MASKS FOR THE AIR SERVICE:

UNITED STATES AIR FORCE MASKS THROUGH THE DECADES

By Lieutenant Colonel Robert D. Walk

Since their inception as a separate service in 1947, the US Air Force (USAF) has always cared for their airmen. Initially, they followed the Army's lead in mask development, but later adopted USAF-specific solutions as needed. They have run separate programs for their aircrew and their ground support personnel to ensure the best protection. This article will look at the history and continuing efforts of the USAF to provide protection from chemical, biological, radiological, and nuclear (CBRN) inhalation hazards.

Aircrew Masks

The USAF must be able to attack the enemy under any hazardous condition—including a CBRN event. Over the years, USAF leaders have developed ejection seats to ensure aircrew survival from stricken aircraft, improved flight helmets to protect the head and neck, and improved oxygen masks to ensure good air supply. While not ignored, protecting the aircrew from the effects of CBRN hazards has not always had the highest priority. For many years, the USAF assumed that the aircrew would breathe using the aircraft's oxygen supply and would not require additional respiratory protection. On the ground, the aircrew would use the standard ground protective mask and receive oxygen through a clean air supply. This idea originated during World War II and appeared to have continued through the 1960s. However, during the Vietnam War, an experimental aircrew version of the M28 riot control agent mask was produced.

In 1971, realizing the need for a chemical-biological (CB) protection helmet for fighter pilots, the USAF tested a modified HGU-15/P "clamshell" helmet. Modifications to the helmet included adding a filter element to the oxygen system, a nosecup, an inlet check valve, a drinking tube, a Valsalva (pressure equalizing) valve, a low-pressure hose, and electrical system modifications. Additionally, a neck seal was included that functioned much like the hood on other masks. The seal, made of butyl-coated nylon fabric, fully covered the shoulders and extended over the chest. A cord could then be tightened around the neck to keep the seal tight. A total of 16 masks were manufactured—4 from the original HGU-15/P mask design (with the filters mounted inside the helmet) and 12 from the final design (with the filters carried externally). The masks were successful in that they protected the user, but the USAF never adopted them.[1]

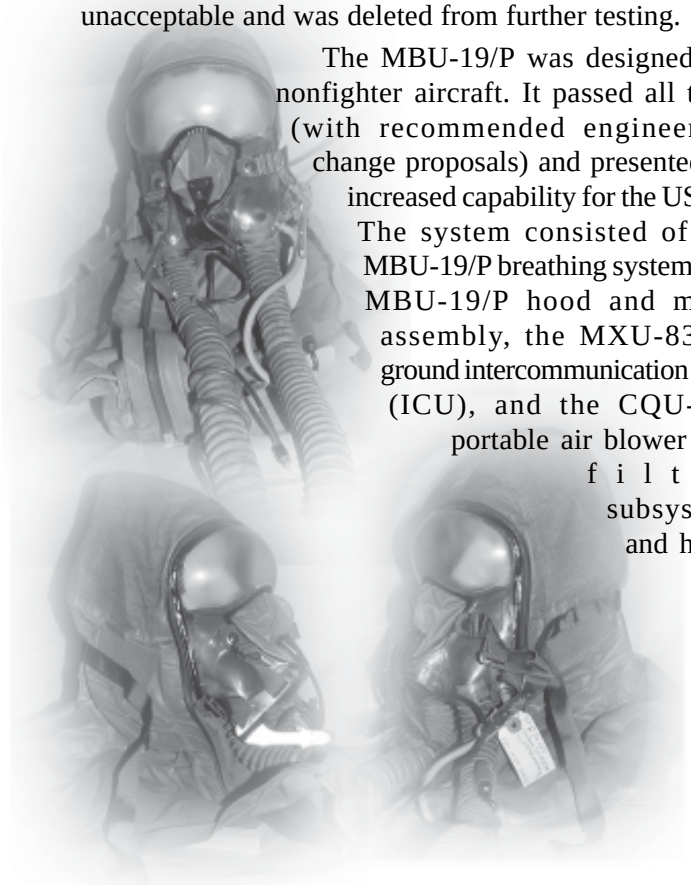
By 1975, the USAF had adopted the mask breathing unit (MBU). This unit consisted of the MBU-13/P CB oxygen mask, the HGU-41/P protective hood and shoulder cowl, and the CRU-80/P filter pack (which used the then-standard, M13-series filters). While the mask did provide protection for the aircrew, it was not perfect. It reduced the user's field of vision, was poor fitting, had no Valsalva or drinking capability, and did not work with the advanced-concept ejection seat (ACES) II. By the early 1980s, the mask needed replaced. However, despite inadequacies, the mask is still authorized for use today.

HGU-15/P clamshell helmet

In the 1980s, with continued interest and knowledge that the Russian colossus had and would most likely use chemical agents, the USAF continued their efforts to field a mask for aircrews. The USAF sent out requests for mask designs and received a great response from firms in the United States, Great Britain, and Germany during the Phase I evaluation. The design submissions included the Tactical-Aircrew Eye Respiratory System (TAERS) (submitted by ILC Dover, Incorporated); the Advanced Chemical-Defense Aircrew Respirator (ACDAR) (submitted by Scott Aviation, Incorporated); the Protective Integrated Hood Mask (PIHM) (submitted by ILC Dover, Incorporated); the German Chemical Respirator System; and the British Nuclear, Biological, and Chemical (NBC) Aircrew Respirator-5, Mark I and II. These masks were evaluated on five different aircraft—the F16B, F15B, F4E, UH-1N, and KC-135E. In Phase II, the selected systems (TAERS and PIHM) were designated the MBU-18/P and MBU-19/P, respectively.

The MBU-18/P was specifically designed for high-performance fighter aircraft. This system was tested extensively in fighter aircraft, but it was ultimately declared unacceptable and was deleted from further testing.

The MBU-19/P was designed for nonfighter aircraft. It passed all tests (with recommended engineering change proposals) and presented an increased capability for the USAF. The system consisted of the MBU-19/P breathing system, the MBU-19/P hood and mask assembly, the MXU-835/P ground intercommunication unit (ICU), and the CQU-7/P portable air blower and filter subsystem and hose.



ACDAR mask

MBU-13/P CB oxygen mask, HGU-41/P protective hood and shoulder cowl, and the CRU-80/P filter pack

The new mask design integrated the standard MBU-12/P oxygen mask, which included a visor, a neck dam, a bromobutyl rubber hood, a drinking tube, and a communications connection. It attached to the standard USAF HGU-55/P helmet with standard connectors. The breathing subsystem used a standard C2 filter canister, hose, and manifold for emergency oxygen. The blower unit used a standard C2 filter canister with batteries and an external power cable. Finally, the ICU allowed for communication with others while protected and not connected to the aircraft communication system. However, the aircraft required a modification consisting of a mounted blower unit and a 28-volt, direct-current power outlet (Class II modification).[2]

The onset of Operation Desert Storm created an urgent need for protection for the tactical aircrew. The MBU-19/P was hastily modified and tested for use in high-performance fighter aircraft. While an improvement in both comfort and visibility over the older MBU-13/P, the modified mask was not recommended for type classification because of problems with excess oxygen demand and limited mission time.[3]

After the first Gulf War, the US military had six different aviation masks: the MBU-13/P (USAF), the MBU-19/P (aircrew eye and respiratory protection [AERP]) (USAF), the AR-5 variant (US Navy and US Marine Corps), the M24 (US Army and US Marine Corps), and the M43 (Type I and Type II) (US Army). The masks represented five unique solutions and had no interchangeable parts between them. With increasing cooperation between the services and new emphasis placed on integrated logistics, it was easy to see the need for a joint aviation mask solution.

Joint Services Aircrew Mask

In 2000, the Joint Services Aircrew Mask Program was initiated to develop, manufacture, and field a mask system to protect the aircrew from CBRN environmental hazards. The goal was to manufacture a product, which was similar to the AERP mask and included a hood, an oral-nasal mask and lens assembly for the head, and a battery filter-blower assembly. The objective of creating a standard mask with only minor variations between models was extremely optimistic. The designers were faced with creating a mask, from numerous helmet designs, with varying missions and cockpit requirements. The new design needed to work for the aircrews of the C-17 and KC-135 (roomy transport aircraft) and the aircrews of the F-117 Nighthawk and F-15 Eagle (cramped fighter aircraft). Additionally, the mask needed to work across the services to the Navy and Marine Corps F-18 and AV-1 Harrier. And finally, the mask needed to be easily usable with USAF helicopter requirements (UH-60 variants), Navy helicopter requirements (UH-60 variants), Marine Corps helicopter requirements (UH-1W and AH-1S), and Army helicopter requirements (including the AH-64 Apache, which had unique requirements). It was clear that it would be difficult to achieve good program results in a short period of time.

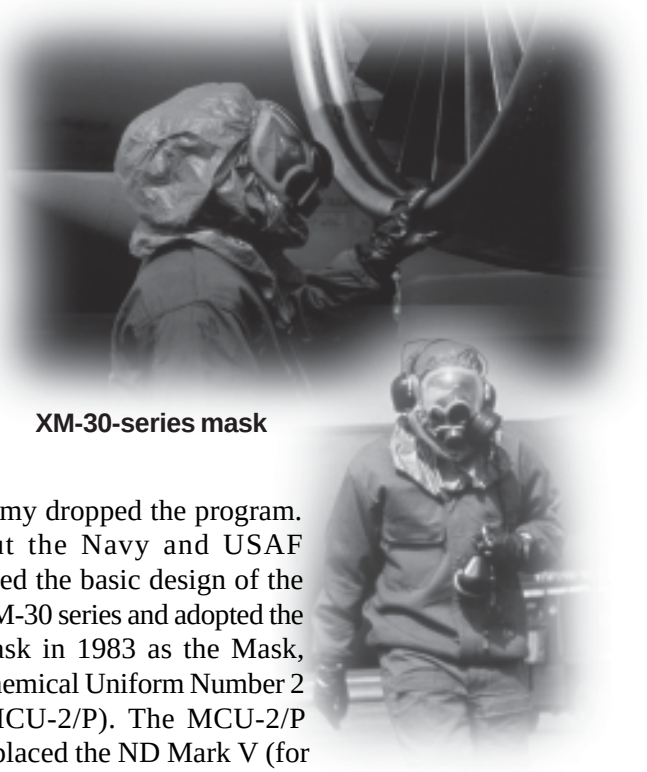
A mask program like the Joint Service Aircrew Mask (JSAM) Program starts off with a program design risk reduction (PDRR) effort, followed by a system design and development (SDD) phase and then production. The preparatory design work on the mask design is performed during the PDRR phase, and the final mask design is produced during the SDD phase.

The PDRR for the JSAM resulted in two prototype masks produced by two design teams—one from Science Applications International Corporation (SAIC) (with Scott Aviation Corporation as a partner) and one from the Gentex Corporation. These new mask designs formed the basis for the design proposals submitted for consideration in the SDD phase. Scott Aviation, rather than SAIC, submitted a mask for consideration and was awarded the contract. Gentex went on to file a protest, citing the lead switch from SAIC to Scott, but the decision was upheld after a lengthy review. Scott Aviation continues to produce the JSAM mask today.[4]

USAF General Issue Masks

When the USAF became a separate service in 1947, they brought with them the standard Army mask for nonaviators and continued to use the masks through the 1950s and 1960s. While these masks—the M3, M4, M5, and M8 (World War II masks) and the M9- and M17-series masks—were good masks, technology was advancing and new ideas emerged.

In the 1970s, the military began to explore the use of silicone for aviation purposes and for use in chemical warfare defense. Silicone was considered a wonder material because it did not produce allergic reactions and was flexible so that anyone could be fitted with a mask. Using silicone as the faceblank material, the Army created a joint program to replace the myriad of standard masks with the newly designed XM-29 and XM-30-series masks. However, after receiving unacceptable test results, the Army dropped the program. But the Navy and USAF liked the basic design of the XM-30 series and adopted the mask in 1983 as the Mask, Chemical Uniform Number 2 (MCU-2/P). The MCU-2/P replaced the ND Mark V (for forces afloat) and the M17-series masks (for forces ashore), easing a big logistical burden. The new features of the mask included two voicemitters (one for speaking and one for use with a telephone), a nose cup to minimize eye lens fogging, a spectacle insert capability, and an opening to drink from a canteen. The North Atlantic Treaty Organization (NATO) standard C2 filter canister could be mounted on either side of the face piece, and an outsert could be added for scratch and sun protection. The MCU-2/P was later altered to fit a microphone pass and was redesignated the MCU-2A/P. The new mask design, which was available in sizes small, medium, and large, was the primary mask used by the USAF during Operation Desert Storm (in addition to M17-series masks remaining in the system). Seeking to further improve the voice transmission of the mask, the USAF used the same voicemitter amplifier as the Army (the M7) and bought an improved, although nonstandard, variant.



XM-30-series mask

Joint Services General-Purpose Mask

As technology advanced, the USAF continued the search for a better mask than the MCU-2/P. The USAF is a full partner in the Joint Services General-Purpose Mask (JSGPM) program. The JSGPM is a lightweight, inexpensive, and compact mask issued to all military personnel. The JSGPM system consists of two masks: the XM50 general-purpose mask and the XM51 for armored-vehicle operators. The mask can be readily converted from the XM50 to the XM51 and vice versa by adding or removing a microphone and hose. These masks are tested against standard industrial chemicals to ensure user protection in a modern toxic environment. The objective of the program is to lower the total ownership cost for the military and, since this mask is used by all services, the initial unit cost and spare and repair parts are cost benefits. In essence, the more masks the military buys, the less each mask will cost. A reduction in overall weight and bulk is also critical, and the JSGPM mask occupies less space than a replacement MCU-2A/P face piece.

JSGPM mask

The PDRR base developmental contract for the JSGPM was awarded to Avon Rubber and Plastics on 30 March 2001. Avon is the manufacturer of the FM12 and S10 military masks for the United Kingdom and many other NATO countries. The company brought a wealth of knowledge with it when it began development on the JSGPM program, and the program continues to do well. The PDRR is complete, and the mask has been further refined. The most obvious difference from the original PDRR mask is the extended cape under the chin, which allows the mask to be used with the Joint Service Lightweight Integrated Suit Technology (JSLIST) protective suit. This variant is currently undergoing testing and is expected to go into production in 2006.

Conclusion

The USAF is a full partner in the Joint Chemical and Biological Defense Program. Through the JSAM and JSGPM programs, they are seeking improved levels of respiratory protection. While the JSAM program is technologically challenging, the USAF continues to work on developing a jointly interoperable protective mask for all aircrew personnel—USAF, Navy, Marine Corps, Coast Guard, and Army.

Endnotes

[1] *"Modification of Flight Rated Helmet HGU-15/P for Use in Protective Mask Studies: Final Report,"* Robert Controls Company, Anaheim, California, March 1971.

[2] *"Aircrew Eye/Respiratory Protection (AERP) Program Development Test and Evaluation (DT&E)-MBU-19/P Chemical Protective Hood/Mask Assembly Evaluation,"* AFDTC-TR-93-72, Eglin Air Force Base, Florida, November 1993.

[3] *"Aircrew Eye/Respiratory Protection (AERP) System"* TAC Project 86-063T, Eglin Air Force Base Florida, January 1991.

[4] *"Gentex Corporation–Western Operations,"* 25 March 2003, B-291793, B-291793.2, B-291793.3, *<http://www.gao.gov/decisions/bidpro/291793.htm >*, accessed on 22 April 2004.

Lieutenant Colonel Walk is an Active Reserve chemical officer currently assigned to the Army G8. He is a graduate of the US Army War College, the US Army Command and General Staff College, and the US Army Chemical School. He has held commands at the detachment, company, and battalion levels. Lieutenant Colonel Walk is a qualified hazardous-materials technician and a Pennsylvania Essentials trained firefighter.

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