Design of firefighting nozzle

Original commercial ”lance” design

-used by firemen to create a far reaching mist. This mist jet consisting of small droplets is very effective at extingushing fire and cooling materials

A new development is to instead of creating a forward mist, instead shooting water backwards forming an ”umbrella” shape. This is used by firemen to cool off doors from the inside so that they can enter a building in flames.

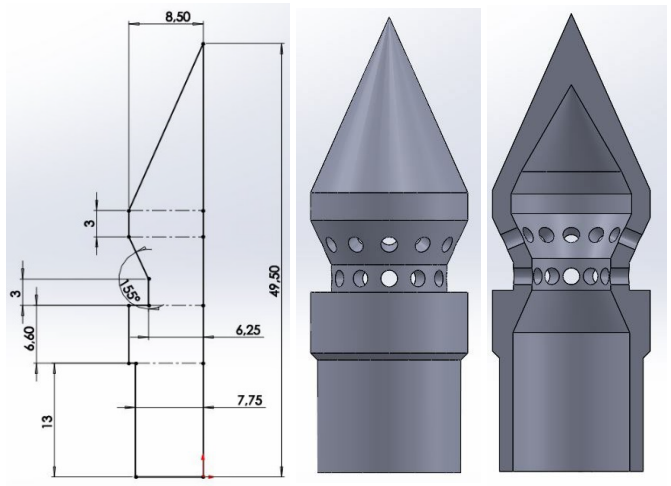
Due to complexity of Manufacturing it is an ideal case for metal 3d-printing. When printing, several variants can be produced at the same time

3d-printed variants of umbrella plume

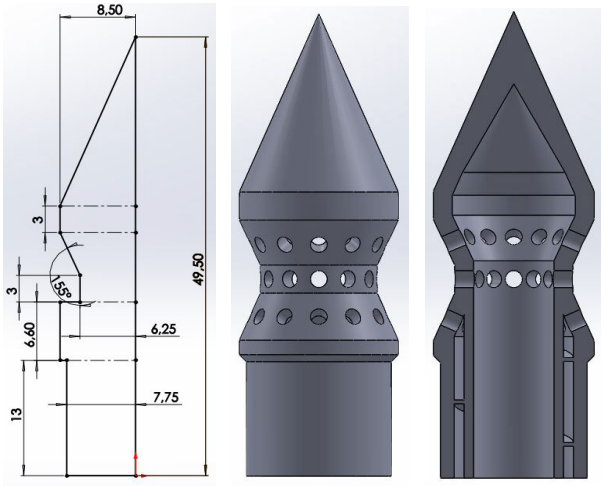
3d-printed copy of original

Design and variations – example of first various designs

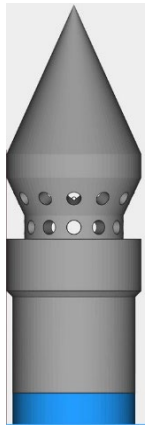
Original



3D-design

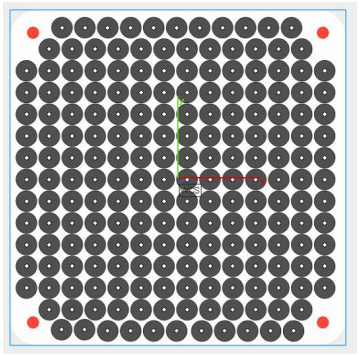


3D-design with inner channels



As printed

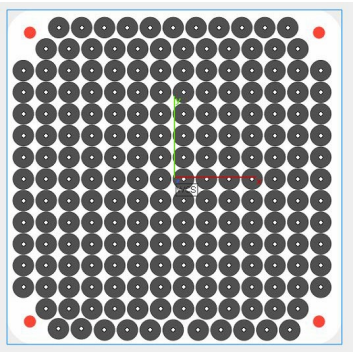
Example layout on build platform 200 pcs batch



Post-processed

Production cost estimation of a 200pcs batch

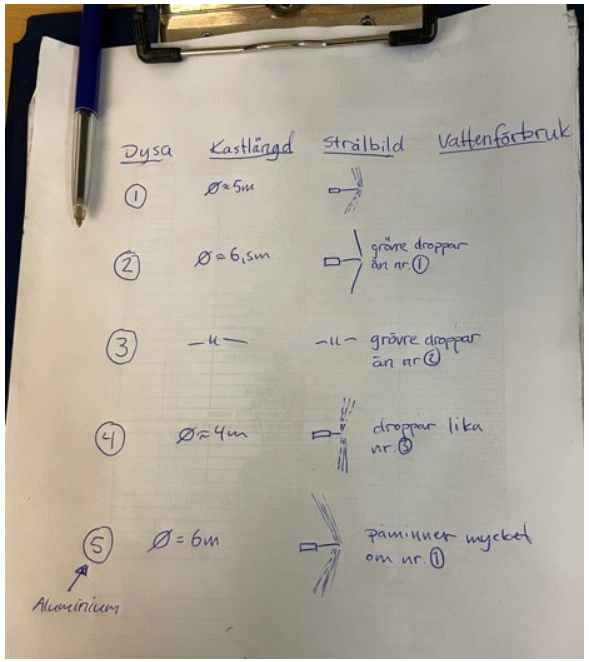
- Build costs
  - Scanning time 5 days and 13 hours (=133h)
  - Machine cost e.g. 100 €/hour = 13 300 €
  - Consumables cost is ~100 €/kg = 573.5 €
  - Total build cost is 13873.5 € or 69.4 €/part
- Post processing (30 min/part, 60 €/h)
  - Heat treatment 3h + cooling
  - Removal from build plate and support with pliers and sandpaper
  - Grinding nozzle heads
  - Turning cylinder for thread and O-ring
  - Threading
- Total cost of building is ~100 €/part
  - + Design cost = 20 h*operator cost
  - + Overheads
  - + Verification
  - + Failed builds



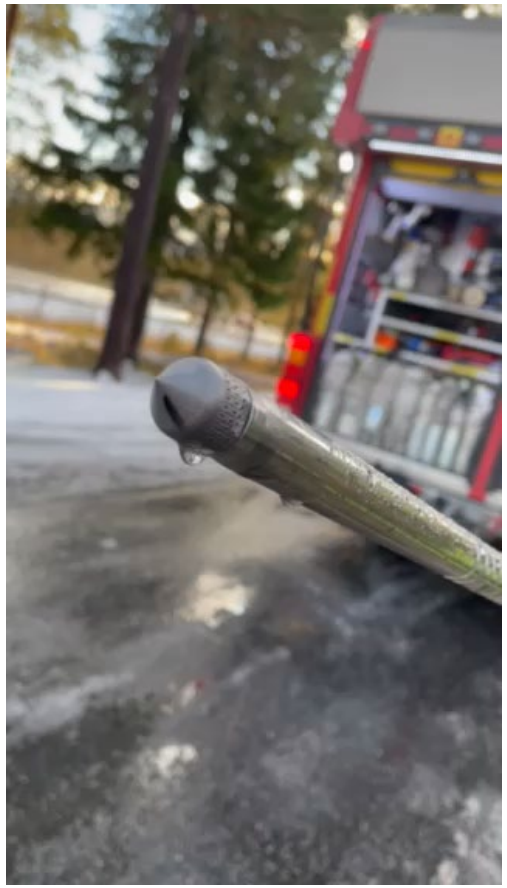
200 pcs batch

Designs and results

3d-printed original



1

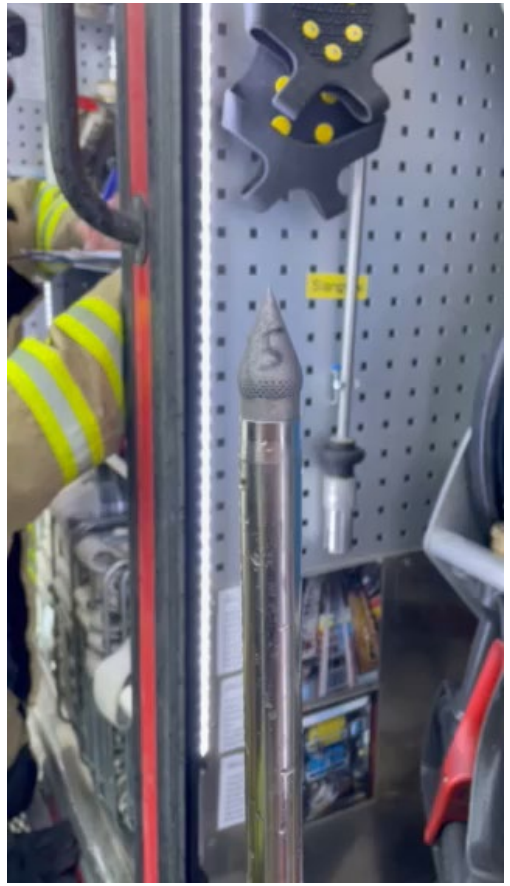


5m length, mist, even distribution

2

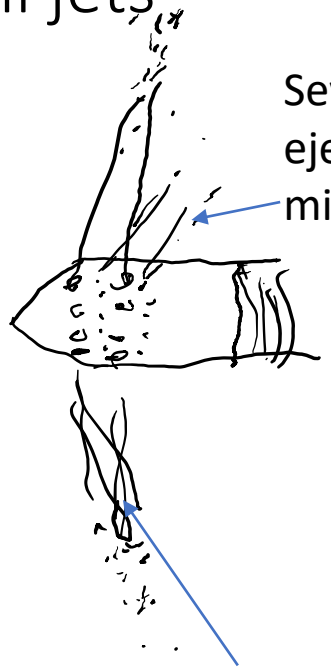
6,5m length, larger drops, jets of water jets colliding to form mist at a distance

5



6m length, mist, even distribution

New design improvement
-”umbrella”, combination of large and small jets

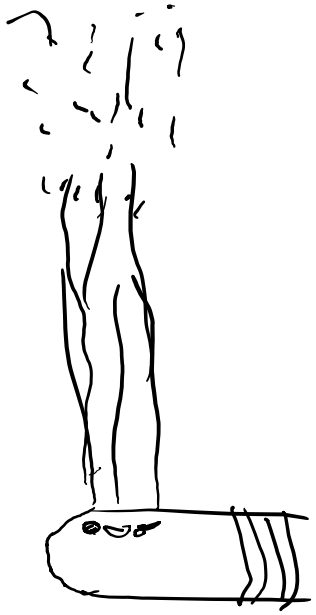


Several smaller holes ejects streams that form mist more backwards

Streams for ”large” holes colliding, forming mist

Combined sized holes form a half cylinder mist backwards

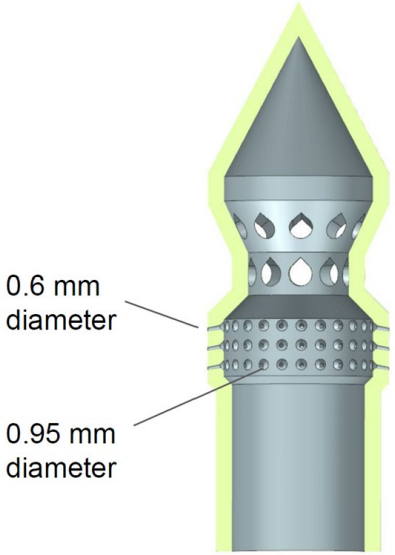
New design of ”Lance” nozzle
-sideways water jet

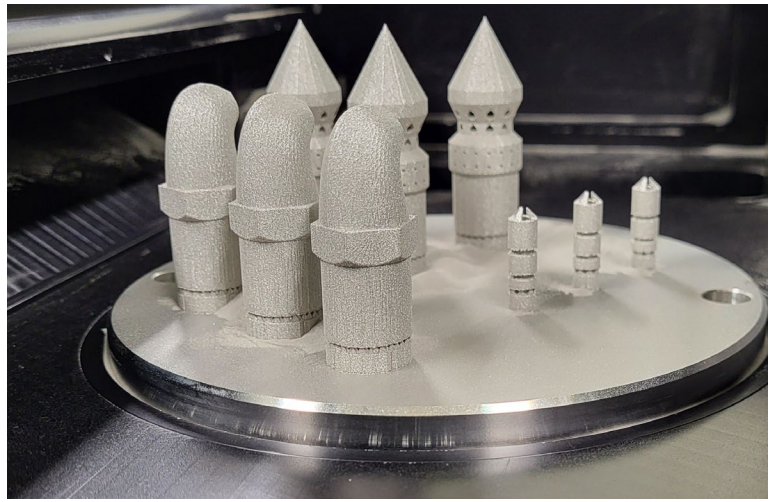


Instead of ”normal” lance forwards, producing stream of long range mist to just one side (could be at different angles, though target is 90 degrees)

Commercial ”Lance” nozzle

Result ”Umbrella”





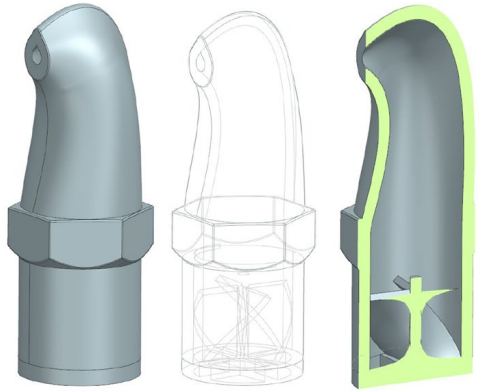
Mist filled umbrella plume

Plume at 12m in diameter

Water consumption 120 l/m

Comment: Equal plume as the original, but more evenly spread mist. Water jets that meet and form mist at a distance combined with direct forming mist from smaller holes at closer distance. Best yet performing design.

Result 90 degree ”lance”



Water jet 90 degree

Throw 13m

Water usage 16-17 l/min

Comment Fine water mist and good throw. At first a bit too low water consumption.

With enlarged opening (3,5mm) -> Similar throw as for the ”original” forward jet and water consumption.

Highly successful design!