PrintKinetic RESOURCE

A Diagnostic Map for FDM Defects

https://printkinetic.com/resources/diagnostic-map-for-fdm-defects/ · Last updated 2026-09-08

A failed first layer, a stringy surface, or a warped corner all look like a single problem with a single fix, and that impression is usually wrong. Each of these symptoms can come from several distinct root causes, adhesion, flow, heat, motion, or moisture, that happen to produce similar visible results. Changing the first setting that comes to mind treats the symptom as the diagnosis, and it frequently makes the actual cause worse while doing nothing for the visible defect. This guide is a map for ranking causes before touching a setting, across the six most common defect categories.

First-layer failure is the highest-cost defect because it ends the print immediately, and it has several distinct causes: bed leveling, first-layer height, bed temperature, bed surface condition, and even ambient drafts can each produce the same visible symptom, a layer that will not stick. The First-Layer Failure Triage engine ranks these hypotheses against the specific symptoms observed, because assuming it is always a leveling problem wastes time on prints where the actual cause is bed temperature or surface contamination.

Warping and corner lift look like an adhesion problem but are actually a thermal contraction problem: as a part cools unevenly, internal stress pulls corners and edges up off the bed or away from earlier layers. The fix depends on which specific thermal factor dominates, enclosure temperature, bed temperature, part geometry, or cooling fan behavior, and that is exactly what the Warping and Corner Lift Triage engine works through rather than jumping straight to "increase adhesion" when the real cause is uneven cooling.

Stringing and under-extrusion get confused with each other more often than any other pair of defects on this list, because both can produce thin, inconsistent-looking surface artifacts. Stringing is a retraction and travel-temperature problem: the nozzle oozes a thin thread of filament while moving between features. Under-extrusion is a flow-rate problem: not enough material is coming out of the nozzle for the commanded movement. The Stringing Triage and Under-Extrusion Triage engines exist as a pair specifically because treating one as the other, tuning retraction to fix what is actually a flow problem, wastes a tuning cycle without addressing the real cause.

Layer separation and dimensional error are the two defects most likely to be invisible until the part is loaded or measured. A part can look complete and still delaminate under stress if the interlayer bonding was weak, from moisture, low print temperature, or excessive cooling; a part can look complete and still be out of tolerance if shrinkage or seam placement pushed a dimension outside its allowed range. The Layer Separation Triage and Dimensional Error Triage engines both work backward from the observed symptom toward the specific process variable most likely responsible, rather than assuming every defect is visible before the part is put to use.

Consider a print that comes off the bed with thin, hair-like wisps of plastic between separate features. The first instinct is often to tighten retraction settings, treating it as classic stringing, but the wisps persist even after several retraction adjustments. Run through the Stringing Triage engine's ranked hypotheses, the actual cause turns out to be a nozzle temperature set too high for the specific filament batch, which thins the melt enough that it oozes between travel moves regardless of retraction settings. Retraction tuning alone would never have fixed this, because the ranked cause was never retraction to begin with; it took ruling out the more common cause first to find the real one.

The same ranking discipline applies across printers, not just across settings on one machine. A defect that consistently traces back to bed leveling on one printer can trace back to a completely different cause, ambient drafts near a window, or a heat-creep issue in an aging hotend, on another printer that shows the identical visible symptom. Treating a past diagnosis as a permanent rule for "this kind of defect" rather than re-running the ranking process for the current machine and material is a subtle version of the same mistake this guide is built to prevent: mistaking a past correlation for a current cause.

A common mistake is changing more than one setting at a time in response to a defect. When several plausible causes exist and two settings get adjusted together, a print that improves does not tell you which change actually mattered, and a print that fails again does not tell you which change to reverse. Rank the likely causes first, change the setting tied to the most likely one, and confirm the result before touching anything else.

FAQ

Does one setting change usually fix a defect?

Rarely by itself. Most visible FDM defects have several plausible causes that share a symptom, so a defensible fix starts by ranking causes, not by changing the first setting that comes to mind.

Can stringing and under-extrusion look similar?

Their symptoms are distinct but often get treated with the same guesses. Stringing is a retraction and travel-temperature issue; under-extrusion is a flow-rate issue. Confusing the two wastes tuning time.