

 **West Texas A&M University**TM
ACADEMIC RESEARCH ENVIRONMENTAL HEALTH AND SAFETY
STANDARD OPERATING PROCEDURES

SOP No. 24.01.99.W1.02AT WTAMU Hot Shop: Glass Furnace and Kiln Safety

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Environmental Health and Safety at WTAMU is composed of two distinct but integrated environmental safety departments that report to the Vice President of Research and Compliance.

Academic and Research Environmental Health and Safety (AR-EHS) is responsible for research and academic related compliance, which includes laboratory and academic research and the associated compliance committees. Fire and Life Safety (FLS-EHS) is responsible for fire related compliance and conducts fire and life safety inspections of campus buildings and assists with the testing all fire detection and suppression systems.

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1. Purpose

This procedure is written to ensure oversight and operations of the GLASS FURNACE, GLASS KILNS/ANNEALERS and CERAMIC ELECTRIC AND GAS KILNS is conducive to a productive environment for faculty, staff, students, and visitors. This procedure advises and provides guidance for compliance with regulations that apply to all public buildings on the WTAMU campus and all WTAMU facilities. This will help prevent occupational exposures to potentially harmful air contaminants, heat, and other potentially harmful operations and materials.

2. Scope

This procedure applies to all buildings and structures owned by West Texas A&M University, to all employees and students of the University, to all occupants of university buildings, and the external organizations who work in or use any WTAMU facility.

Definitions:

- A **glass furnace** is an enclosed structure to apply heat to glass and contribute to its production, according to the website Glass Online. Glass furnaces are usually used to melt a batch of glass, maintain working supplies of molten glass (as it must be heated in a certain temperature range to be malleable), and to reheat partially formed objects via a glory hole. The HOT SHOP at WTAMU uses a pre-melted glass. No “raw” batch is to be used. It is critical for the operation of the furnace that it is continually operated 24 hours a day and is only to be turned off during maintenance. Operating temperatures range from 2000° F – 2400° F. – **Continuous Operation**
- A **glory hole** is a reheating device similar to a metal forge. Glory holes are most commonly gas fired with burner perpendicular to the working opening. The opening must have an aperture door system to gradually change the size of the working opening. A glory hole is an important part of a soft glass, or soda-lime glass production in particular and is used to heat or reheat glass that is being formed. Glass is only malleable when hot. Soda/lime glass cools relatively quickly, requiring that all objects be reheated on a regular and continual basis the entire time that the object is being worked. **Intermittent Operation**
- A **glass kiln or annealer**, is an oven used in the production of glass and serves many purposes. Specifically, an annealer refers to a kiln used for the slow and calculated cooling of the glass in all methods of forming glass through the application of heat including the blowing and kiln forming processes. The operating temperatures for this equipment range from room temperature (approximately 70° F) to 950° F, depending on the required annealing temperature specific to the glass composition. Kiln forming - slumping/fusing, mold melting and enameling are done in the GLASS KILNS specified. This process is performed at varying temperature and exceeding the annealing temperature. GLASS KILNS used for kiln forming processes are operated from room temperature (approximately 70° F) to 1680° F. It should be understood that these can also operate as ANNEALERS for the blowing process. If glass is not cooled / annealed properly it will create stress and instability. The cooling of glass is directly related to the composition and especially the thickness. As the thickness changes the time grow exponentially. GLASS KILNS/ANNEALERS must never be opened higher than 100° F when coming down. Depending on the glass thickness and the specific operation, the GLASS KILNS used may operate continuously from 8 hours to 30 days or more. Certain GLASS KILNS may be used to fire ceramics to facilitate the timely production of the students work to meet course deadlines outlined in the course syllabus. The designated Faculty must approve all scheduling and use of the GLASS KILNS,

regardless of process. Only approved Faculty and Graduate Assistants, under the direction of the designated Faculty, will operate all GLASS KILNS/ANNEALERS.

- A **ceramic kiln** is a furnace used in the production of Ceramics (items composed of clay) and serves many purposes. The operating temperatures for this equipment range from room temperature, approximately 70 degrees F, to 2350 degrees F, depending on the required firing temperature specific to the ceramic process or glaze. A CERAMIC KILN may be fired using natural gas, propane, electricity, wood or other combustible material.
- The primary difference of a GLASS KILN/ANNEALER and a CERAMIC KILN is the operating temperature, atmosphere, construction and length of continuous operation. Glass requires much more control in temperature and environment. Ceramic materials (refers to objects created using clay) are more accepting and resistant to thermal shock in comparison to glass which requires extended heating and cooling times for the glass to be considered safe and stable without stress. Another difference between the industries is the consideration for environmental and safety. GLASS KILNS/ANNEALERS produced by professional manufacturers other than those producing CERAMIC KILNS are generally more efficient and safer to operate. It is the preference of glassmakers to have elements/heating coils on all surfaces. GLASS KILNS/ANNEALERS must have elements on all the walls, depending on construction. Front loading GLASS KILNS/ANNEALERS will have at least three walls with elements/heating coils. It is preferable to have all surfaces covered. The GLASS KILNS/ANNEALERS in the WTAMU HOT SHOP have elements/heating coils on three walls and the floor. This is very important for properly annealing glass and efficiency of the GLASS KILNS/ANNEALERS. Due to the differences in temperature GLASS KILNS/ANNEALERS will primarily use NiChrome for the elements/heating coils whereas CERAMIC KILNS use FerroChrome or Kanthal elements/heating coils. The manufacturers of all GLASS KILNS/ANNEALERS and CERAMIC KILNS state that “kilns should not be located in a room that exceeds 105.5 degrees Fahrenheit (40.8 degrees Celsius) or less than 30.5 degrees Fahrenheit (.8 degrees Celsius) as damage to the electronic components may result.” – *Skutt Operating Manual, Skutt Ceramic Products, Portland, Oregon.*
- GLASS FURNACES burners inject fuel and an oxidizer, generally propane and forced air or natural gas and forced air. Some GLASS FURNACES, such as the one operated in the HOT SHOP at WTAMU, use recuperation which provides preheated air prior to ignition. The burner is mounted externally and fires into the combustion chamber. This process creates temperatures in glass furnaces that may reach as high as 2400 degrees Fahrenheit. GLASS FURNACES AND KILNS/ANNEALERS should be operated with a PID controller that allows for ramping.
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3. Procedures

3.1 Yearly inspections

Annual inspections and evaluations of glass furnace and kiln systems, work areas, and related equipment should be performed by EHS to ensure safe operation, cleanliness, and effective

performance of the environmental control systems, laboratory work areas, and related equipment. This will reduce the risk of potentially harmful exposure to faculty, staff, students, and visitors. Records will be kept and maintained by EHS documenting all investigations, evaluations, and maintenance operations.

3.2 Glass Furnace and Kiln Safety Procedures

The Principal Investigator (PI), Designated Faculty/Instructor, and EHS will also conduct inspections and training for safe operations of glass furnaces or kilns used in conjunction with any Fine Arts course (faculty/student research, or public exhibition).

Safety Investigation Protocol:

- Investigating complaints from building occupants.
- Performing visual assessments of the workplace; for example, unsecured equipment, potential electrical hazards, potential flammable hazards, etc.
- Conducting appropriate environmental monitoring.
- Recommending appropriate corrective measures.
- The PI or Designated Faculty/Instructor will maintain record keeping and retention for future reporting and evaluations. All record keeping and retention will be in compliance with A&M policy and the specific discipline. The format for this process will be defined by EHS and the PI or Designated Faculty/Instructor.

4. Responsibilities

4.1 Furnace and Kiln Safety Responsibilities:

Read, understand and implement the installation and operating manual as well as the controls manual before operating your GLASS FURNACE OR KILNS/ANNEALERS. Please direct any and all questions to contact the PI or designated safety officer.

GLASS FURNACE OR KILNS/ANNEALERS are as safe as any other electrical appliance when used under normal and proper operating conditions. To create and maintain this safe environment, observe all safety precautions.

The staff working in and around furnaces or kilns must maintain a monthly report documenting maintenance records, work assignments, periodic training opportunities, and injuries.

4.2 Emergency Shut Off Provision

The GLASS FURNACE AND KILNS/ANNEALERS power supply connection (plug/receptacle, breaker or disconnect) acts as the emergency electrical power shut off. Access to these devices should be unobstructed and safe at all times.

All electrical installations for direct-wired models (those without a plug/receptacle connection) must include a power disconnect near the GLASS FURNACE, GLORY HOLES AND KILNS/ANNEALERS and that is easily accessible and safe for emergency power shutoff.

Additionally, the GLASS FURNACE AND GLORY HOLES have redundant safety systems that allow the equipment to only run if all systems are complete operable. These include, UV/flame sensors, high and low-pressure gas sensors linked to solenoids and air pressure sensors linked to solenoids. If any of these are not complete the fuel will not be allowed to flow and prevent the equipment from operating.

4.3 Electrical Safety

A licensed electrician should be used for all electrical installation and service. All applicable local, state and federal electrical codes must be followed.

Use correct voltage, wire size and fuse or breakers. GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS electrical requirements are located on the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS nameplate or within the designated control panel. Make sure all electrical connections are tight. Avoid using aluminum wire. GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS require the use of TGGT - high temperature wire in certain locations and under certain conditions. Most KILNS/ANNEALERS of any quality and meeting the standards of the industry as well as code will also have redundant fusing to protect all components with the control system.

Always use the proper electrical receptacle. Never alter the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS cord-set or cord-set plug. Alterations can be dangerous. Alterations will void any warranties along with nullifying any Listing Agency markings.

EHS recommends that a voltage check be performed before placing the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS into service, ideally before actual purchase. The GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS operating voltage (printed on the glass furnace or kilns nameplate or in the control panel) must match the applied voltage (actual electrical service voltage). If it does not, do not install or operate the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS as potential electrical and fire hazards exist.

The GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS must be properly grounded.

Unplug or disconnect the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS from the electrical service before accessing the chamber for servicing or vacuuming. Do not attempt to touch or replace the heating elements while any KILNS/ANNEALERS are plugged in or connected to the electrical service. Before servicing the appropriate power should be shut off using any power switch located on the equipment, then the safety disconnect and finally the main breaker. Failure to comply or follow this policy may result in electric shock, serious injury or death.

Only the appropriate cord that meets the electrical requirements of the equipment may be used. This may only be done in intermittent or temporary use or for use in emergency situations such as a power outage.

4.4 GLASS FURNACE or KILN Location Safety

The best location for the glass furnace or kiln is a concrete floor. If not available, GLASS FURNACE OR KILNS/ANNEALERS must be placed on a minimum of 2" of masonry extending at least 12" beyond the outside perimeter of the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS.

Do not place or use GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS on combustible surface.

The surface on which the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS are placed shall be capable of safely supporting the combined weight of the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS, load and any operating personnel.

Observe all building, fire and safety codes when installing the glass furnace or kiln.

Do not install the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS closer than 12" (31cm) from combustible wall surface or object or 36" from any ceiling surface in all opened and closed positions.

Install in a covered, well-ventilated area that is not open directly to the elements and maintains an ambient operating temperature of 40-100° F.

Never place the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS in a small, enclosed area such as a closet, cabinet or very small room. The room in which the glass furnace or kiln is placed into service shall be capable of safely dissipating all heat produced by the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS.

It is the user's responsibility to be knowledgeable regarding any and all contaminants, produced by the ware during firing, and take steps to properly and legally contain and dispose of these contaminants.

It is the responsibility to provide ventilation capable of removing all gases, fumes and other airborne contaminants produced by the ware during firing safely from work the area and building structure.

Do not store flammable or combustible products near or in the same room the glass furnace or kiln such as gasoline, paint, aerosol cans, paper, curtains, plastics, etc. These items must be stored in another separate structure designed for this purpose.

Position the power supply cables, power supply conduit, controller cables, pyrometer thermocouple leads and other materials in such a way as not to create a tripping hazard around the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS and in a way that does not hinder movement around the equipment for normal operation, emergency and meets ADA requirements.

The area around the GLASS FURNACE, GLORY HOLES AND KILNS/ANNEALERS should be free of obstructions that interfere with the proper and safe operation of the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS.

Never place anything under or above the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS for storage. It is common studio and school practice to use the area around this equipment to dry plaster molds. This should be done only with the expressed permission and direction of the PI or designated safety officer.

4.5 GLASS FURNACE or KILN Use Safety

The surface of the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS is hot and burn injuries are possible and common. Keep all children and unsupervised personnel away. Always wear protective clothing, gloves and eyewear when operating and handling a GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS.

Use extreme care when accessing a functioning and/or GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS. The GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS is equipped with a power interrupt/limit switch assembly that is designed to remove electrical power from all heating elements when either the lid or chamber is opened. This power interrupt/limit switch assembly is a mechanical device and it can fail. Under no circumstances should you touch the heating elements with your body or any other devices like tools. Electrical shock may result in serious injury or death. It should be understood that if the switch fails no current will be allowed to flow through the switch as it is a NO (Normally Open) switch.

Use care when accessing or looking into a GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS, this includes looking through a cracked lid or peepholes. High heat escapes quickly and burn injury may result. When accessing or looking into a GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS, approach slowly deliberately with caution and wear; protective clothing and gloves designed to withstand high heat and eyewear capable of filtering Infrared, Ultraviolet light and possibly Soda Flare. All three of these are common and are also produced by the sun.

Protective clothing should be worn when operating the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS. This includes, but is not limited to, cotton clothing, heat resistant gloves and eyewear capable of filtering Infrared, Ultraviolet light and possibly Soda Flare. Under no circumstances are any polycarbon materials such as synthetic fleece or nylon to be worn at any time while operating a GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS

Do not operate the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS over the maximum temperature rating printed on the nameplate, listed in the control panel or printed information from the manufacturer. All operation will be performed by the PI or designated Faculty/Instructor. The operating temperatures are addressed in each course. Please notify the PI or designated Faculty/Instructor as soon as possible if the any of the GLASS FURNACE, GLORY

HOLES OR KILNS/ANNEALERS exceeds the operating hi and low temperature, flame is not present or an error or failure message is shown on the specific computer.

Never fire a GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS unattended beyond its anticipated firing schedule. THE GLASS FURNACE must remain on at all times. This may only be shut-off by the PI or designated Faculty/Instructor

Never allow the power cord to touch the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS. If the cord, plug or receptacle becomes damaged discontinue use and replace immediately.

Do not remove the heat resistant, fiberglass sleeve affixed to a power cable. This sleeve protects the power cable from heat directed from the firing chamber.

If the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS model is equipped with support and safety bars (hold open the lid and/or chamber) be sure that they are secured before releasing the lid or chamber. The hardware used for these support and safety bars should be inspected periodically for damage and wear. If these devices are not operating properly discontinue GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS use until repair or adjustment is made.

It is recommended that a fire extinguisher, capable of extinguishing an electrical fire, be accessible in the event of fire. No water should EVER be used on any GLASS FURNACE, GLORY HOLE OR KILN/ANNEALER.

Keep the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS lid and/or chamber closed when not in use.

It is the user's responsibility to have knowledge of the material intending to be fired. If you are unsure as to the safety of firing a particular material contact your materials supplier for guidance and get approval and guidance from the PI or designated Faculty/Instructor. If you remain unsure as to the safety of firing a particular material do not do it. Firing hazards include materials that explode or produce toxic gases is prohibited. Finished ware hazards include materials containing lead. Materials containing lead should not be used for articles intended for food use.

Fire all ware according to the material manufacturer's instructions. Improper firing may result in damage to the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS or ware.

Do not use the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS to prepare food, heat a living space, dry clothes or ice-laden articles or use as a storage devise. The GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS is designed for one purpose and one purpose only: the firing of glass materials.

All GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS models not equipped with an automatic shutoff devise (electronic control or glass furnace or kiln sitter) must not be allowed to exceed the rated operating temperature indicated on the glass furnace or kiln nametag. To

prevent GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS from exceeding this maximum temperature disconnect it from the electrical power supply.

A GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS will remain very hot long after the firing is complete. All safety recommendations should be followed, even with the glass furnace or kiln unpowered, to avoid any burn injuries. Keep children and other unauthorized personnel away.

This is not applicable and may cause damage to the electrical components and should only be performed by the PI or designated Faculty/Instructor.

4.6 GLASS FURNACE or KILN Maintenance Safety

Disconnect electrical power from the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS before performing any GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS maintenance. Failure to disconnect the electrical power supply may result in electrical shock that can cause serious injury or death.

Replace any worn, damaged or defective parts immediately. Discontinue use GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS until parts are replaced.

When vacuuming the GLASS FURNACE, GLORY HOLES OR KILNS/ANNEALERS use only HEPA filters on the vacuum. Prolonged exposure to dust and other loose refractory materials can cause lung injury if appropriate respiratory precautions are not practiced. It must be understood that standing undisturbed refractory is very safe until it becomes airborne in a particulate.

Inspect all electrical service connections periodically for wear.

Periodically check chamber jacket clamps for tightness. Tighten as necessary.

5. Training

West Texas A&M University Environmental Health and Safety will follow the Texas A&M University System Policy [33.05.02 Required Employee Training](#). Staff and faculty whose required training is delinquent more than 90 days will have their access to the Internet terminated until all trainings are completed. Only Blackboard and Single Sign-on will be accessible. Internet access will be restored once training has been completed. Student workers whose required training is delinquent more than 90 days will need to be terminated by their manager through Student Employment.

6. Record Retention

No official state records may be destroyed without permission from the Texas State Library as outlined in [Texas Government Code, Section 441.187](#) and [13 Texas Administrative Code, Title 13, Part 1, Chapter 6, Subchapter A, Rule 6.7](#). The Texas State Library certifies Agency retention schedules as a means of granting permission to destroy official state records.

West Texas A&M University Records Retention Schedule is certified by the Texas State Library and Archives Commission. West Texas A&M University Environmental Health and Safety will follow [Texas](#)

[A&M University Records Retention Schedule](#) as stated in the Standard Operating Procedure [61.99.01.W0.01 Records Management](#). All official state records (paper, microform, electronic, or any other media) must be retained for the minimum period designated.

Related Statutes, Policies, or Requirements

24.01.01.W1.02AR WTAMU Hazard Communication Program
24.01.01.W1.24AR WTAMU Lockout/Tagout Hazardous Energy Procedure
24.01.01.W1.33AR WTAMU Chemical Hygiene Plan

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