

ZMF FORGING – MADE IN ITALY

FORGED RECEIVERS FOR AR15

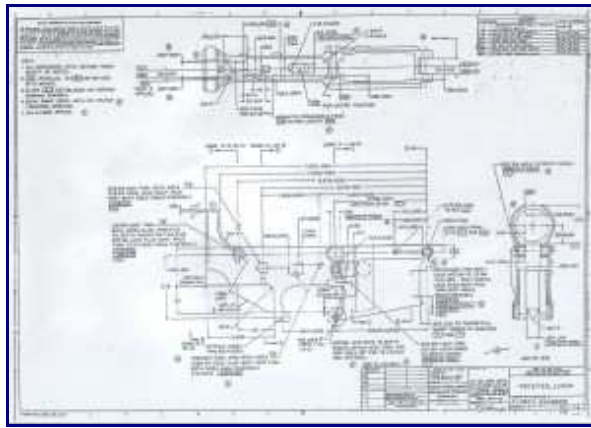


The coupling of AR15 with its aluminum receivers obtained from forging, are known to be an original American-made product.

In over half a century from their first production, only few industries in the world were able to face and win the technical and economic challenge of providing quality AR15 components made by forging process. One of these companies is located in Italy.

Back in time, when the first AR15 ([Armalite](#) model 15) was fabricated, not many countries had the necessary technical and metallurgic know-how to produce such components.

A certain amount of time and American technical support were needed, so that AR18, another project by Stoner, was designed to be a cheaper alternative for licensed production in all those countries who lacked the necessary technological know-how of aluminum processing. In spite of being an effective project, Ar18 didn't become as popular as AR15.



Blue Print of M16A1 lower receiver

Over time, whilst technological skills improved, the cost of the finished product continued to be a problem. The plant running costs could have been balanced only by a production volume equal to the American one; but in other countries it would have been difficult to reach such figures, as licensed productions are subject to strict regulations for sales to third persons.

Technological innovations in CNC working units increased the number of manufacturers who started fabricating and offering their own receivers thanks to the flexibility and versatility of the new CNC machines allowing also small and medium-size productions.

In spite of the opportunities provided by the modern CNC working centres, the traditional production from forged elements, if flawlessly carried out, ensures a high quality product with top class technical and mechanical characteristics.

The classic production, though unchanged in the general concept, benefited anyway from technical innovations, allowing to maintain competitive prices while improving the product's overall quality and characteristics.



ZMF plant.

Over 60 years from the first production in U.S.A. of the first forged receivers, an Italian company succeeded in penetrating the existing market sector by implementing the most innovative forging process technologies. ZMF (www.zmforging.it), also known as Zucchetti Mario S.p.a, from the name of its founder, was established in 1975.



The area dedicated to forging presses, the machines are placed behind the acoustic insulation walls.

The company started its activity with brass presswork, becoming a leader in the hot pressing for taps and water fittings. The company developed further and in the late '90s, thanks to important investments in structures, machinery and specialized staff, also became a leader in the presswork process of non-ferrous multi-alloys metals, from brass to aluminum, then copper, titanium and the most common bronze alloys.

Such developments brought the company into several market sectors: valves, chrome-plated taps and water fittings, installations and machineries, aerospace, hobbies, mechanic accessories, boating, automotive and electrical components.

More recently the 40-year experience of ZMF forgers resulted in a new special production line branded as ZMF TACTICALS.



Raw material warehouse with bar-cutting machines.

Some nostalgics of stars-and-stripes "keyhole" might find the pair of water fittings and receivers a bit weird, but we must remember that also Cerro Forge, a historical manufacturer of forged receivers, boasts the same kind of production.

ZMF bravely walked this path aiming to provide both the national and international markets with high quality products at a competitive price.



Part of the material exhibited at IWA 2015 by ZMF.

The first official presentation to the public of this new line was at IWA 2015 in Nuremberg, where ZMF, besides exhibiting the different components and samples, also illustrated their technical characteristics, the expedients and patents used for the production.

The hottest item in this line is the Lower receiver in alloy 6061T6, pierce-forged and patented in January 2015.



The 1000 ton press used for forging.

This component is the result of the 3D forging technology, typical of the valves sector, applied to aluminum processing. The production machine of this component is also ZMF-exclusive from 2011: a powerful 1.000 t press that replaces the rigid wedge traditionally used by aluminum forgers.

ZMF designed this machine by arranging in orthogonal position lightening pins to achieve the production of both water fittings and receivers, an avant-garde technique and a winning solution in terms of cost savings of raw material and machining time.



Upper mould.

Dedication and commitment of ZMF staff in the designing phase have been fundamental, but it is inside the plant that you can really appreciate how the

potential of the best and most advanced simulation software, interfaced with real data gathered through accurate analysis and constant machine monitoring, played their role and allowed to optimize the standard production parameters thus reaching a full correspondence between simulation and reality and ensuring the maximum mechanical, metallurgic and aesthetic output.



The forged billet with scrap to be removed; this operation is done by shearing with another press.

A great attention was dedicated to the selection of the alloys, of the pressing process and working temperatures. These parameters, together with a careful analysis and choice of the treatments to be carried out during the several production phases, permitted to obtain aluminum parts characterized by a perfect orientation of the fibers, to grant the product a high mechanical strength and elasticity and avoid break failures or cracks.

The production was optimized from every point of view and material wastes have been drastically reduced thanks to a patent studied for the Lower presswork, which results in weight and cost reduction right in the production stage and thus on the finished product.

The same attention was dedicated to the following process phases: milling, drilling, surface finishing and anodizing.

The result is a finished component fabricated with certified metal alloys, capable of meeting well known technical specifications and performance parameters, fabricated in the respect of the dimensional tolerances foreseen by MILSPEC standard.

The aforesaid ensures a safe product, compatible with all the components and accessories, either made in USA or not, which abide by the correct production tolerances.



Detail of the 3 finishing levels

ZMF Tactical line currently features three AR15 components: upper receiver, lower receiver and buffer tube, besides a 1911 gun frame.

The company chose to offer the components in two different aluminum alloys: the standard EN AW 7075 T6 ERGAL, used from the beginnings in American receivers, and the EN AW 6061 T6 ANTICORODAL, more elastic, already used by other manufacturers either for forged components or receivers machined from billet.

Actually alloy 7075, always used for receiver forging, was designed for tool machining in the aviation sector.

This choice dates back to 1953, when the President of Fairchild Engine and Airplane Corporation, a great enthusiast of weapons as well, came to know the ideas of George Sullivan, chief consultant for patents at Lockheed Aircraft Corporation, regarding the use of plastic and aluminum materials in mechanical projects. Hence the idea in October 1954 to set up a new division destined to become a historic brand: Armalite.

Fairchild's goal was to fabricate and offer to the market new concept weapons, light, with modern ergonomic characters and design, exploiting at best the possibilities provided by the modern production techniques of aluminum alloys and plastic materials.



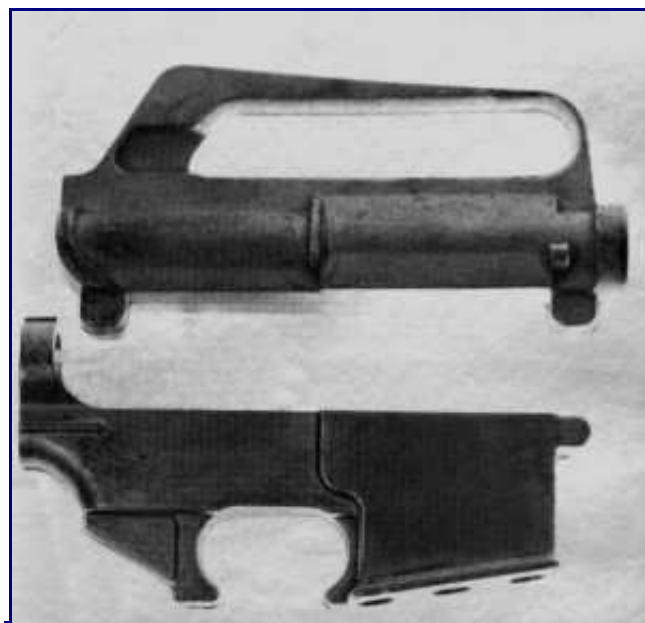
Eugene Stoner in 1967, Armalite project manager with the first prototypes of AR10

Eugene Stoner, Armalite project manager, before becoming one of the most renowned designers in the weapon field, was a marine, veteran in the second World War.

At the beginning of the activity, the aim was the private and sports market, but the rich orders issued by the Army in those years soon oriented Armalite towards this sector.

In one year Armalite released the project AR10, based since its first prototypes on forged receivers in alloy 7075 whose characteristics and peculiarities were widely known by the company and designers, given their traditional use in the aviation sector.

Unfortunately the Ar10 was not a success, and was replaced by M14. This early defeat did not affect the research that a few years later came up with AR15, a project that was sold to Colt in early 1959.



Forged receivers from the early productions.

Derived directly from AR10, the new project borrowed from this not only the functioning principle and peculiar characters, but also materials, although first conceived for other uses. The use of raw materials already available on the market was a phenomenon not limited to receivers, but also regarding breechblocks, made with common construction steel for buildings. Even though the MILSPEC specifications encompass these materials because they meet specific parameters, time and research led to more performing solutions.

But this world has a strong bond to traditions and doesn't feel the need for a change.

As regards ZMF products, the main difference between the two alloys employed is the superior ductility and elasticity of alloy 6061. These characteristics make the components more resistant in case of abnormal stress, such as a blow with breechblock closed or major bumps, allowing the material to deform plastically, instead of cracking or splintering, preventing also damages to the operator due to scraps and slivers.



A display of ZMF Tactical solutions for lower, upper and buffer tubes.

The 6061 alloy is also easier to surface processing by anodizing: a hardened surface crust can be obtained whereas it cannot be achieved with traditional aluminum alloys.¹

Besides the possibility of choice between two alloys, in order to satisfy different customers, ZMF offers its components in 3 different stages of processing:

¹ N.d.r. About employing this alloy instead of the classical 7075 and about its benefits we had discussed in the NEA15 texts published by Armi e Tiro - December 2013 issue - and on our blog.



Raw forged buffer tube next to a machined one.

- **RAW FORGED:** It is the full or plugged unit press-worked. In this case the components are semi-processed, not to be considered as parts of a weapon and thus free to purchase. While upper, buffer tube and frame for 1911 are available in 6061 or 7075 raw forged, lowers with patent procedure of partial unloading of the pipe union are made in alloy 6061 only, while the classic version is in 7075 only.

All the components in this stage of processing are available with raw or sandblasted surface or even medium steel shot blasting, or simply pickled;



Upper and lower semi-processed at 80% also available already anodized which really make operations easier for manufacturer or assembler.

- **SEMI PROCESSED 80%:** it's the intermediate step. Valid only for upper and lower receivers, available in both alloys. For the Italian regulations, they are not to be considered parts of a weapon and are thus free to purchase.

The reasons that make these components “not part of a weapon” are: the impossibility to assemble them and to make them shoot even a single shot. Design choices have proved fundamental to fabricate the components in such a way they satisfy the law regulations and not be considered parts of a weapon, but at the same time they are designed to make the final machining from licensed operators as easy as possible.



Upper processed 80%.

The removal of excess material that inhibits the use and the drilling of the lodgings of these components are the operations that define the function as part of a weapon. In this stage of production the components can be ordered with raw forged surfaces, medium steel shot blasting or already anodized, with a great advantage for the customer.



Anodized finishing also offered on 80% processed items.

In anodized items, the lack of final machining don't risk to splinter the anodized surface, as the areas still in need of this process are provided with

a small dedicated bevel angle.

Furthermore, 80% anodized items ensure an aesthetically perfect component ready to be assembled once the final machining is completed. The anodizing of finished and registered components, especially in 7075, can be risky as it might compromise the sale of the product from an aesthetic point of view.

In fact, if the hard oxidizing process creates stains or halos, the 100% finished item must be disposed (CERIMAT) with the subsequent loss of the production and machining cost, a non-existent risk on 80% ready made items.



Upper and lower 100% finished with black anodizing

- **100% FINISHED COMPONENTS:** they are the final components, complete and ready to be assembled. Available both in 6061 and 7075.

In this case the Italian regulations consider them as parts of a weapon, they are thus registered and can be sold following the regulations regarding weapons and parts of the same.

The buffer tube is free to purchase also finished 100% . The finishing is obviously sandblasted and anodized.

100% finished versions are also available pickled or sandblasted only.

The products feature the ZMF logo only in the raw versions, while in semi-processed and finished products the logo is removed by machining, in order to avoid legal problems once the logo of the manufacturer of the complete finished weapon is applied.



Lower receivers in 3 processing stages; from right, pickled raw forged, sandblasted surface and semiprocessed 80%.

ZMF also allows to receive components with a customized logo for a minimum order of 50 upper + lower, including the cost of artwork for the modified die. Design, geometries, tolerances, machining can be customized in many different ways. The company fabricated forged products according to customers' specifications for over 40 years.

Standard anodizing is matt black Hard Coat type, but other colors are also available upon customer's request.

The offer of semi-processed products to the companies aiming to produce AR15 is a notable advantage because it gives them the possibility to have a safe product, from a legal point of view, at competitive price, without unnecessary complex machining work to finish the product, including the anodizing treatment of small series.

To achieve this kind of product offer has not been a simple task, it required investments and project dedication, expert consulting, meetings with specialized bodies and authorities, to clarify and define at the best every possible interpretation about the most minute requirements for components destined to such a peculiar use, in a law context not always precise and easy to understand.



Detail of a raw forged upper, ready for further processing, and a lower 80%. Particular attention was dedicated to the research of better solutions to identify 80% processed products.

We have had to deal with regulations that, instead of listing all that's forbidden, detail what is allowed; in addition, the related norms have been conceived and written basically to govern the issue about weighbridges, castles, double-barreled shotguns, overlapped and cylinders, but never considered seriously in detail some components of a relatively aged project such as AR15.

The EUROPEAN REGULATION 477/91 as well has not clarified the matter, having been not entirely received. The result is a chaotic legislation: components that are not considered parts of a weapon in Europe, even though 100% finished, in Italy are subject to individual interpretations that can lead to significant legal consequences.

Considering the recent commercial success and the number of similar weapons available on our market, the legislator should proceed to a radical update that adjusts our regulations to the European standards on weapons, instead of carrying on setting partial rules, often useless and dangerous.



Upper receiver, raw, pickled and processed 80%.

ZMF goal is not just Italy but the world market, considering the recent regulations about the B7 category weapons, for which we have no further news about their development as well as about the related elucidations supposed to be released by authorized associations and organizations .

ZMF steadily continued its course, taking contacts with European and extra-European producers of AR15 and paying special attention to respecting the regulations of the different countries.

Extremely open to manufacturers and assemblers' requests even for small orders, ZMF has brought a revolution in the sector by offering different options for these components, thus confirming its leadership in the production of value for quality items for assembly and repair of AR15 platforms, and also AR10 in the future.



The anodized surface is offered on both the semifinished product 80% or 100% finished product.

Up to now the choice was restricted to three categories: made in USA components, tied to end-users, import licenses, long waiting times and consequent costs, made in Italy or Europe components, made by milling from solid at very high prices, and East Europe, South-East Asia and made in China components.

The only quality of these products, offered by different dealers in recent exhibitions, was their extremely cheap price.

They had in fact no certification as regards materials, dimensional coherence and quality control. Tolerances were often slack and some lots required several adjustments or additional processes to make them acceptable, so that the few assemblers who tried these products considered them absolutely not convenient.



Pair of upper and lower ready finished at 100% .

Eventually, we are also proud to be able to offer a totally made in Italy product, designed and patented in Italy and entirely fabricated here.

After the positive experience of IWA 2015, ZMF is already planning to return to Nuremberg in 2016 with more interesting novelties. In the next exhibition we will have a larger booth, rich in contents and an forged AR10 line designed to meet more and more the requirements of the market and the needs of our customers.

Here are some simulation videos analyzing the forging phases of a receiver.

Simulation of forging of a lower receiver from aluminum billet.

The simulation highlights the billet temperature during the closing phase of the mould. It's important to avoid that the temperature of the material on the mould surface grows beyond a certain value, in order to obtain a part with excellent mechanic and finishing characteristics.

Simulation of forging of a lower receiver from aluminum billet.

The simulation aims to highlight the billet deformation during the workpress process; it's important that the billet deformation is optimized so that every part of the mould is correctly filled with material during the plastic deformation by pressing. A correct contact with all the surfaces of the mould prevents surface faults or blurred details in the forging.

Simulation of forging of a lower receiver from aluminum billet.

The forging implies the plastic deformation of the billet in a mould. The operation causes an inevitable change in the inner disposition of the material fiber bundles, which must be kept optimal to grant a higher mechanical strength to the finished product. This simulation analyses in detail the deformation of the fiber bundles on two levels, parallel to the two halves of the mould.

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The forging implies the plastic deformation of the billet in a mould. The operation causes an inevitable change in the inner disposition of the material fiber bundles, which must be kept optimal to grant a higher mechanical strength to the finished product. This simulation analyses in detail the deformation of the fiber bundles on two levels, orthogonal to the two halves of the mould.