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# PROCESS TO DETECT AIR LEAKAGES IN A 3D PRINTER

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# *Process to detect air leakages in a 3D printer*


## Abstract

In 3D printers, the Powder fusion process occurs in a sealed environment called print chamber, that is kept at negative pressure (relative to client room); the print chamber is sealed not only to prevent undesired contamination of the client room, but also to avoid unwanted air leaks from the client room (or by other zone of the 3D printer itself) to the print chamber. In fact, these air leaks may cause unwanted airflows in the printing area: they cool down only a specific zone of the printable area, changing the energy balance in this region and therefore affecting Part Quality.

A difference in printer air leaks worsens the printer-to-printer repeatability, which is crucial for customers. Also, since these leaks are not controlled, it implies a poor job to job repeatability.

Hence, detecting the air leaks is crucial to ensure robust and repeatable PQ across printers. In this disclosure we show a process to detect the Air leaks and give the customer or HP Service engineer recommendations on how to solve them.

## Description

The basic idea of the test is to use hot powder and the forced convection induced by air movement to detect leaks. In order to do that, a specific value of negative pressure is applied in the print chamber and compared against the baseline (NCUTR or scenario 0) where no cooling is applied.

The Main process works as follow (also visually described in Figure 1):

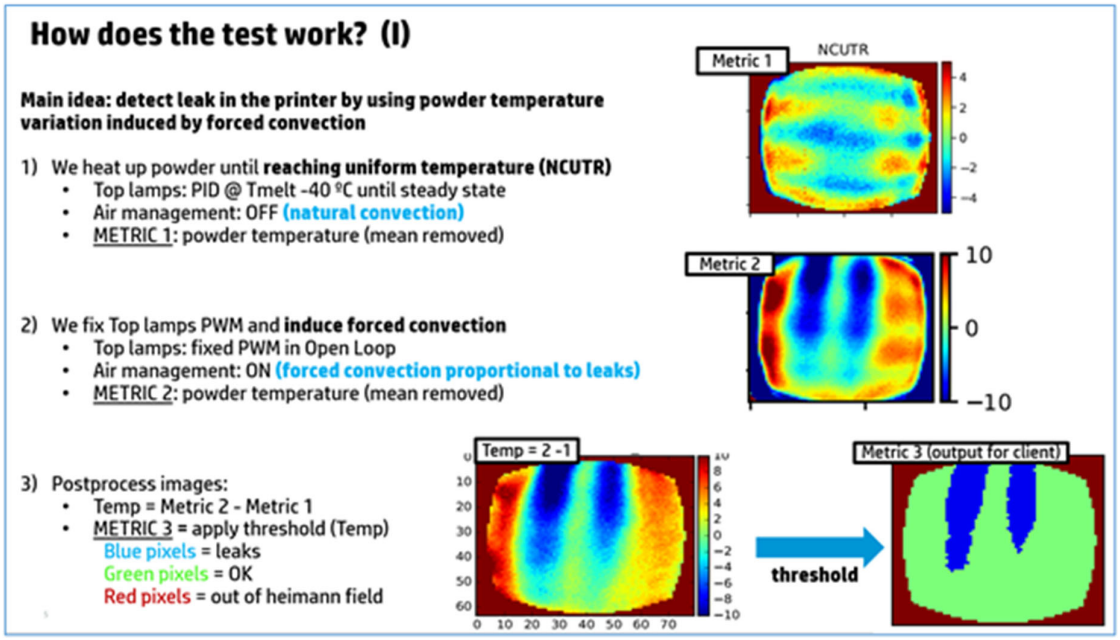
1. We start spreading powder, while no heating is applied.

2. Then we start heating the powder at Uniform temperature with only Natural Convection (NCUTR = Natural Cooling Uniform Temperature Recipe). This phase (called "baseline") has no Leak, since the Print Chamber is left at the same pressure of the room, while the top lamps are in Closed Loop @ Reference temperature-40°C until steady state is reached. We take 10 Thermocamera images and we compute METRIC 1.

3. After a fixed amount of time, when Powder bed temperature reaches steady state, we fix the PWM of the Top Lamps, and we create negative pressure in the print chamber; in presence of undesired Air Leaks, we induce forced convection on powder. Again, after a fixed amount of time, we take 10 Thermocamera images and we compute METRIC2

4. The difference between the desired scenario (METRIC2 with Forced Convection) and the baseline (METRIC1 with Natural Convection) shows the area with higher convection and reveals the leak (See METRIC 3 in Figure 1)

5. By appropriately selecting the process setting, the Air Leak Test can identify 2 type of leaks: leaks from the client room to the print chamber, and leaks from other volumes of the 3D printer itself to the print chamber.




- *Figure 1 Main Functional Block of the Air Leak Test*

***Disclosed by Hector Vega, Nicola Cofelice, Marc Borras, HP Inc.***