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Key Points

The U.S. Air Force has suffered a persistent shortage of approximately 2,000 pilots for over twenty years, with fighter pilots comprising over half of this shortfall. This gap severely degrades the Air Force's combat readiness and ability to prosecute a peer-level warfighting campaign.

Pilot experience is a critical advantage in combat air operations. Experienced combat pilots have higher mission effectiveness rates, can adapt to unpredictable adversaries, and are crucial to maturing the skills of new pilots.

Combat squadrons need a healthy ratio of experienced pilots to ensure the Air Force can prevail in a peer-level conflict. This ratio is much greater than the minimum viable needed for peacetime operations. The Air Force must establish this higher ratio well prior to conflict since it takes years to generate an experienced pilot.

The Air Force must recapitalize and grow the capacity of its combat air forces to deter and, if necessary, fight and win in a peer conflict. This requires a concurrent growth of its combat pilot corps, or it could further strain the readiness of its Active Component (AC) squadrons by reducing their pilot experience levels.

The Air National Guard and USAF Reserve, the Air Force's Reserve Component (RC), capture experienced pilots exiting its Active Component squadrons and often retain these pilots until they retire. Taking full advantage of these accessions would help the Air Force to grow its cadre of experienced combat pilots across the Total Force.

Current Air Force plans seek to divest nearly a quarter of the service's combat aircraft inventory over the next five years, and the bulk of this divestment is in its Reserve Component. Migrating RC units away from combat flying missions risks irreversibly losing this crucial pilot experience. Recapitalizing the Air Force's RC and AC combat units in parallel will be key to affordably growing the size and experience levels of the nation's pilot corps to meet warfighting requirements.

Want Combat Airpower? Then Fix the Air Force Pilot Crisis

by Heather R. Penney

Senior Resident Fellow, the Mitchell Institute for Aerospace Studies

Abstract

The Air Force's pilot corps is now too small and poorly structured to sustain a healthy combat force that can prevail in a peer conflict and meet the nation's other national security requirements. History has demonstrated that without the strategic depth of experienced aircrew and aircraft, air forces collapse in conflicts because they cannot flow enough forces forward to continue operations as losses mount. While this crisis extends across the entire pilot corps, the shortfall in fighter pilots is especially dire, comprising over half of the shortfall.¹ Fighter aircraft are foundational to establishing air superiority, suppressing and destroying surface-to-air missile defenses, interdicting time-sensitive and mobile targets, and supporting troops in contact—all missions that are essential to effective joint force operations. Combat pilot *experience* is equally critical to success in peace and war. Experienced pilots have better survivability rates and mission outcomes in combat and confer those benefits to their less experienced wingmen. The Air Force's combat pilot experience levels continue to drop as the service suffers from ongoing budget-driven force cuts and reduces opportunities that are essential to pilot career progression.

The solution to these challenges requires the Air Force to increase its aircraft inventory, grow its pilot corps, and experience its combat pilots across its Active and Reserve Components—its Total Force—simultaneously. Leveraging the depth of pilot experience in the Reserve Component (RC) should be a major part of this solution. The RC represents the bulk of the nation's experienced combat pilot corps, as many of the seasoned pilots who exit the Active Component continue to serve in the Air National Guard or Air Force Reserve. Pending actions to decommission RC combat squadrons risk losing this experience, further depleting the Air Force's warfighting capacity, and devastating the Air Force's ability to fulfill the nation's current and future global security requirements: defend the U.S. homeland, deter nuclear threats, and remain ready to prevail in a major conflict with a peer adversary. To meet these goals and succeed in a great power conflict, the U.S. Air Force must:

- Recapitalize nearly its entire inventory of combat aircraft
- Increase its combat capacity by growing force structure
- Grow and preserve its Active and Reserve combat pilot corps commensurate with the size of its combat aircraft inventory and create enough strategic depth to replace aircraft and airmen lost in combat

Each of these actions requires the thoughtful addition of budget and resources, consistently and predictably. By optimizing the balance of combat aircraft and pilot training across its Total Force, the U.S. Air Force can grow and retrain its cadre of experienced pilots while accelerating the absorption of new.

Introduction

U.S. Air Force airpower is on the verge of collapse from both an aircraft inventory and human capital perspective.² The service is already stretched thin to meet unrelenting rotational and contingency response demands around the globe. In a high-intensity, peer conflict, the Air Force does not have the depth of forces—not aircraft nor pilots—it needs to withstand combat losses and sustain effective combat operations at the scale, scope, and speed necessary to prevail. It takes years to build an experienced combat pilot, and the Air Force may not have the time to produce, train, and season new replacement pilots at the pace of need. The U.S. Air Force must have a strategic reserve of aircraft and experienced combat pilots that can seamlessly flow forward to replace losses and sustain effective and war-winning combat operations. But the service has suffered a chronic pilot shortfall for decades that it has been unable to resolve. In 2024, the service was short by nearly 1,850 pilots. Of those vacancies, 1,142 were fighter pilot billets.³ The U.S. Air Force must work now to resolve its persistent pilot shortfall, especially its experienced combat pilots.

History shows that experienced combat pilots have better survivability rates and superior mission outcomes, which are essential for an air force to be successful. Experienced pilots are even more critical if U.S. air forces are outnumbered, as would be the case in a future conflict against China's People's Liberation Army (PLA). Survival in war is never guaranteed, and even the most seasoned pilots can be lost in combat, driving a need for greater experience ratios in war than peacetime operations require. An air force needs a large enough corps of experienced pilots so that it can continue to employ the right mix of newly trained and experienced pilots throughout a conflict. As new pilots are trained and sent forward into

Two components make up the Air Force

The U.S. Air Force has two components: the **Active Component (AC)** and **Reserve Component (RC)**. Together, the AC and the RC make up the Air Force's "Total Force." AC forces are what most people think of as "active duty" and are the nation's first responding air forces. The Air Force's Reserve Component has two organizations: the Air National Guard (ANG) and the USAF Reserve (USAFR). RC airmen (in either the ANG or USAFR) are typically "part-time," balancing a civilian job with their service. Historically, the AC was large enough to use the RC as an attrition reserve. Consequently, the RC flew older aircraft that had been retired from the AC and often did not have the advanced capabilities or level of training and proficiency as the AC. Today, the AC is too small to sustain peacetime deployments alone and relies on the RC as an operational reserve that routinely deploys alongside AC squadrons with like-capability and employment. RC airmen often begin their service in the AC and join the Reserve Component after their initial active-duty service commitment (ADSC) is completed—for pilots, this is typically at the 10-year point where they have become experienced instructor pilots. Given the high exit rates in the AC and the different accession points between the two components, the RC has a significantly larger ratio of experienced pilots than the AC. This also means that there are significant interdependencies between the two components that must be recognized and honored if the Air Force is to optimize for the global security challenges the nation now faces.

combat to replace losses, the force must retain enough experienced pilots to successfully lead formations and missions. Importantly, as the United States prepares for the high possibility of peer conflict in the next decade, it can no longer assume most operations will occur in permissive environments, resulting in near-zero loss rates, as it has done for the past thirty years. Combat attrition must be anticipated to credibly deter technologically capable and

numerically robust adversaries. Numbers matter—if an air force does not have enough experienced pilots in reserve, it reaches a tipping point where it begins to hemorrhage its forces and loses efficacy in combat, just as Germany and Japan experienced in WWII.

Growing the size of the Air Force's pilot corps is key to fielding a war-winning force, but this cannot be accomplished without seasoned pilots who can survive and be mission-effective in a highly contested battlespace. The U.S. Air Force must grow and retain its *experienced* pilot corps as well to successfully employ these capabilities across the range of conflict in any theater around the globe. This is an existential imperative for the Air Force and the nation.

The Air Force's shrinking force structure is directly causal to its pilot shortage. Three decades of divesting infrastructure and force structure while deferring recapitalization have left the U.S. Air Force at a point where its capabilities and capacity may no longer meet the needs of the nation. Fiscal pressures drove the Air Force to continuously downsize its force structure and talented manpower. As a result, aircraft retirements have outpaced procurements for too long. Many senior Air Force leaders warned for years of the risks to the nation if it does not modernize and grow the Air Force. General David Goldfein, then Chief of Staff of the Air Force, stated in 2016 that the service was “too small, too old, less ready, and out of balance for the challenges that we as a nation are going to face.”²⁴ Then-Secretary of the Air Force Heather Wilson agreed, cautioning in 2017 that “we are too small for what the nation expects of us.”²⁵

General Larry Spencer, former Vice Chief of Staff of the Air Force with experience as the Joint Staff's director for force structure, resources, and assessments, continued to sound the alarm in 2018, explaining that “a glaring vulnerability of the world's greatest air force is it is too small for its multiple

assigned missions.”²⁶ General Mark Kelly, then Commander of Air Combat Command, stated in 2022 that the Air Force needs at least 60 fighter squadrons to meet its concurrent responsibilities of homeland defense, overseas contingencies, overseas presence, and crisis response.⁷ Despite these warnings, the U.S. Air Force has only continued to shrink, divesting core capabilities and aircraft without on-hand replacements. This deleterious dynamic is particularly concerning in the Air Force's combat aircraft, where inventories and pilot numbers continue to decline.⁸

During the Cold War, when the United States last confronted a peer adversary, the Air Force possessed 422 bomber and well over 4,000 fighter aircraft.⁹ Today, America faces a more complex array of peer threats around the globe. Yet, the U.S. Air Force's combat aircraft inventory is the smallest that it has ever been in its history: roughly 160 bombers and just over 2,000 fighter aircraft, averaging nearly 50 and 30 years old, respectively. The age of these aircraft has adversely impacted their readiness levels, thereby reducing available capacity. In 2023, the last year that the Air Force made mission-capable rate data available to the public, no bomber fleet exceeded a 60 percent mission-capable rate. Fighters reported between 52 percent and 69 percent.¹⁰ The U.S. Air Force's combat aircraft are well past their service design life, with most lacking the attributes and capabilities necessary for peer-level conflicts.¹¹

The Air Force must now recapitalize nearly its entire inventory of combat aircraft and grow the size of its forces if it is to meet current peacetime rotational and training demands *and* be ready to fight and prevail in a complex and protracted peer conflict. This means the service must grow its pilot corps concurrently while retaining experienced pilots—both in the right ratios in squadrons and with the strategic depth needed across the

Total Force that a peer conflict would require.

For the Air Force to recapitalize, grow its force structure, and increase the size of its combat pilot corps, it must mitigate the stresses recapitalization and growth impose on its pilot corps. Namely, these efforts could slow pilot absorption and dilute pilot experience levels in its operational squadrons. To address these tensions, the Air Force must preserve as much experience as possible in its pilot corps across the Total Force. Failing to do so could risk further collapsing the Air Force's combat

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readiness. As it stands, the U.S. Air Force's chronic pilot shortage now presents a major barrier to recapitalizing and growing its force structure. The U.S. Air Force has suffered this shortfall for well over a decade, but aging combat aircraft inventories, continued force structure divestments, and projected squadron closures complicate its ability to ensure its pilots have the experience needed to succeed in combat. The Air Force's senior leadership is responding

by keeping more of its combat pilots in operational squadron positions, preventing them from receiving the education and other training that are key to promotion. This also reduces combat pilot presence on headquarters staff—a major risk given the importance of combat pilot perspectives when it comes to decisions regarding procurement, strategy, and force design. Pilots increasingly voice their frustrations from serving as high-demand, low-density assets in constant hard use. Continual high ops tempos are burning them out and placing strain on their families. These factors risk creating a death spiral, where more Air Force pilots decide to leave the service, further reducing the experience levels of its combat pilot cadre and robbing the service's staffs of the pilots needed to organize, train, and equip the force. The Air Force is currently consuming the

pilot equivalent of its "seed corn."

The bottom line is that the Air Force's pilot corps today is too small and poorly structured to sustain a healthy combat force that can prevail in a peer conflict and simultaneously defend the U.S. homeland, deter nuclear attacks, and meet other mission requirements. To optimize and grow its corps of experienced combat pilots, the USAF must increase its pilot production capacity and rapidly absorb those new pilots. Perhaps more importantly, it must retain its experienced combat pilots across the Total Force. *The Air Force must, therefore, better leverage its Reserve Component* if it is to credibly dissuade, deter, compel, and prevail against a peer threat. The Active Component cannot meet the service's mission requirements alone; the experience and strategic depth of its Reserve Component are critical to the health and operational viability of the Total Force. The service struggles to retain experienced combat pilots when they complete their Active-Duty Service Commitment (ADSC), but many of the pilots who exit choose to continue to serve in the Reserve Component. Therefore, leveraging the Reserve Component through targeted investments and strategies can enable the Total Force to accelerate the rate at which it gives its newly qualified pilots the training they will need to succeed and maximize its ability to retain and grow its corps of seasoned combat pilots. The Department of the Air Force (DAF) must grow the Reserve Component smartly and cultivate and employ its deep bench of experienced combat pilots thoughtfully as they grow the Active Component.

This report focuses on the fighter pilot force the Air Force requires to prevail in a peer conflict as representative of the larger combat pilot corps. Each pilot corps, whether bomber pilot, airlift crew, special operations pilot, or remotely piloted aircraft (RPA) team, has airframe- and mission-specific training and requirements to establish experience in their operators. Pilot experience matters to

mission outcomes in each of these mission areas, and many of the dynamics, findings, and recommendations of this study may apply similarly. This paper, however, is scoped to examine the fighter pilot corps both because of the extremity of this shortfall and the severity of the consequences this shortfall would incur on U.S. Air Force and joint operations should this community remain in crisis.

Additionally, this paper addresses the Air Force the nation needs, not the budget-constrained force that has resulted from the last three decades of Air Force underinvestment, nor the limited force the service can afford within its current inhibited budgets. These budgets are, and have long been, insufficient to meet the demands of current operations, much less the force required for a peer conflict. Understanding the force and pilot requirements actually needed to meet the nation's global security goals better highlights the risk that the DOD and Congress will assume if they continue to fail to resource and size the Air Force properly.

The study's recommendations are not meant to solve all pilot production or retention issues; instead, they focus on how the U.S. Air Force can *accelerate* absorption and *better optimize* its Total Force combat pilot corps as it recapitalizes its forces and increases its combat capacity for future peer conflicts:

1. The U.S. Air Force should **grow its combat forces to increase the quantity and rate at which it can absorb new pilots and maintain their readiness**. This includes growing and standardizing the number of primary aircraft in individual combat units across the Total Force as well as standing up new squadrons. The service must have more fighter aircraft to be able to experience new pilots at a rate that meets or exceeds the pace at which pilots exit the service

and the pace at which new pilots enter operational squadrons. Expanding the fighter force is likewise necessary to bolster the nation's combat capacity to account for aircraft attrition in times of war.

2. The U.S. Air Force should **preserve and grow the number of its Reserve Component fighter squadrons as well as increase the number of fighters assigned to them**. Capturing and retaining experienced fighter pilots who exit the Active Component is the most efficient way to help grow the number of experienced combat pilots in the Total Force and is also the least disruptive way to manage pilot lifecycle dynamics. As the service increases the size of its Reserve Component, it should use these squadrons to aid in the absorption of inexperienced Active Component pilots.
3. The U.S. Air Force should **recapitalize and modernize its combat forces to improve the mission-capable rates of its fleet**. This requires accelerating the production rate of F-35A and F-15EX. If production rate expansion cannot be scaled at the rate necessary to arrest the inventory's decline and grow it to the size the nation needs, the service should consider procuring advanced F-16 models to replace legacy airframes. Budget factors have delayed fighter modernization for so long that a rapid injection of new aircraft is essential. While types like the F-15EX and new-build F-16s do not offer the same level of combat utility and survivability as a 5th-generation fighter, they do preserve pilot capacity and absorption, mitigate growing sustainment costs, and offer the ancillary benefit of easing unit transitions. Recapitalizing and modernizing is now the only path for accelerating the Air Force's new pilot absorption rates and increasing its Total Force readiness.

4. The U.S. Air Force should **ensure that it concurrently recapitalizes and modernizes its Active and Reserve Components**. The Reserve Component depends on the Active Component for core support and sustainment activities for its aircraft fleet, and it must have the same type of aircraft and other equipment for this support to be effective and affordable. The Air Force must avoid creating a segregated force structure in order to fully integrate the Reserve Component into all operations, from routine rotational deployments to major air campaigns. This concurrency honors the interdependencies between the two components and increases flexibility and options across them to address unforeseen training opportunities in peacetime and combatant commander needs in wartime.
5. The U.S. Air Force must **ensure that advanced simulators are connected to the Joint Simulation Environment and are available to squadrons**. Advanced simulators are crucial to training against high-end threats and scenarios that current physical ranges cannot accommodate. They also allow fighter pilots to employ the war reserve modes of their aircraft mission systems in ways that do not reveal their attributes in open-air environments. Pilots need to experience scenarios that deeply stress their skills within the safety of simulation so they can expand their ability to handle the challenges they will face in a peer conflict. While advanced simulation is critical to developing these skills, it is equally important that U.S. Air Force leaders remain mindful that simulation does not build the same kind of airmanship and judgment that live flying provides and cannot replace it.

The Air Force and Congress must commit to the Total Force investments, growth, modernization, and other efforts necessary to field a force of combat aircraft and experienced combat aviators needed for a high-end fight with a peer competitor. The fighter aircraft inventory and pilot corps must be capable of and sized to defeat the pacing threat of China while simultaneously defending the homeland and meeting its other global security commitments. While improving the entire life cycle of the Air Force's pilots is imperative, the service should focus on accelerating its pilot absorption process and retaining experienced combat pilots across the Total Force. Addressing force size, pilot absorption, and experienced pilot requirements is key to rebuilding a force that wins.

Without Experienced Combat Pilots, Air Forces Collapse in Contested Campaigns

Warfighter experience is *essential* to prevailing against adversaries—it is often the critical differentiator that can tip operational outcomes in favor of America's forces and a factor that cannot be replaced by artificial intelligence (AI) algorithms or drones. The term "pilot experience" captures the difficult-to-quantify elements of airmanship, wisdom, judgment, and intuition that can make the difference between winning and losing. While this experience can be tricky to measure with precision, the evidence of it is not: experienced combat pilots have better mission outcomes and decreased attrition rates compared to inexperienced pilots. Combat pilot experience has proven its value during air campaigns since World War I. *Experienced* combat aircrew—in the right numbers and ratios to provide a sufficient attrition reserve—are an enduring operational advantage in a major conflict with a peer adversary that cannot be substituted or bought.

Air forces must also have enough experienced aircrew in reserve to cycle pilots through frontline combat operations, rest war-weary aircrews, and continue to train replacement pilots. If an air force does not have this kind of strategic depth and pilot production pipeline, its pilot corps is at risk of collapsing when stressed in combat. Air forces *must* have experienced aircrew in sufficient quantity if they are to sustain effective combat operations over the course of a protracted warfighting campaign, as attrition will ultimately take its toll. This requires air forces to manage their combat pilot corps—in peacetime—so that they can replace combat losses in a way that preserves pilot experience ratios where they matter the most: at the leading edge of the battlespace.

Without enough experienced pilots, the U.S. Air Force could find itself unable to continue effective combat operations in a prolonged fight to defeat Chinese or Russian aggression, much less defend the U.S. homeland and fulfill its other global security commitments. Experienced combat aircrew are an operational advantage in a major conflict with a peer adversary. Moreover, history teaches that the wisdom, judgment, and leadership skills of experienced pilots transfer to their less-experienced wingmen, enhancing an air force's overall survivability and mission outcomes.

Uncrewed collaborative combat aircraft (CCA) are needed but will not reduce requirements for experienced pilots

The Air Force is aggressively pursuing CCA to boost its combat capacity and fill its combat aircraft shortfalls. Studies and operational analysis indicate that CCA may improve the Air Force's operational effectiveness by expanding a fighter's sensor or missile ranges, providing electronic warfare support, acting as communications relays, and otherwise enhancing mission performance.

The imperative for strategic depth

A nation must have strategic depth in its forces if it is to prevail in a protracted peer conflict that inflicts attrition. For air forces, this means having enough aircraft with enough pilots so that it can flow replacements forward as combat losses mount and sustain effective combat operations for the duration of the conflict. While force sizing efforts often focus on the number of aircraft needed for a specific scenario, they may be overly optimistic regarding loss rates and the duration of a conflict and, thus, not plan for adequate combat replacements. They also tend to neglect concurrent demands like homeland defense, nuclear deterrence, or additional contingencies that flare up opportunistically. Without strategic depth, an air force may run out of aircraft and pilots and be unable to continue to effectively—and successfully—execute combat operations.

The advanced technologies, autonomous algorithms, and lower costs of CCA appear to make them attractive candidates for replacing crewed combat aircraft altogether. However, CCA capabilities are still unproven, especially for complex and coordinated operations in highly contested environments.

Even as they mature, CCA cannot replace human fighter pilots in contested battlespaces because of the fundamental limitations of autonomous technologies. Software engineers in the leading CCA companies—from prime to non-traditional—unanimously agree that the ability to even approach a replacement type of artificial intelligence is decades away.¹² Even then, most expressed hesitation on whether AI could fully replace human cognition in a highly contested battlespace. Many resolved the uncertainty of mission effectiveness with the assurance that losing an autonomous platform was acceptable, given that no loss of human life occurred.¹³ Regardless of whether

the loss of a CCA is acceptable, Air Force senior leaders must consider the effect of AI on mission outcomes. The loss of the CCA may not imperil a pilot's life, but it may place the larger operation and other warfighters at greater risk. Despite advances in artificial intelligence, autonomy will continue to have limitations and vulnerabilities that humans do not share—namely, the ability to decide and operate appropriately when presented with novel, unexpected, surprising, or ambiguous data. Humans can borrow and apply experiences and insights from seemingly unrelated fields and topics, innovate in relevant ways in real-time, take the initiative even when disconnected from external command and control resources, and make decisions in highly uncertain operational conditions. The Air Force should develop CCA and explore the full potential of these platforms to improve combat outcomes, but the nation must have the proven, reliable, and resilient combat outcomes that only combat pilots can provide.

History demonstrates the value of pilot experience and strategic depth in combat

World War I presented the world's more advanced militaries with a new challenge: how to wage war in the air. The introduction of aviation to the Western Front in Europe quickly demonstrated the value of military aviation. As the use of aircraft in combat rapidly evolved from observation and scouting to aerial combat and interdiction, early combat pilots learned how to fight through trial and error. These early combat pilots understood the importance of experience: only by flying at the front could pilots develop the airmanship and judgment needed to survive. Some seasoned aces, like Rees, Biddle, Deullin, and Boelke, devised rulesets and wrote pamphlets on how to fight, seeking to pass on their knowledge and experience. Still, these new pilots proved exceptionally

vulnerable their first few sorties.¹⁴ They simply had not yet developed the experience they would need to be effective—the experience that only flying at the front could provide. Early in the war, experienced flight leaders would take new pilots on practice patrols to teach them the ropes.¹⁵ Even so, survival could be as much a matter of luck as it was skill in the face of extreme attrition rates.

The urgency to backfill Allied pilots lost in combat meant that replacement pilots arrived at their units with fewer and fewer hours of flight time as the war progressed and the demand for pilots increased. No longer did they have the luxury or time for practice patrols, nor did squadrons have enough experienced pilots to lead them. Replacement pilots, in addition to lacking advanced flying skills, did not know how to read the frontline disposition of forces, understand the threat, or maneuver their aircraft when in contact with enemy fighters. WWI Royal Flying Corps fighter pilot Arthur Gould Lee would write in his memoirs that “Most pilots average 15–20 hours’ flying time when they arrive here, with maybe 10–20 solo and five on the type they’re expected to fight on. With that amount of piloting they can’t even fly, let alone fight.”¹⁶ The spiraling demand for replacement pilots created a vicious cycle that accelerated the loss of pilots and aircraft. By the end of WWI, an Allied replacement pilot had an average of three weeks to live once they began combat operations. Some were dead within three days.¹⁷

The lack of experienced pilots and a pilot force with insufficient strategic depth is a fatal combination

An air force's combat pilot corps must have sufficient strategic depth to rotate experienced pilots through operational units engaged in combat and continue to train replacement pilots to enhance their

mission effectiveness and survivability. Without this kind of reserve, an air force risks collapsing in a protracted conflict. In WWII, Germany and Japan had skillfully trained fighter pilots—arguably the best in the world—but were overly optimistic about how quickly their militaries could bring the conflict to a resolution. Both lacked depth in their pilot corps, and their training pipelines proved insufficient to train and absorb enough new pilots to replace combat losses. Experienced pilots in both air forces had to remain indefinitely at the front to satisfy inflexible leadership paradigms and meet demands to fill sorties. Without a sufficient reserve of experienced pilots, a robust training pipeline, and the time to season their pilots, the Luftwaffe and Japanese air forces collapsed under the pressure of U.S. and Allied combat air operations.

The German Luftwaffe entered WWII with a highly trained, very experienced corps of combat pilots. In September 1939, Luftwaffe pilots had, on average, approximately 240 flight hours and 90 combat hours of experience compared to 200 flight hours and 50 combat hours for Britain's RAF pilots.¹⁸ At the beginning of the war, the Luftwaffe planned to acquire 11,732 aircraft, of which only 2,730 were combat aircraft.¹⁹ German leaders anticipated that future conflicts would yield light casualties and be quickly won. However, constant operational demands prevented the Luftwaffe from ever having the chance to regenerate its experienced corps of pilots. This mistake was compounded by the Wehrmacht's insistence on only sending its air combat units back for new replacements and training after they were shattered. The Luftwaffe was not scaled to withstand high levels of attrition, it did not build a robust training pipeline, and it did not develop an enterprise approach to

absorbing its newly trained pilots.²⁰ Instead, instructor pilots were pulled from their training duties and committed to high-intensity combat operations throughout the conflict, further hollowing the training pipeline.

These policies ultimately cost Germany its air force in World War II. Germany's failure to adequately train its replacement pilots resulted in far higher attrition rates as the war progressed. Offensive campaigns across 1940–1942, although yielding victories to Germany, took a serious toll on Luftwaffe pilots, where attrition could reach over 9 percent in some months. These losses quickly added up, and by 1942, Germany had lost the equivalent of two air forces worth of pilots.²¹ The Luftwaffe thus curtailed the duration of its training programs to meet the incessant demand for replacement pilots, which accelerated its loss rates in both combat and non-combat operations. From May 1940 to December 1942, the Luftwaffe lost, on average, 65 percent of its fighter strength every six months. By 1943, Luftwaffe pilots received roughly half the number of flying hours in training as Allied pilots, and Luftwaffe loss rates rose to 170 percent. In the first half of 1944, the Luftwaffe lost a staggering 250 percent of its fighter strength.²² Even more devastating to the Luftwaffe was its loss of experienced pilots, especially its *Experten*—high-scoring aces with a hundred victories or more. The effect of these losses was devastating and put an impossible demand on the Luftwaffe replacement program. As more pilots were killed, their replacements were sent to operational squadrons with less and less training. The result was predictable: these less-trained pilots were killed even more rapidly, accelerating the Luftwaffe's downward spiral.²³

Like the Luftwaffe, Japan's pilot training program emphasized creating an elite combat air force. At the war's outset, Japanese pilots were arguably the best trained and equipped in the world. Training

for the Japanese pilots was rigorous, lasted 3.25 years, and washed out 70 percent of pilot candidates. By contrast, the U.S. Army Air Force washed out about 40 percent of its pilot candidates during training.²⁴ Japan concluded from its overwhelmingly successful employment of air power against China in 1937 that it did not need to scale its combat air forces or pilot production. During the opening stages of World War II, the Imperial Japanese Navy viewed the use of airpower as an elite capability carried out by a small, exclusive force that would dominate enemy forces. This assessment underestimated the value of massed airpower or strategic depth in their air forces—qualities that were precluded by the fact that Japanese planning and training focused on producing small quantities of highly skilled aircrews.²⁵ This focus on intensive training for the Japanese naval pilots initially paid off as the *Kido Butai*, the Japanese naval fleet, conquered and secured over ten thousand square miles of ocean and territories in the South Pacific in less than four months—largely due to Japanese airpower.²⁶

Japan's focus on quality over quantity (not unlike today's U.S. Air Force) for its combat pilot corps would come to haunt it. While this approach initially yielded successes in combat, Japan did not have the reserve or strategic depth of pilots to continue its string of victories in a protracted conflict.²⁷ The Japanese practice of keeping pilots at their operational stations rather than rotating them in and out of combat kept their best and most experienced carrier pilots in the fight continuously, resulting in their attrition. These losses proved catastrophic to the health of Japan's air forces because the intensity of the Japanese training regime, coupled with its small size, made it institutionally impossible to quickly scale its pilot pipeline to account

for the realities of combat. Japan simply could not produce experienced replacement pilots at the rate necessary to keep its naval combat air forces viable. Large-scale reforms only began in 1943 in response to Japanese combat pilot losses at the Battle of Midway and then the Battle of Guadalcanal. By then, it was too late to reverse the impact on Japanese carrier forces, and their pilot losses accelerated. During the Marianas "Turkey Shoot" in June 1944, the Japanese lost 366 aircraft in the air while the U.S. Navy lost only 30 aircraft. By 1944, training for Japanese pilots had dropped to anywhere from six to two months. Fuel shortages prevented adequate pilot training, and the new pilots who graduated from training were so inexperienced they were ordered not to attempt to land on aircraft carriers.²⁸

By the end of the war, Japan's combat pilot corps and pilot production pipeline had utterly collapsed. Because Japan initiated conflict with such a small force, they were unable to withstand high levels of pilot attrition over the duration of the conflict. The Japanese military-industrial complex was premised on quality alone, so it crumpled as it lost the experienced pilots needed to make its small number of airframes a meaningful source of airpower. Neither the Japanese aircraft industry nor Japan's military pilot training was scaled or resourced to produce replacement aircraft or pilots in the timelines needed to maintain Japan's dominance in the Pacific theater against accelerating losses. Without a viable training pipeline for replacing pilots lost in combat, Japan's desperation to defend its home islands led to its adoption of *kamikaze* tactics that used inexperienced pilots as human-guided missiles. These suicide missions only aggravated the underlying problem of too few experienced pilots with insufficient time to train the next generation of combat aviators. *Kamikaze* attacks were

more effective than bombs or torpedoes and terrified U.S. sailors but were not enough to turn the tide of the conflict.²⁹

In contrast, The United States did not enter the war with a large or even exceptionally trained combat pilot corps. In fact, peacetime budget-driven measures saw airmen discouraged from pursuing combat airmanship—even basic aerobatics—to reduce peacetime accident rates, thereby reducing expenditures.³⁰ However, both the U.S. Army Air Forces (USAAF) and the U.S. Navy benefitted from the nation's rapid mobilization for total war. The latent capacity of U.S. civil aviation enterprises enabled the USAAF and Navy to contract quality pilot training even as they scaled production to expand their pilot corps while replacing pilots lost to combat operations. Had military training pipelines been confined to pre-war military production capacity, the United States would not have been able to meet the needs of both the European and Pacific theaters. In 1937, the Army Air Corps graduated only 184 pilots from advanced training, with only three bases conducting the range of primary, basic, and advanced pilot training. Yet, by the end of WWII, the Army Air Forces had produced over 250,000 pilots at over 63 different contract training schools.³¹

The volume of pilots the United States was able to graduate on a monthly basis during WWII was large enough to prevent its forces from falling into the attrition-experience death spiral that hollowed out Germany and Japan's air forces. Even though training timelines were compressed from nine months to seven over the course of the war, U.S. pilots still received 140 hours of flight instruction, the same that they received at the beginning of the United States' entry into the conflict.³² The quality of this training imparted airmanship, skill, and an initial level of judgment to newly trained pilots such that they could rapidly

acquire the common sense and intuition that combat required once they got into theater. Moreover, the scale of pilot production enabled the U.S. Army Air Forces to rotate pilots to non-flying duties or even back to the United States, where they could pass on their knowledge to student pilots and other instructors.³³

U.S. forces in WWII proved that a combat air force must have sufficient experienced pilots to offset combat attrition, provide a reserve of experienced pilots to sustain high-intensity combat operations, and simultaneously surge pilot production. These lessons remain particularly relevant today since WWII was the last time the United States fought at a global scale and scope. The USAF's combat forces are now about half the size of the force it maintained to deter Russia during the Cold War. Because of the budget-driven force structure divestments it was forced to make over the last thirty years and subsequent loss of talent at the squadron level, the Air Force is rapidly approaching a pilot experience threshold where it may be unable to wage a protracted, high-intensity conflict with China—DOD's pacing threat—or even Russia. This is not a sustainable path.

The U.S. Air Force must increase the strategic depth of its corps of experienced combat pilots

The U.S. Air Force's combat pilot corps shortfalls have grown over the last decade as the service retired force structure without replacement aircraft, and the force is now too small to even meet its existing peacetime mission requirements. In 2006, the U.S. Air Force was nearly 200 fighter pilots short of stated Air Force requirements.³⁴ By 2017, the gap had grown to over 1,000 fighter pilots and has not improved.³⁵ Increases to the Air Force's rated retention bonuses and efforts to improve pilot career stability and quality of life have failed to stem its pilot

losses. One senior Air Force officer stated the service's fighter pilot retention rate has stabilized at 45 percent—meaning that of the pool of pilots eligible to separate in any given year, *more than half* choose to do so.³⁶

The U.S. Air Force must take aggressive action to solve its combat pilot shortfall while simultaneously growing the size of its combat forces. It is not enough to simply produce new pilots at the same rate as seasoned pilots leave during peacetime; the U.S. Air Force must also develop *and experience* new pilots at the same or greater rate as its losses, especially knowing wartime attrition will drive far higher backfill demands. Current constraints in the Air Force's pilot production and absorption pipelines should be a cautionary signal to service leadership. If the Air Force cannot dig

out of its pilot exit dynamics to close the shortfall, this may be an indicator that the service would be unable to replace combat losses in a peer fight. If the Air Force is unable to replace combat losses through the production pipeline in a relevant timeline, the need for strategic depth in the force grows even more imperative.

The pilots who exit the service today are often highly experienced and have advanced qualifications as instructor and evaluator pilots. Without their presence in squadrons, new pilots cannot receive the training or supervision they need to become experienced and upgrade to instructors and evaluators themselves. But the value of experience is far greater than smoothing peacetime squadron management and training. Experienced fighter pilots have developed real-world wisdom and judgment from executing combat sorties, dropping bombs, resolving aircraft emergencies, flying in poor weather, and integrating their operations within the larger force and in collaboration with joint partners. Replacing these pilots

is a long-term process. If, for example, 175 pilots choose to separate from the service in a year, then at least 175 pilot candidates must be recruited and commissioned, 175 pilots must graduate from pilot training, 175 pilots must graduate from their formal initial fighter training course, 175 pilots must progress from inexperienced to experienced, and 175 other pilots in the squadrons must advance in their careers. Of course, immaculate progression is not possible, so even larger numbers must be in play to allow for attrition and the reality that some individuals will not meet the standards necessary to progress to subsequent levels of advancement. Maintaining a healthy influx of new entrants is the only way to ensure the Air Force does not suffer from a shortfall of combat-qualified pilots and the leadership they need to maintain the readiness to fight.

Increasing the Air Force's combat aircraft capacity will also require a growth rate of more than one new pilot for one new aircraft. The Air Force's required crew ratios for fighter aircraft are typically 1.25 pilots per aircraft, which means a squadron with 24 aircraft would have 30 assigned pilots (24 x 1.25 = 30).³⁷ This ratio is intended to ensure a squadron has enough pilots to perform necessary squadron leadership functions, such as acting as a supervisor of flying, director of operations, scheduler, or mission planner, while other pilots can receive their required crew rest before their next sortie. Importantly, these additional pilots cannot all be newly trained pilots. As aircraft inventory is added, squadrons must stand up with the appropriate leadership, instructor pilots, evaluator pilots, flight leads, and other supervisors to ensure safe and effective flight operations. This means that *new* pilot production alone cannot solve the Air Force's force structure challenges. Reducing pilot shortfalls and growing its combat aircraft capacity will require the Air Force to produce and absorb pilots faster than they exit and retain more *experienced* pilots for a longer duration.

Reducing pilot shortfalls and growing its combat aircraft capacity will require the Air Force to produce and absorb pilots faster than they exit and retain more experienced pilots for a longer duration.

Figure 1 (below) is an FY2023 snapshot of the Total Force fighter pilot requirement and inventory across pilot year groups. The blue line in this graph is the number of fighter pilots in that year group, with ranks depicted at typical promotion windows. For example, the requirement for fighter pilots in year four of their service (nominally ranked at captain, or O-3) is approximately 290, but the actual inventory in the Total Force (blue line) is closer to 275. The green area represents most of the U.S. Air Force’s “fight tonight” fighter pilots, as well as those assigned to training and test duties, where the red shaded area is staff, and yellow accounts for developmental education such as Air Command and Staff College, Air War College, other professional military education, and fellowships.³⁸ This data shows that the Air Force is short of fighter pilots in *every year group*.

While many think that the Air Force’s budget-driven aircraft inventory decline will reduce the pilot crisis, the opposite is true. Divesting combat aircraft works against

increasing the strategic depth of the Air Force’s pilot cadre because it constrains the service’s ability to absorb additional pilots.³⁹ Very simply, fewer cockpits mean fewer sorties, translating to less pilot absorption and training capacity. Divesting aircraft can also disrupt the *shape* of the Air Force’s pilot corps. Crew manning is tied to force structure, and when aircraft fleets are downsized, their pilots often leave the service. Reducing pilot production, reassigning pilots to different specialties, or reductions in force structure are all means by which the U.S. Air Force reduces the size of its pilot corps. USAF force downsizing initiatives in the mid-1990s used all of these approaches, which had the unforeseen consequence of distorting the service’s pilot corps by flooding the system with new pilots and creating large gaps in pilot experience.⁴⁰ The Air Force’s pilot shortage actually worsened instead of resolving itself as the service shrank the size of its combat aircraft inventories. The service continues to work aggressively toward better understanding these dynamics, but it has not yet fully recovered from the consequences of downsizing.⁴¹

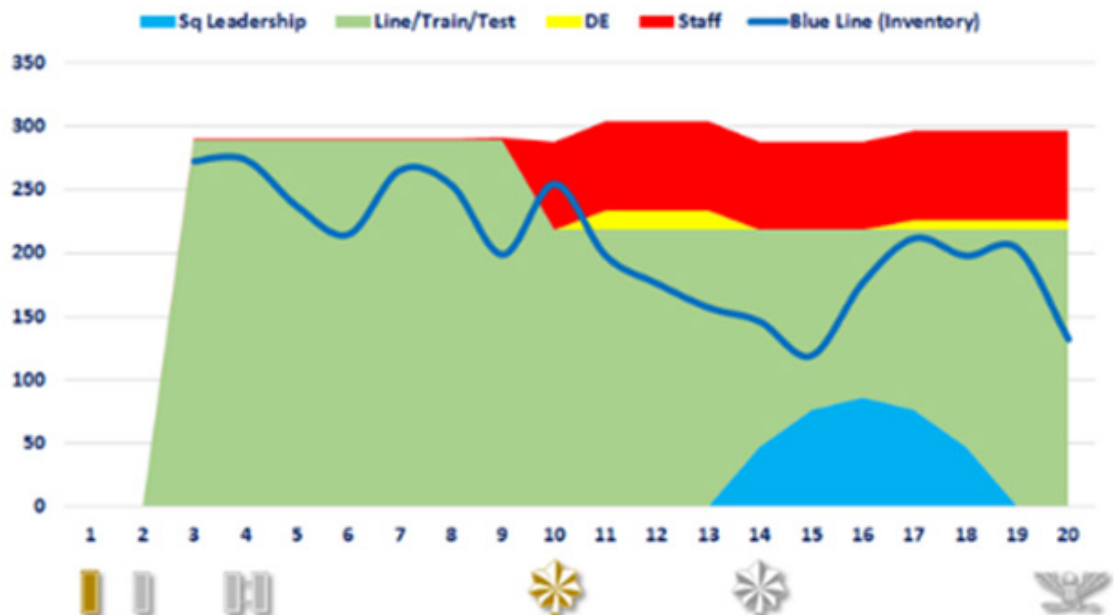


Figure 1: FY23 Total Force Fighter Pilot Requirement and Inventory. In no year group does the Air Force have enough fighter pilots, and it continues to underproduce pilots for all its aircraft types.

Source: Mitchell Institute, data from “Rated Production, Absorption & Talent Management,” Aircrew Crisis Task Force senior statesman briefing, May 2023.

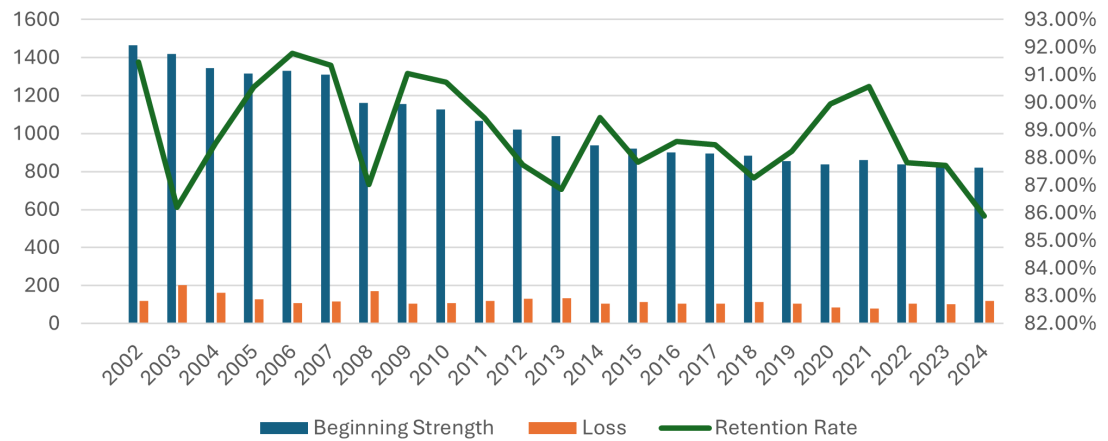


Figure 2: Air National Guard Retention Rate, 2002-2024. Air National Guard Retention rates of their fighter pilots (AFSC 11F) are well above the Active Component. In over 20 years, the ANG has maintained an average of 89 percent retention rate for its fighter pilots. Retention rates from the Active Component are not available.

Source: Mitchell Institute, data provided by the National Guard Bureau/Air Force Personnel Center (NGB/AFPC), October 2024.

The Air Force’s Reserve Component helps preserve pilot experience across the Total Force

Many qualified, experienced pilots who exit the Air Force’s Active Component choose to continue to serve in the Reserve Component. This is how the RC accesses most of its pilot end strength. While the Reserve Component does hire new personnel from their local communities to fill pilot positions, these career Guardsmen represent a diminishing percentage of most RC fighter squadrons. Units trend towards hiring current, qualified, and experienced pilots exiting the Active Component. In 2002, undergraduate pilot candidates hired by Air National Guard squadrons made up over 90 percent of the Air National Guard’s fighter pilot corps. By 2024, many had aged out of their careers, reducing that ratio to 56 percent.⁴²

By relying more aggressively on pilots exiting the Active Component to fill its pilot positions, the Reserve Component is becoming increasingly reliant on the Active Component for pilot production and absorption. This benefits the Total Force. The Air Force’s Reserve Component’s pilot retention rates far exceed that of its Active

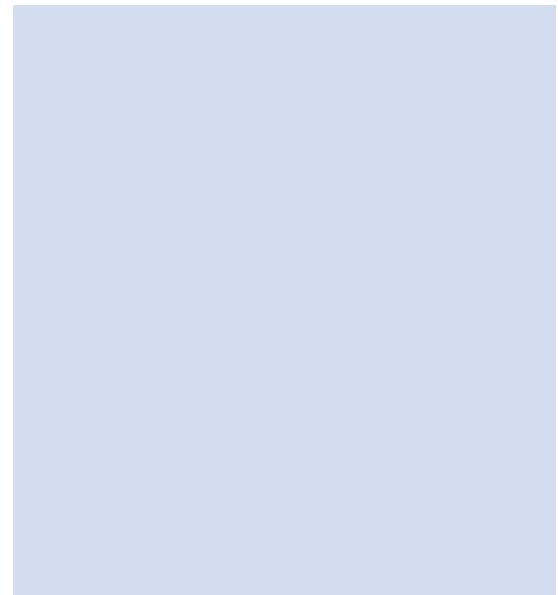
Component. Figure 2 demonstrates that for over 20 years, the Air National Guard has averaged a retention rate of 89 percent. These high retention rates mean the Reserve Component can keep the talent it recruits, which ensures investments made to mature these pilots are not lost to the Total Force. Also, the RC captures pilots with significant levels of experience. The experience that pilots gain over the course of serving out their active-duty service commitment creates a strong foundation for their transition to the Reserve Component, resulting in most RC fighter pilots having more flying hours, sorties, simulator time, and deployments than pilots in AC squadrons. The Air Force must not underestimate the expertise and operational value of these pilots.

As the proportion of AC pilots transitioning into the RC increases, both components benefit. These pilots serve their formative years in the Active Component, after which their integration into the Reserve Component helps merge their cultures and improve interchangeability between the two components. Experienced pilots joining the RC reach retirement sooner than career RC pilots because they join the RC later in their lifecycles. This helps ensure that RC units

do not become stagnant. Moreover, the tight interpersonal networks that AC pilots develop during their service in the Active Component can improve crosstalk, cooperation, and collaboration between the two components.

The RC's consistently high retention rates—well over 80 percent—stand in stark opposition to the Active Component's rates, which averaged roughly 40 percent between 2017 and 2022.⁴³ But even with higher retention rates, the Air National Guard was short 225 (roughly 22 percent) of its authorized 1,045 fighter pilot billets in 2023.⁴⁴ These billets do not appear to be degrading fighter squadron readiness significantly. RC fighter wing commanders generally report that they are fully manned and routinely turn away pilots exiting the Active Component. This indicates that much of the key talent exiting the Active Component would like to continue to serve, so increasing flying opportunities in the RC offers a way to retain experienced fighter pilots for their full lifecycle.

The U.S. Air Force must increase the strategic depth of its combat pilot corps, and it should optimize both its Active and Reserve Components as it does so. The Reserve Component, because it dominantly recruits from experienced AC pilots and retains them through the end of their careers, presents a huge opportunity for U.S. Air Force senior leadership to build strategic depth. But modernizing and growing the fighter inventory across the Total Force will require increasing the Active Component's capacity to absorb pilots and accelerating the rate at which it can do so. Operational units must be able to rapidly mature new pilots that join operational squadrons and simultaneously maintain the readiness and upgrade the skills of pilots already in the squadron. This is one of the objectives of the Air Force's Ready Aircrew Program (RAP) and annual RAP Tasking Messages.



The Air Force's Ready Aircrew Program (RAP) Provides a Measurable Proxy for Experience and Mandates for Readiness

Following the conclusion of the Vietnam conflict, the Air Force's younger pilots had difficulty completing upgrade training and executing complex tasks in the air. This was partly due to the Air Force's lack of a clearly structured plan or standard by which to train and evaluate its pilots. The service subsequently developed quantitative proxies to define "experience" standards for flying squadron training, which became the Rated Distribution and Training Management system (RDTM). The RDTM established a total-hours-flown threshold to differentiate the experience levels of its new pilots and experienced pilots. In addition to this threshold, the RDTM established minimum monthly flying requirements for both inexperienced and experienced pilots, as well as the activities they must perform and the frequency they must accomplish them to remain fully qualified to perform their missions. Inexperienced pilots were mandated to fly more per month and accomplish required events more frequently so that they could accumulate the airmanship and skills they needed to be effective in combat. The RDTM later evolved

into the Graduated Combat Capability System for the Air Force's Tactical Air Command and the Integrated Crew Training System for the Strategic Air Command.⁴⁵ The Air Force merged these systems into the Ready Aircrew Program (RAP) in the late 1990s.⁴⁶

RAP recognizes that combat pilots across the board need to fly and perform certain tasks to maintain their combat readiness and their proficiencies.⁴⁷ Pilots maintain their proficiency by flying sorties and participating in simulator training sessions, practicing and advancing the skill sets needed to successfully execute their squadron's mission. The program defines how many sorties and events a pilot must fly, as well as with what frequency and how recently, to maintain their combat mission ready (CMR) status. The RAP:

- Establishes monthly, quarterly, and annual requirements combat pilots must meet to maintain their flying proficiency and overall mission readiness
- Governs how squadron commanders allocate sorties and schedule pilot activities
- Differentiates between inexperienced pilots and experienced pilots

Each type of Air Force combat aircraft has its own manual that describes its specific Ready Aircrew Program. These different RAP requirements include a pre-determined number of sorties; flying events such as aerial refueling, night landing, or strafing; qualifications; and simulator events that pilots must complete during 30, 60, and 90-day "lookback periods" to remain current. A pilot's combat mission readiness (CMR) or basic mission-capable (BMC) status is directly impacted by their ability to maintain their currencies. For example, an inexperienced Active Component F-16 pilot is required to fly nine sorties every month, while an experienced pilot must fly eight sorties.⁴⁸

The Ready Aircrew Program directly impacts how new pilots in squadrons gain experience and the burden placed on squadrons as they work to absorb new pilots, upgrade them, and simultaneously ensure that other pilots in the squadron receive enough training to maintain their combat-ready status. Inexperienced Air Force pilots must fly more hours and more frequently than experienced pilots, and they also must fly with supervision. Squadron commanders must carefully balance their flying schedules to ensure that their RAP and training priorities are executed while seasoning new pilots at appropriate rates. This process of building experience in new pilots is called *absorption*.

Reserve Component pilots require fewer flights and simulator events to maintain their status because they generally have higher experience levels and less availability for training because they must balance their military duties with their non-military jobs. An inexperienced RC F-16 pilot requires eight sorties per month, while an experienced RC pilot requires only six sorties per month. It is also important to understand that RAP sets absolute "minimum" requirements. Unfortunately, because of the combination of underfunding, aircraft shortages, and pilot shortfalls, RAP requirements are treated more like a "goal" than a "minimum." A more desirable "goal" for F-16 pilots is flying at least four times a week, or 16 sorties a month—not eight or nine.

Failing to complete RAP requirements has consequences.

Failure to meet minimum RAP sortie requirements could cause a pilot to be placed on probation or regress to a non-combat mission-ready status. Pilots on probation must fly enough sorties to regain their required lookback. If regressed, they must complete a formal retraining program to be recertified.

The Ready Aircrew Program dictates currency requirements for events that pilots must accomplish periodically to ensure their proficiency irrespective of component—both AC and RC pilots have the same currency requirements. For example, an inexperienced F-16 wingman, regardless of their component, must execute a night landing once every 120 calendar days, while a flight lead must do so every 180. If a pilot goes non-current in any of these events, they are designated non-combat mission-ready (N-CMR) and are ineligible for deployments or rotational obligations. These pilots must successfully complete an in-house training program supervised by an instructor pilot or a flight lead certified squadron supervisor and then fulfill their one-month lookback to regain CMR status.⁴⁹ Failing to meet RAP requirements can have deleterious and cascading consequences for the holistic health of a combat squadron.

In addition to meeting RAP requirements, squadrons must resource additional non-RAP training events that are crucial to pilot development and healthy squadron operations.⁵⁰ Non-RAP requirements include training to absorb inexperienced pilots, conducting check rides, and executing formal upgrade programs to qualify pilots as flight leads, instructor pilots (IP), or mission commanders. These upgrades are crucial to advancing pilot skills and ensuring squadrons have cultivated the in-house qualifications they need to operate. For example, squadrons need to “grow” their own new IPs as established IPs reach the end of their tours and proceed to their next assignments. A squadron cannot operate without IPs because these airmen are responsible in large part for absorbing the next crop of inbound inexperienced pilots for their first operational tour, upgrading selected candidates for the next qualification, or even just providing supervision to pilots who have lost currency or been placed on probation.

Four Key Factors that Influence Squadron Pilot Absorption Capacity

A squadron’s ability to absorb new pilots, fully execute its Ready Aircrew Program, complete continuation training, and upgrade its mature pilots depends on four key factors. These factors must be managed within squadrons and across the broader Air Force combat pilot enterprise to optimize the absorption rates, depth of experience, and capacity of the Total Force:

- A combat squadron’s ratio of experienced pilots and instructor pilots to inexperienced wingmen
- The number of pilots in a squadron
- How many sorties a unit can generate
- How accessible advanced simulators are to the unit

The rate at which newly minted Air Force pilots can accumulate the necessary flying hours and complete training events to become experienced determines when they will be capable of upgrading their qualifications and performing squadron leadership duties. A squadron must absorb its new pilots and upgrade them at a rate that will allow it to replace its departing experienced pilots and maintain its combat readiness.

A squadron’s ratio of seasoned pilots and instructor pilots to inexperienced wingmen impacts how quickly it can grow experience

One of the most important factors for a squadron to maintain its health and rapidly absorb new pilots is its ratio of experienced pilots to inexperienced pilots. In peacetime, squadrons must absorb new pilots at the same rate as their experienced pilots move on to their next assignments. In combat, squadrons must absorb new pilots at a rate that is equal to or greater than their pilot attrition. Without sufficient experienced pilots to achieve these rates, squadrons could

become ineffective in peacetimes and suffer the same higher attrition rates and losing outcomes as Luftwaffe and Japanese combat squadrons did during World War II.

The ability to create a sound combat pilot corps begins at home base. Squadrons must have the right manning, pilot experience, and qualification levels to manage their flying schedules so they can rapidly mature pilots and absorb them at a rate that is equal to the inflow of new, inexperienced pilots. For example, if a unit receives three inexperienced wingmen from their initial training courses, then at least three pilots must advance their level of experience. Otherwise, the number of inexperienced pilots in the squadron grows, and the sustainable ratio of experience to inexperience becomes imbalanced and unsustainable. History has shown this can ultimately break squadrons to the point where they are no longer combat-qualified.⁵¹

Absorption rate constraints at the squadron level can also have disastrous consequences for the Air Force's entire fighter enterprise. If new pilots do not become experienced in their first operational units, the absorption burden is simply passed on to their next operational squadrons. This can have a snowball effect. Squadrons receiving these partially experienced pilots face three challenges: absorbing these second-tour pilots, training their own inexperienced pilots, and seasoning their new pilot accessions.

Unit manning impacts the sorties a unit must generate to keep its pilots mission-ready

Mathematically, a squadron's unit manning determines a baseline requirement—which is defined by a RAP Tasking Message (RTM)—for the number of sorties the squadron must plan to fly monthly. A very rough estimation uses the number of pilots in a squadron with a multiplier for the minimum

Understanding pilot absorption

Absorption is the process by which new pilots gain experience in their operational aircraft. This process takes years. From the time that pilots enter undergraduate pilot training until they are “experienced” in their operational aircraft can take up to five years. New pilots must undergo and graduate from basic and advanced flight training, complete intermediate transition training into their mission aircraft, and then accomplish a final qualification in their operational squadrons. These fledgling combat pilots will then go to their first operational squadron, where they will undertake combat mission qualification training—new combat pilots are not eligible to go to war until they complete this top-off. New fighter pilots will remain wingmen until they are approved to upgrade and operate as flight lead. It is this process of seasoning and continual training that imparts the wisdom and airmanship that the U.S. Air Force calls “experience.”

number of sorties each pilot must fly. If an F-35 squadron has 18 experienced pilots and 12 inexperienced pilots who must fly 8 and 9 sorties per month, respectively, then the squadron must generate a *minimum* of 252 sorties per month ($18 \times 8 + 12 \times 9 = 252$).

Pragmatically, squadrons must generate more than the bare minimum of sorties to anticipate cancellations for bad weather or other exigencies and support pilot upgrade programs and unique training demands. Upgrades include formal training courses conducted inside squadrons, such as Flight Lead Upgrade or Instructor Pilot Upgrade. Upgrade programs require at least one instructor pilot, which may result in experienced pilots flying well over their allotted RAP requirement. Perhaps most importantly, more sorties per pilot equate to greater proficiency and lethality. A squadron

must generate enough planned sorties to accomplish both the RTM for their unit and additional upgrade training. This typically requires an overage of the minimum RAP requirement.

Over-manning or undermanning can collapse the health of a flying squadron.

In peacetime, squadrons must have enough pilots to execute their mission training tasks, maintain their flying operations through normal pilot absences such as vacations, sick leave, and other temporary assignments, and maintain quality of life for squadron members. In combat, squadrons must have enough personnel to execute their air-tasking order missions, balance crew duty days against needed crew rest days, fill additional duties such as mission planning, and absorb combat losses. A rough rule of thumb for understanding the health of a unit's manning is based on its crew ratio. Basically, the more pilots in a squadron, the more sorties the squadron must generate with its fixed number of aircraft. A squadron's sortie generation and training plan must also account for "guest pilots" who are not assigned to the squadron. These guest pilots are typically staff members in higher unit echelons, such as the wing level, but must also maintain their RAP currencies and requirements. Squadron manning documents and personnel authorizations do not typically account for this additional training demand.

The Air Force must be careful to avoid overmanning its combat squadrons. If a unit cannot generate enough sorties for its assigned and guest pilots, it will not be able to maintain its readiness and absorb new pilots at the right pace. This is especially problematic for older fighter fleets that suffer poor mission-capable rates and struggle to fly bare minimum utilization rates. RAND studies have consistently found that when a squadron's assigned and guest pilots exceed 110 percent of

Understanding combat squadron sortie generation math

A notional Air Force combat squadron that has 24 fighter aircraft and schedules for a monthly utilization rate of 13 sorties per aircraft should be able to generate 312 sorties per month ($24 \times 13 = 312$). Assuming each of the squadron's pilots must fly nine times in a month—a gross simplification—a squadron would need to fly approximately 270 sorties to meet its RAP. This would leave 42 excess sorties that could be used by non-squadron guest flyers. This is a simplified example that does not account for the many complexities of real-world squadron operations and assumes perfect sortie generation rates.

unit manning, the unit is stressed and may fail to meet training requirements.⁵² Over time, this can break the combat readiness of a squadron.

Squadron undermanning impacts the unit's absorption capacity and the broader health of the Air Force's combat pilot corps as well. Undermanning can create situations where a squadron has excess sortie capacity that it cannot use to generate qualified, experienced pilots for the force. More problematically, an undermanned unit may not have the required level of readiness to execute its assigned combat tasking.⁵³ The same is true if a squadron lacks enough experienced pilots to train all its personnel. In this case, squadrons may not be able to maintain their readiness even if it can generate enough sorties.⁵⁴ Squadron commanders at an operational F-35A base have struggled to simultaneously absorb and upgrade new and transitioning pilots because of a combination of undermanning and low aircraft mission-capable rates. Moreover, as soon as they were able to upgrade a pilot to instructor, that pilot was often reassigned to either a new F-35A unit standing up or to a Formal Training Unit.⁵⁵

Ideally, healthy squadrons must ensure that all of their pilots—including guest flyers—are able to fulfill their RAP requirements. If a squadron cannot generate enough sorties to meet its training requirements, some of its pilots may lose their combat mission-ready certification. And if enough pilots are considered non-combat mission-ready, the unit's overall combat status may be lost. A squadron must be appropriately manned and able to generate and fly enough sorties if it is to effectively absorb new pilots, meet RAP requirements for squadron personnel and its guest pilots, and conduct upgrade training.

Sortie availability also determines a squadron's ability to generate and maintain experienced and ready pilots

There are practical limits to how many sorties a squadron can generate and fly over the course of a training year. The number of jets that a unit is assigned (Primary Mission Aircraft Inventory, or PMAI) must fly at a certain utilization rate (UTE) each month. Together, this provides a generic sortie pool that squadrons can use to train their pilots. But aircraft can only fly if they are mission capable, a status that describes an aircraft's airworthiness and mission system health, and these are dependent on the aircraft's age and how well it is sustained. In 2004, Air Force target utilization rates were 18 per month for the AC and 17.2 for the RC.⁵⁶ How the fleet is resourced; the availability of spares; and the manning, experience, and qualifications of maintenance personnel all are factors that impact each aircraft's mission-capable rate—and these all constrain a squadron's ability to generate and fly sorties.

Aircraft age can significantly degrade a squadron's ability to generate sorties, which is why aircraft fleets must be replaced in a timely manner. The older an aircraft is, the more flying hours it has accumulated, the more takeoff

Understanding Air Force aircraft maintenance coding

When an aircraft returns from a sortie and is fully mission capable with no maintenance issues, it is considered "Code One," and a through-flight inspection can prepare it to quickly turn to the next sortie. An aircraft that has maintenance issues that can be deferred and, therefore, can still fly is "Code Two." A Code Two jet may have limitations on what types of sorties it can fly and in what environments, depending on the issues. An example of a Code Two jet might be that it has a fault in the radar warning receiver. This jet might be approved to fly a training sortie, but not a sortie into a threat environment. A "Code Three" aircraft cannot fly again because the issue is so serious that it must be resolved before it flies again.

When an aircraft is Code Three and not available for planned scheduling, it is coded as non-mission capable (NMC) until it is satisfactorily repaired. Reasons include being down for maintenance (NMCM), lack of spare parts and supply (NMCS), or both (NMCSB). When parts cannot be sourced from the supply system, a squadron may use another aircraft as a "CANN bird," one from which maintenance crews cannibalize parts to install in other aircraft. Depending on the situation, this cannibalization can further decrease aircraft available for operations. Aircraft fleets can have high NMC rates due to insufficient maintenance personnel or spares.

and landing flight cycles it has completed, and the greater the wear and tear on its structure and mission systems. Over time, aircraft suffer metal fatigue and corrosion, and their parts—such as fuel pumps, hydraulic actuators, generators, and computer processors—deteriorate. The diminishing availability of spare parts and system obsolescence are key

factors in a squadron's ability to maintain its aging aircraft. Together, these factors increase the cost to maintain and operate squadrons.⁵⁷ Other factors that degrade aircraft readiness include not enough maintenance personnel with the right specialties and experience levels and insufficient depot-level throughput and return rates.

The Air Force suffers from these shortfalls today—and all directly translate to reduced combat effectiveness. Over time, military aircraft need routine maintenance, phase inspections of their critical systems, periodic depot-level work, and other repairs. Routine maintenance and inspections can be scheduled and planned and thus are part of a squadron's aircraft utilization rate calculus, but unforeseen repairs and equipment replacements are not.

An aircraft fleet with less than five years of operational flying time typically has higher maintenance costs and requires more sustainment work because its maintenance practices are still being honed, and unforeseen technical issues are still being identified and solved.⁵⁸ As a fleet matures and more aircraft are fielded, its sustainment costs come down and stabilize, and its aircraft availability increases because sustainment activities are well known, the supply base is established, and depots and maintenance personnel are manned and trained. Aircraft fleets that have reached their aging phase typically reverse these trends and require more maintenance and replacement parts. Older aircraft often suffer from corrosion, structural fatigue, scarcity of spare parts, unanticipated breaks, obsolete parts, and other materiel issues that decrease their availability and increase the cost to maintain them. For fighter aircraft, this aging phase begins around fifteen years into their operational lives. The U.S. Air Force fighter fleet is roughly twice that age, and the older the aircraft, the lower their mission-capable rates.⁵⁹

Mission-capable (MC) rates report the percentage of time that an aircraft fleet is fully qualified to execute its mission in combat. These measures include its airworthiness and the health of its mission systems. Higher mission-capable rates mean that a fleet is largely available and able to fly combat sorties with no restrictions. For example, a 100 percent MC rate would mean that every jet in a fleet is able to fly their designated combat missions. High mission-capable rates provide combatant commanders with more capacity to create combat effects in the battlespace. Lower mission-capable rates reduce this combat potential by decreasing the number of jets available to fly missions. While a 100 percent mission-capable goal may be unrealistic, 90 percent is extremely robust, and 80 percent is a minimum threshold for health.⁶⁰ In 2023, the last year that the U.S. Air Force made mission-capable rates for its fleets publicly available, fighter mission-capable rates were abysmal (see Figure 3).⁶¹ The net effect is that a historically small combat Air Force inventory is *even smaller*, given poor aircraft availability.

Low MC rates create an effective decrease in aircraft that are available to fly training missions. An F-16 squadron with 24 aircraft that have an average mission-capable rate of 69 percent would mean that it has only 16 aircraft that are available to fly at any given time. Over a one-month period, this F-16 squadron could generate a maximum of about 215 total sorties ($24 \times 13 \times 0.69 = 215$). Low mission-capable rates create an effect where the squadron is functionally overmanned. Using a rough estimation of eight sorties per month as an RAP demand signal, 215 monthly sorties could only support training for 26 pilots. Typically, a squadron with 24 aircraft would have 30 pilots. This limitation can significantly degrade the mission readiness of a squadron and its guest pilots.

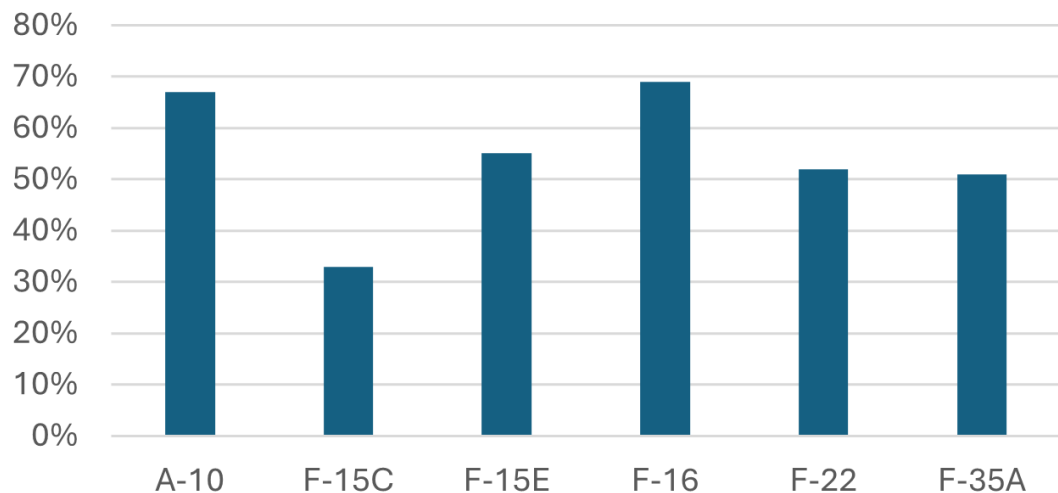


Figure 3: U.S. Air Force Fighter Mission-Capable Rates, 2023. Mission-capable (MC) rates represent the percentage of time that an aircraft is available and airworthy to fly. Poor MC rates hurt pilot absorption, squadron readiness, and combat capacity.

Source: [Air & Space Forces Magazine](#).

Mitigating the challenges created by operating fleets of older combat aircraft

There is a two-fold prescription for increasing the Air Force’s combat aircraft MC rates, which have reached historic lows. First, Congress should fully fund the service’s Weapon System Sustainment (WSS) accounts, which include programs to acquire aircraft parts and other equipment. The Air Force has historically underfunded its WSS accounts because of its need to address other budget priorities. For example, in 2022, the U.S. Air Force listed Weapon System Sustainment as its top priority on the unfunded priority list it provided to Congress.⁶² Given its budget limitations, the service could not make enough internal tradeoffs to fund all its WSS requirements. The increasing age of the Air Force’s fighter fleet will make it even more difficult to overcome such abysmal MC rates. Many of its current fighters are now so old that it is questionable if the Air Force could increase their MC rates to over 80 percent even if it received funding for 100 percent of its projected WSS requirements.⁶³

There comes a point in time when problems created by a fleet’s advanced age can no longer be sufficiently remediated by increasing WSS funding and repairs alone. The Air Force has long since passed this point, which is why it must now replace its aged aircraft as quickly as possible.⁶⁴ The F-35A is the U.S. Air Force’s keystone fighter for recapitalizing its fighter forces. However, budget pressures have forced the U.S. Air Force to suppress its annual buy rate well below its originally planned full rate of 80 per year, which is still not fast enough to sustain a healthy combat pilot corps. At a minimum, the Air Force must increase its F-35A acquisition to 74 aircraft per year and consider boosting F-15EX procurement. If production factors with these existing programs of record are unable to scale sufficiently to reverse the Air Force’s capacity death spiral, then the service should consider expanding acquisition to include new-build advanced models of the F-16, which are currently in production, to replace its aged F-15Cs and F-16s. The Air Force is nearing a point where it must “break glass” to avoid a death spiral whose

fundamental conditions are so adverse and complex that a recovery is nearly impossible. Service leaders have warned of these conditions for years, and it is time that Department of Defense and Congressional leadership act. This requires a larger budget share. The combination of additional WSS funding and a more aggressive new aircraft acquisition plan is essential to achieving the higher MC rates that will stop the decline in the health of the Air Force's combat pilot corps and, more importantly, improve its combat mission effectiveness.

Advanced simulator training is crucial to developing pilot proficiency but is not a substitute for tactical wisdom and airmanship

The Air Force used advanced simulator training and established it as a RAP requirement in part to address the diminishing mission-capable rates of its legacy aircraft. Air Force studies suggest that including simulation training as a RAP requirement could accelerate its pilot absorption rates.⁶⁵ As technology progresses, advanced simulation becomes an increasingly crucial means to train pilots for threats, scenarios, tactics, and capabilities that they cannot experience in live ranges.

Advanced simulation training is necessary and essential to the Air Force's combat readiness, especially as it evolves into a 5th-generation force. For instance, U.S. fighter pilots cannot employ and operate aircraft in their war reserve modes in open-air training ranges because of the potential for adversaries to collect intelligence on these capabilities. Moreover, replicating some adversary capabilities in real-world training ranges could reveal intimate U.S. knowledge of those threat systems and cause adversaries to change and adapt their systems in ways that might counter U.S. capabilities. Learning how to face and prevail over these threats can be the difference between mission success or failure.

Simulation also provides a safe environment for pilots to face these high-intensity threats and live another day to apply their learning.⁶⁶ Squadrons can also use simulators to train their pilots in the collaborative tactics and procedures that they will use in combat, and to do so in a building block approach prior to major large-scale exercises like Cope Thunder, Black Flag, and Red Flag.

While advanced simulation is core to mission rehearsals and pilot proficiency, it cannot substitute for in-flight activities to mature pilot airmanship, judgment, and flight leadership. The rest of the squadron enterprise also requires the training afforded by flying aircraft—everyone from a line chief to an avionics technician. Simulation must be *in addition to*, not instead of, flying. Simulation hones a pilot's tactical procedures and skill in managing an aircraft's sensors and other mission systems but fundamentally lacks many of the unplanned complications and surprises that occur in flight. Pilots still need to fly to develop judgment and airmanship to deal with these unplanned events. Experienced fighter pilots also stress the necessity to fly because only flight can impart the lessons and attributes that can be learned by experiencing actual emergencies, pulling Gs, physical fatigue, and other unpredictable events. Finally, simulators do not go to war, and pilots must learn to trust the aircraft they will use in combat. This requires real-world sorties, not just simulations.⁶⁷

Planned Force Structure Reductions Will Further Degrade the Combat Credibility of the Air Force's Combat Pilot Force _____

Cuts to the Air Force's force structure, in addition to the low mission-capable rates of its remaining legacy iron and slow recapitalization, have severely stressed the service's ability to fly enough sorties to build the experienced combat pilot corps the nation needs. Fewer combat aircraft means fewer cockpits and sorties to

absorb new pilots and give them the experience they need to succeed in combat. And simply producing fewer fighter pilots in response to a shrinking aircraft inventory is an untenable path for the service and the nation. These are the core ingredients of a pilot corps death spiral.

Despite these basic truths, the U.S. Air Force is not on track to recapitalize or grow its combat air forces to reverse its readiness decline in a strategically relevant timeframe. While the service is procuring the F-35A, acquisition rates fall far below what is needed to recapitalize aged aircraft, much less grow the fighter force. The Air Force is not replacing legacy aircraft at the same rate it is retiring them, which means the size of its combat forces will continue to reach new, historic lows. The Air Force's combat fleet is already the smallest it has ever been and is well past the point where modifications to its remaining aircraft will create a smaller but more lethal force.⁶⁸ In 2006, the U.S. Air Force had a total of 2,419 fighter aircraft and was short by 5 percent of its authorized fighter pilot billets, or 192 pilots. By 2024, its force structure shrunk to 2,093 fighters—a cut of nearly 400 aircraft—but nonetheless was short 1,142 fighter pilots.⁶⁹

The Air Force's contraction is having an adverse effect on its ability to absorb its pilots and maintain a ready force. The only solution to this challenge is to produce *more* pilots, not fewer. The Air Force must also *grow* its fighter force structure to maintain a healthy and ready combat pilot corps and sustain a force that can win in a peer conflict. More combat aircraft would mean more cockpits to absorb new pilots that are currently in production. Too few aircraft and too many inexperienced pilots can break a flying squadron's combat readiness. The only way to prevent this currently is to significantly limit the number of new pilots graduating from a formal initial fighter course and entering an operational squadron. These smaller cohorts

would only mask the problem, though, since squadrons would then find themselves with an insufficient number of experienced pilots and qualified instructors. A RAND study, initiated in 1993 as a part of a years-long project to understand and model Air Force fighter pilot requirements and absorption, found that force cuts were the primary reason for the service's current pilot absorption crisis.⁷⁰ Continuing to shrink the force risks making the Air Force's fighter pilot shortfall unrecoverable.

Divesting legacy aircraft places the Reserve Component and its experienced combat pilots at risk

The U.S. Air Force must reverse these trends if it is to successfully shape and deter America's adversaries and defeat peer aggression should deterrence fail. This will require accelerating its absorption of new pilots while retaining as many experienced pilots as it can. Fully exploiting the experience levels of pilots in the Air Force's Reserve Component would help in this regard. This will not be cost-free; the RC is also suffering from aging aircraft and force cuts that degrade the mission readiness of the rest of the force. Air Force senior leadership must ensure that the Reserve Component is recapitalized concurrently at a one-for-one rate and equipped with the same types of aircraft as the Active Component.

The oldest aircraft in the Air Force's combat inventory reside in its Reserve Component, including F-15Cs, A-10s, and early-block F-16s. These aircraft are at the greatest risk of divestiture. But as aircraft recapitalization programs have been terminated, deferred, and slow-rolled, the convention of sending older equipment from the AC as it is modernized to the RC is no longer tenable, placing the Reserve Component in distress. Without one-for-one replacement in the near term, divesting these aircraft would result in a major loss in combat capacity and experienced fighter pilots if they are not replaced.

Reserve Component combat aircraft divestments have already occurred and continue today. The 107th Fighter Squadron at Selfridge Air National Guard Base (ANGB) in Michigan is slated to lose its A-10s in 2027.⁷¹ The 171st Aerial Refueling Squadron, a sister squadron to the 107th Fighter Squadron, is part of the 127th Wing and operates the KC-135 Stratotanker. As part of the compromise to closing the 107th, Air Force senior leadership have promised to recapitalize the 171st ARS with twelve KC-46s. Such a dramatic shift in mission is more akin to standing up an entirely new squadron. As important as the KC-46's mission is, the closure of the 107th still represents a loss of combat capacity and experienced fighter pilots.

The 175th Wing of Martin State, Maryland, will also lose its A-10s, and it will not receive a flying mission in its place. Instead, the 175th Wing will become an entirely cyberspace operations wing.⁷² Like Michigan's 127th Wing, the Maryland Air National Guard conducts two types of operations: a flying operations mission supported by the 104th Fighter Squadron and a cyberspace mission. The Air Force plans to leverage the experience of the 175th Cyberspace Operations Squadron to increase its cyberspace operational capacity and consolidate the cyberspace mission under a single wing. This is a rational approach, but like the 127th Wing, it represents a real loss of basing, fighter capacity, and experienced combat pilots.⁷³ Unlike manpower in the Active Component, the intelligence, operations, and maintenance specialists in the Air Force's RC cannot be transferred to other RC fighter squadrons. Most of the individuals who currently fill specialties necessary to conduct flying combat operations will be lost entirely when the mission changes, representing a net loss to the strategic depth and experience of the Total Force.⁷⁴

The Air Force intends to inactivate or "re-mission" 13 of its fighter units across the Total Force. Since the Reserve Component operates the oldest fighter aircraft in the Total Force's inventory, it is at high risk of suffering from these types of mission changes. Fleet age is a major factor in these force structure decisions, especially for units with combat aircraft that are at or beyond their planned service life, have structural deficiencies and rapidly growing sustainment costs, and are increasingly difficult to maintain and modernize.⁷⁵ Both the 107th Fighter Squadron in the Michigan Air National Guard and the 104th Fighter Squadron in the Maryland Air National Guard were targeted for divestment because of the age of their A-10s and the Air Force's desire to wholly retire its A-10 inventory. While some RC squadrons will recapitalize with new F-35As, many RC fighter squadrons are without a plan to replace their legacy iron. Those squadrons programmed to convert to post-Block F-16s will remain at risk due to the age of those legacy aircraft and the lack of a recapitalization plan. Post-Block F-16s will be an "orphan fleet" in the RC, unsupported by the Active Component that has no post-Block F-16s in their inventory. Crucially, these legacy aircraft, while able to defend the homeland, lack the lethality and survivability to deter and prevail in a peer conflict.⁷⁶

Shuttering fighter squadrons across the Reserve Component will further stress the Active Component's forces, which are already too small to need. Too many administrations have focused on budget constraints at the expense of peer warfighting capabilities, seeking divestment without committing to robust recapitalization. The Total Force has too long been undersized for its current rotational demands, homeland defense, and other force deployments, resulting in grueling peacetime operational tempos and deploy-to-dwell rates that are unsustainable and create

a poor quality of life.⁷⁷ This contributes to pilot decisions to “vote with their feet” and leave the Air Force. Continuing to retire RC squadrons and divest their combat flying missions will also risk losing the Reserve Component’s ability to attract and capture experienced pilots exiting their Active Duty Service Commitment. Experienced pilots leaving the AC expect to find more stability and a better work-life balance in the Reserve Component. However, because the RC is now a de facto *operational* reserve, continuing to shrink the Reserve Component will demand even greater participation from each Active Component squadron. This will increase pilot deployment frequencies and durations, decrease pilot combat readiness, and cause more family instability and friction.⁷⁸ If service in the RC does not provide some relief from the stresses that cause pilots to leave the AC, then they may choose to leave the Total Force entirely.

Simultaneously Recapitalizing and Growing the Air Force’s Combat Capacity Can Reduce Pilot Experience

The need is clear: the Air Force must recapitalize and modernize its aged fighter fleet if it ever plans to stop its current force structure decline—and then grow its combat capacity. As the Air Force divests older aircraft such as A-10s and F-15Cs, experienced pilots must learn and acquire operational experience in the more advanced aircraft that replace them, as well as the tactics, techniques, and procedures (TTPs) for employing them effectively in combat. Even experienced instructor pilots, when assigned to a new aircraft type, must attend a transition course and regain their qualifications through upgrade programs. Transitioning from one type of aircraft to another can stress squadrons, which must absorb both new pilots and transitioning pilots. Both activities require increased supervision.

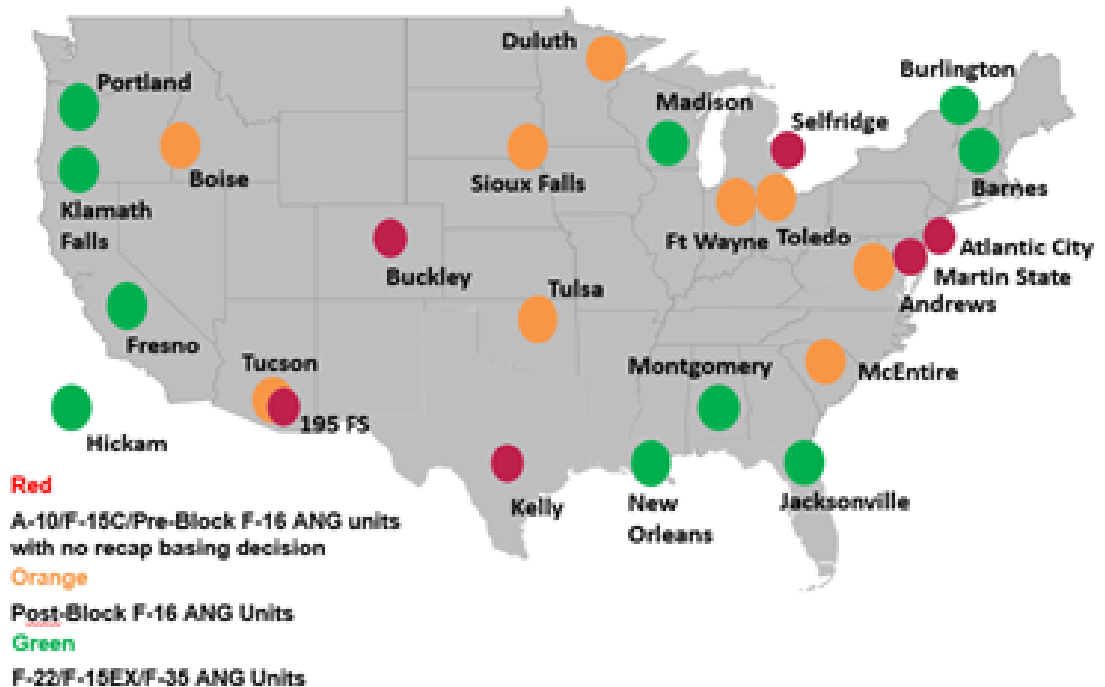


Figure 4: Air National Guard Fighter Squadrons, April 2023. More than half of ANG Fighter units are at risk. Martin State and Selfridge have been announced as losing their fighter mission; those units planned to receive “Post-Block” F-16s, the flow-down F-16s from the Active Component, remain at risk due to the age, MC rates, and relevance of those older F-16s.

Source: Mitchell Institute, data provided by the Director’s Action Group, Air National Guard, October–November 2024.

It is not uncommon for an experienced pilot to be assigned to a new aircraft and complete a formal transition course. Pilots transitioning from one jet to another type lose their experience designation and qualifications and must complete additional sorties after completing their initial transition training to regain them. For example, an experienced A-10 flight lead who transitions to the F-16 and graduates from the F-16 transition course must still fly another 50 F-16 sorties and complete 4-ship flight lead upgrade training before being designated as “experienced.”⁷⁹ Specialized qualifications, such as those needed for employing a specific weapon, will also have to be re-accomplished because the interfaces, avionics, and tactics in the new aircraft will be different.

While transitioning pilots with prior experience reach these milestones more quickly and with fewer sorties than new pilots, they still compete with new pilots for instructor pilot time and other flight supervision resources. Because transition courses take place at an FTU, transitioning pilots take resources that could otherwise be used for the initial qualification of new pilots in a B-Course. This is why FTUs must be sized and resourced and have instructor pilots to accommodate the necessary throughput of both transition and B-course students. Transitioning pilots also require the same RAP monthly lookback as new pilots, which may over-task a squadron’s available sorties. Thus, even experienced pilots transitioning to a new-to-them fighter require absorption capacity from a squadron.

While the threat environment demands that the Air Force aggressively increase 5th-generation fighter numbers as much as possible, too many years of constrained budgets buying too few fighters have created an absorption challenge that

Understanding Air Force combat pilot qualification courses

Prospective Air Force combat pilots must complete several formal training courses to be certified as combat-capable. A basic course (B-Course) completes the initial qualification training for new pilots in their first combat aircraft and is the primary focus of the Air Force Formal Training Unit (FTUs). FTUs are the Air Force’s schoolhouses that train new pilots who have graduated from Specialized Undergraduate Pilot Training (SUPT) and Introduction to Fighter Fundamentals (IFF) courses. Just like any fighter squadron, FTUs are constrained in how many sorties they can produce monthly. Because transition courses (TX) take place at an FTU, transitioning and re-qualifying pilots take resources, such as academics, sorties, and instructor pilots, that could otherwise be used for the initial qualification of new pilots in a B-Course.

must be addressed should the Air Force succeed in boosting fighter buys. Rapid retirement of F-15Cs, A-10s, and pre-block F-16s is seeing a bow wave of necessary new aircraft accession hit the service at a level that will limit the Air Force’s training and absorption capacity.

Rapidly retiring an entire fleet of a particular combat aircraft model can flood the Air Force’s training system with transition pilots who must be farmed out to multiple flying units for training. A squadron that transitions from one aircraft type to another, such as when an F-16 unit is recapitalized with F-35A, experiences this dynamic in totality. When a squadron converts from one type of combat aircraft to another, every pilot, from squadron commander down, suddenly becomes inexperienced and loses the supervisory roles and other qualifications they previously held. Selected squadron

instructor pilots and pilots in other key positions typically are temporarily farmed out to other squadrons to earn back their experience and qualifications so that they can conduct upgrade and supervisory activities for their home squadrons. The Air Force Personnel Center (AFPC) often reassigns experienced and qualified instructor pilots from other squadrons to a transitioning unit to develop a core cadre of instructor pilots in the gaining squadron. While this helps kickstart squadrons that are recapitalizing with new aircraft, it may also decrease the experience levels and instructor pool in the losing squadron, stressing that unit's health. The dynamic of getting a converting squadron to the point where it can begin to absorb both previously experienced and new pilots is crucial, but it can also be disruptive if the converting pilots do not gain enough training and experience in their new aircraft to backfill departing experienced instructor pilots. A squadron is effectively unavailable for training missions during this conversion period.

Converting squadrons to new aircraft types can also require the Air Force to complete environmental impact surveys and other studies, construct facilities such as specialized briefing rooms or secure compartmentalized facilities (SCIFs), and renovate existing airbase buildings and hangars. It can also require more advanced and secure data networks and infrastructure, different ground support and mission planning equipment, and other supporting systems that are unique to the new type. Maintenance personnel must be retrained and requalified. Because of these challenges, it can take over two years for a squadron to convert from one type of aircraft to another and return to combat-ready status. The downtime that these squadrons require to become combat-ready effectively shrinks the U.S. Air Force's available combat capacity—the service simply has fewer squadrons to meet operational rotations and deployments.

Growing the force will require the Air Force to stand up entirely new squadrons. Like converting squadrons, new squadrons need a core of experienced instructor pilots to train and absorb incoming pilots. This means new squadrons compete with converting and established units for these valuable experienced pilots. Growing the Air Force's pilot corps by standing up new squadrons could flood freshly graduated, inexperienced pilots into the system. This reduces the Air Force's ability to absorb these pilots and disrupts its ability to upgrade other pilots to flight leads and instructor pilots. Without sufficient training, new pilots may remain or intermittently degrade into a non-combat mission-ready status, which generates an even larger training burden. It is even possible that these pilots may not reach their required experience milestones by the end of their first operational tour. Second-tour inexperienced pilots become an absorption burden for their next operational squadron, creating a deleterious cycle. These challenges should *not* be misconstrued as an excuse to limit growth, flat-line the force, or even shrink capacity. Instead, these dynamics are a clear-eyed call to smartly manage the imperative for growth by preserving experience in the pilot corps across the Total Force. History has shown the adverse consequences of shrinking the force—the Air Force must grow.

While aggressive 5th-generation fighter modernization needs to continue to dominate Air Force modernization investment, a tipping point may have occurred where the modernization bathtub is so bad that it may be necessary to consider procuring advanced versions of legacy-type aircraft. The F-15EX already represents a program of record in this regard. New-build advanced versions of the F-16s represent another potential option. Both have a

reduced transition burden on the force. For example, Air Force F-15C units undergoing transition to the F-15EX are not facing the same issues posed by units transitioning to entirely new aircraft. When there is sufficient similarity between a legacy aircraft and its more advanced version, transitioning pilots do not automatically lose their experience and qualification ratings. Instead, these pilots undergo “differences training” that is more akin to an upgrade program than a formal transition course. This type of training leverages previous expertise to understand the differences in aircraft and weapon systems, and it is utilized often within squadrons. Moreover, this type of conversion does not take squadrons off their deployment status. Replacing aged-out iron with new, advanced versions of the same type does not burden the formal training unit at the same levels that recapitalizing with a new type would. However, the service must be transparent that operational risk does come with this approach, as a new-build 4th-generation aircraft does not offer the same combat utility and survivability of a more modern type, like the F-35 or eventually the Next Generation Air Dominance (NGAD) fighter. A tiered set of capabilities will exist until a full conversion to 5th-generation and beyond capabilities can—and must—take place.

What is beyond clear is that after thirty years of downsizing, the U.S. Air Force must now rapidly recapitalize its geriatric aircraft inventory and grow its combat capacity. The threat environment demands this approach. The Air Force has no other choice if it is to perform its core roles and fulfill its responsibilities. The joint force cannot effectively engage without the capacity and capabilities afforded by Air Force fighter aircraft and their experienced pilots. Reducing the advanced age of its combat aircraft inventories while

simultaneously improving its capabilities is critical to keeping pace with China and Russia. This will induce stress on its larger ecosystem, including its pilot corps. The combined challenges of recapitalizing, modernizing, and growing the size of the Air Force can greatly reduce the service’s pilot absorption rates and increase its pilot exit rates. This combination can be lethal. A pilot corps that is too small and lacks sufficient experience is at greater risk of suffering from higher attrition rates and less staying power in combat—when it counts the most. This does not have to be the case. Taking full advantage of the Reserve Component can greatly reduce the impact of rebuilding a Total Force that is capable of deterring and, if necessary, defeating aggression by a peer adversary. This will require the Air Force and Congress to provide the RC with the resources it needs to stop its force reductions and continue to attract and maintain a right-sized cadre of experienced, combat-ready pilots.

Growing Capacity in the Reserve Component Will Increase the Total Force’s Combat Capacity and Avoid Diluting its Experience Levels

The U.S. Air Force has been unsuccessful in meaningfully improving its pilot retention rates for over twenty years. To break this stalemate, the service’s senior leadership should take advantage of the Reserve Component’s higher pilot retention rates. Growing the Reserve Component’s combat capacity would create additional opportunities to retain the Air Force’s most valuable pilots and keep them current and qualified on combat aircraft that are critical to the nation’s defense. In this sense, maintaining a robust Reserve Component fighter force should not be viewed as a problem but rather as part of the solution to reversing the Air Force’s decline as a combat-ready force.

Preserving and increasing fighter capacity within the Reserve Component increases retention and readiness for the Total Force

Increasing the Air Force's Total Force combat aircraft inventory would improve its readiness to fulfill the needs of the nation in today's unpredictable global threat environment. Internal and external Air Force studies have found that its sustained high deployment and rotational rates over the past thirty years have created instability in the force that is causal in pilot decisions to exit the Active Component.⁸⁰ These studies cite another reason why the service's pilots are departing at increased rates—they are simply not flying enough, and flying is the reason they chose to join the Air Force in the first place. But many pilots who leave the Active Component seek to join the Reserve Component, which offers more stability and the opportunity to continue to fly and serve. The Air Force must acknowledge this reality as it reoptimizes for great power competition and conflict.⁸¹ Growing the Total Force's combat capacity would also help mitigate the pressures of the Air Force's growing force deployment and rotational commitments, as these would be spread across a larger force. The Air Force has faced non-stop demand for decades, yet it *must* be able to sustain this volume and pace of force projection. Growing the Total Force is the only viable and available way that the Air Force will be able to continue to provide the decisive combat airpower the nation needs.

Preserving the Reserve Component's existing fighter squadrons and increasing the number of aircraft assigned to them are the keys to this approach. The Air Force must recapitalize and grow its Active Component, but it cannot do so at the expense of its Reserve Component without hazarding the long-term health of its combat pilot corps. Today, this peril is

very real—the Reserve Component's fighter squadrons are at high risk of divestiture due to the advanced ages of their legacy aircraft. By retaining these fighter squadrons and equipping them with modern aircraft, the Air Force can create additional retention opportunities for experienced pilots exiting the Active Component.

Recapitalizing and growing the capacity of the Reserve Component's combat squadrons can help avoid diluting the Total Force's pilot experience levels

Recapitalizing the Air Force's existing Reserve Component squadrons and standing up additional RC squadrons would reduce the potential of diluting the service's pilot experience levels and increase its pilot production and absorption capacity. And because the Reserve Component gains most of its experienced pilots from the Active Component, growing the RC's combat capacity would not increase strains on the Air Force's pilot production enterprise. To realize these advantages, the Air Force must prioritize recapitalizing RC squadrons that now operate aircraft that have reached or even exceeded their planned operational lives. If these squadrons are not recapitalized with new fighters, the Air Force will lose much-needed combat capacity and experienced combat pilots. Once a fighter squadron migrates to another mission, or even another aircraft such as an airlifter or aerial refueling tanker, its experienced combat pilots and all the associated mission support and expertise are lost to the Total Force—possibly forever. Prioritizing the most at-risk RC fighter squadrons is necessary to preserve these combat capabilities and capacity.

The Air Force should also modernize its Reserve Component fighter squadrons with the same aircraft its Active Component squadrons receive. The reality is that the Air

Force shrunk so dramatically in the decades following the Cold War that the Reserve Component is now baked into all war plans as an essential player. This only works if they are equipped with the aircraft required to execute missions in a modern threat environment. A concurrent modernization approach will also create commonality between the two components that yields support and operational efficiencies across the Total Force. Sharing the management, acquisition, maintenance, and logistics “tails” that an aircraft fleet requires is crucial to amortizing its costs. This tail also includes testing and weapons certification activities; acquiring aircraft spares, ground equipment, and other materiel; managing the flow of aircraft through maintenance depots; and training maintenance personnel. Commonality is essential for maintaining the “tooth” of an air force, too—its ability to plan, deploy, fight, and maintain its integrity in combat. Having the same equipment enables flying units to seamlessly

rotate through a theater and provide capabilities required by commanders without disruption or to augment other squadrons with jets and pilots to meet operational needs. Moreover, pilots leaving the Air Force’s AC will have nowhere to go if the Reserve Component does not have the same type of aircraft they have invested years of their lives training to fly in combat.

In addition to recapitalizing its fighter forces, the Air Force should stand up new combat squadrons in its Reserve Component. Growing the Reserve Component’s combat capacity would help reduce many of the challenges that result from creating new Active Component flying units. A number of Reserve Component wings have a single fighter squadron, which creates opportunities to stand up additional squadrons of the same type of aircraft on the same bases while

reducing the need for additional infrastructure and staff. Many Active Component fighter bases have excess capacity that could be used for additional squadrons of aircraft, but the AC would need to produce more pilots to fill these units, potentially causing absorption issues. Standing up new RC units on these bases would take advantage of this capacity and reduce the pilot production bill that is typically required to create new AC squadrons.⁸² The Air Force’s Active Component must grow to meet operational demands for airpower, but concurrently increasing the service’s RC would help maintain experienced pilots in the force that the Active Component has already developed *but cannot fully retain*.

To further harness this opportunity, the Air Force should increase the number of jets assigned to its Reserve Component fighter squadrons. Reserve Component fighter wing commanders routinely report they must turn away qualified pilots who are exiting the Active Component.⁸³ These AC pilots clearly want to continue to serve and fly, and growing capacity in the Reserve Component is the only realistic means for ensuring they can do so. Most of the Air Force’s Active Component fighter squadrons have 24 combat-coded aircraft, while its RC fighter units are assigned 18 aircraft. Increasing these RC squadrons to 24 assigned jets would create seven to eight more pilot positions per squadron. These additional aircraft would need associated maintenance support and spares to ensure squadrons can fly them at required rates, but the benefit of retaining more experienced combat pilots would greatly outweigh the costs of these additional resources.

Finally, the U.S. Air Force should equip its newly created combat squadrons with the same type of aircraft as the units with which they are collocated. It is all about amortizing existing sunk costs. Standing up new squadrons in existing combat wings would reduce the need for more staff overhead and

The Air Force’s Active Component must grow to meet operational demands for airpower, but concurrently increasing the service’s RC would help maintain experienced pilots in the force.

additional base infrastructure. Moreover, experienced personnel in existing squadrons could help their immature sister units absorb new and cross-over pilots and maintainers. And because pilots in the Reserve Component primarily come from AC units, they would not need to complete formal transition training or retraining, assuming they were qualified in the same type of aircraft. This would free the Air Force's FTU capacity to conduct transition training and B-course training for its Active Component pilots.

The U.S. Air Force must recapitalize and modernize its forces as it reoptimizes for great power competition and conflict. As it does so, it should adopt approaches that maintain a robust, experienced corps of combat pilots across its Total Force. Continuing to divest the Reserve Component's fighter forces will eliminate opportunities to capture pilots departing the AC and retain them in the service—the Air Force *cannot* afford to lose these pilots entirely. Increasing the Air Force's long-term pilot absorption capacity and retaining those pilots over their flying lifecycle will require recapitalizing and growing the size of its RC and AC *concurrently*. Recapitalizing and growing both components is the best approach for optimizing the service's combat pilot experience across the Total Force.

Considerations

As the Air Force transforms its force design by acquiring advanced technologies like CCA and NGAD, it should cultivate the asymmetric advantage that few of its competitors can match—its cadre of highly trained and experienced combat pilots. The cat-and-mouse game of military-technical competitions will remain an important element of preparing for air combat, but an overly myopic focus on technology can run the risk of neglecting the value of experienced combat pilots. The United States should never surrender its ability to *be the pacing*

threat for the People's Republic of China and other adversaries around the globe. Algorithms and software, no matter how sophisticated, cannot replace the creativity, initiative, and judgment to decide and act through the fog and friction of war that only human cognition at the forward edge of the battlespace can provide. This is just another reason the U.S. Air Force must ensure that it has a strategic depth of experienced fighter pilots if it is to remain a force that wins.

During a conflict with China or Russia, the Air Force will not have time to produce and absorb fighter pilots at the same rate as the attrition rate it could experience, nor can it replace the combat aircraft it will lose in combat. Today's defense leaders need to pay attention to the cautionary tale of Germany and Japan's wartime experiences. The U.S. Air Force today shares unnervingly similar attributes. If the combat air force is stressed at peace, it will not sustain itself when subject to the demands of war. Reoptimizing for great power conflict means the Air Force must recapitalize, modernize, and replace very nearly its entire fighter force as it simultaneously grows its combat capacity. Decades of budget-driven deferred modernization cannot be ignored indefinitely when the threat environment is mounting. This modernization bow wave threatens to drastically impact the ability of the service's operational combat squadrons to absorb new pilots at the required scale, especially as it has proven unable to retain fighter pilots in the quantities the Air Force needs to maintain its existing forces.

The U.S. Air Force must continue to address the core reasons that are driving its experienced fighter pilots out of its Active Component or out of service entirely. Many of the fighter pilots exiting the AC seek to join the Reserve Component because they perceive the RC as a more flexible way to continue their service. The Active Component has been unable to increase pilot

retention rates, so taking advantage of the Reserve Component's potential to capture many of these departing pilots is part of the solution to preserving experience in the Total Force—and building the strategic depth the nation needs in the U.S. Air Force.

The Air Force must recapitalize, modernize, and grow its fighter forces without jeopardizing the health of its combat pilot corps. Concurrently recapitalizing and growing the size of the Air Force's Reserve and Active Component's combat forces will help the service

Concurrently recapitalizing and growing the size of the Air Force's Reserve and Active Component's combat forces will help the service create a ready force that has the strategic depth required for peer conflict.

create a ready force that has the strategic depth required for peer conflict and do so in a way that is cost-effective. It is also conscientious of the Air Force's combat air force enterprise as a complex system that has many interdependencies. Understanding and taking advantage of these interdependencies is the only way to resolve the Air Force's longstanding combat pilot

shortfall. The following considerations are essential to achieving this balanced force design:

- **The U.S. Air Force must increase the capacity and elasticity of its pilot production enterprise.** The Air Force must increase the production capacity and elasticity of its undergraduate pilot training enterprise and formal training units. The service has not been able to achieve its pilot production objectives for eight consecutive years and fell short of its 2023 goal by 120 pilots.⁸⁴ At 100 percent capacity, the service should be able to produce 1,500 pilots. It has thus far been unable to produce more than 1,300 pilots per year.⁸⁵ The Air Education and Training Command (AETC) has aggressively explored technological approaches, including simulation, to accelerate its pilot production. This has yielded some improvements.

For example, AETC's student pilots now receive their wings after completing their primary training in the T-6 aircraft before progressing to their advanced fundamentals training phase. But simulation alone will not reduce the Air Force's pilot production shortfall—new training aircraft are also needed. Like the service's operational aircraft, its pilot training aircraft are old and facing serious maintenance and sustainment issues. These must be solved in ways that will allow AETC to surge pilot production when needed. The Air Force should also consider how it could increase the elasticity of its pilot production enterprise to meet changing demand, even if it means reopening pilot training bases that were closed because of BRAC actions or funding contract pilot training, as it did in WWII.⁸⁶

- **The U.S. Air Force should use its pilot lifecycle modeling capabilities to better understand the potential unintended consequences and benefits of recapitalizing, modernizing, and growing its force structure.** The U.S. Air Force has invested heavily in its capabilities to conduct advanced modeling of its pilot lifecycle to better understand its variables and outcomes. The service is currently undertaking major force structure and organizational changes that could incur unexpected consequences on its ability to absorb pilots and give them the experience they will need for combat operations. For example, it is not entirely clear how the four-phase Air Force Force Generation (AFFORGEN) training cycle will impact pilot absorption, and the same is true for transforming its forces into Deployable Combat Wings and other organizational changes. The Air Force should use its considerable pilot lifecycle models to better anticipate these effects and inform its future reorganization decisions.

Ultimately, the U.S. Air Force must build and maintain an experienced combat pilot corps that has the strategic depth to meet the nation's global security needs. The Air Force today is too small to do this now, which is the true root cause of its persistent pilot shortfall crisis. Growing the size of the Air Force and modernizing its forces—especially its Reserve Component's combat squadrons—is the only viable, cost-effective means to resolve this shortfall and increase the retention of experienced combat pilots across the Total Force.

Recommendations

The U.S. Air Force has been studying its pilot absorption and lifecycle dynamics for over two decades. Today, the service has better data and models that it can use to understand its pilot ecosystem, but these tools have yet to produce solutions to many of its problems. There comes a point where studies alone will not fix the problem. It takes investment. The Air Force's pilot shortage has grown even as it cut the size of its forces, increased its pilot retention bonuses, and decreased its pilot staff requirements by opening those positions to its ground specialties, civilians, and contractors. These death spiral patterns must be arrested and reversed.

The fundamental reason for this is not complicated: decades of chronic underfunding have yielded an Air Force aircraft inventory far too small and far too old to support the existing pilot force. The Air Force must grow its combat forces if it is to solve its pilot crisis and do so in a way that avoids collapsing the experience of its pilot corps. This means it must grow the size of its RC combat forces together with its AC combat air inventories—it cannot neglect one in favor of the other. The Reserve Component is a linchpin to resolving the Air Force's pilot shortfalls, too, because its combat squadrons

capture many of the experienced pilots who choose to leave the Active Component. To this end, the Mitchell Institute offers the following recommendations:

1. **The U.S. Air Force should grow its Active Component fighter forces to increase the quantity and rate at which it can absorb new pilots and maintain their combat readiness.** The service must have more fighter aircraft to be able to develop the experience its new fighter pilots require at a rate that equals or exceeds the pace at which its experienced pilots exit the service. A larger combat force combined with a larger corps of experienced pilots is the only path toward reducing the growing gap between the Air Force's combat capacity and its global operational requirements. This would also have significant collateral benefits, like decreasing the frequency and duration of pilot rotational deployments that have a marked impact on pilot retention.
 - **Replace old aircraft with new at a one-for-one rate.** The U.S. Air Force can no longer pursue a “divest to invest” strategy for recapitalizing its aging forces. Any further decreases in the service's force size will exacerbate its pilot crisis to a point from which it cannot recover. Instead, the U.S. Air Force must immediately stabilize its force size by replacing aircraft at a one-for-one rate. This will also stabilize the Air Force's fighter pilot corps as it recapitalizes its fighter fleet.
 - **Increase the Air Force's F-35A acquisition rate.** The F-35A is the primary fighter program for the U.S. Air Force, but its annual procurement rates continue to fall far below the service's original program of record—and, more importantly, its need.

The Air Force should procure F-35A at a rate of 74 aircraft per year to recapitalize and modernize its Total Force combat squadrons. Anything less will allow the average age of the service's fighter fleet to continue to increase, reducing its capacity and readiness for combat.

2. **The U.S. Air Force should preserve and grow the number of Reserve Component fighter squadrons and increase the number of fighters assigned to each squadron.**

Capturing and retaining experienced fighter pilots who exit the Active Component is the most efficient and least disruptive way to increase the number of experienced combat pilots in the Total Force. The Air Force has been unable to stop and reverse the rate at which pilots exit the Active Component. Rather than fight this dynamic, the Air Force should leverage the Reserve Component's ability to capture and retain these experienced pilots. And as the service increases the size of its Reserve Component, it should use its squadrons to further expand the Air Force's ability to absorb inexperienced Active Component pilots.

- **Grow the number of Reserve Component fighter squadrons.** Many Reserve Component wings have a single fighter squadron. The U.S. Air Force could cost-effectively grow the number of fighter squadrons in its Reserve Component by taking advantage of the unused ramp space and infrastructure at bases that host these wings. Collocating new squadrons in wings with seasoned squadrons that are equipped with similar types of aircraft would also help facilitate training the new unit's pilots and other personnel.

- **Grow the number of primary assigned aircraft at Reserve Component fighter squadrons.** Most Reserve Component wings with a fighter mission have a single squadron of 18 primary aircraft. Increasing the number of primary assigned aircraft in these units to match the number of aircraft in Active Component squadrons would gracefully grow the Total Force's combat capacity and pilot corps with fewer adverse effects.
- **Leverage Reserve Component pilot experience to absorb Active Component pilots.** As the U.S. Air Force grows its Reserve Component, it should use some of that additional capacity to help absorb new AC pilots graduating from their initial fighter qualification courses. The Air Force has previously used the Reserve Component in this way, but its effectiveness faltered as the RC's aircraft aged out, and the Active Component's pilot corps fell further into crisis.

3. **The U.S. Air Force should recapitalize and modernize its combat forces to improve the mission-capable rates of its fleet.**

This requires accelerating the production rate of F-35A and F-15EX. If production rate expansion of the F-35A cannot be scaled at the rate necessary to arrest inventory decline and improve mission-capable rates, the service should consider procuring advanced F-16 models to replace legacy airframes and grow the inventory. While types like the F-15EX and new-build F-16s do not offer the same level of combat utility and survivability as a 5th-generation fighter, they do offer the ancillary benefit of easing unit transitions and mitigating F-35A unit conversion downtimes. Recapitalizing and modernizing is now the only path for accelerating the Air Force's new pilot absorption rates and increasing its Total Force readiness.

- **Procure the F-15EX and advanced versions of the F-16 to triage legacy aircraft availability and prevent squadron closures.** Replacing current F-15Cs and F-15Es with the F-15EX and replacing F-16s with an advanced version of the F-16 would modernize the Air Force's fighter squadrons with minimal operational downtime. These aircraft are mature and will achieve the high mission-capable rates that are essential to successful combat operations. Experienced pilots would retain their experience levels while the new aircraft would increase combat capability and relevance across a broader spectrum of conflict.
 - **Fully fund weapon system sustainment accounts, fully man all maintenance billets, and increase aircraft maintenance depot throughput.** The Air Force must fully fund and resource the weapon system sustainment accounts of all its aircraft if it is to achieve the mission-capable rates necessary to absorb and maintain the readiness of its Total Force.⁸⁷ This means fully funding aircraft spare parts, fully manning maintenance personnel at the right experience levels, and increasing depot throughput to decrease turn times. The optimal way to decrease the staggering WSS costs of maintaining its aging aircraft is to *replace* them as rapidly as possible.
4. **The U.S. Air Force should recapitalize and modernize its Active and Reserve Components *concurrently*.** The Reserve Component depends on the Active Component to provide core support for its aircraft, and the Reserve Component provides crucial experience and depth to the Total Force. This means that both components must have the same type of equipment for this support to be effective and affordable. The U.S. Air Force must avoid creating a segregated force structure if it is to fully integrate the Reserve Component into all its operations. This concurrency creates interdependencies between the two components that increase their flexibility to adjust to changing training requirements in peacetime and the dynamic needs of combatant commanders in wartime.
5. **The U.S. Air Force must ensure its advanced simulators are connected to the Joint Simulation Environment and are available to squadrons for daily training.** The Joint Simulation Environment provides the necessary tools for combat pilots to train to their most stressing scenarios and employ wartime modes and capabilities, but not all squadron simulators are connected to this model. Advanced simulators are crucial to training combat air forces for high-end threats in scenarios that current physical ranges cannot accommodate. Simulators also allow fighter pilots to use their aircraft war reserve modes in ways that do not disclose their capabilities. Pilots need experience in scenarios that stress their abilities within the safety of simulation so they can expand their skill sets and strengthen their cognition. This is key to producing pilots that can handle the many challenges that they will face in a peer conflict, and it requires that pilots have access to the Joint Simulation Environment at the squadron level.

Conclusion

The U.S. Air Force needs to recapitalize, modernize, and grow its combat forces without breaking the readiness of its most important asset—its cadre of experienced combat pilots. This is obviously only one phase of the pilot lifecycle, but because operational squadrons are the heart of the nation's airpower combat capacity, it is arguably the most important. Moreover, the Air Force must increase its pilot production to

Experience matters in war, and our nation must have a combat pilot corps that is organized, trained, and equipped for high-intensity conflicts of a kind that it has not experienced since WWII. Failing to secure this vector may cause the nation to lose a future major war.

successfully field a lethal, war-winning force that can fight tonight and prevail in future conflicts. If the Air Force cannot keep its pilot force from eroding during peacetime, there is no question that it will suffer catastrophic consequences in wartime, given the pressures of combat attrition. Multiple rounds of force cuts, delayed modernization programs, and base closures have left the service with a pilot force that is undersized and insufficiently experienced. Issues such as aging aircraft and their corresponding maintenance problems have prevented the Air Force from increasing its pilot training capacity for years. Well-intentioned pilot training approaches that explore and implement technologies such as advanced simulation, self-paced computer-based training, and virtual and augmented reality compress the time required to complete undergraduate pilot training.

But technology alone is not a panacea, and operational commanders have expressed concerns about substandard airmanship and the judgment of their new pilots given their reliance on these new approaches.⁸⁸

Likewise, collaborative combat aircraft or other uncrewed aircraft will not be able to replace human cognition in combat. While these aircraft will afford advantages as they mature over the next several decades, their algorithms and artificial intelligence will remain unable to effectively operate and perform in complex, uncertain, and ambiguous threat environments. Human cognition, initiative, and improvisation will continue to provide an asymmetric advantage in peer conflict. Autonomous aircraft will be valuable tools for humans, but there is no true substitute for fighter pilots and other combat pilots in the battlespace. However, to be

effective and lethal, pilots must have the flying combat training sorties. This experience has repeatedly proven to be the difference between mission success and failure in combat.

Former Secretary of the Air Force, Frank Kendall, was right when he said, “We are out of time.”⁸⁹ It takes between three to five years to plan, program, budget, source, build, and deliver a fighter jet—about the same time that it takes to recruit, train, and absorb a fighter pilot. If a conflict with China should erupt, the United States cannot wait five years to build the force that it needs to win. The Air Force must have the standing strategic depth to defend the homeland, provide nuclear deterrence, secure its standing global commitments, and win a conflict against a peer adversary. To achieve this, the Air Force must pursue an aggressive recapitalization program that replaces its fighter aircraft at a one-for-one rate as quickly as possible or risk being unable to build the force the nation needs in time.

Experience matters in war, and our nation must have a combat pilot corps that is organized, trained, and equipped for high-intensity conflicts of a kind that it has not experienced since WWII. Failing to secure this vector may cause the nation to lose a future major war. No form of joint power projection is viable without the scale and scope of the U.S. Air Force’s combat aircraft and pilots. The U.S. Air Force cannot continue to trade its capacity for capability; it can no longer increase its lethality by modifying its geriatric aircraft. This is a prescription for mission failure and losing the next war.

The Air Force’s prior efforts to address its broken squadrons, pilot shortages, reduced experience ratios, and unsustainable pilot departure rates have fundamentally ignored the root cause of these issues: the service is simply too small to meet the full range of the nation’s global security demands.⁹⁰

The administration and Congress must fully fund the Air Force's requirements to recapitalize and grow its combat aircraft inventories and the pilots that fly them. This must be done in conjunction with a more robust flying hour program, increased operations and maintenance funding, and fully resourced weapons system sustainment accounts to ensure a healthy combat enterprise. This must also be a Total Force effort—the Air Force cannot recapitalize, modernize, and grow its combat capacity without fully leveraging its most experienced pilots in the Reserve Component. If the Air Force fails to pursue this path, it risks forfeiting what has long been America's asymmetric advantage: airpower and the experienced airmen it takes to win. ✪

Endnotes

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- 9 ["The United States Air Force in Facts and Figures: An Air Force Almanac."](#) *Air Force Magazine*, May 1989.
- 10 John A. Tirpak, ["Air Force Mission Capable Rates Fall in 2023, Led by Declines for F-15C and B-1,"](#) *Air & Space Forces Magazine*, May 29, 2024; and ["2023 USAF & USSF Almanac: Equipment,"](#) *Air & Space Forces Magazine*, June 22, 2023. For the impact these rates have on realistic operational availability in a conflict, see Deptula and Gunzinger, [Decades of Air Force Underfunding Threaten America's Ability to Win](#), figures 2 and 3.
- 11 The U.S. Air Force's entire fleet is well past its design life. Consider the average age of the tanker fleet (nearly 50 years old and the backbone of force extension), the KC-135 (over 60 years old), and the airlift fleet (averaging nearly 25 years old). Trainer aircraft average over 35 years old, while specialized mission ISR aircraft vary widely between six years old for an MQ-9 to over 60 years old for many wide-body ISR aircraft. The special operations fleet appears to be the healthiest, averaging 8 years old across its inventory. ["2024 USAF & USSF Almanac: Equipment,"](#) *Air & Space Forces Magazine*, June 7, 2024.
- 12 Audry Decker, ["Robot reality check: Crewed warplanes will remain vital for years, USAF general says."](#) *Defense One*, December 7, 2024.

- 34 Stephen Losey, “[The military’s stunning fighter pilot shortage: One in four billets is empty.](#)” *Air Force Times*, April 11, 2018. These requirements are defined by aircraft inventory and crew ratios (how many pilots per aircraft) and the number of rated billets in wing leadership and headquarters staff that are coded for fighter pilots due to the expertise they can bring to that position’s duties and responsibilities. The USAF has coped with its fighter pilot shortfall by moving pilots out of the staff, changing staff codes, and/or filling those positions with contractors who are retired fighter pilots.
- 35 Rachel S. Cohen, “[Perennial pilot paucity puts Air Force in precarious position.](#)” *Air Force Times*, March 3, 2023.
- 36 Author conversation with Lt Gen Adrian Spain, Deputy Chief of Staff for Operations, in September 2024.
- 37 Secretary of the U.S. Air Force (SECAF), “[Financial Management: US Air Force Cost And Planning Factors.](#)” Air Force Instruction (AFI) 65-503, July 13, 2018.
- 38 Pilots commit to ten years of service when they commission, so one would expect stability of pilot inventory across the first ten years. Instead, the variability in the blue line reflects variability and constraints in pilot production.
- 39 William W. Taylor, James H. Bigelow, and John A. Ausink, *Fighter Drawdown Dynamics: Effects on Aircrew Inventories* (Santa Monica, CA: RAND Corporation, May 19, 2009). While some might expect that the service could shrink its aircraft inventory to match its pilot inventory, this does not solve the pilot shortfall. In fact, aggressive aircraft divestment adversely impacts the health of the entire pilot ecosystem because of the disruptions it causes to pilot production, absorption, and year-group management. RAND clearly documented how aircraft divestitures in the 1990s caused harm to the USAF’s pilot corps, many consequences of which the Air Force continues to struggle with today.
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- 41 A special office in HAF/A3 is dedicated to understanding pilot retention decisions and addressing the root causes of why pilots exit the service. Accepted wisdom directly connects pilot exit to airline hiring as the dominant, if not only, factor that impacts pilot retention choices. Sensing surveys conducted by the A3 Aircrew Task Force offer better insight to root causes that drive pilots out of the service. These include unsustainable deployment frequency and durations, lack of agency regarding assignments, and lack of resourcing to accomplish the mission (like training and flying hours). Airline hiring, in this view, may be strongly correlated to pilot exit because it gives pilots alternative and lucrative employment options, but it is not causal nor even the main reason pilots choose to leave. Increasing pilot bonuses can influence these decisions, but pilots’ motivation for service are not fundamentally transactional or financial. The U.S. Air Force must better understand and strengthen these motivations and rewards (which include attributes like patriotism, adventure, meaning, camaraderie, and achievement) to enhance commitment to service and reduce administrative burdens and family friction. Based on discussions with ACTF lead, June 2023.
- 42 2002–2024 Air National Guard End Strength Pivot Tables. Data provided by NGB/AFPC as of October 2024.
- 43 “Rated Production, Absorption & Talent Management,” Aircrew Crisis Task Force senior statesman briefing, May 2023.
- 44 In 2017, the U.S. Air Force was short by 27 percent of its fighter pilot authorizations. *Military Personnel: DOD Needs to Reevaluate Fighter Pilot Workforce Requirements*, GAO-18-113 (Washington, DC: GAO, April 2018).
- 45 *Aircrew Training: Tactical Air Command and Strategic Air Command Flying Hour Programs*, GAO/NSIAD-86-192BR (Washington, DC: GAO, September 1986).
- 46 Charles M. Colegrove and Winston Bennett Jr, *Competency-based Training: Adapting to Warfighter Needs* (Mesa, AZ: Air Force Research Laboratory Warfighter Readiness Research Division, December 2006).
- 47 *Aircrew Training: Tactical Air Command and Strategic Air Command Flying Hour Programs*, GAO/NSIAD-86-192BR, pp. 5–6.
- 48 Table 5a, “RAP Sortie/MTC Requirements,” in the F-16 RAP Tasking Memorandum for the U.S. Air Force for 2024.
- 49 SECAF, “[Flying Operations: F-16—Aircrew Training.](#)” Air Force Manual (AFM) 11-2F-16 vol. 1, June 26, 2024.
- 50 A pilot’s obligations to meet RAP standards versus other non-RAP types of flying training can conflict, causing tension and difficulties for the squadron. When experienced IPs are required to supervise inexperienced pilots during the pilot absorption process, for example, they must participate in a two-ship basic intercept mission geared toward training a new pilot and may not receive the sorties they need to practice more-advanced skills to fulfill their RAP requirements. Similarly, when squadrons have to provide their own Red Air, these missions can count as “non-demanding,” because they do not test the skills, proficiencies, or tactics that a pilot would typically exercise.
- 51 A squadron’s unit manning document (UMD) describes how many pilots a squadron is allocated, what ranks are required, and whether they are experienced or not. But squadrons are often also responsible for flying wing staff and other “guest” pilots who are not on the UMD. These additional pilots are often coded as Basic Mission Capable (BMC) and do not require the same number of sorties a squadron pilot would need to meet their RAP requirements. In addition, these guest flyers are often experienced flight leads or instructor pilots, and can provide supervision and execute other flight-duties. But because these guest flyers are not on the squadron’s UMD, a squadron’s real monthly sortie demands may not be fully represented at higher echelons.
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- 66 Antiquated threat systems on ranges cannot stimulate the sensors on advanced aircraft appropriately, degrading training. Ranges and associate military training areas are increasingly constrained in space, volume, and scheduling as urban development encroaches and commercial air traffic increases.
- 67 Ignacio A. Lara, [Hurry Up and Wait: Over-Absorption in a Pilot Shortage: Simulating Pilot Absorption at a US Air Force Fighter Squadron and the Implications of Recent Policy Changes](#) (Santa Monica, CA: RAND Corporation, July 25, 2024).
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- 74 The job disruptions caused by mission changes in Reserve Component units are often skimmed over by asserting that the total number of employment billets remains the same. Yet, while the job quantities may remain stable, the job types do not. The very real effect for those in the unit is that they lose their job entirely, and a different person is hired to fill the new role. An engine maintenance specialist, for example, is unlikely to transfer into a similar rank/level of cyberspace coding operations. Even if they are willing, they may not be the best candidate for that position. These types of mission transfers are akin to closing a business entirely and having a new business in a different market space open.
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- 78 [Military Personnel: DOD Needs to Reevaluate Fighter Pilot Workforce Requirements](#), GAO-18-113. Deployment-to-dwell ratios are defined by DOD instructions and further clarified by OSD Memoranda.

- In 2021, OSD set the objective dwell rates for the Active Component at 1:3 (for every month gone, three months at home), with a minimum threshold of 1:2. For the Reserve Component, the mobilization-to-dwell objective is 1:5, with a threshold of 1:3. Longer periods at home for the RC is meant to ease participation with employers and families. Members of the Reserve Component members still seek to maintain positive relationships with employers and see invoking the Uniformed Services Employment and Reemployment Rights Act (USERRA) as a last resort. OUSD(PR), [“Deployment-to-Dwell, Mobilization-to-Dwell Policy Revision,”](#) DTM 21-005, August 16, 2021, Incorporating Change 1, October 13, 2022; and [“USERRA - Uniformed Services Employment and Reemployment Rights Act,”](#) U.S. Department of Labor.
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- 84 Rachel S. Cohen, [“Air Force to fall nearly 150 pilots short of annual training goal,”](#) *Air Force Times*, September 11, 2023.
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- 86 Contract pilot training has precedent in WWII. If this path is pursued, the U.S. Air Force should consider how they impart the values, culture, and Air Force ethos into the pilot graduates.
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About the Author

Heather R. Penney is a Senior Resident Fellow at the Mitchell Institute, where she conducts research and analysis on defense policy, focusing on the critical advantage of aerospace power. Prior to joining Mitchell Institute, Penney worked in the aerospace and defense industry, leading budget analysis activities, program execution, and campaign management. An Air Force veteran and pilot, Penney served in the Washington, DC Air National Guard flying F-16s and G-100s and has also served in the Air Force Reserve in the National Military Command Center.

