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# PURGE PROCESS TO REDUCE INK SPILLS

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# *Purge process to reduce ink spills*


### *Abstract*

In some printers, during the start-up, the Ink Delivery System is purged by using a gas purger (instead of a printhead) fluidically connected to the fluid interconnect on the carriage, which allows to evacuate air or any other gas that may be present in the Ink Delivery System.

The gas in the Ink Delivery System is purged through the gas purger in response to a fluid being pumped into the Ink Delivery System. The ink pressure gradually increases while the ink moves upstream to the fluid interconnect. Once the ink reaches the purgers and the foam collapses, the ink pressure exponentially increases.

Prior to remove the purgers, the ink pump is turned off. If the remaining ink pressure is too high, there could be ink spills when the gas purgers are removed from the fluid interconnect.

The purge process of the Ink Delivery System is a critical process, as it is the first impression that the customer has with the printer, thus any ink drop falling in the printer has a negative impact on the experience and the robustness perceived by the customer. Furthermore, ink drops may dry on electrical components, gears... to the point to cause a printer malfunction. Also, ink located on the Fluid Interconnect of the carriage will get dry and during the printhead replacement, may end entering to the printhead and affecting its performance.

This invention describes a process to reduce the remaining ink pressure when the ink reaches the purgers to avoid the ink spills when the gas purgers are removed.


### *Invention*

Typically, during the purge process, the ink pump needs to be turned on at a certain speed (or above) to create enough vacuum pressure to achieve that the ink reaches the ink pump (ink pump is self-primed). The solution proposed relies on using different ink pump speeds (or voltage) during the purge process to reduce the remaining ink pressure when removing the gas purgers.

First, the ink pump is turned on at a certain rpms (or voltage) that guarantees enough vacuum pressure to self-prime the ink pump. The time in which the ink pump is self-primed can be detected based on the ink pump consumption (it increases) and/or by monitoring the pressure read by a pressure sensor located in the ink lines. Another solution could be based on a time since activation or based on a visual check by the Service Engineer if the workflow requires to check if the ink pump is self-primed before continuing with the purge process.

Once the ink pump is self-primed, the ink pump works at a lower speed (or voltage) that is enough to overcome the pressure losses to purge the ink lines. By purging at a lower speed, the remaining ink pressure is reduced.
Furthermore, purging at a lower speed increases the detectability of the exact time in which the ink reaches the purgers to turn off the ink pump, not unnecessarily increasing the ink pressure.

The following graphs shows the remaining ink pressure during the start-up for two different conditions in cold-swap printers (without Intermediate Tank).

Purge at nominal speed: the ink pump is turned on at the nominal speed during the overall process. Once the ink reaches the purgers, the ink pressure rapidly increases from 2Psi to 9Psi, in less than 1 second.
Note that the ink sensor is saturated once the ink pump is turned off, but the ink pressure is higher than 9Psi.

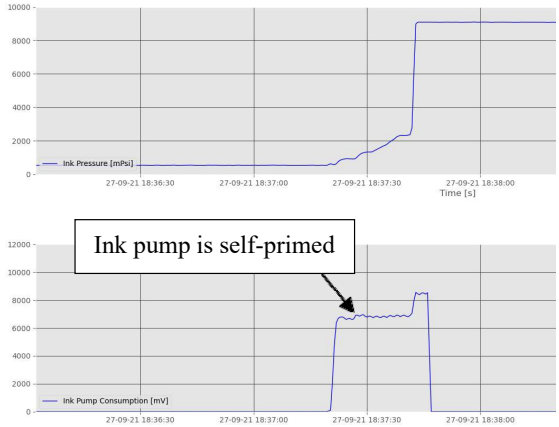



Figure 1. Purge process at current ink pump speed

Purge at dual speed: the ink pump is turned on at the nominal speed until the ink reaches the pressure sensor. Afterwards, the ink pump is set at a lower speed. Once the ink reached the purgers, the ink pressure slowly increases. In this case, the exponential part takes more than 5 seconds to increase from 1.2Psi to 6Psi.
Note that in this case, the ink pump is manually turned off.

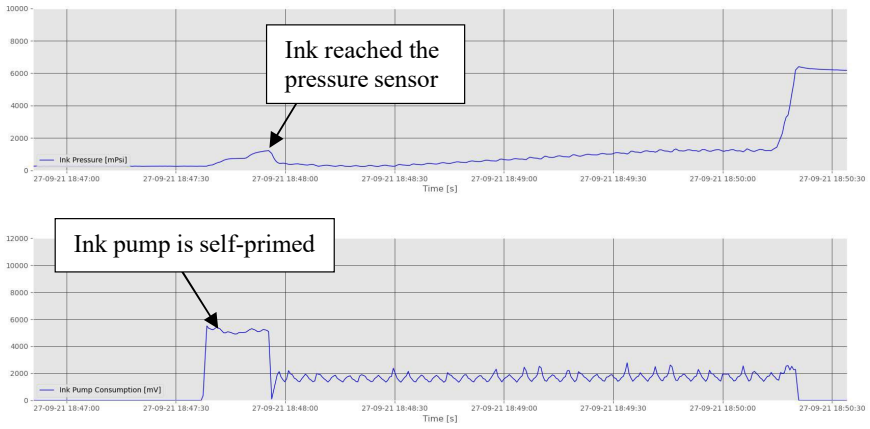


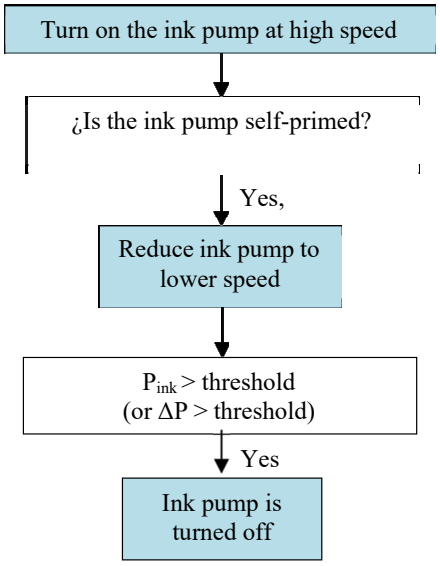

Figure 2. Purge process with dual speed

The solution proposed allows having algorithms that detects the event in which the ink reaches the purgers and stop the ink pump before the ink pressure drastically increases. The algorithm could be based on reaching a certain delta pressure that indicates that the ink lines is purged or when a certain pressure threshold is reached.

Note that in hot-swap printers, when the ink reaches the purgers and the Intermediate Tank starts to be refilled, there is a sudden pressure increases due to the pressure loss related to the ink entering the Intermediate Tank. In this moment, it can be detected that the ink reached the purgers and stop the ink pump and remove the purgers.

Other solution may consist of having several ink pumps speeds, progressively reducing the ink pump speed depending on the ink pressure read, like a pressure servo.

The following flow-chart describes the process of the invention:




The advantages of the invention are as follows:

- Customer experience: no ink spills will happen when removing the gas purgers, improving the perception of robustness of the printer.
- Automatic process: it does not require extra operations to be done by the customer.
- Flexible solution: it does not depend on the relative location of the supplies, Intermediate Tank (if so), printhead architecture or gas purger version.
- Cost: this solution does not imply to modify the current hardware of the printer. The solution will be implemented by a firmware upgrade.

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