

MELTIO

**Laser-Wire DED
Additive Manufacturing**

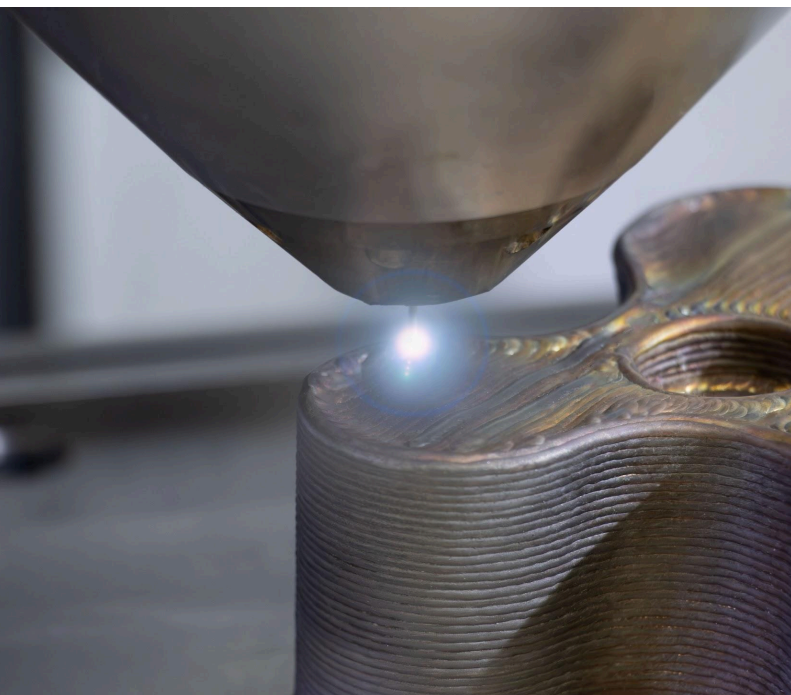
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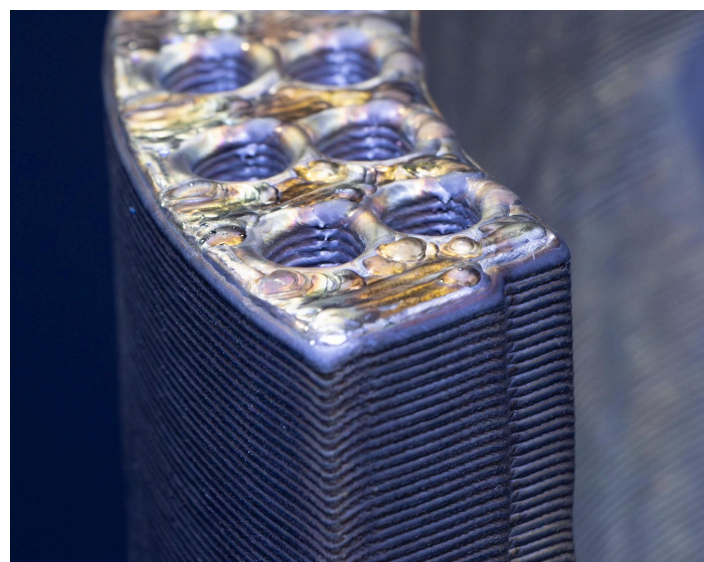
1. How it works, what it's for, and why you should consider Meltio

Metal additive manufacturing is no longer a novelty. In many industries, it is already a competitive requirement: **shortening lead times, enabling designs that reduce assembly steps, and unlocking repair strategies that keep high-value assets in service.** Yet for many organizations, the practical barrier has not been *“can we print metal?”* but *“can we print metal reliably, safely, and predictably enough to justify adoption and do it with materials and properties we can trust?”*

That is the problem Laser-Wire Directed Energy Deposition (DED) is designed to solve, and it is the reason Meltio's approach is relevant. Meltio's wire-based Laser Metal Deposition (LMD) platform focuses on what matters most when moving from a demo part to production: repeatability, density, mechanical performance, industrial transparency, and an ecosystem that supports qualification rather than trial-and-error.



This document explains how Meltio's Laser-Wire DED works, where it fits, and why it is often the right choice when you need metal AM that behaves like a manufacturing process, not an experiment.



2. Why Laser-Wire DED matters now

Many metal AM approaches deliver impressive results in controlled conditions, but are less convincing when you evaluate the full manufacturing reality: material handling, safety procedures, post-processing, property consistency, supplier qualification, and the cost of scaling. In practice, adoption succeeds when a technology can be explained and defended in three ways:

- **The process must be inherently stable and controllable.**
- **The outcome must be measurable and repeatable (density, defects, properties).**
- **The workflow must integrate with manufacturing (materials, machining, qualification).**

Meltio's Laser-Wire DED is built around those three principles. Meltio uses metal wire as feedstock and combines it with controlled laser energy to create dense metal parts with reproducible performance, while avoiding the operational complexity of powder handling and the material waste that often comes with powder-based systems. **The result is a process that aligns better with how real factories operate.**

3. In essence: What Meltio Laser-Wire DED is

In essence, Laser-Wire DED is a process in which a laser generates a controlled melt pool on a substrate while metal wire is continuously fed into that melt pool. By moving the deposition head along a programmed path, the system deposits and fuses successive beads, building a three-dimensional metal structure layer by layer.

What makes Meltio's implementation distinctive is not just that it uses wire; it is that Meltio designs the process as an integrated platform; laser architecture, sensing, process control, parameterization strategy, and material qualification are treated as one system. That platform orientation is what allows Meltio to talk about outcomes such as high density and mechanical performance in a way that is supported by defined methodologies rather than assumptions



4. How Meltio Laser-Wire DED works

The deposition mechanism

At the heart of the process is a controlled interaction between three things:

Energy input

(laser power and distribution)

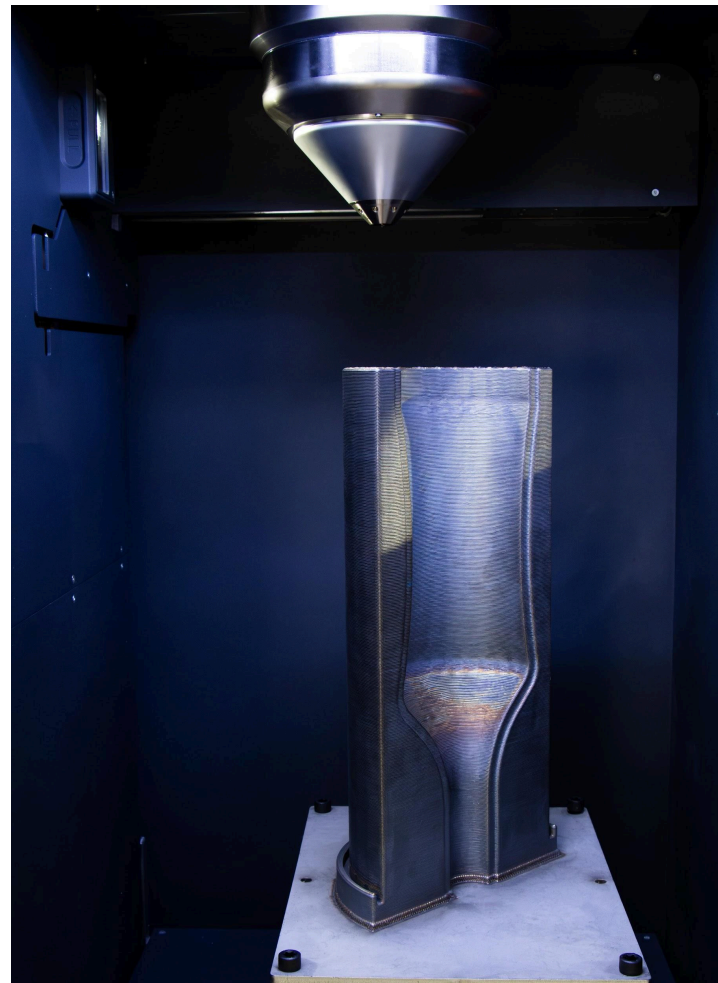
Material input

(wire feedstock flow and geometry)

Motion

(how the head moves relative to the part)

The laser provides the heat needed to form a stable melt pool. The wire is fed into that melt pool in a controlled manner. The motion system—robotic, CNC, or hybrid—moves the head so that beads overlap correctly, fuse fully, and create the intended geometry. Each new layer bonds metallurgically to the layer below, creating a continuous structure rather than a stacked assembly.



The system architecture

A Meltio Laser-Wire DED solution is not *“just a head”* or *“just a laser.”* It is a manufacturing product that typically includes:

- **A Meltio deposition head** with controlled laser delivery
- **Wire feeding hardware** tuned for stable material flow
- **Motion system integration** (robot, CNC, hybrid)
- **Meltio software workflows and validated print profiles** for different geometries
- **Process control mechanisms** that help preserve stability when conditions change (geometry, working distance, thermal accumulation)

This is important because in DED processes, the most expensive problems are rarely caused by a single parameter being wrong. They are caused by system interactions: thermal behavior changes with geometry, small shifts in working distance change bead formation, and minor material inconsistencies can be amplified over long builds. Meltio’s platform approach is designed to make those interactions visible and manageable.

5. Laser technology: Why wavelength and beam strategy matter

Many conversations about DED focus on laser power alone, but Meltio makes clear that wavelength and absorption are decisive, especially as you expand beyond steels and nickel alloys into reflective materials.

Meltio works with infrared and blue laser systems, and explicitly contrasts their wavelengths (blue around 450 nm and infrared around 976 nm) and the absorption implications for metals. Blue wavelength offers higher photon energy and, for many metals, improved absorption efficiency compared with infrared; one of the reasons blue laser architectures are relevant for materials like copper and aluminum that can be challenging in infrared.

Just as importantly, Meltio's approach is built around **multi-laser energy distribution**. Rather than relying solely on a single high-power source, Meltio uses a matrix of multiple beams arranged to approximate a more uniform (*“top-hat-like”*) energy distribution within the spot. A more uniform distribution helps stabilize the melt pool and supports repeatable bead geometry, two factors that directly affect density and mechanical performance.

In market terms, this matters because it reframes the conversation from:

“How much power do you have?” to “how consistently can you deliver the energy your material and geometry require?”

6. Process control the way manufacturing needs it: Energy density and stability

One of the strongest differentiators is how Meltio explains process control: not as a mysterious “*black box*,” but as a structured engineering and scientific relationship.

Energy density as the governing variable

Meltio uses energy density (**expressed as J/mm^3**) as a practical way to link process inputs (laser power, layer geometry, speed, and material volume) to outcomes. Energy density is not the only physics involved, and those values are not directly extrapolable across different materials, but it is still a powerful unifying metric to describe why parts become porous, why lack of fusion occurs, and why too much energy can destabilize the process.

Process bands: Turning “trial and error” into a selection framework

Instead of simply listing recommended settings, the handbook groups outcomes into three process bands:

Low energy density	(high speed) with the risk of a lack of fusion and serious defects
Medium energy	where parts generally perform well but may show minor defects that can affect fatigue
High energy density	where parts can be fully dense and defect-free under high-resolution inspection, at a controlled speed, and in a reliable way

This is a market differentiator because it gives customers a vocabulary to choose: *“Do we prioritize maximum throughput for noncritical features, or do we prioritize fully dense builds for structural integrity?”* Meltio’s framework makes those trade-offs explicit and measurable.

Real-time process control: Continuity and working distance

DED processes depend on consistent wire delivery and correct interaction between the head and the melt pool. Meltio describes process control as detecting loss of continuity between the deposition head and the substrate and dynamically adjusting material flow to restore stable conditions. It also identifies common activation scenarios (too high energy density, incorrect or increasing working distance, excessive overhangs) and practical corrective actions (adjust energy density, use working distance routines, adjust material flow, review design suitability).

That matters because it is the difference between *“the operator notices something went wrong”* and *“the process is designed to remain stable and recover.”*



7. Materials: Open platform, real wire, and controlled freedom

A frequent adoption barrier in metal AM is material lock-in. A different barrier is the opposite: a system that claims openness but leaves customers alone to solve qualification and reliability.

Meltio positions Meltio's LMD technology as an **open material platform** that enables customers to use readily available welding wire while also offering Meltio-supplied, validated materials with ready-to-use parameters integrated into Meltio software.

It emphasizes that Meltio Materials are fully validated and optimized for Meltio systems, and that the process can deliver high-density parts with

“Zero material waste. 100% of the deposited material is used in the final part.”

The differentiation here is “open, but not uncontrolled.” Meltio supports experimentation while also providing a fast path to industrial reliability.

Printability is treated as a material-physics question

Meltio doesn't treat printability as a guess. It explicitly calls out why materials become difficult: reflectivity at the laser wavelength, oxidation affinity, thermal conductivity, melting temperature, and cracking tendency. It provides a printability-oriented view of material families (steels and nickel alloys are easier; aluminum and copper are more difficult; titanium oxidation sensitivity) and explains why.

That framing is important: It shows Meltio's technology positioning is grounded in thermodynamics and metallurgy, not marketing.

8. Qualification and transparency: The fastest route to trust

The single most convincing market message is that Meltio treats qualification as a structured process with defined gates, metrics, and standards references, because that is how industrial buyers make decisions.

Meltio's phased characterization methodology

For the Blue system, Meltio describes a four-phase qualification workflow: printability, bulk density verification (including CT and hardness), structural properties (tensile, hardness after heat treatment, metallography), and advanced properties (fatigue/impact and chemical analysis depending on the material). For infrared systems, the methodology is similarly staged, with phases designed to identify optimal parameters and validate performance.

The handbook also explains verification procedures: using simple geometries for defect analysis, penetrant liquid testing, micrography/metallography, and acceptance criteria aligned to NASA-STD-6030 porosity guidance for dense builds.

This matters because it answers the customer's real question: *"How do you know these parameters are production-worthy?"*

TRL classification: Credibility through clarity

Meltio applies a Technology Readiness Level classification to materials, translating the 1–9 TRL scale into Meltio Explore, Develop, Qualified, and Proven. Some materials (notably copper and aluminum) are still in validation and optimization phases for certain build types and sizes, while steels, nickel alloys, and titanium are at higher readiness levels.

This is not a weakness; it is a differentiator. Many vendors avoid maturity transparency.

**Meltio uses it to build trust and to help customers
make correct process choices.**

9. Performance you can plan around: Density, deposition rates, and properties

A convincing manufacturing technology is not one that prints a sample; it is one that lets you estimate time, cost, and risk.

Density and defect outcomes

Meltio frames density outcomes as an explicit target and provides process-band guidance and verification methods. It also highlights that Meltio testing targets very high densification (with examples of densities above 99.75% and up to higher values in specific cases) and uses CT scanning and metallography where appropriate.

Deposition rate transparency

Meltio publishes deposition rates (kg/h and cc/h) across materials and across laser configurations (**infrared, blue 1.0 kW, blue 1.4 kW**), including solid and hollow profiles. It even summarizes relative performance improvements between configurations.

This is rare in the market and is extremely practical. It enables realistic production planning instead of optimistic assumptions.

Mechanical properties in context

Meltio documentation provides reference comparisons to conventional manufacturing standards (cast and wrought) and reports mechanical properties for both blue and infrared systems. It clearly positions Meltio results as favorable compared to cast standards and, in many cases, approaching wrought properties, with explicit cautionary notes and an emphasis on referencing third-party lab analysis where applicable.

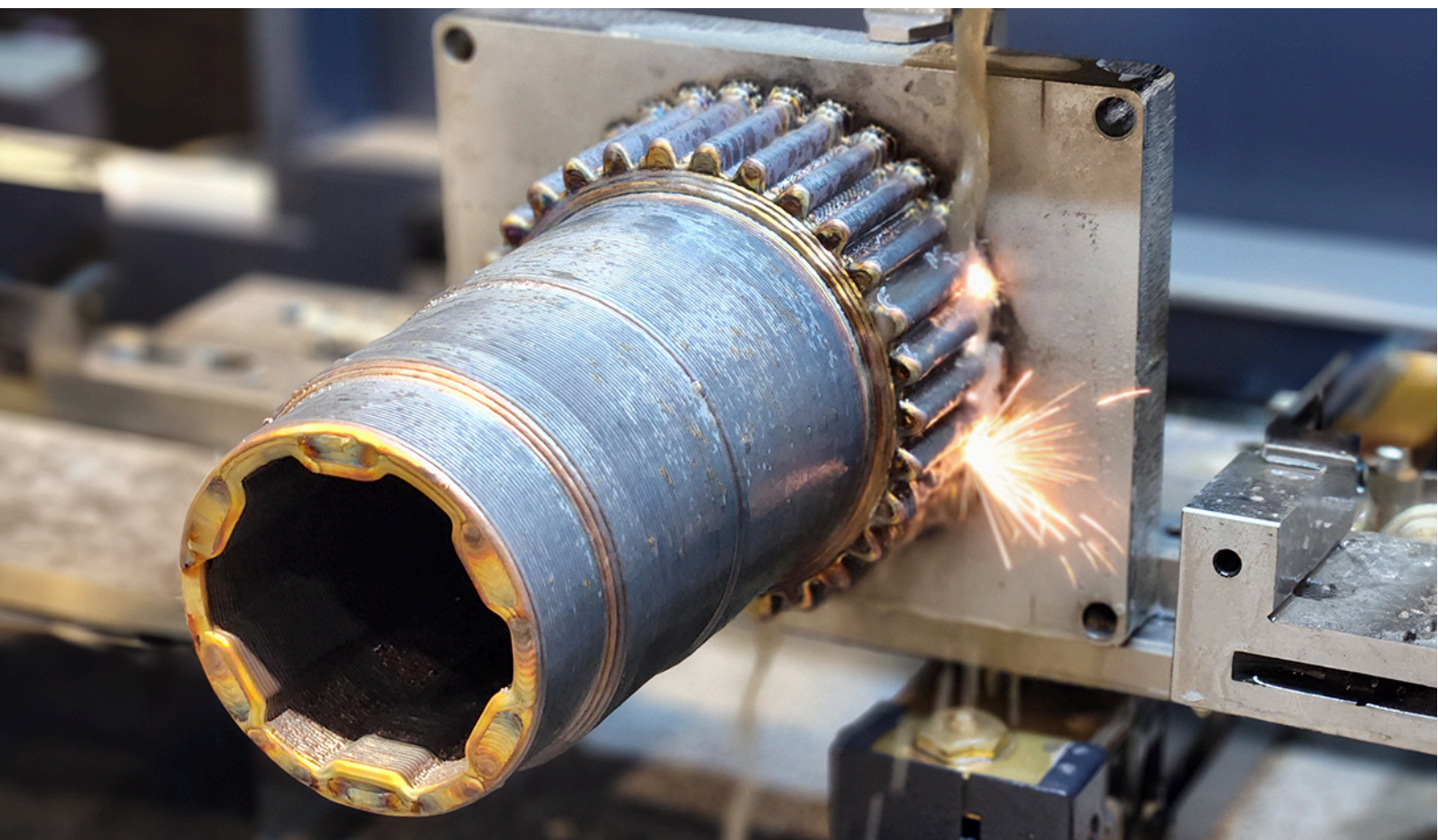
Again, the differentiator is that Meltio does not rely on vague “*strong parts*” statements; **it frames performance relative to recognized benchmarks.**

10. Geometry-aware manufacturing: Why Meltio is more than “a parameter set”

One of the most practical advantages is how Meltio treats geometry as part of the process of physics.

It distinguishes parameterization strategies for solid parts versus hollow parts, and it treats perimeter count as a meaningful manufacturing variable (1P vs 2P vs ≥ 3 P behaving effectively like solid strategies). It introduces the aspect ratio (height/width) of deposited beads as a stability metric and explains why minimum layer time and cooling strategies matter, especially for thermal accumulation-sensitive materials.

This is a major difference from the “*one profile fits all*” mentality. Geometry changes heat flow; heat flow changes microstructure; microstructure changes properties. Meltio’s documentation makes that chain explicit, and that is how a technology convinces engineers.



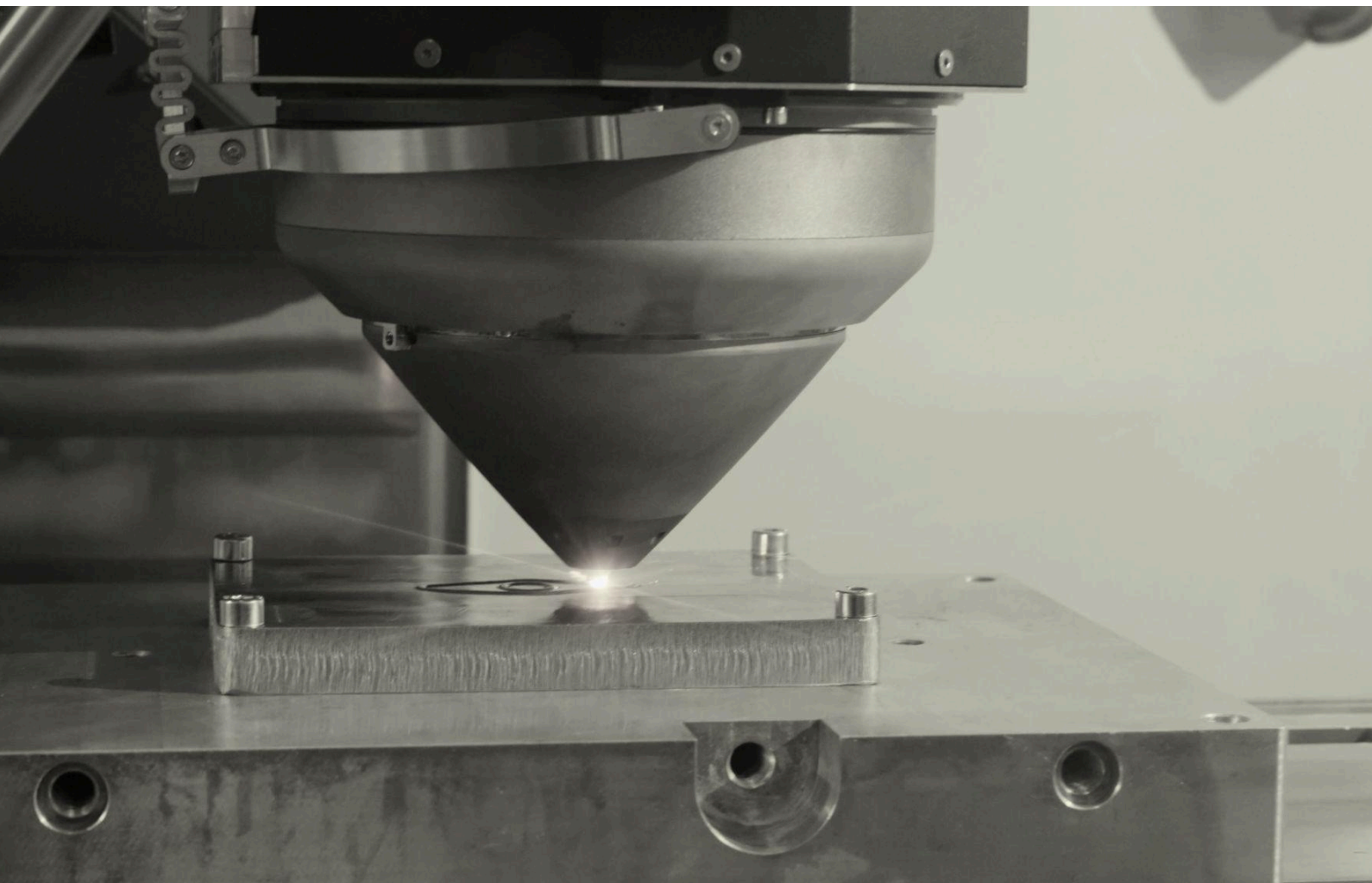
11. Hybrid manufacturing and post-processing: Thinking like a factory

Manufacturing adoption isn't just printing. It is machining, heat treatment, tool wear, and controlling distortion and residual stress.

Meltio documentation includes a clear discussion of post-processing and heat treatment logic: when stress relief is performed, when treatments are needed to improve properties, and how cost scales with part size and process type.

It goes further by discussing how cooling strategies influence hardness, ductility, and tool wear in hybrid systems, and it provides practical recommendations (avoid liquid refrigerants during printing; use controlled cooling to room temperature or compressed air strategies depending on needs).

This is important because it shows Meltio understands downstream reality. A platform that ignores machining and thermal strategy cannot credibly claim production readiness. Meltio explicitly connects additive process decisions to subtractive outcomes.



12. What Meltio Laser-Wire DED is for

When you put these pillars together, Meltio Laser-Wire DED becomes especially compelling for:

- **Industrial production of near-net-shape metal parts**, where material utilization and machining reduction matter.
- **Repair and remanufacturing**, where you need strong bonding to substrates and controlled deposition.
- **Hybrid manufacturing workflows**, where additive and machining coexist and a thermal strategy must be managed.
- **Applications requiring known density and predictable properties**, supported by a qualification framework.
- **Organizations that need material flexibility**, but also want validated, ready-to-use profiles to minimize risk.



Meltio's differentiation is that it reduces the risk in a structured way:

Wire feedstock	Improves operational safety, stability of material flow, and eliminates powder waste; Meltio emphasizes that deposited material becomes the part, enabling zero waste in deposition terms.
Laser architecture choices	(including blue wavelength capability and multi-laser energy distribution) Expand printable materials and improve process efficiency and stability.
Energy density and process bands	Provide a manufacturing language for balancing speed versus quality, and tie parameterization to measurable outcomes.
Process control and advanced options	Hotwire is treated with engineering discipline, including when and how to apply them to protect stability.
Material qualification	Is a defined methodology, not a claim, supported by staged testing, inspection, and mechanical validation paths.
TRL transparency	Makes material maturity explicit, enabling informed industrial adoption rather than surprises.
Deposition rates and mechanical references	Are published, enabling realistic planning and comparisons to casting and wrought benchmarks.
Geometry-aware parameterization and hybrid manufacturing guidance	Reflect a process designed to be deployed in real production environments.

When a technology can explain itself this way—through system design, measurable outcomes, and disciplined qualification—it becomes easier to justify adoption internally, easier to scale, and easier to defend in front of quality, operations, and management stakeholders.

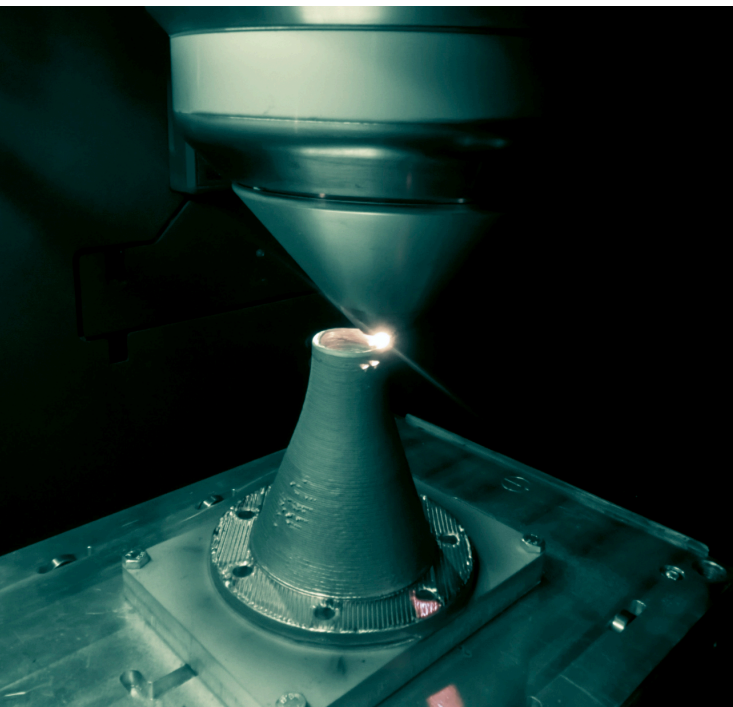
14. How Meltio compares to other metal additive manufacturing technologies and when it is the right approach

Most established metal additive manufacturing technologies—such as powder bed fusion, direct metal laser sintering, electron beam melting, and related powder-based processes—offer well-known advantages. They enable high geometric complexity, fine resolution, and good repeatability for relatively small, highly detailed parts. For many applications, particularly in tooling inserts, medical devices, and small precision components, these technologies are an excellent solution.



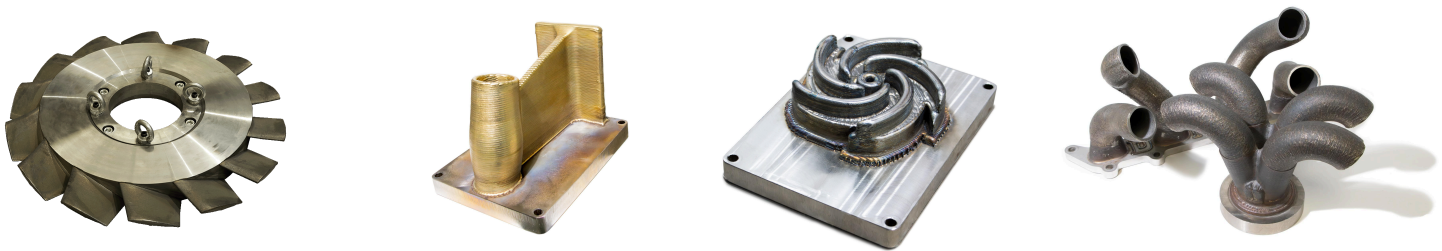
Limitations of powder-based additive manufacturing become increasingly apparent. Build volumes are constrained by machine envelopes; material costs rise sharply, especially for reactive or exotic alloys; powder handling introduces safety, contamination, and oxidation concerns; and scaling production often means long qualification cycles and high operational complexity. In addition, maintaining consistent mechanical properties across larger builds or repaired regions can be challenging due to thermal accumulation and process instability.

Wire-based laser DED, as implemented by Meltio, represents a distinct and deliberate approach that balances flexibility, control, and industrial practicality.



Meltio's Laser-Wire DED technology combines the precision and controllability of a laser heat source with the inherent advantages of solid wire feedstock. Unlike powder-based systems, the wire is fully consumed during deposition, resulting in **zero material waste, improved operational safety, and simplified material logistics**. Different from arc-based wire processes, the laser provides **more localized and controllable heat input**, enabling higher resolution, better surface quality, and improved control of microstructure and mechanical properties.

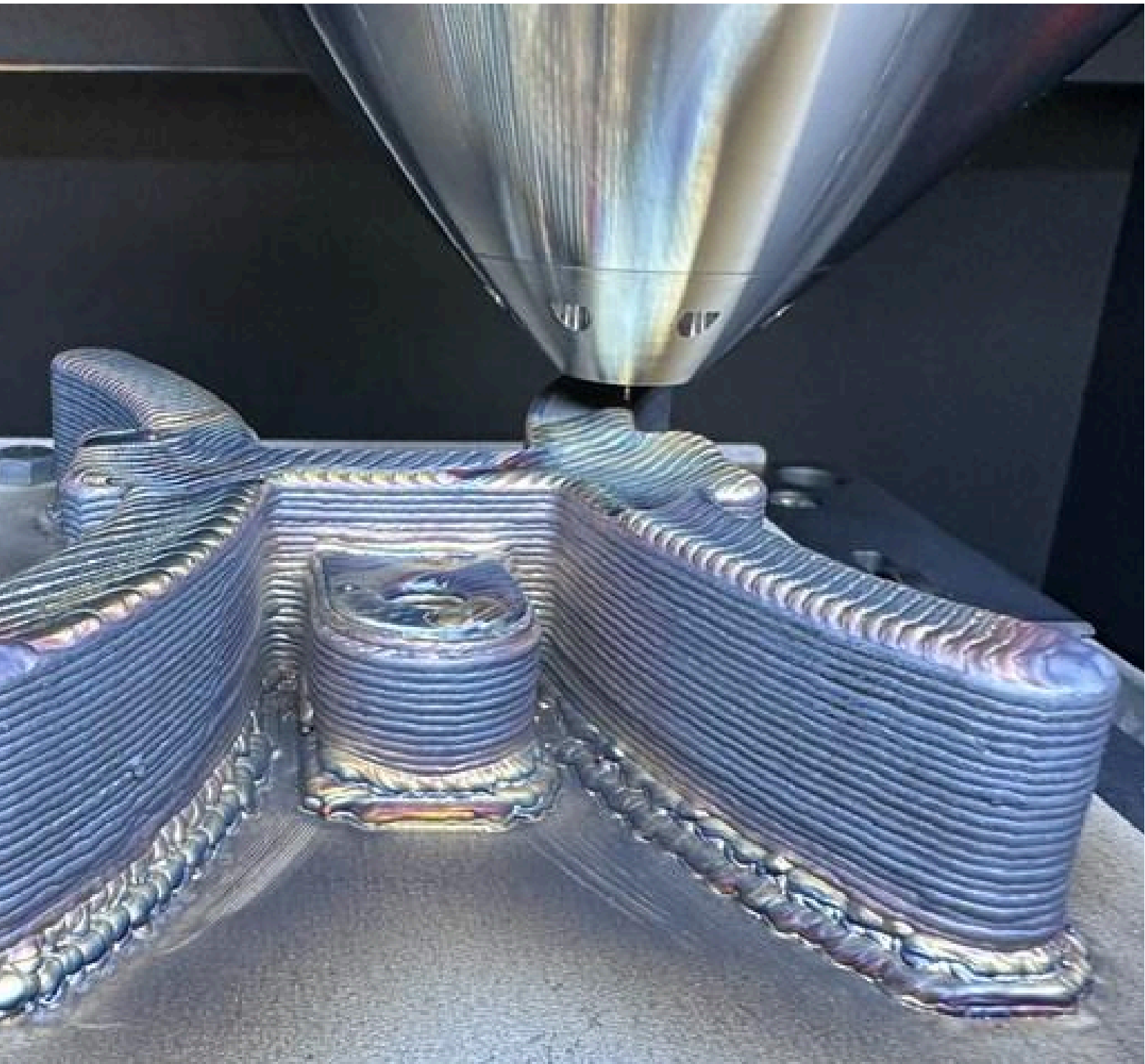
This makes Meltio particularly well-suited for applications where part size, material efficiency, and predictable performance are more critical than ultra-fine feature resolution. Typical use cases include near-net-shape production of medium and large metal parts, structural reinforcements, tooling and molds, component repair and remanufacturing, and hybrid manufacturing workflows where additive deposition is combined with CNC machining.



Compared with traditional manufacturing routes such as forging, casting, and subtractive machining, Meltio offers a compelling alternative. Forged components often involve lead times measured in many months, followed by extensive machining. Casting introduces tooling costs and limits design flexibility, while subtractive machining from billet generates significant material waste and is increasingly exposed to supply-chain constraints and skilled-labor availability. Meltio's Laser-Wire DED reduces lead times from months to weeks or days, minimizes material waste, and enables designs that would be impractical or uneconomical using conventional methods.

Crucially, Meltio's approach is not positioned as a replacement for all manufacturing technologies, but as a **complementary process** that fills a critical gap between high-resolution powder-based AM and large-scale traditional manufacturing. It is the right approach when parts are too large, too material-intensive, or too time-critical for powder bed systems, and when higher precision, better control, or cleaner operation is required than arc-based deposition can provide.

In this context, Meltio's Laser-Wire DED stands out not simply because it can print metal, but because it does so with a level of **process control, material transparency, and industrial discipline** that makes it suitable for real production environments. It is this balance—between flexibility and control, openness and qualification, innovation and manufacturability—that defines why Meltio is the right technology for organizations looking to adopt metal additive manufacturing with confidence.



15. Where Meltio fits: Competing with AM technologies and replacing traditional manufacturing where it makes sense

Metal manufacturing today sits at the intersection of two worlds: established conventional processes such as machining, casting, forging, and tooling, and a growing set of additive manufacturing technologies that promise greater flexibility and shorter lead times. Each approach has strengths, but also clear limitations when evaluated from an industrial, production-oriented perspective.

Meltio's Laser-Wire DED technology has been developed specifically to address the gaps left by both traditional manufacturing and existing metal AM solutions, positioning it as a **practical alternative where scale, material efficiency, and predictable performance matter most.**

Against Powder Bed Fusion (PBF)

Powder Bed Fusion technologies excel at producing small, highly detailed parts with fine surface resolution and complex internal features. For applications that fit within compact build volumes and justify the cost and complexity of powder handling, PBF remains a strong option.

However, PBF systems are inherently constrained by **machine envelope size, high material costs, and powder-related operational complexity**, particularly when scaling part size or transitioning from prototyping to production. Build interruptions, powder recycling, safety protocols, and long qualification cycles can significantly increase both cost and risk.

Meltio is not intended to replace PBF where ultra-fine resolution is required. Instead, it becomes the preferred approach when parts grow beyond the practical limits of powder beds, when near-net-shape manufacturing can dramatically reduce machining time, or when repair, feature addition, or hybrid manufacturing are required.

By using wire feedstock and an open deposition environment, Meltio enables larger components, lower material waste, and simpler industrial integration without the constraints of sealed chambers or powder logistics.

Against Powder-Based DED

Powder-Based DED systems extend build volume and enable repair applications, but they retain many of the drawbacks associated with powder: low material utilization efficiency, overspray losses, contamination risks, oxidation sensitivity, and complex handling requirements. Achieving consistent density and mechanical properties across larger builds can also be challenging due to variability in powder flow and melt pool stability. Meltio's Laser-Wire DED directly addresses these limitations.

Wire feedstock offers near-100% material efficiency, eliminates overspray, and provides a more stable and predictable material input into the melt pool.

This improves process repeatability, reduces operating costs, and simplifies material qualification. As a result, Meltio is particularly well-suited for industrial users who want the flexibility of DED without the operational burden and waste inherent to powder-based systems.

Against WAAM (Wire Arc Additive Manufacturing)

Wire Arc Additive Manufacturing has proven its value for very large structures and high deposition rates, particularly in heavy industries. However, arc-based processes typically involve **higher heat input, larger melt pools, and lower geometric resolution**, which can lead to increased distortion, rougher surface finish, and greater reliance on post-machining. Controlling microstructure and achieving consistent mechanical properties—especially for smaller or more detailed parts—can also be challenging.

Meltio occupies a complementary position between WAAM and powder-based technologies.

By using a laser heat source instead of an electric arc, Meltio achieves more localized and controllable energy input, enabling better dimensional control, improved surface quality, and finer feature resolution.

While still retaining the scalability and wire-based efficiency that powder systems lack, this makes Meltio the right choice when WAAM is too coarse or thermally aggressive, but powder-based AM is too constrained or inefficient.

Against traditional manufacturing: machining, casting, forging, tooling, and molds

Perhaps the most significant impact of Meltio's Laser-Wire DED is its ability to compete directly with conventional manufacturing routes in specific, high-value scenarios.

Forged components often involve lead times exceeding many months, followed by extensive rough and finish machining. Casting requires tooling, limits design flexibility, and can be difficult to iterate. Machining from billet generates large amounts of waste material and becomes increasingly costly and supply-chain dependent for large or complex parts. Tooling and molds, meanwhile, are expensive to modify, repair, or customize once manufactured.

Meltio provides a fundamentally different approach. By enabling near-net-shape manufacturing, feature addition, and repair, it reduces material waste, shortens lead times from months to weeks or days, and enables designs that are impractical or uneconomical using traditional methods. In tooling, molds, and repair applications, Meltio allows material to be added only where needed, extending component life and reducing the total cost of ownership.

Meltio is not positioned as a universal replacement for traditional manufacturing.

Instead, it is a strategic manufacturing tool, the right approach when **flexibility, speed, material efficiency, and controlled mechanical** performance offer clear advantages over subtractive or forming-based processes.

16. The right technology for the right manufacturing problem

Meltio's Laser-Wire DED competes most effectively where **powder-based AM becomes inefficient, WAAM becomes too coarse, and traditional manufacturing becomes too slow, wasteful, or inflexible**. It is particularly well-suited for organizations seeking to industrialize metal additive manufacturing without inheriting the complexity, safety burden, or uncertainty that often accompanies other approaches.

By combining wire feedstock efficiency, laser-based process control, open material flexibility, and a disciplined qualification methodology, Meltio delivers a balanced and pragmatic path to metal additive manufacturing, one that aligns with real production needs rather than laboratory demonstrations.

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