TECHNICAL ANNEX

CARI-Loops, part by part.

What goes in, what comes out, and what your engineer sees at each step: the export, the data check, the tag table, every finding and its next check, the report, the valve test, the dead-band trend, the monthly comparison, where it runs, and the worked example in full.

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A1 · WHAT YOU SEND

The export, field by field.

CARI-Loops reads the trend export your control system already keeps. Send what you have; each signal you add lets the report name more.

File	CSV or Excel (.xlsx) from your DCS, PLC, SCADA or historian; one file or several. Wide layout (one column per tag) or long layout (one row per reading).
Time	One time column: date and time, or seconds.
Per loop, needed	Measurement (PV) and controller output (OP).
Per loop, recommended	Set point (SP) and mode (auto or manual, as text or a number).
Per loop, where logged	Valve position from a smart positioner, under any column name you confirm in the tag table: lost motion and dead band are then sized as a share of travel.
Rate	Fixed-interval readings from uncompressed history. Flow and pressure loops every 1 to 5 seconds; slower loops may be recorded less often. Where the stored history has lost detail, record a fresh stretch.
Length	Two weeks of representative operation is ideal; a few hours at the recommended rate is enough to start.
Your cost (optional)	Per loop, what one unit away from set point costs your plant per hour, in rupees.
Stroke tests (optional)	For a valve to follow: the month of each stroke or signature test and its dead band as a share of travel, and your limit.

THE FIRST ROWS OF THE EXAMPLE EXPORT

```
Timestamp,TIC-201.PV,TIC-201.SP,TIC-201.OP,TIC-201.MODE,TIC-202.PV,TIC-202.SP,TIC-202.OP,TIC-202.MODE, ...
2026-09-01 00:00:00,120.0482,120.0000,49.518,AUTO,95.0325,95.0000,49.992,AUTO, ...
2026-09-01 00:00:02,119.9421,120.0000,50.566,AUTO,95.0288,95.0000,49.993,AUTO, ...
2026-09-01 00:00:04,120.0890,120.0000,49.118,AUTO,95.0580,95.0000,49.985,AUTO, ...
```

WHAT EACH SIGNAL ADDS TO THE REPORT

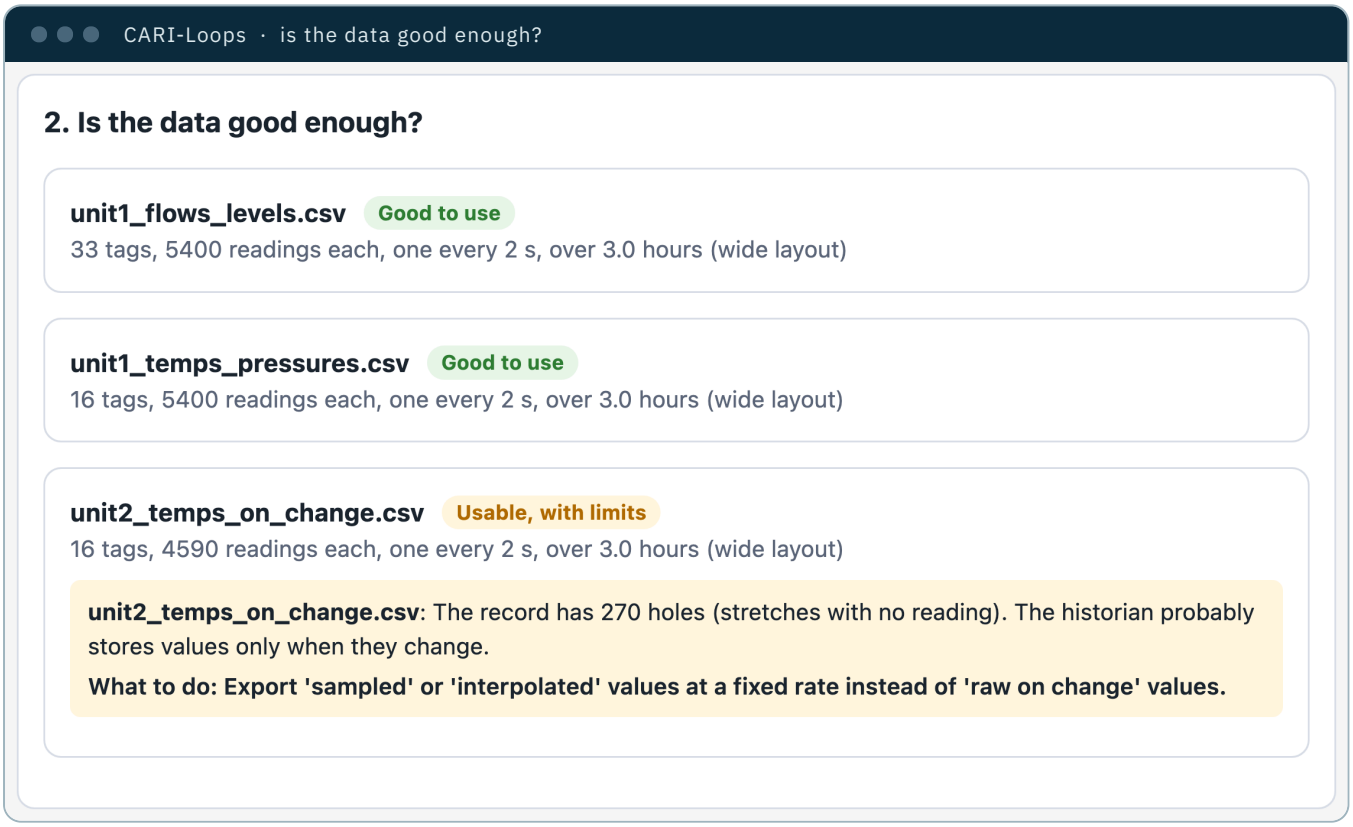
YOU INCLUDE	THE REPORT CAN THEN NAME
Measurement, output and set point	Frozen measurements, outputs at their limit, swinging loops and the sticking-valve pattern; with your cost, the cost ranking.
Mode	Loops left in manual, read directly from the logged mode.
Valve position	Lost motion and dead band, sized as a share of travel.
Stroke-test history	The dead-band trend to your own limit, for repair planning.

> **Your tag names.** The app lists the loops it sees from your tag names, and you confirm them before anything is judged.

A2 · THE DATA CHECK

What each file can show, stated before the check.

WHAT IS FOUND	GRADE	WHAT THE SCREEN TELLS YOU
No time column, no numbers, unreadable file	**Needs a new export**	What to export instead.
A file stored only when values change (gaps)	**Usable, better export named**	Fixed-interval readings from uncompressed history; a fresh stretch where detail has been lost.
Fewer readings than a loop needs	**Usable, better export named**	Export a longer period at the same rate.
A fast loop recorded slowly	**Usable, better export named**	Fixed-interval readings from uncompressed history, every 1 to 5 seconds for flow and pressure loops; a fresh stretch where stored history has lost detail.
A column mapped twice, a duplicated signal	**Stopped at the tag table**	Pick the right column for each signal.



A3 · TAGS, LOOP TYPES AND YOUR COST

Matched from the names	Measurement, set point, output, mode and valve position, with the loop type (flow, level, pressure, temperature, analysis, density, speed or weight): every match shown for you to confirm.
Checked as you go	“Check the mapping” names any loop with a missing, repeated or wrong column before the run.
Your cost	Optionally, each loop's cost per unit away from set point per hour, for a cost ranking beside the health ranking.
Saved as	A plant or unit name and a label, so next month's check is compared with this one.

A4 · FINDINGS AND NEXT CHECKS

Each finding, and the engineer's next check.

Finding names are the app's own words. The next checks help your team confirm the cause before choosing the work.

FINDING	WHAT THE RECORD SHOWS	NEXT CHECK
Instrument frozen	The measurement stopped changing for a long stretch.	Check the transmitter and its wiring. Compare with a local gauge.
Sticking valve suspected	The loop swings up and down in the pattern a sticking valve makes.	Agree a small-step test with operations. Check valve position, or the flow or pressure response, for delayed movement and jumps; use the result to plan the valve inspection.
Valve dead band	The valve does not follow small changes of its signal; it waits, then moves.	Check the linkage, positioner and actuator for friction or play; check positioner calibration and correct it as needed.
Output saturated	The controller output stays at its upper or lower limit for a long stretch, with no further output movement available in that direction.	Check operating limits, valve or pump response and duty before deciding whether to retune.
Swings with others	This loop swings at the same rhythm as other loops, named in the report.	Review the named loops as one job and look for a common cause first.
Loop swinging	The loop swings up and down in a regular rhythm.	With operations, observe the loop in manual. If the swing stops, check valve response before retuning (CARI-Tune gives the settings); if it continues, investigate upstream.
Left in manual	The logged mode shows manual for much of the record.	Confirm why it was in manual. Resolve any fault, then agree with operations whether to return it to automatic.
Export again	The recorded data is not good enough to judge this loop.	Follow the named export correction: use a suitable recording rate and uncompressed history, add a missing signal, or record a fresh stretch where detail has been lost.
No problem found	The checks this export supports found no problem in the record.	No action. Keep it in next month's check.

ALSO SEEN

A loop can carry more than its main finding: a dead band read from the valve position, a sticking-valve pattern to confirm by hand, or the loops it swings with. Each is printed under “Also seen”.

THEN RETUNE

For a loop whose own settings are the cause, CARI-Tune gives new settings to try. The valve is checked first.

A5 · ORDER, HOW SURE, AND THE REPORT

The review order, and the evidence behind it.

Order	Ranked for review by type: frozen measurements, suspected sticking valves, valve dead band, outputs at their limits, shared swings, other swings, manual running, then loops needing a better export; loops with no problem found at the bottom. Your team sets the work order with plant criticality in mind.
How sure	High, medium or low describes the strength of evidence for assessed findings. Loops needing a better export carry the reason.
Better export	Loops needing one are listed apart, with the reason and the export setting that fixes it.
Money	At your own cost rate: the value of the error over this record, beside the health ranking.

What every report holds

1. **The count of loops** by result, then **what to look at first:** finding, likely cause, what to do and how sure.
2. **A section for each finding** with its trends, then **loops needing a better export,** with the setting that fixes each.
3. **Formats:** on screen, print or PDF, and the findings as CSV.

Columns of the findings CSV (findings in the app's short form, such as “sensor frozen”): Loop · Type · Finding · How sure · What is wrong · Likely cause · What to do · Detail · Also seen · Could not check · Cost of deviation in this record (Rs, at your rate)

```
LIC-301,level,sensor frozen,high, ...
FIC-102,flow,sticking valve,medium, ...
```

CARI-Loops · report, first page

Control loop and valve health check

Unit 1, reactor area · records from 01 Sep 2026 00:00 to 01 Sep 2026 02:59 (3.0 h) · files: export_flows_levels.csv, export_temps_pressures.csv

12	7	1	4
loops checked	with a problem found	could not be judged from the data	no problem found

What to look at first (8 items, 8 loops)

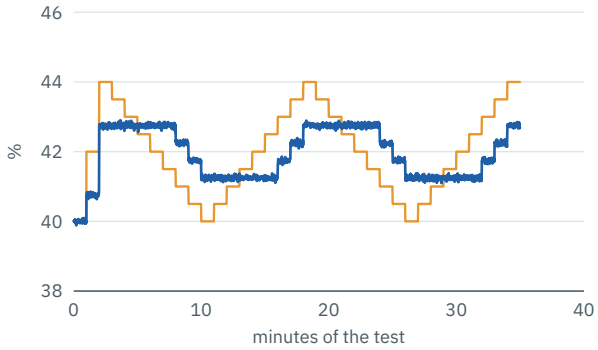
#	Loop	What is wrong	Likely cause	What to do	How sure
1	LIC-301	**The measurement stopped changing for a long stretch.**	Most likely a stuck or failed transmitter, or a broken signal wire. The controller was acting on a frozen number.	Check the transmitter and its wiring. Compare with a local gauge.	High
2	FIC-102	**The loop swings up and down in the pattern a sticking valve makes.**	Most likely valve friction (tight packing, a sticking stem). The same pattern can also come from a loose linkage or an uneven process.	Put the loop in manual and move the output in small steps (0.5 %, 1 %, 2 %). If the reading does not move until several steps add up, then jumps, the valve sticks. Then service the valve.	Medium
3	FIC-103	**The valve does not follow small changes of its signal; it waits, then moves.**	Play (lost motion) in the valve, its linkage or positioner, measured from the valve's own position signal.	Check the linkage, positioner and actuator for play; re-calibrate the positioner.	High

A6 · THE MANUAL VALVE TEST

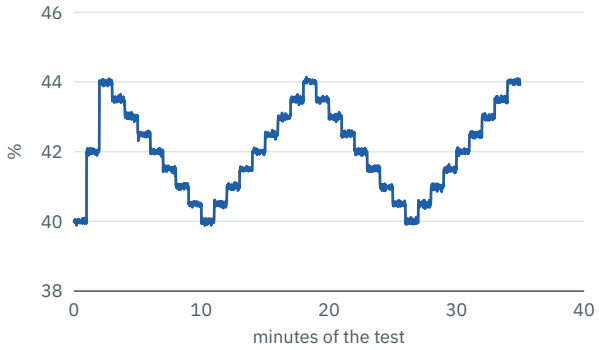
How the valve answers small moves.

When	On a valve the report lists as a suspect, or any valve your team wants checked. About half an hour of steps in the example.
The plan	Small held steps up and down around your working point, planned by the app for your engineer and operations to review.
How	Agree the operating conditions and permitted output moves with operations. With the loop in manual, your engineer sets and holds each level. Export the output and the valve's position (best) or the flow or pressure it moves, every 1 to 5 seconds, under any column names; you confirm which column is which.
The answer	Whether the valve answered the small moves, and the dead band as a share of the output signal (stroke tests and position records give it as a share of travel).

Sticking valve dead band 2.5 % of output



Sound valve followed small moves



Controller output, stepped by hand — Valve position

TEST RESULT, STICKING VALVE

The valve does not answer small moves: the test indicates dead band. Check the linkage, positioner and actuator for friction or play, and check positioner calibration.

TEST RESULT, SOUND VALVE

The valve answered the small moves.

Your team runs the live test. Trend review changes nothing in your control system. The valve test moves a live output, so it is run by your own team under your plant procedures, with timing, step sizes and holds agreed with operations before it starts.

THE TEST EXPORT (.ZT: THE VALVE POSITION)

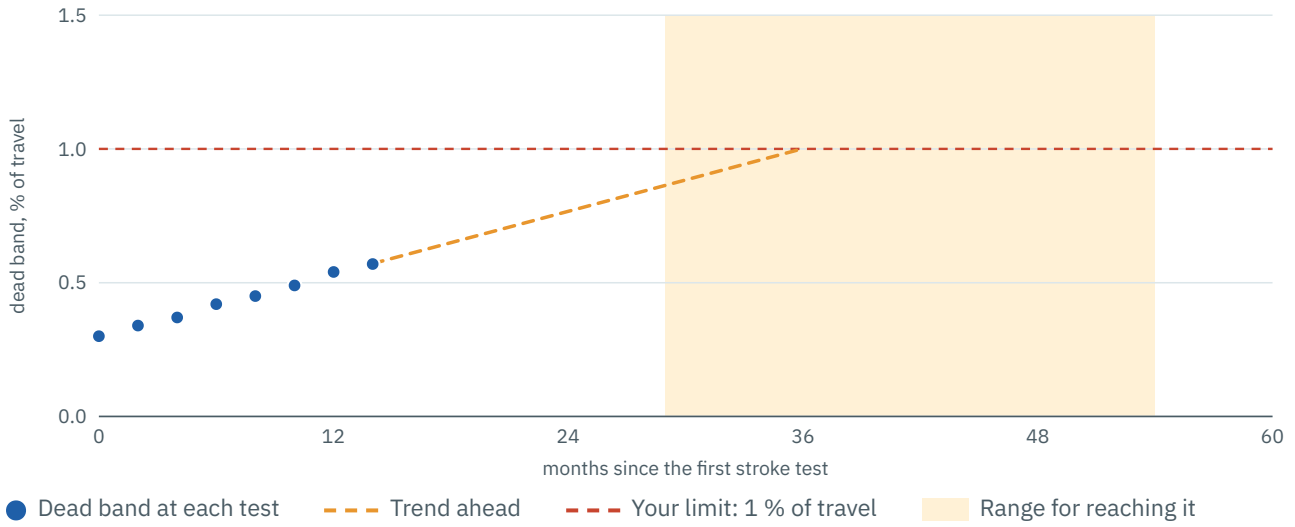
```
Time_s,FIC-SAMPLE.OP,FIC-SAMPLE.ZT
0,40.000,40.0063
1,40.000,39.9934
2,40.000,40.0320
...
```

A7 · DEAD BAND TO YOUR LIMIT

From stroke tests to repair planning.

You enter	The month of each stroke or signature test of one valve, its dead band as a share of travel, and your limit.
You get	An estimated time to your dead-band limit, with a range and the limit used, to help plan the repair.
Limit	Your own limit, as a share of travel.

Example stroke-test history, one valve 8 tests, every two months



The app's answer: from this example history, about 22 months to the 1 % travel limit, with a range of 15 to 40 months. The estimate is updated as each new stroke test is added.

A8 · MONTH BY MONTH

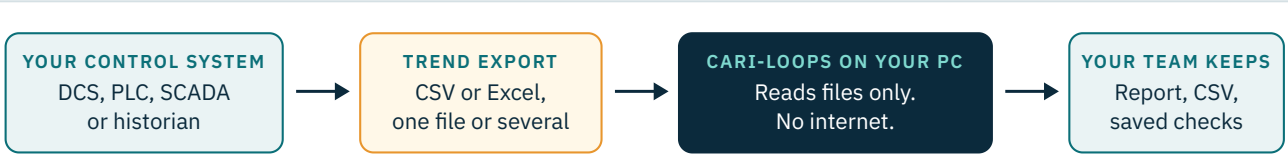
Saved projects	Each check is saved under the plant or unit name, with its label, its findings and its tag table.
Next month	Add a new check to the same project; the tag table of the last check is reused where the same columns appear.
Compare two checks	Pick an earlier and a later check: loop by loop, what is new, what is gone and what stayed.
Projects page	Every check of the plant in one table: when it ran, how many loops, how many with a problem.

LOOP	EARLIER CHECK	LATER CHECK	CHANGE, AS THE APP SHOWS IT
FIC-102	Sticking valve suspected	Sticking valve suspected	still there
PIC-401	Export again	Loop swinging	judged now: problem found
FIC-101	No problem found	No problem found	still fine

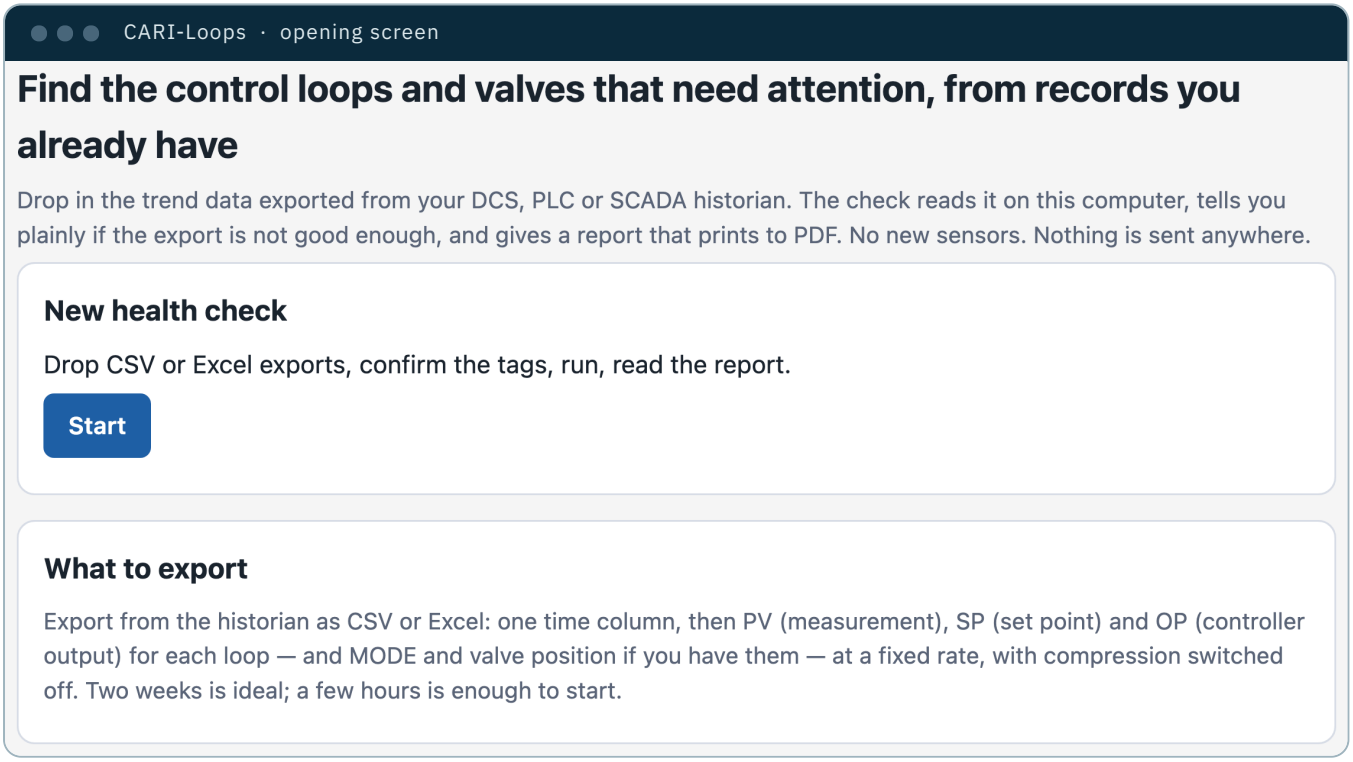
A9 · WHERE IT RUNS, AND YOUR DATA

On your PC, for your eyes.

Where it runs	On your own PC, opened in a web browser. It listens on that PC alone and needs no internet.
Your records	Read on your PC; the app itself sends nothing anywhere.
Link to the control system	None needed: CARI-Loops reads exported files and changes nothing.
Speed	The worked example, twelve loops and three hours of records, was checked in 31 seconds on one PC.
Size	One or several files can be loaded in one check. Use CSV for exports beyond Excel's worksheet row limit.
Set-up	CARIMO sets up the app with your team, maps the first unit's tags and goes through the first report with your engineers.



One-way review: exported files in, reports out. CARI-Loops writes nothing to the control system and sends no data elsewhere.



READ-ONLY

Trend review changes nothing in your control system.

YOUR DATA STAYS

The app stores exports, reports and projects on the PC that ran them. You choose what to share with your team or CARIMO.

WORKED EXAMPLE

The example unit comes with the app, so your team can try every step before its own export.

A10 · WORKED EXAMPLE IN FULL

The example unit, loop by loop.

Records	Two trend files, vendor-style tags, one row every 2 seconds, 3 hours, twelve loops; checked in 31 seconds on one PC.
Answer	Twelve loops in one list, ranked for review: seven with findings, one needing a better export, four with no problem found.
With a cost typed in	At example rates per hour away from set point (Rs 1,500 per °C for temperature, Rs 200 per m³/h for flow): Rs 2,706 on TIC-201, Rs 714 on TIC-203, Rs 468 on FIC-102 over the three-hour record.

#	LOOP	FINDING	LIKELY CAUSE	NEXT CHECK	HOW SURE
1	**LIC-301** level	Instrument frozen	Most likely a stuck or failed transmitter, or a broken signal wire. The controller was acting on a frozen number.	Check the transmitter and its wiring. Compare with a local gauge.	High
2	**FIC-102** flow	Sticking valve suspected	Valve friction or linkage play may explain the pattern. A small-step test checks the valve response.	Agree a small-step test with operations. Check valve position, or the flow or pressure response, for delayed movement and jumps; use the result to plan the valve inspection.	Medium
3	**FIC-103** flow	Valve dead band	The position record shows delayed valve response. Friction, mechanical play or positioner behaviour may explain it.	Check the linkage, positioner and actuator for friction or play; check positioner calibration and correct it as needed.	High
4	**FIC-104** flow	Output saturated	Demand, operating limits, or a valve or pump not delivering the required response, may be holding the output at its limit.	Check operating limits, valve or pump response and duty before deciding whether to retune.	High
5	**TIC-201** temperature	Loop swinging	Controller settings, valve sticking or an upstream disturbance; a manual observation and a valve check help separate them.	With operations, observe the loop in manual. If the swing stops, check valve response before retuning (CARI-Tune gives the settings); if it continues, investigate upstream.	Low
6	**TIC-203** temperature	Loop swinging	Controller settings, valve sticking or an upstream disturbance; a manual observation and a valve check help separate them.	With operations, observe the loop in manual. If the swing stops, check valve response before retuning (CARI-Tune gives the settings); if it continues, investigate upstream.	Low
7	**FIC-105** flow	Left in manual	The loop ran in manual for much of the record. Ask the operators whether this was intended and what prompted it.	Confirm why it was in manual. Resolve any fault, then agree with operations whether to return it to automatic.	High
8	**PIC-401** pressure	Export again	The historian stored too few or too coarse values (compression, rounding, gaps), or a needed signal is missing.	Follow the named export correction: use a suitable recording rate and uncompressed history, add a missing signal, or record a fresh stretch where detail has been lost.	—
9	**FIC-106** flow	No problem found	The checks this export supports found no problem.	No action. Keep it in next month's check.	Medium
10	**TIC-202** temperature	No problem found	The checks this export supports found no problem.	No action. Keep it in next month's check.	Medium
11	**FIC-107** flow	No problem found	The checks this export supports found no problem.	No action. Keep it in next month's check.	Medium
12	**FIC-101** flow	No problem found	The checks this export supports found no problem.	No action. Keep it in next month's check.	Medium

A11 · ROLES AND WORDS USED

Who does what, and the words on the screen.

Your control or process engineer	Sends the export, confirms the tags, reads the report, plans the work.
Your instrument and maintenance team	Checks the named transmitters, runs or supports the manual valve test, services the valves.
CARI-Loops	Grades the files, judges every loop, ranks the findings for review, writes the report, keeps each check for next month.
CARIMO	Sets up the app with your team, maps the first unit and goes through the first report with your engineers.

1 Export	2 Data check	3 Tags	4 Run	5 Report	6 Next month
Trend data from your DCS, PLC or historian.	Each file graded; a poor one with how to export again.	Loops found from your tag names; you confirm.	The whole unit in one run.	Ranked for review, with the next check. Print or PDF.	Run again; see what changed.

Wide layout	One time column, then one column per tag: the usual DCS trend export.
Long layout	One row per reading: time, tag name and value, as many historians export.
Several files	Loops may be spread over several files of one export.
Dead band	How far the signal must move before the valve follows: as a share of travel from stroke tests and position records, or of the output signal from the manual test.
Stroke test	Moving a valve through set steps to see how it follows.
Lost motion	Delayed valve response after the controller output changes direction: the output moves before the valve position follows. Check the linkage, positioner and actuator for friction or play, and check positioner calibration.
Output at its limit	A controller output held at its upper or lower limit, with no further output movement available in that direction.
Also seen	A second finding on the same loop, printed under its main finding.
Ranked for review	The order of the list: by type of finding, with loops needing a better export named and loops with no problem found at the bottom.
How sure	High, medium or low: the strength of the evidence behind an assessed finding.

START WITH ONE UNIT

Send one export. Get one ranked list. The first unit is run with you, on a call on your own PC or from an export you send. Write to **contact@carimo.tech** with your unit, roughly how many loops, and your export format.

WEB

carimotech.com
CARI-Loops finds the trouble. CARI-Tune is CARI-Loops plus tuning.