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SHAPING YOUR FUTURE Automotive Applications by Extrude Hone



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MAKING THE WORLD SAFER, HEALTHIER & MORE PRODUCTIVE®



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Automotive a core Extrude Hone business

Designed by us

Extrude Hone has been in business since the 1960's, building on its proprietary technology extrude honing, which has developed into what it is more commonly known as today - Abrasive Flow Machining (AFM). Along the way additional technologies have been added to the portfolio offering, like Thermal Deburring (TEM) and Electrochemical Machining (ECM), two technologies that perfectly fit the high-volume requirement and high-quality standard in the automotive.

From niche Engine Performance to Additive and EV applications

The first components Extrude Hone processed were lower intake manifolds to increase horsepower in a Ford Mustang Cobra SVT. This was done using AFM.

Since then, a lot have been done.

We are still working with Racing teams, from Nascar, WRC and F1 to some well-known Sport Car brands.

But most of today's volume applications are for components used in commercial models. Fuel Systems and Powertrain being the two main domains beside a myriad of other applications.



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The Applications in a nutshell

We started with Abrasive Flow Machining, AFM and we still do. In addition, we have developed flow tuning with the so called MICROFLOW process, an AFM variation. Added years ago, to our portfolio: Electrochemical machining (ECM) allowed Extrude Hone to enter the diesel market to provide stress relief / radiusing applications for components enduring high pressure. In the last years we extended these applications toward gas components. In parallel ECM started to be applied for gearbox components and crankshaft finishing. Both being highly automated and high-volume production. Thermal deburring, is also broadly applied in the automotive industry especially when it's just about removing burrs in seconds.

In 2017, we started to focus on new emerging Additive applications. At the same time, we transition to Mild-Hybrid gearboxes components and even added some Electrical Vehicle motor components, proving that our processes are future proof in a changing industry.

Some of the automotive champions:

- Pumps
- Common rails
- Fuel Injection components like nozzle and plates
- Gears and gear shafts
- Crankshafts
- Intake's manifold and cylinder head
- Airbag components
- Brake components



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Surface matters, Finishing Methods as well

Extrude Hone finishing methods

Depending your finishing requirements, the component geometry, material and the manufacturing process we have solutions for you.

Surface Finishing and deburring

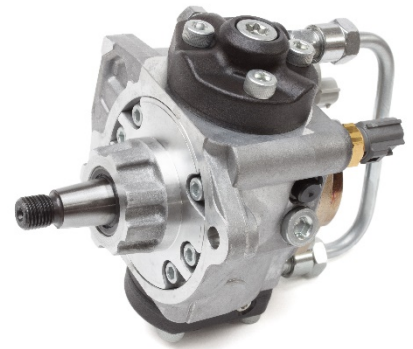
Abrasive Flow Machining is still the way to go when you want to improve flow quality and performance. It's the process suitable by nature for additive intricate passageways requiring surface improvement.

MICROFLOW is a process dedicated to flow tuning, it is now available in a high flow variation which enlarge the scope of application from car to truck nozzles.

Electrochemical Machining/Deburring (ECM /ECD) is a deburring and edge radiusing technology.

Electrochemical machining is a method that finishes the workpiece surfaces by means of anodic metal dissolution.

TEM - When it's all about burrs removal and cleanliness without radiusing the edges, Thermal Energy Method is the Solution as it removes burrs, flashing and unwanted particles in milliseconds.



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Crankshaft

Solution for radiusing and deburring of hard-to-reach areas on crankshafts where highest process reliability is required.

Crankshaft are components that have been adjusted to new patterns. The downsizing tide in parallel with the use of start and stop has increased dramatically the level of stress endured by these components. In addition, lead free bearings have added new constraints.

As a results it becomes broadly necessary to radius oil holes intersection to enhance fatigue strength and to polish the inner passages for cleanliness purpose.

Electrochemical machining (ECM) for deburring and radiusing of the most critical areas on a crankshaft enables to increase durability of the powertrain at low cost per part. By nature, ECM is also capable to cope with high volume and is easy to integrate in a fully automatized line.

In some cases, in order to improve oil retention ECM can also apply a texturing pattern at the bearing surface.

CHALLENGE

- Finishing of all cross holes on oil intersections on the crankshaft
- Required minimum radius 0.3mm
- 100k parts /year and +

BENEFITS

- 3 minutes cycle time
- Improve stress resistance and cleanliness
- Minimize risk of field failures
- Highest process stability and controllability.



Gears, radius and stress relief

Ensuring a smooth transmission

Automatic gearboxes became incredibly complex. They rely heavily on electronic and hydraulic systems. As part of additional constraint, they must behave silently and smoothly while dealing with increasing power level.

This industry is looking to enhanced fatigue strength, which means radiusing teeth edges, and to ensure that components are free of microcontaminant.

Mechanical action could fit the first needs but will generate secondary burrs.

Electrochemical Machining (ECM) delivers a better solution. It will shape a perfect edge radius, under tight tolerances, everywhere with the same accuracy and without generating any contaminant as dissolving the material. It does this at high productivity level.

In a planetary design transmission several components are likely to be ECM processed: sun wheel, output shaft, center gear, guide wheel shaft and planet gears.

Above applications are now taking shape for Mild-Hybrid transmissions.

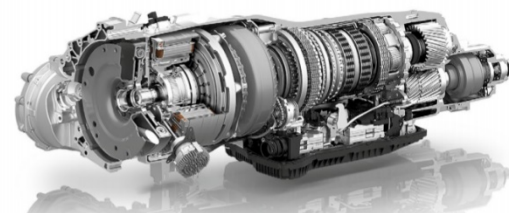
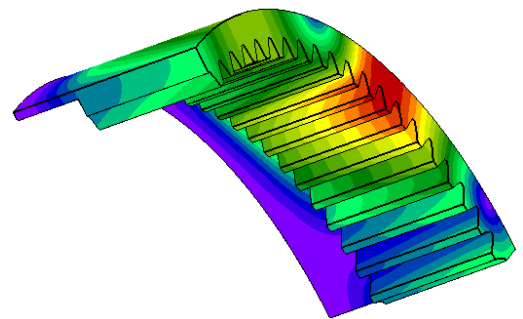
Regarding EV, we even hear about use of more sophisticated gearboxes to get the best efficiency. Of course here, silence matters.

CHALLENGE

- Complex polishing of curved surfaces

BENEFITS

- Automated process with accurate, consistent and repeatable machining
- Fast cycle times - 7.5s / planet gear on a 6-fold fixture for high volume production
- Improve surface finish as well as deburr and radius in a single operation



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Gears, deburring and cleanliness

Eliminate all burrs and micro burrs to avoid oil contamination

Machining of gear components leaves behind micro-burrs which can break off and contaminate the transmission oil leading to premature maintenance requirements and even failure of the transmission system.

The Thermal Energy Method uses a high temperature heat wave to vaporize micro-burrs and micro-contaminants instantaneously without creating secondary burrs. No mechanical process can achieve the same results.

This method is particularly well-suited to high volume production, offering very fast cycle times and cost per part.

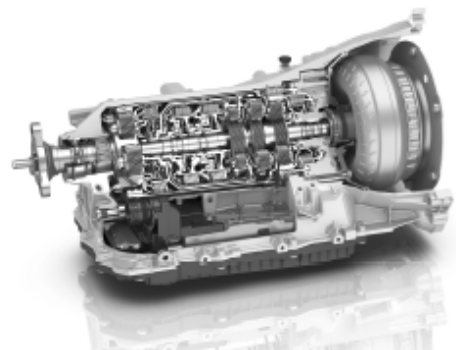
Sometime the TEM is used prior to an ECM operation.

CHALLENGE

- Remove burrs at intersecting holes
- Eliminate micro-contaminants on all internal and external surfaces

BENEFITS

- Automated process with accurate, consistent and repeatable machining



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Fuel nozzle, gas combustion improvement

Multiple processes for multiple purposes

Fuel system injector is a complex assembly of different parts.

The injector cup seals the cooling systems from the injector inside the cylinder head. If the injector cup fails, then fuel will enter the coolant system and cause damage to its components. Extrude Hone uses its ECM technologies to remove burrs and creates a small edge radius at the drilling intersections of the injector cup which prevents damage and ensures that no fuel can contaminate the coolant system.

Solution to create heart shape gallery into the main bore of the nozzle. This is a common operation used for diesel injection nozzles on car, truck, and ship engines. Electrochemical machining is the process of choice to shape gallery into internal bores.

Flow tuning of nozzle spray holes, in order to improve atomization, reducing consumption, increasing efficiency and reducing emission. MICROFLOW will flow media following the exact same fuel path. As a results a uniform entrance radius and bore will improve performance while preserving the spray hole geometry, which could be trumpet like.

CHALLENGE

- Remove burrs and create small radius at intersection
- Shaping gallery in holes

BENEFITS

- Eliminate risk of fuel contamination



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ABS Valve Block

Removing the burrs that could compromise safety

The ABS valve is a vital component that makes the braking systems of modern vehicles so effective. The ABS valve prevents the wheels from locking under extreme braking conditions which can drastically reduce stopping distance.

The valve block is full of drilling intersections which are left with burrs. If a burr is left behind, it can detach during the life of the block and cause a seizure in the ABS valve hydraulics. This, in turn, could compromise the braking function and have serious implications to the safety of both the occupants of the vehicle and other road-users or pedestrians.

With Electrochemical Machining, ECM, you can be confident that no burrs are left behind and, what's more, you can improve productivity in your production at the same time.

CHALLENGE

- Ensure complete removal of burrs at all drilling intersections within the valve block
- High volume production necessitates highly productive solution

BENEFITS

- Automated process with accurate, consistent and repeatable machining
- Be 100% confident that all burrs are gone





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Clutch Housing

Radiusing solution for snap ring groove and gear front face.

The clutch housing is a vital component across different architectures (including hybrid and full EV) to ensure that the transmission performs at its best.

Insufficient deburring of the snap ring groove and tooth profile on this components increases scrap rate and has a negative impact on assembly time. ECM is a selective, reliable and repeatable machining process that deburrs and radiuses the target area without damaging the sealing area which has very tight tolerances. With Electrochemical Machining, ECM, you can rest assured that every part will be burr free and have the pre-defined radius.

The ECM process is very well suited for high-volume production and can help you improve productivity in your manufacturing process.

CHALLENGE

- Deburr and radius snap ring groove ($R < 0.1\text{mm}$)
- + Deburr and radius tooth profile ($R < 0.3\text{mm}$)
- + No work to be done to the sealing area
- + Reduce component scrap rate

BENEFITS

- Automated process with accurate, consistent and repeatable deburring and radiusing
- Reduced scrap rate and therefore increased cost saving





Valve sleeve in shock damper

Burr removal and edge radius solution for cross-drilling intersections on a shock damper valve sleeve.

Shock dampers are a vital component on any wheeled vehicle in order absorb the shock that comes through the wheels into the chassis when the vehicle travels over uneven ground.

On a hydraulic shock absorber system, the valve sleeve forms part of an incorporated hydraulic device which converts kinetic energy into heat energy within the hydraulic fluid.

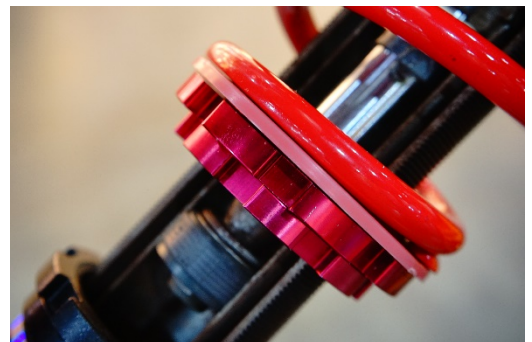
ECM removes burrs and creates a small edge radius at the drilling intersections of the valve sleeve which prevents damage to the seals which can lead to leaks and ensures that no burr can contaminate the hydraulic fluid which can lead to system seizures.

CHALLENGE

- Remove burrs and create small radius at cross-drilling intersection
- Eliminate risk of hydraulic fluid contamination, system seizure and seal damage

BENEFITS

- Automated process with consistent and repeatable machining
- Fast cycle times - approx. 20s per fixture load
- Process suitable for high volume production



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Additive in Automotive, it's now!

After the Racing teams who jumped early on using Additive to get very complex parts, the one they were dreaming off, produced. It's now the Automotive industry who is also gaining pace. New BMW Mini model incorporates 4 AM serial parts made by DMLS process, is just the latest example. To be noted also the use of new materials such as Copper, which is currently driving the innovation in heat-exchanger and other applications for Automotive.

While DMLS consolidates its position, the rise of new technologies such as HP Metal Jet is further accelerating the technology's adoption. Thanks to a year-long collaboration with GKN and Volkswagen, the 3D printing giant is walking the talk on the implementation roadmap: 2019 has been the year of cosmetic models, in 2020 the first functional parts will roll out and after 2021 full platform production is expected..

Post-processing, including support removal, surface enhancement, HIP and coating are Industry Hot-Topics due to their significant contribution to AM final quality.

In this scenario, industrial solutions for finishing are becoming a cornerstone to success; this is where Extrude Hone solutions – AFM, COOLPULSE, and TEM – can deliver an unprecedented advantage to their adopters, with unique quality delivered.

CHALLENGE

- Surface finish requirements for additively manufactured components

BENEFITS

- Removal of partially sintered or bonded material
- Support structure removal
- Smooth surfaces reduce harboring of bacteria





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Equipment or Contract Shop, your choice

Extrude Hone supports customer in the Automotive fields in various ways:

Feasibility – Testing

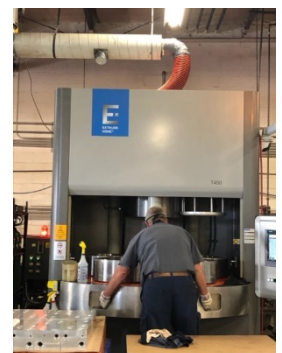
- Test different technologies or a combination to find the perfect solution that suits their needs.

Contract shops

- No need to invest - we have contract shops that can do the job for you.

Equipment

- Want to keep the process a secret, bring machines to your location.
- The full equipment portfolio is for sale. We will support during ramp-up and we will be beside you for service and consumables in the long term.





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Industry Experience

BURGMAIER HIGHTECH uses ECM to provide The Edge.

Radiusing & shaping solution for bore intersections at high-pressure areas of injector bodies. Absolute burr-free conditions by using ECM and thus achieves fatigue resistance in high-pressure components along with optimal efficiency due to enhanced flow properties.

The diesel fuel injection system is one of the core components of a diesel engine. It is responsible to supplying the right amount of fuel at exactly the right time.

Nowadays, where increasingly stringent emission standards force the manufacturers to lift the efficiency of their engines. Modern diesel engines, for example, are using pressures over 2000 bar to increase the efficiency of the internal combustion. This also means immense stresses, especially on the bore intersections of the high-pressure area.

Tobias L., responsible for the ECM processes at BURGMAIER Hightech GmbH in Laupheim, gives us an insight to his daily work and how collaboration with Extrude Hone helps them to provide the edge: “I have joined BURGMAIER in 2004 as foreman for lines in the production. After several years of experiencing the ECM processes in our production I`m now responsible for maintenance of all the ECM equipment in our plant. Since we started using ECM at our facility in Laupheim we have always relied on the expertise and experience from Extrude Hone. This very close partnership starts with running feasibilities during the bidding phase in early project phases, finding and defining the perfect production process steps for ensuring best parts quality and cleanliness, and perfecting aftermarket service support with innovative ideas to optimize our processes and to lower our running costs.

We are an international manufacturer of precision parts. We have succeeded in both consolidating our position as a technology market leader and fulfilling the needs of our global customer base. Customer satisfaction is our top priority – we achieve it with the three pillars of our corporate culture: expertise, precision and reliability. With continuous improvement and by working closely with our customers, we aim to achieve technology and cost leadership.”

 BURGMAIER
Faszination durch Präzision



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Industry Experience

Extrude Hone has been a ZF supplier of choice for ECM systems since 2006. Multiple components of an automatic gearbox benefit from the Electrochemical process.

In a planetary design transmission several components are likely to be ECM processed: sun wheel, output shaft, center gear, guide wheel shaft and planet gears.

In addition, Thermal Deburring is used for simple deburring operation, to reduced burrs volume prior to ECM, or simply to eliminate all potential contaminants.

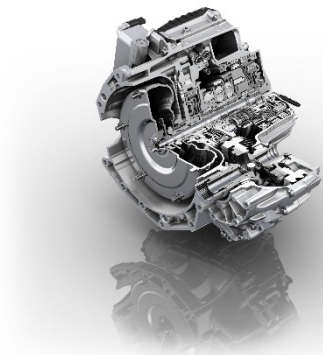
Quality of the gearing helps to reduce wear, vibration, friction and noise while reducing oil contamination. Superior automatic gearbox quality comes with perfect controlled edge breaks which ECM can performed with short time cycle contributing to high level productivity while fully integrated in production line.

May 2020:

“Last year ZF and Extrude Hone agreed on several projects in order to streamline our product costs. Nowadays ZF is able to implement this technical cost savings in their shop floor, particularly regarding new transmission projects.

Many thanks to Extrude for their readiness and support!”

C. Hauser, Manager Corporate Material Management - ZF
Commodity machine and equipment related tools.



Source ZF





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Industry Experience

Delphi-TVS is a joint venture between Delphi Automotive systems (USA) and T.V. Sundaram Iyengar & Sons (Kancheepuram, India). Delphi is the largest automotive supplier in the world and Delphi-TVS is the largest automotive systems supplier in India.



“Being a global company, we have a great responsibility to maintain world-class quality standards in our products,” says T.N. Umasankar, head of the Delphi-TVS manufacturing engineering department. “We manufacture diesel fuel injection parts – high-volume components. The main issue is burr removal on cross-sectional holes from previous machining operations.”



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Although it’s not spoken openly – and many wouldn't even admit to it – deburring is fast becoming a quality issue that won’t go away.

Companies, using state of the art precision machinery, can produce complex components these days that many design engineers couldn’t even dream of a few years ago. Part now take seconds to produce but minutes to deburr. Bottle-neck in production are now in the deburring sections and costs are biased toward finishing rather than production. Whilst the expectation of machine precision quality and repeatability has increased, huge damage and irregularities can still be done by hand deburring.

The TEM process is particularly appropriate for high-volume applications where conventional deburring departments struggle to keep pace,” Umasankar agrees. “ Its instantaneously deburr a large number of intersecting holes, threads and hard-to-reach areas in a flash, literally in 20 milliseconds. Its ability to fire multiple components at the same time increases its capacity and cost-effectiveness enormously. Any other process, including high-pressure water jet, will not provide this value.”

After experiencing quality improvement and substantial reduction in rejection we opted to go for two more TEM machines from Extrude Hone to cope with our production. We would say it is a nice experience to collaborate with Extrude Hone for value addition to our end products.”



Industry Experience

Ventura use ECM for automotive braking system components.

Headquartered in Les Franqueses del Vallès in Spain and with facilities in Houston, USA and Suzhou, China, Ventura Precision Components is an expert in the supply of high-precision turned components for the automotive sector and for other market segments such as trucks, motorbikes and aeronautics.

With more than 45 years' experience, Ventura supplies components to leading Tier 1s such as Robert Bosch, Continental and TRW and prides itself in its ability to offer the highest quality components at competitive prices. Ventura's primary product line is pistons for brake system, and, in this market, they are worldwide leaders in the production of new generation pistons.

Ventura's success lies in no small part in its use of state-of-the-art equipment and production processes. One of these processes is electrochemical machining (ECM) and Extrude Hone is proud to support Ventura in delivering superior quality components to the end customers.

Electrochemical machining works on the principle of anodic metal dissolution and provides a high degree of precision on components that are difficult to manufacture and finish using conventional methods. Because ECM is a non-contact process, it does not subject the workpiece to mechanical or thermal stresses. This means no burrs/secondary burrs and no distortion of the workpiece, even on thin-walled aluminum components. ECM is very well suited for Ventura's high-volume production and offers great accuracy and a high degree of repeatability.

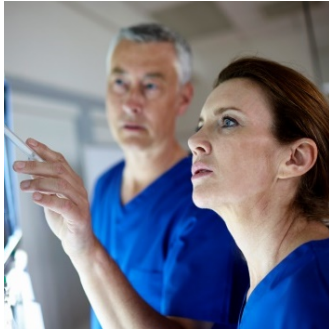
Ventura use ECM to deburr and radius cross-hole intersections on piston plungers (depicted in the image). It is critical that this area is free of burrs. A burr detaching from these cross holes could contaminate the brake's hydraulic system causing the system to seize or damage seals allowing hydraulic oil to leak and/or air to enter the system rendering the system ineffective.



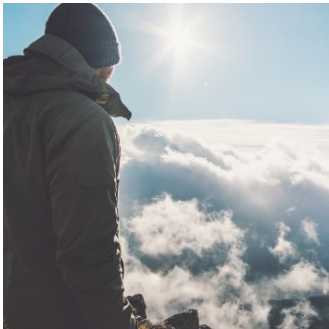
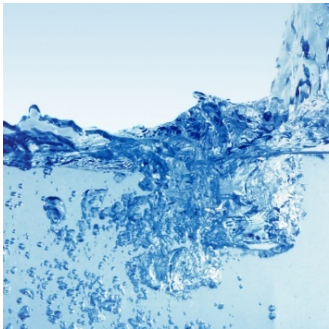
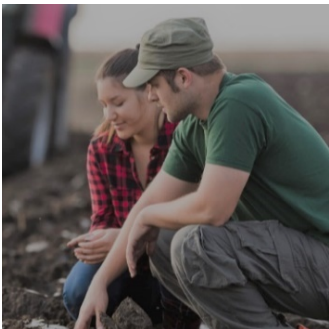
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