

EcoTank innovation #1: Cool, long-life ceramic crystals

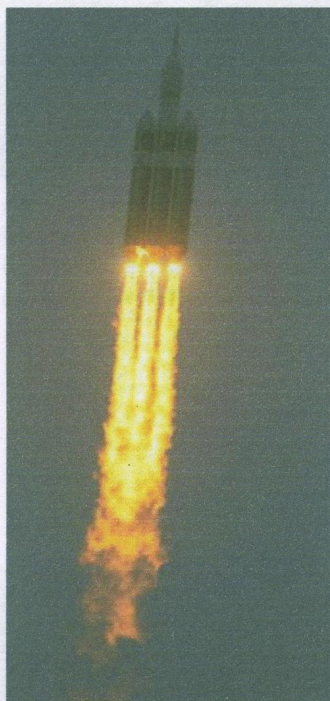


Figure 3: Typical chemical rocket launched by NASA.

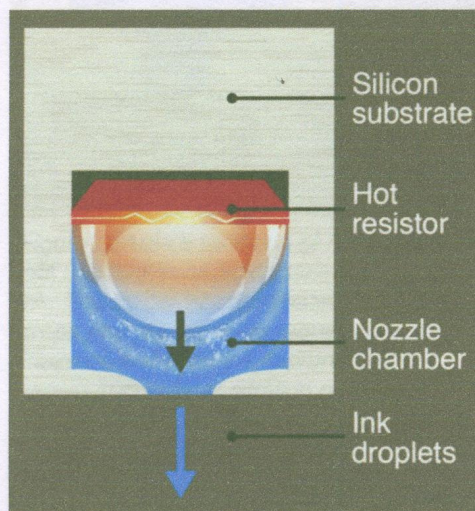


Figure 4: Artist's rendition of how thermal inkjets use hot resistors that boil the ink. Thermal resistor is only 1 micron thick, but shown thicker for illustration purposes. Printhead nozzles vary by manufacturer and model.

As shown in Figure 3, all chemical rockets use the same basic design: Fuel and oxygen mix to produce a controlled explosion, expanding gas blasts out the nozzle, and the rocket is pushed ahead.

But in a very short time, the fuel is all gone, the nozzle is pitted and burnt, and the spent rocket section drops away, discarded.

The payload continues on by itself, like the probe that recently flew past Pluto. Dawn's long-lasting fuel supply lasts for years, enabling it to explore more than one target.

Printing with vaporized ink: hot and explosive

Much the same as a chemical rocket, a thermal inkjet or bubble jet printhead is subject to "severe mechanical stresses" including heat higher than the boiling point of water (212° F) and extreme negative atmospheric pressures.³

In this design, electricity heats up thousands of thin resistors submerged in ink, as shown in Figure 4. When the resistor is hotter than the boiling point of water, a bubble of gas forces a drop of hot ink to spray through the nozzle on to the paper. In effect, the resistor vaporizes the ink in the nozzle chamber.

The whole cycle takes less than 30 microseconds. But as each resistor heats up and cools down over time, damage accumulates. Resistors are stressed, protective coatings can be weakened, metals warped, and the bonding between materials loosened.

Another problem: Boiling the ink creates a residue of plaque that builds up on the hot surfaces of the printhead. This plaque can clog the tiny nozzles, typically narrower than a human hair, or less than 40 microns across.

Plaque also adds more insulation around the resistors, so they must get even hotter to fire the nozzle. This adds more stress that further shortens the lifespan of a thermal printhead.

Yet another problem: Micro-erosion. The intense heat and explosive force of the tiny bubbles of boiling ink are enough to wear away microscopic bits of metal, leaving the thermal inkjet nozzles pitted and scarred.