

ADCL Wind Tunnel – SOP & Checklist

Operator-facing. Print and laminate.

Kshitij Anand

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1. ADCL Wind Tunnel — Standard Operating Procedure

This is the **operator-facing** standard operating procedure for the wind tunnel facility in the **Aeronautics, Dynamics and Controls Laboratory (ADCL)** at UC Irvine.

If you are about to run an experiment, this is the only document you need. It is short on purpose; nothing here is optional.

For a deeper technical view of the facility — hardware internals, code architecture, troubleshooting — see the contributor [Operating & Contributor Manual](#).

1.1 In an emergency

Situation	Action
Life-threatening injury, fire, electrical contact, person trapped	Dial 911 from a mobile phone, or 9-911 from a campus landline.
Need to stop the motor immediately	Press the red Emergency Stop in the control software. If unresponsive, open the main switch.
Smoke, fumes, or odor making you or anyone else feel unwell	Stop the run, open the lab door, dial 911 if anyone is symptomatic. UCI EH&S 949-824-6200.
Anything else that scared you	Stop, document, contact the PI before resuming.

1.2 Read order

1. **Emergency contacts** — keep this open.
2. **Before you start** — qualifications, training, PPE.
3. **Pre-run checklist** — every run, every time.
4. **Running an experiment** — the golden-path sequence.
5. **Shutdown checklist** — also non-negotiable.
6. **Emergency procedures** — what to do when things go wrong.
7. **Quick reference card** — single-page summary intended for printing and laminating next to the computer station.

1.3 The five non-negotiables

1. **One operator at a time.** Whoever runs the tunnel stays at the computer station for the full run.
2. **Test section and exhaust path verified clear before each start.** No exceptions.
3. **All three stop paths tested on the first run of the day.** Software ramp-stop, software emergency-stop, mains kill. If any one fails, no further runs that day.
4. **Door placard reflects active hazards** before starting a flow-visualization run (laser + smoke).
5. **No solo runs after hours.** Have a second person reachable in the building or by phone any time the motor is energized outside normal working hours.

1.4 What this SOP is *not*

- It is not a tutorial on aerodynamic testing.
- It is not a substitute for in-person training. You must be checked off by an existing operator before running solo.
- It is not a substitute for the UCI EH&S Lab Safety Fundamentals course, which is required for every operator.

1.5 When this SOP needs to change

When the procedure here drifts from how runs are actually performed, the SOP is the wrong document — fix it. Edits go through the project repository at `docs/sop/`. After editing, rebuild the PDF, reprint the wall copy, and replace the laminated quick-reference card.

2. Emergency contacts

Verified 2026-05-14 against ehs.uci.edu and police.uci.edu. If any of these are wrong by the time you read them, start at <https://ehs.uci.edu> and the "Who Do I Call?" page.

2.1 Immediate life-safety

Situation	Number
Life-threatening emergency (mobile phone)	911
Life-threatening emergency (campus landline)	9-911
UCI Police Department (24-hour, non-emergency)	949-824-5223

2.2 UCI EH&S — Environment, Health & Safety

Reason to call	Contact
General EH&S, after-hours routing	949-824-6200, safety@uci.edu
Non-emergency chemical or lab incident	Sandra Conrrod, 949-824-6982, sconrrod@uci.edu
Hazardous materials assessment	Alvin Samala, 949-824-4817, amsamala@uci.edu
Hazardous waste pickup (used glycol fluid, etc.)	Danny Ramirez, 949-824-0692, dannyr2@uci.edu
Odors, smells, irritation symptoms (e.g. smoke)	EH&S general team, 949-824-6200, safety@uci.edu
Laser safety questions / Laser Safety Officer	Bridgette Neri, nerib@uci.edu ; general inbox radsafety@uci.edu

EH&S hours are Mon–Fri 07:30–16:30; after hours the 949-824-6200 number routes to EH&S services.

2.3 Lab-specific contacts

These are filled in by the facility owner. Update before printing the SOP.

Role	Name	Phone	Email
Principal Investigator (PI)	TBD	TBD	TBD
Lab Manager / Safety Representative	TBD	TBD	TBD
Senior Operator (after-hours contact)	TBD	TBD	TBD
Building location	Building name, Room number	n/a	n/a

 These lab-specific fields must be filled before this SOP is posted or laminated.

2.4 Door placard requirements

UCI EH&S policy requires the lab door to carry a current placard with:

- the building and room number;
- the PI / lab name with office and alternate phone;
- the Lab Manager or Safety Representative;
- the date of the last certified chemical inventory;
- the emergency instruction "Dial 911";
- GHS pictograms for the hazards present (electrical, laser, fog/smoke).

The placard is generated through the UCI **Chemicals** application. Reference: [Laboratory Door Placards Reference Guide \(PDF\)](#) and the [Labels & Signs](#) page.

The placard must be reprinted whenever a hazard, an active piece of equipment, a contact, or an inventory date changes.

2.5 EH&S policy references

Topic	URL
EH&S home	https://ehs.uci.edu
Who Do I Call?	https://ehs.uci.edu/who-do-i-call/index.php
Laser Safety Manual (PDF)	https://www.ehs.uci.edu/radiation-safety/_pdf/laser-safety-manual.pdf
Electrical Safety Program (PDF)	https://ehs.uci.edu/programs/_pdf/safety/electrical-safety-program.pdf
Hazardous Energies / LOTO Program (PDF)	https://ehs.uci.edu/programs/_pdf/safety/locktagprog.pdf
SOP template hub (PI signature required)	https://www.ehs.uci.edu/sop/index.php
Lab Safety Inspection Checklist (PDF)	https://ehs.uci.edu/research-safety/lab-safety-inspections/_pdf/uci-lsi-checklist.pdf

3. Before you start

You do not run this tunnel until you have completed all of the following.

3.1 Training

- **UCI EH&S Lab Safety Fundamentals** — completed and current.
- **UCI EH&S Laser Safety training** — required if you will run flow-visualization (laser + smoke). The lab uses a 5 mW Class 2 laser.
- **10-person walkthrough** of the facility with an existing operator, end-to-end. You have seen the pre-run checklist demonstrated and you have personally pressed each of the stop buttons with the tunnel running at low RPM.
- **Sign-off** from the PI or lab manager that you are checked out to operate the tunnel solo.

If any of the above is missing, you operate **with an existing operator present**, not solo.

3.2 Personal protective equipment

- **Safety glasses** during normal operation (mechanical hazard from the model, the airflow, the test-section walls).
- **Laser-rated eyewear** is recommended (not strictly required) during laser alignment. For Class 2 sustained viewing, ask the UCI Laser Safety Officer (radsafety@uci.edu).
- **Closed-toe shoes**.
- **No loose clothing or jewellery** that can be caught in moving parts or reflect a stray laser beam.
- **Hair tied back** for anyone working close to the test section or fan.

3.3 Equipment knowledge

You know:

- where the **main switch** is on the wall and how to open it;
- where the **emergency stop** is in the control software (red button, right column);
- the location of the **fire extinguisher** in the lab and the floor where it is rated;
- the location of the **eye-wash station** if the lab has one;
- the route to the nearest **emergency exit**.

3.4 Door placard

Before starting any run that involves the laser or smoke generator, confirm the lab door placard shows:

- the laser pictogram and "Class 2 in use" annotation;
- the smoke / fog warning;
- the PI name and emergency contacts;
- the date of last chemical inventory.

If the placard is missing or out of date, update it through the UCI Chemicals application before running.

3.5 Run-day prerequisites

- **Second person** is reachable for the duration of the run (in the building or by phone).

- The lab is **not occupied** by an unrelated activity that could intersect with airflow, smoke, or laser exposure.
- The wind tunnel area has been **walked end-to-end**: intake clear, test section clear, exhaust path clear past the band saw.
- You have a **plan for the run** — RPM range, what you are measuring, when you will stop. Improvising RPM setpoints under load is how unintended fault conditions get hit.

If any of these is not the case, do not start the run.

4. Pre-run checklist

Walk through this **every run, every time**. Five minutes of checklist beats five hours of post-incident debugging.

4.1 Physical state of the lab

- Exhaust path clear** beyond the band saw. Nothing loose downstream.
- Band saw is in place** across the exhaust opening.
- Test section is clean inside** — no tools, cables, fasteners, or rags. Open the test-section lamp to look.
- Model is mechanically secure**. Visual inspection of every mount; tug test on the sting.
- Test-section access panels are closed and latched**.
- Camera, laser bench, and any tripods are stable**. Cables routed out of the airflow.
- No loose items** anywhere in the airflow path.



4.2 Electrical state

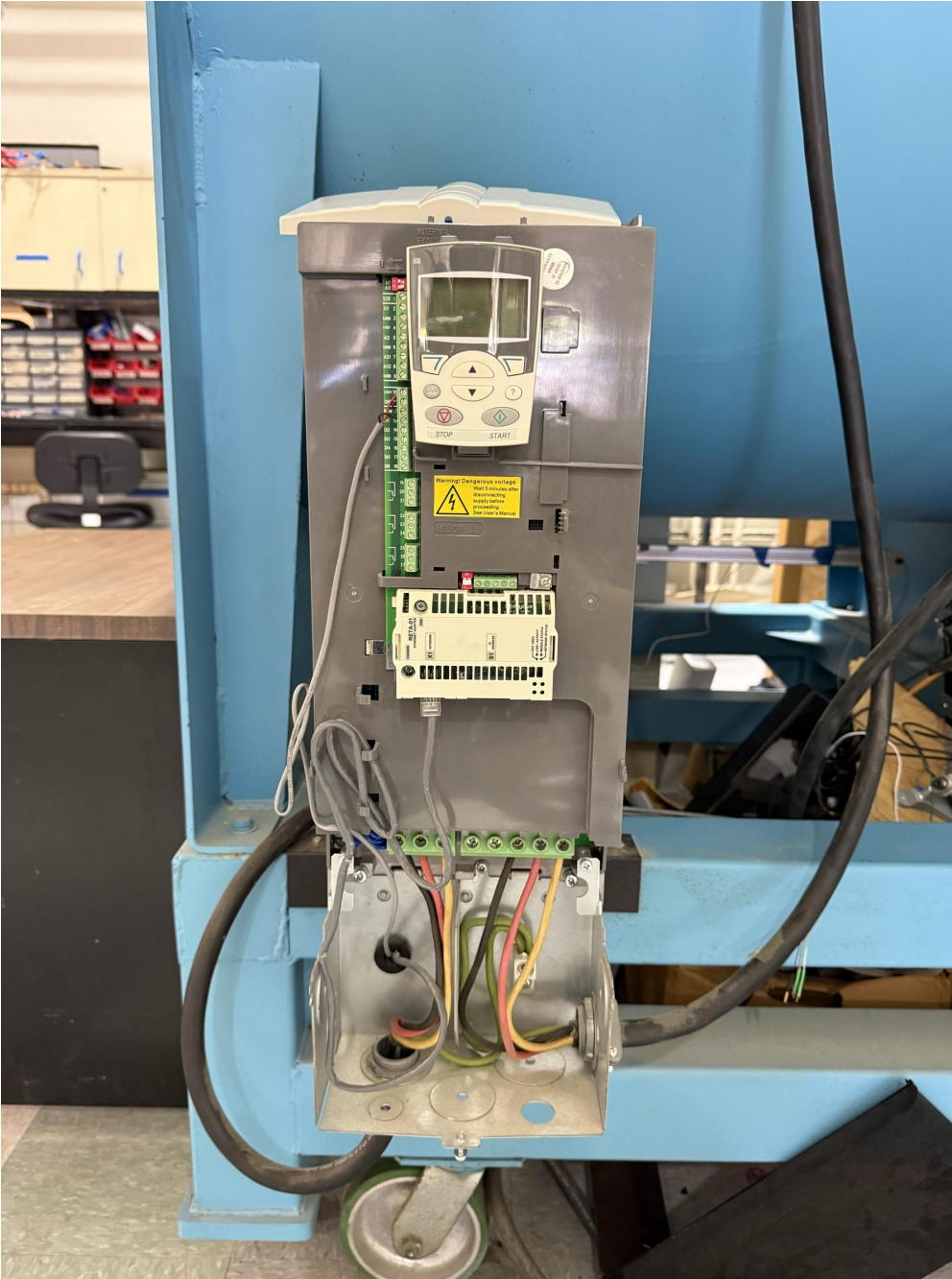
- Main switch is closed** (mains live to the VFD).
- VFD enclosure is closed**. Never run with the enclosure open.
- No visible damage** to cables between the main switch, the VFD, and the motor.
- Lockout/tagout** is currently applied to the main switch.



4.3 Drive state

Keypad shows **REM** in the upper-left corner. If it shows **LOC**, press **LOC/REM** on the keypad.

Keypad shows **fault codes** on the keypad. If a fault is latched, clear it with **RESET** and identify the cause before proceeding.



4.4 Network and PC state

- ✔ **PC is on** and not pending a forced update.
- ✔ **Ethernet 4 adapter holds 192.168.50.100**. If unsure, ask a contributor to verify.

4.5 Software state

- ✔ **ADCL WinSoft launched**. (Double-click `ADCL WinSoft.exe`.)
- ✔ **Router shows "Connected"** on the Modbus side (green indicator).
- ✔ **Router shows "DAQ: cDAQ1"** — not "DAQ: simulated" — if you expect to record data.
- ✔ **Data output folder for today exists** and the destination drive has free space.



4.6 Laser & smoke generator (only if flow-vis)

- 1. **Laser power supply set to 12 V exactly.** Do not raise the voltage.
- 2. **Beam path inspected.** Beam terminates on a diffuse non-reflective surface. No reflective objects in the beam path.
- 3. **Smoke generator is off and unplugged from fluid refill within the last 5 minutes.**
- 4. **Glycol reservoir has fluid.** Refilling mid-run is disruptive and a spill hazard.
- 5. **Laser placard updated** to show laser and smoke in use.



4.7 First powered run of the day — stop-path verification

Before loading a real test article, do this with the tunnel empty:

1. Start the tunnel at **100 RPM** setpoint.
2. Press **Stop Tunnel** in ADCL WinSoft. Motor decelerates to zero. ✓
3. Start again at 100 RPM.
4. Press **Emergency Stop**. Motor coasts to zero quickly. ✓
5. Start again at 100 RPM.
6. **Open the main switch**. Motor coasts to zero. Software loses Modbus. ✓
7. Close the main switch. Re-launch ADCL WinSoft. Verify reconnection.

If any of the three paths fails, **do not load a model and do not run today**. Escalate to a contributor.

5. Running an experiment

The golden-path sequence. If the run does not follow this pattern, stop and re-read the [Pre-run checklist](#).

5.1 1. Pre-run checklist complete

All items in [Pre-run checklist](#) are checked off. Stop-path verification done if this is the first run of the day.

5.2 2. Start the laser (if flow-vis)

1. Confirm 12 V on the power supply.
2. Enable the supply's output.
3. Confirm the laser sheet appears in the test section and terminates on the dump surface.
4. Confirm door placard shows laser in use.

5.3 3. Start the tunnel at a low RPM first

Bring the tunnel up gradually; do not jump to high RPM from idle.

1. In ADCL WinSoft, **Quick Tunnel** panel: set the slider to **100 RPM** (or whatever your run plan's lowest point is).
2. Press **Apply Setpoint**. The drive accepts REF1.
3. **Look at the test section one more time. Is it clear of people and tools?**
4. Press **Start Tunnel**. The drive transitions through the start sequence. The motor spins up.
5. Confirm the **Speed RPM** readout settles at the commanded value (100 RPM).

5.4 4. Start the DAQ (if recording)

1. Confirm the footer shows **DAQ: cDAQ1**.
2. In the right column, press **Start DAQ**.
3. The Signals tab shows live readings.
4. The CSV is being written to `E:\Wind_tunnel\ADCLWinSoft\Data\YYYY-MM-DD\...`.

5.5 5. Start the smoke generator (if flow-vis)

The tunnel must already be running. Smoke without airflow pools in the room.

1. Confirm the wired remote is at your station.
2. Press the smoke generator's ON button. A puff of smoke enters the inlet.
3. Adjust the heater / fan settings if needed for the visualization quality you want.

5.6 6. Run the experiment

1. Adjust the **Quick Tunnel** slider to each target RPM in your run plan.
2. Press **Apply Setpoint** to write the new RPM. Do **not** press **Start Tunnel** again — that stops and restarts the drive.
3. Wait for the speed reading to stabilize at each setpoint before taking data.
4. Watch the footer for:

5. **Connected** (Modbus, green)

6. **DAQ: cDAQ1**

7. No red **Fault** banner

8. If a fault appears, stop the run and consult a contributor.

5.7.7. Stop the smoke generator (if flow-vis)

Before stopping the tunnel:

1. Press the smoke generator OFF.
2. Wait until the visible plume in the test section clears (10–20 s of continued airflow).

5.8.8. Ramp-stop the motor

1. Press **Stop Tunnel** in ADCL WinSoft. The motor decelerates per the drive's ramp time.
2. Confirm the **Speed RPM** readout reaches 0 and the drive keypad shows 0 Hz.

5.9.9. Stop the DAQ recording

1. In the right column, press **Stop DAQ**.
2. The CSV is finalized. Note its filename in your run log.

5.10.10. Stop the laser

1. Disable the supply's output.
2. Power the supply down.

5.11.11. Continue or shutdown

- To run another experiment immediately, return to step 1 and repeat the pre-run checklist (an abbreviated version is fine if nothing in the lab has changed).
- To end the session, follow the [Shutdown checklist](#).

5.12 Do not, ever

- Press **Start Tunnel** while the motor is already running. This stops it.
- Reach into the test section while the motor is energized, even at zero commanded RPM.
- Reach into the exhaust path while the motor is energized.
- Leave the computer station while the motor is running.
- Use AeroWare to spin the motor (its VFD path is broken; see the contributor manual).
- Increase the laser power supply above 12 V.

6. Shutdown checklist

End of session. Walk through in this order; the order matters.

6.1 Order

1. **Smoke generator OFF.** Wait until the visible plume clears the test section.
2. **Tunnel ramp-stop.** Press **Stop Tunnel** in ADCL WinSoft. Confirm Speed RPM reads 0.
3. **DAQ stop.** Press **Stop DAQ**. Confirm the CSV is finalized.
4. **Close ADCL WinSoft** cleanly (use the window close button; the app saves its settings on exit).
5. **Laser OFF.** Disable the DC supply output, then power the supply down.
6. **Test-section lamp OFF** if it was on.
7. **Main switch OPEN.** This de-energizes the VFD and motor. The drive keypad goes dark.
8. **Visual confirmation:** keypad dark, motor not spinning, no audible whirring, no laser beam.

6.2 Cleanup

- Wipe up any smoke-generator fluid spills with a paper towel; dispose in the lab's solid waste.
- Coil up any cables that were routed across walkways.
- Restore the band saw to its blocking position across the exhaust if it was moved.
- Lock the lab if you are the last person out.

6.3 Run log

In the run log (paper or digital — whichever this lab uses) record:

- Date, start time, end time.
- Your name and any observers.
- RPM range and number of test points.
- Data file names (or the folder).
- Anything unusual: fault codes, software hiccups, noises, smells, anyone entering the lab during a run.

6.4 When something was wrong

If anything during the run was unexpected — a fault that took multiple resets, a smoke plume in the wrong direction, a model that shifted on its mount, a software glitch — escalate to a contributor and open a new milestone log (`WT_MS_<n>/debug_session.md`) in the project repository. Do not let the unexplained incident sit; it will recur and the next operator will not know to expect it.

6.5 Do not, ever

- Walk out leaving the motor energized.
- Walk out leaving the laser energized.
- Walk out leaving the smoke generator energized.
- Skip the run log because "nothing happened" — the log of unremarkable runs is what makes the abnormal ones detectable.

7. Emergency procedures

Read this **before** the emergency. Looking it up while it's happening is too late.

7.1 General principles

1. **Stop the motor first.** Almost every wind-tunnel emergency gets worse with airflow continuing.
2. **Then call for help** if anyone is hurt or anything is on fire.
3. **Then secure the area** — keep others out, keep yourself out of the exhaust path and the test section.
4. **Then document** when it is safe to do so.

7.2 Stopping the motor

Three independent paths. Use whichever you can reach first.

Path	Speed	Effect
Software E-Stop (red button in ADCL WinSoft)	Fastest if the PC is responsive.	Drive coasts to zero, no ramp.
Software Stop (Stop Tunnel button)	Slower (ramp time, typically a few seconds).	Drive decelerates per its ramp. Use for routine stops, not emergencies.
Main switch (wall, next to computer station)	Slow electromechanical operation but always works.	Drive de-energizes; motor coasts.

If the software is unresponsive or you cannot reach the PC: **mains kill**.

7.3 Specific scenarios

7.3.1 Person in the airflow path or test section

1. **Mains kill** — don't bother trying the software.
2. Verbally direct them out of the area.
3. Confirm motor has stopped (no fan noise, no airflow).
4. Triage any injury; dial 911 if needed.
5. Do not restart the tunnel that day. Open `WT_MS_<n>/debug_session.md`.

7.3.2 Visible flames, smoke from the VFD, or smell of burning electrical insulation

1. **Mains kill**.
2. **Evacuate** to outside the lab. Pull the building fire alarm if the fire is more than a small smolder.
3. Call **911**.
4. Do not re-enter to retrieve equipment.
5. After the response, contact UCI EH&S **949-824-6200** and the PI before any further use of the facility.

7.3.3 Person reports respiratory irritation, eye irritation, coughing during a smoke run

1. **Smoke generator OFF**.

2. **Software Stop** the tunnel (a normal ramp-stop is appropriate; the immediate hazard is the smoke, not the airflow).
3. Open the lab door for ventilation. Walk the affected person to fresh air.
4. If symptoms persist, dial 911. UCI EH&S 949-824-6200 for follow-up.
5. Do not resume runs until you understand whether the smoke setting was excessive or the ventilation is insufficient.

7.3.4 Suspected laser eye exposure (someone looked into the beam)

1. **Laser OFF** immediately (disable the supply output).
2. Walk the affected person out of the laser path.
3. If any visual symptoms (afterimage persisting more than a minute, blurred vision, eye pain), seek medical attention. **911 for serious symptoms.**
4. Report to the UCI Laser Safety Officer: nerib@uci.edu , radsafety@uci.edu .
5. Do not resume laser use until cleared.

7.3.5 Drive fault that will not reset

1. **Mains kill** to de-energize.
2. Wait at least 5 minutes before opening the enclosure.
3. Read the fault code from the keypad before powering back on.
4. Escalate to a contributor; consult the contributor manual's [Faults and alarms](#) page.
5. Do not repeatedly reset the same fault — it indicates a real condition.

7.3.6 Loud unusual noise from the motor or fan

1. **Software Stop** (you do not need to coast it if nothing is in danger).
2. Wait for full stop.
3. Mains kill.
4. Inspect for anything loose or rubbing. Do not restart until the noise source is identified.

7.3.7 Total power loss to the lab

1. The drive will coast down naturally.
2. The PC may shut down ungracefully; that is fine — settings are persisted on each clean shutdown, so worst case the next launch is identical to the previous one.
3. When power returns, do not auto-resume runs. Do a full pre-run checklist and stop-path verification before starting again.

7.4 Reporting

Within 24 hours of any of the above, open a `WT_MS_<n>/debug_session.md` and email the PI with:

- what happened;
- what you did;
- what the system state was at the time;
- what should change so this is less likely next time.

UCI EH&S incident reporting is at safety@uci.edu / 949-824-6200.

8. Quick reference card

Print this single page. Laminate. Keep at the computer station.

8.1 EMERGENCY

Life-threatening	911 (mobile) / 9-911 (landline)
UCI Police non-emergency	949-824-5223
UCI EH&S	949-824-6200
PI	<i>TBD — fill in before printing</i>

Stop the motor first. Software E-Stop (red) → main switch (wall).

8.2 START SEQUENCE

1. Pre-run checklist complete. Test section clear. Exhaust clear. Band saw in place.
 2. Drive keypad shows **REM**, no fault.
 3. ADCL WinSoft: footer shows **Connected + DAQ: cDAQ1**.
 4. (Flow-vis) Laser ON at **12 V exactly**.
 5. RPM slider → low (100 RPM) → **Apply Setpoint**.
 6. Look at test section one more time.
 7. **Start Tunnel**. Confirm RPM readout reaches setpoint.
 8. **Start DAQ**.
 9. (Flow-vis) Smoke generator ON.
 10. Run. Change RPM with **Apply Setpoint** only — never **Start Tunnel** mid-run.
-

8.3 STOP SEQUENCE

1. Smoke generator OFF. Wait for test section to clear.
 2. **Stop Tunnel**. Confirm 0 RPM.
 3. **Stop DAQ**.
 4. Close ADCL WinSoft.
 5. Laser OFF (supply output then supply power).
 6. Test-section lamp OFF.
 7. **Main switch OPEN**. Keypad dark.
 8. Run log entry.
-

8.4 EMERGENCY STOP

Threat	Action
Person at risk	Software E-Stop (red button), or Main switch
Fire / smoke from VFD	Main switch → evacuate → 911
Respiratory symptoms	Smoke OFF → ramp-stop → ventilate → 911 if severe
Laser exposure	Laser OFF → medical if symptoms → notify Laser Safety Officer

8.5 NEVER

- Press **Start Tunnel** mid-run (it stops the motor).
 - Reach into test section or exhaust with motor energized.
 - Run AeroWare to spin the motor (its VFD path is broken).
 - Raise laser supply above 12 V.
 - Leave the station while motor is running.
 - Run alone after hours.
-

Verified 2026-05-14. Replace this card whenever the SOP changes.