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| #1 Process  (if applicable) | Extrude bound metal pounder, remove bonding constituents, and sinter model to make functional prototypes of metal. |
| #2 Equipment | Bound Metal Deposition (BMD) system. Desktop Metal 3D Printer, Debinder, and Sintering Furnace, which are a part of the Desktop Metal Studio + system. |
| #3 Personal Protective Equipment (PPE) | Minimum shop PPE. |
| #4 Environmental /  Ventilation controls. | Make sure equipment is stable. |
| #5 Required training or approval | * Desktop Metal 3D Printer Training is required. * Review and observe general shop safety practices for this shop. * Refer to the manufacturer’s operating manual and recommendations for all operating procedures. These may be found in physical format (manual) and digital format: <https://fab.desktopmetal.com/> * Read all SDSs for the debinding process: Debinding Fluid SDS and Gas No. 1 SDS. |
| #6 Inspection requirements before use | * Locate and ensure you are familiar with the operation of the touch screen control panels for the printer and debinder stations. * When using the printer:   + Check that no unwanted materials are obstructing the print platform and that a build plate is properly installed. Remember that the build plate side without the writing on it should face upward.   + Ensure that the material you selected in the slicer software matches that which is loaded in the machine. Ask the lab manager if you need materials changed.   + Check the purge trays for excess purge material. Empty if necessary.   + Check the housing for cracks or other signs of damage. If found, immediately report to the lab manager and cease use of the machine. * When using the debinder:   + Check that no unwanted materials are in the debinding chamber and that there is no remaining liquid in the chamber.   + Check the housing for cracks or other signs of damage. If found, immediately report to the lab manager and cease use of the machine. |
| #7 Safe operating procedures or precautions | * CAUTION: The printer build platform using a vacuum pump to keep the build plate flat during printing. Keep hands clear of the build platform while it is printing. * CAUTION: The printer nozzles will be extremely hot during operation. Do NOT touch. * DO NOT change the build material or printing heads of the printer unless you have been trained by the lab manager on how to do so. * Print heads MUST be changed while the power is on. * The printer must undergo recalibration after every print head change. This will take up to 30 minutes. Prepare accordingly. * Once a print head has been used on a certain material, it cannot be used with another. The machine and software will also restrict this. * Although print jobs are sent to the printer over a network connection, the print jobs must be started at the machine. * Please be cognizant of other peoples’ time. If your print job has finished, pick it up at your earliest availability. * Do not turn off the machine after you are done using it. This will keep the chamber primed for future prints, avoid the need to go through set-up processes, as well as assist in keeping moisture out of the build area. * If the control screen freezes, alert the lab manager and cease use of the machine while it is rebooted. * Do not store media cartridges in direct sunlight. * The waste container on the debinder must only ever be replaced by the lab manager. Contact the lab manager if the debinder says it is full. * Keep ignition sources away from the debind fluid and debinder. * ONLY place materials from Desktop Metal into the debinder. Failure to do so may result in damage to the machine and a hazardous situation. * To start a print on the DM Printer:   1. Push your part into the Live Studio browser-based slicer software: <https://fab.desktopmetal.com/>   2. Once sliced, push all objects you plan to print to the printer queue.   3. Move to the printer and ensure a fresh build tray has been installed.   4. Ensure that your material is correct for your slicer profile.   5. Ensure that the doors are closed.   6. Select the job you would like to start and hit the start button.   7. When print is complete, remove entire build tray and peal off of the bottom of your models.   8. You may keep your models in this “green” state while you print other jobs. When ready, move onto the debinder steps. * To start a debinding session on the DM Debinder:   1. The jobs ready for debinding should have been automatically pushed to the debinder after printing. If not, go into the Live Studio software and push them manually to the machine.   2. Ensure the machine is not running, then open the two lids and remove the part tray.   3. Place the parts that are a part of your desired jobs onto the part tray, ensuring adequate spacing for the debind fluid (about 0.5” around all sides).   4. Lower the part tray back into the chamber and close the lids, ensuring that all locks are re-sealed.   5. On the debinder screen, select the jobs associated with all of your parts and select the start button. DO NOT open the debinder while it is working.   6. When debinding is complete, open the two lids and remove your parts **ensuring to be very careful with them.** Your parts are now “brown” parts and are extremely fragile. Avoid breathing in the minimal debinding fluid vapors that may still be present. If some debind solution is left over in the chamber, wear nitrile gloves when removing your parts and let them fully dry.   7. Hand your parts off to the lab manager to keep in preparation for sintering. * **The sintering furnace may only be used by the lab manager**. It is run at maximum once per week, on Thursdays. You will receive an estimated time to part completion from the lab manager when it is started. * Depending on requirements for surface finish, you may need to do some post processing. Connect with the lab manager on your needs and they will guide you to the appropriate method for your job. * **FOR LAB MANAGER:**   + - **Printer**     - Do not use commercial cleaners on clear panels; Only soap and water     - When switching materials, ensure that you also change feed trays and nozzle brushes to avoid contamination between materials.     - Avoid tipping the media cartridges in the vertical direction; They should be held horizontally at all times.     - To remove print heads, they must first be released via the touch screen before they be removed by hand.     - When replacing a head, always ensure that the locking lever on the head is fully activated.     - **Debinder**     - When removing the debinder waste canister, be aware that the canister and the waster canister heater plate may be hot; proceed with caution.     - **Furnace**     - Load parts shortest to tallest, left to right.     - Make sure when furnace closes to keep button pressed for a few more seconds.     - Never attempt to open the furnace chamber during the sintering process.     - Use caution when removing items from the furnace, as they will likely be hot. Use heat safety gloves.     - Never touch the insulation.     - Do NOT handle insulation dust until all safety precautions have been read and understood. Do NOT breath in dust.     - Only brown parts should be added to the furnace.     - Do not place objects on top of furnace.     - Keep fingers and hands free of furnace chamber during opening and closing.     - Always verify that the gas type installed is appropriate for the build material of the prints.     - When replacing binder trap, ensure that replacement is installed properly; Improperly installed traps may expose users to CO and furnace effluent.     - Inspect furnace chamber for foreign objects before sintering.     - Always ensure all parts of the retort box are properly aligned to avoid damaging the furnace.     - Use all five stacking rings when loading parts.     - Ensure that parts do not come in contact with the graphite rings or bottom of trays.     - **IF the furnace completes debind, but does not complete sintering**, the model material may become metal dust, posing an inhalation hazard and/or a combustion hazard. **Contact your Desktop Metal reseller immediately**.     - ALWAYS wear heat resistant gloves when removing items from the retort after sintering; interior of chamber and items may be upwards of 200C.     - **Unload parts from the furnace according to the steps on page 42 of the Studio System Furnace Operations & Maintenance Guide.**     - If metal came into contact with the graphite retort rings, carefully scrape the metal off; if the Retort cannot be cleaned, or it is damagerd in the process, contact your reseller for replacement. It MUST be replaced.     - Inspect furnace insulation package before and after each run to ensure no damage; If damage is noted, contact DM for replacement.     - Always clean off bottom of furnace chamber to ensure longevity of insulation package.     - NEVER use compressed air to clean the inside of the chamber. Furnace insulation can be an inhalation hazard if made airborne.     - Before each run, also check the vacuum pump oil levels.     - Vacuum pump oil should be changed every 35 jobs. |
| #8 Chemicals/ spill procedures/waste disposal | Avoid excessive build-up of purge material under the build platform as this may inhibit the platform’s movement. Also avoid opening the chambers of the printer or the debinder while the machines are processing a job. |
| Author Signature: Date: | |