

EQUIPMENT LIFECYCLE GUIDES

Decommissioning, optimization, and structural overhaul playbooks engineered to maximize hardware lifetime value.

01 ASSESS	02 OPTIMIZE	03 MODERNISE	04 EXTEND	05 RETIRE
Purpose Use these guides to decide whether an environmental chamber or associated system should be maintained, optimized, modernised, structurally overhauled, relocated, repurposed, or responsibly decommissioned.				

Industrial Equipment Lifecycle & Intelligence

How to Use This Guide

This field-oriented playbook is intended for chamber owners, maintenance teams, facility engineers, laboratories, service partners and asset managers. It supports structured lifecycle decisions without replacing equipment-specific OEM instructions, applicable safety procedures, refrigerant regulations or site risk assessments.

- 1. Lifecycle Assessment** — Establish technical condition, criticality, obsolescence and remaining-useful-life indicators.
- 2. Optimization Playbook** — Recover performance, reduce avoidable energy use and improve reliability before major capital intervention.
- 3. Modernisation & Retrofit** — Upgrade controls, sensors, electrical systems, refrigeration and connectivity where the mechanical platform remains viable.
- 4. Structural Overhaul** — Restore chamber envelope, floor, doors, insulation, air-management and load-bearing elements.
- 5. Relocation & Recommissioning** — Protect asset integrity during dismantling, transport, reinstallation and qualification.
- 6. Decommissioning** — Safely isolate, recover controlled materials, document disposition and preserve reusable value.
- 7. Lifecycle Records** — Create a decision trail for repairs, upgrades, calibration, spares and future capital planning.

Decision principle Do not replace equipment solely because of age. Assess safety, structural integrity, achievable performance, parts availability, operating cost, compliance needs and the economics of restoration versus replacement.

1. Lifecycle Assessment

Begin with a documented baseline. The objective is to separate recoverable degradation from fundamental end-of-life conditions and to identify the intervention with the best lifecycle value.

No.	Inspection / action	Status
1	Confirm equipment identification: manufacturer, model, serial number, chamber type, working volume and year of manufacture.	☐ OK ☐ Action
2	Record required operating envelope: temperature, humidity, altitude or other controlled parameters, ramp rates and test loads.	☐ OK ☐ Action
3	Review breakdown history, preventive-maintenance records, calibration results, alarms, repeat faults and major component replacements.	☐ OK ☐ Action
4	Inspect chamber structure, insulation, door alignment, seals, floor, penetrations, viewing windows, cable ports and corrosion.	☐ OK ☐ Action
5	Assess refrigeration condition: compressors, heat exchangers, valves, piping, refrigerant circuit, oil condition and leak history.	☐ OK ☐ Action
6	Assess heaters, humidification/dehumidification, circulation motors, fans, dampers and air distribution.	☐ OK ☐ Action
7	Assess electrical panel condition, protection devices, wiring, terminals, contactors, drives, relays, PLC/HMI and safety circuits.	☐ OK ☐ Action
8	Compare chamber indication with traceable reference measurements across representative operating points.	☐ OK ☐ Action
9	Identify obsolete or unsupported components and document practical replacement or retrofit paths.	☐ OK ☐ Action
10	Review utility consumption, cooling-water/air requirements and opportunities to reduce avoidable operating cost.	☐ OK ☐ Action
11	Classify business criticality, downtime consequence, test-program dependency and availability of backup capacity.	☐ OK ☐ Action
12	Assign lifecycle action: maintain / optimize / modernise / overhaul / relocate / decommission.	☐ OK ☐ Action

Lifecycle Decision Matrix

Condition	Typical evidence	Preferred action	Planning horizon
Healthy	Stable performance; parts supported; no structural concerns	Maintain + monitor	Routine
Recoverable	Efficiency loss, drift, wear or recurring minor faults	Optimize	Near term

Obsolescence risk	Controls/sensors/components unsupported but base machine sound	Modernise / retrofit	Planned shutdown
Major degradation	Structural, refrigeration or electrical deterioration with viable frame/envelope	Overhaul	Capital maintenance
End of viable life	Safety risk, severe corrosion, uneconomic repair or inability to meet required performance	Decommission / replace	Controlled retirement

2. Optimization Playbook

Optimization is the first intervention when the chamber is fundamentally serviceable. Establish a baseline before adjustment, then verify performance after each meaningful change.

2.1 Thermal & Airflow Optimization

No.	Inspection / action	Status
1	Clean condenser/evaporator heat-transfer surfaces and verify unobstructed airflow.	☐ OK ☐ Action
2	Inspect circulation fan direction, blade condition, motor current, bearings and vibration.	☐ OK ☐ Action
3	Check air-distribution plenums, baffles and return paths for blockage, leakage or unauthorized modifications.	☐ OK ☐ Action
4	Inspect door gasket compression and chamber penetrations for air leakage.	☐ OK ☐ Action
5	Compare unloaded and representative loaded performance before changing control parameters.	☐ OK ☐ Action
6	Confirm sensor placement is representative and not directly influenced by supply air, heaters, humidifier discharge or product mass.	☐ OK ☐ Action
7	Only tune control parameters after mechanical, refrigeration and sensor faults are excluded.	☐ OK ☐ Action

2.2 Refrigeration Optimization

No.	Inspection / action	Status
1	Record suction/discharge pressures and relevant temperatures under stable, representative conditions.	☐ OK ☐ Action
2	Check condenser approach, airflow or cooling-water condition before attributing poor performance to refrigerant charge.	☐ OK ☐ Action
3	Inspect for oil staining, frost anomalies, restrictions, abnormal compressor noise and excessive cycling.	☐ OK ☐ Action
4	Verify solenoid valves, expansion devices, capacity-control devices and defrost logic where fitted.	☐ OK ☐ Action
5	Compare actual pull-down and recovery performance against the required test duty rather than nameplate limits alone.	☐ OK ☐ Action
6	Correct root causes before refrigerant adjustment; refrigerant work must be performed by appropriately trained personnel.	☐ OK ☐ Action

2.3 Energy & Reliability Improvements

- Restore insulation, seals and panel closures before considering major refrigeration changes.
- Use staged capacity, variable-speed devices or revised control logic only where the equipment architecture supports them safely.
- Track compressor run hours, heater duty, alarms and downtime to quantify improvement rather than relying on subjective observation.
- Prioritize changes that reduce repeat service calls and improve stable operation over changes that only improve peak specifications.

Verification After optimization, repeat the same baseline test profile and compare pull-down, heat-up, stability, uniformity, recovery time, utility demand and alarm behavior.

3. Modernisation & Retrofit

Modernisation is appropriate when the chamber body and core mechanical platform remain viable but controls, electrical hardware, sensors, refrigeration components or connectivity create reliability and obsolescence risk.

3.1 Controls & HMI Upgrade

No.	Inspection / action	Status
1	Capture the existing I/O list, electrical drawings, interlocks, alarm logic, sequencing and communication interfaces.	☐ OK ☐ Action
2	Back up controller programs and parameter sets before removal where technically possible.	☐ OK ☐ Action
3	Identify all safety functions that must remain independent or fail-safe after the retrofit.	☐ OK ☐ Action
4	Prepare a point-to-point migration plan for sensors, actuators, contactors, drives, alarms and safety circuits.	☐ OK ☐ Action
5	Provide manual/automatic operating modes, alarm history, trend visibility and service diagnostics appropriate to the application.	☐ OK ☐ Action
6	Update electrical drawings, terminal schedules, component lists, software backups and revision records after commissioning.	☐ OK ☐ Action

3.2 Sensor & Instrumentation Upgrade

No.	Inspection / action	Status
1	Replace damaged, unstable, inaccessible or obsolete temperature/RH/pressure sensors with suitable industrial equivalents.	☐ OK ☐ Action
2	Confirm sensor range, accuracy, environmental suitability, response time and transmitter compatibility.	☐ OK ☐ Action
3	Maintain traceability between physical sensor, controller channel, calibration certificate and asset record.	☐ OK ☐ Action
4	Perform post-installation comparison/calibration and document correction factors only where permitted by the control architecture.	☐ OK ☐ Action

3.3 Refrigeration / Electrical Upgrade

No.	Inspection / action	Status
1	Confirm required operating envelope and load before selecting replacement compressor or refrigeration components.	☐ OK ☐ Action

No.	Inspection / action	Status
2	Check refrigerant compatibility, oil, pressure ratings, heat-exchanger suitability and applicable environmental requirements.	☐ OK ☐ Action
3	Validate cable sizing, protection, contactor/drive ratings, fault levels and earthing for changed electrical loads.	☐ OK ☐ Action
4	Preserve service access and avoid retrofit layouts that create future maintainability problems.	☐ OK ☐ Action
5	Commission through staged functional testing before full-load performance qualification.	☐ OK ☐ Action

3.4 Connected Asset Upgrade

- Add remote monitoring for key parameters, alarms, uptime and fault events where network/security requirements permit.
- Maintain a digital equipment record linking asset identity, service history, calibration, parts and retrofit revisions.
- Use remote data to improve diagnostics and maintenance planning; do not bypass local safety interlocks or site operating procedures.

4. Structural Overhaul

A structural overhaul can extend useful life when deterioration is concentrated in the chamber envelope or mechanical construction while the asset remains technically and economically recoverable.

4.1 Chamber Envelope & Insulation

No.	Inspection / action	Status
1	Inspect internal/external skins for corrosion, distortion, cracks, failed joints and moisture ingress.	☐ OK ☐ Action
2	Inspect insulation for saturation, compression, thermal bridging and loss of integrity around penetrations.	☐ OK ☐ Action
3	Repair or replace compromised panels using materials compatible with the operating temperature, humidity and test environment.	☐ OK ☐ Action
4	Reseal penetrations and panel joints with suitable temperature- and moisture-resistant systems.	☐ OK ☐ Action
5	After restoration, inspect for condensation, cold spots, hot spots and abnormal external surface temperatures.	☐ OK ☐ Action

4.2 Door, Floor & Structural Elements

No.	Inspection / action	Status
1	Check hinges, latches, frames and door alignment; restore uniform gasket compression without excessive closing force.	☐ OK ☐ Action
2	Inspect floor panels, load points, wheel tracks, ramps and thresholds for deformation or corrosion.	☐ OK ☐ Action
3	Confirm structural support is suitable for intended specimen and trolley loads.	☐ OK ☐ Action
4	Inspect viewing windows, heated frames and seals for condensation, cracks or delamination.	☐ OK ☐ Action
5	Restore drainage paths and ensure condensate cannot accumulate inside insulation or structural cavities.	☐ OK ☐ Action

4.3 Air-Management Restoration

No.	Inspection / action	Status
1	Inspect fan shafts, bearings, impellers, housings, motor mounts and vibration isolation.	☐ OK ☐ Action
2	Restore baffles, ducts and plenums to the intended air path; eliminate bypass leakage.	☐ OK ☐ Action
3	Balance airflow only after mechanical defects and obstructions are corrected.	☐ OK ☐ Action
4	Perform spatial mapping after major air-system or structural work to confirm usable-volume performance.	☐ OK ☐ Action

Hold point Major structural changes can alter airflow, heat leakage and chamber performance. Treat the repaired chamber as requiring recommissioning, not merely cosmetic completion.

5. Relocation & Recommissioning

Relocation should be managed as an engineering project. Improper isolation, lifting, transport or reassembly can convert a serviceable asset into a high-risk repair.

No.	Inspection / action	Status
1	Capture photographs, wiring references, piping routes, settings, software backups and equipment condition before dismantling.	☐ OK ☐ Action
2	Identify lifting points, centre of gravity, detachable assemblies and transport restraints.	☐ OK ☐ Action
3	Safely isolate electrical, water, drains, compressed air and other utilities under site procedures.	☐ OK ☐ Action
4	Handle refrigerant circuits in accordance with applicable regulations and manufacturer requirements; avoid uncontrolled venting.	☐ OK ☐ Action
5	Cap and protect open pipes, ducts, connectors and sensor ports against contamination and moisture.	☐ OK ☐ Action
6	Label disconnected cables, tubes and assemblies using a controlled reinstatement schedule.	☐ OK ☐ Action
7	Inspect foundations, access path, ventilation and utilities at the destination before equipment arrival.	☐ OK ☐ Action
8	Level, anchor and reconnect the equipment; verify phase sequence, earthing and utility quality.	☐ OK ☐ Action
9	Perform leak checks, electrical safety checks, functional tests and alarm/interlock verification.	☐ OK ☐ Action
10	Complete temperature/humidity performance verification and calibration/mapping as required before release to testing.	☐ OK ☐ Action

6. Decommissioning Playbook

Decommissioning should leave the site safe, preserve recoverable asset value, prevent uncontrolled release of regulated materials and create a clear record of final disposition.

6.1 Pre-Decommission Review

No.	Inspection / action	Status
1	Approve retirement decision and identify whether the asset will be sold, relocated, cannibalized for spares, recycled or scrapped.	☐ OK ☐ Action
2	Export required service records, calibration records, controller programs, recipes and configuration files.	☐ OK ☐ Action

No.	Inspection / action	Status
3	Identify refrigerants, oils, batteries, electronic assemblies, lamps, chemicals or other controlled materials present.	☐ OK ☐ Action
4	Define lockout/tagout, lifting, access, hot-work and waste-handling requirements for the site.	☐ OK ☐ Action
5	Identify reusable components and preserve traceability before dismantling.	☐ OK ☐ Action

6.2 Safe Isolation & Dismantling

No.	Inspection / action	Status
1	Shut down using the normal operating sequence before isolating energy sources.	☐ OK ☐ Action
2	Lock and verify electrical isolation; discharge stored electrical energy where applicable.	☐ OK ☐ Action
3	Recover refrigerant using suitable equipment and route it for reuse, reclamation or disposal in accordance with applicable requirements.	☐ OK ☐ Action
4	Drain water systems and manage oils/fluids without discharge to unsuitable drains or soil.	☐ OK ☐ Action
5	Remove batteries/electronic waste and segregate materials according to local disposal requirements.	☐ OK ☐ Action
6	Support heavy components before releasing mounts, piping or structural fasteners.	☐ OK ☐ Action
7	Protect personnel from sharp sheet metal, pressurized circuits, heavy doors and unstable assemblies.	☐ OK ☐ Action

6.3 Final Disposition Record

Asset ID / serial number

Final operating date

Refrigerant type & recovered quantity

Reusable parts retained

Waste / recycler reference

Data/program backup location

Final disposition & authorization

Important The exact handling and disposal requirements depend on jurisdiction, refrigerant type, site rules and equipment construction. Use qualified personnel and applicable local environmental and safety procedures.

7. Lifecycle Records & Asset Intelligence

The value of lifecycle management increases when each intervention improves the asset record. A reliable history makes future repair-versus-replace decisions faster and more defensible.

Minimum Digital Asset Record

No.	Inspection / action	Status
1	Asset identity, manufacturer, model, serial number, location and ownership.	☐ OK ☐ Action
2	Original specifications and current required operating envelope.	☐ OK ☐ Action
3	Warranty status, commissioning date and major relocation history.	☐ OK ☐ Action
4	Preventive maintenance, breakdowns, root causes and corrective actions.	☐ OK ☐ Action
5	Calibration certificates, mapping reports and measurement history.	☐ OK ☐ Action
6	Component replacements, retrofit revisions, software versions and backups.	☐ OK ☐ Action
7	Critical spare-parts list and obsolescence status.	☐ OK ☐ Action
8	Runtime, alarms, uptime/downtime and condition-monitoring data where available.	☐ OK ☐ Action
9	Lifecycle assessment date, condition classification and recommended next action.	☐ OK ☐ Action
10	Decommissioning and final disposition record when retired.	☐ OK ☐ Action

Recommended Lifecycle Review Triggers

- Repeated failure of the same subsystem
- Loss of required stability, uniformity, ramp rate or recovery performance
- Major refrigerant or compressor intervention
- Control platform or critical component obsolescence
- Structural corrosion, insulation failure or recurring condensation
- Material change in test requirements or specimen load
- Relocation to a new facility
- Rising maintenance cost or downtime
- Major safety modification
- Approaching planned capital replacement window

8. Lifecycle Decision Record

Complete this summary after an assessment or major intervention. Attach supporting photographs, measurements, calibration data, quotations and engineering notes where applicable.

Customer / site
Equipment / asset ID
Assessment date
Current condition
Critical risks
Obsolescence concerns
Recommended lifecycle action
Estimated shutdown required
Follow-up target date
Assessor / reviewer

Recommended Action

☐ Maintain	☐ Optimize	☐ Modernise
☐ Structural overhaul	☐ Relocate	☐ Decommission

Engineering Notes / Scope Definition

Levito lifecycle approach Service the asset when maintenance is enough. Optimize it when performance can be recovered. Modernise it when obsolescence is the constraint. Overhaul it when the platform still has value. Retire it when safety, capability or economics no longer justify continued operation.

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Service • Care • Modernise • Connect