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Deformed Hot-end Tube of a Liquefier

Koos Welling

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Author: Koos Welling, Ultimaker B.V. Geldermalsen, The Netherlands

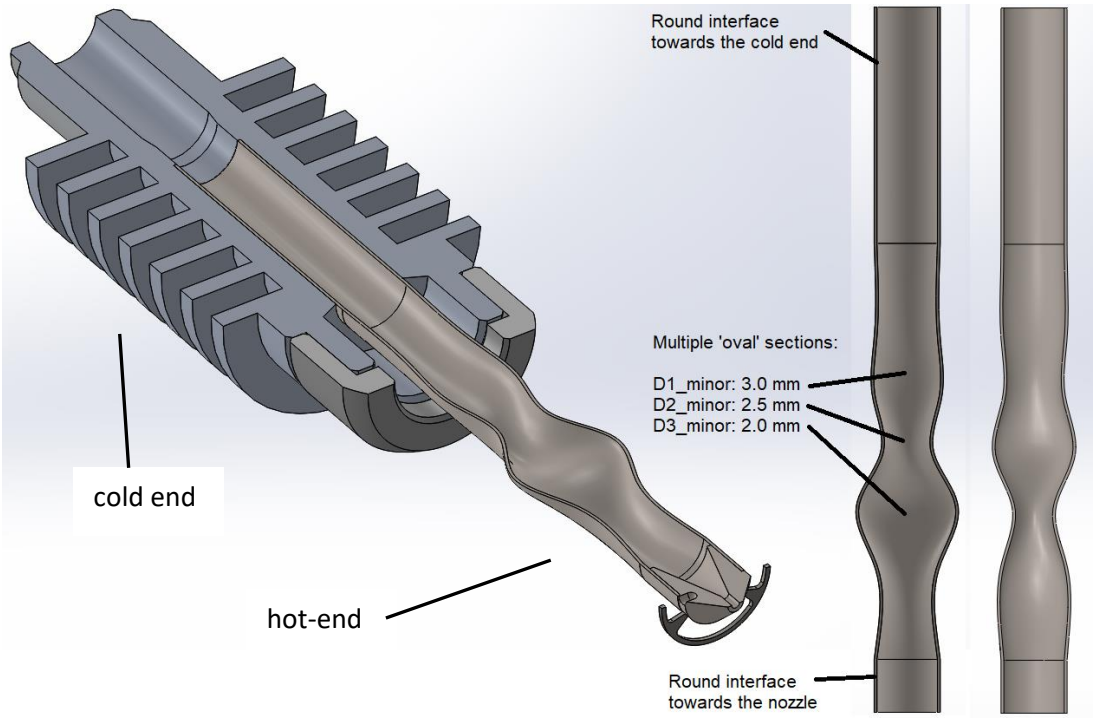
Abstract: This publication relates a deformed hot-end tube of a liquefier of an FFF printing device. The hot-end tube is deformed to achieve an improved heat transfer to the core of the filament, and thus a faster melting of the filament which enables faster printing.

In present systems, for heating up filament inside a liquefier, heat is transferred from a heater into a the tubular hot-end and transferred to the filament inside the hot-end. Due to the filament movement, filament needs to be heated for some time before also the core of the filament is heated. The time required to liquify the filament in the hot-end limits the maximal printing speed.

Decreasing the cross section of the hot-end tube, and using thinner round filament may help to faster heat up the core of the filament. But for the same flow output, such thinner filament has to move quicker as compared to thicker filament. So this solution is not really helping.

We suggest to use a very thin-walled tube, which is mechanically deformed, making the melt channel locally flatter. In this way, the heat transfer from hot-end towards to the core of the filament is faster. This could increase the maximum flow capacity of a hot end, while keeping the same overall length.

Figure 1 shows a cut out of an example of a liquefier having a deformed hot-end. At the right side, two cross sections of the liquefier tube are shown.



The deforming process could be done in different ways. A simple solution is temporary placing a piece of steel rod inside the hot-end and stamp the outside, making it some what oval. This could be repeated a different sections and under different angles. In this way it is also possible to create a somewhat helical-oval shape, (like drilling bits). When different sized rods are used, different thicknesses could also be created. So close to the cold end, the deformation is smaller and moving towards the nozzle, the thin section increases for optimal heat transfer.

Such a mechanical deforming of a very thin walled tube will be a very cheap solution for increasing the heat capacity towards the filament. As a result, the filament flow is increased, while keeping the same hot-end length.

Another possible tube deformation would be to make a ‘D’ shaped filament guide, see Figure 2.

Here it is easier to apply a thin flat RTD element, instead of connecting this element towards a round shaped tube. When using a tube with a thicker wall, it is possible to mill a flat inner surface to create the D-shaped channel, but with thin wall this not possible.

Figure 2.