H350 and Associated Workflow

How to make parts at volume, and track/trace the production quality with an adaptable workflow.

Welcome to The SAF powered H350 3D printer. Giving you control of your production and costs.

The H350 uses a powder bed fusion to form parts layer by layer, and as such, the production environment is tightly controlled by each operator to ensure they get the manufacturing quality they need for their applications.

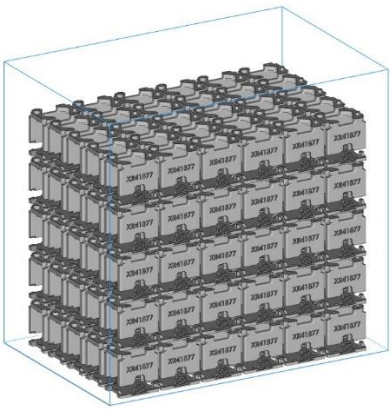
The workflow for H350 is the same as other powder bed fusion technologies, but the operator has more control on how it is deployed and even what equipment they choose.

The main workflow components are:

(1) **NEST**: Nesting parts to create a build job
(2) **SEND:** Sending print jobs to the printer
(3) **PRINT:** SAF technology provides a uniform thermal experience for improved part consistency
(4) **MONITOR**: Monitor all progress of all printers in your fleet with GrabCad Print Server
(5) **DATA RETRIEVAL:** Retrieve data from a build job for quality control and to certify production
(6) **BUILD REMOVAL:** Remove a completing build to cool down
(7) **BREAKOUT AND POWDER RETRIEVAL:** Remove parts from a build and retrieve unfused powder.
(8) **DOSING:** Retrieve unfused powder and dose with virgin material for printer refill
(9) **POWDER REFILL**: Putting dosed powder in the machine (e.g. for 70:30 used:virgin ratio)
(10) **DEPOWDERING/BEAD BLASTING**: use your choice of equipment to remove any excess powder from the part surface to create a finished raw part

Part Finishing: Finish your parts your way e.g. dyeing, smoothing etc

(1) NEST:



Your choice of software

Coming soon!.....

Build freedom, with simple efficient nesting

With SAF technology, the H350 allows you to nest efficiently and quickly without many rules that make nesting slow or unfavorable for getting more highly packed build for a bigger yield per build. For instance this build job took 20 minutes to manually nest using the Materialise Magics 3D Print suite, it contains 300 parts (150 pairs) and has a Time to Print of just 8.23hrs (note: this only includes printed layer time). Orientation of parts can be important in order to target certain application feature requirements such as best elongation at break for flexible hinges or aesthetic details such as embossed text.

(2) SEND:

The Stratasys H350 Build Processor ensures that the build job can be processed correctly.

(3) PRINT

The H350 has an easy to use interface to help operators print jobs as well as explaining how to carry out essential cleaning and maintenance tasks required to run the printer. It informs operators about fluid and powder levels, bed temperature and other important parameters that an operator may wish to quick keep track of. Once installed, there are not mandatory internet connections required to print and your data is not stored in a cloud. There are no forced firmware updates, and you can reuse your previous print settings.

Operators can change bed temperature settings from a default setting to + or – 3 degrees C. This fine tuning allows operators to tailor specific jobs in order to optimize for particular part properties such as strength, accuracy or surface finish.

Loading additional fluid is easy with the H350, and it might be very familiar to those already operating FDM equipment in Stratasys. The easy to load cartridges fit here [load in cartridge] and the waste is collected here. The display will tell operators when to change the new cartridge.

Dosed powder, which might typically be at a ration of 70:30 used to virgin, is put into the printer here [point at powder cap]. We will discuss powder refilling a little later in the tour, but what I can tell you is that the mixing is done inside the printer which is a unique feature of the H350. It saves on external mixing processes which can be quite messy and ensure a consistent mixing of powder improving build to build consistency.

The printing process itself happens inside the hot box, which is an air-based system that does not require nitrogen to run. There is an extraction outlet here [point to it] which acts to remove gases and airborne powder and serves as a way to keep a controlled build box temperature to give consistency throughout the build job production cycle.

The H350 has two carriages, and both are timed to give each particle on the bed surface the same thermal experience. This is unlike other powder bed fusion systems and is designed to improve consistency across the whole bed to improve production yields. The carriages have a specific sequence of fusion too: Print, fuse, powder recoat and powder-heat, all in the same direction. This unidirectional printing is a key of SAF technology and is designed to give those particles on the same layer the same thermal experience, delivering within layer consistency.

The print heads themselves are industrially designed and have been widely adopted in other manufacturing process such as the ceramic tile printing industry. They are built to withstand dusty and hot environments and use a recirculating fluid technology which helps keep the nozzles dust free and cool at the same time. The added benefit of these print heads is that they can print highly loaded fluids close to the bed surface, ensuring fine feature resolution without the need for a second cooling agent, which is why there is no second print-fluid consumable.

(4) MONITOR

Monitor progress of all printers in your fleet with GrabCad Print Server

(5) DATA RETRIEVAL:

Key metrics from the build is reported from the machine. Information on key sensor outputs are also included. This enables operators to retain key information required for Quality Assurance managements and can assist in certification protocols required in some highly regulated industries. The transparent nature of the data provided is a key provision of the H350 and its production readiness for manufacturing.

(6) BUILD REMOVAL: Removing a completing build to cool down

Once a print job is complete, it has a cool time required in the printer which is material dependent. Once that time is complete, the build can be removed in the Build Removal box, and taken to a shelf

to complete the cool down process. The Stratasys H Trolley allows for easy removal and operator use.

The time required to cool the hot melted parts inside each build is material dependent, but also an operator's choice. Chunky parts may have different requirements to smaller thinner parts, so the operator is free to choose where a build will be stored, under what cooling conditions and for how long in order to suit the application requirements. Heat loss from any build is down to physics and often can't be rushed. These small agile units are easy to store and add to as required giving complete flexibility to the process without being tied into expensive, bulky, specified equipment.

(7) BREAKOUT AND POWDER RETRIEVAL:

Once a build is cooled, the next stage involves removing as much unfused powder from around the parts as possible. Unused powder can then be dosed with virgin powder to replace what went into making parts and refilled back into the H350. We are using here the Farsoon Powder Retrieval Station, which is operated ideally under extraction to reduce airborne powder. It includes a sieve which takes out any of the large lumps which can't be put back into the system. Operators are free to choose which ever solution works best for their environment. There are many options available in different locations, so an operator can choose which ever system gives them the best labour saving, cost investment that gives them the powder return that they are looking for.

At this stage, some operators wanting to certify production will take powder samples in order to measure to a quality standard they have developed in house. They will keep this data along with the build report from the printer and other key metrics such as part properties they might have produced test pieces for inside the build job.

(8) DOSING

Once powder is retrieved into these convenient H350 Powder Containers [show barrels], virgin powder can be added to make the appropriate mix. These batches can be organised by an operator as per their own quality standards. In some cases, operators may wish to mix and test batches, or tailor their weighing and mixing protocols in order to meet operator expectations on quality management. As the workflow is open, operators can choose to operate in a way that gives them control.

(9) POWDER REFILL:

Once a powder batch is prepared, it can be refilled back into the printer. The printer itself can run at least 2 full jobs before being refilled, but an operator is free to choose the frequency of this operation. The Stratasys H Trolley loads up the container, and helps the operator load the powder in to the machine in a clean, and efficient way.

Further Part Finishing

(10) DEPOWDERING/BEAD BLASTING

In order to fully remove powder from the parts, bead blasting (typically glass beads) is required. There is a wide range of manual and automated systems that can be specified depending upon

operator requirements. The parts are then fully useable as ‘raw’ parts, but can then be further finished to suit a wide range of different applications.

Optional next steps:

(a) **DYEING:** a popular finishing step when parts are on display rather than hidden behind panels, but not a requirement for many functional application
(b) **TUMBLING:** a popular finishing step where general smoothness is required to give the surfaces a more aesthetically pleasing look when parts will be ‘in hand’
(c) **VAPOUR SMOOTHING**: an alternative to tumbling, which may also enhance other part properties such as EAB or Impact resistance. Parts may also be better sealed/less surface porosity for applications that pass air or fluid through them.
(d) **SHOT PEENING:** often chosen to increase part properties such as impact resistance, but also, applications where parts need a more robust surface finish to prevent e.g. finger marks.
(e) **SEALING:** used in certain applications where a completely non-porous surface is required
(f) **PAINT SPRAYING:** many available options of colour, either with a undercoat or not, to change the colour of the part and or add effects such as a glossy or satin finish.
(g) OTHER: the parts lend themselves to a range of finishes that operators can experiment with in order to meet the needs of different applications.