

AOE DEPARTMENT SAFETY REVIEW FORM FOR **EXPERIMENTAL RIGS**

In the context of this form 'rig' refers to any potentially hazardous piece of equipment whose safe operation requires more detailed instructions and procedures than can be included in the Experimental Workspace Safety Review form for the area in which the rig is housed. Examples include a wind tunnel, laser system, high pressure tank, material testing machine, rotating system.

Before any such rig in the Department of Aerospace and Ocean Engineering is brought into operation, and **at least once per year** thereafter, a copy of this form must be completed, signed and submitted by the responsible faculty/staff member (usually the principal investigator). When an existing rig undergoes modifications which could affect its safety, a new copy of this form must be submitted by the responsible faculty/staff member at that time, and before it is operated again.

Completed forms should be submitted to the AOE Assistant Department Head for Facilities (Michael Philen) and should also be made available to other faculty/staff with relevant expertise, or with direct involvement in the rig or space where it is housed. Any advice resulting from this interaction should be copied to the Assistant Department Head, as well as being transmitted back to the responsible faculty/staff member. Once the responsible faculty/staff member is satisfied that all safety concerns have been met the final version of the form should be signed and submitted and a copy displayed in a prominent position on or adjacent to the rig and on the department safety website. The responsible faculty/staff member may then authorize its operation. Under no circumstances may a rig be operated without a completed, current copy of this form prominently displayed.

Date of form 8/29/2023..... Form expires (no more than 1 year after form date): 8/15/2023.....

Name of Rig Boundary Layer Wind Tunnel.....

Workspace where rig is located Corporate Research Center Research Building 2 suite 101
Include room, building and name given to the space on the EHS training website.

Faculty/staff member responsible for the rig and its safety Todd Lowe

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1. An evaluation of the above rig has been performed and the following safety risks have been identified (append details where necessary):

- Risk of injury from obstruction of flow path or tunnel exhaust. Air is driven through the wind tunnel using a fan located at its upstream end. Substantial obstruction of the flow path or exhaust could raise the pressure upstream of the obstruction that may cause segments of the wind tunnel walls to pull out of their mounts. Objects then falling into the flow path could then strike a person standing downstream.
- Risk of physical injury from the external and internal tunnel structure, attachments, probes and glass windows. Many parts of the facility and its attachments have sharp projecting edges or points. Walking into or otherwise striking these (such as by tripping on cables) when in or around the tunnel has the potential to cause injury. In addition, one test section has glass walls, while glass windows are used in other applications with this rig. Given the use of metal tools, there is a risk of breaking the glass and being cut.
- Risk of fan failure. As with all systems employing centrifugal fans there is a small risk of fan blade failure. Failure of fan blades could result in physical injury from flying debris.

2. The following actions have been taken to minimize those risks (append details where necessary):

Risks have been mitigated by developing an operating procedure, as describe in section 3.

3. A safe operating procedure has been developed (attach the procedure to this form). This includes protective equipment to be worn, whether users may operate the rig alone and, if necessary, precautions to be taken by others working in the same laboratory. The procedure is in a form suitable for posting on the rig.

The Boundary layer wind tunnel (BLWT) is a simple electrical blower-driven rig with conditioned airflow that passes through a rectangular section of approximately 4" x 9" cross-section. At this cross-section, it is possible to adapt the flow to a number of test sections and uses. To follow, the standard operating procedures for the rig will be presented follow by precautions when using the rig. As with any rig, safety is the responsibility of all users and care should be taken to follow good lab practices, such as leaving a tidy work area daily, never modifying others' setup and instruments without first obtaining permission, using personal protective equipment (PPE) as required, providing proper warnings via door signage to notify other users of possible risks, and keeping the walk-space clear of all obstructions. To operate the tunnel, the following steps are required:

- 1.....Examine the room, experimental setup, test section and instrumentation to ensure that no foreign objects are present in the flowpath or around the shaft of the blower.
- 2..... If using laser diagnostics, refer to the procedures for the system being used to ensure proper controls are in place for safeoperation.
- 3.....Check that all unused flow access ports, such as the tubes into the plenum, are terminated to avoid flow leakage.
- 4.....Turn on the room ventilation hood via the switch that is in the adjacent laboratory.
- 5.....Once all steps are prepared for running the experiment, turn on the wind tunnel by pressing the green "Start" button mounted tothe plenum chamber.
- 6..... If using particle seeding, turn on the seeding methods to introduce particles into the flow. When possible, run the seeding onlyduring data acquisition periods.
- 7.....Run the experiments expediently but carefully.
- 8.....Turn off particle seeding and laser diagnostics.
- 9.....Turn off the tunnel by pressing the red "Stop" button that is mounted to the plenum chamber.
- 10....Run the ventilation air for at least 10 minutes following the test to remove all particles from the room.
- 11....Turn off the ventilation air.
- 12.... If experiments are complete, secure all lasers and instrumentation and tidy the space before leaving.

Under normal operating conditions, no PPE is required for operating the tunnel. There are two exceptions:

- 1..... If you will be working with the tunnel in a free jet configuration or you will be working near the exhaust of the tunnel, safety eyeglasses are required to protect against projectiles or debris that could exit the tunnel at high speeds.
- 2.....Anytime a new particle seeding method is to be used, an evaluation must be done including reviews by Prof. Lowe and properprofessionals at EHS. For instance, if chemicals other than water, glycol, DEHS, or mineral oil are to be used, these must be reviewed. Further, if seeding methods change dramatically, such as using seeding at much greater concentrations that previously done, these may warrant additional measures. As a precaution for all instances, if you feel light-headed or short of breath, you should leave the room immediately, seek fresh air and report the incident to Prof. Lowe.

4. Check one and include a list: The rig may only be operated by the following individuals.

The rig may only be operated under the supervision of the following individuals.

(List individuals here)

Todd Lowe, Gwibo Byun, Humza Butt, Monica Shanmugam, Advait Borole

5. The above individuals are all registered on the EHS training website at https://secure.hosting.vt.edu/www.ehss.vt.edu/training/training_report.php and have taken all appropriate safety training courses. Their training is current and is recorded on the EHS website, under the above workspace name. The appropriate safety courses are (list here): Laser safety

Signature of faculty/staff member responsible
for the rig and its safety

Todd Long

Date *8/29/2023*