Is it safe to print ABS indoors without ventilation?

Asked 3D Content Team
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Abstract. Azimi et al. measured ABS emitting hundreds of times more ultrafine particles than PLA, plus styrene. What the studies found and the ventilation they advise.

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1 Is it safe to print ABS indoors without ventilation?

The studies advise against it. Printing ABS releases styrene and, in Azimi et al.'s chamber tests, hundreds of times more ultrafine particles than PLA. The authors urge caution in poorly ventilated rooms. NIOSH and UL's Chemical Insights Research Institute both put ventilation first, whether that means airing the room or an enclosure that is filtered or vented outdoors.

1.1 What the studies measured

Azimi and colleagues ran five desktop printers in a test chamber on ABS (acrylonitrile butadiene styrene), PLA (polylactic acid) and other filaments. They measured ultrafine particles (UFPs, under 100 nm) and volatile organic compounds (VOCs). UL's team tested printers certified as low-emitting under the UL 2904 standard, first in a lab chamber and then in classrooms. Each row keeps its study's own units, so compare ABS with PLA across a row, not down the columns.

The two studies split on PLA. Azimi et al. measured far fewer particles from it than from ABS, but in UL's newer test one PLA out-emitted ABS by particle count. ABS still led on particle mass.

1.2 Why ABS gives off more

Temperature is most of it. UL notes that ABS and nylon "typically print at higher temperatures and consequently release significantly more UFPs and VOCs." The US National Institute for Occupational Safety and Health (NIOSH) came to the same view in its summary of chamber work. Extruder temperature drove emissions most, though filament brand also had "a substantial effect."

Styrene comes from the plastic itself. It is the S in ABS, and Azimi et al. found it was the main VOC from all six ABS printer and filament pairs they tested. The authors point out that the International Agency for Research on Cancer classes styrene as a possible human carcinogen (group 2B). Their screening model put the worst-case styrene level about

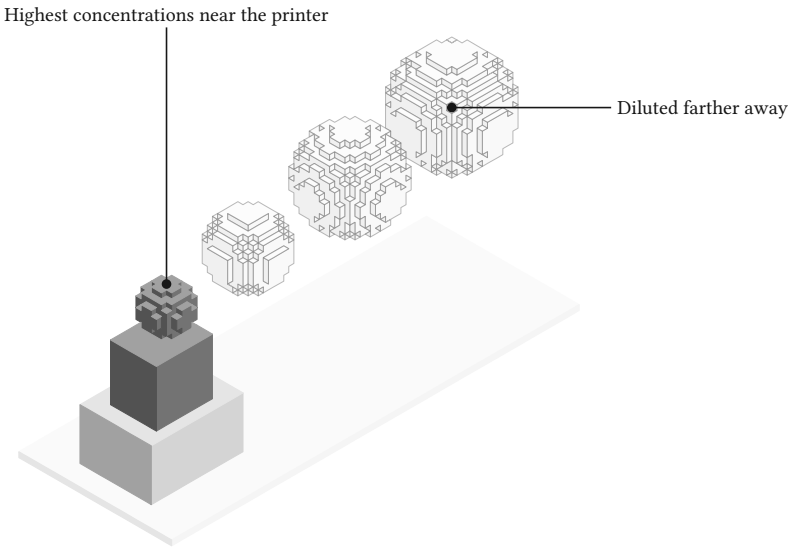


Figure 1. Particle concentrations are highest right beside the printer and fall as the air dilutes them across the room.

Table 1. What the studies measured

Study	What was measured	ABS	PLA
Azimi et al. 2016, chamber	Median ultrafine particle emission rate	About 2×10^{10} to 9×10^{10} per minute	About 10^8 per minute
Azimi et al. 2016, chamber	Main VOC and its emission rate	Styrene, about 12 to 113 µg per minute	Lactide, about 4 to 5 µg per minute
Azimi et al. 2016, screening model of one printer running nonstop in a 45 m^3 office with one air change per hour	Predicted steady-state level of that VOC, worst case	Styrene about 150 $\mu g/m^3$	Lactide about 6 $\mu g/m^3$
UL, 2024, lab chamber	Particle number emission rate	1.13×10^8 per hour	1.28×10^4 and 3.42×10^8 per hour for two PLA filaments
UL, 2024, lab chamber	Particle mass emission rate	4.46 µg per hour	Under 1 µg per hour
UL, 2019	Toxicity of the emitted particles	"Higher responses than the PLA filament due to their much higher emission rates"	A comparable response to ABS at a similar dose

20 times above the highest reading in the Environmental Protection Agency's survey of US commercial buildings.

NIOSH is careful about what the health data show. Its guide cites one case of work-related asthma in a worker running ABS, and a survey in which 27 of 46 workers using PLA, ABS and nylon printers reported respiratory symptoms. It adds that "it is unclear" whether such effects come from the particles, the vapors or both.

1.3 What the studies advise

- **Ventilate or vent the printer.** UL calls ventilation "the highest priority": either enough airflow to dilute emissions or a local exhaust that "vents directly to the outside." In research UL cites, a ventilated enclosure cut particles by 99.7 percent and total VOCs by 69.5 percent. For makerspaces, NIOSH points to one study recommending at least six air changes per hour and another that found three too few for regular use.
- **Filter both particles and gases.** UL advises HEPA (high-efficiency particulate air) filters for particles and activated carbon for VOCs. With filtration in place, it reports peak particle levels falling by 95 percent or more. Azimi et al.'s caution is aimed at printing "without the aid of combined gas and particle filtration systems."
- **Do not count on a leaky box.** In Azimi et al.'s tests, a partial enclosure cut the median particle rate by only about 35 percent, a change within the test's uncertainty. The authors suggest this was "perhaps because the enclosure was not completely sealed." Styrene came out slightly higher with the enclosure in place.
- **Keep your distance.** NIOSH suggests spending less time near the printer, watching it remotely and keeping as far away as you can. UL flags the first 20 minutes of printing, when particle emission peaks.
- **Wait before opening.** Keeping an enclosure shut for about 20 minutes after printing lowered exposure in research by the UK's Health and Safety Executive, which NIOSH cites.
- **Print cooler, or print PLA.** UL and NIOSH both suggest the lowest nozzle temperature that still gives a good print, and PLA instead of ABS where the part allows.

Printer makers give the same advice. Bambu Lab's ABS guide calls for an enclosed printer in a well-ventilated area, or with "an effective air filtration or exhaust system." If anyone with asthma, a pregnant woman or a child is present, the guide says to increase ventilation or pause the print. Prusa asks for "a well-ventilated room," but without a draft across the print.

1.4 How to check your own setup

- **Keep it away from return vents.** UL warns never to place a printer near a return air vent, "since it recirculates emissions throughout the building."
- **Look for gaps.** A filter only cleans the air it pulls through. If the filter fan runs too slowly, Bambu Lab notes, the chamber loses negative pressure and "some gases may escape through gaps."
- **Change the carbon filter on schedule.** Bambu Lab expects its activated-carbon filter to need replacing about once a month on ABS, against about three months on PLA. A hot chamber also lowers how much the carbon can hold.
- **Do not trust a PM2.5 monitor alone.** PM2.5 readings measure the mass of particles 2.5 microns and smaller. UL notes they "may not represent the particles in the ultrafine size range" and may understate the effect of printing.
- **Skip the dust mask.** UL states that "standard dust masks are not effective for filtering ultrafine particles or volatile organic compounds." For long ABS jobs, Bambu Lab's guide suggests a mask with vapor filtration instead, such as an activated-carbon mask.

References

[1] Emissions of Ultrafine Particles and Volatile Organic Compounds from Commercially Available Desktop Three-Dimensional Printers with Multiple Filaments, Azimi et al., Environmental Science & Technology (2016). https://pubs.acs.org/doi/10.1021/acs.est.5b04983. Accessed September 23, 2026.

[2] The Impact of 3D Printing on Indoor Air Quality in Educational Settings, UL Chemical Insights Research Institute (2024). https://c

hemicalinsights.ul.org/wp-content/uploads/2024/08/R360_3DP_081624.pdf. Accessed September 23, 2026.
[3] 2019 Executive Summary Report: 3D Printer Emission Research, UL Chemical Insights Research Institute. https://chemicalinsights.ul.org/wp-content/uploads/2022/12/2019-3D-Printing-Summary-Report.pdf. Accessed September 23, 2026.
[4] 3D Printing Emissions and Its Impact on Health, UL Chemical Insights. https://chemicalinsights.ul.org/3d-printing/. Accessed September 23, 2026.
[5] Approaches to Safe 3D Printing, NIOSH Publication 2024-103. https://www.cdc.gov/niosh/publications/numbered/2024-103.html. Accessed September 23, 2026.
[6] ABS / ASA / PC Usage Guide, Bambu Lab Wiki. https://wiki.bambulab.com/en/filament/abs_asa_pc. Accessed September 23, 2026.
[7] X1E Chamber Setting Guide, Bambu Lab Wiki. https://wiki.bambulab.com/en/x1/manual/X1E-chamber-temp-guide. Accessed September 23, 2026.
[8] ABS, Prusa Knowledge Base. https://help.prusa3d.com/article/abs_2058. Accessed September 23, 2026.

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