TRUMPF

Whitepaper

3D printed high pressure nozzle

Contents

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Abstract

The process of cleaning large sewer lines involves a series of steps. The production of the sewer cleaning nozzles is key because this specific attachment is responsible for spraying water at pressure levels up to 300 bar. Often times, the multiple steps in production of these attachments cause imperfections somewhere down the line. Imperfections can negatively affect the jet's guidance, resulting in poor performance.

In a project with USB-Düsen and Heilbronn University, TRUMPF reduced the number of steps to manufacture the sewer cleaning nozzles from four to one with 3D printing. The attachments are made with the TRUMPF TruPrint 1000 3D printer, which features a single laser, as well as a multi-laser option. You can read more to learn about the benefits of 3D printed sewer nozzles.

Situation

To clean large sewer lines, workers plug a hose into a vehicle-mounted machine, at the end of which is a ‘bomb’ or ‘grenade’ that slides down channels on a carriage. The head of the bomb is fitted with 12 to 15 nozzles that spray water. These jets hit channel walls at pressure levels up to 300 bar to blast away the sludge, which is then sucked into the vehicle via the hose.

The nozzles’ design is simple, but it still takes four steps to manufacture these attachments. The first is to cut the raw material and then thread it on a lathe to create what is in effect a massive bolt. Then two blanks are placed in a milling machine to cut the contours of a nut into the front face. Finally, a worker glues in a ceramic insert by hand. “The operator has to remove the component from the machine for each step. What’s more, gluing often leaves imperfections that change the jet’s guidance,” says Fatih Arikcan, additive manufacturing application engineer at TRUMPF, with a note of disapproval.

Figure 1:
3D printed nozzle for a sewer cleaning system, optimized by TRUMPF.

The solution

TRUMPF decided to go with additive manufacturing to cut production time while boosting cleaning performance. This decision reduced the number of steps it took to manufacture the sewer cleaning nozzles from four steps to one single process. In a project with USB-Düsen and Heilbronn University, TRUMPF has optimized sewer cleaning nozzles for 3D printing. A subsequent test series has shown that the 3D-printed variant clearly performs better than the conventionally manufactured nozzles.

TRUMPF experts took a hybrid approach for the new nozzles, combining conventional and additive processes. They stuck with the lathe for the massive threaded base component, which is called a preform. "This process is solid. AM doesn’t add any value here,” says Arikcan. The 3D printer is to perform the following steps, milling and gluing. TRUMPF opted for Laser Metal Fusion (LMF), a manufacturing process where a laser builds up the component layer by layer in the powder bed. “This process is perfect for complex geometries. We need these to put these functions – that is, maximum cleaning performance with minimum water consumption – into practice,” explains Arikcan.

TRUMPF experts streamlined the component’s design so it can be printed without any supporting structures, and with no finishing to be done afterwards. This printing process is software-driven, so the imperfections associated with manual gluing have been relegated to history. TRUMPF staff enlarged the nozzle attachment and added an outer channel guide to improve the component’s properties. This serves to furnish air to the system and creates a tighter throw pattern when the jet hits the surface to be cleaned. The preforms with the add-on component can be screwed into the bombs immediately upon printing. The substrate plate does not even have to be removed from the machine to do this. “For the first time, this will allow 10,000 nozzle inserts to be manufactured per year,” notes Arikcan.

Its experts set up a test bed to examine and validate the 3D printed components. “Measurements have shown that this shortens the job time for conventional steps by 53 percent,” says a clearly delighted Arikcan. The parts were made with the TruPrint 1000 3D printer; developed by TRUMPF, it features a single laser. This expert is confident that the time savings will be even greater with a multi-laser system. The new nozzles also deliver more persuasive performance with benefit of improved jet guidance. “We demonstrated that the water jet flows smoother than with the conventional design. We also expect the pressure on the surface to increase and water consumption to decrease,” says Arikcan. Another positive side effect is that this boosts turning and milling stations’ availability.

Equipment

Figure 1:
The TruPrint 1000 from TRUMPF is a compact machine for the production of small metal components by laser metal fusion.

TruPrint 1000		
Build volume (cylinder)	mm x mm	Ø 100 x H 100 Optional: Smaller build volume
Processible materials[1]		Weldable metals in powder form, such as: Stainless steels, tool steels, aluminum[2], nickel-based, cobalt-chrome, copper, titanium[2] or precious metal[2] alloys
Build rate[3]	cm^3/h	2 – 18
Layer thickness[4]	µm	10 – 50
Laser source (TRUMPF fiber laser)	W	200 Optional multilaser: 2 x 200
Beam diameter	µm	55 Optional: 30
O_2 concentration	ppm	Down to 3000 (0.3%) Optional: down to 100 (0.01%)
Scan speed (powder bed)	m/s	Max 3
Shielding gas		Nitrogen, argon
Power supply	V / A / Hz	230 – 7 – 50/60
Dimensions (incl. filter)	mm	1445 x 730 x 1680
Weight (incl. filter)	kg	650

[1] Current material and parameter availability upon request
[2] Available with option packages
[3] Dependent on system configuration, process parameters, material and degree of filling
[4] Individually adjustable
Subject to alteration. Only specifications in our offer and order confirmation are binding.

Materials

TRUMPF can provide the perfect materials for your TruPrint 3D printing systems.

- Wide range of high-quality metal powders available
- Open parameters configured for TRUMPF powder
- Optimized to ensure ideal laser metal fusion processes

Figure 1: TRUMPF metal powder.

Figure 2: The best powder for your TruPrint.

01

Perfectly matched

to your TruPrint system

The powders and test parts undergo rigorous chemical and physical analysis to guarantee quality. With processes, such as, scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) the powder can be perfectly matched.

02

Consistent quality

due to constant quality control

We consistently monitor the metal powder quality. Every new batch is examined at the TRUMPF laboratory, for grain size distribution, flow rate and bulk density. Before any powder leaves production, the powder undergoes test part production on a TruPrint system, followed by a material evaluation. This guarantees the quality remains high and reproducible using TRUMPF powders and parameters.

TRUMPF TruPrint equipment can process powders available from third party suppliers. Additionally, the following materials have been tested and are available for purchase.

TRUMPF metal powder portfolio

Material group	Alloy	Supply quantity	Packaging	TRUMPF material number
Aluminum	AlSi10Mg-A LMF	1.5 kg	Can	2052374
		25 kg	Barrel	2239195
	AlSi12-A LMF	25 kg	Barrel	2239263
	AlSi9Cu3-A LMF	1.5 kg	Can	2351698
		25 kg	Barrel	2348968
Stainless Steel	316L-A LMF	5 kg	Can	2051164
		50 kg	Barrel	2237856
	630-A LMF	5 kg	Can	2052355
		50 kg	Barrel	2052372
Cobalt-Chrome	BEGO Mediloy S-Co	5 kg	Can	2052497
	CoCr-B LMF	5 kg	Can	2243444
Copper	Bronze 90/10-A LMF	5 kg	Can	2052499
	CuNi2-A LMF	5 kg	Can	2359141
Nickel-based	718-A LMF	5 kg	Can	2051201
		50 kg	Barrel	2237990
	625-A LMF	5 kg	Can	2052353
		50 kg	Barrel	2052371
	HastX-A LMF	5 kg	Can	2052491
		50 kg	Barrel	2052485
Titanium	Ti2-A LMF	2.5 kg	Can	2052513
	Ti64 ELI-A LMF	2.5 kg	Can	2052524
Tool Steel	1.2709-A LMF	5 kg	Can	2051195
		50 kg	Barrel	2237854

Product range may be subject to modifications depending on country. Content is subject to change. Only information provided in our quote and order confirmation are binding.

Process

Laser metal fusion is often referred to as metal 3D printing, powder bed fusion, or selective laser melting. The laser builds up a high-quality workpiece from a powder bed, layer by layer. A CAD model provides the plan for doing so, and no tools are required. The powder is added to the build platform. The laser beam accurately melts on the powder according to the CAD data and joins defined points to the layer underneath. The laser then repeats this process until the metal part is finished. The workpiece has the same properties as the metal powder which was used.

As a supplement to conventional production methods, the LMF method offers a number of advantages. There are virtually no limits on the design freedom, which enables complex forms and custom components to be produced quickly, cost-effectively, and with flexibility. When conventional production methods reach their limits, LMF can provide the answer. It enables cost-effective production, even for small lot sizes.

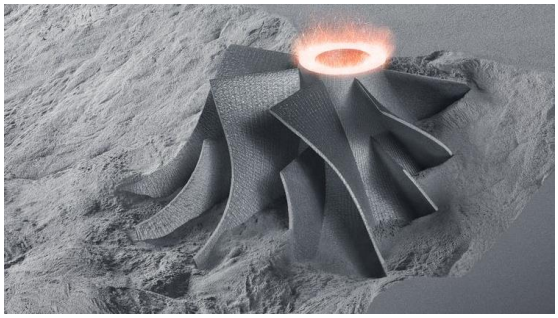

Figure 1:
Laser metal fusion is an additive manufacturing method where a workpiece is built up gradually in a powder bed.

Good to know

01

Simple and intuitive

The small size of the TruPrint 1000 makes it easy to operate. A generously-sized processing chamber and doors enable ergonomic handling. An intuitive touch screen and setup wizard allows for simple operation. With intelligent functions, the control software supports efficient production.

02

Remote operation and monitoring

With the TruTops Fab App you can operate and control the TruPrint 1000 flexibly, even with a tablet. The operator can keep an eye on the production process via live images, and provide comprehensive monitoring of the machine conditions for full transparency of the machine productivity.

03

High processing speed

The TruPrint 1000 overlaps the automated powder coating procedure with laser exposure to reduce the build time per layer. This enables higher processing speeds and increases productivity. The X-profile recoater medium, enables a robust and equal powder recoating.

04

Maximum productivity

With the multilaser option, productivity is boosted up to 80% compared to the standard machine. At the same utilization rate, the option with 2, 200 W TRUMPF fiber lasers yield a higher part output. This reduced processing time per build makes a variety of operations possible and enables express part availability.

Conclusion

When it comes to cleaning large sewer lines, the key component to blast away the sludge is the sewer cleaning nozzle. Instead of conventionally manufacturing the attachment in a four step process, TRUMPF reduced the manufacturing process to one step. The TRUMPF TruPrint 1000 allows you to maximize the cleaning performance of large sewer lines with 3D printed sewer cleaning nozzles. Consistently achieve outstanding results with TRUMPF's 3D printing system.

For more information about the TRUMPF TruPrint 1000, please visit our website.

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