

Introduction to Problem Solving in

Introduction to Problem Solving in Mechanical Plant Technology

(A concise, structured guide for students and technicians)

Mechanical Plant Technology

1. Why Problem Solving Matters

Reason	What It Means for the Plant
Reliability	Keeps equipment running without unexpected stops.
Safety	Prevents hazardous conditions caused by malfunctioning machinery.
Efficiency	Reduces waste of energy, materials, and labor.
Cost Control	Minimises repair expenses and unplanned downtime.
Continuous Improvement	Generates data for design upgrades and process optimisation.

2. The Problem Solving Cycle

1. Identify the Symptom

- Observe abnormal behaviour (noise, vibration, temperature rise, loss of output).
- Record when it occurs (start-up, steady-state, shutdown).

2. Define the Problem

- Convert the symptom into a clear statement: "Pump A delivers 30% less flow at 150°C than spec."

3. Gather Data

- Instrument readings (pressure, flow, temperature, vibration).
- Maintenance logs, operating manuals, past failure reports.
- Visual inspection photos or videos.

4. Generate Possible Causes (Cause/Effect/ Ishikawa diagram)

- **Mechanical** – wear, misalignment, seal failure.
- **Hydraulic/Pneumatic** – blockage, cavitation, pressure drop.
- **Electrical** – motor winding fault, control wiring.

Introduction to Problem Solving in

- **Operational** – improper setpoints, overload, human error.

Mechanical Plant Technology

5. Test Hypotheses

- Use “one factor at a time” or *design of experiments* (DOE) to isolate the root cause.
- Apply non-destructive testing (ultrasonic, thermography, vibration analysis).

6. Implement a Solution

- Repair/replace component, adjust settings, modify procedure, or redesign part.

7. Verify Effectiveness

- Re-measure key parameters.
- Confirm that performance meets design specifications for a defined period (e.g., 48 h).

8. Document & Standardise

- Write a *Problem Solving Report* (see Section 5).
- Update SOPs, maintenance schedules, and training material.

3. Core Analytical Tools

Tool	Typical Use	Key Output
Root Cause Analysis (RCA)	Trace the origin of a failure.	Causal chain diagram.
Fault Tree Analysis (FTA)	Model logical relationships of failures.	Probability of top event.
Failure Modes & Effects Analysis (FMEA)	Anticipate potential failures in design/operation.	Risk Priority Number (RPN).
Vibration Analysis	Detect imbalance, misalignment, bearing defects.	Frequency spectra, amplitude trends.
Thermal Imaging	Locate hot spots, insulation failures.	Temperature maps.
Flow/Pressure Mapping	Verify hydraulic/pneumatic network performance.	Pressure drop charts, flow rate curves.
Statistical Process Control (SPC)	Monitor process stability over time.	Control charts ($\bar{X}$, R).

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4. Common Mechanical Plant Problems

Scenario	Typical Symptoms	Likely Causes	First Step Test
Pump Cavitation	Loud noise, vibration, reduced flow, temperature rise.	Low inlet pressure, high suction	