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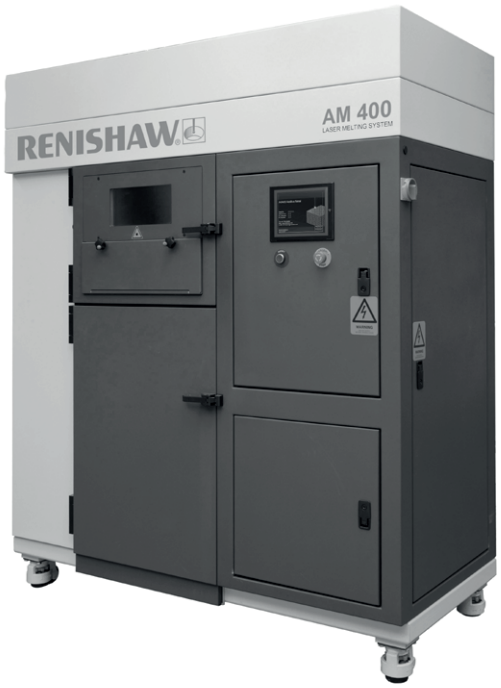
AM 400 additive manufacturing system

System description

The Renishaw AM 400 is the latest development of the Renishaw AM platform and features an increase in laser power from 200 W to 400 W whilst still maintaining the same 70 µm spot size at the powder bed. It has been designed for users who require the flexibility to change between different materials, a range of accessories being available to minimise the risks of cross-contamination.

The AM 400 is capable of processing build files created for the standard AM 250 system without additional changes allowing an easier transition from AM 250 to AM 400. New build files will be required to fully exploit the additional laser power available on the AM 400.



System specification

Build area X × Y × Z	250 mm × 250 mm x 300 mm (9.8 mm × 9.8 mm × 12 mm)
Build volume X × Y × Z	248 mm × 248 mm × 285 mm (9.7 in × 9.7 in × 11 in)
Build rate*	Up to 20 cm^3/hr (1.22 in^3/hr)
Powder layer thickness	In the range of 20 µm to 100 µm (1 µin to 4 µin)
Laser power	400 W
Laser focus diameter	70 µm (3 µin)
Speed scanning	Up to 2 m/s (6.6 ft/s)
Speed positioning	7 m/s (23 ft/s)
External dimensions without accessories	853 mm × 1700 mm × 2115 mm (34 in × 67 in × 83 in)
Weight (gross/net)	1225 kg / 1100 kg (2700 lb / 2425 lb)
Running argon consumption after initial fill	< 50 L/hr (< 61 in^3/hr)
Filling/purge argon consumption	600 L to 1500 L (21 ft^3 to 53 ft^3)
Power supply	220 V to 240 V, 16 A, 45 Hz to 60 Hz, single phase
Compressed air	Required
Materials	AlSi10Mg, CoCr, In625, In718, stainless steel 316L, Ti6Al4V†

* Build rate is dependent on part geometry and material

† Material file will be available on initial release of AM 400 for full 400 W laser parameters, all other material files will follow after initial release

Optical system

Laser energy source

Renishaw laser powder bed fusion systems use high-stability ytterbium fibre lasers, focused and guided through a dedicated optical module to deliver energy at intensities high enough to fuse metallic powders.

The system features a 400 W ytterbium fibre laser, which is integrated into the system control hardware and software. Energy is transmitted via a fibre optic cable and delivered using a point-by-point exposure methodology which provides precise control of energy into the powder bed. The process is configurable using open access parameter development and optimisation tools at the build file preparation stage.

Beam positioning technology

Renishaw laser powder bed fusion systems use a two-axis galvanometer to precisely position the laser beam in the X and Y axes. The Renishaw optical system is calibrated to deliver a positioning accuracy of ±25 µm across the working area. A number of different laser tool paths and scanning strategies are available, depending on the demands of the part geometry, all configurable using the build file preparation software tools.

Focusing capability

The AM 400 uses a quartz f-theta objective to achieve a flat field correction of the scan area. F-theta based focusing systems are classed as two-axis optical systems.

Higher laser power f-theta based optical systems can suffer from the risk of instability caused by thermal distortion of the f-theta lens causing the beam to defocus. The AM 400 benefits from a source of clean dry air to ensure that the optical system remains thermally stable.

Machine

Z-axis construction

The AM 400 uses the same Z axis as the current AM 250 with indirect encoding from the drive motor, and a high-performance sealing system engineered for extended service life. Standard Z axis travel is 300 mm.

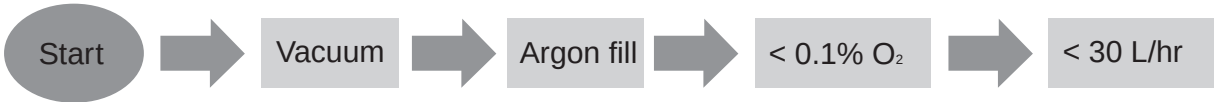
High-capacity filter

The patented SafeChange™ filter system enables builds to be run for long periods within a stable, controlled atmosphere. The SafeChange™ filter captures process emissions in a safe and efficient manner. Changing the SafeChange™ filter is an operator task and does not require specialist service and support from Renishaw. Both AM 250 and AM 400 systems now benefit from larger SafeChange™ filters, allowing longer builds to be run with improved system performance.

Filter elements are a standard consumable and every machine is shipped with one additional filter housing so that filter cleaning can be done when the system is running, enabling rapid turn-around between builds.

Gas usage

Our patented inert atmosphere generation technology starts by drawing a vacuum to remove air and moisture from the chamber, followed by backfilling with argon gas. This method of chamber preparation achieves low gas usage on initial fill, particularly as a very low concentration of oxygen is required, and a rapid build preparation time compared to other methods. Careful management of the recirculating gas leads to class-leading low gas consumption of < 50 L/hr, contributing significantly to low cost of ownership.



Secondary gas flow

Maintaining laser transmission energy onto the powder bed is a key consideration for all laser powder bed fusion processes. On the AM 400 a portion of the argon gas flow is diverted, creating a secondary gas flow across the protective laser window. This secondary flow acts to prevent contamination from process emissions building up on the laser window. The result is a cleaner and more reliable build, also helping to maintain the condition of the protective window over the long term by minimising manual cleaning, and contributing to quicker system turn-around.

Control system and software

The AM 400 uses the same control system and software platform as AM 250 with the improvements of Renishaw's Optical Control Software (OCS). Control hardware is based on an industrial PC running Windows® and a PLC control for sub system modules such as moving axes, gas recirculation and sensor signal processing. A dedicated safety controller regulates key safety circuits, such as door interlocks, emergency-stop, and critical sensors, that monitor chamber condition and laser safety. All safety circuits comply with laser radiation standards to Class 1 for machine operation, and Class 2 when using the targeting laser for calibration instrument set-up. The industrial PC takes care of laser and optical system control, calibration and process file handling. The Human Machine Interface (HMI) is via an 8 inch touch screen, where all the necessary machine set-up controls and information screens are displayed.

Powder handling

Main hopper

The load hopper is located on top of the rear of the machine and features a loading valve that provides an access point for new material. Material can be loaded using the Renishaw stainless steel flasks, whilst the system is running. This protects both the material from the atmosphere, and the user from exposure to the material. The load hopper has a level sensor as a guide to material status.

Material overflow hopper

On the AM 400 unused material is collected in one of the two overflow flasks located on the left-hand side of the machine and can be removed, sieved using the PRS 400 sieving system and re-introduced to the machine whilst the process is running.

Glove-box

Once the build is complete the user removes the material from the build through the machine glove-box under an inert atmosphere. The majority of unused powder is guided via the front overflow into the overflow flask.