Bowen Laboratory Safety Plan

1.0 General

In order to ensure a safe and productive work environment, the following safety plan was developed to address the needs specific to Bowen Laboratory. While working anywhere in or around the Bowen Laboratory facility, it is the responsibility of the individual to wear appropriate Personal Protective Equipment (PPE) described later in this plan.

It is the responsibility of the individual to comply with this safety plan. Anyone violating this plan will be requested and expected to leave the laboratory until requirements of the safety plan are satisfied. All individuals working in the laboratory shall work together to enforce this plan for students, faculty, andstaff alike. If a student sees a member of the faculty or technical staff working in violation of the plan, theyshould not hesitate to point out the oversight. Violations of the safety plan may result in suspension of an individual's work privileges until those privileges are reinstated by the laboratory safety committee.

Major safety violations shall be immediately reported in writing to the Laboratory Director. Following a major safety violation, or repeated violations, a meeting will typically be held between the student, the faculty advisor, and the Laboratory Director. An immediate suspension of work privileges may be imposed by the Laboratory Director or Laboratory Supervisor based on the nature of the violation(s). The process to evaluate suspension of work privileges, including temporary suspensions of duties, involves the following steps: Based upon the seriousness and/or number of violations of the Safety Rules, a student may be asked by the Laboratory Director to appear before the Laboratory Safety Committee for a decision on suspension of work privileges. Typically, the student and his/her advisor will be asked to appear before the Safety Committee to gather information related to the violation(s) before ruling on a case. Decisions on suspension of work privileges will involve an appropriate time period for the suspension and the nature of the suspended duties.

Horseplay, the use of alcohol or drugs, or inappropriate behavior while working in the laboratory will not be tolerated and will result in immediate disciplinary action. Also, Bowen Laboratory is not to be used for the repair and maintenance of personal vehicles and machinery.

2.0 General Safety Plan

2.1 Clothing

Long pants and steel-toe work boots must be worn by students, faculty, staff, and visitors when working in the high bay, machine shop, basement, small-scale testing lab, outside the laboratory building, and in other areas as designated. Sneakers, tennis and running shoes, or dress shoes are not acceptable for working at Bowen Laboratory but are acceptable if the individual simply needs to walk into working areas for a short duration or to observe a test from a safe distance. Open-toed shoes are not permitted at any time. The use of work boots is encouraged at all times.

Shorts, skirts, dresses, Capri slacks, and athletic work-out clothing are not permitted on the test floor and in staging areas, fabrication areas, machine shop, basement, small-scale testing lab, and work areas outside the laboratory building. They may be worn, however, in the office area and designated passageway zones. The dress code is applicable at all times (24 hours/day, 7 days/week) and for all circumstances (fabrication, setup, gaging, wiring, testing, observing a test, checking control/data acquisition systems, cleanup, examining specimens, discussing technical activities, etc.). Exceptions to thedress code may be granted under special circumstances by the Bowen Laboratory Director. Anyone violating the dress code will be asked to comply or will be expected to vacate all but the office area.

Long sleeve shirts should be worn if operating grinding equipment or performing hot work (welding and torch work). Loose-fitting clothing, such as lab jackets, ties, etc., should not be worn when

operating the sanding belt or other rotating equipment where such clothing could become tangled or caught in the equipment.

2.2 Personal Protection Equipment (PPE)

Personal protective equipment consists of, but is not limited to, the following: protective clothing, respiratory devices (respirators), shields, hardhats, gloves, and eye and ear protection. In addition, individuals shall use PPE to protect against chemical, radiological, biological, or mechanical hazards and irritants capable of causing injury or impairment through absorption, inhalation, or physical contact. Purdue University policy is that personal protective equipment be provided, used, and maintained in a sanitary and reliable condition.

Purdue's PPE policy, which can be found at http://www.purdue.edu/REM/home/booklets/PPEPolicy.pdf, will be utilized at Bowen Laboratory. This policy implements the PPE requirements of the Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1910.132 - 29 CFR 1910.140.

A hard hat and eye protection are required in most Bowen Laboratory areas including the high bay, machine shop, basement, and other areas as appropriate (such as when work is being conducted outdoors). The eye protection and hard hat policies are provided in Sections 3.0 and 4.0, respectively. General eye protection is required of everyone entering the work areas. Specific tasks and equipment require additional eye protection measures. Hardhats and safety glasses for visitors are stored immediately outside the doorway leading to the lab floor from the lobby area.

Hearing protection should be used when using equipment that is particularly noisy. The use of grinders on metals, rivet installation, and impact wrenches to tighten bolts are examples of particularly noisy activities. In such cases, disposable earplugs or earmuff hearing protectors should be used. Earbuds used for musical devices are not considered ear protection and shall not be used in the Laboratory areas of the Bowen Lab; earbuds may be used only in the office area of the lab.

Hard hats, gloves, ear plugs, hearing protection, safety glasses, goggles, face shields, dust masks, harnesses, and other protective equipment can be acquired from the laboratory technical staff (not project technical staff, employed by individual projects). This equipment should be used as needed to ensure safe working practice. See a member of the laboratory technical staff for proper use of this equipment. Respirator use is restricted to people who have taken the respirator training course and respiratory medicalexam.

2.3 Limits on and Required Training for Equipment Use

Before using any of the common power tools in the laboratory, students are required to demonstrate to the laboratory technical staff proper use of those tools or undertake formal training by the laboratory technical staff in the use of power tools. A list of common power tools will be kept on file for each student, and it will be initialed and dated by the student and a member of the laboratory technical staff adjacent to each item for which the student has demonstrated proficiency. Safety glasses, goggles, or face shields shall be worn, as appropriate, when using this equipment.

For equipment use under all of the following categories, except hydraulic equipment and pre- or post-tensioning of strands, tendons, or thread bars, students must obtain permission from their faculty supervisor(s) and the laboratory technical staff before undergoing training by the laboratory technical staff. Failure to demonstrate proficiency in use of equipment for which the student received training, either from the laboratory technical staff or through a formal training program outside Bowen Laboratory, may result in permission to use the equipment being denied by either the faculty supervisor(s) or the technical staff.

All tools must be cleaned and returned to their proper storage location at the end of the work day.

Forklift, Bobcat, and Walkie-Stacker

Only technical staff and faculty who have received formal training and certification in forklift (class V) and Bobcat (class VII) use may operate these type forklifts. The forklift and Bobcat may not be operated by students at any time.

Technical staff, faculty, and students who have received formal training and certification in the walkie-stacker (class III) use may operate the walkie-stacker.

Bowen Lab Truck and Trailer Use

For use of the Bowen Lab truck with or without a trailer, all employees must first adhere to all REM policies which can be found at https://www.purdue.edu/business/risk_mgmt/Vehicle_Use_Info/index.html. Graduate staff, staff, and faculty may use the truck and trailer if they are an active university approved driver and can demonstrate proper operation and inspection of the vehicle prior to use as described below.

For truck use, the driver must demonstrate knowledge of general maintenance such as checking oil, coolant, and tire pressure and performing a 360-degree visual inspection to identify damage or hanging parts. Knowledge of the payload capacity of the truck must be demonstrated, and the capacity must not be exceeded. The driver will also be required to perform a driving test to demonstrate that they can navigate, park, dock, and maneuver the vehicle in alleys and tight passageways.

For truck and trailer use, drivers must abide by the Purdue Risk Management Procedures for Driver Approval, Vehicle Assignment and Liability Coverage. These operating procedures support the policy on Use of Vehicles for University Business and state "Any individual who will be towing a trailer while operating a Vehicle for University Business must have towing experience or have received at least two hours of behind-the-wheel towing instruction. Departments and drivers may contact the Risk Management Department for access to training modules regarding trailer towing."

Crane and Chain Hoist Use

Students are permitted to operate the cranes in the high-bay area for only light, routine lifts (less than 8,000 lb and not exceeding 10 ft in length), and only after receiving training from the qualified laboratory technical staff member. Heavier lifts or unusual lifts (e.g., those having a non-standard shape that is susceptible to sudden movement or instability) will be performed by only the laboratory technical staff. Under unusual circumstances, heavier and/or non-routine lifts may be performed during regular working hours by students if approved by the faculty supervisor(s) and the laboratory technical staff. The designated form for these lifting exceptions must be filled out and signed by the Faculty Advisor, Student, and the Laboratory Manager. The lifting exceptions may be revoked at any time depending on situation.

Students are permitted to use the chain hoists in the Machine Shop, Geotech Area, and IISL Lab only after receiving training from the qualified laboratory technical staff member. This may either be done through the crane training or a chain hoist only class.

All cranes and chain hoists in the lab may only be used during normal working hours when the Technical Lab Staff is present. If use of this equipment is desired outside of normal operating hours a request must be made and approved by the Lab Manager, Lab Director and Faculty Advisor.

Hot Work

Welding – Students must demonstrate having received formal training for performing a particular type of weld, or successfully demonstrate to their faculty supervisor(s) and the laboratory technical staff the ability to perform that particular type of weld. Students are not permitted to perform structural welding (joining elements along a load path that forms part of a resistance mechanism in a test specimen or loading apparatus) unless they have certification for such welding.

Torch Work – Students must demonstrate having received formal training in the use of torches (oxy-acetylene, plasma, or carbon air arc), or successfully demonstrate to their faculty supervisor(s) and the laboratory technical staff the ability to properly use torches.

When welding or cutting using thermal methods, individuals are required to wear special goggles

and/or a face shield and appropriate clothing. Welding shields are to be placed to protect passersby from weld arcs and airborne debris. Never look directly at welding operations without proper eye protection.

Machine Shop Equipment

Students are permitted to use the small drill press, vertical band saw, horizontal band saw, grinder, and disk/belt sander after receiving training from the laboratory technical staff. Students may use the radial-arm drill press after undergoing training by the laboratory technical staff and demonstrating for a member of the laboratory technical staff and their faculty supervisor(s) proficient use of the equipment. Students may not use the milling machine or lathes unless they can demonstrate to the laboratory technical staff and their faculty supervisor(s) that they have received previous formal training and are proficient in the use of these machines.

Hydraulic Equipment

Students must have hydraulic equipment setups (both closed and open-loop systems) inspected and approved by the laboratory technical staff after the hydraulic system has been assembled and before introducing pressure into the system. Systems will be tagged once they are approved.

The valves for the pressure outlets on the four MTS manifolds in the basement will be tagged and locked out when not in use. If a test is temporarily stopped, then the manifold valve should be closed until the test is resumed. However, the valves will be closed, tagged, and locked off for MTS pressure outlets that are connected to the manifold but have been inactive for more than one month.

Pre- and Post-Tensioning of Strands, Tendons, and Thread Bars

Students must have a faculty supervisor or laboratory technician present when using hydraulic equipment to tension the first prestressing strand, tendon, or high-strength thread bar in an experimental setup. Prior to performing a tensioning operation for the first time, the student must submit to the laboratory technical staff or faculty supervisor(s) calculations used to determine the pressure needed to produce the desired force in the hydraulic ram used for tensioning. In addition, prior to conducting tensioning operations, those in the immediate vicinity as well as those in line with (in front or behind) the elements being tensioned shall be notified of the impending tensioning operation.

Inserting Thread Bars into the Strong Floor

Before inserting thread bars into the strong floor, students must survey the basement area directly beneath the location where they intend to insert thread bars to avoid conflicts with personnel and existing test setups or items that have been stored in the basement. While inserting thread bars into the strong floor, someone must be stationed in the basement and in direct radio communication with the person(s) inserting the thread bars. If thread bars project into the basement so that bar ends are not more than 7.5 ft above the floor, the bottom end of each bar must be covered in foam padding or some other form of protection. After thread bars are removed from the strong floor, floor caps must be reinserted to prevent a tripping hazard on the strong floor.

UAV Use at Bowen Laboratory

UAV may be operated only within the Bowen Laboratory high bay; UAV operation is strictly prohibited on any Bowen Laboratory property outside of the high bay, unless written permission is requested and provided by either the Laboratory Manager or Director. UAV operators must demonstrate competence to control and maneuver the craft to the Laboratory Manager or Director. Whenever a UAV is used inside Bowen Lab there must be both an operator and a spotter. The purpose of the spotter is to watch the surrounding area and ensure that no one walks into the portion of the Laboratory where a UAV is being used. The UAV must be kept in the operator's line of sight and clearly observable from their position on the ground. In no case are any personnel to be below the UAV being used. The operator and members of the research team must ask written permission to photograph any set-ups, specimens, equipment, etc. in the laboratory.

2.4 Fall Protection

Fall protection equipment must be used for all activities performed above six (6) feet for construction activities and four (4) feet for testing applications where enclosed railings are not available (see Purdue University fall protection policy). Fall protection equipment and training on proper use will be obtained from the Bowen Lab Laboratory Manager.

The ends of all reinforcing bars protruding beneath workers will be covered with reinforcing bar caps designed to provide protection against impalement.

Safety provisions should be taken to protect personnel when one of the two hatches on the strong floor are used to access the basement area of the laboratory. A warning line or controlled access zone should be erected around the hatches when they are opened up for access. Moreover, personnel working within the warning zone and adjacent to the open hatch should wear a harness with a lanyard tied off to an adequate support to protect against falling into the open basement area.

2.5 Housekeeping

Clutter in a fabrication, preparation, or test area can lead to slips, trips, and falls. Keep all work areas and aisles clean and free of debris. Identify and place warning cones or signs at potential trip or sliphazards. Inform the laboratory technical staff of any hazardous conditions. All laboratory personnel are expected to participate in periodic laboratory clean-up events which are intended to ensure a neat and safeworking environment.

2.6 After Hours Work

Work is permitted in or outside the laboratory after normal working hours, but an additional person must be present or notified of the work activity. (See Two Person Rule in Section 5.0).

2.7 Incident Reporting

All accidents should be reported to the laboratory Director, senior laboratory manager, and faculty supervisor(s) as soon as possible after the occurrence. All safety incidents and potential hazards should be reported to the laboratory Director and senior laboratory manager. Near-miss incidents should be reported using the REM self-reporting form available on the intranet. Equipment problems should be reported to the laboratory technical staff.

3.0 Policy on Eye Protection

3.1 Objective

The policy on eye protection is intended to enhance safety in the laboratory.

3.2. Policy

All laboratory areas, except offices, conference rooms, the lobby, and designated passage zones, are designated as requiring general eye protection. General eye protection is required of everyone entering the high bay, machine shop, basement, instrumentation room, microscope room, and other experimental research areas inside or outside the laboratory, regardless of affiliation with Purdue University and regardless of the reason for entering the laboratory areas (i.e., working or observing). In addition, specific activities are designated as requiring special eye protection (examples: use of power tools, hot work, chemicals, etc.). General eye protection is required only as needed in the small-scale testing room: specifically, when the Baldwin testing machine is in use, when any swivel valve on the outlet pressure manifold for the servo-hydraulic equipment is in the open position, or when any testing or test set-up work is underway.

Acceptable general eye protection includes, but is not limited to:

- Prescription lenses (personal daily glasses) as long as the lenses cover the area from the eyebrow to the cheek.
- Prescription safety glasses
- Commercial safety glasses
- Commercial safety glasses that fit over prescription lenses.

Some specific tasks and equipment require additional measures to ensure adequate eye protection. Tasks and corresponding eye protection include, but are not limited to those listed in the following table.

Task	Eye Protection Required
Testing	Glasses with safety lenses and side protection, safety glasses, safety goggles, or full face shield
Power Tools - Grinding, drilling, machining, sawing, etc.	Glasses with safety lenses and side protection, safety glasses, safety goggles, or full face shield
Hydraulics - Connecting pipes, hoses, etc.	Glasses with safety lenses and side protection, safety glasses, safety goggles, or full face shield
Chemical	Goggles or face shield
Torch soldering & thermal cutting	Safety glasses with appropriate shading
Welding, oxygen or plasma arc cutting	Face shields with appropriate shading
Applying load with hydraulic rams using either servo-controlled or other mechanical means	Glasses with safety lenses and side protection, safety glasses, safety goggles, or full face shield

3.3. Supply of Eye Protection:

Non-prescription commercial safety glasses will be provided by Bowen Laboratory. One pair of safety glasses will be issued by the laboratory technical staff to each person requesting safety glasses. It is strongly recommended that care be taken to minimize damage to or loss of the glasses.

For all personnel working in the laboratory who have prescription lenses, personal daily glasses that meet the cheek to brow requirements are sufficient for general eye protection. If the personal daily glasses do not meet the cheek to brow requirements, either commercial safety glasses over the personal daily glasses or prescription safety glasses are required.

Laboratory technical staff: Purdue University will provide ANSI approved prescription safety glasses with side shields (permanently attached or attachable) for staff not having acceptable personal daily glasses. The purchased glasses must meet all safety glass usage requirements. Additional protection for specific cases (goggles or face shield) must be used as appropriate. Alternate personal daily glasses will not be provided.

Students, researchers, & other personnel working part-time in the laboratories: The Principal Investigator or Supervisor will be responsible for evaluating the project needs and establishing whether purchase of ANSI approved prescription safety glasses is warranted. It is up to the PI to provide project funds for prescription safety glasses. Bowen Laboratory funds will not be available for prescription safety glasses.

4.0 Policy on Hard Hats in Bowen Laboratory

4.1. Objective

The hard hat policy is intended to enhance safety in the laboratory.

4.2. Policy

Faculty, students, and staff are required to wear hardhats whenever they are in the high bay, machine shop, and the basement. Hard hats are also required when work is being performed outside the laboratory. Hard hats are required only as needed in the instrumentation room, small-scale testing room, microscope room, and designated architectural engineering lab rooms when work is underway that could

potentially cause head injuries. Hard hat protection is required only as needed in the small-scale testing room: specifically, when the Baldwin testing machine is in use, when any swivel valve on the outlet pressure manifold for the servo-hydraulic equipment is in the open position, or when any testing or test set-up work is underway.

4.3. Supply of Hard Hats

A hard hat will be issued by a member of the laboratory technical staff to each person submitting a request. Please place your name in or on your hard hat. Do not store your hard hat on the lab floor. Keep your PPE at your office workspace or in an assigned locker.

Hardhats for visitors are stored immediately outside the doorway leading to the lab floor from the lobby area.

5.0 Two Person Rule

5.1. Issue

The operation of some Bowen Laboratory equipment can, in an instant, produce an injury where the operator could be rendered incapable of helping themselves or calling 911.

5.2. Rationale

At times, it is necessary to have a work partner in order to ensure students, faculty, and staff do not place themselves at unnecessary risk. A “two person” rule applied in a testing laboratory environment provides an increment of safety unavailable to an individual working alone.

5.3. Policy

Operation of potentially hazardous equipment (e.g. power tools, hydraulic equipment, machine equipment, overhead cranes, hot work etc.) within Bowen Laboratory or immediately outside the laboratory requires the operator to have another individual (a "buddy") working alongside to ensure his/her safety. During regular working hours, a “buddy” may not be needed if another individual is working in close proximity. The “two person” rule is required for most work conducted outside regular laboratory working hours.

When laboratory technical staff are involved in specimen installation, testing, or tear down of a project, a person with direct knowledge of and responsible for the project should be working directly with the technical staff to ensure safety and proper handling of test pieces. In the rare cases where it is impossible for such a person to be present, at a minimum, it must be confirmed that 1) those with such knowledge have worked with those performing these tasks previously and are satisfied the work can be done safely in their absence and 2) those performing such work (staff, students, etc.) have a clear understanding of how to perform such work in a safe manor.

Exceptions to the two person rule include, for example, checking briefly on the operation of a fatigue test or collection of data for a test that is underway in the laboratory. In either case, another person inside the laboratory should be notified where you will be and be instructed to check on your well being if you do not return within an agreed-upon time. Once you have completed your work, you should notify the person that they are no longer responsible for your well being.

Emergency Call List

Name	Office Phone	Home Phone	Cell Phone
Prof. Bowman	765-494-2220	765-474-4304	765-404-7894
Tom Bradt	317-727-7843		317-727-7843
Kevin Brower	765-494-9370	765-564-6303	765-418-1189
Prof. Connor	765-496-8272	765-589-3945	765-414-3992
Prof. Dyke	765-494-7434		765-409-9924
Prof. Frosch	765-494-5904	765-463-7110	765-404-4232
Prof. Irfanoglu	765-496-8270	765-838-1525	510-507-2921
Prof. Prakash	765-494-6696		650-492-0912
Prof. Sharma	765-496-8368		
Prof. Seo	765-418-3903		765-418-3903
Harry Tidrick	765-494-2232	765-477-9744	
Prof. Varma	765-496-3419	765-463-3357	517-974-0936
Prof. Williams	765-494-5828		618-218-6912
Purdue Police	DIAL 911 FROM CAMPUS PHONE		
Purdue Fire Dept.	DIAL 911 FROM CAMPUS PHONE		

A shaded cell is the preferred phone number.