

CAAAM Guidelines and Procedures

As CAAAM continues to grow, we will continue to implement Guidelines and Standard Operating Procedures (SOPs) that apply to all CAAAM equipment. These steps are designed to minimize common mistakes, minimize wasted time and material due to mistakes, and prevent harm to equipment and/or personnel.

1. User Information:

- All current users must have safety training certificates on file from within the last calendar year. Many of you have likely completed these trainings in the recent past, but you must send the CAAAM staff proof of completion including your name and the date of completion. Please note that Radiation Safety is only required for usage of the X-ray facilities in CAAAM. The Radiation Safety is the longest one, don't waste your own time if you don't have to.
- All current users must have an FOM account information form on file. Many of you likely have an account with MRF, but you must send the CAAAM staff this information as well.
- If you lack the safety training certificates, or an FOM account form, you will be unable to access CAAAM or use any equipment until these requirements are met.

2. Basic Guidelines of the Lab:

Guideline 1: PPE

- Appropriate PPE must be used/worn during any work in CAAAM Facilities. This includes, but is not limited to, N95+ masks, gloves, eye protection from particulates, eye protection from laser radiation, and others. Specific PPE needs for CAAAM equipment are discussed as part of training on that equipment. Else, see Guideline 3.

Guideline 2: Keep the lab clean

- All machines and workstations should be cleaned and all equipment and tools put away when work is done. Any powder or chemical remnants should be handled with appropriate PPE when being cleaned, as in Guideline 1. Care should be taken to prevent contamination between work areas, i.e., do not walk through the halls with a powder suit on, discard contaminated gloves before leaving the work area, etc.

Guideline 3: If you don't know, then Ask.

- Guessing will lead to mistakes, mistakes lead to damaged machines and wasted time/material. If you are unsure, or want to double check anything, ask the lab staff. Our primary duty is to ensure safe and proper operation of the equipment, ergo questions are never a bad thing.

3. Training Requests/Proposal Forms:

a. Training Requests

All users wishing to be trained on CAAAM equipment must submit a training request for every individual piece of equipment they need training on, with one exception for Powder SOP Equipment, see Item 4. Training should not be requested for equipment that is planned to be used rarely. For one-off or otherwise rare deposition or analysis needs, users should detail these needs in a proposal and will work through the lab staff to perform the necessary work. E.g. a single X-ray CT scan, or a small set of indentation tests to complete a project would be best completed working through the lab staff if they are unlikely to be repeated. Training requests are for frequent or repetitive users. The training request form can be found on the CAAAM website. Please note that a training request requires Dr Dahotre's signature and will be rejected if submitted without his review.

b. Initial Proposals

Any project that would utilize CAAAM facilities must have an Initial Proposal Form reviewed and approved by the lab staff. These proposals are to ensure that any project has adequate basic planning, that the researcher has an understanding of the materials and processes required, and to communicate the materials and processes required with CAAAM staff, such that the lab can remain prepared. E.g. swapping AFSD tools in a timely manner or swapping gas cylinders/mixtures as appropriate. To enable the review process, CAAAM staff will have office hours once a week, Friday afternoons 2-5pm. Proposals must be brought to the CAAAM offices for a quick review during these hours. Proposals that are emailed, or brought outside of office hours, will be ignored. CAAAM staff do not have the bandwidth to field proposals at the whim of every possible user, rather the users must plan 1 week ahead and communicate their needs with CAAAM staff during the weekly office hours.

4. Powder Standard Operating Procedures (SOP):

a. Powder Storage

All powders must be stored properly when not in use. Proper storage includes a sealed container that is clearly and specifically labeled with the material/alloy/composition and the origins of the material, manufacturer or batch number or other identifiers. Proper storage also includes desiccant to prevent moisture buildup. All powder handling, including removing powders from storage, placing powders back into storage, or otherwise handling powders must be performed with appropriate PPE, and should be confined to the powder handling room as much as possible. Additional expectations for powder handling are posted in the powder handling room.

b. Powder SOP

For all users that will be using powder processing equipment and/or powder deposition machines (LPBF, LDED, Binderjetting, Spheroidizer), CAAAM will require a

preliminary powder assessment to be performed as part of the workflow. The procedure is summarized as Shape – Size – Density/Flow – Contaminants. To expedite this process, CAAAM facilities can be used for all the analysis, and a single training request for a user specifying “Powder SOP Equipment” can be submitted to encompass all these machines at once.

- A microscope image characterizing the Shape of the powder will be required. This can be taken on the optical/digital microscope in CAAAM, or any other microscope the user has access to. This image must be specific to the powder about to be utilized.
- Size characterization will be required. This can be performed on the PSD machine in CAAAM. These results must be specific to the powder about to be utilized. Should the size distribution need to be adjusted, sieving can be performed on the sieving equipment in CAAAM. Size characterization after sieving will be required.
- Density and Flowability measurements will be required. This can be performed on the Tap Density Meter and the Hall Flowmeter in CAAAM. The tap density, tap/apparent density ratio and Hall flow time must be specific to the powder about to be utilized.
- Contaminant checks will be required. This can be performed with the oven and LECO analyzers in CAAAM. This is primarily concerning moisture content in the powder, which should be kept close to zero by drying powder as needed, and by always storing powders with desiccant. LECO analysis for Oxygen, Nitrogen, and Carbon levels along with treatment for moisture must be specific to the powder about to be utilized.
- The Shape-Size-Density-Contaminant order of these operations is not absolute, you will be expected to use your best judgement on an appropriate order, and on repeating steps as required. E.g. if you adjust the size of powder through sieving, the flow and density measurements will be different compared to un-sieved powder. If you have to dry off moisture, the LECO analysis as well as the flow and density measurements will also change. Some of the SOP steps will have to be repeated to establish clear initial conditions for any AM/powder process.

Finally, as no standard procedure could ever prepare for every unique situation that may occur, defer to the instructions of lab staff if there is ever any conflict, per Guideline 3. Thank you for your adherence to these procedures, and your cooperation with the requirements of our facility.