC Funding (LE17010118)
Thermo Fisher Scientific Helios 5 UX FIBSEM	ARC Funding (LE200100132)

Publication references can be sent to the to the MCEM role account mcem@monash.edu.



MICROSCOPE CALIBRATION AND CHARACTERISATION

It is your responsibility to ensure that the microscope is fit for your purposes and to carry out any calibration or characterisation measurements necessary for your work.

Electron microscopes are capable of achieving remarkable magnification, up to several million times for a transmission electron microscope (TEM) and around half a million times for a scanning electron microscope (SEM). However, at best the accuracy of the indicated magnification or camera length will be 1%, more typically 5% and in some circumstances worse than 10%. It is difficult to calibrate an SEM above 50,000 times magnification as there are few suitable standards.

Electron microscopes can be operated with a very wide range of conditions, for example, you can vary the accelerating voltage, beam current, magnification and focus. It is not possible to calibrate the microscope under all possible operating conditions. The calibration is done at a few fixed settings and the microscope then estimates the magnification at other settings by interpolation or extrapolation.

The accuracy of the magnification calibration at the fixed settings is usually about 2%. Note that for a scanning mode the X magnification and Y magnification are calibrated independently and so will be a little different, and that the angle between the X and Y scan directions may not be exactly 90 degrees. A scanning microscope also makes complex calculations to correct the beam position for image rotation caused by changing the strength of focussing lenses. This ensures that the X and Y beam scan directions are close to but not exactly the same as the X and Y stage movement directions. The SEM must make dynamic magnification, focus and scan rotation corrections when observing a highly tilted sample such as for EBSD. The image of a tilted sample is likely to suffer from distortion and to be less well focussed in places.

A TEM is often fitted with multiple cameras and various STEM detectors each requiring calibration.

There are many important microscope parameters that need to be considered, some of these are listed below:

- Magnification/camera length
- Focus (SEM working distance)/defocus (TEM)
- Image distortion/linearity
- Accelerating voltage
- Beam current
- Resolution/probe size
- Rotation between diffraction pattern and image
- Convergence angle
- Acceptance angle for detectors
- Energy calibration of detectors (EDX, EELS, CL...)
- X-ray analysis standards
- Dark current and flat field corrections for cameras
- Detector sensitivity
- Stage temperature
- Rotation between X and Y scan directions and X and Y stage movement directions

The Microscope Manager can provide advice on calibration and characterisation of particular microscope parameters needed for your research.



STORAGE OF SAMPLES AND MATERIALS

MCEM Users are not permitted to store samples or other materials in the building.

MCEM operates on a "Carry-in/Carry-out" basis. It is assumed that anything left behind is not needed and after one week these materials will be disposed of.

Samples and sample preparation materials labelled with the User's name, telephone number, date and composition can be left in designated areas within the specimen preparation laboratories for short periods while samples are actually being made. Users are not permitted to store samples or other materials within the building.

MCEM staff members can assist you if you need to store or transport your samples under special conditions, for example, vacuum or inert gas.

COMPUTING

Computer room

You **MUST NOT** install or run new software on MCEM computers. Please contact the Manager if you need to use a new program, it may be possible to have this software installed.

Computer Room computers are only to be used for data processing and analysis. They are not general use computers.

Please use the "Computer in Use" form to let people know when you are running a long calculation. Programs running on unattended computers will be closed.

Some special-purpose computers have restricted access.

TeamViewer has been installed on most computers in the Computer room to allow remote access. Please contact the Manager if you need remote computer access.

You are not permitted to use TeamViewer or any similar software running on an MCEM computer to remotely access an external computer.

Microscope Managers are able to use TeamViewer and Zoom to enable Users to participate remotely in microscope sessions.

Eduroam wireless network

In Australia AARNet supports eduroam, a secure global roaming wireless network for the research and education sector.

• eduroam (<u>https://monash.edu/esolutions/network/connect-eduroam-wifi</u>) – for all Monash staff and students and visitors from other eduroam institutions.

Data storage and transfer

Storage and security of your data is your responsibility.

Data can be lost at any time due to hardware or software faults, or User error.

In general, you should not leave your data on MCEM computers. However, in some circumstances where you need access to your data during subsequent microscope sessions, or for data processing and analysis, files can be left on an MCEM computer.

Each microscope Support Computer and Computer Room computer has a local 'Shared_Data' or 'UserData' folder in which you can create a sub-folder for your temporary use. **The sub-folder name must be your first name or initial and surname followed by your Project Number so that we can identify the owner of the data, for example: 'J Bloggs 21006'.**

Folders not conforming to this format or created elsewhere including the desktop will be deleted.



Please delete all of your data from MCEM computers when it is no longer needed.

A new shared data folder is created each year and data from previous years may be deleted to free up storage. It is your responsibility to move any data that you wish to keep on an MCEM computer into the current year's folder.

Use of USB devices is not permitted due to the risk of infection by malicious software. You can write your data to DVD or CD or you can transfer your data to your computer via the shared N: drive. You can access the shared N: drive from the equipment computer and from your personal computer, see instructions below.

N: Drive

The N: drive is shared network storage supported by eResearch. You can use this drive to transfer data between MCEM computers and your computers.

Instructions on how to map the N: drive on Windows 10 and Mac computers can be provided upon request.

Rules of use for the shared network (N:) drive:

- 1. The shared network (N:) drive must only be used for transfer of data generated within MCEM between MCEM computers and your computers.
- 2. Each microscope and some other equipment have their own 'Shared' folder on the N: drive where you can create a sub-folder to hold your data. Do not create folders elsewhere. The sub-folder name must be your first name or initial and surname followed by your Project number so that the owner of the data can be identified. For example: 'J Bloggs 21006'. Folders that do not conform to this format will be deleted.
- 3. The shared network drive must not be used for long-term data storage. Please note that files on this drive are accessible to all MCEM Users (400+ people). These files are not secure or confidential and a hardware or software fault, or an unintentional or deliberate act could result in the loss or corruption of some or all of your data. In addition, eResearch does not scan files on this network drive for viruses or malware.
- 4. All files on the N: drive are temporary; it is your responsibility to ensure that you have secured your data. All files on the N: drive are deleted at the end of each year.
- 5. Please ensure that no filename (including the full pathname) exceeds 260 characters in length.

SAFETY RULES AND LABORATORY PROCEDURES

It is essential that you understand and follow MCEM's Safety Rules and Laboratory Procedures. These general rules and procedures apply to all people working in MCEM laboratories. You will be instructed in any additional rules and procedures that apply for specific items of equipment or procedures as part of your training, for example, handling liquid nitrogen or electropolishing.

For information regarding OHS Risk Management at Monash University, see the Monash OHS Web Page: <u>http://www.monash.edu/ohs/index.html</u>

Any occurrence that leads to or *potentially* leads to injury or danger to health must be reported to the Safety Officer, Dr Russell King or the Manager/Safety Officer, Dr Flame Burgmann. A Hazard and Incident Report must be submitted online to the Safety Analysis and Risk Analysis Hub (SARAH+), see Monash OHS website.

Failure to comply with MCEM Safety Rules and Laboratory Procedures may result in a penalty being imposed. Penalties include warnings, reduction in licence level, temporary loss of licence, permanent loss of licence and permanent loss of access to MCEM.

OHS Responsibilities Workers

The following is extracted from Section 2 of Monash University Procedure "OHS Roles, Responsibilities and Committees Procedure" (see

https://www.monash.edu/ data/assets/pdf file/0005/129614/OHS-roles-responsibilities-andcommittees-procedure.pdf

Each worker at Monash University is responsible for ensuring that:

2.1.1 Their conduct, whilst participating in Monash University related activities, protects their own health and safety together with the health and safety of any other persons.

2.1.2 They comply with any reasonable health and safety related direction given by someone with the appropriate authority to do so.

2.1.3 Health and safety related hazards and incidents have been reported in a timely manner to the most appropriate manager/supervisor in accordance with the Managing OHS Hazards and Incidents Procedure.

2.1.4 They complete all OHS related training in accordance with the OHS Training Requirements Matrix as directed by their Performance Manager.

Risk Assessments

Risk Assessments have been carried out on all equipment and procedures used within MCEM and Safe Work Instructions (SWI) have been written to manage any hazards identified. Risk Assessments and Safe Work Instructions are available in SARAH and as hard copies in the laboratories.

It is your responsibility to ensure that you have carried out a Risk Assessment to identify any hazards associated with your sample materials and sample preparation/handling methods.

If your work involves a hazard with risk medium or higher and a SWI covering this work is not already available (for example, there are many SWI's available for electropolishing) then you must prepare a SWI, see https://www.monash.edu/ohs/info-docs/risk-management-and-work-safe-instructions. MCEM staff members may be able to advise you about risks associated with managing non-biological samples.

All SWIs must be checked and counter-signed by an MCEM Safety Officer.

Dangerous Goods and Hazardous Substances are used in the building. Safety Data Sheets (SDS) for all chemicals used in the building can be accessed using ChemWatch. A computer is provided for this purpose in Specimen Preparation Laboratory Room G35.



Laboratory Use

- If in doubt, always seek help!
- You must comply with any temporary notices or tags that may be used from time to time in MCEM. For example, Do Not Operate notices and warnings of changed operating conditions due to equipment faults.
- You may only operate equipment for which you hold a valid licence.
- Doors and emergency exits must be kept clear.
- No running in the building.
- Do not tamper with fire extinguishers, first aid kits and other emergency equipment.
- MCEM is equipped with very sensitive smoke and fire detectors. Any work that may generate smoke or dust must be carried out under a fume extraction hood or in a fume cupboard.
- Only authorised personnel may enter rooms in the Laboratory Area unsupervised. Room access rights are summarised in Table 2.
- No food or drink may be stored or ingested in any laboratory.
- Equipment logbooks must be filled in at the start and end of a session. Note any unusual conditions or equipment problems and report these to an MCEM staff member.
- You must follow the Operating Procedures provided with each piece of equipment and you must comply with all Laboratory Operating Procedures.
- Access to the electropolishing room is restricted by proximity card access and is strictly limited to licensed Users of electropolishing equipment and trainees under direct supervision.
- Never attempt to repair any equipment. If equipment is not functioning as you expect, seek help! Any problems, faults, or unusual behaviour must be reported in sufficient detail in the logbook. Names of MCEM staff members responsible for laboratories can be found on the Laboratory Protocol sheets. Names of MCEM staff members responsible for equipment can be found in Operating Procedures and on the MCEM website https://www.monash.edu/researchinfrastructure/mcem/facilities/staff-responsibilities.
- No items of equipment, tools or consumables can be removed from the room in which they belong without the permission of an MCEM staff member.
- Clear and clean your work area when finished. Glassware must be cleaned immediately after use.
- Samples and sample preparation materials labelled with the User's name, telephone number, date and composition can be left in designated areas within the specimen preparation laboratories for short periods while samples are actually being prepared.
- It is assumed that anything left behind is not needed and after a short grace period, these materials will be disposed of.
- Keep benches, sinks, and fume hoods clean and clear of clutter.
- You are not permitted past the yellow with black striped "Restricted Area" tape on the floor in microscope rooms.



Microscope Laboratory Doors

All microscope laboratory doors must be kept closed for the following reasons:

- TEMs are operated with subdued or no lighting;
- To ensure thermal stability of microscope rooms. (Microscope laboratories have special designs to enable better than 0.1°C/hour to optimise microscope performance);
- To keep out dust. (Microscope laboratories have special air flows and filters to minimise dust in order to protect the microscope and your specimens);
- To provide acoustic isolation to prevent degradation of microscope performance by outside noise.

Room in use light

You must turn on the 'Room in use' light while you are using a microscope. Please turn off the 'Room in use' light at the end of your session

If the 'Room in use' light is on you must knock before entering a room and wait to be admitted. The microscope rooms have very good acoustic shielding and so you often will not be able to hear the microscope User's reply to your knock. *If the microscope User does not respond you may not enter as they may be conducting a sensitive measurement.*

After-Hours Operation

MCEM business hours are between 8:45am to 5:30pm on normal university working days.

The University is closed Christmas to New Year and only approved MCEM staff members may enter the building during this period.

People in the building outside business hours must have After-Hours access or must be under the direct supervision of someone with After-Hours access.

An After-Hours licence is required to use equipment outside normal business hours.

Tenupol electropolishing and cryogenic ultramicrotoming are classed as hazardous procedures and are not allowed to be undertaken outside normal MCEM business hours.

Security Procedure

An additional After-Hours security procedure applies:

- Between the hours of 8:00pm and 7:00am on normal University working days;
- Anytime on weekends or university holidays.

All people in the building during this period must fill in the After-Hours Logbook in Reception and must ring Security (27777) on arrival and departure.

In the event of a fire alarm after hours, make the equipment safe (if safe to do so) and evacuate the building on the first fire alarm (Orange light, Beep-Beep alarm). Do not re-enter the building until you are advised that it is safe to do so by a University security staff member or MCEM staff member.



Personal Protective Equipment and Clothing

- Personal Protective Equipment (PPE, e.g. laboratory coats, long trousers, protective aprons, safety glasses, full-face safety shield, gloves...) must be worn wherever indicated.
- Personal protective equipment zones in specimen preparation laboratories are indicated by the yellow tape markings on the floor. All work completed within these zones requires the use of laboratory coats, safety glasses and gloves.
- Due to the COVID19 situation all users must bring their own safety glasses and laboratory coats when carrying out work that requires these items.
- Individual sets of PPE stored in the building have been provided for people using cryogenic liquids (face shield and leather gloves) and undertaking electropolishing (face shield and chemically-resistant apron, gloves and long gloves).
- Closed footwear must be worn in all laboratories.
- Disposable nitrile gloves of various colours are provided in laboratories.
- Black gloves are worn for your protection when handling hazardous materials such as electropolishing solutions, solvents, resins or other chemicals. These gloves must be removed and disposed of before you leave the room. Do not touch door handles or any other communal items while wearing gloves that may be contaminated.
- Coloured gloves (colour other than black, for example, blue, pink, green...) are used during the final stages of sample preparation and when handling items that will go into the microscope vacuum such as sample holders. Coloured gloves do not have to be removed when you leave the room as you may need to carry a sample between the sample preparation room and the microscope room.
- Personal protective clothing and equipment must not be worn in office areas or meals areas.

Fume Cupboards

Work with the sash only open far enough to perform the procedure comfortably.

Do not leave any unnecessary glassware, chemicals, equipment in the fume cupboard.

Never use a fume cupboard if the extraction fan or backwash are not working. Report any faults <u>immediately</u> to an MCEM staff member.

For further information on use of fume cupboards see <u>https://www.monash.edu/ohs/info-docs/safety-topics/chemical-management/use-of-local-exhaust-ventilation-systems-fume-cupboards</u>

Samples and Chemicals

MCEM's standard procedures for handling and preparing samples are only suitable for nonhazardous materials. You must carry out a Risk Assessment (see <u>https://www.monash.edu/ohs/info-docs/risk-management-and-work-safe-instructions</u>) and must prepare Safe Work Instructions for your work. You must inform MCEM of all hazards associated with your work, ideally at the New Project Meeting. MCEM staff members may be able to assist you with this.

Examples of hazardous materials include:

- Carbon fibres
- Nanoparticulates and nanofibers
- Samples containing toxic elements such as As, Be, Cd, Cr (VI), Hg, Pb, TI



- Samples containing radioactive materials such as Ra, U, Th
- Any sample containing biological material

Safety Data Sheets (SDS) for each chemical stored or used in an MCEM laboratory are kept in the master SDS folder located in Room G35 or can be assessed online using ChemWatch from a computer (Nikon optical microscope) located in Room G35. Ensure that you read the SDS for all chemicals that you will use. A glossary of terms used in the SDS forms is located in each folder.

You must complete the online course available in myDevelopment: "Chemwatch SDS and Chemical Register application".

Only those chemicals listed for each laboratory in the front of the master SDS folder may be stored or used in MCEM.

You MUST NOT bring any chemicals into MCEM without permission. Please contact the Safety Officer of Manager if you need to bring a chemical into the building. If it is a new chemical then it must be added to MCEM's ChemWatch register and it will be necessary to carry out a Risk Assessment.

You must not transport chemicals between laboratories. If this is necessary, for example, low supply level, contact an MCEM staff member who will arrange transport of the chemical.

The following chemicals are strictly BANNED from MCEM.

- Hydrofluoric Acid
- Perchloric Acid/Acetic Anhydride mixes
- Nitric Acid/Ethanol mixes

Electropolishing solutions are potentially explosive and must be handled under highly controlled conditions to minimize the risk of explosion. (Several deaths have been reported worldwide from exploding solutions.) <u>Only licensed electropolishers</u> are permitted to handle the electropolishing solutions and washing methanol that are stored in G37.

Access to the electropolishing room G37 is by Proximity Card and is strictly restricted to licensed electropolishers and trainees under direct supervision.

Engineered nanoparticles (ENPs)

There is very little information on the safety of Engineered Nanoparticles (ENPs) but as some of these will be dangerous to health the best practice is to treat all ENPs as toxic substances unless a specific nanoparticle SDS is available.

The most dangerous ENPs are likely to be those that are not soluble in water. They cannot be eliminated from the body and therefore have a very long biological persistence. Carbon nanoparticles and most metal oxides fall into this category. Studies of carbon nanotubes have shown that some of them have dimensions that are similar to asbestos fibres and produce similar effects under experimental conditions.

Materials that are not hazardous on the micron scale may prove to be hazardous as nanoparticles due to their novel properties. Gold is an example of an ENP with novel properties. Although gold in its bulk form is unreactive, gold nanoparticles in the 2-5 nm size range are highly chemically reactive. SDS sheets for the bulk material may therefore be unreliable, hence the need for specific SDS that relate to the nanoparticulate form.

For hazardous substances the high surface area and number density of the ENP form may mean that safe exposure limits based on weight may not be appropriate.

Inhalation, ingestion, and permeation through damaged skin or wet membranes (i.e. eyes) are the most likely routes into the body.



Handling ENPs

Dry ENPs must be handled inside a fume cupboard to prevent inhalation.

Gloves and safety glasses must be worn when handling dry or liquid suspensions of ENPs to prevent skin or eye contact.

Biological materials

The MCEM laboratories broadly meet the requirements for a PC1 Laboratory but are not certified as a PC1 laboratory and do not have PC1 hazard signs.

MCEM cannot be used to study biological materials requiring a laboratory rating of PC2 or higher. The Ramaciotti Centre is an accredited PC2 laboratory.

The following is extracted from Monash's "Using Biologicals and Animals Procedure", see <u>https://www.monash.edu/__data/assets/pdf_file/0006/147156/using-biologicals-animals-procedure.pdf</u>. Basically, only microorganisms in Risk Group 1 can be examined in MCEM.

5. Microorganisms

5.1. Risk Groups

Microorganisms are divided into risk groups 1 (lowest risk) – 4 (highest risk) based on their risk to health and safety.

- A list of risk group 2, 3 and 4 organisms can be found in AS2243.3, section 3.3 (Tables 3.1-3.11).
- The risk group classification has been established to match the physical containment level of the facility where the work is to be conducted, e.g. risk group 2 organisms must be handled in a PC2 facility.

and

12. Risk Management

Risk management must be completed on all processes/procedures/activities that involve biologicals and/or animals in accordance with the OHS Risk Management procedure.

MCEM staff members are not able to assess the risk of biological materials and are not able to assist you with processing of these materials, either to make the samples suitable for electron microscopy or to make them safe to handle. You will need to do this. The Ramaciotti Centre may be able to provide some assistance.

If you wish to study biological materials using MCEM then either you need to demonstrate that the materials are not covered by Monash's "Using Biologicals and Animals Procedure", for example, wood or milk powder, or you need to follow Monash's OHS Risk Management procedure and provide a reference to your SARAH Risk Assessment for your work which must show that the materials to be examined in MCEM are rated as Risk Group 1.

Spills procedures

Chemical spill kits are located in rooms G35, G37 and corridor G48 (East corridor).

Chemical spills requiring clean-up are classified as Incidents and must be reported immediately to a Safety Officer or other MCEM staff member.

Spills involving electropolishing solutions require special cleaning procedures detailed in the "Safe Working Procedures" for electropolishing solutions and *must be handled by licensed electropolishers or members of the Breathing Apparatus (BA) team*. Licensed electropolishers may only clean up minor spills less than 50 ml. Larger spills must be cleaned up by the Breathing Apparatus team.



Glass breakages and sharps

Broken glass and sharps must be disposed of in the broken glass container in Room G35.

Safety showers and eye wash facilities

Safety showers and eye wash facilities are located in Rooms G27, G35, and G37.

Supply and disposal of chemicals

The Centre will arrange for the supply and disposal of all chemicals used for sample preparation and other purposes. You will receive instructions on waste disposal as part of your training to operate equipment and/or carry out procedures.

Storage cabinets are available to segregate different classes of chemicals (refer to SDS for class). Store all chemicals in the appropriate cabinet.

Label all chemicals, reagents, samples and wash bottles. Labels on working solutions and preparations must include the chemical composition and product name, the preparation date, expiry date (if appropriate) and the owner's name and telephone number.

Waste solvents and expired washing methanol in G37 are to be placed in a 10L waste solvent container in Room G37 flammable storage cabinet.

Waste solvents in Room G35 are to be placed in the 2.5L waste solvent container in the flammable storage cabinet.

MCEM uses Cleanaway for chemical waste disposal.

Ergonomics

Operating an electron microscope may involve long periods of sitting. Please adjust your chair and workstation for comfort, close your eyes or focus on something distant every 15 minutes or so and get up to stretch and move about every 30-60 minutes. For further information on ergonomics see websites <u>https://www.monash.edu/ohs/info-docs/safety-topics/ergonomics</u> and <u>https://www.monash.edu/</u> <u>data/assets/pdf file/0020/147044/Office-Ergonomics-guidelines.pdf</u>.



EMERGENCY RESPONSE

In an emergency the most important things are to ensure your safety and the safety of others.

Please report any emergency situations as quickly as possible.

There is an emergency break glass alarm on the Fire Indicator Panel door in the entrance foyer.

Emergency Evacuation

Evacuate the building on hearing or seeing any alert or evacuation alarm:

- ALERT tone (Beep Beep ...) or seeing the flashing orange ALERT light;
- EVACUATION tone (Whoop Whoop) or seeing the flashing red EVACUATION light.

If safe to do so, put the equipment into a safe state, for example, close microscope column isolation valve.

Close but do not lock office/laboratory doors as you leave.

Leave the building by the nearest safe exit. If working after hours and it is safe to do so, fill in the log book as you leave so that emergency services know that you have left the building.

Proceed to the ASSEMBLY AREA which is to the East of 15 Innovation Walk (Building 75), see Figure 4.

Follow instructions given by Floor Wardens (Yellow Hats).

Remain at the ASSEMBLY AREA until an MCEM Warden or Monash Security staff member gives the ALL CLEAR.

Contacting emergency services

If emergency services (Ambulance, Police, Fire Brigade) need to be contacted:

immediately dial 000 from your mobile telephone

As an alternative, you can dial 0000 from a university telephone with access to an outside line (Foyer and Specimen Preparation Laboratory G35).

The decision to call emergency services is at your discretion. State:

- Nature of Emergency
- Location 10 Innovation Walk (Building 81)
- Nearest room number
- Your name

Once the required emergency service has been contacted you must notify Monash Security on **9905 3333 (Telephone/Mobile) or 333 (Red Phone)** in order that the emergency services can be escorted to the scene by security staff in a timely manner.

For less urgent matters you can ring the Security on **990 27777**.



Emergency evacuation plan



Figure 4. Emergency evacuation diagram.

Firefighting measures including location of extinguishers

MCEM is supplied with ABE dry powder fire extinguishers (white band at top) suitable for normal combustible materials, flammable liquids and electrical fires (Room G38, Entrance foyer) and CO₂ fire extinguishers (black band at top) suitable for flammable liquids and electrical fires (all other locations).

Fire extinguishers

- Room G38 (Gas Store, ABE Powder)
- Room G10 (Tea Room, CO₂)
- Corridor outside Room G20 (FEGTEM Operators Room, CO₂)
- Corridor opposite Room G38 (Gas Store, CO₂)
- Corridor outside Room G43 (next to FEI Magellan SEM Room, CO₂)
- Fire Hose Reel cupboard in Room G02 (Entrance foyer, ABE Powder)
- Inside Fire Hose Reel cupboard next to mezzanine tea point, CO2
- Room 110 (Research Fellows' Office, CO₂)

Hose reels

Hose reels are located in the entrance foyer, in the corridor near the loading bay entrance and on the mezzanine level near the tea point.



Fire blankets

Fire blankets are located in Room G35 and Room G38.

Break glass alarm

There is an emergency break glass alarm on the Fire Indicator Panel door in the entrance foyer.

Power failure

Microscopes are powered by Uninterruptible Power Supplies (UPS) backed up by a generator and will continue to operate in the event of a power failure. However, all other services such as general power outlets, lighting, network, telephones and air conditioning will fail. Emergency torches are provided in microscope rooms.

In the event of a power failure lasting more than about one minute you must put the equipment into a safe state (for example, close microscope column isolation valve) and leave the building. You must not re-enter the building until a Centre staff member advises you that it is safe to do so.

YOU MUST NOT ENTER OR REMAIN IN THE BUILDING WHILE THE AIRCONDITIONING IS INOPERATIVE (see Compressed Gases).

Emergency power shut off procedure

Emergency stop buttons

Laboratories G30, G31, G35 and G37 are fitted with an Emergency Stop button. Pressing this button will cut all power to GPOs in these five rooms. Fume cupboards are also fitted with Emergency Stop buttons that will cut power to that fume cupboard.

In an emergency other laboratory equipment excluding electron microscopes can be turned off at the wall if safe to do so.

Electron microscopes

Report any emergency involving an electron microscope to an MCEM staff member as soon as possible. If an MCEM staff member cannot be quickly contacted, for example, when working after hours, and it is necessary and safe to do so, then follow the Emergency Power Off procedure described on the sheet located on the entrance door.

Emergency gas shut off procedure

Isolation taps for reticulated gases are located in two panels outside the gas store Room G38.

Bottled gas is managed by trained MCEM staff members only.

The following compressed gases are used in the Centre:

- Argon (reticulated)
- Argon/Oxygen (reticulated)
- Helium (bottle)
- Hydrogen (reticulated)
- Natural Gas (reticulated)
- Nitrogen (reticulated)
- Nitrogen/2% Hydrogen (bottle)
- Oxygen (reticulated)
- Sulphur hexafluoride (bottle)



All microscope rooms and most laboratories have reticulated nitrogen supplies supplied from liquid nitrogen boil-off. There is an asphyxiation hazard if there is a major nitrogen gas leak and the air conditioning is not operating, for example, during a power failure.

YOU MUST NOT ENTER OR REMAIN IN THE BUILDING WHILE THE AIRCONDITIONING IS INOPERATIVE, FOR EXAMPLE, DURING A POWER FAILURE.

Note:

- There is an alarm panel above the gas isolation taps. This alarm warns of low gas pressure indicating that a gas bottle needs changing or low nitrogen pressure; *this is not a hazard alarm*.
- Maintenance on gas cylinders, regulators or other gas fittings is only be performed by trained MCEM staff members.

First Aid kit locations

- Fire hose reel cupboard in the entrance foyer
- Corridor outside Room G32

Uninterruptible power supply (UPS)

All microscope power outlets and power outlets for water chillers in Utility rooms are supplied from uninterruptible power supply (UPS) units located in the electrical plant room. Red general power outlets (GPOs) in microscope rooms and in the General Office are also connected to UPS. UPS power is provided in the Research Fellows Office for the Communications Rack (two outlets at high level) and to the floor box closest to the communications rack. UPS power outlets are not protected by RCDs.

SF₆ sensors and alarms

All TEM microscope laboratories are fitted with SF_6 sensors and alarms. If an alarm sounds, leave the room and advise an MCEM staff member of the alarm. If an SF_6 alarm is operating, you must not enter the laboratory.

Oxygen sensors and alarms

Laboratories G21, G23, G30, G31, G35, G37 and G38 are fitted with oxygen sensors and alarms that will operate if the oxygen level drops below 19.5% (normal reading ~20.9%). If a low oxygen level alarm sounds, leave the room and advise an MCEM staff member of the alarm. If an Oxygen alarm is operating, you must not enter the laboratory. Oxygen levels can be monitored remotely on the control panel in Communications Duct Room G46A.

Liquid nitrogen

People needing to use liquid nitrogen (LN₂) must complete the Cryogenics induction, see Use of cryogenic liquids, page 61.

Liquid nitrogen is a cryogenic liquid and is the liquefied form of nitrogen gas. The major hazards from LN₂ as used in MCEM are cold burns (boiling point -196 °C), asphyxiation (gaseous nitrogen can displace oxygen from the air) and pressure build-up (liquid to gas expansion ratio 790 times).

Liquid nitrogen can cause severe burns and the eyes are particularly vulnerable.

Runners with mesh uppers and sandals are not acceptable when handling liquid nitrogen.

Liquid nitrogen boil-off can displace oxygen so there is a risk of asphyxiation – minimize spillage and decant in well-ventilated areas. The 160ltr Dewar must not be stored or used anywhere other than the Gas Store (Room G38), which has direct external ventilation.



Thermal shock can cause materials to fracture: only use the stainless steel or Nalgene Dewars provided, or Dewars provided by equipment manufacturers to handle liquid nitrogen.

As liquid nitrogen gasifies, there is a large volume increase – never store liquid nitrogen in sealed vessels.

Liquid nitrogen must not be removed from MCEM.

Be aware that liquid nitrogen will cause liquid oxygen to form on cold surfaces by condensation from the atmosphere.

Further information about safe handling and storage of LN_2 can be found on the Monash Occupational Health & Safety website – Health & Safety Topics, see:

https://www.monash.edu/ohs/info-docs/safety-topics/chemical-management/handling-andstorage-of-liquid-nitrogen



Ionising radiation

The interaction of electrons with matter produces ionising radiation in the form of X-rays within scanning and transmission electron microscopes. Microscope and accessory manufacturers design their equipment to limit emission of X-rays to safe levels. Microscopes and accessories are measured for X-ray leakage by the manufacturer and measurements are made at installation. MCEM has radiation monitoring equipment and microscopes are checked for leakage at installation and after any significant change to the microscope's configuration.

An electron microscope is not classed as "ionising radiation apparatus" for the purpose of the Victoria Government Radiation Act 2005, see Victoria Government Gazette No. S 207 Friday 31 August 2007 (see below and

https://www2.health.vic.gov.au/getfile/?sc_itemid=%7bB1CBBC78-D0C3-42FC-AC99-418F58ACFFED%7d&title=Declaration%20that%20certain%20material%20and%20apparatuse s%20are%20not%20radiation%20sources).



Radiation Act 2005

DECLARATION THAT CERTAIN MATERIALS AND APPARATUSES ARE NOT RADIATION SOURCES

- 1. I, Fran Thorn, Secretary to the Department of Human Services, acting under section 4(1) of the Radiation Act 2005 ('the Act'), declare that–
 - (1) the following classes of materials are not radioactive material for the purposes of the Act:
 - (a) radioactive material used as luminous markers in timepieces, safety items and gunsights; and
 - (b) thorium in gas mantles.
 - (2) none of the following items is an ionising radiation apparatus for the purposes of the Act:
 - (a) a television receiver (cathode ray tube);
 - (b) a visual display unit (cathode ray tube);
 - (c) a cold cathode discharge tube; and
 - (d) an electron microscope.
 - (3) a complete domestic smoke detector containing less than 40 kilobecquerel of americium 241 and no other radioactive substance is not a sealed source apparatus for the purposes of the Act.
- 2. I am satisfied that the ionizing radiation emitted by the classes of materials and the classes of apparatus specified in this declaration do not pose a significant risk to the health or safety of any person or the safety of the environment.
- 3. This declaration takes effect on 1 September 2007. Dated 29

August 2007

FRAN THORN Secretary Department of Human Services



SAFETY OFFICERS, WARDENS AND RELATED ROLES



Figure 5. Safety Officer Dr Russell King Room G34 Tel.: 990 53804



Figure 6. Safety Officer Dr Flame Burgmann Room G06 Tel.: 990 50336

Building Wardens

Flame Burgmann (Building Warden) Russell King (Deputy Building Warden)

Fire Wardens

Assoc. Prof. Laure Bourgeois Dr Emily Chen Dr Xi-Ya Fang Assoc. Prof. Matthew Weyland

Breathing Apparatus

Dr Russell King

Dr Zhou Xu

Wellbeing Champion

Dr Laure Bourgeois

MCEM OHS Committee

Russell King (Chairperson), Flame Burgmann, Zhou Xu, Emily Chen, Darren Cram (MCEM User Representative).



FIRST AID OFFICERS

First Aid kits are located in the Fire hose reel cupboard in entrance foyer and in the corridor outside Room G32.

The following MCEM staff members are qualified as Monash Level 2 First Aiders:



Figure 7. Dr Tim Williams (First aid co-ordinator) Room 103 Tel.: 990 20721



Figure 9. Dr Russell King Room G34 Tel.: 990 53804



Figure 8. Dr Xi-Ya Fang Room 107 Tel.: 990 20821



Figure 8. Dr Emily Chen Room 104 Tel.: 990 55348

Nearest Medical Health service

The Monash University Medical Health Service clinic is located on the Clayton campus at 21 Chancellors Walk, Ground floor (see Campus Map Figure 1), tel. 990 53175.



OHS INDUCTIONS

You will need to complete various inductions depending on your planned activity within the MCEM building. These inductions include:

- 1. Monash staff, student, long-term visitor or external user working in laboratory areas
- 2. Client or Visitor under supervision
- 3. Computer room only user
- 4. Contractor engaged by MCEM
- 5. Monash staff member or contractor not engaged by MCEM

Additional inductions are required for high-risk restricted activities:

- 1. After hours work
- 2. Use of cryogenic liquids (LN₂)
- 3. Electropolishing

Access to SARAH, Moodle, shared network drive and Monash website

MCEM users also need access to:

- 1. SARAH to submit and access Risk Assessments and Safe Work Instructions, and to submit incident reports;
- 2. Moodle to complete training and inductions;
- 3. MCEM shared network drive;
- 4. Monash Website to access many OHS policy documents and procedures.

For external users MCEM can submit a "Request to Create Custom Accounts/ext Accounts/Shared Mailbox" to eSolutions. A Monash email address created by eSolutions allows the external user to access the Moodle training courses and the MCEM shared network drive. External users won't have a Monash ID card and so will not have building access.



Monash staff, student, long-term visitor or external user working in laboratory areas

You must have a current Monash email address and a current iLab Project.

If you are a Monash User, you must have completed the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" for your School/Department, see: https://www.monash.edu/ohs/induction-training/local-area-induction

If you are an external User, you will be issued a Monash external email address and arrangements will be made to give you access to myDevelopment, Moodle, SARAH, shared network drive and other resources.

You must have completed the following online training courses available in myDevelopment:

- 1. OHS Staff Induction all Users
- 2. ChemWatch SDS and Chemical Register application all Users, needed to access ChemWatch;
- 3. Dangerous Goods and Hazardous Substances Basic Principles all Users;

You must complete the following two Moodle courses:

- 1. MCEM Building & Safety Induction Part 1. Building Tour
- 2. MCEM Building & Safety Induction Part 2. Business hours induction

You will need to download and study sections of the MCEM Manual and have this available while completing the Moodle courses.

You must complete, sign and return the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" for MCEM.

You must complete, sign and return the "LOCAL AREA OHS INDUCTION CHECKLIST - LABORATORY, WORKSHOP OR STUDIO INDUCTION" for MCEM.

You must complete, sign and return the MCEM Safety Induction Checklist and User Agreement (MCEM-FRM-0005).

Client or Visitor under supervision

- A Client User or Visitor must at all times be under the immediate supervision of a host who has completed the full MCEM laboratory induction.
- Visitors must fill in the Visitor's Book in Reception.
- A Client User or Visitor is not permitted to use any Centre equipment.

Document MCEM-REF-0009 "Client or Visitor Under Supervision Information" is available in Reception.



Computer room user

You must have a current Monash ID, Monash email and authcate and must have a current iLab Project.

If you are an external User, arrangements will be made for you to be issued a Monash ID. You need a Monash ID in order to access the various Moodle training courses.

Computer room users are:

• Permitted to work unsupervised in the Computer Room 102 only and must at all times be under the immediate supervision of a host who has completed the full Centre laboratory induction in laboratory areas.

• Not permitted to use any Centre equipment outside Room 102.

You must have completed the following online training courses available in myDevelopment:

1. OHS Staff Induction – all Users

You must have completed the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" for your School/Department, see:

https://www.monash.edu/ohs/induction-training/local-area-induction

You must complete the following two Moodle course:

- 1. MCEM Building & Safety Induction Part 1. Building Tour
- 2. MCEM Building & Safety Induction Part 2. Business hours induction

You will need to download the MCEM Manual and have this available while completing the Moodle courses.

You must complete the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" for MCEM.

You must read document "Computer Room User Information" (MCEM-REF-0008) and then complete, sign and return the attached User Agreement. This document is available in Reception.

External users

Access to myDevelopment

As part of the MCEM safety induction, external users need to complete a number of courses now only available in MyDevelopment. For example:

- 1. OHS Staff Induction;
- 2. ChemWatch SDS and Chemical Register application;
- 3. Dangerous Goods and Hazardous Substances Basic Principles;
- 4. Cryogenic Material Basic Safety Principles.

External users can create an external myDevelopment profile but they don't have direct access to the request form needed to do this. An MCEM staff member will need to open the Access myDevelopment intranet page for the external user, see

https://www.intranet.monash/talent-leadership-development/myDevelopment/accessmydevelopment.

This page has instructions and a link to the myDevelpment access request form.



Contractor engaged by MCEM

Contractors must:

- 1. Complete the Monash Contractor Induction Program provided by the Buildings and Property Division, see <u>http://www.monash.edu/contractors/contractor-induction</u>.
- 2. Complete MCEM in-house contractor induction.
- 3. Complete, sign and return "LOCAL AREA CONTRACTORS OR VISITORS INDUCTION CHECKLIST", see:

https://www.monash.edu/ohs/induction-training/local-area-induction

This will be done at the time of the in-house induction.

Monash staff member or contractor not engaged by MCEM

Buildings and Properties will manage inductions for Buildings and Properties staff and contractors.



Advice on how to complete the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" for MCEM

You will have already been instructed in many of the matters listed in the "GENERAL LOCAL AREA STAFF, HONOURS OR POSTGRADUATE INDUCTION CHECKLIST" when you completed a similar document in your home Department/School.

Download and print a copy of this checklist, see:

https://www.monash.edu/ data/assets/word doc/0015/122910/induct-staff-students.docx

Here is advice on how to complete this form:

Fill in Inductee details

- A. Online OHS Induction
 - You will have completed the compulsory Online OHS Induction
- B. Roles and Responsibilities at Monash University
 - Most items in this section will have been covered in your home Department/School induction. A list of MCEM local safety contacts is provided in this induction and in the MCEM Manual.
- C. Access Requirements
 - Inductee requires access without supervision only during business hours.
 - Access is required to restricted areas (MCEM laboratories).
 - You are only permitted to enter rooms in accordance with your equipment licences.
 - If after-hours access is required this will handled separately at a later time.
- D. Emergency Preparedness
 - Emergency Preparedness is covered in the Building and Safety Induction Moodle course and the MCEM Manual.
- E. Risk Management
 - Items in this section are covered in the Building and Safety Induction Moodle course and the MCEM Manual or will have been covered in your home Department/School induction. MCEM Risk Assessments and Safe Work Instructions are available in laboratories and in SARAH.
- F. Hazard and Incident Reporting
 - All items in this section will have been covered in your home Department/School induction.
- G. Work in higher risk areas

The inductee is required to access a work area that has additional safety induction requirements (MCEM laboratories) so the "Laboratory, Workshop, Studio or Makerspace Local Area Induction" must also be completed.

- H. Sign Off
 - Inductee to sign the document and return it to MCEM. The "Signature of Supervisor" will be signed by an MCEM staff member.

Please return the completed and signed checklist to the MCEM General Office.



Advice on how to complete the "LOCAL AREA OHS INDUCTION CHECKLIST - LABORATORY, WORKSHOP OR STUDIO INDUCTION" for MCEM

This checklist is for routine laboratory work within MCEM. You will need to fill in additional copies of this checklist for higher risk work such as:

- 1. After hours
- 2. Use of cryogenic liquids
- 3. Electropolishing

Download and print a copy of this checklist, see:

https://www.monash.edu/ data/assets/word doc/0015/122901/induct-lab-workshop.docx

Here is advice on how to complete this form:

Fill in Staff/Student details

- A. General Local Area Induction
 - You will have completed the General Local Area Induction for MCEM.
- B. Access requirements
 - For the purpose of this form the Inductee requires access without supervision only during business hours. Access to high-risk restricted areas is not required.
- C. Procedures for entering and exiting
 - This is covered in the Building and Safety Induction Moodle course and in the MCEM Manual. No food or drink in the work area. PPE laboratory coat/apron/protective eye equipment/closed toe shoes and gloves are required. PPE to be removed prior to exiting a laboratory with the exception of disposable gloves used to handle samples and microscope parts.
- D. Emergency response
 - Chemical spills procedures, Safety showers and Eye wash facilities, Firefighting measures including location of extinguishers, Emergency power and gas shut off procedure and First aid procedures are covered in the Building and Safety Induction Moodle course and in the MCEM Manual.
- E. Hazards present in the work area
 - The following hazards are present in the work area:
 - Chemical hazards
 - High risk specialised plant/equipment (electropolishing, saws, ovens)
 - Pressurised vessels (vacuum systems)
 - Cryogenics
- F. Risk management requirements
 - Immunisation and Health Surveillance are not required. Other items are covered in the Building and Safety Induction Moodle course and in the MCEM Manual.
- G. Work in higher risk areas
 - This form is for Other: Work in MCEM laboratories. Separate checklists are required for after-hours access, use of cryogenics and use of electropolishing.



- H. Sign off
 - Inductee to sign the document and return it to MCEM. The "Signature of Supervisor" will be signed by an MCEM staff member.

Please return the completed and signed checklist to the MCEM General Office.

Additional inductions for high-risk restricted activities

Additional inductions are required for high-risk restricted activities.

After-hours access

After-hours access gives you 24/7 access to the MCEM building except when Monash is closed during the end-of-year period. You will enter the building via the main entrance.

In order to use equipment after hours you must:

- 1. Have an after-hours licence on the equipment;
- 2. Have completed the MCEM After-hours Building and Safety Induction (Moodle).

Requesting after-hours training

Typically, a minimum of several months regular, trouble free use is needed before you can apply for an after-hours licence.

To request after-hours training on equipment you must submit an iLab "After-Hours Training Request (After-Hours)", see the iLab "New Users and Service requests" tab. Please note that some items of equipment cannot be used after hours.

The Equipment Manager will contact you to discuss your training request. If applicable complete the After-hours Cryogenics training and induction.

If the Equipment Manager agrees to issue you with an after-hours licence you will be given additional training to allow you to correctly manage minor issues should these arise after hours when MCEM staff members are not available.

Once your after-hours licence has been granted you will need to complete the MCEM After-hours Induction Moodle course (you may have already done this if you have other after-hours licences).

MCEM After-hours Induction Moodle course

You will be enrolled in the MCEM After-hours Induction Moodle course.

This course requires you to:

- 1. Read the MCEM After-Hours Information document (MCEM-REF-0006) which details MCEM's after-hours operating and safety procedures (five pages).
- 2. Agree to follow MCEM's after-hours procedures.
- Complete, sign and return another copy of the "LOCAL AREA OHS INDUCTION CHECKLIST - LABORATORY, WORKSHOP OR STUDIO INDUCTION" (see earlier advice) with section "B. Access Requirements" updated for after-hours access (answer to "Only during business hours" is No and to "Access required after-hours..." is Yes).
- 4. Complete, sign and return the MCEM After Hours User Agreement (MCEM-FRM-0009)

Use of cryogenic liquids

Everyone needing to handle liquid nitrogen in MCEM must complete the Cryogenic Liquids induction. This includes all TEM users, cryo-PIPS users, cryo-ultramicrotome, cryo-fracture users, some SEM/FIB users and cryo-PECS.

You must:



- 1. Complete MyDevelopment course "Cryogenic Material Basic Safety Principles".
- 2. Complete MCEM in-house handling cryogenic liquids training.
- 3. Complete MCEM in-house cryogenics induction for business hours.

The checklists will be completed as part of the in-house training.

Electropolishing

The relevant Electropolishing Manager will arrange your training (Struers Tenupol/Struers Electropol/Atom probe tip polisher). After completing training, you will be able to use your Monash ID card to access the electropolishing room.

You must:

- 1. Complete training on the relevant electropolishing equipment.
- 2. Complete, sign and return the Electropolishing User Agreement.
- Complete, sign and return another copy of the "LOCAL AREA OHS INDUCTION CHECKLIST - LABORATORY, WORKSHOP OR STUDIO INDUCTION with section G updated for Electropolishing.

The User Agreement and checklist will be completed as part of the electropolishing training.

Induction checklists and further information can be found at <u>http://www.monash.edu/ohs/ohs-training-and-induction/ohs-induction/local-area-ohs-induction</u>.



Monash Centre For Electron Microscopy