



EXTRUDE
HONE®

New applications, new challenges for the ECM Technology

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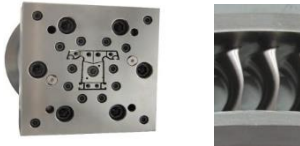
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Company presentation - Extrude Hone Technologies



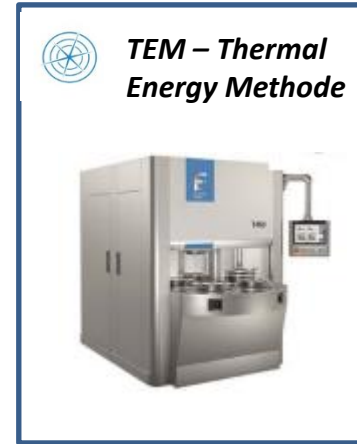
...Material removed by abrasive action created by an pressurized high viscosity abrasive Media



...Flow calibration Technology using low viscosity media which correlates to Calibration oil



...Material removed by dissolving the material using DC Energy



... Material (burrs, particles) vaporized



Application areas for compressor with air bearings

O₂ - Compressor for fuel cells

- 2030 > 4 Mio. fuel cell vehicles
- each vehicle approx. 3 compressors (truck)
- oil free oxygen feed

Compressor for refrigerant circuit

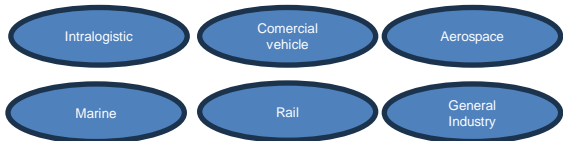
- smaller space
- higher efficiency
- less weight
- higher lifetime
- silent

Gas agitation/gas recovery

- smaller space
- contamination free operation

Misc. Applications

- Additive Manufacturing
- Clean Air Applications
- etc.

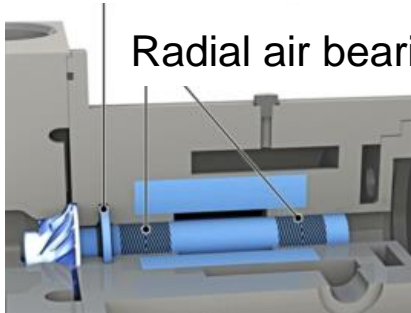




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Comparison of established manufacturing technologies

Axial air bearing



(2 x radial & 2 x axial air bearing required / compressor)

Manufacturing Technologies – State of the ART

- Fs (Femtosecond) Laser – High Investment, long processing time
- Etching – not suitable for mass production, long processing time
- HSC-Milling – expensive, long processing time, additional deburring process required

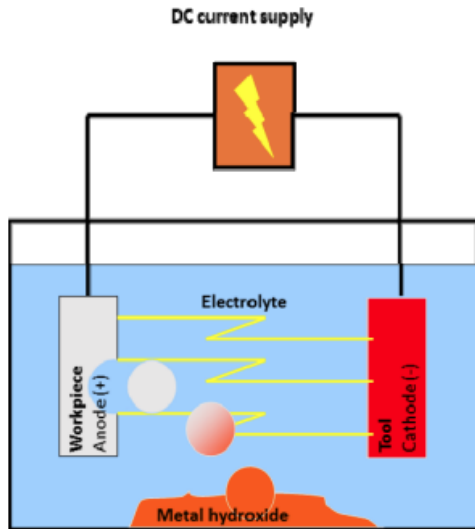
Advantages of microstructures by Extrude Hone ECM

- Short processing time
- Manageable Investment
- Low cost per part
- No secondary burrs
- High dimensional accuracy (removal, volume, roughness)
- Etc.

Extrude Hone – Products

- Contract Shop (also for small series, prototypes, pre-series production, etc.)
- ECM Machines
- ECM Fixtures

Process – Microstructures with ECM



- Electrolytic machining (ECM) is a subtractive method that works on the principle of anodic metal dissolution.
- It is driven by an external DC power source.
- An important feature of the ECM method is the lack of contact between the tool (-) and the workpiece (+)
- The shape of the tool cathode determines the shape of the removal. ECM is also an imaging method.
- An electrolyte solution (NaCl or NaNO₃) handles charge transfer in the working gap. The resulting electron current releases metal ions from the workpiece.
- The technology follows the law of Faraday, which says, that removed material is in relation to the flown charge (= electricity x time). Therefore, the technology is easy to be controlled and managed.
- The removed material comes out as a hydroxide, is rinsed out of the gap by the flow of electrolytes and must be removed from the electrolytes by an appropriate separating device.

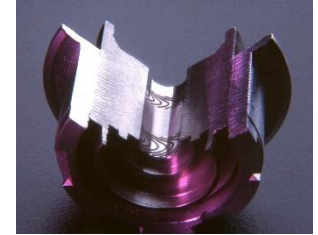


Process – Manufacturing of microstructures with ECM

ECM from Extrude Hone is used since decades for the manufacturing of microstructures of fluid dynamic bearings

Advantages of the ECM-Technology

- **Highest Productivity**
 - Multiple parts / cycle possible
 - Multiple features per workpiece / cycle
 - Very short processing time (sec. vs min.)
- **Flexibility**
 - Independent of the material
 - Inside, outside, radial, axial, etc.
 - Structure of cathode reproduces the negative in workpiece
- **Precision**
 - Accuracy with regards to geometry & volume can be easily reproduced
 - Manufacturing possible on selective areas
 - Structures in the area of a couple of μm up to $100\mu\text{m}$ possible
 - Volume deviation from part to part of $<10\%$



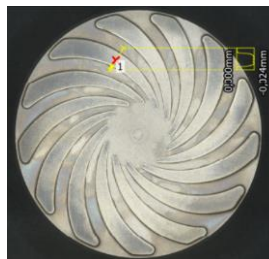


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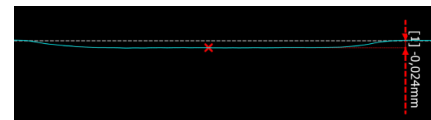
Sample Part

- Processing time: around 30s
- Shut off by Idt (Therefore, high repeatability with regards to volume)
- Depth of contour: 25µm with $\pm 2\mu\text{m}$
- Number of contours: 14
- Current Consumption: 240A pro Piece
- Roughness Ra < 0,2µm
- Roughness Rz < 0,8µm
- Sample Part Material: Stainless Steel

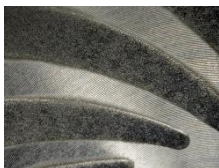
Measurement contour depth



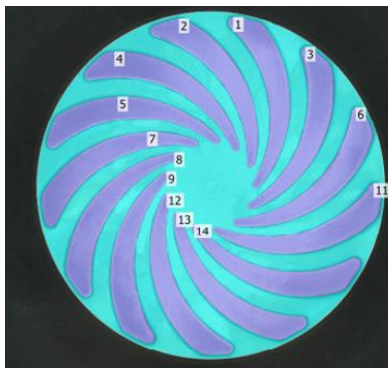
Nr.	Name	Value	Unit
1	Depth1	-0,024	mm



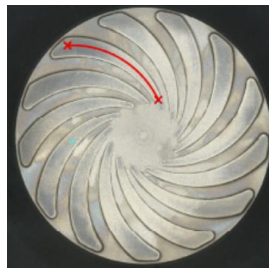
Optical Result



Volume Deviation



Measurement contour roughness



Nr.	Name	Value	Unit
1	Ra	0,174	µm
2	Rz	0,761	µm

