A Brief History of Russian Flying Helmets and Aviator Oxygen Masks

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Some general background:

For over fifty years, factual information on a wealth of details concerning Russian military materiel and systems was successfully obscured behind a tight blanket of state-imposed security. Attributable to polar economic philosophies characterising the clash between America's system of capitalistic democracy and the Soviet Union's form of state-sponsored (Communist) socialism (during the culminating expression of that super power contention that was 'The Cold War' of the 50s, 60s, and 70s), it was not until the crushing financial burden of this competition resulted in the downfall of the Soviet State that valid information concerning many of the Russian developments in military materiel was finally revealed.

Areas of particular interest to Western military historians that were kept carefully hidden included Soviet space systems and hardware design efforts, advances in submarine and undersea weapons systems (e.g. nuclear missile submarines), and improved aviation life support/egress systems development and aircrew survival hardware.

Partly owing to the consequent extreme difficulty associated with gaining understanding of Russian military systems [note: the use of the word 'Russia' will hereafter suffice to represent both the post 1991 Russian Republic and the former Soviet Union for our present purposes], and partly attributable to the popular Western sport of *'Russia bashing'* (i.e. automatic denigration and dismissal of anything produced by Russia's defense science as technologically inferior) that was politically in vogue during the Cold War period, little serious thought and analysis was dedicated towards more objective understanding of Russian advancements in aerospace egress and life support science. (For our purposes here, one may think of *egress* in terms of aircraft emergency ejection seat systems, and of *life support* as aircrew personal equipment such as oxygen breathing systems, protective helmets, and survival gear.)

Only in the past 10 years has it become clear that the ejection seat systems used in Russian aircraft are not just theoretically highly advanced, but that they function extremely well in saving the lives of Russian pilots ejecting from their crippled aircraft. Not surprisingly, the same high standards of technological development are also to be found within the field of Russian aircrew personal life support equipment (helmets, oxygen masks, and related personal equipment used by Russian aircrew).

It is my intent in this brief assessment to examine Russian military aviation oxygen breathing masks, and to a slightly lesser extent, the protective helmets used with these masks. Although a perfunctory examination of this complex subject, and one that demands a much more intensive and more carefully documented examination, it is our hope here that at least the basic materiel parameters will be a bit more understandable upon its conclusion. I should like to mention that the accompanying table of technical details pertinent to Russian oxygen breathing masks was developed largely from an excellent table of information on Russian life support gear prepared by my friend and fellow life support historian *Alexei Gershin*, who for years specialized in aviation gear used by the Russian Air Force when it was still not a popular nor timely venue for conventional interest on the part of historians. Alexei operates a website that may be found at the URL *www.redpilot.com* and there one may see images of much of the gear in reference, as well as many technical notes on the items. Alexei deserves full credit for much of the knowledge that has emerged on this area of previously poorly understood information since the fall of the former Soviet regime in the early 90s. Without his dedicated and persistent work, many important Russian life support concepts would doubtless remain unclear to aviation historians today.

What I have presented here is intentionally limited in scope, with no attempt to provide actual images of many of the items being discussed. For that important additional asset, I suggest a visit to Alexei's website, where he has carefully gathered and assembled images of most of the applicable masks in reference. A small collection of significant images of Russian masks (and helmets) appears at the end of this paper.

Russian Oxygen mask developments:

In a manner similar to that experienced in the West, Russian developments in aircraft technology (such as the aircraft reciprocating engine supercharger) prompted corresponding urgent and parallel developments in aircrew life support technology. As aircraft flew higher into the atmosphere, the need for more sophisticated aircrew protective, life support, and survival gear developed concurrently. In the West, several early specialists doing historical research in this somewhat obscure area of historical inquiry were the previously mentioned Alexei Gershin, Alan Wise (the latter a co-author of *Jet Age Flight Helmets*, now a classic pictorial reference for ALSE historical specialists), and Mick J. Prodgear (whose unique histories of pre-WWII and WWII era flying gear stand by themselves as important illustrated aviation history reference works.

Irrespective of their actual merits, Russian ALSE developments (*Aircrew Life Support Equipment*) tended to be summarily (and undeservedly) dismissed out of hand by many individuals as being somehow either inferior, or were often regarded as being directly copied from original concepts pioneered in the West. Although many Russian technical items were not always the equal of their Western counterparts in terms of advanced materials technology employed, their theoretical designs and particularly their functional utility were continually of the highest substance. In some areas of technical investigation Russia was actually ahead of the West, just one noteworthy example being the early use of methodologies developed for fabrication of difficult to fabricate Titanium alloys.

With regard to Russian aircrew helmets and oxygen masks, a recent objective comparison of Russian life support equipment alongside American (Western) counterparts has produced some quite surprising results. One reason for these positive Russian functional comparisons was the fact that unlike in the Western defense economy, wherein a number of unrelated civilian commercial defense contractors compete for military contracts, in Russia the same organization developed *all* components of *each* aircraft specific system as an integrated package. The practical result of this was that while in the West a helmet and mask pair-up might provide a high degree (but not complete) of protection from windblast in an ejection, in Russia all components of a system (such as a protective helmet and oxygen breathing mask combination) were designed, engineered, tested, and produced by a single comprehensive production entity from start to finish. Thus it was that some Russian features such as wind blast venting holes placed in a helmet shell to relieve positive pressure from sudden wind-blast effects upon ejection characteristically functioned *very* effectively to keep a helmet and mask in place on an aircrewman's head during a high-speed ejection, since the entire system was subjected to functional testing by the same producer/manufacturer that developed and designed all of its sub-assembly components. Since the ejection seat being used by the Russian pilot was ALSO made by the same company (in most cases *RRP Zvezda*) , the chances for successful recovery of an ejecting airman were of a very high order indeed, as the *entire* range of aircrew safety systems fell under the responsibility and oversight of a single Russian defense manufacturing group.

With specific regard to oxygen breathing systems used by the Russian Air Force over the past 60 years, some of the breathing mask designs were quite original and explored advanced concepts that did not take place in the West until a substantially later date. A few examples of this are the development of the occipital bladder system that actuated during high-G aerial combat maneuvering to firmly seal the breathing mask against the pilot's face (thereby helping to retain the mask and help keep the face-seal from leaking). Another excellent innovation was the incorporation of the side-exiting main oxygen delivery hose (now commonly referred to as a *side-hose* mask) that helped lower the inertial moment of G load upon a pilot's neck by keeping the mask's mass closer to the head's COG (center of gravity). Russian helmet visors were also quite effective in working with the masks they were used with to preclude adverse wind-blast effects (experienced in high-speed ejection) and in some ways the Russian helmets performed *more* effectively than their early American counterparts (such as the early, original USAF 'P-helmet' series of the 1950s).

One characteristic of Russian design and development that has frequently been noted and commented upon in the West (as pattern that has in recent decades become clearer) is the purported Russian tendency to 'copy' Western technological developments outright. Some of the criticism directed towards this pattern of design development preference has resulted from misunderstanding and misinterpretation and some from the usual reflexive Western habit of disparaging *all* Russian technology as being somehow rude and rough.

It has been noted by several aerospace historians who are a bit more fair-minded and objective in their assessments of Russian aviation technology that Russia did not copy Western items as much to avoid researching concepts, as for the usefulness of adopting existing developments in rapidly adding knowledge to their technological database. This served to prevent and forestall needlessly re-covering previously traveled ground, as it were (eliminating having to 'reinvent the wheel', so to speak). It helps to recall that during the Cold War era, Russia and the United States were engaged in a bitter and determined contest to outdo each other in their respective bids to become the single ascendant world military power. Russia did not have as much proportionate defense funding available as the United State did during much of that period (without a consequent severe curtailment of their internal economy's development), hence shortcuts were frequently deemed highly desirable and regarded as financially worthwhile and cost-effective measures. An excellent example of this principle was the Russian retro-engineering of the US Boeing B-29 that resulted in the production of the Tupelov Tu-4 bomber.

Since Russia lacked (at that time, in the immediate aftermath of WWII) a suitable multi-engined strategic bomber, the Tu-4 provided both an interim weapons delivery system and many valuable insights into the Western technological database that enabled it (while pointing the path towards Western advancements in aircraft design). Therefore, although it was largely a 'copy' of the American aircraft, the Tu-4 bomber spurred many collateral developments along far more readily than an entirely indigenous effort would have, given the severe depredations (in technical expertise, finances, and materiel) the Second World War had forced upon the Soviet Union. It also assured Russia of having at least a temporary, stopgap airborne delivery system for its new nuclear weapons (also largely based upon 'borrowed' Western scientific advancements).

Perhaps one of the most interesting of these Russian 'design comparisons' (in aircrew life support gear) was the *Russian type ZSh-2* aircrew protective helmet and its corresponding KM-24 pressure-demand type oxygen breathing mask. At the end of what is known in Russia as 'The Great Patriotic War' (our WWII), the Soviet Union was still using soft leather flying helmets and continuous flow type oxygen masks in its fighters and attack aircraft, since most of the Soviet missions involved low-level attack. Having had the opportunity to test-use American flying gear in its *Lend-Lease* American aircraft (notably the P-39 *Airacobra*, which was extensively employed with great success by the USSR as a ground attack aircraft), Russia had already had ample opportunities to examine the American A-8B continuous flow (re-breather) oxygen mask, as well as the A-14A (demand type) oxygen mask, at close hand. The A-8B mask in particular was highly favored by Russian aircrews. These actual combat evaluations of the A-8B and A-14A masks in particular provided much valuable insight for Russian ALSE engineering specialists in formulating future aircrew needs.

Additionally, capture of German aircraft and aircrew survival gear had further afforded Russia the opportunity to evaluate the function utility of Luftwaffe gear, such as their soft leather helmets (notably the LKpW-101 series leather helmets) and Draeger/Auer designed demand oxygen breathing masks (specifically the type 10-6701 mask). Favorable impressions of the German gear had resulted in the production of later Russian counterpart designs (like the ShL-50 series leather flying helmets that used communications avionics based substantially on the German WWII earphone receiver designs) complete with integrated throat-type laryngophonic (LA-3 and LA-5) microphones.

Pre-War Russian flying helmet/mask systems: some background

Many individuals are surprised to learn of the early pioneering aeronautical research and engineering that began in Imperial Russia, under the Tsar. In fact, paralleling a strong early Russian interest in spaceflight technology and rocket technology that astonishingly reaches well back into the mid-1800s, a number of early turn-of-the-century advancements were fostered in aircraft design. Thanks to Tsar Nicholas II's brother-in-law's grasp of the coming importance of airplanes as a significant strategic weapon, Grand Duke Alexander Mikhailovitch, Imperial Russia took its first steps towards establishing an Imperial Flying Corps in 1909.

By the end of the second decade of the new century, a number of brilliant future Russian aeronautical engineers (such as Igor Sikorsky) had begun their first experiments in aviation engineering. As early Russian aircraft emerged from design studies of that era, the open cockpit was still the standard concept and aircrew protective clothing was developed to contend with the principal threat to human abilities to operate an aircraft: the severe cold and wind-effects encountered in open-cockpit flight. Aircrew clothing consequently consisted of heavily insulated leather suits, pants, coats and boots, donned with an insulated but simple leather flying helmet, and goggles. Much the same pattern is noted throughout the entire early (Eastern and Western) 1900s era. Since radio communications had not yet been installed in aircraft, no transceiver headphone and microphone equipment were used with these helmets.

Since early aircraft rarely flew above 10,000 feet, even supplemental oxygen equipment was not looked upon as a necessary aircrew need. When oxygen was needed (which was seldom), a simple continuous-flow pipe-stem system was used, as uniform in almost all early 1900s aircraft.

Only much later, during the Second World War period, spurred on by radically accelerated advances in aircraft technology that permitted higher and faster flight, was the need to design and issue more comprehensive headgear and oxygen delivery systems recognised. Due to the ferocious engagement of the Russian Air Force with the German Reich's Luftwaffe, Russian engineers soon recovered German designed aircraft and flying helmets, with their Siemens GmBH telecommunications and oxygen delivery systems, for study. The German equipment was technologically advanced, of the highest quality, and perfectly designed to facilitate optimal aircrew capability to fly and fight in the new high-speed, high-performance fighter aircraft. As moted Russian aircraft designers such as Lavochkin, Mikoyen and Yakovlev began to produce advanced Russian counterpart combat aircraft, rather than design and engineer entirely new aircrew communications and oxygen delivery systems, the German systems were adopted almost exactly as they existed in Luftwaffe operations.

This period in Russian Air Force life support development is poorly documented, with little factual historical documentation existing in terms of specific aircrew life support developments and their chronology. What we do know is that Russian aircrew protective headgear progressed rapidly from lined (insulated, usually with dog fur) and unlined simple leather flying helmets without oxygen connector fastenings or communications headphones through several newer styles. At the time this was taking place (late war period through late 40s), no apparent effort was made to specify or designate protective leather helmet models numerically (or alphabetically); labels found in these transitional leather flying helmets typically give only a date of manufacture and the name of the factory they were produced in.

At least two or three distinct Russian helmet designs emerged with communications headsets built in, one of the most universally liked among pilots being a Russian copy of the LKpW-101leather flying helmet, complete with the characteristic press-molded external leather earphone housings that instantly identify German helmets of this era. Whereas the German versions invariably used lambs' wool for insulation, the Russian counterparts used black and brown dog hair, and differing from the German practice of attaching a bilateral laryngophone microphone set-up to the rear of their helmets, the Russians used a separate bilateral laryngophone. These Russian copies of the German LKpW-101 series leather helmets used 4-pin DIN connectors identical to the German versions and in fact the electronic (radio) specifications of their communications gear were identical as well. For this reason, Russian pilots not infrequently would use a captured German leather flying helmet rather than a Russian version. Quite popular with the Russian pilots was the lightweight, ventilated *Netzkopfhaube* summer helmet during hot weather. By 1945, the Russian copy of the German LKpW-101 leather helmet was being produced and in use by Russian pilots and would remain in service until the first 'new' Russian post-war design came into service (the type ShL-50 leather flying helmet).

Pre-Korean War Russian oxygen mask developments

Due to the fact that most Second World War Russian aerial combat occurred at low altitudes (typically in the ground attack role and only occasionally in higher altitude interception missions), the first indigenous (wholly Russian) oxygen mask design did not come into use until the late 40s and Western oxygen masks such as the A-8B and A-14A masks were commonly used when Western Lend-Lease aircraft were flown during the war.

Russian experience with the continuous-flow A-8B US Army Air Corps Mask in particular had been quite favorable and the introduction by Yakovlev, Lovochkin and Mikoyan of newer, more modern high-speed combat aircraft at war's end highlighted the future Russian Air Force's need to develop its own aviator breathing masks. By the late 1940s several early Russian oxygen masks were designed and starting to enter production. These included the KM-15A, KM-15L, and somewhat later the KM-19 continuous flow aviator breathing masks. The KM-15A was a simple rubber facepiece shaped like a cup, with a small diameter hose entering at the front. Two small holes in the facepiece served to allow expired air to escape.

The KM-15L mask was a Russian design that used the same rubber facepiece cup featured on the A model, but that included a rebreathing reservoir made from latex rubber. No inlet or outlet check values were used on this mask and expired air escaped through a single hole in the front of the facepiece. Both the KM-15A and the KM-15L masks were held on the face with rubber straps that fitted around the head in the manner of USAAF A-8B masks. One characteristic feature of the KM-15L mask unique to Russian practice is the inclusion of a small tubular water trap mid-way in the small diameter oxygen delivery hose (to catch condensation of expired air, since aviator grade oxygen itself is 'bone-dry'). Interestingly, the simple KM-15 masks continued in production well into the late 1970 and were still in use in the 1980s for lower altitude military and civilian flying applications.

The somewhat later KM-19 continuous flow mask was substantially influenced by the USAAF A-8B series masks and featured an improved head-strap that held the mask securely in place. Although fairly large numbers of the earlier KM-15 masks still exist today, the KM-19 remains one of the rarer early Russian masks. By way of clarification, it should be noted that all Russian continuous flow aviation oxygen masks lacked fastening attachments to allow them to be fitted directly to leather flying helmets and it was not until the first wholly Russian diluter-demand breathing mask (the KM-16 series) came into use that the WWII two and three-point German 'ring and stud' oxygen mask fastening system was adopted, largely eliminating the old rubber/fabric head-strap system (two exceptions would be the KM-24 and KM-30 masks of later vintage, both somewhat rare today). One unique feature of the KM-19 mask that would be subsequently used on almost all Russian oxygen masks up through recent times: a chamois skin face sweat-seal layer that improved mask retention and sealing qualities.

By the end of the 1940s a further development came into use that permitted higher altitude flights in the newer and faster post-war aircraft. This was the KM-16 series of diluter-demand aviation breathing mask. The KM-16A started off this series of masks as an improved Russian interpretation of the WWII German Type 10-69 diluter-demand mask. Featuring a simple elasticized strap fastening system that hooked up to studs situated on either side of the frontal opening of a leather flying helmet, the A model lacked a third (forehead) attachment point that was introduced on the improved KM-16N model. The KM-16A also featured a corrugated rubber oxygen delivery hose in contrast to the (drab colored) fabric sheathed hose used on the later three-point retention system KM-16N model. Both the KM-16A and the KM-16N masks were initially produced with green natural rubber face-pieces, although late issue KM-16N masks were produced in black rubber. A simple rubber check-valve was used on the expiration circuit of both models, while an equally basic circular rubber one-way check valve was used on the hose inlet. This reduced rebreathing of expired air and assured a fresh supply of air-diluted oxygen that was free of expired carbon-dioxide. Both the early KM-16A and the later improved KM-16N masks came with accessory stud accessories that could be easily installed on leather flying helmets to hold them in place, since Russian leather flying helmets were *never* produced directly from the factory with these studs pre-installed (unlike many Western leather helmets immediately prior to introduction of the new Western 'hard' protective helmets). The KM-16A mask featured a spring-loaded securing clip on its distal connector (virtually identical to the German Luftwaffe type) that could be attached to clothing or a harness to hold the connector in place. With the later KM-16N mask a securing retention fastener could be installed on the parachute harness to which a stud on the mask's hose connector could be quickly secured; this securing retention fastener came with each KM-16N mask, along with the face-piece studs, as part of the original issue accessories (most used KM-16 masks found today lack both the studs and the harness retention fastener, since those did not remain with the masks). Examples of early KM-16 masks are somewhat difficult to find today, but there seem to be endless numbers of the later KM-16N masks on hand.

It is worth noting that the KM-16A mask had the molded letter 'A' encircled on the front of its outer rubber face-piece, whereas the upgraded KM-16N mask had the letter 'H' encircled on its front. It should be noted in passing that although strap-to-helmet fasteners could be easily changed on the KM-16 series masks, the original KM-16A masks were issued with old-style looped clips for use with retention studs, whereas the improved KM-16N masks came with newer hook-clips (introduced with the ShL-61 leather flying helmet) that would become a common Russian mask retention feature until adoption of a newer Russian bayonet system in the early 1980s.

Introduction of the new jet-turbine powered aircraft spurs further change

When the first Russian advanced jet aircraft designs started to be produced in the USSR, the Russian pilots were wearing the 'new' ShL-50 type helmet and LA-3 microphone (throat laryngophone) assemblies to fly the new MiG-15 swept-wing jets. As the opening rounds of the Korean War began, MiG-15 pilots were not yet wearing hard protective helmets in the cockpit, although the greatly increased aerodynamic buffeting forces encountered in jet aircraft clearly required improved head protection and mandated improved high-altitude oxygen systems (such as a pressure-demand type mask system), as well. With the MiG's substantially increased ceiling capability over that of the American F-86A model *Sabrejet*, full use of that last tactical asset could not be advantageously exploited without a concurrently enabling oxygen breathing mask; simple diluter-demand type masks were only useful up to a certain altitude and sustained flight in the upper reaches of the MiG's performance envelope could not be routinely or easily accessed without pressure-demand breathing. This was a classic case of aircraft technology enhancements spurring requisite collateral improvements in aircrew life support gear.

So it was, after examples of the US *Sabre* and its aircrew protective gear were acquired by Russia (thanks to the cooperation of the Chinese Communists), that Russia carefully examined the US Air Force P-3 type protective helmet and its standard A-13A (later to be MS22001) pressure-demand oxygen breathing mask to evaluate their suitability for jet pilot protection.

This evaluation resulted in the decision to produce a uniquely Russian expression of the American P-3 helmet that was designated the *ZSh-2 aircrew protective helmet*; limited numbers of it were manufactured and issued to selected pilots for further evaluation. A Russian version of the American A-13A pressure-demand mask was also produced and this was designated the *Russian KM-24 pressure-demand oxygen breathing mask*. Both component life support items were used together in a series of flight evaluations conducted by the Russian Air Force Research Flight Test Institute, and provided much valuable insight into contemporaneous conventional Western life support technological processes.

It is extremely interesting to note in passing that on the cover of his fascinating autobiographic book *('Stepan Anastasovich Mikoyan: Memoirs of Military Test-Flying and Life with the Kremlin Elite',* ISBN 1-85310-916-9, Airlife Publishing Company, 1999), author Mikoyan is shown wearing the Russian ZSh-2 helmet and KM-24 mask, while in the background on his left another Russian test pilot wears the ZSh-3 helmet that would shortly become standard issue for all Russian pilots in the 60s and 70s.

Despite its resembling the American P-3 helmet and A-13A oxygen mask, and although used for a brief period of time in developmental evaluations (and on a limited operational flight basis), the decision was made to not mass produce the KM-24 mask and the ZSh-2 helmet and instead rely on a Russian approach to the same problem that would be configured around the existing ShL-50 type soft leather helmet, already in use.

Again, foreign influences could be identified in the new hard Russian ZSh-3 helmet (adopted in preference to the ZSh-2 helmet), with its shell of padded aluminum metal. During the Second World War, the *German Air Ministry Research Organisation (RLM)* had begun investigating the development of hard protective aircrew helmets for use by its jet and rocket aircraft aviators. Among those designs were 'hard' helmet prototypes that featured a double-layer aluminum external shell. When the war had ended, all of the captured RLM research material was delivered to the USSR for evaluation and testing. Perhaps owing to the lack of an adequate existing polymeric textile-fibre technology, a decision was made to incorporate aluminum as a hard helmet shell material instead of a Bakelite type polymer sandwich like that found on the American P-1 through P-3 helmets.

The aluminum shell of the new helmet proved to have some advantages (it was inexpensive, easy to fabricate and fairly light) and some disadvantages (easily dented and deformed, thereby losing some of its protective extended use potential) over its American counterparts, but soon the new ZSh-3 helmet was in standard production. In electing to use the two-piece head protection model, Russia followed the same philosophy held by the United Kingdom, which developed their Mk.1 hard external shell for use over its existing 'G type' soft fabric protective communications helmet. [In the United States, the US Navy also elected to follow this path later with its subsequent H-3 and H-4 series helmets, after first trying out the one-piece (H-1 and H-2) helmet approach in the late 40s.]

Russian Oxygen Breathing Masks Continue to Evolve:

As mentioned earlier, after a brief period of experimental testing and evaluation of the American inspired KM-24 pressure-demand type mask, Russia continued to develop its own unique approach towards designing an oxygen breathing mask of the pressure-demand type to be used with its ZSh-3 helmet system, since the American A-13A pressure-demand mask was less than perfect under high-G conditions and tended to leak at the face-seal. For some relatively low-altitude flight applications, the early Russian KM-16 type demand oxygen mask was used with the ZSh-3 helmet and met with success; although essentially a highly *Russified* Draeger Type 10-6071 mask, it was not useful above altitudes of 30-35,000 feet.

After examining the post-war United Kingdom developments in pressure-demand oxygen breathing masks (particularly the British Type M pressure-demand mask), it was decided that a side-hose mask concept presented certain advantages over a design like the American A-13A mask, with its lower frontal hose inlet placement. Further, by eliminating the A-13A mask's wind-blast cheek flaps and instead forming the mask to fit over the oronasal area only (with a small chin extension) and joining the oxygen delivery hose to the right side of the mask, a far better mask-seal seemed to be attainable. The face seal was further enhanced by the use of soft chamois skin on the face contact portion of the seal.

These observations found their way into design and production of the first Russian pressure-demand oxygen breathing mask, designated the *Russian KM-30 pressure-demand mask*. This new mask, that could be suspension-configured to be used with both early ShL-50 type helmets by themselves and those used with the hard ZSh-3 external shell, had no provision for internal use of a microphone (there was no molded-in receptacle inside the KM-30's rubber facepiece as there was in the later KM-32), but it did incorporate a left-sided small-diameter hose intended to be connected to an occipital bladder (situated behind the head, external to the ShL-50 helmet). This innovative breakthrough in mask pressure-sealing capability constituted a remarkable advancement, although the mask continued to feature an upper-nose suspension cable for connection to the forehead hook of the ShL-50 helmet (like its KM-16 predecessors). The new KM-30 mask also featured an interesting hose-end demand type pressure regulator, only slightly different in function from that found on the British M pressure-demand mask (that attached to the pilot's pressure jerkin). The KM-30 mask was intended from its inception to be used with existing Russian LA-3 and LA-5 type laryngophonic microphones, since no internal facepiece provision had been made to accommodate a microphone.

A chief feature of the KM-30 mask was its reliance upon a rather roughly fabricated reddish-brown polymeric positive pressure exhalation valve that was the functional equivalent of the ingenious American MSA pressure-demand exhalation value (incorporated in the A-13A mask as far back as 1944). This valve, instead of being directed back into the incoming oxygen delivery hose inlet, used a separate small diameter hose that ran parallel to the mask's main oxygen delivery hose—a feature that would be characteristic of almost every Russian pressure-demand oxygen mask design up to the KM-36 type mask of the early 2000s. Although it was functionally equivalent to the more elegant, all metal housed American valve, what the Russian exhalation valve lacked in sophisticated craftsmanship it more than made up for its seeming roughness in rugged durability and functional dependability (this has been a characteristic of almost all Russian technology produced during and beyond the Cold war era, it would seem).

The hose juncture on the KM-30 projected slightly forward on the right side of its facepiece, however, adding some inertial G-moment neck loading stress potential, and a reevaluation of the design, consequent with the recognised need to provide an internal facepiece microphone pocket, resulted in the successive KM-32 pressure-demand mask that would become as widespread and as ubiquitous in its applications among aircrew of Russian made aircraft as the ZSh-3 helmet. One other interesting feature of the original KM-30A design was its complicated strap harness assembly that allowed it to be used with a bladder bag at the rear of the leather helmet that would enhance face-sealing. Two variants of the mask were produced, one that featured the full harness assembly and bladder bag for use with leather helmets of the ShL-50 and 61 type, and another one (KM-30M) intended to be used with hard helmets like the short-lived ZSh-2.

The 'new and improved' KM-32 pressure demand oxygen mask replacing the KM-30 type corrected the small faults of its predecessor (the KM-30M), featuring a right side exiting main oxygen delivery hose that angled further downwards (rather than forwards), and it added a molded-in microphone pocket on its left side (for use with the *MG-1 microphone assembly*, although Russian pilots seem to have preferred to use the older throat laryngophone system). As before, the KM-32 mask featured a simple clip retention device that had been in previous use to secure the mask with new hook-clips to the new ShL-61 model (introduced in early 60s).

As testimony to its substantially sturdy nature, the Russian ZSh-3/ShL-61 type two-piece helmet, worn with its KM-32M pressure demand oxygen mask (and despite its relative age), remains perhaps the most widely produced and worn protective military aircrew helmet in the entire world. The type is still in use today (2008), interestingly enough and probably shall remain so indefinitely.

With the new advances being made in the West in aircrew life support technology in the 60s, Russia actively evaluated and investigated the latest Western innovations in keeping with the previous custom. With the introduction of a brand new American mask design (the MBU-5/P pressure-demand oxygen mask) in 1959, the decision was made to design and produce an entirely new helmet and oxygen mask system for Russian aircrew. The new helmet would be a one-piece design that featured bayonet mask retention receivers that were roughly similar to those introduced with the American MBU-5/P mask, although typically, the Russian counterpart featured a few novel improvements. Among these was a method of allowing a pilot to back the mask off his face slightly without having to fully disengage the bayonets. This allowed the mask to be quickly and firmly reattached in place on the pilot's face with a minimum of fumbling, should the need arise.

A new pressure demand oxygen mask designated the KM-34 was also produced to be used specifically along with the new ZSh-5 helmet series. This mask featured a glass-fibre outer shell fitted over an inner rubber facepiece (not dissimilar in concept to the MBU-5/P principle, although quite different looking), however under that new external shell, the rubber facepiece was largely similar to the earlier KM-32 facepiece. The new KM-34 came in a range of sizes from 1 to 5 (one being 'small' and 5 being 'extra-large'), featured in internal microphone pocket and an occipital bladder outlet (just like that found on the KM-32 and the KM-30), and was manufactured in a shade of light medium green glass fibre. As usual, the actual face-seal contact portion of the mask featured a soft chamois type material—an innovation first used by the Germans in the Second World War and subsequently adopted by the Russians for all their oxygen masks. The KM-34 mask deviated from the earlier right side-hose oxygen inlet design and instead featured its inlet at the bottom front of the hard shell, just below the standard pressure-compensating exhalation vale found on all Russian pressure-demand type masks.

While relatively well received by Russian aircrew (not in part due to its excellent peripheral vision fields), the new ZSh-5 helmet and its KM-34 mask were not long after replaced by newer generational developments (this was in part due to an unforeseen poor quality of the fiberglass used that allowed cracks to develop along the lateral surfaces of the helmet). With the introduction of the new ZSh-7 series helmet, with its clever internally secured hard visor assembly, a radically upgraded version of the KM-34 and slightly improved KM-34D masks was introduced. This was the *KM-34D Series 2 pressure-demand mask* (known hereafter for simplicity's sake as the *KM-34Ds2*).

The KM-34Ds2 mask was essentially a redesign of the existing KM-34/D mask that again featured a right-side exiting main oxygen supply hose, a redesigned external polymeric face shell, an internal microphone pocket, and a left-side exiting occipital bladder connection (as on earlier masks). As with the earlier KM-34/D designs, the face contact portion of the mask had soft chamois material on its surface and the pressure-compensating exhalation valve featured the standard small diameter hose running parallel to the OD fabric-covered, corrugated main oxygen delivery hose. 5 sizes were again produced in the conventional manner. Shell colors are found to vary among the KM-34Ds2 masks from light gray to darker gray (in contrast to the KM-34/D series, which shell was made only in a light medium gray-green material). The new KM-34Ds2 mask's main oxygen delivery hose featured a standard distal connector made from aluminum, similar to that used on late KM-16, KM-32, and KM-34 masks.

With the introduction of newer aircraft types (notably the Sukoi Su-27 and subsequent advanced fighters), a further upgrade of the KM-34Ds2 mask was carried out. This was designated the *KM-35 pressure-demand oxygen breathing* *mask*. Bearing a remarkably close resemblance to the existing KM-34Ds2 mask in widespread use with the ZSh-7 type helmet, the new KM-35 design had a few subtle differences that are notable. Among these were a redesigned distal oxygen hose connector intended to be compatible with the newer life support systems interfaces featured on the Sukois. This feature worked together with a somewhat modified pressure-compensating exhalation valve arrangement to provide a slightly difference appearance to the usual parallel hoses arrangement featured on the KM-34Ds2 predecessor mask.

On the KM-35 mask, instead of the face-piece's pressure compensating exhalation valve hose being run parallel to the main oxygen delivery hose, it is joined to the main delivery hose about half-way down the length of the main oxygen hose itself. This fact is somewhat obscured by the fabric sheath used to enclose the main oxygen delivery hose, but a careful look will reveal this unique and distinctive difference between the KM-35Ds2 mask and its KM-35 type counterpart.

Aside from that, the KM-35 mask remains virtually identical to the KM-34Ds2 mask at a casual glance. It is interesting to note that KM-35 masks have been produced with both OD/sage green nylon hose sheaths and black nylon sheaths. Of interest also is the fact that a photographic image in Alan Wise's flight helmets book (*Jet Age Flight Helmets*) shows what is identified as a 'KM-35 mask'. The mask depicted is actually of a very early prototype KM-35 proposal that featured a straight distal facepiece oxygen hose inlet with combined inhalation/exhalation valve (a similar concept to the American MBU-5/P and MBU-12/P masks); on the subsequent production masks a reversion was made to the KM-34Ds2 type right-side oxygen delivery hose inlet, although the straight hose exit facepiece was retained for the distinctive NBC KM-35 mask design (curiously enough). The KM-35 mask is further positively identified by labels appearing inside its hard external shell stating 'KM-35' as well as having 'KM-35' stamped into the inner rubber facepiece (on the KM-34Ds2 masks, the inner facepiece may be stamped KM-35, but the rigid outer external shell is labeled on its internal side as being 'KM-34D series 2').

The Russian Air Force KM-35 series masks feature a light olive-drab/gray or sage fabric oxygen hose cover, while the Russian Naval Air Arm KM-35 masks feature a high-visibility orange fabric oxygen hose sheath (intended for use with the VMSK-4/5 orange naval aircrew survival/pressure suits and an orange painted ZSh-7 or GSh-6 helmet). Both the KM-34Ds2 and the KM-35 type masks remain in active service among Russian aircrews today (2010).

One of the most recent Russian pressure-demand oxygen breathing masks, although not yet in current widespread distribution, is the new *KM-36 pressure-demand oxygen breathing mask*. A Russian counterpart to the West's (American) MBU-20/P design (*Combat Edge* and *HA/LP* variants), the new KM-36 mask bears a superficial resemblance to the American MBU-20/P design with its lightweight cut-away exoskeleton face shell. An early prototype KM-36 mask is shown on Alexei Gershin's *RED PILOT* website that originally incorporated a metal external shell rather than a polymeric shell (as found on the MBU-20/P); the prototype also differed in its suspension fastener system and several other smaller details. As of this date (November 2010), the KM-36M mask has been finalized as a discrete standardised design and is reportedly in limited production and select distribution. Presumably, the KM-36M pressure demand mask will be used with the latest Russian flight helmets such as the new ZSh-90 model, using existing Russian bayonet suspension. Since the production and distribution status of the new KM-36M mask is uncertain (at least insofar as Western knowledge of its developments is concerned), the existing KM-34Ds2 and KM-35 masks remain in active daily service among Russian Air Force and Naval Air Arm aircrew as standard Russian life support personal equipment for the foreseeable future.

A further pressure-demand oxygen breathing mask developed and produced in Russia for use mainly on rotary wing aircraft and transports is the KM-37. This mask uses a KM-35 type rigid facepiece with a small pressure-demand regulator affixed to its frontal aspect (very much like the Scott Aviation/EROS civilian airliner crew emergency mask) that is linked via a small diameter high-pressure hose to the aircraft's main on-board oxygen system. Like the KM-34Ds2, KM-35 and KM-36 masks, it is issued with a built-in microphone inside the facepiece. [Note: a special version of the KM-35 mask was also produced in the same configuration as the KM-37 with a distal facepiece mini-regulator attached, but for limited issue and operational flight testing use only; the mask is designated the KM-35i-2].

[Note: Immediately below appears a data table that highlights the important chief features and characteristics of the Russian masks; this is a modification drawing substantially upon original material researched and produced by my esteemed colleague Alexei Gershin of WWW.REDPILOT.COM]

SOVIET / RUSSIAN AVIATION OXYGEN MASKS (after Alexei Gershin: www.redpilot.com/)

Oxygen Mask (*'helmet-used-with'* in brackets) Please note that the English equivalent of the Cyrillic alphabet has been used here to keep things less confusing (i.e. Russian 'H' = English 'N', etc.)

KM-15 (ShL-50) This simple continuous flow type mask features a black rubber face-cup with a small diameter inlet hose and two holes in the face-cup for exhaling air (no rebreather bag attached).

KM-15B (ShL-50) A rare variant diluter demand mask, uses a KM-15 rubber face-piece fitted with inspiration and expiration valves, with corrugated oxygen delivery hose. Uses heads-strap for retention.

KM-15I (ShL-50) An upgraded and improved KM-15 continuous flow mask featuring a single hole in the black rubber face-cup for exhaled air and a latex rebreathing bag attached to its lower aspect. A small glass tube is fitted inline on the oxygen delivery hose to catch condensation. Both the KM-15 and KM-15i use a rubber head-strap retention system; they are not attached directly to the helmet (such as with studs, hooks, or bayonets).

KM-16A (ShL-50/61) Replacement of the earlier KM-15 mask and used as simple low-altitude demand mask; based closely on the WWII German Draeger 10-6701 mask. The KM-16 type mask is still in limited use today with helicopter pilots. Early original model used a bakelite type plastic connector of reddish brown or black color. Demand type mask. Available in black (later) and green (early) colors, but not often found today, the mask is immediately identifiable by its lack of a forehead wire attachment and its unique single elasticised fabric strap (with hook loop) on each side. The *Cyrillic* letter A is molded within a circle on its outer, frontal aspect. A small rubber bite black is found inside the mask that its wearer could grip in his teeth for mask enhanced retention during high-G maneuvers. A simple rubber inlet and exhalation check-valve system is used to direct airflow within the facepiece.

KM-16N (ShL-50/61, GSh-3) Modification of the original KM-16 mask. Late model readily identified by anodised blue aluminum connector. Demand type mask. The principal improvements consist of a "Y" configured green nylon strap on each side of the mask (that attach to lateral clips on the leather flying helmet) and a forehead attachment point of either a thin-diameter wire and clasp or stamped metal hook. Chinese version is the YM-6503 (green or black rubber). Otherwise similar to the earlier KM-16A model in most all aspects. Chamois is used to line the facepiece for enhanced sweat-seal. (Lateral *clasp* attachment hooks issued with this mask may be exchanged quickly and easily for earlier *loop-hook* types).

KM-18 (ShL type helmets) A 'Russified' version of the US made A-8B oxygen mask. Continuous flow (re-breather) type mask. Possibly used with ZSh-2 helmet.

KM-19 (ShL type helmets) A Russified modification of the USAAF A-8B continuous flow oxygen breathing mask that used a rebreather bag (similar to that found on the KM-15i) and incorporated bilateral circular sponge discs for exhalation (sponge enhanced anti-icing effects). Somewhat rare and difficult to find today.

KM-24 (ZSh-2, a copy of the US P-3 helmet) A Russian version of the US made MS22001 pressure demand oxygen mask; this mask and the ZSh-2 helmet worn with it are very rarely found today and are quite costly when a specimen set is located. Had a unique appearing pressure-regulator on the distal hose end; chamois lined face-piece for enhanced sweat-seal. Made in two variant subtypes, it featured a complex nylon fabric head harness system allowing it to be used with both clip-equipped leather flying helmets and hard helmets (such as the ZSh-2 type). No provision within the facepiece for a microphone. The KM-24 mask used a forehead hook as a third point for securing the mask to either an ShL-61 type helmet or a hard-shelled ZSh-2 type.

KM-30 (ShL-61 & ZSh-2) Next major Russian oxygen mask upgrade since KM-16. Pressure-demand type. This is one of the first Russian masks that allowed attachment of an occipital bladder, although the bladder was worn on the back of the pilot's head over the leather helmet. No built in microphone, pilots relied on the

La-3 and La-5 neck mounted microphones. Used a pressure regulator mounted at hose end. A complete issue included the mask, its occipital bladder, hose-end regulator, and a carrying satchel. Occasionally found today without the hose-end regulator or bladder assembly, but still rare in any configuration.

KM-30M (ShL-61 & ZSh-2) No information available; presumably an improved version of KM-30, since 'M' represents the Russian term for 'modification'.

KM-32 (ShL-61, ShL-78, ShL82, ZSh-3, etc.) The most common Soviet/Russian pressure-demand type oxygen mask. It was used both with ZSh-3 assembly and leather helmets alone. Available in black (late model) and green (early models) colors. This mask contains a connector for the occipital bladder located within the back of (under) the leather helmet. The bladder was filled with air as pilot started doing high-G straining maneuvers, an act which pushed pilot's head firmly against the mask and allowed a better face sweat-seal. Most of KM-32 masks do not have built-in (MG-1 type) microphones installed, although the mask had provision for one (pilots preferred to rely on the neck mounted La-3 and La-5 microphones). Virtually the same Chinese version of this mask is the YM-6504 mask (green or black rubber). One rare variant of the KM-32 mask featured a hole situated directly over the front of the facepiece, allowing a rubber plug to be removed from it for purposes of drinking water through a tube.

KM-32AG (ShL-50, ShL-61, ZSh-3, etc) Facepiece same as KM-32 in almost all respects, but has early-style loop-hooks that allow it to be used with older ShL/Z-50. Mask is also missing occipital bladder connector and the smaller diameter oxygen hose that connects to the front of the mask, since it is strictly a demand mask and *NOT* a pressure demand mask; uses a simple frontal exhalation valve with one-way check diaphragm where the standard KM32 mask's pressure-demand exhalation value would be located. The KM-32AG mask lacks the third-point forehead securing hook found on all other KM-32 masks.

KM-32 NBC (NA) This mask covers the whole face of the pilot and is held in place with upper and lower rubber straps running around back of head (as on gasmasks). Outside shell is made out of rubber for a better seal and there is no chamois skin layer on the face-contact sweat-seal portion. Top part of the mask is made out of clear plastic, while bottom part contains the oronasal oxygen mask itself, as well as a built-in microphone. Similar to whole face Russian GP-7 type gasmasks in concept and does indeed look like a 'gasmask'.

KM-34 and KM-34D (ZSh-5) This pressure-demand type mask was designed specifically for the then-new ZSh-5 helmet and is essentially just a distinctly modified KM-32 rubber inner facepiece with an outer KM-34 type fiberglass shell. Mask is attached to the (ZSh-5) helmet with bayonets and as such cannot be used with earlier made ZSh-3 or any of the leather helmets (unless the attachment fasteners are changed out). As with previously made KM-30 and KM-32, this mask has the attachment for the occipital bladder (which was secured inside the ZSh-5 helmet's aft liner). KM-34D does not have a built-in microphone; pilots relied on the La-3 and La-5 neck mounted microphones, although a mic kit can be added to mask, if desired.

KM-34D series 2 (ZSh-5, 7, 90) This is a major upgrade of the KM-34D pressure-demand type mask. Made in 5 sizes (1=small, 5=extra-large) and intended principally for use with the new ZSh-7 helmet, but could be also attached to the earlier series of ZSh-5 helmets. Mask has a built-in microphone. Connector for the occipital bladder is installed, exiting face-piece on the left side, with main oxygen delivery hose exiting on right side of face-piece. The bayonet attached facepiece features a main delivery hose and exhalation valve hose arrangement similar to the KM-32 and KM-34D masks but is often mistaken for a KM-35, due to similarities between the two masks. Corrugated, fabric-clad OD and black hoses may be found on KM-34d2 polymeric face-pieces molded in several hues of gray (from light to dark).

KM-35 / KM-35M (Zsh-5, 7, 90) Further development of the KM-34D series 2 mask. This pressure-demand type mask is likely used only in certain Su-27 and MiG-29 (or newer) fighters and is not interchangeable with older versions of oxygen masks; it is typically used *only* with type ZSh-7 helmets, though it may be attached to and used with the older Zsh-5 helmet. The primary difference between the earlier KM-34Ds2 mask and the KM-35 series is that the positive pressure exhalation valve merges directly into the main oxygen supply hose on the KM-35 about half-way down its nylon cover (on the quite similar KM-34Ds2 mask, this valve is fed by a separate oxygen hose of smaller diameter that runs *parallel* to the main hose for its full length). The original KM-35 prototype featured a distal front facepiece hose exit (no right-side hose attachment), one example of which is shown in the Wise & Breuninger book, 'Jet Age Flight Helmets'; the final production models featured a side-hose exit. The mic connector found on KM-34Ds2 masks and KM-35 masks may have either a two-pin or a three-pin microphone-to-helmet connection (KM-35Ds2 masks typically use a two-pin connector). Both the KM-34Ds2 masks and the KM-35 masks have identically sized rubber boots over their exhalation valves, although due to the angle of some photographs it may appear as if there is a slight difference between the two types. The KM-35 mask may have either sage-green, gray, or black nylon fabric loosely sheathing its main oxygen delivery hose (late models tend to the black color) and the face-pieces may be molded in a range of gray polymeric colors (from light to dark). [Note: The Chinese version of the Russian KM-35M mask is designated the YM-9925 mask and it is readily identified by its overall jade-green facepiece and hose assembly.]

KM-35-I-8 (ShL type helmets) Experimental version of KM-35 mask with old style hooks for attachment to leather helmets and typically flown in rotary-wing or slow-movers. Small mini-regulator attached to front of polymeric KM-35 style face-piece, with woven fabric-covered, small diameter high-pressure hose attaching to aircraft oxygen supply. Rare. Intended principally for use with a special titanium shell version of the ZSh-7 helmet in rotary wing combat aircraft.

KM-35MS (ZSh-5, 7, 90) A variant version of the KM-35M oxygen mask, designated KM-35MS is used with ZSh-7AN helmet (Navy). The Russian Naval Air Forces version of the KM-35 mask, readily identifiable by its bright orange high-visibility oxygen hose nylon fabric cover and flown on some carrier-based Russian Naval aircraft. Uses a lower impedance microphone than Russian Air Force versions (with gray-green color nylon fabric hose covers). Further information unavailable at this time, but some specimens have emerged (esp. on eBay) in recent years.

KM-35I NBC (Compatible ZSh-5,7,& 9) Very similar in intent and general configuration to predecessor, KM-32 NBC mask, except that hose exits distal facepiece and not from side, as on KM-34Ds2 and KM-35 and KM-35M masks. Uses same polymeric lower frontal mask shell as that found on the KM-35 prototype mask (Alan Wise's *Jet Age Flight Helmets*)

KM-35AN (NA) No information available on this mask at present, but it appears to be a modified KM-34Ds2 mask with a special exhalation pressure hose assembly. Perhaps a prototype for the KM-35M system or perhaps a special purpose application mask (see picture in images section).

KM-36 (ZSh-90) This is one of the newest Russian pressure-demand type oxygen masks. Designed as a Russian answer to the new US MBU-20 and 23/P series masks, the prototype featured a metal exoskeleton over a rubber facepiece, and was fitted with a left side-hose. The production model, designated the *KM-36M pressure demand mask*, features a lightweight polymeric exoskeleton (with right-sided oxygen hose inlet) that bears some similarity to the American MBU-20/P design, but also to the earlier KM-35 mask. The positive pressure exhalation valve appears to share functional similarities with the British P-mask and the American MBU-20/P and HA/LP series masks. Although the exact status of this latest Russian fighter aircrew oxygen breathing mask is uncertain, it is felt to be already in limited production and distribution to select Russian crews for further flight testing and evaluation. No specimens have yet emerged in the West in private hands to date (November 2010), to the best of our knowledge. The mask is intended to be used with the newer ZSh-90 type helmets, although our understanding is that it may be used with the ZSh-7 as well.

KM-37 (ShL, ZSh-7 and ZSh-90 helmets) This mask has a polymeric face-piece with what appears to be a much improved and size-reduced pressure regulator installed directly into the lower frontal shell, connecting via a woven-fabric covered high-pressure hose to the aircraft main oxygen supply. A more elegant and well designed rotary-wing combat and slow-mover pressure-demand oxygen mask along similar lines to the earlier experimental KM-35-I-8 mask. It uses special leather attachment tabs that may be installed on or fitted to any Russian flight helmet in current use.

USEFUL RESOURCES:

The Red Pilot
http://www.redpilot.com/index-eng.html
This web reference by Alexei Gershin is perhaps the single best combined

referenced resource on modern Russian (ex-Soviet) aircrew flightgear. A wonderful source for both factual documentation and excellent images of the items discussed and categeorised.

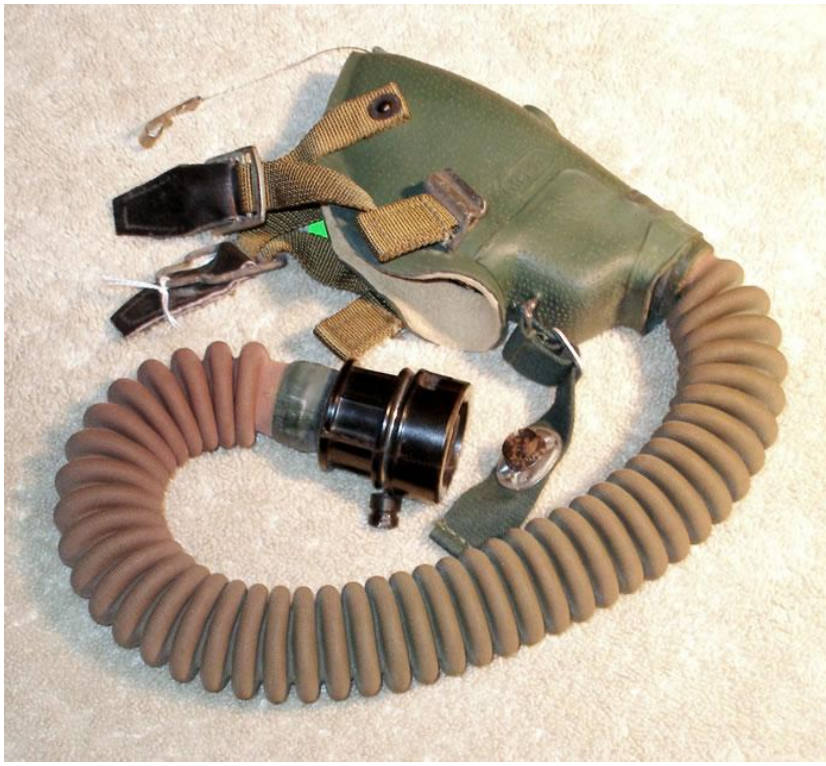
Gauntlet International
http://www.gauntletinternational.com/helmets/SovFlite.htm
A web reference URL maintained by Major Craig Martelle, USMC (ret). Craig carried out a number of interesting assignments in former Soviet Bloc nations and was particularly interested in Russian/Soviet aircrew flight gear. His resources remain excellent for reference and data on this subject.

Jet Age Flight Helmets
http://www.amazon.com/Jet-Age-Flight-Helmets-Aviation/dp/0764300709/ref=sr_1_1?ie=UTF8&s=books&qid=1263059112&sr=1-1
Although now a bit dated and containing several assumptive errors, this archetypal photo-illustrative reference by co- authors Mike Breuninger and Alan Wise remains an excellent source of visual detail on Russian aircrew flight helmets (and flight helmets in general). One of those books any serious student of aircrew life support history should have on the reference shelf.

A small selection of reference illustrations follow

(Below left, Russian KM-15I continuous flow rebreather; below right, KM-16A face-piece detail)

Below: The German Draeger 10-69 influence is clear on this KM-16N type mask)



(below: The KM-32P variant, allowing hydration through port while in use)

(Below: The KM-32AG, diluter demand version of standard KM-32 pressure-demand mask)

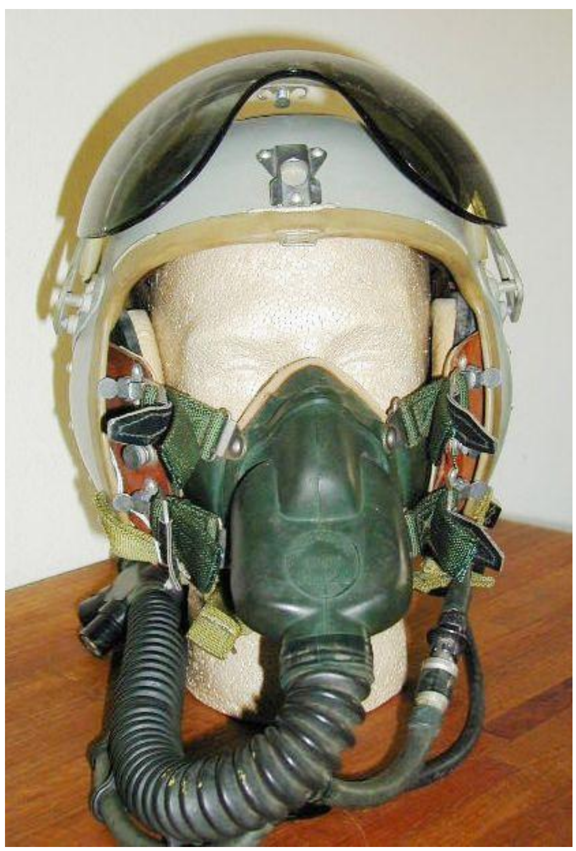
(below: Detail of the simple exhalation valve used on the KM-32AG diluter-demand mask
to replace the pressure-demand exhalation valve used on the KM-32; note that this is the same
exhalation valve used on the early KM-15B diluter-demand mask)

(Below: SzH-82 soft leather helmet worn...usually under ZSh-3 hard outer helmet...with standard KM-32 pressure-demand oxygen mask.)

(Below: "Standard" Russian KM-34 mask face piece)

(Below: Russian KM-30M pressure-demand mask, KM-32 precursor;
the mask used a distal hose end pressure regulator)

(Below: The Russian KM-30M pressure-demand oxygen mask, worn with the
equally rare US-knock-off ZSh-2 helmet, patterned after the USAF P-3)



(Below: A very useful comparison of the primary visual differences between the early Russian KM-35—left—and the visually similar KM-34D2 mask—right)

(Below: The Russian KM-35 *prototype*, never put into production)

(Below: Closer detail of the Russian KM-34D-Series 2 mask)

(Below: Closer detail of an early version Russian AF KM-35M mask—compare with following image)

(Below: earlier model Russian AF KM-35M mask—note sage colored nylon hose)

(Below: Russian Naval Air Arm KM-35MS mask, characterised by distinctive high-visibility orange nylon hose cover—used in Yak-38 and Yak-41 carrier aircraft)

(Below: Specially equipped ShL helmet with KM-30 mask and occipital bladder)

(Below: KM-34D-R variant mask; note unusual modified metal expiry valve)

(Below: Note KM-30 mask in use with specially fitted ShL type helmet)

(Below: KM-19 mask; note sponge disc outlet valves)

(Below: Two views of the Russian KM-35 NBC variant mask)

(Below: Russian KM-36 pressure-demand mask *prototype*)

(Below: Another view of the KM-36 mask)

(Below: Two views of Russian KM-36M production mask, note differences with prototype)

(Below: Two views of the Russian KM-37 pressure-demand mask with built-in regulator; the helmet is a special titanium ZSh-7 type used in combat rotary-wing aircraft)

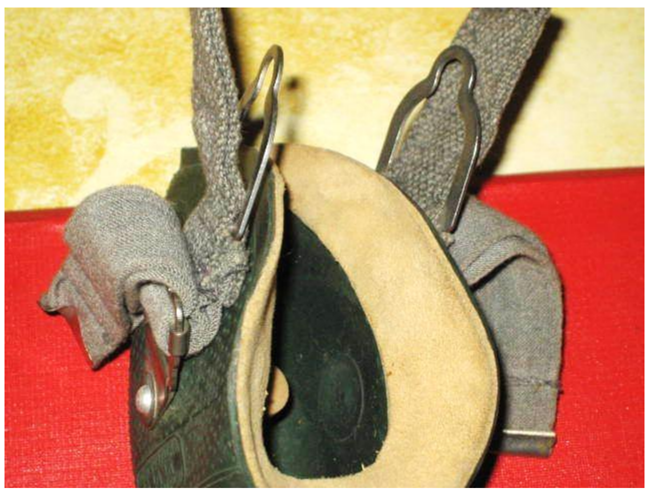
(Below: Russian KM-35-I-8 pressure-demand mask with mini regulator on face-piece)

Below: New style Russian ZSh-90 helmet with a KM-36 pressure-demand prototype mask)

(Below: Russian ZSh-90 helmet, rear left view)

(Below: North Korean defector No Kum-Sok in his 1953 Chinese MiG-15 flight gear; shown is the Russian ShL-50 leather helmet and Russian KM-16A oxygen mask)

(Below: The following sequence of images show details of the early KM-16A mask, directly influenced by German WWII Draeger 10-69 aviation mask and the first 'modern Russian diluter-demand design, post war.)

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(Below: Russian Air Force engineer & test pilot Stepan Mikoyan wearing ZSh-2 helmet with KM-24 pressure-demand mask in mid 1950s; these were unique Russian copies of the US P-3 and A-13A; note Russian ZSh-3 helmet just barely in view at right edge of image, in background)

(Below: Very rare early diluter-demand version of KM-15 mask, the KM-15B)

A NOTE ON RUSSIAN OXYGEN MASK SIZING:

Russian oxygen mask sizes are five in total, ranging from very small (Size 1) to very large (Size 5). An average Russian face will take a Size 2 mask. Russian flight helmets (data NOT applicable to pressure helmets) used with these masks come in three sizes, ranging from small (Size 1) to large (Size 3). A Size 2 helmet corresponds approximately to an American hat size of about 7 1/8.

IMAGE ACKNOWLEDGEMENTS:

My most sincere thanks to the following individuals for use of their photographic images of some of the masks described here. I have a great number of similar images of my own, but shamefully, my files are so voluminous and disorganised, I find it sometimes more expedient to borrow images, rather than waste time prowling through my own disorganised archives to find just the right one.

Alexei Gershin (of www.redpilot.com), Mark Sindiong (a fellow collector and researcher in Hawaii), Alan Wise (author and collector), Craig Martelle (of Gauntlet International); if I have used any of YOUR images and not acknowledged their use, please contact me so that appropriate credit may be given. Thank you!

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[Updated: 25 November 2010]