# Industrial Hydraulic Systems Root Cause Analysis Workbook - Abnormal Noise or Vibration

Industrial Hydraulic Systems | Abnormal Noise or Vibration | Asset ID FIX-15-06-05

**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 industrial hydraulic systems. It helps a trained team separate command, pressure, flow, leakage, temperature and actuator evidence. 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 | Abnormal Noise or Vibration |
| Operating state | Stopped / standby / starting / running / loaded |
| Safety owner | _____ |
| OEM reference used | Document number and revision: _____ |

## Evidence areas for this system

For a abnormal noise or vibration, 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 | Command and valve indication | As-found note: _____ |
| 2 | Reservoir level and fluid condition | As-found note: _____ |
| 3 | Accessible leakage evidence | As-found note: _____ |
| 4 | Temperature trend | As-found note: _____ |
| 5 | Actuator response | As-found note: _____ |
| 6 | Filter or restriction indication | As-found note: _____ |

## Root Cause Analysis Workbook

Use this section to describe location, timing, frequency and load relationship without relying on a vague sound label. Record where it is strongest and which operating change affects it before choosing the next action.

| Branch | Confirmed fact | Cause hypothesis | Discriminating evidence |
|---|---|---|---|
| 0 | Observed fact: _____ | Possible link to command and valve indication | Evidence needed: _____ |
| 1 | Observed fact: _____ | Possible link to reservoir level and fluid condition | Evidence needed: _____ |
| 2 | Observed fact: _____ | Possible link to accessible leakage evidence | Evidence needed: _____ |
| 3 | Observed fact: _____ | Possible link to temperature trend | Evidence needed: _____ |
| 4 | Observed fact: _____ | Possible link to actuator response | Evidence needed: _____ |
| 5 | Observed fact: _____ | Possible link to filter or restriction indication | 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.

## Industrial Hydraulic 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 | Command and valve indication | Observe and identify | Evidence ID: _____ | Finding: _____ |
| 2 | Reservoir level and fluid condition | Record source and time | Evidence ID: _____ | Finding: _____ |
| 3 | Accessible leakage evidence | Compare with reference | Evidence ID: _____ | Finding: _____ |
| 4 | Temperature trend | State what it supports | Evidence ID: _____ | Finding: _____ |
| 5 | Actuator response | State what it rules out | Evidence ID: _____ | Finding: _____ |
| 6 | Filter or restriction indication | Choose the least invasive next check | Evidence ID: _____ | Finding: _____ |

## Scenario boundary

For this abnormal noise or vibration, do not approach unguarded or unstable rotating equipment to improve an observation. 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.

## Abnormal Noise or Vibration Condition Workbook

The goal is to describe location, timing, frequency and load relationship without relying on a vague sound label. 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 | Where it is strongest and which operating change affects it |
| 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 | Command and valve indication | Method / source: _____ | Value / state: _____ | Time: _____ |
| 2 | Reservoir level and fluid condition | Method / source: _____ | Value / state: _____ | Time: _____ |
| 3 | Accessible leakage evidence | Method / source: _____ | Value / state: _____ | Time: _____ |
| 4 | Temperature trend | Method / source: _____ | Value / state: _____ | Time: _____ |
| 5 | Actuator response | Method / source: _____ | Value / state: _____ | Time: _____ |
| 6 | Filter or restriction indication | 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 | Command and valve indication hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 2 | Reservoir level and fluid condition hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 3 | Accessible leakage evidence hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 4 | Temperature trend hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 5 | Actuator response hypothesis | For: _____ | Against: _____ | Next evidence: _____ |
| 6 | Filter or restriction indication hypothesis | For: _____ | Against: _____ | Next evidence: _____ |

## Five-why chain with evidence

| Level | Explanation | Proof or gap |
|---|---|---|
| Problem | Abnormal Noise or Vibration | 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 | Abnormal Noise or Vibration | Absent / present / not tested |
| Primary function | Command and valve indication | Pass / fail / not tested |
| Related function | Reservoir level and fluid condition | 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 abnormal noise or vibration, 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 command and valve indication | 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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