

■ Centrifugal Pump Troubleshooting Matrix

Symptom	Most Likely Causes	First Checks
No/low flow	Not primed; suction valve closed/throttled; excessive lift; wrong rotation; plugged impeller	Rotation vs arrow; suction pressure; strainer dP; vent casing
Low discharge head	Air entrainment; worn wear rings; impeller damage; speed low	Amp draw; discharge pressure vs curve; check vortexing in sump
Cavitation noise (gravel sound)	NPSHa < NPSHr; suction restriction; high liquid temp; low suction level	Calculate NPSH margin; strainer dP; suction line for air pockets
High vibration	Unbalance; misalignment; bearing wear; operating far from BEP; pipe strain	Vibration spectrum; coupling alignment; flow vs BEP; check hold-downs
Seal leakage	Seal face wear; flush plan failure; dry running; pressure excursion	Seal pot level/pressure; flush flow; API plan operating correctly
Bearing overheating	Over/under lubrication; misalignment; excessive thrust; cooling loss	Oil level and condition; cooling water flow; thrust balance line
Motor overload	Flow beyond runout; high viscosity/SG; mechanical rubbing; low voltage	Throttle discharge toward BEP; amp reading; free rotation by hand (LOTO)

■ Key Formulas

Affinity laws	$Q2/Q1 = N2/N1$ $H2/H1 = (N2/N1)^2$ $P2/P1 = (N2/N1)^3$
NPSH margin	NPSHa - NPSHr $\geq$ 0.9 m (3 ft) minimum; 1.5-2x ratio preferred for critical service
Specific speed	$Ns = N(\text{rpm}) \times Q^{0.5} / H^{0.75}$ - guides impeller type selection
Hydraulic power	$P(\text{kW}) = Q(\text{m}^3/\text{h}) \times H(\text{m}) \times \text{SG} / 367 / \text{efficiency}$

■ Operating Window (API 610 guidance)

Preferred operating region: **70-120% of BEP flow**. Allowable: per vendor curve. Below minimum continuous stable flow: recirculation damage, rising vibration, temperature rise. Beyond runout: NPSH problems, motor overload.