Department of Engineering – Risk Assessment.

Ref No. A-SDG33-2_1

Title of project/experiment/activity **4th Year Project – Propulsion Systems for Electric VTOL Aircraft**	
Location of activity Whittle Laboratory, Multi-Stage Room	**Start and end dates** Oct '20 – Jun '21
Brief description (or attach procedure/protocol) Project involves testing of both open-rotor propellers as well as ducted fans on a small quadcopter style drone (~1kg), undertaking stationary and small displacement dynamic tests in an indoor test environment. Test environment is a wire mesh with 10mm grid fastened to a wooden frame with approximate dimensions 2.2m x 2m and a height of 2.4m	

Risk -> Effect	**Likelihood * Severity**	**Risk**	**Mitigation**	**Likelihood * Severity**	**Mitigated Risk**
MECHANICAL					
Contact with rotor while armed -> laceration or similar injury	2 * 3	6 **HIGH**	Perform all tests inside the caged test environment. Only arm the drone inside the cage and once all personnel have exited the cage. Never enter the cage while drone is armed.	0 * 3	0 **LOW**
Loss of blade while armed -> laceration/eye damage	1 * 3	3 **MEDIUM**	Perform all tests inside the caged test environment. Only arm the drone inside the cage and once all personnel have exited the cage. Never enter the cage while drone is armed. Remove blades from motors for any testing that does not require them. Conduct FEA on new blades.	0 * 1	0 **LOW**

Loss of control (LOC) while armed -> property damage, personal injury/laceration/eye damage	2 * 3	6 **HIGH**	Perform all tests inside the caged test environment. Only arm the drone inside the cage and once all personnel have exited the cage. Never enter the cage while drone is armed. Enable manual kill-switch prior to arming to allow shutoff in case of LOC. Automate position control to reduce human piloting error.	1 * 1	1 **LOW**
ELECTRICAL					
Battery failure/explosion during charging -> Burning of operator/property	1 * 3	3 **MEDIUM**	Supervise all charging activities. Use charging bags for charging LiPo batteries in case of explosion. Use a smart charger to balance charge battery cells and monitor battery health during charging. Set charging limits to reduce likelihood of over-charging. Check batteries prior to charging (no swelling, cuts etc)	1 * 1	1 **LOW**
Contact with wire/high current source (battery or tether) -> Electrocution/property damage	2 * 2	4 **MEDIUM**	Ensure all exposed wires are heat shrunk to avoid contact likelihood. Connect **GND** wires first when attaching power sources (battery or tethered). Use insulated long-nose pliers when connecting wires together.	1 * 1	1 **LOW**

AERODYNAMIC					
Large downwash from aeroengines -> Displacement of dust/lighter objects in the vicinity of the tests.	3 * 1	3 **MEDIUM**	Ensure all loose/light objects are secured or removed from the test environment. Regularly sweep/vacuum clean the test rig to remove dust.	0 * 1	0 **LOW**
Suction into aeroengine intakes -> Damage to drone and engines from incoming debris. Resultant LOC and associated risks.	1 * 3	3 **MEDIUM**	Ensure all loose/light objects are secured or removed from the test environment. Perform all tests inside the caged test environment. Only arm the drone inside the cage and once all personnel have exited the cage.	1 * 1	1 **LOW**
OTHER					
Use of workshop tooling	2 * 2	4 **MEDIUM**	Following appropriate workshop guidance and rules.[1]	1 * 1	1 **LOW**
Use of 3D printers	2 * 2	4 **MEDIUM**	Read and sign the 3D printer risk assessment [2].	1 * 1	1 **LOW**
Excessive Noise -> Ear damage	2 * 2	4 **MEDIUM**	Where ear defenders while the drone is armed. Be aware of any other testing in the lab and use ear defenders if necessary.	0 * 0	0 **LOW**
COVID-19 Risk of infection during international pandemic	3*2	6 **HIGH**	Follow Whittle Lab social distancing measures put in place to ensure COVID secure workplace.[1] Do not share equipment and	1*2	2 **Low**

[1] See https://whittle-intranet.eng.cam.ac.uk/SafetyPage

[2] See https://whittle-intranet.eng.cam.ac.uk/3Dprinterriskassessment20151027.pdf

			tools and regularly wash hands.		

Personal Protective Equipment (PPE) required [*eye/face protection, respiratory protection, gloves, lab coat etc*] • Ear defenders. • Use appropriate PPE when using workshop tools, as set out in the workshop risk assessment. • Face mask to wear in corridors and communal areas.
Emergency Instructions & First Aid • Adhere to the appropriate emergency procedures of the Whittle Laboratory. [3] • Contact the local first aider in event of an incident (Dominic Basham or John Saunders).
Any special monitoring required [*e.g. hearing test, vibration monitoring, health surveillance*] None.
Further control measures required? If yes, list with actions. None.
Biological/Laser/Radiation Approval [*requires relevant Specialist Safety Officer signature and date*] None.
Out of hours/Lone working Adhere to the rules set out for the Whittle Laboratory. [3]

Signature to confirm that this is a suitable and sufficient assessment of risk and that stated control measures are in place. This risk assessment should be reviewed if additional risks not covered in this assessment are identified or if there is any reason to indicate that the control measures are insufficient.

[3] See https://whittle-intranet.eng.cam.ac.uk/SafetyPage

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Local Safety Coordinator J. SAUNDERS	**Signature**	**Date** 9/10/20
Departmental Safety Office Steve Wickens safety-office@eng.cam.ac.uk	**Signature**	**Date** 12th October 2020

Title of project/experiment/activity

Additional Users	Signature	Date

Signatures to confirm that risk assessment has been read and understood.