

# MASK WARS

By Colonel Robert D. Walk

*In the beginning, U.S. protective gas masks were developed in one location—Edgewood Arsenal, Maryland, the “Eden” of gas mask creation. And the masks were good. Around the world, there were other oases of mask creation, such as Porton Down, Great Britain. But then, in 1937, the U.S. Navy had a disagreement with the mask design titans, and they left the “garden.” They (gasp!) had their masks developed and produced by Mine Safety Appliances, another titan of masks located in Pittsburgh, Pennsylvania. Thus, gas mask “Eden” was sundered and gone forever . . . or was it?*

As late as the 1980s, each Service still chose and developed its own masks and, despite some interplay, did their own thing. But mask developers, striking from a hidden base in northern Virginia, have since won their first victory against the evil “separate-Service Mask Development Empire.” The victory might be fleeting, though, as there are more battles to be won. Not all mask programs are joint, and so the work continues. Pursued by the budgeteers, our gallant mask developers and program managers must ultimately triumph to save money and restore freedom to the gas mask community.

We are involved in a mask war. Unlike the war in Afghanistan, the mask war results in no injury, death, or destruction. It is a war of ideas, contrasting concepts, competing technologies, and trade-offs in a never-ending search for the ultimate mask, which is a mask that allows the user to enter a toxic environment without vision restrictions, labored breathing, heat stress or, of course, exposure to agents. Although technological limitations do not allow for a “perfect” mask, improvements are continually made through the pursuit of perfection. The fields of conflict in the pursuit are the—

- General-purpose mask (GPM).
- Special-purpose mask.
- Aircrew mask.

## GPMs

For the GPM field of conflict, the war was over and the victorious mask crowned—the joint Service GPM, or M50 (and M51), is being fielded to the Services. And yet, there is an upstart! Another champion has emerged in the United States, and it is backed by Great Britain.

About 600,000 M50s have been produced to date, with more than 400,000 fielded to the U.S. Marine Corps, Navy, and Air Force. Army fielding is scheduled to begin in 2013. While other masks have been produced in larger quantities, this is the single largest Department of Defense (DOD) mask fielding effort since 1947. The final developer, Avon Protection Systems, Incorporated, is now producing

the mask in Cadillac, Michigan; however, since initial production, continual improvements have been made to the mask components and filter to increase system capabilities. An ongoing toxic industrial chemical/material filtration media effort should further increase capabilities. Other accessories will also be adopted through modernization. The extremely low expected ownership cost should save the American taxpayer money over the lifetime of the program.

The basic M50 is a thoroughly modern mask. It is comprised of a single lens mounted binocularly with dual, teardrop-shaped lenses and a bridge over the nose, which improves vision. To ensure low breathing resistance, the dual external filters have ingenious one-way valves so that, if necessary, each filter can be removed and replaced—one at a time—in a contaminated environment. The filters have locking mechanisms to prevent them from loosening during operations and three sealing surfaces to ensure a robust filter-to-mask seal. The filters were designed for minimal interference with weapons firing. The mask comes with a set of filters, a canteen cap, operator cards, an accessory pouch, a clear outsert with pouch, a carrier, and a waterproof bag. All masks have an electronic, three-pin pass-through to accommodate the various electronic communication devices used by the Services. The M51 variant, which is used by armored vehicle crews, consists of the basic M50 facepiece; a hose that connects it to the collective protection of the armored vehicle; a microphone; and a lightweight, rugged, flame-resistant hood. Accessories include a voicemitter amplifier, spectacle inserts, laser (green) outserts, and a sun glare (gray) outsert.

The M50 and M51 masks make use of unique, nonstandard, lug-connecting filters, which replace the world standard 40-millimeter filter connector. There are some concerns, however, with these filter connectors. According to the program managers, the reasons for using these filters include—

- A single filter can be exchanged in a contaminated environment.
- M50 filter connectors (to which M61 filters attach) address DOD Inspector General findings by

correcting issues identified during protection factor testing and by rectifying known maintenance issues.

- The filter creates a better mask profile.

The streamlined, low-profile filters are also mounted closer to the cheek (resulting in better mask balance than that provided by a single, side-mounted canister); and they improve comfort, increase the field of view to more than 85 percent, and enhance downward vision while reducing the risk of compromising seal integrity through breakage during warfighter exertion. And compared to legacy systems, the new design reduces breathing resistance by about 50 percent. Because fiscal concerns may interfere with customers' ability to purchase the nonstandard connector, Avon also offers a commercial variation (the C50), which contains a National Institute for Occupational Safety and Health-approved standard connector attached in lieu of the military filter connector. Either connector will work, but the new locking connector provides a more secure connection, which better protects the Soldier; therefore, it is the better choice.

The United States may consider the M50 to be the ultimate mask; however, some of our allies disagree. Great Britain, in particular, is developing its own, similar mask—the general-service respirator. While we used Great Britain's most experienced mask developer in the development of the M50, they used one of the most respected U.S. mask developers—Scott Safety (which also developed the M95, M98, M110, M120, and AV-3000 masks)—in the development of their mask. Scott Safety has developed a special triseal facepiece that is similar in principle to the M50—in effect, creating a mask within a mask. The mask—which is capable of being swiftly removed when necessary—can be used with any North Atlantic Treaty Organization standard-thread filters and hoses. In addition, Scott Safety has developed a filter connector that is similar to, but supposedly better than, the M50 filter connector. A secondary filter can also be used with the mask. Many excellent, user-repairable items have been incorporated to reduce lifetime ownership costs of the mask.

### Special-Purpose Masks

For special military uses, the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) has developed the M53—a truly multipurpose, chemical-biological (CB) protective mask system with enhanced capabilities. The M53 can be used as a standard air-purifying respirator or in conjunction with a powered air blower system and filter or a self-contained breathing apparatus. Standard 40-millimeter filter connectors enable the use of standard hoses to interface with blowers and self-contained breathing apparatuses.

The Marine Corps, Navy, and Coast Guard have documented their requirements for the M53 system. The Army and Air Force should review the M53 capabilities and establish their requirements as well. The Army, in particular, should carefully consider documenting system requirements—especially for special users such as Army



**A Soldier wearing an M51 mask in an Abrams tank**

National Guard civil support team members and dismantled chemical, biological, radiological, and nuclear (CBRN) reconnaissance elements. The highly capable, very adaptable M53 would make a great single-mask choice, reducing the number and types of masks that must be maintained.

The M50, M51, and M53 are well made, but bulky; and warfighters sometimes need lightweight, easily concealable masks. Consequently, mask developers created the M52 Joint Service Chemical Environment Survivability Mask, which weighs about 1.2 pounds and can be kept in a desk drawer or carried in a commuting backpack. One size fits all, and the mask is disposable, making the M52 an office worker special!

### Aircrew Masks

While most Soldiers, Marines, Sailors, and Airmen use the GPM, aircrews require specialized protection that can be adapted to their onboard oxygen systems. This need is currently being met by a bewildering variety of masks, including the M48 (Army Apache), M45 (Army non-Apache), Mask Breathing Unit (MBU)-13 (Air Force), MBU-19 (Air Force), A/P22P-14(V) (several configurations for the Navy and Marine Corps), and others—a logistics nightmare! The Joint Service Aircrew Mask (JSAM) Program was originally established to replace all of these masks with a single-mask system. However, conflicts arising from differing Service and airframe requirements forced the inclusion of variants, creating a family of systems. The family of systems includes the rotary-wing and fixed-wing programs—each with two variants. Oiy!

The overall objectives in the development of various masks within the JSAM family of systems are to—

- Keep long-term costs as low as possible.
- Make no aircraft modifications.
- Provide users with 16 hours of continuous CB protection.
- Provide users with greater comfort and fewer physiological burdens.

- Improve flexibility of use with man-mounted systems.
- Achieve compatibility with aircraft life support equipment for each Service—a particularly significant objective, considering the number and different types of aircraft in use.

There are additional requirements for each individual family of systems program.

### ***Rotary-Wing Program***

The rotary-wing program is the most advanced of the JSAM programs. In general, both rotary-wing mask variants consist of a hood with a face ring, or coif, which aircrew members place on their heads under their flight helmets when a CBRN encounter is possible. If necessary, the facepiece can be quickly connected to the coif and blower or simply to the filter. In many ways, the rotary-wing aircrew mask is reminiscent of the equipment of knights of old—with a chain mail coif to which a facepiece is attached.

The Mask Protective Unit (MPU)-5(V)/P is the standard helicopter respirator, and the MPU-6(V)/P is the AH-64 Apache variant. The developmental test readiness review for the MPU-5(V)/P is complete, and the developmental testing/operational testing phase is underway. The MPU-6(V)/P is currently in full-rate production, and fielding began this year; it is the replacement for the M48 mask throughout the Army. Unlike the M48 mask, the MPU-6(V)/P does not require a blower to ensure protection in case of emergency egress. Despite the difficult engineering challenge, the Apache variant was probably the easiest to tackle because the developers needed to please only one Service—the Army. The MPU-5 (V)/P is a bit more of a challenge due to the differing Service requirements. So far, however, Aviation Oxygen and Respiratory (AVOX) Systems, Incorporated, has met the challenge.

Design concerns to be overcome with rotary-wing aircrew masks include fitting the coif under the helmet without causing undue discomfort and enabling quick and easy mask attachment. Because each Service has its own protective headgear, fitting the coif under a specific helmet without changing the helmet presents an engineering challenge.

### ***Fixed-Wing Program***

The JSAM fixed-wing program is more complex. Three types of mask configurations are required—one for use before donning a flight jacket, one for use while walking to the aircraft, and one for use during flight. To compound and complicate design considerations, individual Service and international user requirements may conflict with one another. Whew!

There are two variants and one upgrade kit currently under development for the fixed-wing program—MBU-25, which is designed for low g-force (non-pressure-breathing [PBG]) environments (but with a PBG upgrade kit available for high g-force environments) and a mask for the JSAM Joint Strike Fighter (JSF). Masks used by fighters in high g-force environments must be capable of functioning in



**M50 GPM**

the extreme gravitational conditions created by aircraft maneuvering at high speeds. However, the ability to withstand high g-force environments is not necessarily a requirement for aircrews in other types of aircraft. It may be necessary for some aircrews to use masks at high altitudes, requiring a PBG-for-altitude capability. Despite some early contractual issues, the fixed-wing program is now well underway, with Gentex Corporation serving as the current JPEO-CBD mask developer.

The MBU-25 non-PBG mask is designed to provide a common mask that will enable breathing for crew members of F/A-18 fighter jets and other aircraft such as transports (C-17s and C-130s) and tankers (KC-46As). The MBU-25 will provide flame and thermal protection and reduce the heat stress imposed by current masks. It will also be compatible with hoodless CB-protective ensembles such as the Joint Protective Aircrew Ensemble and CWU-66/P. While designated as non-PBG, the MBU-25 will simultaneously provide CB and PBG-for-altitude protection and a PBG capability up to 7.5 g.<sup>1</sup>

The MBU-25 with PBG upgrade kit will serve as a common mask for all Service aircrew members in high-performance aircraft such as F-15, F-16, and F-22 fighter jets. Although a separate mask (the MBU-26) was a precursor to the MBU-25 with upgrade kit, careful analysis revealed that a modification to the MBU-25 could provide the necessary capabilities at a reduced cost—an important consideration in today's constrained fiscal environment. This was an amazing discovery, given the severe stress imposed on life support systems during high-speed maneuvering and, worse, when the aircrew must eject over water to survive. The MBU-25 mask system was designed for the worst-possible CB conditions, and the MBU-25 with PBG upgrade was designed to ensure aircrew survival in all

environments—a true tribute to the engineering skills of the JPEO-CBD and their contractors.

The JSF variant is an MBU-25 mask that has been further engineered to meet the requirements of the international JSF program. Many changes have been incorporated into the basic MBU-25. Specifically, the JSAM-JSF will be fully integrated into JSF pilot flight equipment and life support, communication, and helmet-mounted systems. The JSF is still evolving, and the program should be a lively one to complete.

The M53 special-purpose mask is also being used as the basis for the development of a simpler respirator to support aircrews who do not require PBG for high g-force environments. This could ultimately save millions of dollars in procurement, operations, and sustainment costs. The mask has been demonstrated to successfully perform at altitudes of up to 42,000 feet, which would support a significantly large number of aircraft and aircrews.

### Conclusion

We are fighting a mask war. At risk are American lives—the lives of people who, for the most part, know nothing of this never-ending war of ideas about the best way to protect them, thereby enabling mission accomplishment. The JPEO-CBD and their contractors are fighting the good fight to provide American Soldiers with the best GPM, the best special-purpose mask, and the best aircrew mask in the world. The struggle will likely continue forever.



Two variations of the JSAM family of systems

#### Endnote:

<sup>1</sup>*g*<sub>z</sub> refers to the vertical component of gravity.

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JSAM-JSF variant

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