Arcam provides a cost-efficient Additive Manufacturing solution for production of implants. Arcam’s EBM® technology is used for production of FDA-cleared and CE-certified orthopedic implants.

Since 2007 EBM-manufactured acetabular cups with Trabecular Structures™ for improved osseointegration have been implanted. EBM is also used for production of augments, femoral stems and spinal cages.

Arcam is an innovative partner for manufacturing in the orthopedic implant industry, where we deliver customer value through our competence and solution orientation.
Arcam’s Electron Beam Melting technology is the ultimate solution for additive manufacturing of orthopedic implants. The Arcam EBM® process is particularly useful for cost-efficient production of high volume press-fit implants with advanced Trabecular Structures™ as well as one-off custom implants built with data derived from CT-scans of individual patients.
Inside the Arcam EBM® process

Something totally different

Arcam has designed the EBM process specifically for cost-efficient production of orthopedic implants. The implants are built up layer-by-layer of metal powder, melted by a powerful electron beam. Each layer is melted to the exact geometry defined by the 3D CAD model.

The Arcam EBM machines are equipped with a high power electron beam gun that generate the energy needed for high melting capacity and high productivity. The electron beam is controlled by electromagnetic coils which allows for an extremely fast and accurate beam control. The Arcam production platforms are capable of delivering a beam power of 3000 W and a scan speed that allows several melt pools to be maintained simultaneously - Arcam EBM MultiBeam.

The vacuum system is designed to maintain a controlled vacuum level of $1 \times 10^{-5}$ mbar, throughout the entire build cycle. The vacuum environment eliminates the risk of oxidation of the built material and secures state of the art material properties.

In the medical field there are two obvious areas of special interest, cementless standard implants with advanced Trabecular Structures - Engineered Porous Materials and patient-specific (custom) implants based on CT-data. Today there are a large number of CE-certified and FDA cleared implants on the market produced by the Arcam EBM process. These products include primary and revision hip implants such as acetabular cups and augments as well as spinal implants.
EBM benefits

Paradigm shifts

The benefit with the Arcam EBM process should be seen from two perspectives. First, it is a cost-efficient production alternative to conventional casting and machining. Secondly, and more important, it opens up a world of opportunities for product differentiation. Due to the inherent freedom in design, the EBM process offers completely new opportunities for product differentiation and development of new trademarked trabecular structures.

Further benefits with EBM production of press-fit implants:
- Single step production of solid and porous sections (Trabecular Structures)
- Structural continuity between solid and porous sections
- All-porous implants possible (augments, wedges, blocks, etc)
- Advanced Trabecular Structures achieved without grain growth in base material

Standard implants

The EBM technology is a cost-efficient process for manufacturing both press-fit implants and cemented implants. For press-fit implants specifically, the EBM process lends itself for high volume production. Solid and porous sections of the implant are built in one process step, eliminating the need for expensive secondary processes for applying traditional porous materials.

Trabecular Structures™ – Engineered Porous Materials

The EBM technology offers a unique opportunity to design and manufacture your own trademarked trabecular structure designs. When choosing the EBM technology for manufacturing you set yourself free from design constraints you normally have to consider due to limitations of traditional technologies for building porous materials.

Through the freedom in design offered by the EBM process you may develop a trabecular structure design in a CAD environment with a minimum of capital investment and a virtually total freedom in design. To achieve the properties you look for in terms of osseointegration, primary fit etc you may optimize your design in terms of:
- Pore geometry
- Pore size
- Relative density
- Roughness
- Structure thickness

Custom implants – CAD to Metal®

The EBM-technology offers a direct CAD to Metal process allowing production of patient-specific implants using data derived from Computer Tomography (CT). The CT data is used to create an exact CAD model of the desired implant. This CAD model is then used by the EBM machine to build the actual part.
The EBM Roadmap
From concept to production

The Arcam application specialists are available for you to support your product idea, through the R&D process to product release, and in your ongoing production.

1. Design Phase
In the design phase of a new orthopedic implant Arcam offers support to:
- Optimize build parameters i.e. to achieve the desired trabecular structure properties and appearance
- Generate timely prototypes for design iterations
- Simulate production runs and develop ROI calculations
- Support your product certification process (CE and/or 510k approval under FDA regulations)

2. Setting up a production case
While setting up your production case Arcam offers support to:
- Optimize build strategy, e.g. stacking of parts for optimal productivity
- Optimize build parameters for highest possible productivity
- Supporting the process validation with EBM-specific validation guidelines
3. In Production

Due to the high build speed, high repeatability and excellent material properties the EBM process is well suited for volume production. Arcam provide a number of tools to support volume production.

- Production-specific user interface fulfilling FDA requirements
- Layer verification capable of identifying any defect down to 100 μm
- EBM LogStudio for analyzing each build
- EBM Build Report to verify the success of each build
- Integration with Streamics software

Cad environment
Optimize your Trabecular Structure design for:
- Pore geometry
- Pore size
- Relative density
- Roughness
- Structure thickness

Apply your trademark Trabecular Structure design to the actual implant design.

Prototyping and design verification
Build prototypes for evaluation, testing and design iterations.

Pre-production of implants for product certification and process validation.

EBM production
Volume EBM production
EBM materials

Way beyond average

Meeting established standards for material properties is important for any industrial application, for orthopedic implants it is crucial. Arcam is committed to ensure first-class material properties on all released materials.

EBM-built materials have excellent material properties verified by static and dynamic testing of mechanical properties, chemical composition, detailed analysis of microstructures and biocompatibility studies. Arcam has developed the EBM technology for the following materials, each complying with applicable material standards for medical devices.

- Titanium Ti6Al4V
- Titanium Ti6Al4V ELI
- Titanium Grade 2
- Cobalt-Chrome, ASTM F75
Production equipment

Machines and more

Arcam offers a complete portfolio of equipment, software, metal powders, service and training.

The Arcam Q10

The Arcam Q10 is the 3rd generation EBM machine, optimized for cost-efficient production of orthopedic implants. It is a robust and reliable production equipment featuring many technical innovations that contribute to the state-of-the-art productivity, surface finish and user friendliness.

Features include:
- Arcam EBM MultiBeam for high surface finish in combination with high build speed
- Active cooling and insulated powder bed for fast builds and high productivity
- Layer verification system ensuring build quality

Auxiliaries

In addition to the EBM machines Arcam offers explosion-protected vacuum cleaners, powder handling trolleys and powder recovery systems as part of our standard offer. The Arcam Powder Recovery System (PRS) is designed to minimize manual intervention and includes powder sieving for efficient powder recycling.

Powders

Arcam has a validated powder supply chain with full traceability of every powder batch delivered. All powders supplied by Arcam are extensively tested before release to customers which includes making sure the EBM parameter settings (Process Themes) are optimized to work well with the powders.

Service and maintenance

Arcam offers support agreements to ensure the performance of the machine throughout its lifetime. Arcam’s service agreements include spare parts, updates, phone/mail support, emergency support and regular visits for preventive maintenance by our highly qualified field service engineers. Arcam’s support organisation ensures that you get the best possible output from your EBM systems.

Training

Arcam offers basic training packages as well as advanced training packages for customers who require more in-depth EBM knowledge, or where the applications require special training.