

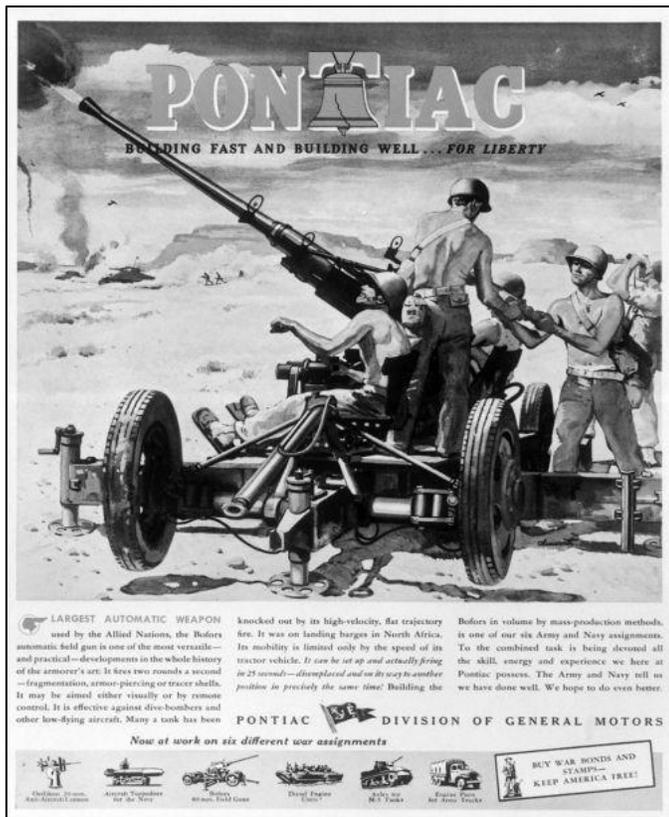
# Fact vs. Folklore; the 40mm “L-60” Bofors Gun

By CMSgt Bill Walter, USAF (Ret.)

The 40mm M2A1 gun currently used on the AC-130 Gunship has Swedish roots dating back to the 1930s. Originally invented by Bofors Ordnance, Karlskoga, Sweden as the Model 1934, you could say the gun was truly in the right place at the right time at the beginning of WWII. The outbreak of hostilities caught the United States and Great Britain woefully unequipped with

machined steel and alloy parts. They also discovered the gun was built in the old world craftsman tradition of machining parts slightly oversized and using “file to fit at assembly” production techniques. Unfortunately, hand-fitted parts are very problematic for mass production manufacturing methods. The first US company contracted to build the naval version of the Bofors gun was York Safe & Lock, York, Pennsylvania. A contract was formally awarded in April of 1941 even though work began months earlier using “acquired” Dutch machine drawings. The first problem encountered was conversion of the Dutch drawings to American measurements which resulted in “uniquely dimensioned parts” compared to the original Bofors gun. As production began, many technical problems were encountered resulting in slow progress and low production quantities. The final gun produced by York Safe & Lock was functionally identical, but dimensionally unique in comparison with the original Swedish gun. These guns served on US Navy ships throughout WWII.

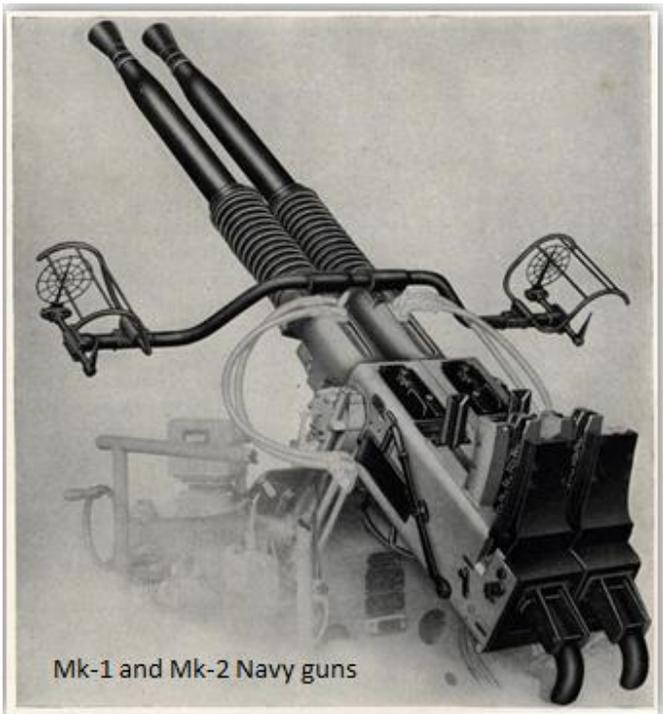
Coinciding with the Navy gun production effort, the US Army ran a similar unlicensed 40mm gun acquisition program for the Army version of the Bofors gun. To meet projected demands, The Army decided to award a contract to Chrysler Corporation. Chrysler was very experienced in mass production methods in their automotive assembly plants, but building guns differs greatly from building automobiles. Their first problem followed the experience of York Safe & Lock. Chrysler dedicated a great deal of work to convert drawings acquired from Great Britain to American measurements. As the program progressed, Chrysler engineers decided simplification of the complex functional design was not possible. As such, Chrysler re-designed components and materials only enough to enable mass production within the capability of their production lines, tooling and foundry. Chrysler was confident they could meet production goals but experienced extreme difficulties standing up a production line. It took Chrysler one year to produce their first unique version of the Bofors gun. Within a few months of full production, Chrysler was manufacturing a complete gun from start to finish in ten



suitable air defense guns. Both countries needed guns...many guns, and quickly. Trouble is there was nothing “quick” about building the Bofors gun. A single gun took Bofors 450 man-hours to produce and they could only produce limited quantities of guns per month. The US and Great Britain needed many thousands of guns. To meet heavy production demands, the US sought a license to build the gun themselves, but was unsuccessful in establishing a contract with Bofors. Undeterred and desperate for guns, the US decided to produce unlicensed copies of the gun. After obtaining metric drawings from the Dutch government, Navy engineers discovered the Swedish gun was a highly complex mechanical masterpiece of more than 1500

man-hours. This was an amazing feat that would be difficult to do today even with modern machinery. Eventually, Chrysler took the lead of all 40mm gun production and standardized both Army and Navy guns. The demand for guns at the production height of WWII was so great it surpassed Chrysler's capacity as well. To meet the wartime demand, Pontiac was awarded a contract to build 40mm guns. Pontiac built both M1 and M2 (dual) guns for the US Army. When it was all said and done, production of all versions of the US 40mm gun exceeded 60,000 until production ceased in the 1950s. These guns served US and allied nations well into the early 1990s. Today, the AFSOC AC-130 fleet is the sole remaining user of the gun in the entire DoD and only one of a handful of users of the 40mm "L-60" Bofors gun remaining in the world.

## Differences of Navy and Army Guns



Naval guns carried the traditional Navy "Mk" (Mark) designation while Army guns carried the "M" (Model) designation. The principal differences between Navy and Army guns were the location of the trunions (elevation pivots), the barrel and the breech casing design. Naval Mk-1 and Mk-2 guns used "water jacketed" barrels and trunions near the center of gravity of the elevating mass. Trunions of all Army models and the Naval Mk-5 (submarine/ patrol craft model) were located well aft of the center of gravity to lower mount profile and all guns were equipped with air-cooled barrels.

## 40mm Guns on the AC-130

The L-60 40mm gun was first considered for AC-130 use in 1969 during the Vietnam War. It was meant to increase stand-off distance and improve overall combat effectiveness. Contrary to popular belief, the original AC-130A 40mm guns used in flight testing were Army M1 guns not a Navy Mk-series guns pulled from ships. These guns were heavy and cumbersome, but they existed...and looked like they could fill a rapid combat capabilities need. Mounting the 1000 lb. gun to an AC-130 was not easy. Aeronautical engineers designed an incredibly robust gun mount from plate steel, placed a gun in it and ground tested the assembly. Blast overpressure problems were encountered initially but solved with extensive study and analysis. When ready



for production, engineers selected the M2A1 gun from the US Army M42A1 "Duster" tracked anti-aircraft system. Duster used "mirror imaged" guns bolted together with left and right hand controls. The pair was functionally identical but was loaded and operated from opposite sides of the Duster turret. Mounting the two guns bolted together was not practical or desirable for AC-130 use, so right hand and left hand guns were separated and modified for individual mounts. The first M2A1 (modified) guns were installed on AC-130A Gunships under the "Surprise Package" program. These guns served on AC-130A aircraft until aircraft retirement in the mid 1990s when all the left hand guns were overhauled for use on the AC-130U. These original AC-130A guns, mostly manufactured in the 1950s, continue to serve AC-130U crews in Afghanistan today.

## Back to the Future?

During 2002, as Operation Enduring Freedom reached full swing, the Air Staff realized there were not enough AC-130 gunships to meet demands. In response, they initiated what was called the “Plus Four” program to rapidly build four additional AC-130U gunships. By then, the once prolific M42A1 Duster system had long since been retired. There were no guns available in the supply system for the “Plus Four” program. It appeared all viable sources for guns were depleted. An attempt was made to award a contract to produce newly manufactured guns, but production and financial reality of building a “unique-new-old-gun” was deemed unrealistic and unaffordable.

Recognizing the problem, several AC-130 gunners stepped forward to assist the old fashioned way...scrounging. In the past, they had seen many M42A1 Duster systems sitting on target ranges on Nellis Air Force Base. The guns on the M42A1s appeared to be in very good condition and “ripe for the picking”. With this bit of intelligence, staff officers from the HQ AFSOC Gunship Requirements Branch contacted Nellis Range Operations personnel to arrange a visit to inspect the guns. After approval, several gun technicians and a program analyst quickly arranged a trip to Nellis. The guns were inspected, found to be in good condition and two dual guns were successfully recovered.



The guns were then shipped to Eglin Air Force Base for detailed inspection and modifications. Air Force Research Lab (AFRL) technicians disassembled and inspected the guns and components inspected. They found that with few exceptions, most parts were in serviceable condition. Critical parts were metal particulate inspected and re-finished with a zinc phosphate finish. Breech casings were water-blasted to

remove old paint and corrosion. Once cleaned and inspected, the breech casings were modified and machined in AFRL’s Model Shop to original AC-130 “Surprise Package” drawing specifications. Once all modifications were complete, the unpainted guns were taken to an AFRL range at Eglin for test firing. Using an original AC-130A gun mount and a firing rod borrowed from the “The First Lady” (AC-130A 53-3129) at the USAF Armament Museum. Both guns test fired perfectly in both single and rapid fire modes. A subsequent trip to Nellis AFB netted three more guns. These were shipped, inspected and modified to the same standard as the first two.

After testing was completed, the guns were disassembled, re-inspected, painted flat black, re-assembled and turned into the supply system. Since these guns were manufactured by the same company at the same time that current AC-130 guns were originally built, they are matching in all respects with the current fleet of guns. The entire project took about six months to complete at a cost of \$130K. The real cost of these guns if procured today exceeds \$8.6M. A great level of credit goes to the “out of the box” thinkers whose ideas and hard-work filled a critical requirement for a fraction of projected cost, delivering guns at least four years sooner than planned.



## 40mm Gun Facts

Not a single 40mm gun used by the US was actually built by Bofors in Sweden.

Commonly called the Bofors “L-60”, our gun is actually an L-56 (caliber x 56 = barrel length).

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About the Author: Chief Walter served as AC-130H/U Aerial Gunner for 26 years. He currently works at HQ AFSOC, Gunship Requirements, as a Program Analyst.