Bucking the trend: The finished buck created with CAD technology, laser scanning, digital imaging and 3D printing – all cutting-edge tools that Cooper Technica has incorporated into an innovative and unique approach to high-end automobile restoration. The finished buck is shown next to the body, which is mounted on a rotisserie fixture in Cooper Technica’s Chicago studio.

Begin at the Beginning:
Historical Research and Forensic Sleuthing Inform the Restoration of a 1943 Alfa Romeo Part II READ Part 1

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Introduction

During the Second World War, Alfa Romeo built twenty-eight 6C2500 Super Sport Cabriolets. These were built exclusively for Mussolini’s close friends and associates – mostly high-ranking German officers. Seven of these cars had custom cabriolet bodies designed by renowned Italian coachbuilder Pinin Farina. Cooper Technica, Inc. is now restoring one of these seven, originally built for Luftwaffe Field Marshal Wolfram Freiherr von Richthofen, a cousin of the WWI Red Baron and an ace pilot himself. In 1948, in the hands of a new owner, this car raced Italy’s famous Mille Miglia, finishing 3rd in class and 22nd
overall. Altogether, the Alfa Romeo’s unique history and provenance make it particularly desirable to collectors today.

Part I of this article described how Cooper Technica first acquired the car, and then meticulously researched its complete history, provenance, and construction documentation. We found that, throughout its life, the Super Sport changed hands seven times, sustained a few minor crashes, and had its front end altered when the body was repaired in Milan in 1953. This historical record, as costly and time-consuming as it was to gather, proved essential to restoring the valuable Alfa to the highest achievable standards of authenticity.

Part II of this article will first explain the rationale behind key restoration decisions. Then, we will describe how Cooper Technica used the cutting-edge technology of laser scanning, digital imaging and 3D printing to determine the Alfa’s original shape; and then used traditional “trailing-edge” construction techniques to restore that shape. With archival photos from 1943 and 1945 as our guides, our innovative methods and unique approach have achieved a restored body shape within two millimeters of the original – a level of precision never before possible.

When Preservation Is Not an Option, What Then?

As both historians and restorers, our first goal is to preserve the car as-is, rather than to restore it. When the Alfa Romeo arrived at Cooper Technica, the paint had been stripped, exposing the original aluminum body skin. It was evident that various repair jobs and past alterations had left the body in poor condition. Given that that car was no longer original, and the fact that some restoration work had already been attempted, preservation was not a viable option.

The decision to restore the Alfa Romeo rather than to preserve it raised a number of questions. First, considering the car’s long history and the changes it underwent, to which moment in time should we restore it? As it was delivered to von Richthofen in 1943, or as it was modified for racing the Mille Miglia in 1948? In the end, we elected both options. We restored the car to its original, 1943 specifications. However, the future owner will be able to convert from the 1943 to the 1948 configuration by removing the bumpers, front windshield, convertible top and side windows, and fitting the correct Brooklands type racing windscreens we will furnish.
With that in mind, the question came as to whether the car’s body should be addressed cosmetically, leaving only the appearance of the original, or whether it should be restored to its original shape, finish, and materials. Many restorers and collectors choose the cheapest and easiest path – i.e., a cosmetic treatment. But when it comes to a car that is this significant, mere cosmetic restoration will fail to capitalize upon the car’s highest value, that which is inherent to its original form.

And what about the car’s mechanical components – the engine, the transmission, the steering? If the future owner decides to drive the Alfa Romeo in the annual recreation of the Mille Miglia, then full mechanical functionality and reliability are essential. But racers are less concerned with originality and are often willing to substitute modern components. This can devalue the car when it is shown at a Concours d’Elegance. Instead, we chose the more expensive route of restoring/preserving the original mechanical components as accurately as possible. Since the Alfa was an exceptional performance car in its day, our approach will allow it to perform as well as it did when new, without compromising its value.

Planning with Cutting-Edge Technology

The laser scanner is positioned at various points around the car to capture a 360-degree digital image of the body and chassis.

Our process of body restoration began with laser scanning, digital imaging and 3D printing – all cutting-edge tools that Cooper Technica has incorporated into an innovative and unique approach to high-end automobile restoration. The first step, a 360-degree laser scan of the car, generated a 3D digital image of the full body and chassis. These scans are so detailed that excess data must be carefully stripped from the image in order to produce a clean, digital representation of the car as-is.
The raw laser image of the body on the computer screen, before pruning extraneous data.

Next, we overlaid the clean, 3D image of the existing body (augmented through our CAD program to recreate missing sheet metal sections) with digitized versions of the original photographs from 1943. This allowed us to compare the existing shape to the original and to identify any discrepancies between the two. Because photos are subject to the normal camera distortions of focal length and perspective, we first distorted our own digital images to match the focal length, angle, and proportions of the original photos. When we overlaid the images and added a virtual light source to our image that matched the angle and strength of the original, we could see whether the light reflections in the digitized image matched those in the original photo. Only when those reflections match can we know that the digital body shape is true to the original.

The clean digital image of the front fenders and hood, shown with the guidelines used to form the bucks.

The digital image compared with the original photograph to verify shape. Note that for the 1948 Mille Miglia, the Alfa’s bumpers, front windshield, convertible top, and side windows were removed; and Brooklands style racing windscreens.
were installed; the restoration will conform to that configuration.

Though the grille and the front valence below the grille were missing, the CAD program allowed us to digitally render this area to original proportions.

Finally, to further validate the digitally corrected body shape, we also made a 1/12 scale 3D printed model of the car. This model enabled us to physically study the shape, and photographing it from different angles gave us another way to compare our rendering to the original.

Front view of the 3D-printed, 1/12 scale resin model, built to show the car's actual shape and to verify the digital renderings.
With the correct body shape verified, we designed and built a series of full-sized forms, called “bucks”, over which we re-formed the existing sheet metal panels back into their original shapes. Though bucks are critical if one wants to preserve the original aluminum panels, most restorers today do not make them. Instead, they take the easier and less costly approach of fabricating new panels and discarding the originals. We believe it is more faithful, and adds value to the car, to preserve as much of the original body sheet metal as possible.

In this case, our bucks were made of polystyrene foam machined on a 5-axis milling machine, each one corresponding to one of the car’s body panels. To protect the foam from crumbling as the original aluminum panels were test-fitted, the bucks were undersized by four millimeters to accommodate a fiberglass skin. The fiberglass was applied in layers, coated with resin, and then vacuum-sealed. After a 24-hour curing process and light sanding, the hardened work surface was accurate to the inner dimensions of the original panels.
The bucks were individually machined on a 5-axis milling machine and test-assembled into the full-size body shape.

**Execution with Traditional Techniques**

Although Cooper Technica used high-tech tools to determine the correct shape of the Alfa’s body panels, the actual restoration process required traditional techniques and the very same processes that the Italian craftsmen used at Pinin Farina in 1943. To form the body panels, the Italian metal workers would begin by cutting, shaping, and then welding together a series of aluminum panels. The primary tool used to shape these panels was a power hammer, supplemented with hand hammering and planishing. Throughout this process, they repeatedly test-fitted the body panels over bucks and re-formed them accordingly. In our studio here in Chicago, we used these same techniques, with our own bucks as guides, to reshape the Alfa Romeo’s panels back into their original form.

Next, the body panel sections were butt-welded together with, again, the same techniques used in 1943: aluminum was painstakingly worked with a small oxygen-acetylene hand torch, which leaves a minimal welding bead and does not distort the metal. Modern welding equipment, by contrast, produces so much heat that the joined panels cannot be easily re-shaped, necessitating the extra step of annealing. Using traditional welding techniques and the original seams as guides has allowed us to preserve over 70% of the Alfa Romeo’s original sheet metal.

**Hand-Rubbed Lacquer Paint**

While European coach-built cars of the 1930s and 40s were painted with nitrocellulose lacquer, most restorers today use water-based catalyzed urethane enamels. The difference between enamel and lacquer is analogous to the difference between coffee and tea. Enamel, like coffee, is a solution in which the paint molecules bond with water molecules to produce an opaque solution, the color of which is perceptible on the surface. By contrast, lacquer paint, like tea, is a mixture of colored molecules floating among water molecules, through which the color is perceived. While modern enamel jobs give the illusion of depth by applying clear coats over the paint, with lacquer the depth is inherent in the paint itself. And, because lacquer is harder than enamel, polishing gives it a smooth glass-like finish — not the orange-peel finish typical of modern paint.

The common misconception that lacquer is no longer available is likely borne of the fact that most restorers refuse to invest the time and labor that lacquer requires. Lacquer must be applied in very thin layers, each of which is allowed to air dry for days before being wet block sanded to prepare for the next coat. Though a traditional lacquer paint job takes weeks, it has a depth and luster that can never be achieved with modern paints. For this Alfa, Cooper Technica is
making the investment in authentic lacquer paint, matched from remnant spots to the original 1943 dove grey color.

**Restoration of Mechanical Components**

To restore the front suspension for the recreated Mille Miglia, we rebuilt the original components with new bushings, needle bearings, thrust bearing, and seals. Protective seal covers were re-manufactured to the original specifications.

Because the Alfa’s successful participation in the 1948 Mille Miglia makes it eligible to compete in the annual recreation of the race, Cooper Technica has chosen to restore the mechanical components so that the car can compete equally well today. For the future owner to drive the car vigorously, it must function reliably and handle well; i.e., all mechanical systems must be restored. To take the play and wear out of the engine, transmission, drive train, suspension, brakes and steering, internal components, seals, bearings and bushings have been restored or replaced. The electrical systems have been made to work properly. We make one concession to originality, and have modified the engine to allow it to run on modern, unleaded fuels.

This oil pump was worn, and its excessive clearance between the gear and the housing caused erratic oil pressure, risking engine damage. To restore proper clearances, we fabricated a new gear set with the correct profiles for an oil pump, and developed special tools to re-machine the inside of the housing.

Cooper Technica’s approach to mechanical parts is similar to our approach to body panels: we restore the original parts wherever possible, and fabricate accurate replacements as necessary. If we do not have the tools necessary to make replacement parts, then we design the tools first. Whenever original parts are missing, then we seek original replacement parts before fabricating new ones. For example, the Alfa was missing its original oval-shaped fluted glass headlights. These were used only during the war, when Alfa’s traditional Bosch headlights were unavailable. With extensive searching, we found a pair of NOS war-time
headlights in Argentina. Because the 1943 photos show these headlights fitted with blackout screens for war-time use, we will equip them with screens, as well. The Alfa was also missing its original horizontal six-slat front grille. But in that case, since only one such grille was ever made, a new one, true to the original, will be fabricated from bucks that we will make based on our analysis of historical photographs.

Detail of the war-time headlight with the blackout screen, based on a photo of the car as it was first delivered to Field Marshall von Richthofen in October, 1943.

Conclusion

At Cooper Technica, Inc., we consider our restorations to be functional art, and we are honored to restore cars such as the 1943 von Richthofen Alfa Romeo. These cars represent the finest work of some of the most brilliant designers of the 20th century, and to be true to the art, an authentically restored car must be both accurate and functional. Too many cars are restored cosmetically while the mechanical components remain tired and neglected. Others are over-restored to the restorer’s idea of “better” or different than new. Neither practice is faithful to the original. Cooper Technica’s innovative blend of new technologies and traditional methods permits restorations of peerless accuracy and functionality.

Cooper Technica

Cooper Technica has been privileged to restore some of the finest automobiles ever made. The company specializes in the complete restoration of rare and valuable pre-war and early post-war European cars. Both aesthetic and mechanical restoration, including custom precision fabrication, is performed in-house at Cooper’s Chicago and Lyon studios. The level of restoration and forensic analysis is unequaled.

Cooper restorations are based on in-depth historical research, accurate and verified provenance, and a deep understanding the car’s context and milieu. The company’s methods and equipment span the 1930s to state-of-the-art laser scanning, digital imaging and 3D printing. Adherence to original materials, chemistry, metallurgy and period production techniques is essential to restore these fine cars to original specifications. While this approach is justifiable only for the most valuable cars, there is no other way to achieve this level of authenticity. Cooper restorations have won many awards and meet the highest standards for museums, private collections, investors and competition at Concours. Examples of Cooper Technica’s award-
David Cooper

David Cooper founded Cooper Technica, Inc. in 1989 in the tradition of fine artisans and old world craftsmanship. Cooper personally oversees all aspects of production, design, research, management, marketing and sales. David Cooper apprenticed under a master craftsman for eleven years after a decade in engineering and marketing in the corporate world. He is a third-generation trained fabricator, machinist, and machine designer. Cooper is a published automotive historian, lecturer, writer and consultant to museums, collectors and investors. Cooper judges at Concours d’Elegance across America and is Chairman of the forthcoming Concours d’Elegance of Chicago.

{6 comments... read them below or add one}

Rick Asselin August 11, 2015 at 11:52 am

What can you say but “WOW”
The attention to detail and authenticity is almost unbelievable. Fantastic work, looking forward to seeing the completed project.

Tolyaratunoff August 11, 2015 at 1:43 pm

cryogenicizing all engine parts would be a great idea, along with swain coating all the moving surfaces in the engine.

Alan Yankoloni August 11, 2015 at 1:53 pm

David great article, I’m a big Alfa fan. Question: one of your photos shows the car with US Armed Forces license plate in the 1950s in Europe. Were you able to track the US Army owner by way of the license plate number? Thanks Alan Yank

Fred Puhn August 11, 2015 at 4:59 pm

It is interesting that the cam covers shown in the period photograph look like bare aluminum. All the ones I have seen (all postwar) have glossy black cam covers. I wonder when they started painting the cam covers.

I am restoring my 1948 Alfa 6C 2500SS Touring coupe. I appreciate all the work needed to restore a car to authentic specs, as I am doing on mine. The problem comes when a known weak point in the design needs to be restored. You have to decide if you want to recreate the same weak component or somehow improve it. An example is the critical fasteners in the engine, originally made of soft material.

Gijsbert-Paul Berk August 12, 2015 at 8:17 am

What an impressive account of a very professional approach for restoring classic automobile treasures. Well Witten, full of worthwhile details and with clarifying illustrations. Interesting to see how Cooper Technica uses ultra modern techniques, such as laser scanners, digital imaging and 3D printing to achieve a perfect resemblance of the original car. What I particularity like is the clarification about the use of Nitro cellulose paints and modern water based enamels. Many beautiful cars prepared for concours d’elegance never get an award because they lack the right ‘patina’ as their paintwork is just winning restorations are online at http://www.coopertechnica.com
too glossy. Some restorers try to remedy this by rubbing down the final paint layer with very fine sandpaper or some other abrasive product.

Mark Gutzman  August 12, 2015 at 12:59 pm
WOW! A great restoration of an important Alfa Romeo. I loved the detailed history you uncovered.