HARVARD
Campus Services
ENVIRONMENTAL HEALTH & SAFETY

LABORATORY SAFETY GUIDELINE

Indoor Use of Unmanned Aerial Vehicle (UAV)/Drones

All Unmanned Aerial Vehicle (UAV) Operators who plan to fly indoors must review this document and receive approval from their School's UAV management team before use.

An unmanned aerial vehicle (UAV) is defined as a "powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload". A UAV, commonly known as a drone, unpiloted aerial vehicle, or remotely piloted aircraft (RPA), has its flight controlled either autonomously by on-board computers or by the remote control of a pilot on the ground or in another vehicle.

Unmanned Aerial Vehicles operated solely indoors are not regulated by the Federal Aviation Administration (FAA). "Indoors" is classified as a covered structure that prevents access to the national airspace system. Harvard requires all indoor flight operations to be conducted in a safe and respectful manner that ensures right to privacy, civil rights, and civil liberties. As such, UAV usage must follow this safe use guideline, and any flight that that involves filming and photography must comply with the Photographing of and Videotaping in Harvard Buildings and Facilities Policy – paying particular attention to Section 8: Individual Faculty and Students. Indoor flying that involves human subjects for research purposes must also be reviewed and approved by the University's Institutional Review Board (IRB).

The University has the right to immediately terminate the operation of a UAV if it poses hazards to any person or university facilities, equipment, or other property, interferes with campus operations, or has not received the proper approvals. Please contact your EHS representative for school-specific UAV guidance.

Indoor flights will require approval when they are planned for public spaces, common areas, and areas that may be reserved (e.g., atrium, hallways, classrooms, athletic facilities). In general, these requests will be reviewed by the individuals responsible for the space in addition to the UAV management team prior to approval being granted. Each request is reviewed for:

- Compliance with applicable regulations, policies, insurance requirements, and safe practice guidelines
- Impacts to public safety
- Impacts to privacy, civil rights, and civil liberties
    - UAV may not be used to monitor or record activities where there is a reasonable expectation of privacy.
    - UAV must not be used for unapproved recordings of any campus events or performances, or for any unlawful purpose

Locations that do not require prior UAV management team approval are those indoor spaces that are designated UAV research spaces assigned to specific faculty, staff, or students (e.g., research laboratory, office). Indoor flights by third parties (invitees) require approval in all locations.

Flying a UAV indoors can be uniquely challenging and has several risks including injury to people and pets, damage to property, and damage to your drone.

Following these general indoor UAV use guidelines can help ensure safety for all-

General

- **Familiarize yourself with your UAV.** Every drone is different, and it's important to know the nuances of your specific drone. Read the guidelines in the drone's manual, with particular regard to precautions to take indoors. Some examples that may affect indoor flying:
    - A UAV that calculates altitude using pressure gauges vs. by sonar
    - A controller that tends to move in a specific direction more quickly than in other directions

- **Fly UAVs specifically designed to be flown indoors.**
  - The preference is to start with smaller drones: Gain prior experience by flying smaller (nano-drones or micro-drones) or toy models before moving on to mid-sized drones, and be familiar with the remote and various controls.
  - For mid-sized and larger drones: The UAV system should have an indoor positioning system/obstacle avoidance feature, especially in furnished rooms.
  - Don't fly large drones (such Phantom Size drones) or FPV drones indoors for competitions or demos unless you have considerable experience, or are in a location approved for such drone use.
    - UAVs greater than 55lbs, including the payload, may not be operated indoors
    - Large UAVs operated in small areas can create their own 'weather patterns' that may cause the UAV to not act as anticipated.
    - Obstacle avoidance sensors are superb safety features, until you are flying in very tight spaces. For most drones, you cannot change the object detection range, which may be upwards of 6 feet. If your drone offers 6 feet detection on all sides, then it will not be able to operate at all in a room that is 12 feet across or smaller. Make sure your take-off and landing spots are in a large opening.

UAV Craft Safety

- **Use indoor hulls (rotor/propeller guards) when flying indoors**: Some UAV systems have indoor hulls (prop-guards) which are placed on spinning rotor blades to not only prevent accidental injuries, room/property damage, and to protect the propellers from breaking off, should they strike something.
  - If propeller hulls are not possible to install, carbon fiber propellers should be avoided. Carbon fiber propellers perform better in terms of mechanical robustness and weight, but are more likely to cause injury and damage. If available, plastic propellers are strongly encouraged as they are far less likely to injure someone.

- **Adjust flight controls**: Some UAVs have a pre-set configuration for indoor flying (essentially disables GPS and other visual positioning systems, sometimes called ATTI mode). If your UAV doesn't have this feature, adjust your settings to reduce the remote control's sensitivity, make sure that you are flying at the absolute minimum speed for the drone, and watch altitude climbing closely. Doing this will allow you to better maneuver around objects and corners while indoors. Configuring controls is specific to the UAV so be sure to refer to your user manual to learn how to adjust the parameters of your flight controller.

- **Reset your drone:** Some UAVs have the capability to remember previous flight conditions and settings. If you last used the device outside on a windy day, the UAV could act erratically during indoor flights. Use the reset button or refer to your user manual for proper reset procedures.

- **Disable Return to Home.** The Return to Home (RTH) feature typically causes the UAV to gain altitude with the intention of avoiding obstacles. In an indoor space, the most likely outcome would be the UAV hitting the ceiling and crashing. Not having RTH activated means that it's going to be very important that you always keep the communication between the drone and your remote controller stable. This means not letting your drone fly too far away and avoiding any obstacles to come between the drone and the remote controller.

- **Anticipate loss of GPS-aided stabilization.** This technology allows the UAV to hover in place at a relatively permanent position, moving only to offset drifting caused by the wind. When flying indoors, you may not receive any GPS signal. This means that you will need to control the drone's movement at every moment – you cannot command it to simply hover in place. You should be comfortable operating your UAV without this feature.

- **Anticipate drafts generated by the HVAC system or the UAV itself.** While flying in an enclosed space, possibly without GPS-stabilization, self-generated drafts from a UAV or from the HVAC system, can cause your UAV to move unexpectedly.

- **Magnetic interference.** The intensity of magnetic fields emitted from common electrical devices are usually not strong enough to disrupt the signals between your UAV and the remote controller. However, there are some locations on campus with strong magnetic equipment that may impact your UAV flight. Please contact radiation_safety@harvard.edu for questions.

- **Keep spare parts on-hand**: Flying with damaged parts can impact your UAV's stabilization, causing it to fly erratically. Replace damaged or broken parts before operating your UAV.

- **Inspect the UAV prior to each flight.** This safety check should be performed by the pilot-in-charge, or a person knowledgeable of the flight operation that has been designated by the UAS Operator, to determine that the UAS is safe for flight. The user manual should have a pre-flight checklist available, but there is also a checklist provided in the Appendix.

Operator Safety

- **Consider wearing eye protection** in the event of shattered propellers. Propellers spin at thousands of RPM with high energy and can break unexpectedly.

Public Safety

- **Post signage at indoor entry points, and block off flight area with cones/rope**
  - The area that the UAV is flying within should be contained and clearly marked. UAVs may not fly arbitrarily throughout all available space.
  - Signage indicating that there is a UAV flying in the area should be placed on the perimeter of the cordoned off area. If recording is taking place, that should be noted on the signage as well.
  - UAV nets might be required in crowded public spaces however the netting must be tightly rigged to prevent the propellers from becoming entangled and possible fires starting from a stalled motor.
  - UAVs can be very noisy – as a courtesy, warn observers of the high-pitched buzz your UAV may emit.

- **Consider flying with a spotter and/or visual observer**. A UAV pilot is expected to maintain line of sight, and pay 100% attention to their UAV while operational.
  - Having a spotter/visual observer helps the pilot maintain situational awareness. A visual observer can assist with identifying potential obstacles, and with managing observers or other community members in the area.

- **Visual line-of-sight (VLOS) contact with the UAV must be maintained at all times.**
  - If the pilot experiences any issues using First Person View system (i.e., UAV weighs less than or equal to 15 lbs.), the pilot must switch back to VLOS immediately.

Area Safety

- **Receive written approval** from appropriate/school-specific authority
- **Prepare the area for flight.** Move, rearrange, or remove furniture from the space to ensure that the UAV's flight path is not impeded. If your drone uses sonar to maintain altitude, presence of furniture and other room obstacles may cause your drone to act unexpectedly

- **Avoid flying close to walls, floors, and ceilings.**
  - Flying too close to these surfaces causes uneven airflow around the UAV, which impacts its stability.
  - It helps avoid injury or damage from unexpected changes in altitude
  - It helps you avoid room obstacles, such as light fixtures, sprinkler heads, etc.
    - The Facilities team can help identify sprinkler heads and other equipment that may need to be guarded before your flight

Storage

- Store UAVs in dry, cool locations
- UAV battery storage should follow the [Lithium-Ion Battery Safety Guideline](#), when possible.

Disposal

- UAVs can be disposed of as Universal Waste, as long as they have not been contaminated with any hazardous materials.
- If the UAV contains a reacting and/or leaking batteries it is considered hazardous waste. Please consult Emergency Procedures below.

Transport and Shipping

- Transporting and Shipping hazardous materials, including rechargeable battery systems and electronic components that are found in UAVs must be shipped in accordance with regulatory requirements.
- Please contact EHS for advice regarding transport and shipping of Unmanned Aerial Vehicles and their components.

EMERGENCY PROCEDURES

SHOCK

- Know where your nearest AED is. The heart icons that appear when you zoom in to your building on [this campus map](#) show AED locations.

FIRE

- Pull the fire alarm before attempting to extinguish a fire. Only use a fire extinguisher is you have been trained to do so. EHS offers fire extinguisher training online through the Harvard Training Portal.
- Keep a bucket of sand and an appropriate fire extinguisher on-hand. ABC, CO_2, or Halon are all appropriate options. Contact EHS to discuss which is the best option for your application.
- Call the Operations Center at 617-495-5560. By law, even extinguished fires must be reported.

REACTING BATTERY

- If your battery is overheating, hissing, or bulging, and it is safe to do so, immediately move it away from any flammable or combustible materials, and place it in a non-conductive vessel (e.g., ceramic pot) or non-conductive surface, and allow it to react fully.
- Contact the University Operations Center at (617) 495-5560 [HMS/HSDM (617) 432-1901] if you need support or technical assistance.

LEAKING BATTERY

- Leaking batteries can pose significant contact and inhalation hazards. Only handle if you are confident in your knowledge of the battery chemistry, properly trained, and wearing appropriate PPE.
- If trained and confident, are wearing the appropriate PPE for the hazards of your battery's unique chemistry, and have the appropriate spill supplies:
  - Collect debris in appropriate container and move to your Satellite Accumulation Area. Label with appropriately completed hazardous waste tag and request a waste pickup.
- Contact the University Operations Center at (617) 495-5560 [HMS/HSDM (617) 432-1901] if you need support or technical assistance.
- Leaking batteries cannot be recycled.

SKIN CONTACT FROM LEAKING BATTERY

- Wash with plenty of tepid water for at least 15 minutes using the closest available sink, safety shower, or drench hose. Remove any exposed clothing as well as any jewelry.
- Seek medical attention; call 911 on a landline phone for medical assistance (or provide location if calling on a mobile phone).

EYE CONTACT FROM LEAKING BATTERY

- Using eyewash, flush eyes while holding eyelids open.
- Seek medical attention; call 911 on a landline phone for medical assistance (or provide location if calling on a mobile phone).

INHALATION FROM REACTING BATTERY

- Seek medical attention; call 911 on a landline phone for medical assistance (or provide location if calling on a mobile phone).

INGESTION FROM LEAKING BATTERY

- Never give anything by mouth to an unconscious person.
- Seek medical attention; call 911 on a landline phone for medical assistance (or provide location if calling on a mobile phone).

UNMANNED AIRCRAFT VEHICLE REQUEST FORM

➢ Return to School's UAV management team or Environmental and Safety Compliance Officer (ESCO) for approval ** Items required for outdoor UAV use, and highly recommended, but not required, for indoor UAV use.
Individual Requesting UAV use:
Location requested for UAV use:
Date(s) of UAV Use:
Desired Duration: From: to
Name of UAV pilot(s):
For each pilot indicate the following: Age *(must be at least 16)* **:**
** Valid Remote Pilot Airman Certificate: ☐ (attach a copy)
Purpose for Flight: ☐ Academic/Research ☐ Marketing/Advertising: ☐ Other: ☐ Sponsoring Faculty/Staff/Club:
Please explain the purpose of flight and nature of UAV use (attach additional pages to explain if necessary):
**Description of UAV device: Make/Model:
**FAA Registration number:
**Weight of UAV: _____ (lbs.)
List of third-party devices attached to UAV (attach additional pages if necessary):

Indoor UAV Flight Management Checklist

(To be completed by the operator and maintained as a record of the operation for 1 year.)

Planning Phase		
Completed?		**Resources / Notes**
☐	Familiarize yourself with Harvard's Unmanned Aircraft Systems / Drone Policy and applicable FAA operational conditions	
☐	Familiarize yourself with Academy of Model Aeronautics National Model Aircraft Safety Code	
☐	**Register UAV with the FAA	
☐	**Mark UAV with FAA registration number	
☐	Create flight plan	
☐	Request and receive approval to use the UAV on-campus.	
☐	Confirm the no Temporary Flight Restrictions (TFRs) have been issued for your location (while this is a requirement for outdoor flight, schools and units have the authority to issue TFRs for indoor locations)	
Pre-Flight UAS Craft inspection		
☐	Pack extra parts and tools for adjustments	
☐	Locate Fire Extinguisher, First Aid Kit, other relevant emergency information	
☐	Batteries • Are fully charged • Are in good condition • Stored batteries are managed following Harvard EH&S' Lithium-Ion Battery Guideline	
☐	Inspect Antenna positioning and wear	
☐	Rotor guards (hulls) are installed and in good condition	
☐	Tighten any parts e.g., lug-nuts, rotors, etc.	

☐	Ensure any post-market accessories (gimble, camera, etc.) are securely attached	
☐	Perform any necessary maintenance (see your UAS' owner manual)	
☐	Firmware and software are up-to-date, and there's adequate file storage.	
☐	Verify that communications/control link is functioning prior to commencing the flight plan	
Pre-Flight Area Inspection		
☐	Inspect area for people - Move all persons behind flight area or under cover - Notify nearby people of flight and frequency of use - If flying over people for research, ensure human subjects approval obtained (several weeks ahead); additional approvals apply	
☐	Display signage at indoor entry points, and block off flight area with cones/rope	
☐	Inspect area for service animals	
☐	Check overhead for anything in flight (sprinkler heads, uneven ceilings, light ballasts, wall decorations, etc.)	
☐	Obtain any video/photo releases	
☐	Notify the UAV team if the flight plan is cancelled or substantively modified	
Flight Safety		
☐	PPE (safety glasses) are available	
☐	Do not fly under influence of alcohol or drugs, certain medications, if fatigued, or any other state that may impair your reaction time or judgement	
Emergency Management		
☐	Report any accident - crash, injury, or property damage to the UAV team and the Operations Center.	

**Items required for outdoor UAV use, and highly recommended, but not required, for indoor UAV use.

Form must be signed by a Faculty / Staff member of the University Community.

Person Submitting Request (Print Name)	**Sponsoring Faculty/ Staff (Print Name)**
Signature of Person Submitting Request	**Signature of Sponsoring Faculty/Staff**

Campus Address		**Campus Address**	
Phone Number:		**Phone Number:**	
Email address:		**Email address:**	

UAV Team/ESCO Approval: _____ **Date** _____

By signing above, the person / organization submitting the request agrees to and will abide by all University policies governing the use of University facilities. By signing above, the person submitting this request warrants that the UAV complies with all applicable federal certification requirements or other federal and state laws, including but not limited to, any regulation of the Federal Aviation Administration. The University reserves the right to request additional documentation regarding compliance as a condition of approval. You understand that you are financially responsible for any property damage or personal injuries, including, without limitation, death that may be caused by the use and operation of a UAV, except to the extent limited by Massachusetts law.

For questions email risk-services@harvard.edu