Recommendations — a PM interval proposed from the failure history

Menu: CMMS ▸ Recommendations...

Part 1 — What the function does

What it calculates. CMMS ▸ Recommendations... turns the failure events of closed corrective work orders into a preventive maintenance (PM) interval proposal for one class of identical assets and one failure mode. ReliaEn fits a two-parameter Weibull distribution by maximum likelihood to the times to failure and proposes an interval only when the evidence holds:

Verdict	When	Proposed interval
RECOMMEND	At least 5 failures and the whole 95% confidence interval of the shape β above 1	The B10 life: the age by which 10% of the items have failed
INSUFFICIENT EVIDENCE	Fewer than 5 failures, or the interval of β contains 1	None
NO PM BENEFIT	The whole interval of β below 1	None
NO INTERVAL (REPAIRABLE)	A failure closed with repair type repair or adjust	None

From which data. The class's failure events with their time to failure, and the running time of its assets still in service, counted as suspensions - all in the CMMS file.

When an engineer uses it. To set the PM interval of a class of identical assets from its own failure history instead of the manufacturer's (OEM) interval.

When not to use it.

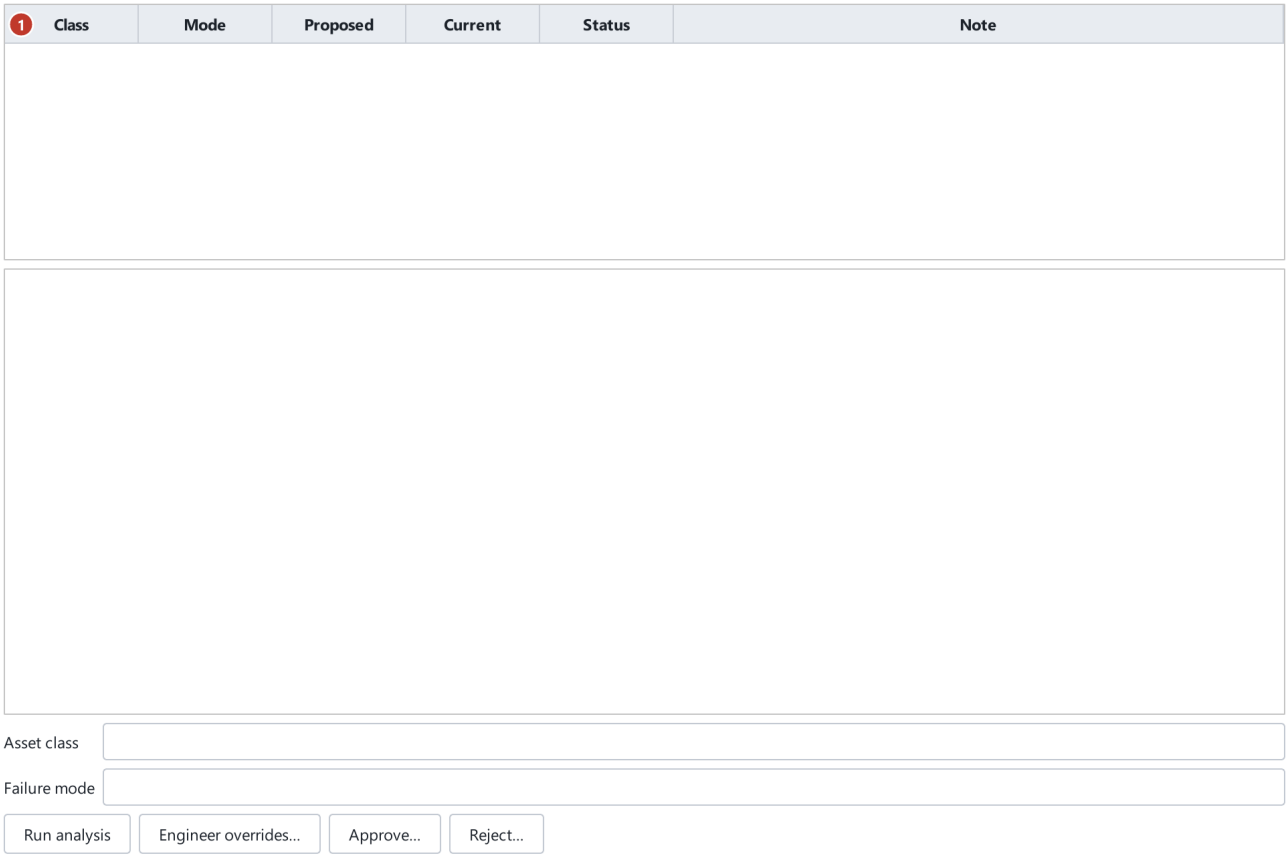
Situation	Use instead
The failure times are in a spreadsheet, not in work orders	Life Data ▸ Time Dependence ▸ Weibull (2P) distribution...
The assets are repaired rather than renewed at each failure	Life Data ▸ Repairable Fleet...

Part 2 — The example's input data

Setting. The cooling-water pumps of class PUMP-CENT: twelve of them each failed once by seal leak and had the seal replaced (repair type replace); three more are still running. The class's PM schedule changes the seals every 90 days, as the OEM advises.

Data of class PUMP-CENT, mode seal leak	Run-hours
12 failures (PUMP-CENT-000 to PUMP-CENT-011)	226, 274, 337, 405, 412, 444, 480, 709, 764, 934, 1086, 1123
3 pumps still running (suspensions)	650, 900, 1200

Input	Value
File in the worked-example zip	6-Recommendations/CMMS-Example-Recommendations.reliaen - these histories and five more classes; no recommendation yet

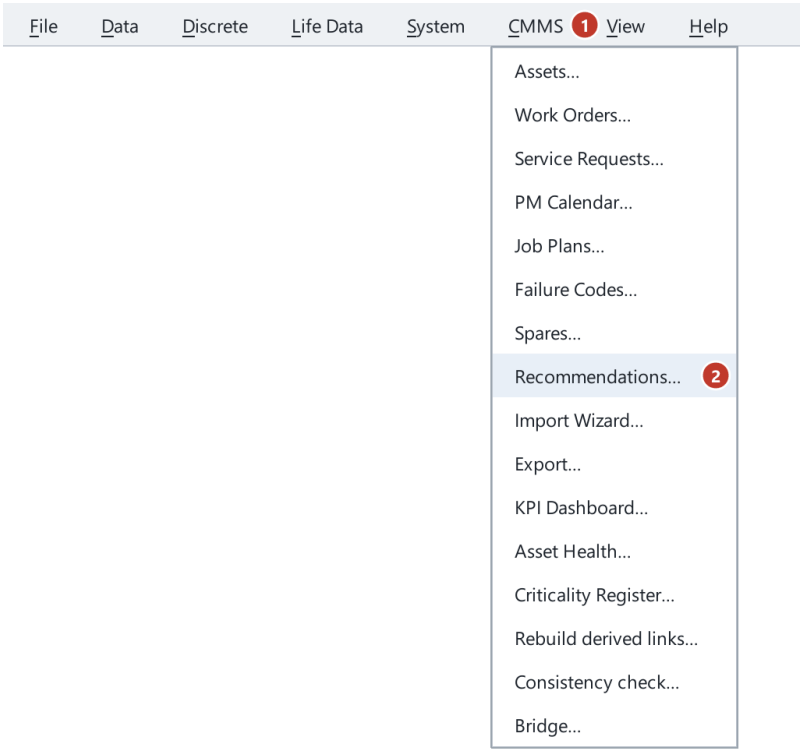


The window as it opens

- ① The inbox: empty, no analysis has been run on the file yet.

Part 3 — How to use it, step by step

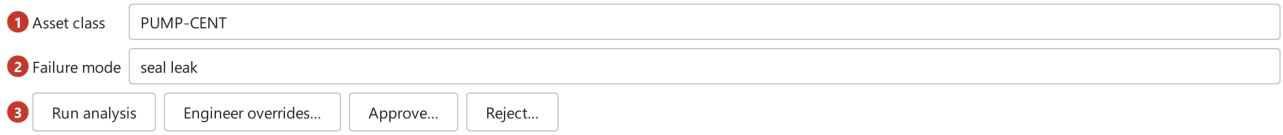
1. **Choose CMMS ▸ Recommendations…** in the menu bar. The first time in a session ReliaEn asks for the file in the box Open or create a CMMS file: choose your copy of CMMS-Example-Recommendations.reliaen. The window CMMS — Recommendations opens.



Step 1 — the menu path

- ① CMMS: the menu.
- ② Recommendations…: the entry to click.

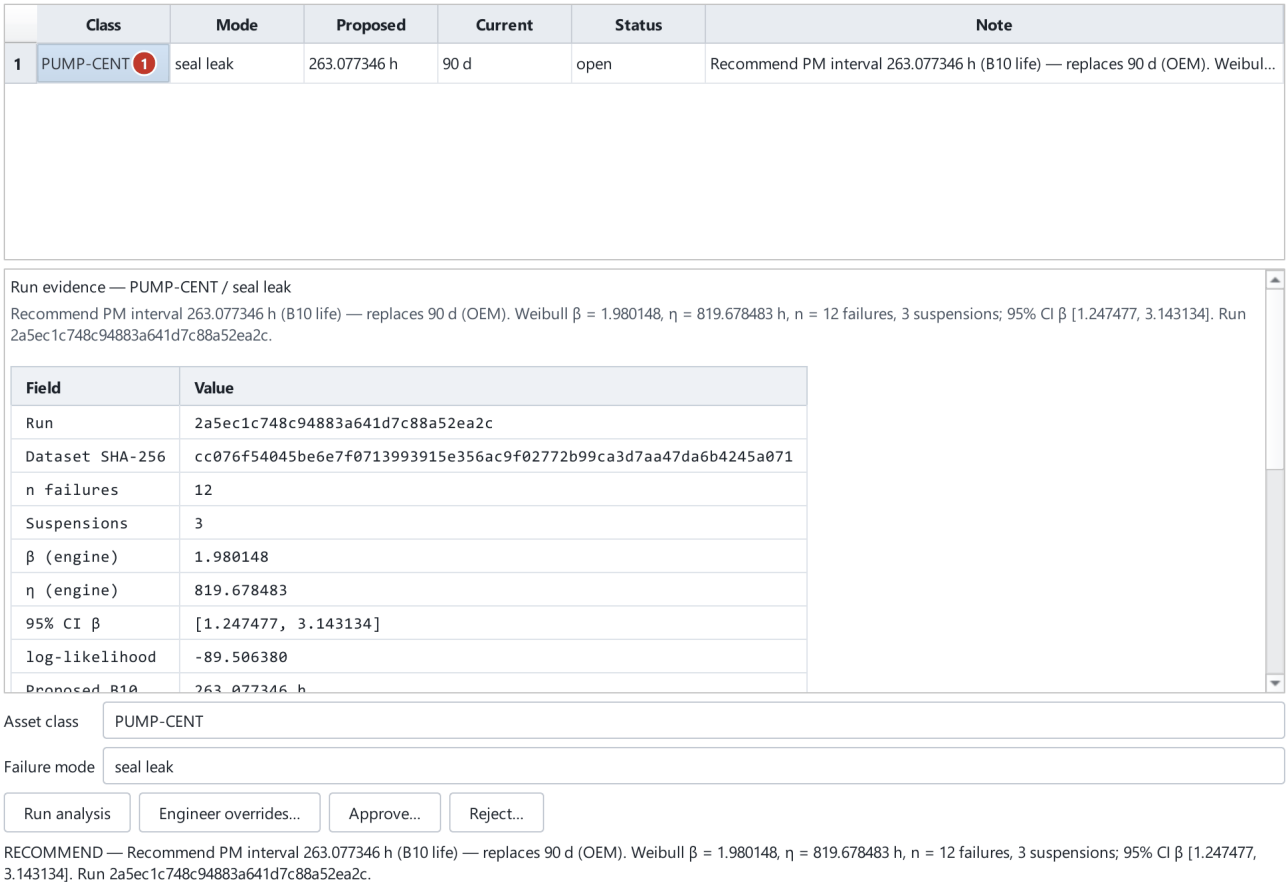
Steps 2 to 4 are marked ① to ③ in the picture:



Steps 2 to 4 — the class and the mode typed

2. ① **Asset class**: PUMP-CENT, as the assets carry it.
3. ② **Failure mode**: seal leak, as the failure events record it.
4. ③ **Click Run analysis.** ReliaEn fits the data, writes the verdict on the line under the buttons and adds a card to the inbox.

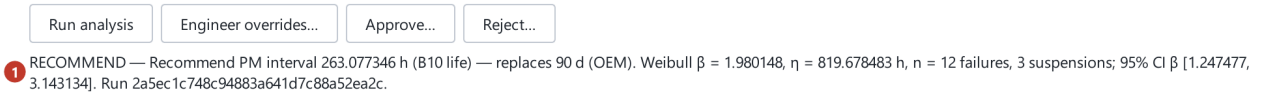
5. ① **Click the PUMP-CENT card** in the inbox. Its evidence shows in the panel below the inbox.



Step 5 — the new card in the inbox

- ① PUMP-CENT: the card to click.

Part 4 — The result, picture by picture



The line under the buttons after Run analysis

- ① The line: RECOMMEND — Recommend PM interval 263.077346 h (B10 life) — replaces 90 d (OEM). Weibull β = 1.980148, η = 819.678483 h, n = 12 failures, 3 suspensions; 95% CI β [1.247477, 3.143134]., then the run's identifier. The verdict first, then the numbers behind it.

	① Class	② Mode	③ Proposed	④ Current	⑤ Status	⑥ Note
1	PUMP-CENT	seal leak	263.077346 h	90 d	open	Recommend PM interval 263.077346 h (B10 life) — replaces 90 d (OEM). Weibul…

The card in the inbox

- ① Class: PUMP-CENT.
- ② Mode: seal leak.
- ③ Proposed: 263.077346 h, the B10 life of the fit.
- ④ Current: 90 d, the class's present schedule interval, from the OEM.
- ⑤ Status: open. Nothing changes a schedule until the card is approved.
- ⑥ Note: the verdict sentence of the line, cut short in the column; the evidence panel shows it whole.

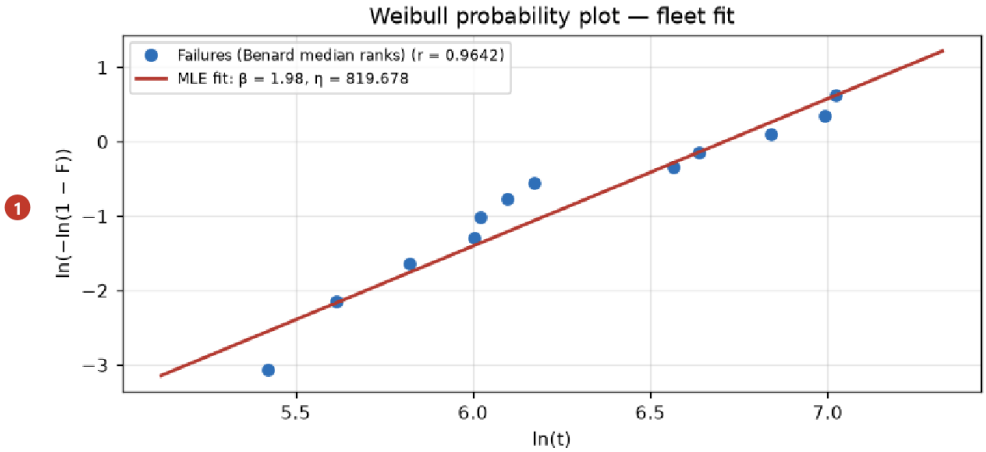
① Run evidence — PUMP-CENT / seal leak

Recommend PM interval 263.077346 h (B10 life) — replaces 90 d (OEM). Weibull β = 1.980148, η = 819.678483 h, n = 12 failures, 3 suspensions; 95% CI β [1.247477, 3.143134]. Run 2a5ec1c748c94883a641d7c88a52ea2c.

Field	Value
Run	2a5ec1c748c94883a641d7c88a52ea2c ②
Dataset SHA-256	cc076f54045be6e7f0713993915e356ac9f02772b99ca3d7aa47da6b4245a071 ③
n failures	12 ④
Suspensions	3 ⑤
β (engine)	1.980148 ⑥
η (engine)	819.678483 ⑦
95% CI β	[1.247477, 3.143134] ⑧
log-likelihood	-89.506380 ⑨
Proposed B10	263.077346 h ⑩

The evidence panel

- ① The title Run evidence — PUMP-CENT / seal leak, and under it the verdict sentence with the run's identifier.
- ② Run: the run's identifier; each run gets a new one.
- ③ Dataset SHA-256: cc076f54045be6e7f0713993915e356ac9f02772b99ca3d7aa47da6b4245a071, the fingerprint of the data the run used: the same data give the same fingerprint.
- ④ n failures: 12, the twelve seal-leak failures.
- ⑤ Suspensions: 3, the three pumps still running at 650, 900 and 1,200 run-hours.
- ⑥ β (engine): 1.980148. Above 1: the risk of a seal failure grows with age.
- ⑦ η (engine): 819.678483 run-hours, the characteristic life: by this age about two seals in three have failed.
- ⑧ 95% CI β: [1.247477, 3.143134]. Even the lower bound is above 1: the wear-out is clear, not a chance result.
- ⑨ log-likelihood: -89.506380, the value the fit maximised; it compares fits of the same data.
- ⑩ Proposed B10: 263.077346 h. By this age one seal in ten has failed.



The Weibull probability plot below the evidence

- ① The plot of the run's data: the twelve failures as points (Failures (Benard median ranks) (r = 0.9642)) and the fitted line (MLE fit: β = 1.98, η = 819.678). The three running pumps have no point; they enter the fit as suspensions.

Part 5 — How to interpret the results

Do the seals wear out? β is 1.980148 and its whole 95% interval, 1.247477 to 3.143134, lies above 1: the risk of a seal leak grows with the run-hours, so a planned change before failure pays. That is why the verdict is RECOMMEND.

What does the interval mean? 263.077346 run-hours is the B10 life: if every seal is changed at that age, one in ten still fails before its change. If that is too many for these pumps, keep the card open and agree a lower target before approving. The proposal is in the unit of the data, run-hours from the meter, while the present schedule counts days.

Does the model fit the data? The points lie close to the line (r = 0.9642), so the Weibull model describes these failures. Points far from the line would ask for another model under Life Data ▸ Time Dependence before any interval is set.

What comes next? Click Approve…, choose the PUMP-CENT-000 schedule under Apply to PM schedule: and click OK: the line reads Approved — interval written with provenance., the card's Status becomes approved, and the schedule takes 263.077346 h with the source analysis in CMMS ▸ PM Calendar…. Reject… asks for a reason and records it instead.