# HVAC Airside and Building Systems Root Cause Analysis Workbook - Leak, Pressure or Flow Issue

HVAC Airside and Building Systems | Leak, Pressure or Flow Issue | Asset ID FIX-11-06-09

**Safety gate: Stop, isolate and verify before exposure to hazardous energy. Lockout/Tagout and live testing require the applicable site procedure, authorised controls and a qualified person. Never bypass a guard, interlock or protective device to complete this workbook.**

## How to use this field resource

This is an equipment-agnostic documentation workbook for hvac airside and building systems. It helps a trained team connect comfort or airflow complaints to operating mode, demand, filters, fans, dampers and controls. It does not identify a fault by itself and does not replace the equipment-specific OEM manual, drawings, limits, permits or a qualified technician's judgement.

| Intake field | Record |
|---|---|
| Asset or equipment ID | _____ |
| Site and location | _____ |
| Reported by / time | _____ |
| Fault situation | Leak, Pressure or Flow Issue |
| Operating state | Stopped / standby / starting / running / loaded |
| Safety owner | _____ |
| OEM reference used | Document number and revision: _____ |

## Evidence areas for this system

For a leak, pressure or flow issue, focus on evidence that can be dated, repeated and handed to another technician. Capture the as-found state before clearing alarms, changing settings or disturbing connections.

| # | Evidence area | First record |
|---|---|---|
| 1 | Space complaint and occupancy | As-found note: _____ |
| 2 | Controller mode and demand | As-found note: _____ |
| 3 | Filter and accessible airflow path | As-found note: _____ |
| 4 | Fan command and response | As-found note: _____ |
| 5 | Damper or valve indication | As-found note: _____ |
| 6 | Temperature and humidity trend | As-found note: _____ |

## Root Cause Analysis Workbook

Use this section to distinguish visible loss, restriction, supply problem and control response. Record fluid or gas, location, operating state, trend and containment status before choosing the next action.

| Branch | Confirmed fact | Cause hypothesis | Discriminating evidence |
|---|---|---|---|
| 0 | Observed fact: _____ | Possible link to space complaint and occupancy | Evidence needed: _____ |
| 1 | Observed fact: _____ | Possible link to controller mode and demand | Evidence needed: _____ |
| 2 | Observed fact: _____ | Possible link to filter and accessible airflow path | Evidence needed: _____ |
| 3 | Observed fact: _____ | Possible link to fan command and response | Evidence needed: _____ |
| 4 | Observed fact: _____ | Possible link to damper or valve indication | Evidence needed: _____ |
| 5 | Observed fact: _____ | Possible link to temperature and humidity trend | Evidence needed: _____ |

### Root-cause standard

- A replaced part is not automatically the root cause.
- Name the physical or process mechanism that produced the failure.
- Explain why the evidence rules out the closest alternative.
- Identify the condition that allowed the cause to persist.
- Define a verification that would fail if the diagnosis were wrong.

## HVAC Airside and Building Systems Evidence Map

**Evidence first: Preserve alarms, event history, settings, trends and the as-found physical state before reset, disconnection or adjustment. If safe access is uncertain, stop and refer the task to the authorised person.**

| # | System area | Evidence action | Trace | Record |
|---|---|---|---|---|
| 1 | Space complaint and occupancy | Observe and identify | Evidence ID: _____ | Finding: _____ |
| 2 | Controller mode and demand | Record source and time | Evidence ID: _____ | Finding: _____ |
| 3 | Filter and accessible airflow path | Compare with reference | Evidence ID: _____ | Finding: _____ |
| 4 | Fan command and response | State what it supports | Evidence ID: _____ | Finding: _____ |
| 5 | Damper or valve indication | State what it rules out | Evidence ID: _____ | Finding: _____ |
| 6 | Temperature and humidity trend | Choose the least invasive next check | Evidence ID: _____ | Finding: _____ |

## Scenario boundary

For this leak, pressure or flow issue, never use hands to search for a pressurised leak. Write the boundary before testing so urgency does not quietly change the rules.

| Boundary | Definition |
|---|---|
| Known good condition | _____ |
| Known failed condition | _____ |
| Difference between them | _____ |
| First missing evidence | _____ |
| Stop-work threshold | _____ |
| Escalation owner | _____ |

### Evidence labels

- FACT - directly observed and traceable.
- REPORT - supplied by another person; source recorded.
- INFERENCE - reasonable explanation that still needs a test.
- UNKNOWN - important gap that must not be filled by assumption.
- LIMIT - OEM, engineering or site acceptance value.

## Leak, Pressure or Flow Issue Condition Workbook

The goal is to distinguish visible loss, restriction, supply problem and control response. Describe the failed state narrowly enough that another trained person could look for the same thing without being told your suspected cause.

| Question | Boundary prompt | Record |
|---|---|---|
| What changed? | Function, output, indication or behaviour | _____ |
| Where? | Asset, side, circuit, zone or process stage | _____ |
| When? | Sequence step, runtime, load or environment | _____ |
| How often? | Every cycle, random, once, or after delay | _____ |
| What restores it? | Nothing, time, reset, cooling or load change | _____ |
| What stays normal? | Unaffected systems or functions | _____ |
| What changed recently? | Work, software, settings, parts or operating duty | _____ |

## Controlled reproduction plan

| Plan field | Record |
|---|---|
| Safe starting state | _____ |
| One condition to vary | _____ |
| Conditions held constant | _____ |
| Evidence captured | Fluid or gas, location, operating state, trend and containment status |
| Maximum attempts | _____ |
| Immediate stop signal | _____ |
| Authorising person | _____ |

### Attempt notes

| Attempt | Starting condition | Result | Decision |
|---|---|---|---|
| 1 | State: _____ | Observed: _____ | Next decision: _____ |
| 2 | State: _____ | Observed: _____ | Next decision: _____ |
| 3 | State: _____ | Observed: _____ | Next decision: _____ |
| 4 | State: _____ | Observed: _____ | Next decision: _____ |

## Measurement and Evidence Register

**Measurement boundary: This page records an approved test; it does not authorise one. A qualified person must choose the method, instrument category, connection points, isolation state and protective controls from the applicable procedure.**

| ID | Evidence area | Traceable source | Result | When |
|---|---|---|---|---|
| 1 | Space complaint and occupancy | Method / source: _____ | Value / state: _____ | Time: _____ |
| 2 | Controller mode and demand | Method / source: _____ | Value / state: _____ | Time: _____ |
| 3 | Filter and accessible airflow path | Method / source: _____ | Value / state: _____ | Time: _____ |
| 4 | Fan command and response | Method / source: _____ | Value / state: _____ | Time: _____ |
| 5 | Damper or valve indication | Method / source: _____ | Value / state: _____ | Time: _____ |
| 6 | Temperature and humidity trend | Method / source: _____ | Value / state: _____ | Time: _____ |

## Instrument and reference record

| Control | Record |
|---|---|
| Instrument or data source | _____ |
| Identifier and range | _____ |
| Calibration / validation status | _____ |
| OEM or engineering reference | Document and revision: _____ |
| Equipment operating state | _____ |
| Uncertainty or limitation | _____ |

### Before using a value

- Check units, scale, timestamp and source identity.
- Keep raw evidence where practical; do not retain only a conclusion.
- Record values that disagree with the current theory.
- Compare only like operating conditions.
- Treat a single normal reading as one data point, not proof that an intermittent fault is absent.

## Cause and Evidence Matrix

List competing explanations before the team settles on one. A good next check separates hypotheses; a poor check produces the same answer no matter which cause is true.

| # | Hypothesis | Supporting | Contradicting | Discriminating check |
|---|---|---|---|---|
| 1 | Space complaint and occupancy hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 2 | Controller mode and demand hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 3 | Filter and accessible airflow path hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 4 | Fan command and response hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 5 | Damper or valve indication hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 6 | Temperature and humidity trend hypothesis | For: _____ | Against: _____ | Next evidence: _____ |

## Five-why chain with evidence

| Level | Explanation | Proof or gap |
|---|---|---|
| Problem | Leak, Pressure or Flow Issue | Evidence ID: _____ |
| Why 1 | _____ | Evidence: _____ |
| Why 2 | _____ | Evidence: _____ |
| Why 3 | _____ | Evidence: _____ |
| Why 4 | _____ | Evidence: _____ |
| Why 5 | _____ | Evidence: _____ |

### Cause confidence

- Confirmed - reproduced or directly measured against a valid reference.
- Probable - best fit, but one meaningful alternative remains.
- Possible - plausible and worth a safe test.
- Unrelated - contradicted by the evidence.
- Unknown - evidence is missing or unreliable.

## Repair Decision and Return-to-Service Gate

**Release authority: Completion of a repair is not permission to energise or operate. Restore energy and return equipment to service only through the site's authorised process, with guards and protective functions reinstated.**

| Decision field | Record |
|---|---|
| Confirmed problem | _____ |
| Evidence-supported cause | _____ |
| Approved repair reference | Document and revision: _____ |
| Work completed | _____ |
| Parts / settings changed | _____ |
| Residual defect or restriction | _____ |
| Person completing / checking | _____ |

## Controlled verification

| Verification | Acceptance basis | Status |
|---|---|---|
| As-found symptom | Leak, Pressure or Flow Issue | Absent / present / not tested |
| Primary function | Space complaint and occupancy | Pass / fail / not tested |
| Related function | Controller mode and demand | Pass / fail / not tested |
| Protection and alarms | Normal protective state retained | Pass / fail / not tested |
| Leak, heat, noise or damage | No new adverse condition | Pass / fail / not tested |
| Recorded operating condition | Load / mode / duration: _____ | Accepted / restricted |

### Release signatures

- Technical check by: _____ Date/time: _____
- Operations acceptance by: _____ Date/time: _____
- Safety or permit close-out by: _____ Date/time: _____
- Follow-up owner and due date: _____

## Handover, Follow-Up and Prevention Plan

Close the record so the next shift can understand the leak, pressure or flow issue, the evidence, the repair decision and any remaining restriction without relying on memory.

| Handover field | Record |
|---|---|
| Current equipment state | _____ |
| What was confirmed | _____ |
| What remains unknown | _____ |
| Operating restriction | _____ |
| Evidence location | Log / work order / folder: _____ |
| Next owner and action | _____ |
| Escalation trigger | _____ |

## Follow-up schedule

| When | Review | Record |
|---|---|---|
| Next shift | Confirm state and restriction | Owner: _____ Result: _____ |
| 24 hours | Review space complaint and occupancy | Owner: _____ Result: _____ |
| 7 days | Check for repeat events under comparable duty | Owner: _____ Result: _____ |
| 30 days | Review effectiveness and maintenance action | Owner: _____ Result: _____ |

### Prevention decision

- Update the task, limit, drawing or training only when the cause supports it.
- Remove any temporary control by its approved expiry point.
- Share the lesson without exposing private, security-sensitive or proprietary data.
- Record whether the action reduced repeat faults, downtime or diagnostic effort.
- Reopen the analysis if the symptom returns under the same conditions.

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