UNLV

SCHOOL OF ARCHITECTURE

Digital Fabrication Lab

Safety Handbook

Revised January 8th, 2025

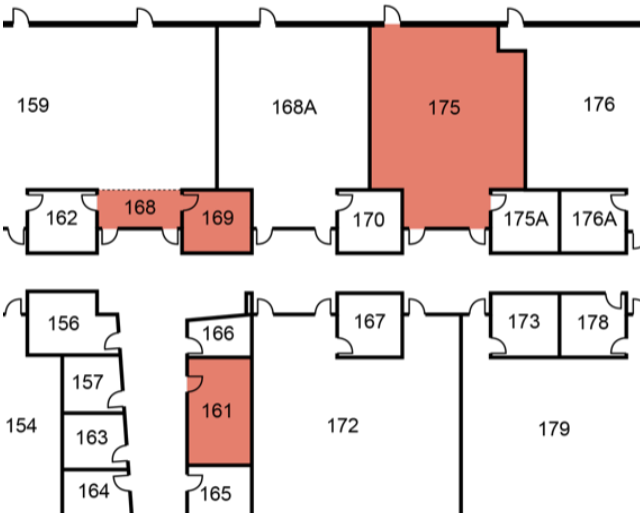
Digital Fabrication Lab
Facilities

Digital Fabrication Lab Coordinator:

Name: Kyle Kithas
Office: ARC 175A
Phone: 702-895-4880
Email: kyle.kithas@unlv.edu

Location:

- **Building:** Paul B. Sogg Architecture Building (ARC)
- The Digital Fabrication Lab facilities are highlighted in red below:



Equipment Location:

- **ARC 161:** Desktop 3D Printers
- **ARC 169:** Laser Cutters
- **ARC 175:** CNC Router

Emergency Equipment Locations:

- **First Aid Kits:** ARC 169 & ARC 175
- **Emergency Eyewash Station:** ARC 175
- **Fire Extinguishers:** ARC 168 & ARC 175
- **AED:** ARC First Floor Lobby (adjacent to the main office door)

Digital Fabrication Lab
Safety Program

Access Control:

Who is permitted to use the Digital Fabrication Lab?

The Digital Fabrication Lab is dedicated solely to supporting academic, research, and University-sanctioned projects. Eligibility to use the lab is limited to Students, Faculty, and Staff who have a current affiliation with the UNLV School of Architecture. Access to the Digital Fabrication Lab will be granted to users upon completion of all necessary safety training requirements.

In order to utilize the lab, Students must be enrolled in classes for the current semester. This requirement ensures that the lab remains accessible to individuals actively involved in the School of Architecture's educational programs and promotes the integration of hands-on learning experiences.

Who is **NOT** permitted to use the Digital Fabrication Lab?

Students, Faculty, and Staff outside of the UNLV School of Architecture Department. Alumni and community members are not permitted to access the Digital Fabrication Lab.

Safety Training Program:

Safety is the first priority in the Digital Fabrication Lab!

Digital Fabrication Lab Safety Training Requirements:

- **CNC Router**: Safety training is **REQUIRED** for all users making appointments to use the CNC router.
- **Laser Cutter:** Safety training is **NOT** required for the laser cutter, as it is operated by trained student employees.
- **3D Printers:** Safety training is **NOT** required for 3D printers, as student interaction occurs virtually through 3DPrinterOS, which minimizes direct physical interaction with the machines.

CNC router safety training is available through Webcampus via a series of online modules. These modules cover the following safety information:

- Emergency Equipment: first aid and eyewash locations
- Personal protection equipment (PPE)
- Incidents & accidents
- General safety rules
- Hand tool safety
- CNC router safety
- Drill safety

Please contact the Digital Fabrication Lab Coordinator via email to gain access to the WebCampus safety training modules.

Please Note: Users may complete safety training at any time as it is offered on an as needed basis.

Assumption of Risk/Release of Liability Waivers

After users complete the online safety training module, users will be required to complete an assumption of risk/release of liability waiver at the lab.

Personal Protective Equipment (PPE)

All necessary PPE to operate Digital Fabrication Lab equipment is provided.

Please Note: Earbuds, headphones, and other music playing devices are **NOT** allowed while working near the CNC router, plasma cutter, and laser cutter. Earbuds and headphones are **NOT** a substitute for ear plugs.

Incidents & Accidents

Users must report **ALL** accidents and injuries (even minor ones) to the Digital Fabrication Lab Coordinator immediately.

In the event of a **fire**, the following steps should be taken:

1. Attempt to extinguish the fire using a fire extinguisher if you have proper training on how to use a fire extinguisher.
2. If the fire can't be **SAFELY** controlled with a fire extinguisher, pull the fire alarm, close the doors, and evacuate.
3. If needed, **CALL 911 OR (702) 895-3669**
4. Notify the Lab Coordinator if this has **NOT** already been done. The Lab Coordinator will notify the School of Architecture Director.
5. The Lab Coordinator will document the incident per the NSHE/UNLV Incident Reporting Procedures for Bodily Injury and Property Incidents.

In the event of an **accident or injury**, the following steps should be taken:

1. The area should be secured. Ensure the hazard is no longer present and the immediate surroundings are safe.
2. Provide comfort. If there are bodily injuries, obtain consent to administer first aid. Ask the injured person if they need any medical assistance or an ambulance.
3. If needed, **CALL 911 OR (702) 895-3669**
4. Once the injured person is stable, notify the Lab Coordinator if this has **NOT** already been done. The Lab Coordinator will notify the School of Architecture Director.
5. The Lab Coordinator will document the incident per the NSHE/UNLV Incident Reporting Procedures for Bodily Injury and Property Incidents.

General Safety Rules

IN CASE OF EMERGENCY, NOTIFY LAB COORDINATOR.
CALL 911 OR (702) 895-3669

- Access to the lab outside posted hours is **STRICTLY PROHIBITED.**
- Only use tools and equipment that you have been **AUTHORIZED** to use.
- Safety is everyone's responsibility. **ALWAYS ASK FOR HELP** if you are unsure how to operate equipment or have limited experience using a specific piece of equipment.
- **DO NOT** use equipment if you are tired or under the influence of drugs, medication, or alcohol.
- **NEVER** work alone in the lab.
- **DRESS APPROPRIATELY**. Do not wear loose clothes or jewelry. Loose clothes, jewelry, or long hair can be caught in moving parts. Long sleeves must be rolled up above the elbow. Gloves **SHOULD ONLY** be used when specified or when hauling material.
- Open-toed footwear is **NOT** permitted in the lab.
- Long hair **MUST** be tied back.
- Safety glasses **MUST** be worn at all times in ARC 175. A dust mask, hard hat, or hearing protection must be used when needed. Everyday eyeglasses are **NOT** safety glasses. Safety glasses must conform to ANSI Z87.1.
- Safety guards **MUST** be in place at all times.
- Keep bystanders, children, and visitors away when using power tools. Distractions increase the risk of injury.
- Report unsafe issues or damaged safety guards, equipment, and tools to the Lab Coordinator.
- Keep your work area clean and well lit, do not store tools or materials on equipment.
- Cleanup is **MANDATORY**. Practice good housekeeping to avoid crowded, cluttered conditions. Put tools away when you are done using them.
- **NEVER** leave equipment unattended.
- Keep blades covered as much as possible.
- When cutting, **ALWAYS** cut away from the body.
- Do not work small pieces on power machinery; use hand tools.
- Always **SECURE** the work piece. Use clamps or a vise if necessary.
- **NEVER** use compressed air without a safety nozzle to clean machines or clothing.
- **NO** running or horseplay.
- **NO** eating in the lab area.
- Always follow the Lab Coordinator's directions.
- Report **ALL** injuries (even minor ones) to the Lab Coordinator.

Drill Safety

A handheld drill uses a multiple-cutting-edged rotating tool to produce a hole in wood, metal and plastics. Normally, drills have variable speeds and feeds. These tools are well suited for driving screws.

Hazards:

Point of Operation: Drill bits are sharp. Severe cuts and punctures can occur if an operator's hand slips while drilling or if they are too close to the bit while cutting.

Rotating Parts: Clothing or hair may become entangled on a rotating drill accessory (drill bit or screwdriver).

Tool Projection: Tools can be flung from the chuck if they are poorly secured or if the wrong tool is used. Drill bits may break during the cutting action and be thrown or projected.

Flying Particles: Wood chips and splinters may be thrown by the cutting action of the blade.

Safe Working Practices:

- Use sharp drill bits only.
- Know what is behind a workpiece before you do the job.
- Use clamps or another practical way to secure and support the workpiece to a stable platform. Holding the work by hand or against your body is unstable and may lead to loss of control.
- Select the desired speed/torque range using the gear shifter. Turn the collar to the drill symbol for drilling.
- **ALWAYS** start with lower torque settings, then advance to higher torque settings.
- Be sure the trigger turns the tool “on” when it is pulled and “off” when it is released.

- Tighten the bit securely in the chuck.
- **DO NOT** attempt to tighten drill bits (or any other accessory) by gripping the front part of the chuck and turning the tool on. Lock off the trigger switch and disconnect the tool from the power source when changing accessories.
- **ALWAYS** ensure the bit is secure before starting the tool.
- Remove material or debris from the area, especially if it could be ignited by hot chips or friction.
- Hold the tool firmly with both hands to control the twisting action of the drill.
- In a binding situation, the tool will react in the opposite direction of the turning bit. When drilling into the workpiece (clockwise), the tool will try to spin counterclockwise.
- **DO NOT** force the tool – apply enough pressure to keep the bit cutting or chipping smoothly. If the motor slows down, relieve the pressure.
- If the bit binds in the workpiece, release the trigger immediately. Disconnect the battery, and then free the bit from the workpiece. **DO NOT** use a lock-on button when drilling in warped, pitched, knotty, or embedded materials (e.g., reinforcing bars in concrete) where binding may be more common. **DO NOT** try to free a jammed bit by starting and stopping the tool.
- As you get close to breaking through the workpiece, reduce pressure and allow the bit to pass through the hole easily.
- Keep the motor running when pulling the bit back out of a drilled hole. This will help prevent jamming.
- **DO NOT** carry tools with your finger on the switch.

A Guide for Protecting Workers from Woodworking Hazards - OSHA 3157. (1999). Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. Retrieved from https://www.osha.gov/sites/default/files/publications/osha3157.pdf

Dewalt Instruction Manual - DCD771. (2020). Towson, MD: Dewalt Industrial Tool Company.

Hand and Power Tools - OSHA 3080. (2002). Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. Retrieved from https://www.osha.gov/sites/default/files/publications/osha3080.pdf

Power Tool, "Safety is Specific": Guidelines for the Safe Operation of Widely Used Portable and Stationary Power Tools. (2007). Cleveland, OH: Power Tool Institute. Retrieved from https://www.powertoolinstitute.com/pti-includes/pdfs/PTI_Safety.pdf

Woodworking eTool > Handheld Drills. (n.d.). *Occupational Safety & Health Administration.* Retrieved from https://www.osha.gov/etools/woodworking/production/machines-tools/handheld-drills

Hand Tool Safety

Hand tools are tools that are powered manually. Common hand tools include: utility knives, files, rasps, saws, hammers, mallets, chisels, screwdrivers, pliers, locking pliers, clamps, allen keys, and wrenches.

Hazards:

Point of Operation: Injuries can occur if an operator's hand slips. Keep tools clean and free of dirt, grease, and oil. Dirty, greasy, and oily tools can increase the risk of the operator's hand slipping. Severe cuts and lacerations can occur if hands or fingers are in the path of the blade during cutting. Injury can occur if hands or fingers are struck while using a hammer or mallet.

Pinch Points: Injuries can occur if an operator's hands or fingers get caught in the moving parts of locking pliers, wrenches, or clamps.

Incorrect Tool Selection: Always use the correct tool for the job. Use each tool only for the job for which it was intended.

Flying Particles: Wood chips and splinters may be thrown by the cutting action of chisels and saw blades or the hammering action of hammers and mallets.

Safe Working Practices:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or another person.
- Forcing a small tool to do the job of a large one may result in injury or tool damage.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike another person.

- Wrenches must not be used when jaws are sprung to the point that slippage occurs.
- If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or another person.
- When using saw blades, knives, or other tools, users should direct the tools away from aisle areas and away from where others are working in close proximity.
- Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones.
- Cracked saw blades must be removed from service.
- Be sure wrenches fit properly. Never use pliers in place of a wrench. Never strike wrenches with hammers. Pull on wrenches, do not push.
- Secure material with clamps or in a vise when using a hand saw.
- Be aware of nails and objects that may damage a tool's cutting edge.
- Always carry sharp tools and chisels with the cutting edge pointed down. Never place sharp tools in your pocket.
- Grip tools firmly during use to prevent slippage.

Agricultural Engineering Safety Lesson Plan: Hand Tool Safety. (n.d.). *Kansas State University Research and Extension [National Ag Safety Database]*. Retrieved from https://nasdonline.org/949/d000790/agricultural-engineering-safety-lesson-plan-hand-tool-safety.html

Hand and Power Tools - OSHA 3080. (2002). Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration. Retrieved from https://www.osha.gov/sites/default/files/publications/osha3080.pdf

CNC Router Safety

A CNC router is a computer numerical controlled router that can perform a variety of different milling and cutting operations on a variety of different materials including woods, plastics, and foams.

Please Note:
The Lab Coordinator will provide assistance to set up and operate the CNC router. Users will be responsible for monitoring their job during the cutting process.

Hazards:

Point of Operation: Router bits are sharp. Severe cuts and punctures can occur if an operator's hand contacts the router bit while rotating.

Pinch Points: Injury can occur if the operator's hands or fingers become caught between the moving parts of the gantry, rack and pinion, or linear rail systems.

Rotating Parts: Clothing or hair may become entangled on a rotating router bit.

Tool Projection: Tools can be flung from the tool holder if they are poorly secured or if the wrong tool is used. Router bits may break during the cutting action and be thrown or projected.

Part Projection: Parts can be flung from the work table if they are poorly secured to the spoilboard.

Flying Particles: Wood chips and splinters may be thrown by the cutting action of the blade.

Safe Working Practices:

- Ensure you are familiar with how to **PAUSE** the cutting process and the location of the **EMERGENCY STOP** control.
- **NEVER** leave the room unattended while the CNC router is cutting.
- The dust collection system and air compressor **MUST** be on while operating the CNC router.
- Keep fingers, hands, and all other objects **AWAY** from the spindle, rack and pinion, and linear rails.
- Before operating the CNC router, make sure to **REMOVE** any obstructions such as wood, tools and scraps from the work table.
- **REMOVE** any adjusting keys and wrenches before turning the machine on.
- **ALWAYS** remain a minimum of **24 inches** away from the machine when it is operating.
- **ALWAYS** ensure the dust shroud is lowered to protect against flying particles.
- **NEVER** remove finished parts or reach over the CNC work table while the machine is cutting.
- **ALWAYS** secure stock to the spoil board with screws, clamps, or blocking. **NEVER** use hands to secure work.
- **NEVER** operate the CNC router without the assistance of the Lab Coordinator.
- Only machine materials on the acceptable materials list.
- **DO NOT** operate the CNC router if water is present around the machine.
- **NEVER** increase the depth of the cut by inserting less of the shank into the collet.
- If the bit breaks, use the emergency stop control to **STOP** the machine immediately - notify the Lab Coordinator.
- If the bit is producing unusual sounds, **PAUSE** the cutting process immediately - notify the Lab Coordinator.
- Only use tools that are **PROVIDED** by the Digital Fabrication Lab.
- Ensure the tools are **SHARP** and free of cracks. Dull tools create friction and heat that can result in fire.
- **CHECK** stock for defects before cutting, such as knots, cracks, and foreign objects.
- Stay alert at all times when operating or monitoring the machine. Be aware of any other personnel in the vicinity.
- **DO NOT** climb on the machine.
- Never perform any maintenance or cleanup without the lockout power switch in the off position.

Section IV: Chapter 4 - Industrial Robots and Robot System Safety. (n.d.). *OSHA Technical Manual (OTM).* Retrieved from https://www.osha.gov/otm/section-4-safety-hazards/chapter-4

Techno CNC Systems HDS User Manual. (2017). Ronkonkoma, NY: Techno CNC Systems.

CNC Plasma Cutter Safety

A CNC plasma cutter is a computer numerical controlled tool that can cut a variety of different thicknesses of steel ranging from 26 ga to 1 inch.

Please Note:
The Lab Coordinator will provide assistance to set up and operate the CNC plasma cutter. Users will be responsible for monitoring their job during the cutting process.

Hazards:

Point of Operation: Injury can occur if the operator's hands or fingers contact the plasma arc during the cutting process. The workpiece may be very hot after cutting.

Pinch Points: Injury can occur if the operator's hands or fingers become caught between the moving parts of the gantry, rack and pinion, or linear rail systems.

Sparks and Hot Metal Splatter: Injury can occur if sparks or hot metal splatter from the cutting process contact skin or clothing. Fire and explosion can be caused by hot slag, sparks, or the plasma arc.

Ultraviolet Radiation: Serious injury can occur to the eyes without proper protection. Arc rays can burn the skin.

Electrical Shock: Injury can occur if the operator contacts electrically "hot" circuits when the plasma cutter is on.

Fumes & Gases: Fumes and gases are produced from the cutting process that are harmful and must be kept out of the breathing zone.

Safe Working Practices:

- When cutting or gouging, keep the roll-up door **OPEN** and your head **OUT** of the gases and fumes. Ensure there is **ADEQUATE** natural ventilation at the arc to keep fumes and gases away from the breathing zone.
- Ensure the non-flammable screening is in place before cutting and **WARN** others not to watch the arc nor expose themselves to the arc rays or to hot metal spatter.
- **ALWAYS** remain a minimum of **24 inches** away from the machine when it is operating.
- **ALWAYS** ground the work or metal to be cut. Be sure the work cable makes a good electrical connection with the metal being cut or gouged. The connection should be as **CLOSE** as possible to the area being cut or gouged.
- Insulate yourself from the workpiece. Take extra care around the water table and when the workpiece is wet to ensure gloves and clothing remain dry.
- Ensure the floor area surrounding the plasma cutter is clean and **DRY**. **DO NOT** stand in water when operating the machine and **CLEAN UP** any water that splashes out of the water table.
- Keep your body **AWAY** from the nozzle and plasma arc.
- **DO NOT** touch the electrode and work (or ground) circuits with your bare skin or wet clothing when these parts are “hot”.
- Ensure **NO** part of the electrode circuit is touching the work (or ground) when not cutting or gouging.
- **NEVER** dip the torch in water for cooling or plasma cut (or gouge) in or under water.
- Be sure there are **NO COMBUSTIBLE OR FLAMMABLE** materials in the workspace.
- **VENT** hollow castings or containers before heating, cutting or gouging. They may explode.
- **DO NOT** climb on the machine.
- **NO COATED METALS** are allowed. Only cut materials on the acceptable materials list.
- EMF fields may interfere with some pacemakers, users with pacemakers should consult their doctor.
- Never perform any maintenance or cleanup without the lockout power switch in the off position.

American National Standards Institute. (2012). Safety in Welding, Cutting, and Allied Processes (ANSI Z49.1:2012). Retrieved from https://www.aws.org/standards/page/ansi-z491

FlexCut 80 Operator’s Manual. (2019). Cleveland, OH: The Lincoln Electric Company.

Section IV: Chapter 4 - Industrial Robots and Robot System Safety. (n.d.). *OSHA Technical Manual (OTM).* Retrieved from https://www.osha.gov/otm/section-4-safety-hazards/chapter-4

Torchmate 4400 | 4800 User Guide. (2018). Reno, NV: Lincoln Electric Cutting Systems.

Laser Cutter Safety

A laser cutter can cut and engrave a variety of different thicknesses and types of materials including paper, cardboard, chipboard, acrylic, and wood.

Please Note:
Lab student employees will set up and operate the laser cutter.

Hazards:

Pinch Points: Injury can occur if the operator's hands or fingers become caught between the moving parts of the gantry, linear rail systems, or the user door.

Laser Radiation: Exposure to the laser beam can cause serious injury to the eyes and physical burns.

Electrical Shock: Injury can occur if the operator contacts circuits that are electrically "hot".

Fumes & Gases: Some materials can produce toxic and corrosive fumes and gases when cut.

Fire: Exposure to the laser beam may cause ignition of combustible materials which can lead to a fire.

Safe Working Practices:

- The exhaust system **MUST** be on while operating the laser cutter. Fumes and smoke from the engraving process must be extracted from the laser system and exhausted outside.
- Ensure compressed air is provided while operating the laser cutter.
- Materials to be processed must **FIT** completely inside the system for proper operation.
- **NEVER** operate the laser system without **CONSTANT** supervision of the cutting and engraving process.

- Always **REMOVE** all material including scrap material from the machine after use. Scrap material that is left in the laser system including materials that collect in the removable cutting table can be a fire hazard.
- Only engrave or cut materials on the **ACCEPTABLE** materials list.
- **DO NOT** stare at the intense light that appears during the engraving or cutting process for long periods of time or view directly with optical instruments.
- **DO NOT** look directly into the red laser beam or use a reflective surface to redirect or view the red laser beam. Never attempt to view the red laser beam using optical instruments.
- The user door **IS** safety interlocked which will prevent the CO2 laser beam from firing when the user door is opened. The Red Diode Pointer is **NOT** safety interlocked and is automatically activated with the user door open.
- **DO NOT** operate the laser system if any safety features have been modified, disabled or removed.
- **DO NOT** touch the optical surfaces with your fingers, handle optics only by the edge or optical housing. Fingerprints can damage the optical coatings.

Professional Laser Series (PLS) User Guide PLS4.75, PLS6.75, PLS6.150D. (2010). Scottsdale, AZ: Universal Systems, Inc.

Section III: Chapter 6 - Laser Hazards. (n.d.). *OSHA Technical Manual (OTM).* Retrieved from https://www.osha.gov/otm/section-3-health-hazards/chapter-6

Desktop 3D Printers Safety

FDM desktop 3D printers heat and extrude either PLA, ABS, PETG, TPU, ASA, PVA, or PET plastic filament in a series of layers to build parts.

Please Note:
Lab student employees will set up and operate the 3D printers. User interaction will occur virtually through 3DPrinterOS.

Hazards:

Point of Operation: Burns can occur if the operator's hands or fingers contact the extruder or build plate during the printing process. Cuts and abrasions can occur from the sharp edges of 3D printed parts.

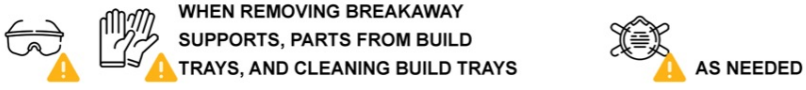
Pinch Points: Injury can occur if the operator's hands or fingers become caught between the moving parts of the gantry or linear rail systems.

Electrical Shock: Injury can occur if the operator contacts circuits that are electrically "hot".

Fumes: Fumes may be produced from the printing process that are harmful and must be kept out of the breathing zone.

Flying Particles: Plastic chips may be projected when removing support material, parts from build trays, and cleaning build trays.

Safe Working Practices:



- Ensure the 3D printer is plugged directly into a grounded electrical outlet. **DO NOT** use an extension cord or power strip
- **DO NOT** reach into the printer's work envelope while the printer is printing.

- **DO NOT** touch the extruder heads or print bed when they are heated. The extrusion head tips get very hot.
- **REMOVE** all other layers from a previous build to avoid a head collision that may result in system damage.
- When prompted, remove a completed part from the build chamber. **DO NOT** press “yes” when asked if the part has been removed, if the part has **NOT** been removed.
- If a print has failed, and the printer is still printing, **STOP** the printer immediately.
- Ensure there is adequate **VENTILATION** while the printer is operating. Keep the 3D print room door **OPEN** when printing to allow for maximum airflow.
- Appropriate respiratory protection must be worn when post processing 3D printed parts (sanding, grinding, polishing, etc.)

Roth, G. A., Geraci, C. L., Stefaniak, A., Murashov, V., Howard, J. (2019). Potential occupational hazards of additive manufacturing. *Journal of Occupational and Environmental Hygiene, 16*(5), 321-328.

Maker Select Pro Ultimate 3D Printer User’s Manual. (n.d.). Brea, CA: MONOPRICE.

User Guide Creator Pro Desktop 3D Printer. (n.d.). Jinhua, Zhejiang, China: FlashForge.

User Guide Guider II Desktop 3D Printer. (n.d.). Jinhua, Zhejiang, China: FlashForge.