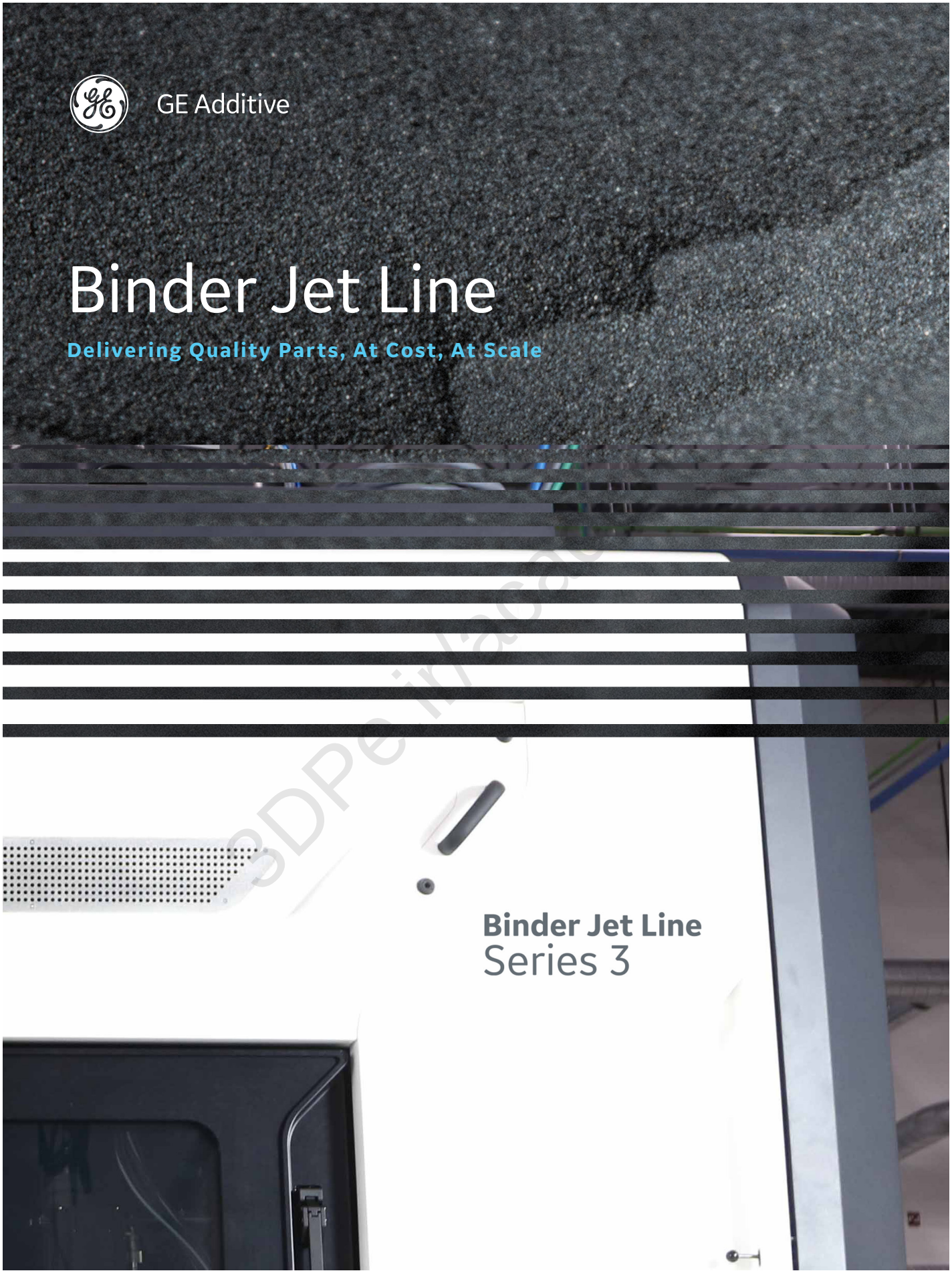
GE Additive

Binder Jet Line

Delivering Quality Parts, At Cost, At Scale



GE Additive's Binder Jet Line

How is GE's Binder Jet technolgy unique?

Binder Jetting Technology - Patented GE binder technology solves significant mass production hurdles:

- ✓ Print, depowder and sinter both small and large complex parts.
- ✓ Superior green strength enables higher yield, allowing for automation production processes.
- ✓ Closed-loop, inert material handling system was designed with high EHS standards in mind.
- ✓ Binder Jet can achieve material properties that conform to the rigorous requirements of highly regulated industries, like aerospace and automotive.
- ✓ GE Additive's proprietary binding agent contributes to clean, stable parts.

Hardware and Process – The Binder Jet Line was meticulously designed and tested for scaled throughput, high uptime, lower costs, safe production with minimal powder interaction and high-quality results.

Software - GE Additive's Amp™ software enables distortion management and control and helps simulate and compensate geometries for accurate final parts.

Consulting - Additive design expertise and consulting drives value of technology across customer products.

Experience – GE Additive's vast experience with metal additive production provides unique expertise for helping customers avoid pitfalls and get to production faster.

Engineered for scaled manufacturing of quality parts, with end-to-end process in mind ... not just a machine, but a production system.

How GE's Binder Jet Line addresses four critical business objectives:

1 Quality

- Achieve repeatable and reliable printing of complex small to large parts
- De-powder intricate parts without destroying fine features
- Sinter parts within the desired tolerances
- Develop high-quality parts faster using distortion simulation, management and control
- Print parts with low surface roughness

2 Cost

- Drive down product cost from powder to part in hand
- Spend less on raw material by recycling unused powder
- Enable low-cost, high-volume part production
- Open space for new applications and innovation
- Introduce new applications and innovations difficult or impossible to manufacture with other methods

3 Scale

- Achieve high productivity with automation-ready technology
- Print 100X faster than other additive manufacturing (AM) methods
- Minimize operator contact with machines and powders
- Integrate into factory cells for smooth operations

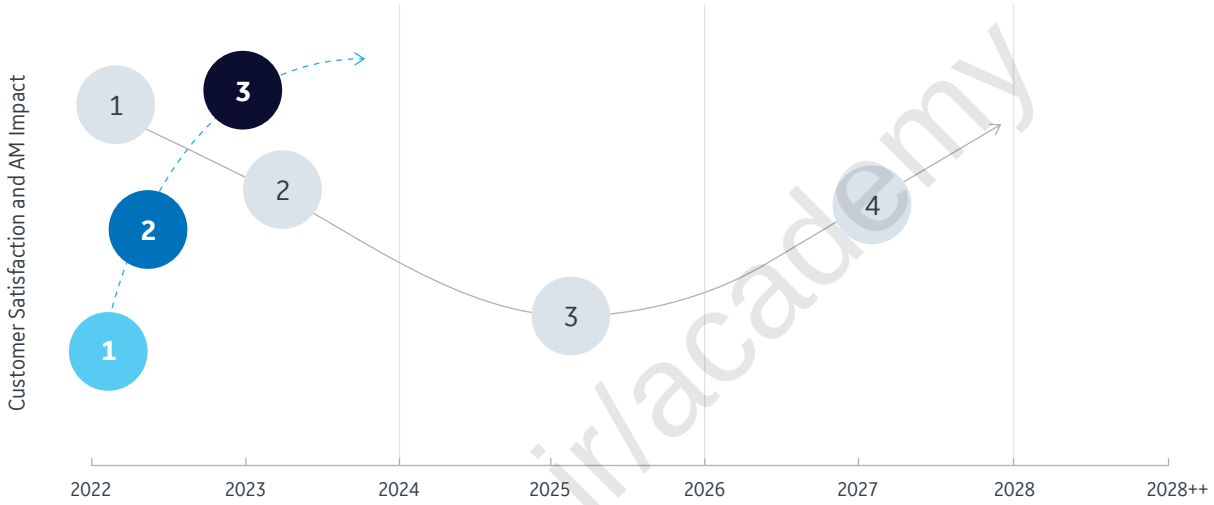
4 Safety

- UL and CE certification
- 100% inert and sealed environment
- Powder-free exposure
- Automation enabled
- Fully capable of reactive and flammable binders and powders
- Installation and operation without hazard zoning required

Additive partnership—where scale meets speed.

Getting to full production with additive can be a long journey with time often in short supply. With GE's Binder Jet Line, you can combine your business and technical expertise with our additive expertise to shorten your path to full metal additive industrialization from eight-plus years to three or less.

Partnerships accelerate industrialization

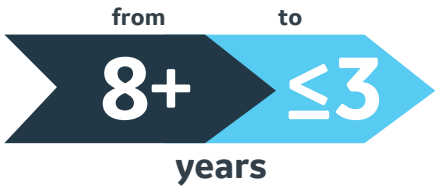


Partnership journey

1. Technology development
2. Qualify & LRIP
3. Production readiness

Individual journey

1. R&D/Experimentation
2. Low-risk, initial testing
3. Process refinement & production planning
4. Part qualification & ramp-up



With support from GE Additive

- Significantly reduce the timeline to full additive production
- Lower capital investments by leveraging GE's facilities, resources and intellectual property
- Drastically reduce risk by incorporating proven methodologies
- Scale operations seamlessly, internally or via outsourcing

Without support from GE Additive

- Undergo a steep, long learning curve to reach full production
- Front a considerable investment for resources and expertise
- Risk your business case and part decision failing during development
- Face unanticipated expenses and obstacles alone

Ready to get started? Let's tackle your top challenges.

Challenge 1

Proving ROI and building a business case

A short-term or part-focused business case often fails to capture the larger impact that additive can have on your business, limiting your ability to innovate and resulting in a perceived negative ROI .

GE Solution: Develop your business plan with a team of additive experts.

Our team collaborates with you to solve your toughest challenges and identify how AM can affect all areas of your business. We help you develop an ROI plan from powder to part that includes piece part cost, capital expenditures, operating expenses, and facilities layout and planning.

Challenge 2

Getting to full-scale production with Binder Jet

It's not as easy as installing a machine and pressing the print button. Reaching full-scale additive production involves careful design consideration, material and application development, business case execution at scale and much more.

GE Solution: Leverage AM industry knowledge and expertise throughout the process.

At GE Additive, we have a proven track record in scaling additive production. Here's how we can support you:

OEM partners:

- Identify, design and productionize specific applications at cost, quality, and needed scale.
- Support applications in production, meeting business cases, part specifications and material properties.
- Develop foundational skills so you can continue on your own.

Tiered suppliers:

- Specify application details to make the parts to quality, cost and scale.
- Establish baseline capabilities for part development.

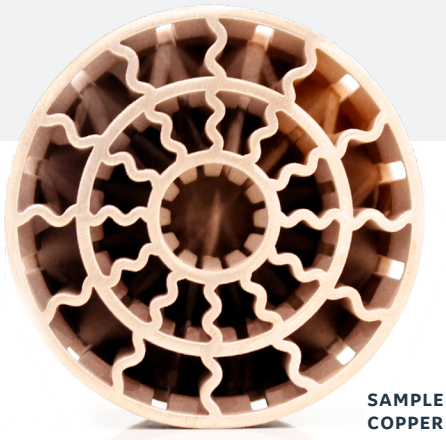
Challenge 3

Outsourcing part production

Many organizations want to achieve full-scale additive production, but producing additive parts in-house is not feasible for their short- or long-term strategy.

GE Solution: Partner with a supplier to produce your parts for the long term.

A service bureau with GE technology can support your AM ambitions by producing your parts for you. We can help lower investment and adoption timeline risks by leveraging GE Additive's facilities, resources and intellectual property.

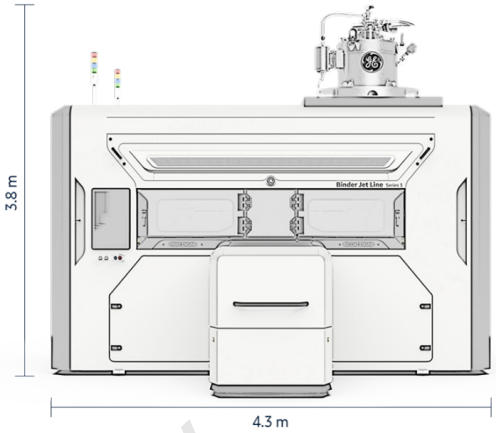


SAMPLE COPPER PART

Binder Jet Line Series 3

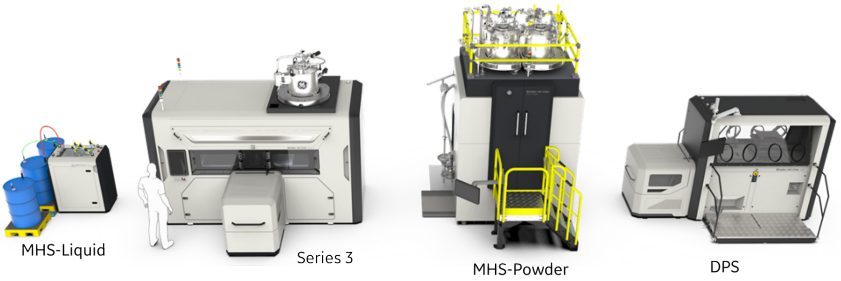
Technical Data

Build envelope	500 x 500 x 500 mm (x, y, z)
Max final part size (sintered at >99% density)	~420 x 420 x 420 mm (x, y, z); large part capability
Layer thickness	20 - 200 µm, 100 µm standard
Print speed	≤ 9,000 cc/hr at 100 µm layers; < 1 day to print full box
Resolution	Native 600 or 900 dpi, configurable
Powder Handling	Fully closed loop, inert capable; supplied automatically via MHS-Powder system
Liquid Handling	Fully closed loop, inert capable; supplied automatically via MHS-Liquid system
Sintering	Supplier agnostic, capability and profile recommended / supplied
Dimensional accuracy	Varies with geometry and sintering design; between CT7-9 post-sinter, CT6 or better as printed
Sintered Density	Fully dense, 99%+ capable
Changeover time	≤ 5 minute build box change out, with cold box preheat ≤ 30 minutes
OPCUA capability	Included, configurable
Power supply	400 VAC, independent ground leg
Air / Inert gas	Non-inert: Standard shop air Inert: Fully inert capable, either Nitrogen or Argon; includes full vapor capture capability
Dimensions	~4.3 x 4.1 x 3.8 m (W x D x H) with tunnels; ~4.3m x 1.7m x 3.8m without ~17.7 x 6.7 x 3.7 m full line footprint*
Environmental	Self-contained environmental control and isolation (30-40˚C +/- 2˚; RH/ Vapor <1% +/- 0.25%; 2-15mbar)
Certification	UL Listed (UL 2011), CE certified



Materials available**

- Stainless Steel 316L
- Stainless Steel 304L
- Stainless Steel 17-4PH
- Stainless Steel 441
- Copper C18000
- Tungsten Carbide
- Reactive alloy capable (not yet developed)



*MHS-Liquid, Series 3 printer, MHS-Powder, and DPS aligned in a cell, with ~3.7m forklift aisles. Excludes additional post-processing.
**Materials that have been developed on Series 2 Beta platform, core physics /print process fundamentally the same for Series 2 Beta and Series 3

GE Additive

Ready when you are.

To transform the way your business approaches today's toughest challenges.
To reimagine the shop floor and how you create products.
And cement a true competitive advantage.

With GE's Binder Jet Line, your company can shorten the path to metal additive industrialization and see the return on your investment faster.

Let's work together to overcome your AM challenges and build a fully realized additive factory floor fit for your business.

Let's go. Talk to GE today.
ge.com/additive/binderjet