

TRAINING MODULE

Ergonomic Static-Load Risk Map

The “vise hand” nobody's stopwatch ever flagged

A working module for engineers with 1–2 years on the floor. By the end you will be able to identify a passive-hold element, calculate its duration-weighted risk, and explain exactly what this map is — and isn't — a substitute for.

Grounded in isometric-load ergonomics research and the RULA / REBA assessment tradition (McAtamney, Corlett, Hignett)

What You Will Be Able to Do After This Module

- 1 Explain why a static, passive hold is a different ergonomic risk than active motion — not just “less work.”
- 2 Identify passive-hold elements from verb patterns, using the same logic already proven elsewhere in the suite.
- 3 Calculate Static Duration % and explain why it's weighted higher than simple Static Frequency %.
- 4 Calculate the full Composite Risk Score by hand, including the CRITICAL override rule.
- 5 Explain clearly what this map is NOT a substitute for — and why that matters.

A Held Muscle Fatigues Differently Than a Moving One

This isn't a motion-economy question. It's a blood-flow question:

DYNAMIC WORK

Muscles contract and relax in cycles — blood keeps flowing through, clearing fatigue byproducts as it goes.

Feels tiring, but recovers quickly.

STATIC (ISOMETRIC) HOLD

A muscle held contracted — even lightly — partially restricts its own blood supply. Fatigue accumulates even when the load feels small.

Feels manageable in the moment; the cumulative cost shows up hours or years later.

A “vise hand” — one hand locked steady while the other works — is exactly this pattern, and it's invisible to a normal cycle-time study.

Four Signals, Combined Into One Score

$$\text{Risk Score} = 0.50 \times \text{Static Duration \%} + 0.30 \times \text{Static Frequency \%} + 0.20 \times (\text{PFMEA Severity} \div 10 \times 100)$$

DURATION %

50%

How much of the CYCLE ITSELF the hold consumes — the biggest weight, on purpose.

FREQUENCY %

30%

How many elements are passive holds, out of all elements at the station.

PFMEA SEVERITY

20%

A hold on a safety/quality-critical part scores worse than the same hold elsewhere.

Duration outweighs Frequency on purpose: ONE long hold can matter more than THREE short ones. A count-only engine would miss that entirely — this is the signal it's missing.

A Triage Signal, Not a Posture Assessment

RULA and REBA are the real, validated ergonomic assessment tools — they score actual posture, force, and repetition from direct observation or measurement. This suite has no posture, angle, force, or weight data anywhere in it. What it has is text descriptions of work elements. The body-region label on this map is a VERB-KEYWORD HEURISTIC, built to point a reviewer toward where a real RULA/REBA assessment is worth doing — and it is labelled that way everywhere it appears.

Confusing a triage heuristic for a measurement is the single most important thing this module wants you to never do.

**RULA /
REBA**

*McAtamney & Corlett ·
Hignett & McAtamney*

WHY THE WEIGHTS AREN'T EQUAL

One Long Hold Can Outweigh Three Short Ones

Same station, two ways of counting. Watch what changes:

E1 Pick up bracket	5s	—
E2 Insert & hold bracket	18s	STATIC HOLD
E3 Visual inspect	4s	—
E4 Apply adhesive dab	3s	STATIC HOLD
E5 Place part, release	5s	—

Static Frequency = 2 of 5 elements = 40%. Static Duration = (18+3) of 35 total seconds = 60%. Frequency alone undercounts — E2's single 18-second hold is more than half the station's real static burden.

Four Inputs, One Score, One Band

1

PASSIVE-HOLD VERBS

Same verb logic as Precedence
Debate's Bilateral Splitting Engine
— reused, not re-invented.

2

TIME-WEIGHTED DURATION

Each element's real Avg(s) from the
JM sheet, not just a step count.

3

PFMEA SEVERITY

Worst matched failure-mode
severity for that station.

4

CRITICAL SURFACE FLAG

Is the held part cosmetic /
customer-visible?

None of the four are collected fresh — all four already exist somewhere else in the suite.

1

STEP 1

Identify Passive Holds

insert / press / screw / rivet / tap / fasten / apply — the exact same list Precedence Debate already uses.

Reusing this list means this map never disagrees with the Precedence Debate's own findings on the same station.

THE VERB LIST

insert

press

screw

rivet

tap

fasten

apply

APPLIED TO OUR FIVE ELEMENTS

Element Text	Match?	Verdict
"Pick up bracket"	no match	not static
"Insert & hold bracket"	"insert"	STATIC HOLD
"Visual inspect"	no match	not static
"Apply adhesive dab"	"apply"	STATIC HOLD

2

STEP 2

Weight by Severity & Surface

The same worked station from the PFMEA module — its Severity calibration carries straight into this score.

shell / visor / sticker / label / cover / casing / panel / frame / cosmetic — the Critical Surface keyword list.

PFMEA SEVERITY (from this station's worst matched failure mode)

Severity = 7 (HIGH, calibrated from MTM Priority)

CRITICAL SURFACE CHECK

Held part = “bracket” — not in the cosmetic keyword list → Critical Surface = NO for this example

THE OVERRIDE RULE — A SECOND SCENARIO

If instead the held part were a “shell” (Critical Surface = YES) AND Severity ≥ 8 , the station is CRITICAL no matter what the composite score adds up to — same safety-override pattern as PFMEA's Action Priority.

Running Our Station Through the Full Formula

$$0.50 \times 46.7 \text{ (Duration\%)} + 0.30 \times 33 \text{ (Frequency\%)} + 0.20 \times 70 \text{ (Sev } 7 \div 10 \times 100)$$
$$= 23.35 + 9.9 + 14 = 47.25 \approx 47$$

RISK BANDS — WHERE 47 LANDS

CRITICAL	≥ 70 OR Critical Surface + Severity ≥ 8	
HIGH	≥ 50	
MEDIUM	≥ 30	◀our score (47) lands here
LOW	< 30	

A Heuristic Points; It Does Not Diagnose

The report shows a “dominant body region” for each station's passive-hold steps — read it exactly for what it is:

WHAT IT IS

A verb-keyword-inferred SUGGESTION of which body region is plausibly loaded — built entirely from element text, for triage purposes only.

WHAT IT IS NOT

Not a RULA or REBA score. Not based on any posture, angle, force, or weight measurement — because none exist anywhere in this dataset.

If a station lands **HIGH** or **CRITICAL**, the correct next step is a real RULA/REBA assessment by someone qualified to do one — not a design decision made off this map alone.

Five Mistakes That Give Junior IEs Away



Reporting the body-region label as if it were a RULA/REBA finding — it's a triage pointer, not a measurement.



Ranking stations by Static Frequency % alone — missing the single long hold that Duration % would have caught.



Missing the CRITICAL override — a station can be CRITICAL on the surface+severity rule even with a moderate numeric score.



Treating a LOW-banded station as “no ergonomic concern at all” — it just means the DATA this map can see doesn't show elevated risk; it isn't a clean bill of health.



Skipping the actual RULA/REBA follow-up on a HIGH or CRITICAL station because the map “already flagged it.”

What generate_ergo_risk_map.py Does For You

Every station on the line, scored and banded automatically — in two formats.

1

Ergo_Static_Load_RiskMap.html

Interactive heatmap — every station's Duration%, Frequency%, Severity, Critical Surface flag, band, and reasoning, one glance across the whole line.

2

Ergo_Static_Load_RiskMap.xlsx

Data table with a conditional-formatting heatmap and scatter chart, ready to drop into a report or a safety review.

3

Band reasoning stated explicitly

Every CRITICAL-by-override row shows WHY it's CRITICAL even if the numeric score alone wouldn't say so — never a silent surprise.

KEY TAKEAWAYS

Recap — Say This Back In Your Own Words

- A static, passive hold fatigues differently than dynamic work — physiologically, not just as a matter of feel.
- Duration matters more than Frequency — one long hold can outweigh several short ones, and the score is weighted that way.
- PFMEA Severity and a Critical Surface flag can push a station to CRITICAL even off a moderate numeric score.
- The body-region label is a triage heuristic from text alone — never a substitute for a real RULA/REBA assessment.

TALK IT THROUGH — 3 QUESTIONS FOR YOUR NEXT LINE WALK

1. Walk your own line — which station has the longest single static hold, and would Frequency % alone have hidden it?
2. Find a station that reads LOW on this map — does that actually mean no ergonomic risk, or just no risk this dataset can see?
3. Has any HIGH or CRITICAL station on your line ever gotten a real RULA/REBA follow-up, or did the map become the final word?