AM-00.07 — The Delta-Sierra reflex: “where are the losses?”

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Course compass

Guiding question: Why is “98% efficiency” never a complete explanation by itself?

Markers: MEASURED · CONVENTION · CALCULATED · TEACHING ASSUMPTION · APPROXIMATION

• understand the concept

• do a simple calculation

• explain every symbol

• check a result

Essential answer

The Delta-Sierra reflex: “where are the losses?”. The question to solve is: Why is “98% efficiency” never a complete explanation by itself? Markers: MEASURED · CONVENTION · CALCULATED · TEACHING ASSUMPTION · APPROXIMATION understand the concept do a simple calculation explain every symbol check a result? 98% of what? Which stream? Over what time? Under which conditions? Efficiency without a system boundary can mislead. The rest of the course turns that idea into an auditable line of reasoning: explicit units, stated assumptions, reproducible calculations, order-of-magnitude checks and interpretation limits. A result is useful only when the reader can explain what it measures, where every input came from and which engineering decision it can support.

Starting synthesis: derivations, examples, limitations and sources are developed in the course body.

Key terms before you start

unit · order of magnitude · assumption · approximation · efficiency

1 — A percentage needs a boundary

98% of what? Which stream? Over what time? Under which conditions? Efficiency without a system boundary can mislead.

Before calculating, identify what enters, what leaves usefully, and what leaves by another path.

2 — Losses go somewhere

Energy becomes heat, water remains in brine, mass is vented, time is spent on maintenance: a “loss” is not necessarily disappearance.

Naming the destination makes the system understandable and may reveal recovery options.

3 — Recovering the last percent has a cost

Moving from 98 to 99.8% may require more energy, filters, pumps, mass, and maintenance.

Survival optimum is not automatically maximum isolated efficiency.

4 — Closed loops and make-up

In a settlement, a small unrecovered fraction can matter over months. Calculate make-up flow and ask whether local resources can supply it.

This connects an abstract percentage to logistics.

Three complete examples: change one assumption to understand

Before each calculation, identify where every number comes from and whether it is measured, conventional, assumed, or calculated.

Example A — 100 L

For a defined 100 L stream, 98% recovery returns 98 L and leaves 2 L outside the useful recovered stream.

CALCULATED: 100 × 0.98 = 98; remainder = 2.

Example B — 76 L/day

For 76 L/day, 98% gives 74.48 L/day recovered and a theoretical 1.52 L/day make-up.

ASSUMPTION: define the stream; this is not all water use in a settlement.

Example C — over 365 days

1.52 L/day × 365 = 554.8 L/year. A small daily fraction becomes a visible logistics quantity.

CALCULATED: accumulation over time.

Inverse calculation

If make-up is limited to 0.76 L/day for the same stream, what recovery is required? Loss = 0.76/76 = 1%, so recovery = 99%.

Common trap and result check

Trap: calling everything outside the useful output a “loss” without asking where the matter or energy actually went.

Always check units, order of magnitude, and physical meaning before accepting a result.

Exercises and answers

Understand

Explain the relationship in your own words.

Change an assumption

Modify one input and predict the direction of change before calculating.

Verify

Name two checks after a calculation.

Primary and educational sources

• NASA Glenn - Guide to Rockets

• NIST - International System of Units (SI)