AOE DEPARTMENT SAFETY REVIEW FORM FOR
EXPERIMENTAL WORKSPACES

Before experimental activities can begin in any room in the Department of Aerospace and Ocean Engineering, 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). 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 space. 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 prominently displayed on the door to the space and on the department safety website. The responsible faculty/staff member may then authorize experimental activities.

Date of form 7/28/25..... Form expires (no more than 1 year after form date): 7/28/26.....

Name and location of workspace Stability Wind Tunnel, Mitchell Hall site.....

Faculty/staff member responsible for Experimental Workspace and its safety William J Devenport.....

Office Address 660 McBryde..... Phone 231-4456 ..... Email devenport@vt.edu .....

GENERAL SAFETY REVIEW

1. The workspace houses the following potentially hazardous experimental rigs. A 'Facility Review Form' has been completed, posted, and is current for each of these.

ONR Rotor Rig, Stability Tunnel Test Section Exchange.

2. An evaluation of the above experimental workspace has been performed and the following safety risks have been identified, in addition to those associated with the above facilities (append details where necessary)

- **Fall risk. The Stability Wind Tunnel is a large facility. Climbing on top of the outside of the facility, or around the plenum, the anechoic chambers, or on top of the test section will place users at risk from falling and resulting injury. In certain configurations gaps may be present in the plenum mezzanine floor or between the chambers and test section which may pose a risk from falling.**
- **Risk of injury from air flow or from fan. The Stability Wind Tunnel can generate air-flow speeds up to 80 m/s. Even at low speeds (<10m/s) anyone in the airflow runs the risk of eye damage from airborne particles. At higher speeds anyone in the airflow runs the risk of physical injury from being blown over. At any speed anyone located close to the fan runs the risk of serious injury from being struck by the fan blades.**
- **Risk of injury from the crane system. Wind tunnel test sections and other large tunnel components are maneuvered using a gantry crane system. The crane system, if misused or used without proper training, poses a significant threat of injury. Items suspended from the crane pose a similar threat.**
- **Risk of injury from the scissor lift system. The tunnel is equipped with a scissor lift. Misuse of this can lead to injury from falling or crushing.**
- **Risk of injury from the Interim Service Facility (ISF) equipment access door system. The equipment access door is heavy and lifted some 12-feet above floor level when open. Door misuse could result in it dropping unexpectedly causing injury or death from crushing.**
- **Risk of injury from misuse of the airlock. When the wind tunnel is in operation, air pressure in the plenum is slightly below atmospheric. Misuse of the airlock in this condition could lead to air flow through the airlock and possible slamming of the airlock doors and thus risk of injury. At high tunnel speeds, the pressure difference across the airlock may impede egress from the plenum chamber.**
- **Risk of physical injury from the sting support, or from models or instrumentation mounted in the test section. A motorized sting support is available to mount models in the test section. This support can move models under power and thus poses a risk to anyone working around a model or the support when it is powered up. Many aerodynamic models and instrumentation have sharp projecting edges or points. Walking into or tripping over these when working in the test section has the potential to cause injury.**

- **Risk of injury from Kevlar window failure. The interior of the anechoic chamber segments may be separated from the air flow through the test section by large tensioned Kevlar sheets. Flow through the test section may be as fast as 80m/s and, depending on the models being tested, the Kevlar windows may be placed under substantial load. Failure of a Kevlar window at high speed would place anyone standing inside the chamber at risk for injury from the torn Kevlar and the airflow itself.**

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

Since the risks described above are inherent in the operation of a facility of this type and size, and in the operation of the peripheral equipment needed to maintain and modify it, risks are minimized by developing and ensuring adherence to safe operating rules and procedures. These are described in attachment 1.

4. All users of this workspace must be registered and are listed on the EHS training website at https://secure.hosting.vt.edu/www.ehss.vt.edu/training/training_report.php. Users have taken all appropriate safety training courses from Environmental Health and Safety. Their training is current and is recorded on the EHS website, under the workspace name Randolph Hall, Stability Wind Tunnel *..... The appropriate safety courses are (list here):*

For faculty, staff, employees, graduate students and undergraduate researchers directly affiliated with the wind tunnel:

Personal Protective Equipment (PPE) Awareness
HAZCOM RTK
Electrical Awareness
Lockout/Tagout Awareness
Portable Fire Extinguishers
Ladder Safety
Fall Hazard Awareness
Laser Safety

Other requirements that may be added depending on individual responsibilities include

Aerial Lift Observation and Training
First Aid/CPR/AED-Adult
Lockout/Tagout Authorized Person
Overhead Crane Observation and Training

Other wind tunnel users include personnel associated with a particular entry. The training requirements for these users depend on the nature and extent of the work they are performing in the facility, and therefore the hazards that they will be exposed to. The determination for the appropriate training will be made by the faculty member responsible for the entry during the planning stages for the work, with the stipulation that the training be completed before the start of the entry.

ATTACHMENT 1
VIRGINIA TECH STABILITY WIND TUNNEL OPERATING PROCEDURES.
TO BE PROVIDED TO, AND SIGNED BY, ALL USERS

This document describes procedures for users of the Virginia Tech Stability Wind Tunnel. All wind tunnel users must read and sign a copy of this form before beginning work in the wind tunnel. A user is anyone who wishes to enter the wind tunnel facility for the purpose of setting up, performing or assisting with a wind tunnel test.

Safety in the wind tunnel is taken very seriously. This document outlines some identified hazards and procedures that, when followed, my help to reduce risk of injury or damage. Ultimately, however, you the user bear the primary responsibility for your own safety and the safety of others around you.

CONTACT INFORMATION

Wind Tunnel Director: William J. Devenport, devenport@vt.edu, 540 231 4456
Deputy Director: Aurelien Borgoltz, aurelien@vt.edu, 540 231 1959
Research Professor, Nanyaporn Intaratep, nintarat@vt.edu, 540 231 2123

IDENTIFIED SAFETY RISKS

1. Fall risk. The Stability Wind Tunnel is a large facility. Climbing on top of the outside of the facility, or around the plenum, the anechoic chambers, or on top of the test section will place users at risk from falling and resulting injury. In certain configurations gaps may be present in the plenum mezzanine floor or between the chambers and test section which may pose a risk from falling.
2. Risk of injury from air flow or from fan. The Stability Wind Tunnel can generate air-flow speeds up to 80 m/s. Even at low speeds (<10m/s) anyone in the airflow runs the risk of eye damage from airborne particles. At higher speeds anyone in the airflow runs the risk of physical injury from being blown over. At any speed anyone located close to the fan runs the risk of serious injury from being struck by the fan blades.
3. Risk of injury from the crane system. Wind tunnel test sections and other large tunnel components are maneuvered using a gantry crane system. The crane system, if misused or used without proper training, poses a significant threat of injury. Items suspended from the crane pose a similar threat.
4. Risk of injury from the scissor lift system. The tunnel is equipped with a scissor lift. Misuse of this can lead to injury from falling or crushing.
5. Risk of injury from the Interim Service Facility (ISF) equipment access door system. The equipment access door is heavy and lifted some 12-feet above floor level when open. Door misuse could result in it dropping unexpectedly causing injury or death from crushing.
6. Risk of injury from misuse of the airlock. When the wind tunnel is in operation, air pressure in the plenum is slightly below atmospheric. Misuse of the airlock in this condition could lead to air flow through the airlock and possible slamming of the airlock doors and thus risk of injury. At high tunnel speeds, the pressure difference across the airlock may impede egress from the plenum chamber.
7. Risk of physical injury from the sting support, or from models or instrumentation mounted in the test section. Many aerodynamic models and instrumentation have sharp projecting edges or points. Walking into or tripping over these when working in the test section has the potential to cause injury.
8. Risk of injury from Kevlar window failure. The interior of the anechoic chamber segments may be separated from the air flow through the test section by large tensioned Kevlar sheets. Flow through the test section may be as fast as 80m/s and, depending on the models being tested, the Kevlar windows may be placed under substantial load. Failure of a Kevlar window at high speed would place anyone standing inside the chamber at risk for injury from the torn Kevlar and the airflow itself.

GENERAL SAFETY RULES FOR WORKING IN THE WIND TUNNEL

1. All users must obtain the advance approval of the wind tunnel director, deputy director, or the research professor before beginning work in the facility.
2. No person may operate the wind tunnel, or work after hours in the tunnel without a second authorized user present. Note also that no user may operate the fan control unless they are a student or employee of Virginia Tech, have received training and explicit prior authorization from the wind tunnel director or deputy director, see below.
3. No person may be in, or may enter the flow path, when the wind tunnel fan is on.
4. No person may enter the test section area (downstream to the settling chamber screens, and upstream to the first set of turning vanes) unless the speed control key is removed from the tunnel control panel. It is the tunnel operator's responsibility to ensure that the control key is removed and remains removed while personnel are in the test section area.
5. No person may enter any other part of the flow path unless lockout/tagout procedures on the wind tunnel fan are implemented. The wearing of badges and the removal of the control key are not necessary when lockout/tagout procedures are implemented.
6. When one or both Kevlar windows are installed, no user may be present in either of the anechoic chambers at test section flow speeds exceeding 30m/s.
7. While working in the wind tunnel it is your responsibility to know
    a. the emergency shutdown procedure (see below)
    b. the location of first aid and emergency equipment

c. the locations of extinguishers and exits
d. how to call the fire fighters, police or rescue squad (dial 911 from any campus or non-campus telephone).

If you don't know, ASK the authorized operator before beginning work.

8. Users should take extreme caution when working in the test section to prepare or remove a test. Probes, models, model supports, traverse equipment and other items may pose a hazard if sufficient care is not taken.
9. Any models, equipment or instrumentation mounted in the flow path must be carefully inspected and securely fastened before turning on the fan.
10. Users who bring in their own instrumentation, materials or other items for use in or with the tunnel are solely responsible for ensuring that appropriate safety precautions are taken in the use of these items. The wind tunnel director, deputy director or research faculty member may deny use of any such item if they feel safety procedures are inadequate.
11. If in doubt about the safety of performing any test, using any piece of instrumentation, or undertaking any other wind-tunnel related operation, DO NOT proceed. No experimental result or setup is worth an injury. Ask for assistance from the Wind Tunnel the authorized operator.
12. If any component of the wind tunnel or piece of apparatus or instrumentation appears faulty, it is your responsibility to report it immediately to the authorized operator. Breakages of glassware should also be reported.
13. Do not dispose of any chemical substance (down the sink, in the trash can or anywhere else). Disposal of such materials will be handled by the authorized operator. Any chemical spills (however small, e.g. mercury from a thermometer) must be reported to the wind tunnel engineer.
14. It is your responsibility to immediately report all injuries, accidents and "near-misses" that you are aware of to the wind tunnel director or deputy director.

RESTRICTIONS FOR OPERATING THE WIND TUNNEL AND WIND TUNNEL EQUIPMENT

1. No user may operate the fan control unless they are a student or employee of Virginia Tech, have received training and prior approval from the director and deputy director, and are named in the wind tunnel log.
2. Models and other equipment may be mounted in the test section or any part of the flow path only with the approval of the wind authorized operator, the wind tunnel director, or deputy director.
3. No modifications to the test section or any other elements of the flow path may be made without the approval of the wind tunnel director, or deputy director.
4. Users may not operate the gantry crane system, scissor lift system or air-pad system.
5. Users may not climb over the outside of the wind tunnel, on top of the test section or elsewhere where there is a risk of falling.

PROCEDURE FOR OPERATING THE EQUIPMENT ACCESS DOOR

No user may operate the large sliding access door to the ISF unless they have received training and explicit prior approval of the Wind Tunnel director or deputy director. Before attempting to move the door, verify that any clamps have been removed from both the inside and outside, and verify that all personnel are aware and at a safe distance from the door.

SPECIAL CONSIDERATIONS DURING THE CONSTRUCTION OF MITCHELL HALL

1. Wind tunnel users are not permitted to enter any part of the construction site surrounding the facility. This necessitates that all users must enter and leave the facility through the Interim Service Facility Building (ISF).
2. Wind tunnel users are not permitted to enter the old airlock structure, or attempt to open the old equipment access door. Both doors lead to potentially hazardous areas of the construction site
3. Construction-site related concerns, questions should be addressed to the Director or Deputy Director or, in time critical situations relayed directly to the Assistant Project Manager for Mitchell Hall construction, Aaron Curfiss at 540 449 9148 and acurfiss@vt.edu.

PROCEDURE FOR OPERATING THE WIND TUNNEL FAN

No user may operate the fan control unless they are a student or employee of Virginia Tech, have received training and prior authorization from the wind tunnel director or deputy director. To operate the fan the following procedure must be followed.

1. Carefully inspect all models, equipment or instrumentation mounted in the flow path to ensure it is securely fastened.
2. Positively verify that all personnel are out of the flow path and that the test section door is securely fastened.
3. Positively verify that the airlock doors and large access door are closed
4. Turn on the main power at the blue Emerson drive control.
5. Press the green run bottom on the operator console and let warm up for a minimum of five minutes.
6. Slowly increase the speed of the fan until it reads 100 RPM as indicated on the operator console, run for minimum of ten minutes
7. After initial warm up, reduce the RPM to zero, the tunnel can now be operated without any further warm up.
8. Rapid changes in speed should be avoided. Without explicit prior approval from the wind tunnel director or wind tunnel engineer the fan speed may not be operated at speeds exceeding 600 RPM and the fan motor may not be operated with a current exceeding 900Amps.
9. After turning off the fan, it is important to allow time for the flow to stop before re-entering the test section. Flow speed should be judged using the dynamic pressure indicator mounted in the control console.

10. Remember that the tunnel is operating in a brand new environment: if you are not sure about a noise or vibration, do not hesitate to stop the fan and inspect the circuit/test-chamber. Better be safe than sorry.

Note: If outside temperature is less than 32 degrees the wind tunnel engineer must check the temperatures of the fan bearings before the tunnel can be operated.

EXCEPTIONS

Requests for exceptions to the above restrictions will be considered on a case by case basis and only where there is a compelling need. Explicit approval of the wind tunnel director (or, in his absence, the deputy director) is required for any exception and will be conditional on additional safety precautions that may include appropriate training and/or use of suitable safety equipment.

EMERGENCY SHUTDOWN PROCEDURE

In case of emergency press the RED STOP button on the operator console or in the flow path at the diffuser entrance. It is important to allow time for the flow to stop before re-entering the test section. Flow speed can be judged using the dynamic pressure indicator mounted in the control console.

ACCESS TO THE FACILITY AREAS

1. Access to the ISF and Stability Tunnel plenum and test section areas is regulated using key access (key EA-8). Keys will only be provided to authorized operators, and must be returned to the director or deputy director at the end of the associated wind tunnel entry.
2. Requests for access need to be submitted to the Dr. William J. Devenport, Dr. Aurelien Borgoltz or the wind tunnel engineer.at least a day in advance.
3. Users may not grant access to the wind tunnel to unauthorized personnel without prior approval from Dr. William J. Devenport, Dr. Aurelien Borgoltz or research professor.

SIGNATURE

I have read and understand all the above risks, rules, restrictions and procedures. I have been provided with a copy of this form

Name of tunnel user_____

Signature of user _____

To be completed by the Wind Tunnel Director or Deputy Director, only:

☐ This user **is not authorized** as a wind tunnel operator

☐ This user **is authorized** as a wind tunnel operator

Signature _____

Date_____

HAZARD COMMUNICATION PLAN

1. A Chemical Hygiene Plan (CHP) is required for this work space. (The responsible faculty/staff member is required to contact EHS to make this determination before answering this question)
No ☒*. Continue to step 2*
Yes ☐*. Sign below to certify that a current and complete Chemical Hygiene Plan has been completed for this space. Provide the location of the CHP in the workspace* .....

2. In signing below I am acknowledging that I am responsible for managing the Hazard Communication Plan for this workspace, specifically, it is my responsibility to ensure:

- *a) that all workspace users (include students, staff, other faculty) understand and follow this plan through Scheduled HazCom training, all necessary EHS training, and disciplinary action.*
- *b) that a hazardous chemical inventory is compiled and maintained, using the EHS Safety Management System at https://www.ehss.vt.edu/sms/index.php. A list of hazardous chemicals, downloaded from that site, is appended to the paper copy of this form to be posted on the door to the space. Note that consumer products intended for household use, and used in a manner consistent with that intent need not be listed.*
- *c) that all containers of classified hazardous chemicals associated with or stored in the workspace are clearly and prominently labeled, in English, with the original manufacturers label. If that label is not available then a label based on information from the Safety Data Sheet (product name, danger/warning indication, pictogram…) that clearly communicates the hazard to the user will be used.*
- *d) that procedures are reviewed at least annually, on or about the expiration/renewal date of this form.*
- *e) that Safety Data Sheets (SDS) are available for all chemicals in the attached list are available to lab users at (give location)* in the yellow MSDS cabinet located in the air lock.....
- *f) that EHS has been consulted on all other training requirements, and these training requirements have been met and are properly recorded on the EHS training website.*
- *g) that meetings to communicate health hazards associated with the use of all hazardous chemicals and the use of proper PPE will be held*
  - *with all new workspace users before they begin work,*
  - *with all workspace users when a new chemical or other hazard is added to the workspace (and at least annually)*
- *h) that all HazCom information and training of employees will at a minimum meet the requirements of OSHA 29 CFR 1910.1200(h), see below .*

Signature of faculty/staff member
responsible for workspace and its safety  Date 7/27/26 .....

LIST OF HAZARDOUS CHEMICALS

Last Chemical Inventory Submit Date: 2023-07-24

Flammable Liquid (Class IA, IB, IC)

Chemical Name	Total Amount in Storage and Use
Acetone	2 Gallons
Isopropyl Alcohol	4 Gallons
	6 Total Gallons

Corrosives

Chemical Name	Total Amount in Storage and Use
Other	2 gallons Naptha;4 gallons Kerosine
	0 Total

Flammable Solids

Chemical Name	Total Amount in Storage and Use
Napthalene	0.75 Pounds
	0.75 Total Pounds

LOCATION OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

In the Interim Service Facility building (ISF)

1910.1200(h)

Employee information and training.

1910.1200(h)(1)

Employers shall provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new chemical hazard the employees have not previously been trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and safety data sheets.

1910.1200(h)(2)

Information. Employees shall be informed of:

1910.1200(h)(2)(i)

The requirements of this section;

1910.1200(h)(2)(ii)

Any operations in their work area where hazardous chemicals are present; and,

1910.1200(h)(2)(iii)

The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and safety data sheets required by this section.

1910.1200(h)(3)

Training. Employee training shall include at least:

1910.1200(h)(3)(i)

Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1200(h)(3)(ii)

The physical, health, simple asphyxiation, combustible dust, and pyrophoric gas hazards, as well as hazards not otherwise classified, of the chemicals in the work area;

1910.1200(h)(3)(iii)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

1910.1200(h)(3)(iv)

The details of the hazard communication program developed by the employer, including an explanation of the labels received on shipped containers and the workplace labeling system used by their employer; the safety data sheet, including the order of information and how employees can obtain and use the appropriate hazard information.

ENERGY CONTROL PROCEDURE, WIND TUNNEL FAN

Purpose	Wind tunnel power source

1. Notify Affected Employees about the purpose of service and maintenance of this equipment and inform them to not remove or bypass the lockout process or attempt to start the machine.

2. Follow the manufacturer's shutdown procedure.

3. Isolate, lockout, and verify each energy source listed in the following table.

ENERGY SOURCE		ISOLATION		LOCKOUT	VERIFY
Type	Magnitude	Device	Location	Device	Method
Electrical	480v ac	Fan Drive	Wind Tunnel Control Room	Lock	Lock the power switch in the off position. Ensure the fan motor cannot be re-energized by pressing the Run button on the tunnel control panel.

4. Isolate, lockout, release, and verify each stored energy source listed in the following table.

ENERGY SOURCE		ISOLATION		LOCKOUT	RELEASE STORED ENERGY	VERIFY
Type	Magnitude	Device	Location	Device	Control Method	Method
Motion of air	Up to 190 mph	Speed control knob	Operator panel	None	Wait for audible sound of airflow and fan to die away	Open test section door and carefully place had in flow path to verify that airflow has stopped
Motion of fan	Up to 600rpm	Motor control breaker	Main panel under contraction	Locks and tags	Ensure motion of air (above) has ceased. Then turn off the breaker.	Attempt to restart tunnel at control panel

5. If lockout cannot be performed or deenergization cannot be verified, notify your supervisor before continuing service or maintenance work.

6. Conduct service and maintenance work.

7. Once work is completed, notify Affected Employees, remove lockout devices, and follow manufacturer's startup procedures.

PERSONS AUTHORIZED TO USE PROCEDURE (NAME AND PHONE NUMBER)	
William Devenport	540 231-4456
Aurelien Borgoltz	540 231-1959
Nathan Alexander	540 231-1152
Cameron Hollandsworth	540 231-6752
Nanyaporn Intaratep	540 231-2123

LOCKOUT ANNUAL REVIEW, WIND TUNNEL FAN

ANNUAL REVIEW INFORMATION			
Department:	Aerospace and Ocean Engineering	Date:	7/25/23
Supervisor:	Bill Oetjens	Reviewer:	William Devenport

	Yes	No
1. Are department personnel who conduct work covered by this manual trained as Lockout Authorized Employees? List those who are trained and those who are not trained but need it.	X	
Nathan Alexander, Aurélien Borgoltz, Cameron Hollandsworth, Nanyaporn Intaratep		
2. Are department Lockout Authorized Employees familiar with and follow the General Lockout Procedure?	X	
3. Have Energy Control Procedures been developed in accordance with the General Lockout Procedure? List Energy Control Procedures needed and whether they have been developed.	X	
Speed control control panel/Verifying that motion of air has ceased. Main panel breaker/Verifying that motion of fan has ceased. Procedures have been developed.		
4. Does the department have adequate locks, tags, and lockout devices? List what is needed and whether or not the department has them.	X	
Locks and tags, hasp. Adequate supply available.		
5. Does the department conduct Group Lockout? Review procedure.		X
6. Does the department conduct lockout work across shift/personnel changes? Review procedure.		X
7. Does the department have an Emergency Lock Removal procedure? Review key security method and list persons who will implement the Emergency Lock Removal procedure/form.	X	
William Devenport		
8. Have Lockout Authorized Employees demonstrate Energy Control Procedures or General Lockout Procedure as appropriate. List Energy Control Procedures demonstrated and the Lockout Authorized Employee who demonstrated.	X	
Bill Oetjens, authorized employee, demonstrated lockout/tagout of fan on 6/29/21		