

FOX200LT Liquid Nitrogen Testing – Operating Procedure & Safety Controls

Scope note: This document is based **ONLY** on the FOX200LT manuals and their stated operating intent. Configuration-specific controls (e.g., hose routing, labeling, monitoring hardware) will be documented separately if needed.

0) Safety Warnings (Read Before Operating)

- **Liquid nitrogen supply required; do not run without LN₂ connected and the flow valve open.** Typical Dewar line pressure \approx **340 kPa (50 psi)**. (*FOX200LT Instrument Manual, §1.1 Quick Start, p.3–4; §6 Low Temperature Operation, p.17*)
- **Prevent condensation/ice: Do not open the test chamber during or immediately after low-temperature runs.** Bring plates to **$\sim 30^{\circ}\text{C}$ for ≥ 30 min** before opening. (*FOX200LT Instrument Manual, §1.1 Quick Start, p.3; §6 Low Temperature Operation, p.17*)
- **Ventilation and oxygen displacement hazard:** Operate in a **well-ventilated room**; route nitrogen gas exhaust if ventilation is poor. (*FOX200LT Instrument Manual, §6 Low Temperature Operation, p.18*)
- **Dry gas purge input:** Purge/dry the chamber using **gas output from the LN₂ Dewar at very low positive pressure** via a **flow control valve similar to TIG welding**. (*FOX200LT Instrument Manual, §6 Low Temperature Operation, p.18*)
- **Finish runs near room temperature** to reduce risk of brittle components. (*FOX200LT Instrument Manual, §4 Program Flow – Running a Test, p.10; §6 Low Temperature Operation, p.17–18*)
- **Dry between tests:** Upper **$+50^{\circ}\text{C}$** , Lower **$+30^{\circ}\text{C}$** , **≥ 2 mm air gap**, **valves OFF** during drying, then **ON** before next test. (*FOX200LT Instrument Manual, §6.1 Drying the Instrument, p.20*)
- **Valve override usage: Override switch (front) ON during tests, OFF during service.** (*FOX200LT Instrument Manual, §6.2 Override Switch, p.20*)
- **General caution: Nitrogen can be deadly if it replaces oxygen;** manage exhaust appropriately. (*FOX200LT Instrument Manual, §6.2 Override Switch – caution box, p.20*)

Additional configuration-specific controls are documented separately.

1) Step-by-Step Operating Process for Liquid Nitrogen Testing

A. Pre-Start (Instrument & Environment)

1. Verify ventilation and LN₂ supply

- Confirm Dewar connected, valves open, typical line pressure \approx 340 kPa (50 psi). (*FOX200LT Instrument Manual, §6 Low Temperature Operation, p.17–18*)

2. Power on instrument; unit warm and dry

- If recently operated at low temp or idle long period, perform **drying cycle**: Upper **+50 °C**, Lower **+30 °C**, **≥ 2 mm gap**, **valves OFF** for **\geq a couple of hours**; then **valves ON** before next test. (*FOX200LT Instrument Manual, §6.1 Drying the Instrument, p.20*)

3. Do not open chamber at extreme cold

- Warm plates to **~ 30 °C for ≥ 30 min** before opening after low-temp work. (*FOX200LT Instrument Manual, §1.1 Quick Start, p.3*)

4. Set valve override

- **ON** during tests; **OFF** during service. (*FOX200LT Instrument Manual, §6.2 Override Switch, p.20*)

B. Instrument Setup (Local Keypad)

5. Select units (SI or English)

- (*FOX200LT Instrument Manual, §4 Program Flow – Screen 1, p.7*)

6. Open stack and calibrate thickness (Delta X)

- Clean plates; **Open Stack / Calibrate Delta X** to zero thickness. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 2, p.8*)

7. Select calibration type

- **NIST 1450b SRM** (typical) or **User Type** per saved calibration. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 3–4, p.8*)

8. Test mode selection and setpoints

- **Test** (not Calibration), **do not maintain temperature between tests** on FOX200LT to avoid LN₂ waste. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 5, p.9*)
- Enter upper/lower plate setpoints (up to 9 pairs). **Heat flow up**; ΔT typically **20 °C**; negative temperature entry via **0 then digits**. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 6, p.9–10; §3 Pre-Saved Calibration, p.6–7*)

9. Insert sample; thickness mode

- **Auto Thickness** (rigid) or **User-Defined Thickness** (compressible); actual spacing displayed; enter **Sample ID** to start. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 7–8, p.11; Screen 8–11, p.11–12*)

C. PC-Assisted Operation (WinTherm32) – If Using Computer

10. Establish communication

- **Aux → Port → Enable** COM/USB (as applicable); confirm **FOX Instrument – COM#** window with live readings. (*WinTherm32 Software Manual, §4.1 Establishing Communication, p.15–16; §4.2 Application and COM window, p.17–19*)

11. Start test from PC (optional)

- **Run → Start → Start Test Run**; **Test Mode: Normal**, select **1450b calibration** (filed/computer or instrument), **Auto/Manual thickness**, then **Run**. (*WinTherm32 Software Manual, §4 “WinTherm32” Run – Start Test Run window, p.16; §2 Quick Start of Tests, p.7–11*)

12. Enter Sample Information and Setpoints

- Name, thickness, Aux Info; enter setpoints (Upper/Lower or Mean/Delta). (*Quick Start on Computer, Steps 4–5; WinTherm32 Software Manual, §5.3.1 Sample; §5.3.2 Setpoints, p.31–33*)

13. Monitoring & Equilibrium

- Observe **U/L temperatures**, **QU/QL** signals, block counter, and equilibrium indicators: **\$ (TE)**, *** (SE)**, **% (PE)**. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 9–10, p.11–12; §5 Data Organization and Equilibrium Criteria, p.16–17*)

14. Results

- Results per setpoint: **λU** and **λL**; use the **average**. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 10, p.12*)

15. End of test / repeat

- Choose to **repeat at same temperatures** or enter new; do **not** maintain low temps between tests on FOX200LT. (*FOX200LT Instrument Manual, §4 Program Flow – Screen 11, p.12–13; Screen 5 guidance, p.9*)

D. Post-Run Drying & Shutdown

16. Dry the instrument between tests

- Upper **+50 °C**, Lower **+30 °C**, **≥2 mm gap**; **valves OFF** during drying; run **≥ a couple of hours**; turn **valves ON** before next test. (*FOX200LT Instrument Manual, §6.1 Drying the Instrument, p.20*)

17. Do not open chamber cold

- Warm to **~30 °C for ≥30 min** before opening. (*FOX200LT Instrument Manual, §1.1 Quick Start, p.3*)

Additional configuration-specific controls are documented separately.

2) Potential Failure or Upset Conditions (Identification)

- **Temperature runaway / overheating or setpoint not reached**
 - Monitor plate temperatures; **WinTherm32 “Use plate overheat check”** option exists and setpoint-reach checks are available; if setpoints are not reached within defined hours the setpoint is skipped. (*WinTherm32 Software Manual, §4.3 Test Setup – More... Test Options, p.23–24*)
- **Condensation/Ice formation**
 - Occurs if chamber door is opened during/after low-temperature runs; **avoid opening**, use **Condensation Reset Button** (rear) to activate heaters raising chassis to room temp. (*FOX200LT Instrument Manual, §6 Low Temperature Operation, p.18*)
- **Insufficient LN₂ flow or valve state**

- **Override switch** must be **ON during tests; OFF during service**; ensure **valves ON** before tests and **OFF** during drying. (*FOX200LT Instrument Manual, §6.2 Override Switch, p.20; §6.1 Drying, p.20*)
- **Equilibrium not achieved / prolonged run**
 - Equilibrium criteria (TE/SE/PE, number of blocks, inflexion) govern completion; thicker/compressible samples may require more time. (*FOX200LT Instrument Manual, §5 Equilibrium Criteria, p.16–17; WinTherm32 Software Manual, §2 Quick Start criteria notes, p.11*)
- **Communication issues (PC ↔ instrument)**
 - COM/USB port selection and enable; use **Aux → Port → Reset Port** if needed. (*WinTherm32 Software Manual, §4.1; §5.6 Aux commands, p.40*)

Additional configuration-specific controls are documented separately.

3) Actions in the Event of a Leak, Line Failure, or Unexpected Nitrogen Release

Safety focus first; follow site emergency protocols.

- **Immediate actions**
 - **Do not open the test chamber at extreme low temperatures**; prioritize preventing condensation/ice damage. (*FOX200LT Instrument Manual, §1.1 Quick Start, p.3*)
 - **Recognize oxygen displacement hazard**: nitrogen can replace oxygen; ensure area ventilation and manage exhaust routing per configuration. (*FOX200LT Instrument Manual, §6 Low Temperature Operation – exhaust routing and ventilation, p.18; §6.2 caution, p.20*)
- **Instrument controls**
 - **Turn valve override OFF** (front) if servicing/state isolation is required; **turn LN₂ valves OFF** (rear button) as appropriate to stop LN₂ flow. (*FOX200LT Instrument Manual, §6.2 Override Switch, p.20; §6.1 Drying – valves OFF instruction, p.20*)
- **Purge and drying as recovery**
 - After stabilization, employ **dry gas purge input** at **very low positive pressure** via **flow control valve similar to TIG** to purge/dry the chamber; execute

standard **drying cycle** (Upper +50 °C / Lower +30 °C, ≥ 2 mm gap). (FOX200LT Instrument Manual, §6 Low Temperature Operation, p.18; §6.1 Drying, p.20)

- **Ventilation management**

- Operate in well-ventilated area and route exhaust gas appropriately to avoid oxygen depletion; **do not allow liquid nitrogen in exhaust**; aim for gas-only exhaust. (FOX200LT Instrument Manual, §6 Low Temperature Operation – exhaust guidance, p.18)

Additional configuration-specific controls are documented separately.

4) Roles and Responsibilities (Normal Operation & Emergency Response)

A. Normal Operation (Technicians)

- **Pre-run safety checks**

- Verify LN₂ supply and **valves ON**; confirm ventilation; prepare for drying if needed. (FOX200LT Instrument Manual, §6, p.17–18; §6.1, p.20)

- **Instrument setup**

- Units selection; thickness zeroing (**Calibrate Delta X**); calibration type; test setpoints; sample insertion; equilibrium monitoring. (FOX200LT Instrument Manual, §4 Program Flow Screens 1–11, p.7–13)

- **Post-run drying & shutdown**

- Execute drying (Upper +50 °C / Lower +30 °C, ≥ 2 mm gap; **valves OFF during drying, ON before next test**). (FOX200LT Instrument Manual, §6.1, p.20)

- **PC operation (if used)**

- Establish COM/USB; configure test; monitor equilibrium and results; manage calibration selection. (WinTherm32 Software Manual, §4.1–4.3, p.15–24; §2, p.7–11)

B. Emergency Response (Technicians; coordinated with EHS)

- **Immediate control measures**

- **Valve override OFF** as needed; **LN₂ valves OFF** to isolate LN₂ supply; maintain ventilation. (FOX200LT Instrument Manual, §6.2, p.20; §6.1, p.20; §6, p.18)

- **Stabilize instrument**
 - Avoid opening chamber at low temperature; when safe, use **Condensation Reset Button** and drying cycle to restore to room-temperature conditions.
(FOX200LT Instrument Manual, §6, p.18; §6.1, p.20)
- **Communications & documentation**
 - Report event per facility protocol; record setpoints, valve states, purge operations, and timing.

C. Roles and Responsibilities

Responsible Engineer (Name: _____)

- Owns the test plan and ensures procedures and controls are current
- Confirms configuration matches the approved setup (purge line, sleeving, venting/ventilation approach, signage, log sheet)
- Reviews results and maintains test records

Engineering Technician / Operator (Name: _____)

- Executes testing per procedure (startup, run, shutdown, drying)
- Uses required PPE and completes pre-run safety checks
- Monitors conditions during testing and isolates/stops the system if abnormal conditions occur
- Completes time-in/time-out log and posts/removes door signage per session

EHS Reviewer (Name: _____) (optional, recommended for initial run)

- Reviews safety controls and documentation
- Observes initial calibration/testing if desired
- Provides feedback for final approval

Additional configuration-specific controls are documented separately if necessary.

Sources Ledger

- **FOX200LT Instrument Manual (Rev 5b)**
 - §1.1 Quick Start (p.3–4)

- §3 Pre-Saved Calibration (p.6–7)
- §4 Program Flow – Screens 1–11 (p.7–13)
- §5 Data Organization & Equilibrium Criteria (p.16–17)
- §6 Low Temperature Operation (p.17–19)
 - Dry gas purge input; exhaust/ventilation guidance; Dewar pressure; Condensation Reset Button (p.18–19)
- §6.1 Drying the Instrument (p.20)
- §6.2 Override Switch for Valves (p.20)
- **WinTherm32 Software Manual (+ Addendum for FOX200LT)**
 - §2 Quick Start of Tests (p.7–11)
 - §4.1 Establishing Computer-Instrument Communication (p.15–16)
 - §4.2 WinTherm32 Application & COM window (p.17–19)
 - §4.3 Test Setup & More... Test Options (p.20–24)
 - §5.6 Aux Commands (Port/Reset) (p.40)
- **Quick Start on Computer (PDF)**
 - COM Port setup; Start Test Run; Sample Information; Setpoints windows (page content)

Document Control / Status

- **Document title:** FOX200LT Liquid Nitrogen Testing – Operating Procedure & Safety Controls (EHS Draft)
- **Prepared by:** Engineering
- **Intended use:** EHS review and approval for calibration and testing
- **Scope limitation:** This document reflects manufacturer manuals and verified operating intent. Configuration-specific hardware controls are documented separately if required.
- **Revision status:** Draft – pending EHS review and initial calibration observation
- **Effective date:** TBD upon EHS concurrence