National Aeronautics and Space Administration

ANNUAL AIRCRAFT REPORT

FOR FISCAL YEAR 2020

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OFFICE OF STRATEGIC INFRASTRUCTURE Aircraft Management Division • NASA Headquarters • 300 E Street, SW Washington, DC 20546

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I. EXECUTIVE SUMMARY

NASA's aircraft operations enable the Agency to achieve its vision and missions put forth in the 2018 Strategic Plan. The numerous accomplishments by the Agency's aircraft operators during Fiscal Year (FY) 2020, a year when the COVID-19 pandemic disrupted all facets of society, can only be described in brief by this report.

In summary, NASA's aviation professionals managed, flew, and maintained 63 active aircraft, totaling 6,104.7 flight hours and 3,327 sorties during the FY. NASA's aviation organizations accomplished their assigned missions safely despite the pandemic, ending the year without any fatalities or National Transportation Safety Board (NTSB) reportable accidents. While the Agency's aircraft operations did incur three Type C and four Type D mishaps that were below the NTSB's reporting threshold in FY 2020, they were all ground incidents that were mostly maintenance missteps.

The reported total aircraft costs of $145.9 million for FY 2020 fell by 9.8 percent, or $15.9 million, from the previous FY. Looking back at FY 2019, if Kennedy Space Center's one-time procurement of Airbus H-135 helicopters to replace its aging Huey II helicopters were excluded, the Agency's total FY 2019 aircraft costs would have also gone down by 2.4 percent, or $3.8 million, over that of FY 2018. In fact, if NASA factored out one-time recapitalization expenditures in the last few years, the Agency's aircraft operational costs declined each year for three consecutive years.

6,104.7 flight hours in FY20

NASA also utilized 837.1 flight hours of Commercial Aviation Services (CAS) in FY 2020 for airborne science. Included in the total FY 2020 aircraft costs was $3 million of flight services provided by commercial vendors. While CAS flight operations augments NASA's aircraft capabilities, the use of CAS also brought a significant safety oversight responsibility on the Agency's aviation community.

Although its growth has slowed, the scope of Unmanned Aircraft Systems (UAS) operations continued to expand across the Agency. It was only in FY 2007 when the then Dryden Flight Research Center—now Armstrong—first operated the Ikhana UAS, the sole-reported UAS in the Agency at the time. By FY 2020, NASA Centers reported slightly over 400 operational and non-operational UAS, with the vast majority of them being small UAS (sUAS) below the Agency's reporting threshold. In fact, NASA only operated four large UAS in FY 2020, the SIERRA UAS at Ames Research Center and the two Global Hawk and a X-56 UAS at Armstrong, that met the Federal Aircraft requirement for reporting to the General Services Administration (GSA). Except for the Glenn Research Center, all NASA centers operated UAS.

NASA primarily operated UAS, large and small, for airborne science and aeronautics research. However, their uses rapidly expanded to all functional areas within the Agency, such as structural corrosion inspection and public affairs videography. UAS operations across NASA have brought about unique challenges in their operational oversight and asset management. The Aircraft Management Division (AMD) in the Office of Strategic Infrastructure actively coordinated with the Inter-Center Aircraft Operations Panel to not only implement policy for safe operations of NASA's UAS, but also to address recommendations from a 2017 Office of Inspector General audit report regarding NASA's UAS property oversight. Policies under development to protect the United States from certain UAS made by adversarial countries may require NASA to replace up to a quarter of the Agency's sUAS inventory.

In FY 2020, NASA's aircraft and their operators enabled the Agency to retrieve International Space Station (ISS) astronauts directly from Kazakhstan after each Soyuz landing; conduct major international Earth Science campaigns; map shrinking Arctic and Antarctic glaciers; perform airborne infrared observations of the stars with the Stratospheric Observatory For Infrared Astronomy (SOFIA) aircraft; and develop new aeronautics technologies to make future aircraft safer, faster, and more efficient. NASA's research aircraft sampled pollutants and greenhouse gases across much of the United States and validated satellite instruments. NASA's aeronautics research aircraft aided the development of sonic boom reduction technologies

and advanced UAS autonomy to integrate UAS into the National Airspace System. NASA's high-performance T-38 trainer aircraft helped NASA astronauts prepare for their missions to the ISS and take on the Nation's future space challenges. NASA aircraft operations supported and monitored commercial launches by SpaceX. In short, NASA aircraft operations contributed to every aspect of NASA's missions, supported other Federal agencies, and collaborated on joint international research objectives.

Over NASA's celebrated history, the Agency evolved from the country's premier aeronautics research organization to the leading space exploration and scientific research organization that it is today. NASA's aircraft operations continuously adapted to meet the ever-changing mission demands placed on the Agency in support of the Nation's Earth and space objectives. The pace of change for NASA's aviation community has only accelerated in recent years. Past declines in aeronautics research and space operations flight support requirements were offset by the steady rise in airborne science research requirements. Science mission requirements, however, began to decline, while missions in support of human space flight activities in the United States ramped up.

In the last decade, NASA's aviation community proactively managed its aircraft portfolio to navigate a landscape of constantly changing mission sets, while at the same time coping with budget pressures. During that time, NASA reduced its overall active aircraft inventory from 86 in FY 2005 to 63 by the end of FY 2020, all the while adding aircraft as needed, such as the execss Department of Defense (DoD) Gulfstream G-III acquired by Langley Research Center and the used Gulfstream G-V purchased by Johnson Space Center, and shedding aircraft without mission requirements, such as the Shuttle Carrier Aircraft and Shuttle Training Aircraft.

To enable missions while containing costs, NASA's aircraft operations shared aircraft, flight crew, and logistic support resources and implemented the aircraft regionalization initiative. In addition, NASA aircraft operations took advantage of excess DoD assets to add or replace flight capability and as no-cost parts support, sometimes even with dissimilar aircraft that had similar components or parts.

The AMD, as the Aircraft Capability Lead in managing NASA's aircraft, initiated a baseline review of all NASA aircraft, including non-operational aircraft, such as display assets and parts aircraft in FY 2014. In coordination with the GSA, NASA disposed of 17 non-operational aircraft in FY 2015, returning $2.3 million in sales proceeds to NASA's aircraft operations. Continuing the progress already made, NASA's aviation community in FY 2020 further sold three aircraft that were used for parts, generating almost $1.4 million in proceeds, donated an S-3 to the San Diego Air and Space Museum, and scrapped a parts aircraft.

This report also incorporates the forward-looking Annual Aircraft Requirements Analysis as required by NPR 7900.3, Aircraft Operations Management with inputs from the Aircraft Advisory Committee integrated for the first time. The analysis of FY 2021 and outyear aviation requirements reviewed all aircraft mission and program requirements, aircraft use, and associated costs projected over a five-year horizon. The FY 2021 Requirements Analysis verified that all active NASA aircraft were meeting funded requirements that were linked to the Agency's strategic plan. The SOFIA Program not withstanding, Science requirements are expected to decline in the next two years, but stabilize at a reduced level over the budget horizon. The reduced Airborne Science Program funding also reflects the lag in program and project aircraft selection decisions and may not be as dire as the trend seemed to suggest Aircraft requirements for the Human Exploration and Operations Mission Directorate, on the other hand, are also projected to hold steady in the outyears.

The Agency's reprioritization of resources as it transitions to the Commercial Crew Program and prepares for the commercialization of the ISS is expected to continue to impact NASA's aircraft operations in the next few years. As NASA proceeds through this transition period, the mission enabling capabilities of the Agency's aircraft must be clearly understood and shepherded. NASA's aviation organization is the world leader in airborne science, aeronautical research, and space program support. It took NASA years to establish this capability and it must be carefully managed to ensure the United States continues to lead in these critical mission areas. To this end, NASA's aviation community proactively manages the risks involved in the right-sizing of flight operations in support of developing space programs and changing airborne research requirements, as well as re-energized aeronautics research initiatives that will require flight test and demonstration.

II. INTRODUCTION

NASA's aircraft operations enable the Agency's myriad missions, from preparing astronauts to go to space, to studying Earth from the air, to developing leading-edge aeronautic technologies. Over the illustrious history of the Agency, NASA's aircraft operations have reshaped itself time and time again to meet the evolving mission requirements the Nation placed on it. This Fiscal Year (FY) 2020 Annual Aircraft Report documents the key accomplishments by NASA's aviation community over the past FY. This report is prepared in accordance with NPD 7900.4C, the Agency's policy directive on Aircraft Operations Management. The contributions and accomplishments made by NASA's aviation professionals and the diverse aircraft they managed, maintained, and operated during FY 2020 are summarized in the report. This report also provides a status of NASA's aviation resources and the major changes that took place during the FY.

Excluding the small Unmanned Aircraft Systems (sUAS) that do not meet the Agency's Capital Asset definition, NASA's aircraft operate from seven NASA Centers located across the United States and conduct flight operations throughout the world. Figure 1 lists the Agency's active aircraft assets that various NASA Centers managed and operated as of the end of FY 2020. NASA's aircraft inventory also includes many display, parts, and other non-active aircraft that were held in flyable or non-flyable storage status for future needs, but they are too extensive to be detailed here.

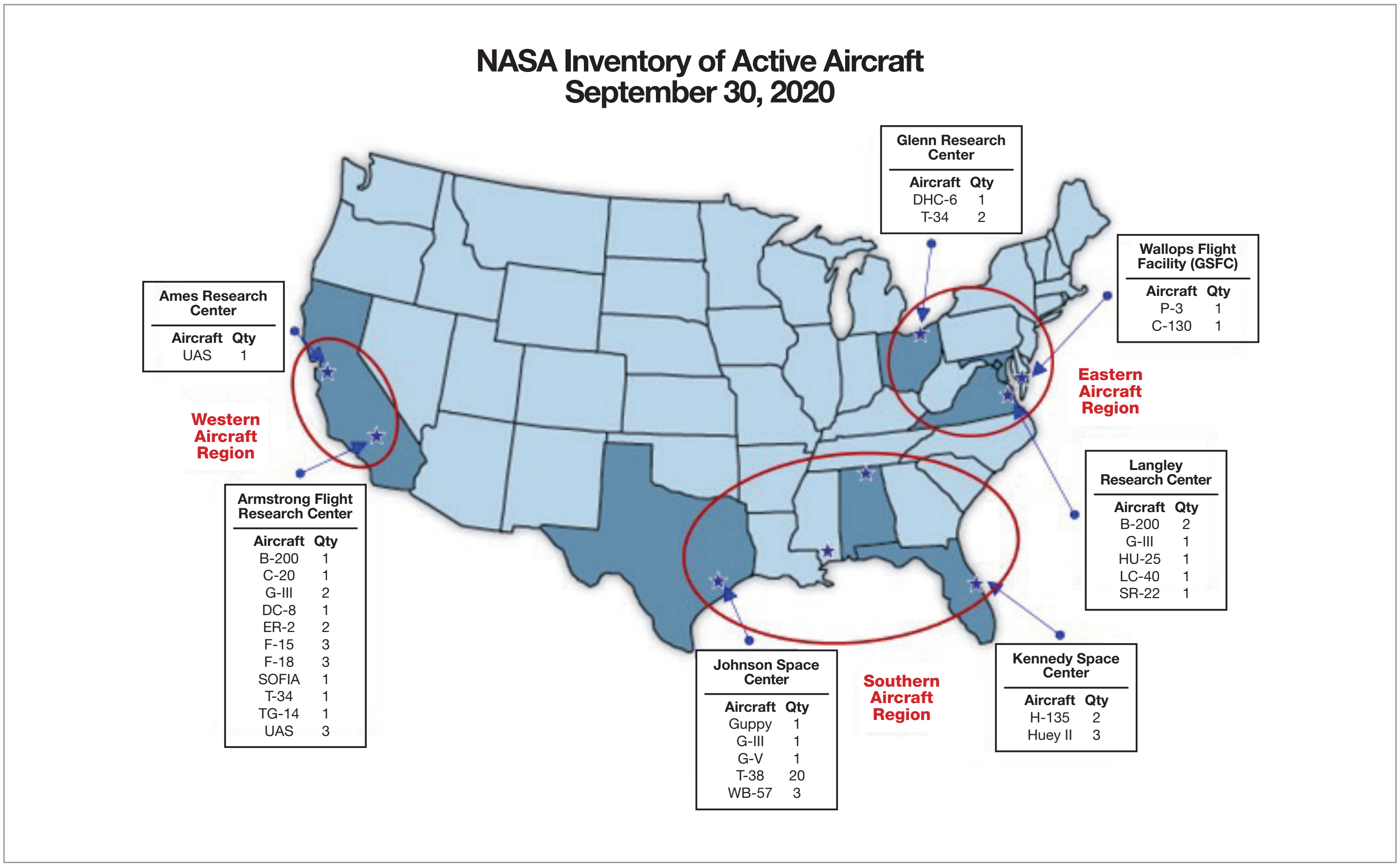

Figure 1—NASA Aircraft by Location

NASA's aircraft operations, with the October 2016 Executive Council decision, are organized into three management regions: the Eastern Aircraft Region, the Southern Aircraft Region, and the Western Aircraft Region. This regionalization initiative aims to increase collaboration, reduce redundancy, and improve aircraft operational efficiency between aircraft centers. The Eastern Aircraft Region consists of the flight operations at Glenn Research Center, Goddard Space Flight Center's Wallops Flight Facility, and Langley Research Center, with Langley as the regional lead. The Southern Aircraft Region, led by Johnson Space

[1]Kennedy Space Center to complete planned transition to 3 H-135 helicopter fleet by mid FY 2021

Center, teams Johnson's flight operations with that of Kennedy Space Center, Marshall Space Flight Center, and Stennis Space Center, the last two of which only operate sUAS. The Western Aircraft Region, with Armstrong Flight Research Center as the lead, integrates Ames Research Center's mainly Unmanned Aircraft Systems (UAS) operations with Armstrong's much larger organization. In addition, Armstrong also provides airworthiness and aircraft operations oversight for the Jet Propulsion Laboratory's (JPL) Commercial Aircraft Services (CAS) activities. The Regional Aircraft Management Model is how NASA's aviation community is implementing the Agency's Mission Support Future Architecture Program (MAP).

It is, however, the people that manage, operate, and maintain the Agency's aircraft that make NASA's flight operations an essential capability for the Agency. NASA is one of only a few Federal agencies with the technical capability and the authority to certify the airworthiness of its own aircraft, as well as contracted aircraft. This flight certification authority recognizes the Agency's human expertise in aircraft engineering, modeling and simulation, flight testing, Quality Assurance, and Aviation Safety, as well as the higher standards that NASA's aviation community holds itself to. NASA's aviation professionals are well recognized for their achievements in Federal aviation. NASA's flight operations have won 20 Federal Aviation Awards given out by the General Services Administration (GSA) in the last 20 years, including 2 for the Agency's FY 2020 aircraft operations. NASA's Level III Safety Management System recertification by the International Business Aviation Council in November 2017 and continued biennial Gold Standard Program Certifications by GSA since 2007, are also evidence of the Agency's aviation excellence.

NASA's Aircraft Management Division (AMD), as required by NPR 7900.3C and designated as the Agency's Aircraft Capability Lead, annually reviews and validates aircraft requirement inputs from the Mission Directorates and Centers. AMD's annual requirements analysis ensures each active NASA aircraft can be mapped to documented aircraft program requirements and funding that are clearly traced back to the Agency's Strategic Plan. Aircraft requirements data from Mission Directorates and Centers also facilitate strategic resource decision-making based on the costs of aircraft ownership. This report concludes with the results of AMD's FY 2021 aircraft requirements analysis based on a five-year projection of aircraft missions and operational budgets.

III. NASA'S AIRCRAFT INVENTORY

NASA only owns and operates aircraft for the Agency's missions in space exploration, aeronautic and scientific research, and technology development. Out of its entire operational fleet of aircraft, NASA has less than a handful of aircraft that can also be operated to transport passengers under the Federal Aviation Administration's (FAA's) civil aviation flight rules, when they are not otherwise engaged in accomplishing the Agency's primary missions. The quantity and type of aircraft operated by NASA Centers change from year to year as the Agency's mission emphasis shifts from scientific discovery, to space operations beyond Low-Earth Orbit, to the Moon, and beyond.

FY 2020 Aircraft Inventory Summary

NASA operated and maintained a total of 63 active aircraft during FY 2020. The 63 aircraft operated during the FY were far fewer than the 79 operated by NASA in FY 2008, and less than three quarters of the 86 aircraft that the Agency flew in FY 2005. NASA's active aircraft at the end of each FY have hovered around 64 or 65 for the preceding seven years as shown in Figure 2. The 63 active aircraft in FY 2020 included Kennedy Space Center's transition to Airbus H-135 helicopters from its aging Huey II helicopters. Kennedy's transition temporarily brought its year-end aircraft inventory up to five and obscured the aircraft reductions that took place elsewhere in the Agency.

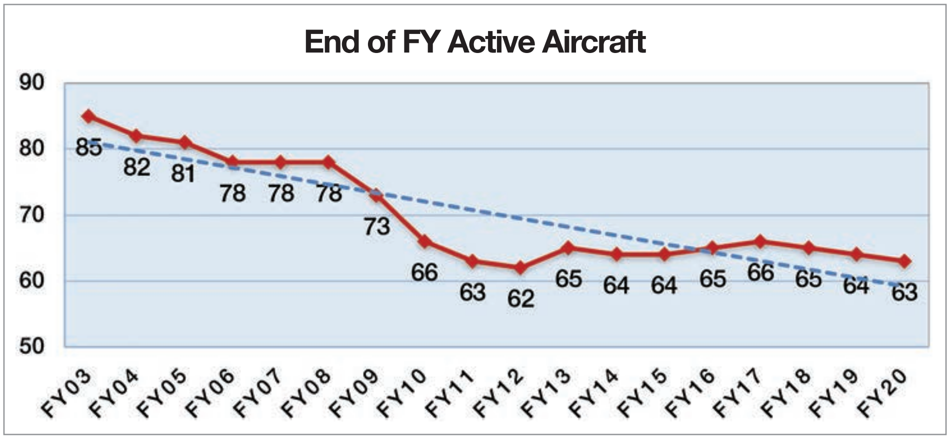

Figure 2—NASA Aircraft Inventory

Initial aircraft reductions of the Agency's aircraft in the last two decades came as a result of the termination of the Space Shuttle Program. With reduced Astronaut Corps requirements, Johnson's T-38 fleet was pared to 20 aircraft by FY 2015. In more recent years, reduced Airborne Science Program (ASP) requirements have impacted manned aircraft operations across NASA, but especially the Eastern Aircraft Region. In response to reduced ASP missions in the last two years, Wallops put down one of its two C-130s, deactivated a C-23, and more recently put its B-200 aircraft into storage. Additionally, Wallops sold three parts aircraft through GSA auction, further reducing the facility's non-operational aircraft inventory, and returned almost $1.4 million in proceeds back into its aircraft operations.

Compounded by decreased aeronautics research requirements, Glenn recently scrapped a parts S-3 aircraft and donated its sole operational S-3 aircraft to the San Diego Air and Space Museum to be used as a display asset. On the West Coast, one of Armstrong'stwo B-200 support aircraft was in storage for all of FY 2020. Along with Armstrong's planned transfer of its entire Global Hawk UAS fleet back to the Department of Defense (DoD) upon the completion of the aircraft's reimbursable project, other planned aircraft dispositions on the near horizon would likely bring the Agency's aircraft inventory to its lowest levels in over 20 years.

NASA's operation of sUAS, on the other hand, grew rapidly in the last two decades for a myriad non-traditional aircraft uses, such as technology research, mishap investigation, facility inspection, and public affair videography. While the growth in UAS numbers have slowed in recent years, by FY 2020, NASA Centers reported just over 400 operational and non-operational Unmanned Aircraft Systems (UAS), with the vast majority of them being sUAS that are below the Agency's capital asset threshold. With potential restrictions regarding foreign made UAS on the horizon, up to a quarter of NASA's sUAS inventory might need to be replaced, however. Figure 3 provides a snapshot of the number of aircraft, including the reportable UAS, that NASA Centers operated at the end of FY 2020.

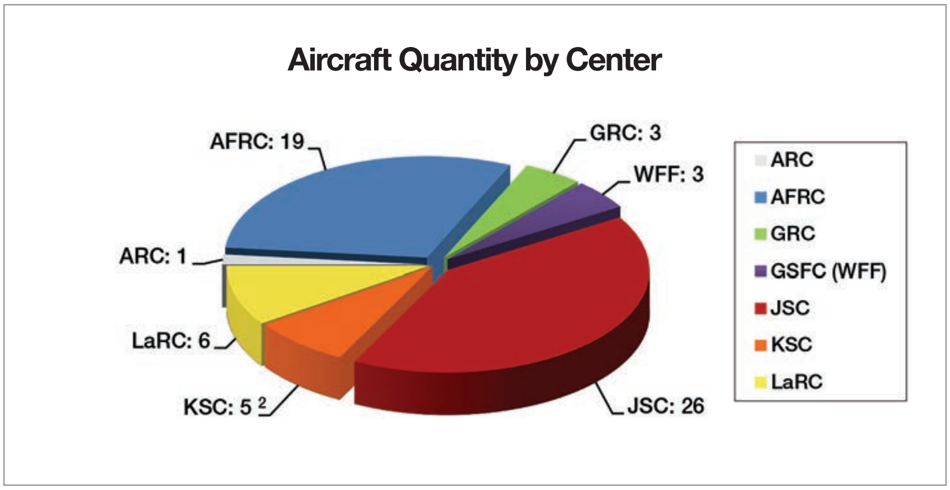

Figure 3—Quantity of Aircraft at NASA Centers

The majority of the Agency's aircraft fleets were operated in direct or indirect support of NASA's space programs. So, it is no surprise that more than a third of the Agency's aircraft operated out of Johnson Space Center. Armstrong Flight Research Center, on the other hand, operated the bulk of NASA's Research and Development (R&D) fleet in support of aeronautics research and airborne science requirements. Going beyond the quantity of aircraft operated at each Center, Table 1 lists the aircraft type and models operated at each Center at the conclusion of FY 2020. Table 1 shows that NASA operated 24 different types of aircraft that made up the 63 active aircraft fleet. These different aircraft type/model/series were needed to meet NASA's very unique variety of requirements across all Mission Directorates.

[2] KSC to complete transition to 3 H-135 helicopter fleet by mid FY21.

Table 1—NASA's Active Aircraft and Quantity by Center

AMES		ARMSTRONG		GLENN		GODDARD/WALLOPS	
Aircraft	Qty	Aircraft	Qty	Aircraft	Qty	Aircraft	Qty
Sierra UAS (Ship #2)	1	B-200	1	DHC-6	1	B-200	1
		DC-8	1	T-34	2	C-130	1
		ER-2	2			P-3	1
		F-15B/D	3				
		F/A-18	3				
		G-III	3				
		Global Hawk UAS	2				
		SOFIA	1				
		T-34	1				
		TG-14	1				
		X-56 UAS	1				

Johnson		KSC		LaRC	
Aircraft	Qty	Aircraft	Qty	Aircraft	Qty
B-377SG	1	Huey II	3	B-200	2
G-III	1	H-135	2	HU-25	1
G-V	1			G-III	1
T-38	20			Lancair LC-40	1
WB-57	3			SR-22	1

As it has been the case for the last decade, in FY 2020 NASA's research aircraft were mostly operated to meet airborne science missions. While aircraft operations in support of space programs stabilized in recent years, reduced airborne science requirements had resulted in the continued reduction of NASA's overall aircraft inventory in FY 2020. Without the temporary swelling of Kennedy Space Center's helicopter fleet during the center's transition to three Airbus H-135 helicopters, NASA's active aircraft at the end of the FY would have been down to 61. A complete list of the aircraft, including the reportable UAS, that NASA operated during FY 2020, these aircraft's primary missions, and their recorded values are provided in more detail in Appendix 1. Aircraft information sheets, each containing a representative photo and brief aircraft descriptions, for the year-end inventory are provided in Appendix 2.

External Aviation Resources

Inter-Agency Cooperation

NASA continued to rely on aircraft services from other Federal agencies, especially the DoD, for a variety of support missions. For the SpaceX Crew Dragon launch on May 30, 2020, the three-team Space Flight Support Force stood ready at Patrick Air Force Base, Florida.; Joint Base Charleston, South Carolina; and Joint Base Pearl Harbor-Hickam, Hawaii, and were prepared to rescue the astronauts if anything was to go wrong. Two U.S. Air Force (USAF) C-17 aircraft transported the Mars 2020 Perseverance Rover from March Air Reserve Base to Kennedy to start the rover's journey to Mars. NASA also relied on the USAF 45th Operations Group's Detachment for contingency aeromedical evacuation in Kazakhstan if American astronauts were injured upon a Soyuz capsule landing.

Figure 4 – NASA's Mars 2020 Perseverance Rover being loaded aboard an USAF C-17 for delivery to Cape Canaveral, Florida.

Commercial Aviation Services

CAS, such as chartered aircraft services, were another resource for NASA to supplement its own aircraft capabilities. In FY 2020, NASA utilized CAS to support the Agency's research requirements in both airborne science and aeronautics technology development. JPL, under the oversight of Armstrong, reported over 500 flight hours of airborne research on CAS aircraft in FY 2020. At the opposite side of the country, Wallops oversaw more than 300 flight hours of airborne science research conducted by CAS operators during the FY. Meanwhile, under NASA contract, Lockheed Martin Aeronautics Company's Skunk Works factory in Palmdale, California, continued the final assembly and integration of the X-59 Quiet Super Sonic Technology (QueSST) aircraft. The X-59 was but another example of NASA's reliance on the U.S. aviation industry to accomplish the Agency's strategic objectives.

IV. CONTRIBUTIONS TO NASA MISSIONS

The COVID-19 pandemic disrupted much of the Agency's overall operations, including aircraft operations, in FY 2020. NASA's aircraft operators, however, still flew a total of 6,104.7 flight hours and 3,327 sorties in supporting the Agency's missions. These numbers do not include external flight support services, such as CAS or the use of USAF aircraft. NASA continued to operate its aircraft in FY 2020 almost exclusively for Research and Development (R&D) and Program/Project Support (PS) missions. For FY 2020, 53.4 percent of the flight hours and 77.5 percent of the sorties were for PS missions, the majority of which were T-38 astronaut training flights.

The heightened health risks from COVID-19 made commercial air travel untenable for NASA personnel during the FY. For critical NASA missions where NASA personnel had to perform critical functions in person, such as the launch of the Mars 2020 Perseverance Rover and the Commercial Crew Program (CCP), flights via NASA's passenger-capable aircraft became the only viable means of long-distance travel. This resulted in a significant increase in passenger flight operations during FY 2020. Including flights whose primary mission was pilot proficiency, NASA's aviation community flew a total of 568.0 flight hours and 198 sorties of passenger carriage flights. In contrast, the Agency only flew a total of 76.0 flight hours and 62 sorties of passenger flights in all of FY 2019. In FY 2020, NASA's flight operations carried 782 passengers and logged just over 860,000 passenger-miles in support of the Agency's programs.

Each passenger transport flight in FY 2020, even those flown in conjunction with pilot proficiency training, was reviewed and authorized in advance according to strict Office of Management and Budget (OMB) and NASA guidelines. Complying with the December OMB policy memorandum that further restricted the use of Government-owned, leased, rented, or chartered aircraft for travel, NASA did not conduct any passenger flights that could have been justified based on costs avoidance. Figures 5 and 6 break down the Agency's FY 2020 passenger transportation flights conducted by Armstrong, Goddard (Wallops), and Johnson, the only NASA Centers that operated aircraft authorized to carry passengers. Johnson, in support of the Agency's human space flight missions, flew the bulk of the NASA's passenger flights in FY 2020.

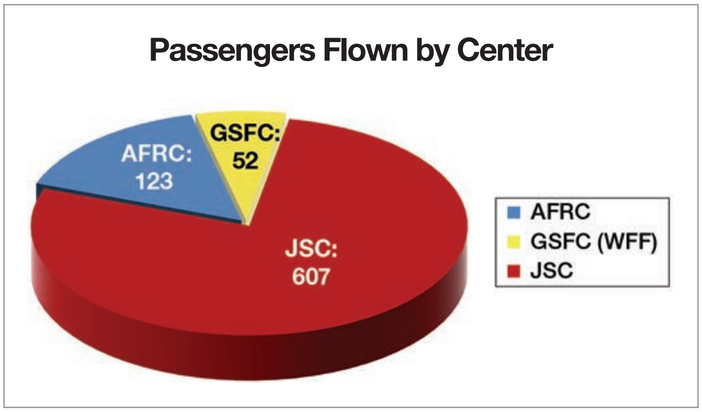

Figure 5—Total Passengers Flown in FY20

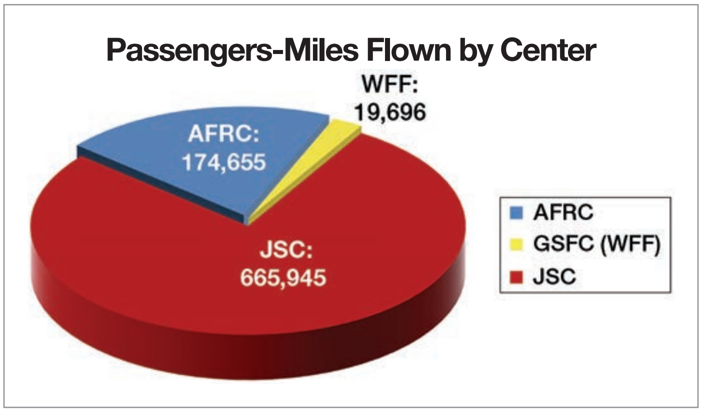

Figure 6—Total Passenger-Miles Flown in FY20

Figure 7 displays the overall scope of flight operations the Agency conducted in the past decade, beginning with FY 2010. Over the last 10 years, NASA's aircraft operations continuously trended downward. The scope of NASA's FY 2020 aircraft operations was the lowest it had ever been and was only about half of what it was at the beginning of the decade. Compared to the prior FY, NASA's FY 2020 aircraft operations fell by 23.9 percent and 21.6 percent, respectively, in terms of flight hours and flight sorties. Much of the FY 2020 decline in aircraft operations was the direct result of the COVID 19 pandemic, as NASA restricted flights to those that were absolutely critical to the Agency's missions.

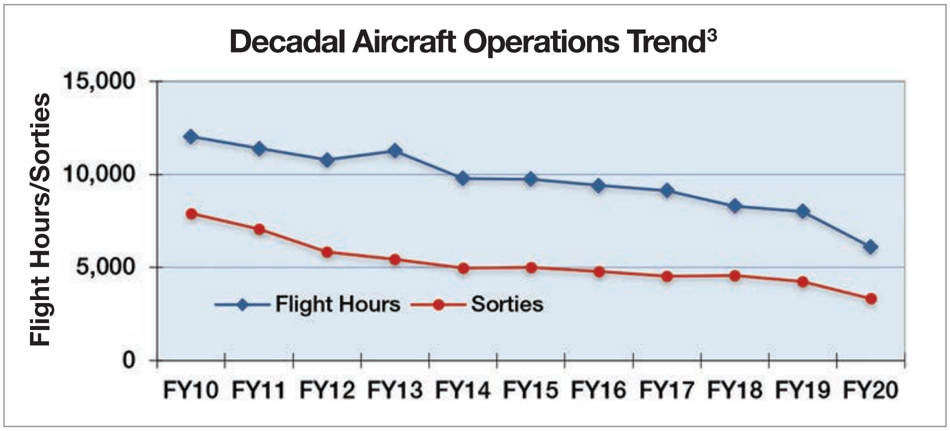

Figure 7—NASA Aircraft Operations Trend

NASA's R&D flight operations, after peaking in FY 2013, steadily trended down in the last five years. Significantly curtailed by COVID-19 restrictions, NASA's R&D flights in FY 2020 declined by 31.2 percent and 32.2 percent, respectively, in terms of flight hours and flight sorties. While much of the FY 2020 decline came as a result of the pandemic, the overall decline in R&D flight operations over the last five years was largely due to a decreasing demand for airborne Earth Science and Space Science research. Wallops, in particular, stopped flying its C-23 Sherpa aircraft in FY 2018 and halved its C-130 Program in FY 2019. In FY 2020, Armstrong put one of its two King Air B-200 aircraft into storage, and Glenn disposed of its last operational S-3 aircraft.

The Agency's aircraft regionalization initiative continued to move forward in FY 2020 despite COVID challenges. Flight operations during the FY by the three aircraft regions are shown in Figures 8 and 9. With Johnson as the lead aircraft center, the Southern Aircraft Region's primary aircraft mission continued to be the support the Agency's space operations missions. As evident in these two figures, the Southern Aircraft Region conducted more than half of the Agency's overall flight operations in terms of flight hours and flight sorties. In the Western Aircraft Region, where the focus of aircraft operations was large-scale and long-duration airborne science, as well as major aeronautics flight research, Armstrong made up just about the entire flight operation for the region. With Langley as the designated lead center, the Eastern Aircraft Region also mainly supported the Agency's airborne science missions, but at a smaller scale than the Western Aircraft Region.

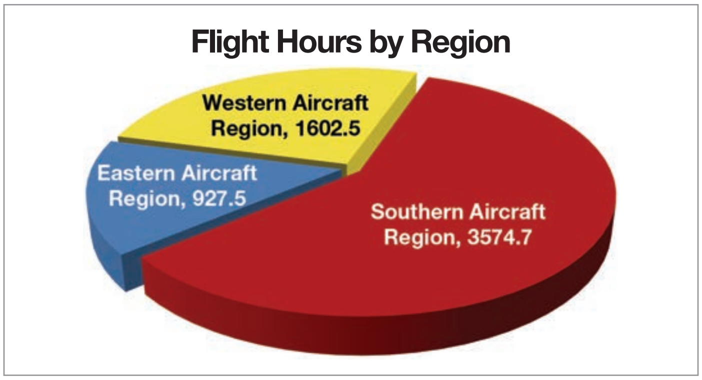

Figure 8—NASA's FY20 Flight Operations (Flight Hours) by Region

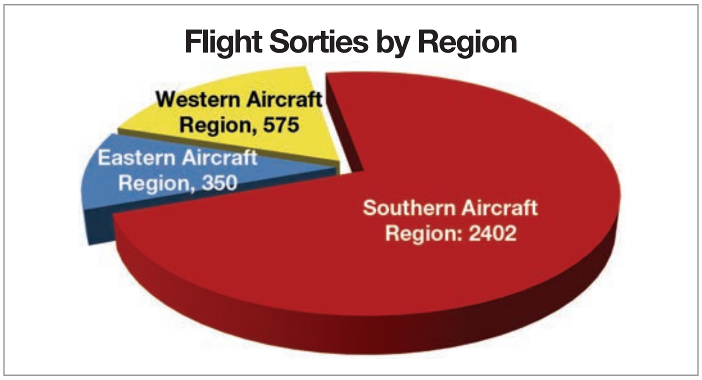

Figure 9—NASA's FY20 Flight Operations (Sorties) by Region

[3]Data shows NASA aircraft flight operations only. Flights on aircraft from external sources are not included.

NASA's FY 2020 flight operations by individual Center are shown in Figures 10 and 11. As usual, the combined flight activity at the Agency's two largest aircraft operators, Armstrong and Johnson, constituted the bulk of the Agency's overall aircraft operations during the FY. These two Centers combined flew 80 percent of the Agency's total FY 2020 aircraft flight hours and 83 percent of the total annual flight sorties.

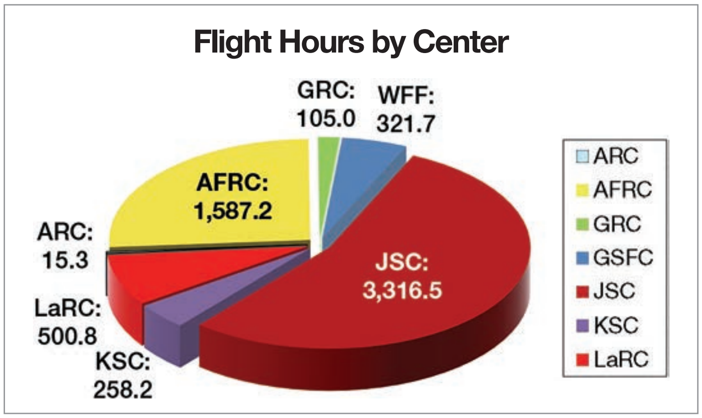

Figure 10—Flight Hours Flown by NASA's Aviation Community in FY20

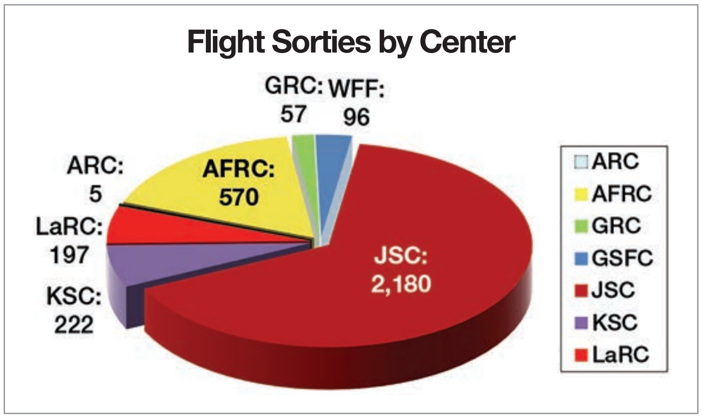

Figure 11—Flight Sorties Flown by NASA's Aviation Community in FY20

At Johnson, its aircraft activity in support of the Agency's space programs constituted more than 90 percent of the Center's overall flight operations during the FY. Johnson's T-38 flight operations in support of NASA's Space Flight Readiness Training (SFRT) Program, by itself, made up 36 percent and 56 percent, respectively, of the entire Agency's FY 2020 flight hours and flight sorties. On the other hand, Armstrong aircraft operations predominantly supported requirements from the Science Mission Directorate (SMD). Flights of Armstrong's three major science platforms, the ER-2, G-III (N802NA), and Stratospheric Observatory for Infrared Astronomy (SOFIA) aircraft, by themselves, comprised 63 percent and 36 percent, respectively, of the Center's entire FY 2020 reported flight hours and flight sorties.

Figures 12 and 13 make abundantly clear the dynamic nature of NASA's aircraft operations. The conclusion of the Space Shuttle Program, the outsourcing and eventual cancellation of the Reduced Gravity Program's flight services requirements, and reduced astronaut space flight training requirements from a downsized Astronaut Corps all combined into a perfect storm for the Southern Aircraft Region in the last decade. The Eastern and Western Aircraft Regions also were not spared the dramatic shifts in flight requirements. In response to the rise and fall of airborne science requirements, Armstrong, Goddard, and Langley all saw growing or steady flight tempos in the first half of the last decade, only to see declining flight requirements in the last five years.

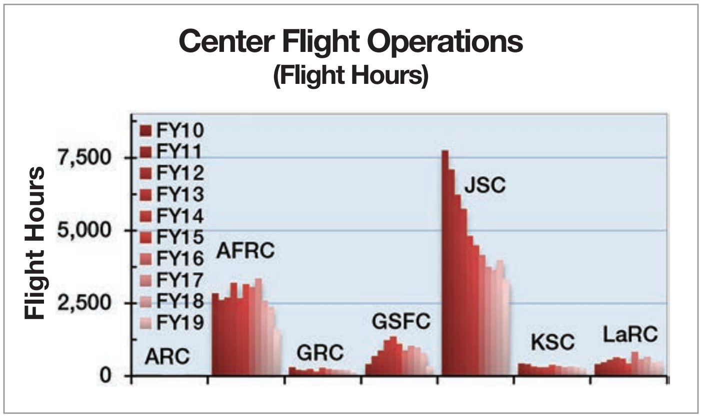

Figure 12—Trends of Center Aircraft Operations (Flight Hours) from FY10 to FY20

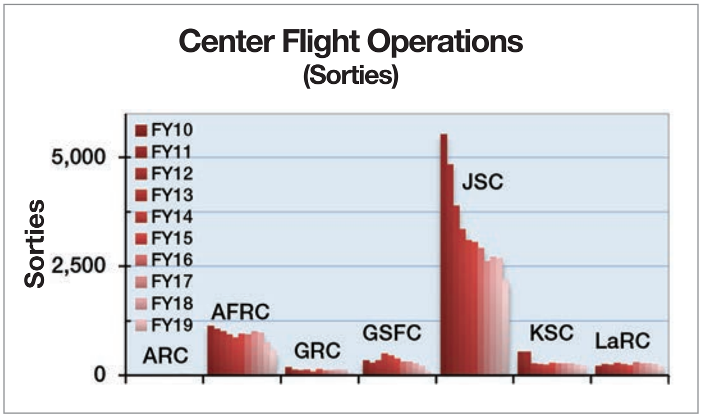

Figure13—Trends of Center Aircraft Operations (Sorties) from FY10 to FY20

Dramatically documenting the impacts from reduced mission requirements, Figure 14 graphs the 57 percent and 61 percent decreases in Johnson's flight hours and flight sorties, respectively, during the past decade. Figure 15 shows that while Kennedy experienced an initial impact from the cessation of space launches from U.S. soil, its helicopter flight operations had held steady since FY 2012. Marshall, on the other hand, stopped manned aircraft operations altogether in FY 2008.

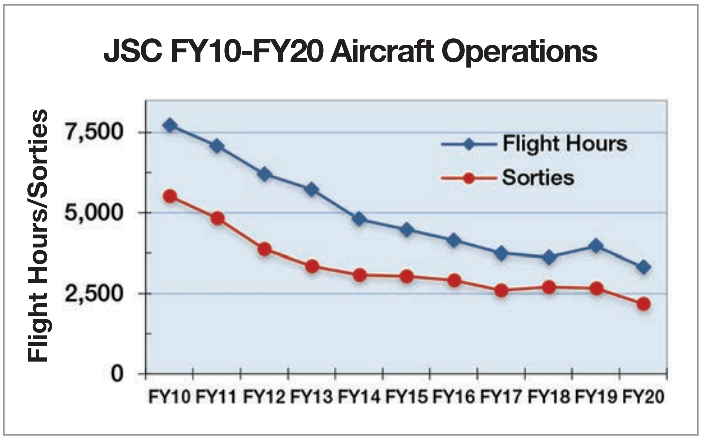

Figure 14—Decadal Trend of JSC Aircraft Operations

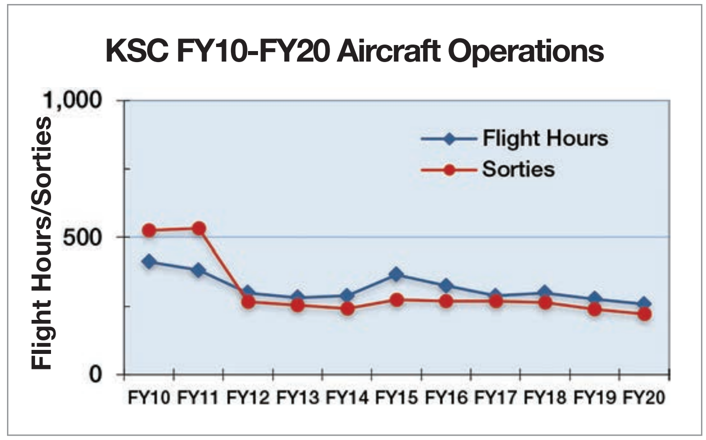

Figure 15—Decadal Trend of KSC Flight Operations

Centers with small aircraft operations are even more susceptible to the ever-changing landscapes of aircraft requirements. For much of the last decade, after a mishap in FY 2013 that destroyed its only Category III UAS, Ames had been rebuilding the SIERRA UAS program as shown in Figure 16, only to have the COVID pandemic put a stop to the Center's entire UAS operations at the beginning of FY 2020. At Glenn, its aircraft activities directly correlated with flight demands from low Technology Readiness Level (TRL) aeronautics research experiments at the Center and from flight demonstration work funded by external customers. While Glenn's aircraft operations peaked above 250 hours a few times in the last decade, the Center's aircraft only flew 105.0 flight hours and 57 sorties in FY 2020 as the pandemic halted its flight operations, as shown in Figure 17.

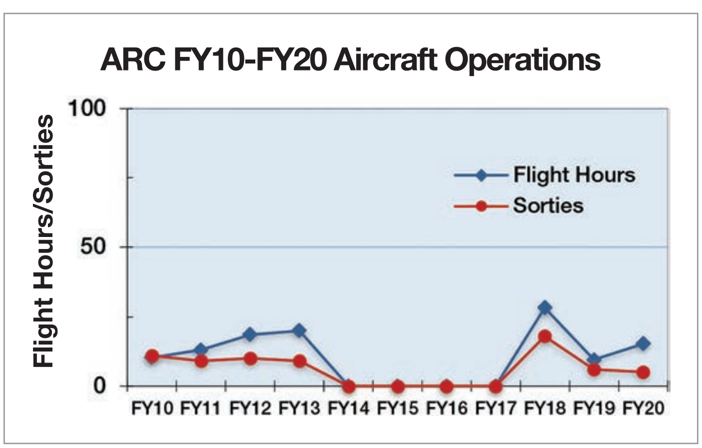

Figure 16—Decadal Trend of ARC Aircraft Operations

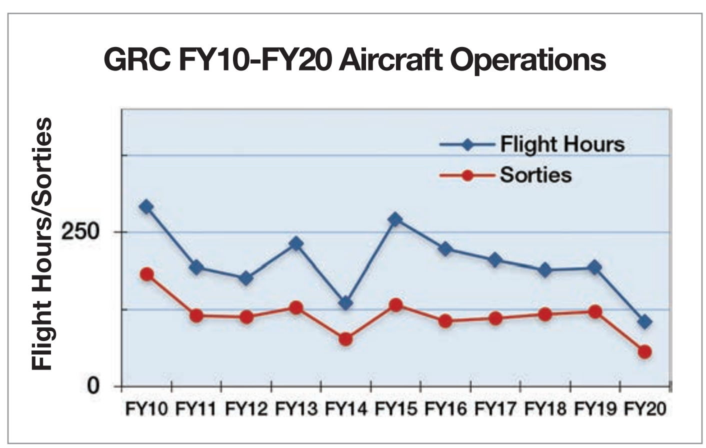

Figure 17—Decadal Trend of GRC Aircraft Operations

Figures 18 and 19 show that both Langley and Goddard saw their aircraft operational tempo rise steadily with increased airborne science missions for the first half of last decade. Langley's flight operations rose dramatically in FY 2016 as a result of a number of long overseas deployments, only to drop back down in the last few years, reflecting the fluctuations in airborne science requirements. Flight activities at Wallops also steadily declined in the last 6 years, going from a peak of more than 1,300 flight hours in FY 2014 to a little over 300 hours in FY 2020 as a result of the conclusion of multiple airborne science programs. The pandemic also significantly curtailed flight operations at both centers in FY 2020.

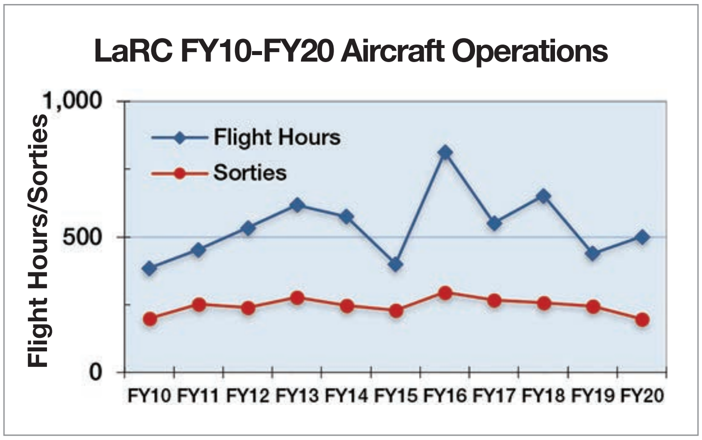

Figure 18—Decadal Trend of LaRC Aircraft Operations

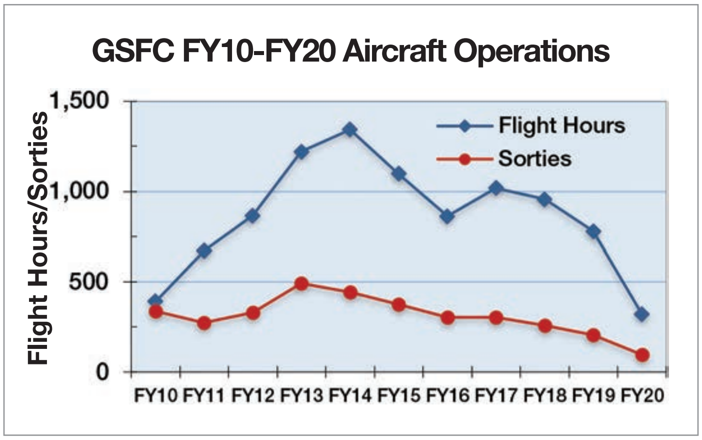

Figure 19—Decadal Trend of GSFC/WFF Flight Operations

At Armstrong, besides having to manage the declining demands of airborne science missions, the Center's flight operations also faced deteriorating aircraft availability as a result of its aging aircraft. Many of Armstrong's older aircraft required ever |more maintenance and inspections to keep them flying safely and were increasingly more challenging to repair with parts obsolescence issues. While it was in large part due to the pandemic restrictions, Armstrong's DC-8 did not fly at all during FY 2020 after NASA discovered damage to all four engines the prior year following a major Airborne Science campaign. In addition, Armstrong F-15 and F-18 aircraft were among the oldest in the world, with the Center's F-15D aircraft often grounded six months or longer due to a lack of parts.

In FY 2020, NASA also utilized a total of 837.1 flight hours of CAS as defined by 41 CFR 102-33 - Management of Government Aircraft. JPL conducted 61 percent of the Agency's FY 2020 CAS flights, while Wallops conducted the other 39 percent. All CAS flights conducted by NASA in FY 2020 directly supported airborne science requirements. As seen in Figure 21, CAS flight activity rose significantly from FY 2010 to FY 2017, in part due to better reporting by NASAs Centers, but declined significantly in the last three years. Travel restrictions from the pandemic forced the ASP to cancel or postpone much of planned CAS science flights in FY 2020.

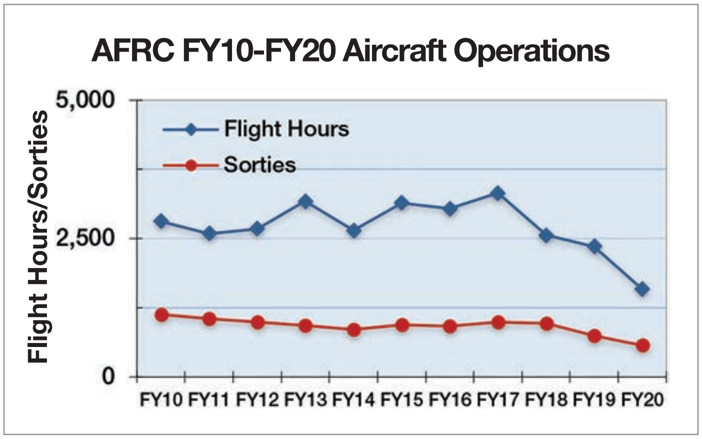

Figure 20—Decadal Trend of AFRC Flight Operations

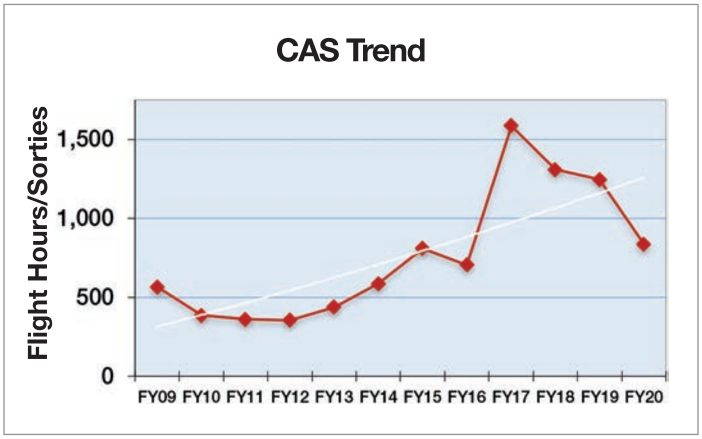

Figure 21—CAS Trend from FY09 to FY20

Missions Accomplished

Navigating around the challenges from the pandemic, NASA's aviation community continued to support the Agency's myriad missions during FY 2020. NASA's aviation community prepared Agency astronauts for space flight, explored the universe, investigated the changing environments of Earth, and tested new aeronautics technologies to make future aircraft safer and more efficient. In the advancement of aeronautics, Armstrong's F-18 aircraft tested an air navigation system transmitter in paving the way for the X-59 QueSST demonstrator. Ames, Armstrong, and Langley also operated sUAS to develop NASA capabilities in UAS modeling and simulation, guidance and control, human systems integration, and integrated test and evaluation. At Glenn, its S-3 and T-34 aircraft flight tested communication technologies to enable the integration of UAS into the National Air Space (NAS).

For Earth-based science investigations, Langley's B-200 and HU-25 aircraft flew scientists and their instruments over the Western Atlantic to improve our understanding of key meteorological processes. Armstrong's ER-2 and Goddard's P-3 studied snowstorms on the East Coast to advance human knowledge of winter precipitation processes. Lending a helping hand in containing the California wildfires, Armstrong's C-20 identified structures damaged in the fires and mapped burn areas that could be at risk of landslides and debris flows. For exploration of our solar system, Wallops' C-130 delivered nearly 5,000 pounds (2,270 kilograms) of mission flight hardware, test gear and equipment to Kennedy for NASA's Mars-bound Perseverance Rover mission. In addition, Armstrong's G-III aircraft transported Mars 2020 management teams from coast-to-coast that resulted in the successful landing of the Perseverance Rover on Mars.

For the Nation's human space exploration objectives, Johnson put NASA, international, and commercial astronauts through the Agency's SFRT Program in its fleet of T-38 aircraft and prepared them for missions to the International Space Station (ISS). Johnson's Gulfstream G-III and G-V aircraft, modified with medical equipment, returned ISS astronauts directly to Houston, Texas, upon their landing in the Russian Soyuz spacecraft. Paving the way for the Artemis 1 mission, Johnson's Super Guppy aircraft returned the Orion spacecraft to Kennedy from Glenn's Plum Brook Station, where the capsule had undergone testing for thermal vacuum and electromagnetic interference and compatibility. Johnson's high-altitude WB-57 aircraft provided imaging support for the final flight test of the SpaceX's Crew Dragon spacecraft, which validated the company's crew transportation system, including the launch pad, rocket, spacecraft, and operational capabilities. In addition, Kennedy's helicopters provided security services for space launches from the space center.

These accomplishments briefly described above were certainly not all of the contributions made by NASA's aircraft operations to the Agency's strategic goals in FY 2020. They were but a few notable achievements during the FY. A highlight of the key missions performed by NASA's aviation community in enabling NASA to accomplish its strategic goals are listed in Table 2. A more detailed summary of the FY 2020 aircraft missions is provided in Appendix 3 of this report.

Table 2—Missions Performed by NASA's Aviation Community in FY20

SPACE EXPLORATION	AERONAUTICS	SCIENCE	NATIONAL AND INTERNATIONAL
Astronaut Space Flight Readiness Training (SFRT) on Johnson's fleet of T-38..	UAS in the NAS flights with Glenn's S-3 and T-34 aircraft.	Western Diversity Time Series (WDTS) flights on Armstrong's ER-2 aircraft.	Aerial imaging of California wildfire with Armstrong's C-20 aircraft.
Kennedy Space Launch Security Operations using Kennedy Space Center's three Huey II Helicopters.	Autonomous Flight Safety System (AFSS) Research using Langley's SR-22 Cirrus aircraft.	Investigation of Microphysics and Precipitation for Coast-Threatening Snowstorms (IMPACTS) flights on Armstrong's ER-2 and Wallops' P-3.	Environmental Protection Agency (EPA) Transportable Earth Re-sources Observation Suite (TEROS) 2020 flights with Langley's Cessna 206 aircraft.
ISS crew direct returns using Johnson's Gulfstream G-III and G-V aircraft.	Airborne Location Integrating Geospatial Navigation System (ALIGNS) flight tests on Armstrong's F/A-18.	Sounding Rocket Program Office (SRPO) cargo transport using Wallops' C-130H aircraft.	Oceans Melting Greenland (OMG) EVS-2 mission on CAS (Borek Air) DC-3.
Orion and Space Launch System component transport by Johnson'sSuper Guppy aircraft.	Autopilot research on Langley's Columbia 300 aircraft.	Sounding rockets imagery support with Langley's HU-25 aircraft.	Commercial and international astronaut training on Johnson's T-38 aircraft fleet.
Commercial Crew Program (CCP) launch imaging support with Johnson's WB-57.	External Vison Systems (XVS) development using Langley's UC-12 aircraft.	Snow Experiment (SnowEx) flights on Johnson's G-III aircraft.	Infrared airborne astronomy with Armstrong's SOFIA Aarcraft.
CCP parachute drop test support with Wallops' C-130 aircraft.	Flight control law development using Langley's sUAS.	Mars 2020 Perseverance Rover Mission Management Team transport on Armstrong's G-III.	

V. AVIATION METRICS

The primary measures for NASA's aircraft operations are safety, cost, and operational effectiveness. Of these, the one metric that is the most critical to the Agency is safety. The costs reported by the Centers for FY 2020 reflect the varied and unique missions of the Agency's aircraft operations during an unprecedented pandemic. The costs to accomplish those missions vary widely depending on the nature of the missions, complexity of modifications required on the aircraft, operational tempo, and many other factors, and would not provide meaningful comparisons of the Agency's aircraft operations to commercial aviation or to other Federal agencies' flight organizations.

Similarly, due to the extreme diversity of NASA's flight operations, the usual aircraft operational measures are not particularly appropriate or useful. Typical industry utilization metrics, such as flight hours and sorties for aircraft utilization and costs per flight hour or costs per seat mile for efficiency, are not applicable to the Agency's unique aircraft operational needs and requirements. The Super Guppy at Johnson typifies that uniqueness. The Super Guppy is only used to transport out-size cargo for the Agency's Orion Program. So, the frequency of the Super Guppy's use is low. Yet, when the need arises, the Super Guppy is invaluable.

Additionally, while flight time is a good aircraft utilization indicator for high-volume operations, the metric does not tell the whole story with regard to requirements for NASA to retain an aircraft. For example, flight tests for aeronautics technology incubator projects involve an iterative approach with the associated ground facility. In many instances, equipment will be moved back and forth between a test cell and aircraft many times, with taxi tests and integrated ground tests before the equipment is actually flown, sometimes even grounding the aircraft during the process. To better characterize the unique nature of NASA's aircraft operations, future reports will incorporate ground utilization measures.

Aircraft cost and performance metrics are provided in this report to show the scope and trend of NASA's flight operations. These aircraft cost and performance measures are only useful when viewed in terms of program accomplishments, i.e., did the flights enable the scientists, engineers, astronauts, or programs to carry out their planned agenda, which would be contained in individual program reports.

Aviation Safety

For Aviation Safety, NASA measures aviation mishaps by mishap types (Types A, B, C, and D) in accordance with NPR 8621.1D, the Agency's procedural requirements for mishap reporting, investigating, and recordkeeping. Mishaps are differentiated based on severity of damage or injury. Type A mishaps include those with loss of life or aircraft or property damage exceeding $2 million. Type B mishaps are those that resulted in costs that are more than $500,000 but less than $2 million or permanent partial disabilities. Type C mishaps are those with costs that are less than $500,000 but more than $50,000. Lastly, Type D mishaps are events with property damage exceeding $20,000 but less than $50,000.

The Agency's aviation community incurred three Type C and four Type D mishaps, all being ground incidents, during the FY, but no Type A or Type B mishaps. Two of the Type C mishaps involved Wallops' P-3 aircraft, with one being pre-flight discoveries of cracks in the ailerons and the other resulting from a missed safety procedure when ground power was applied. All the other mishaps involved minor personnel injuries. The Type C and Type D mishaps in FY 2020 resulted in approximately $185,000 of material damages and 4 lost duty days.

Figures 22 and 23 present the Agency's Aviation Safety trends for manned aircraft flight operations during the last decade. Figure 22 shows the annual number of aircraft mishaps, while Figure 23 shows the annual mishap rate, expressed in mishaps per thousand flight hours. NASA has not experienced a Type A loss of aircraft mishap since 1995, and the Agency's last Type

B mishap in 2010 was a ground incident that was a result of Foreign Object Damage (FOD). The two total aircraft mishaps in FY 2016 and the three in FY 2017 demonstrate NASA aircraft operators' continued dedication to safety. Figures 22 and 23 also show that NASA's mishap statistics continued to be much better than the comparable records of the U.S. military services or those of the civilian aircraft operators flying similar aircraft and conducting similar missions.

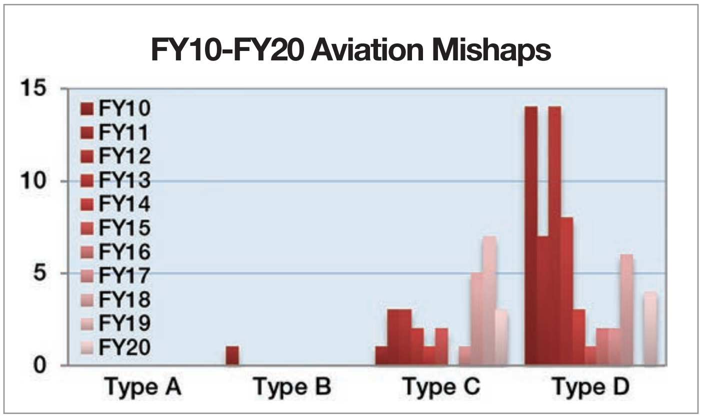

Figure 22—NASA's Decadal Aircraft Mishaps Trend Categorized by Type

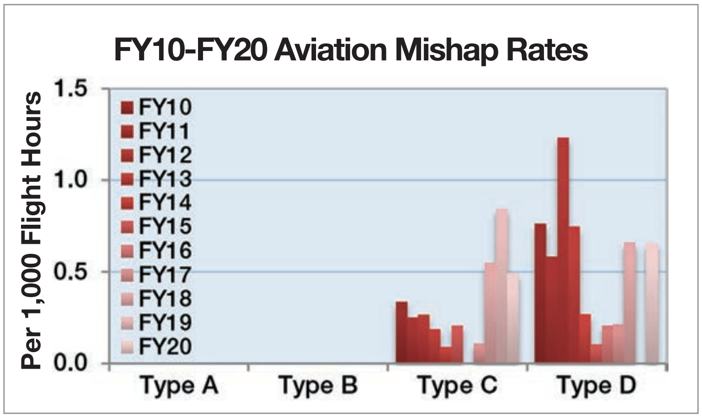

Figure 23—NASA's Decadal Aircraft Mishap Trend (per 1,000 Flight Hours)

While the number of mishap occurrences and mishap rates are good indicators of safety performance, management of Aviation Safety must also be based on the nature and the specifics of the mishaps. NASA's FY 2020 aircraft mishaps are briefly described in Table 3. The fact that there were zero flight incidents was a testament of NASA aviation community's continued adherence to high safety standards. NASA's mishap history for the last 16 years is provided in Appendix 4 of this report.

Table 3—FY20 Aviation Mishaps

MISHAP CATEGORY	MISHAP TYPE	BRIEF DESCRIPTIONS
Ground	Type C	Scheduled maintenance inspection discovered accelerated wear and/or damage to DC-8 high pressure compressor incurred during Airborne Science research flight campaign.
		WB-57 (N928NA) departed runway in an aborted takeoff.
		Left, outboard main landing gear tire on Gulfstream G-III shredded during takeoff. Mission aborted with safe RTB.
	Type D	Employee's hand injured by drill bit during maintenance.
		Employee reported chemical burn after spilling fuel on his pants while working on T-38.
		Employee suffered cut to the head bumping into T-38.
		Mechanic pinched index finger between scissor lift handrail and C-130 Pitot tube.

Five of the seven ground mishaps cited in Table 3 involved aircraft maintenance-related personal injuries. These aircraft maintenance-related injuries do highlight the need for continued emphasis on ground safety for the Agency's aircraft operations. Recognizing the need to continually improve aviation ground safety, NASA's aviation community has been implementing number of Maintenance Resource Management (MRM) initiatives across the Agency.

Aviation Costs

For FY 2020, NASA Centers reported a total of $145.9 million of expenditures in operating, maintaining, and upgrading the Agency's fleet of aircraft. This total also included the acquisition of flight services from CAS vendors during the FY. As compared with the prior FY, the Agency's total FY 2020 aviation expenditures declined by 9.8 percent, or $15.9 million. Looking back at FY 2019, excluding Kennedy's one-time $4.5 million capital investment to modernize its small fleet of helicopters, NASA's total aircraft operational expenditures in that FY would have also fallen by 2.4 percent, or $3.8 million the year prior, marking two straight years of decreased expenditures.

The Agency's aircraft cost trend for the past decade is captured in Figure 24, broken down by how much directly funded contractors and commercial procurements and how much funded expenditures internal to the Federal Government, such as civil servant salaries. NASA's overall aircraft operations expenditures in the last decade show a declining aviation cost trend in the last five years after a steady rise from FY 2009 to FY 2013. While the fluctuating aircraft expenditures do reflect the constant changes in aircraft operational requirements across the Agency, the rise and fall of aircraft costs also include accounting instabilities stemming from accounting practice changes, such as Armstrong's adoption of a new overhead cost allocation methodology in FY 2014 that simplified its cost reporting process and discontinued its reliance on consultant support in overhead cost accounting.

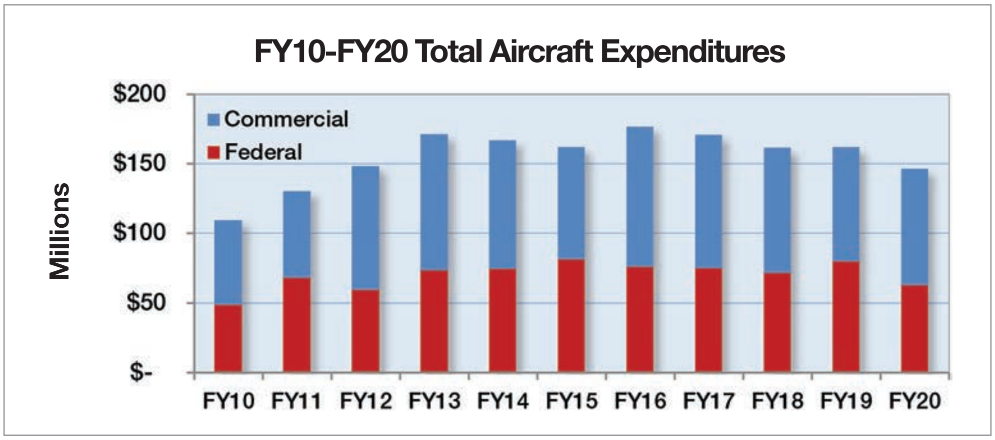

Figure 24—NASA's Aviation Expenditures in the Last Decade

As shown by Figure 25, more than half, or $82.6 million, of the total FY 2020 expenditures directly funded commercial vendors, and 43.4 percent, or $63.4 million, either funded the Agency's internal flight organizations or were paid to other Federal agencies. While the ratio between commercial support and internal NASA resources varied over the last decade, Figures 24 and 25 show that the Agency's flight operations continued to rely heavily on contractor-provided support services, ranging from aircraft maintenance and repair of our aircraft to turn-key CAS flights.

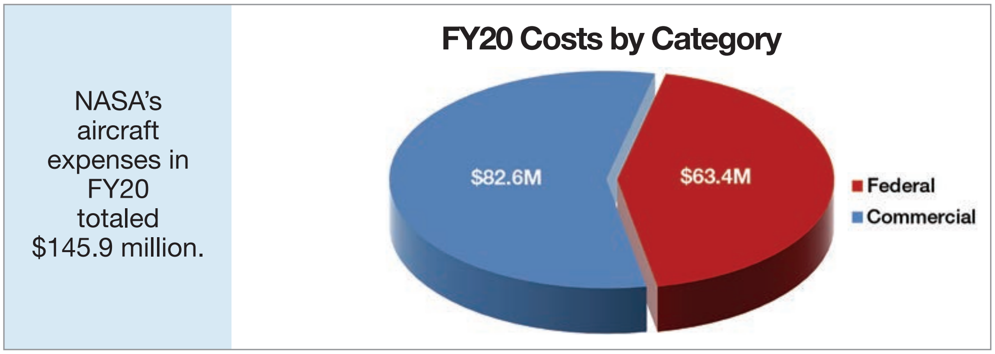

Figure 25—NASA's Total FY20 Aviation Expenditures

About 61 percent, or $88.6 million, of the Agency's aviation expenditures in FY 2020, as shown in Figure 26, funded the Fixed Costs of operating NASA's aircraft. Generally, the two biggest components of Aviation Fixed Costs are Aircraft Operations Overhead, which covered management and administrative staff salaries, assessed facilities, and utilities, and Fixed Maintenance, which covered maintenance crew salaries and calendar-based maintenance actions. In FY 2020, fixed flight crew and maintenance personnel costs alone accounted for almost 57 percent of the FY's total aviation Fixed Costs, with allocated administrative overhead costs making up another 15 percent. Investment Expenditures made up less than 1 percent of NASA's total FY 2020 aircraft expenditures. With scheduled flight operations disrupted by the pandemic, Variable Costs, which by definition were only incurred if aircraft was operated, was a little less than 39 percent of the FY's total aircraft expenditures.

Administrative and operational overhead costs made up 34 percent of all FY20 fixed costs.

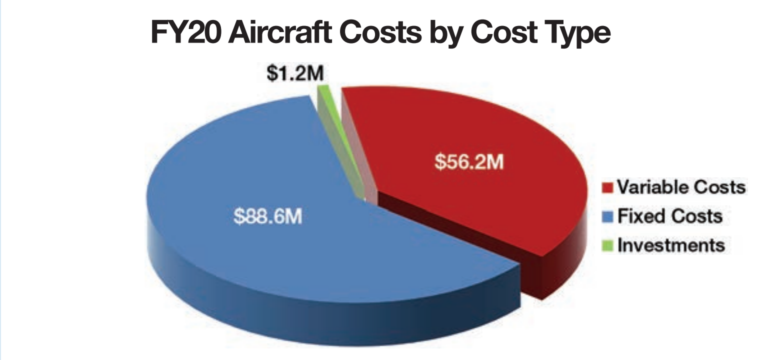

Figure 26—FY20 Aviation Investments and Costs

NASA has relied heavily on the acquisition of excessed DoD aircraft assets to meet the Agency's aircraft requirements and only infrequently purchased aircraft. Kennedy's $4.5 million acquisition of replacement helicopters, along with the FY 2016 acquisition of a used G-III aircraft by Armstrong's aircraft and the acquisition of a used G-V Johnson's, were the few aircraft actually purchased by NASA in the last decade. With NASA's aircraft investment expenditures typically paying for aircraft modifications for science payloads or modernization of avionics, aircraft investments have always been a small fraction of the Agency's annual aviation costs as seen in Figure 27.

Also evident in Figure 27, NASA's aircraft costs consistently increased until FY 2013 due to rising airborne science requirements and reimbursable customer demands. The downward cost trend from FY 2013 to FY 2015 was almost entirely the result of a sharp drop in reimbursable work for Johnson's WB-57 Program. In FY 2013, Johnson's WB-57 aircraft flew 1,322 hours, at a reported cost of $64.1 million. By FY 2019, however, the reported $4.6 million WB-57 operating cost and 106.4 flight hours flown were both less than 10 percent of the FY 2013 peak. The more recent flight reductions have been the result of declining ASP demands, hitting Wallops especially hard. The reduced ASP requirements led to the FY 2020 cancellation of the Wallops C-23 flight operations, which flew at its FY 2015 peak of 487.5 hours at a reported annual cost of $1.6M. In addition, the Wallops C-130 Program went from a 332.3 flight hour and $8.6 million worldwide operation in FY 2015 to just 116.1 flight hours and $1.9 million in FY 2020.

Aviation investments in NASA's aircraft in FY20 was the lowest in a decade.

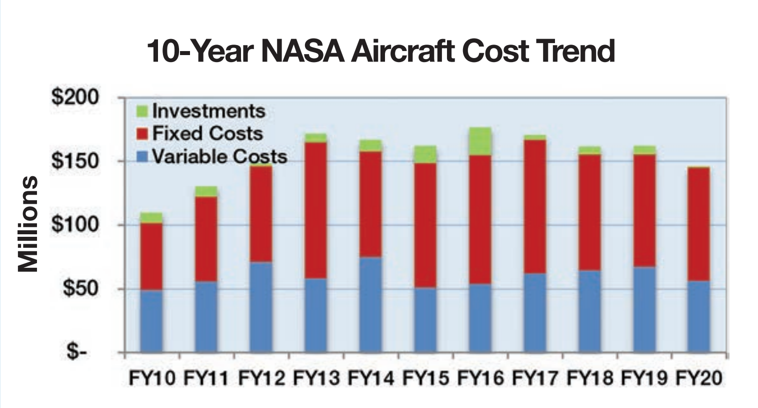

Figure 27—FY10 to FY20 Aviation Costs

With the FY's aviation expenditures segregated by NASA Centers, as shown in Figure 28, it was not surprising that Armstrong and Johnson's aviation costs comprised a significant portion, or just over 84 percent, of NASA's total FY 2020 aviation expenses, as these two Centers combined flew 80 percent of the Agency's total aircraft flight hours and 83 percent of the total aircraft flight sorties during the FY. With the resurgence of U.S civilian space launch activities, SMD's continued mission requirements for the one of a kind DC-8, ER-2, and SOFIA aircraft, and the Armstrong's unique fleet of high-performance support aircraft, Armstrong and Johnson continued to be the two main aircraft operators of NASA's aviation community.

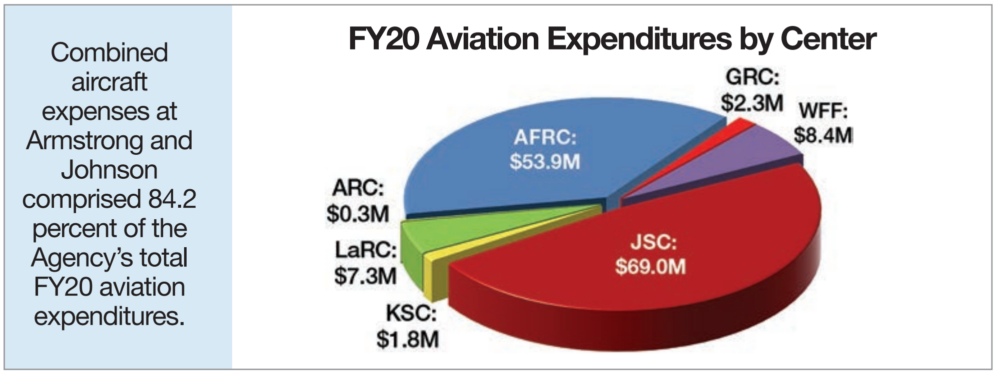

Figure 28—FY20 Center Aviation Costs

The expenditures in Figure 28 also reflect the diverse nature of aircraft operations across the Agency. For instance, Johnson operated the Agency's largest fleet of program support aircraft comprised largely of T-38 training jets in support of space operations, while Langley operated a small fleet of aircraft only for R&D projects. Even within the R&D aircraft operations environment, there were variations in how the missions are conducted. For example, Armstrong's SOFIA aircraft is the only flying telescope at NASA, operating at night for long durations. The DC-8 aircraft operated by Armstrong and the P-3 aircraft operated out of Wallops, while providing great flexibility in terms of science payloads, required unique integration for each research mission. The WB-57 aircraft at Johnson, on the other hand, utilized a palletized payload system and required less integration per mission.

The 10-year aircraft expenditure trends at each Center, shown by Figure 29, convey the budget and program volatilities that NASA's aircraft operators have always faced. Aircraft operations at Ames went from a single large aircraft program, the SOFIA, to a much more limited scope of sUAS operations by FY 2008. Langley, with the disposal of its Boeing 757 Aries aircraft in FY 2006, bore the brunt of the aeronautics flight research budget cuts as its aircraft operations expenditures fell by half in FY 2007. The gradual rebound of Langley's aircraft operations faltered FY 2019, reflecting reduced ASP requirements. Similar to Langley, aircraft operations at Wallops also dramatically rose and fell with the waxing and waning of Airborne Science demands. With the injection of the SOFIA Program, flight operations at Armstrong peaked in FY 2017, but have been hampered by aircraft sustainability challenges. At Johnson, rising maintenance costs across the board contributed to the FY 2020 cost increase despite declining flight activities.

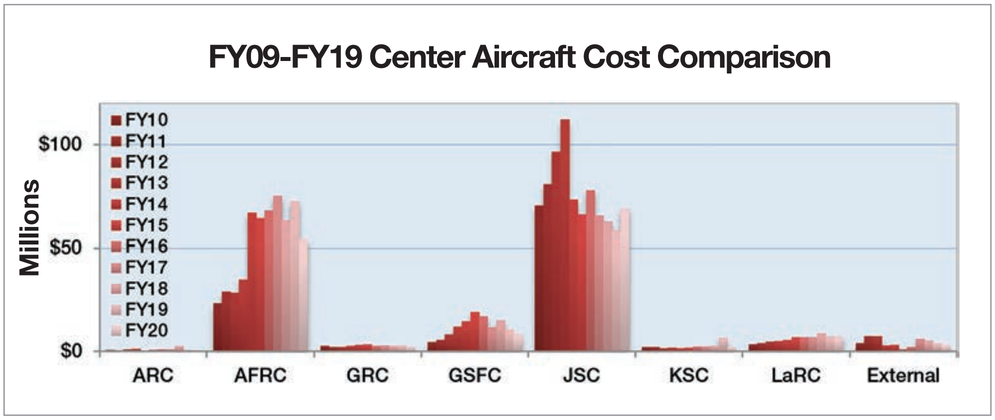

Figure 29—FY09-FY19 Center Aviation Cost Comparison

The budget and program volatilities that NASA's aircraft operators must respond to are even more dramatic when looked at individually. Figure 30 shows the relatively low, but fluctuating, UAS operations at Ames and Figure 31 shows a steady expansion of Langley's flight operations for much of the last decade. What is not shown by either figure was Ames' reported aircraft operations expenditures in FY 2019 was only 8 percent of its FY 2006 peak. Having lost 68 percent of its aircraft business from FY 2006 to FY 2007, flight operations at Langley have slowly risen during the last decade, but never returned to its peak 15 years ago.

Figure 30—Decadal ARC Cost Trend

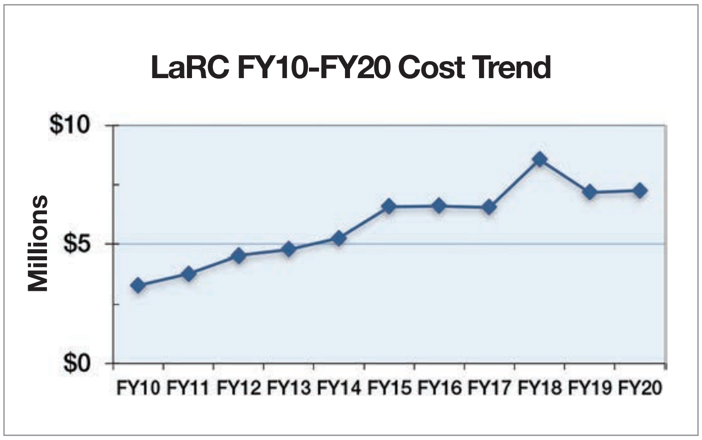

Figure 31—Decadal LaRC Cost Trend

From the $56 million in FY 2004 aircraft operational expenditures, Armstrong reported a striking 71 percent decline in its aircraft expenditures the following year in FY 2005. However, as seen in Figure 32, Armstrong's flight operations experienced a steep rise in aircraft operations for most of the last 10 years that came as a result of rapidly expanding Airborne Science missions. The sustainability challenges of aging aircraft have degraded Armstrong's operational capability, however. Aircraft operations at Wallops also expanded dramatically from FY 2010 to FY 2014, more than tripling its aircraft operations and associated expenditures in that timeframe. Wallops' aircraft operations have been on a downward glide slope since FY 2015, however, as seen in Figure 33. The uptick in Wallops' aircraft costs in FY 2018 that came despite of contracting flight activity was the result of higher unscheduled aircraft repair costs and a spike in fuel costs.

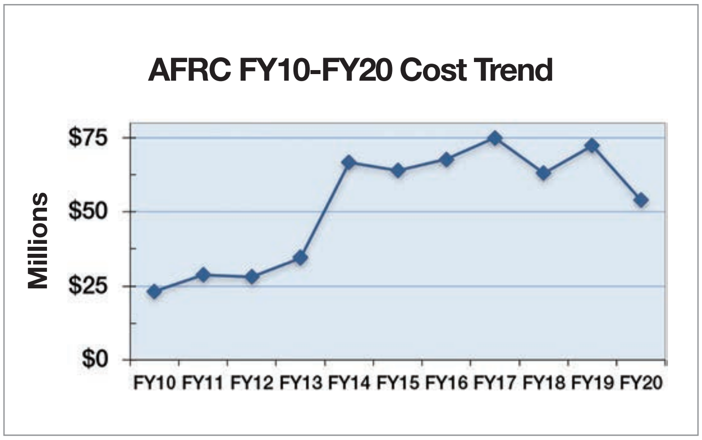

Figure 32—Decadal AFRC Cost Trend

Figure 33—Decadal GSFC/WFF Cost Trend

Aircraft operations at Johnson, while being the largest in both scope and aircraft numbers, hasn't been immune to mission fluctuations. The termination of the Shuttle Trainer Aircraft and Shuttle Carrier Aircraft Programs, the contraction and expansion of the Astronaut Corps, and major aircraft support contract re-procurements all have combined to result in cost swings on the order of tens of millions of dollars in Johnson's flight operations over the last decade.

The cost of NASA's use of CAS is influenced by the type of aircraft utilized and the number of flight hours or flight sorties flown. However, costs of CAS also vary with aircraft integration requirements, as well as research campaign location. CAS aircraft modifications, when required for airborne science and flight research, have dramatic cost implications, as well as introducing new safety risks. So, while CAS flights have steadily increased for much of the last decade, CAS costs during that time have fluctuated greatly, as shown in Figure 35. Within the last 10 years, NASA's reported CAS costs peaked close to $7.5 million in FY 2010 and FY 2011, dipped below $800,000 in FY 2015, only to bounce back up to $5.9 million in FY 2017, and then drop down to $3 million in FY 2020. The FY 2020 decrease in CAS costs was largely the result of the pandemic, however.

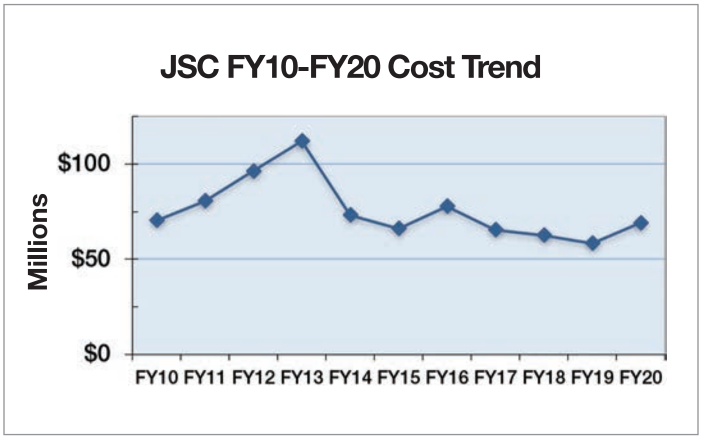

Figure 34—Decadal JSC Cost Trend

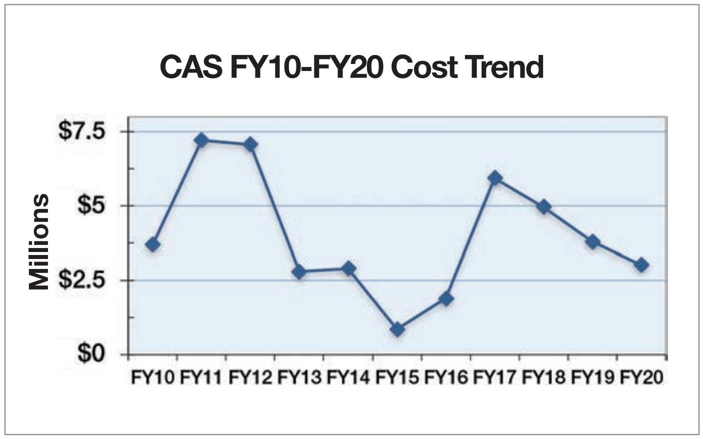

Figure 35—Decadal CAS Cost Trend

The reported operational costs for NASA's aircraft, including the use of CAS flights, reflect the common theme of constant change. Continuously fluctuating flight support requirements and corresponding swings in aircraft operation expenditures at the Centers became the only constant for the Agency's aircraft operators. The termination of the Space Shuttle Program and its successor, the Constellation Program, and the resultant budget swings, dramatically impacted aircraft operations in support of NASA's space programs. Shifting science priorities from in situ airborne research to satellite data collection reduced airborne science flight support requirements, especially in the Eastern Aircraft Region. With the resumption of U.S. space launch activities, NASA's aircraft operations will again need to reshape itself in support of NASA's new priorities.

VI. AIRCRAFT REQUIREMENTS OUTLOOK

NASA's aircraft operations involve a diverse fleet of aircraft and infrastructure with flight operations conducted by Centers in the Agency's three aircraft regions. NASA Headquarters' AMD establishes and enforces standards for safety, as well as maintains the Agency inventory and validates annual usage. NASA-owned aircraft, including UAS, are Agency-wide resources available to support all NASA programs and missions. While AMD funds the Core Aircraft Function of safety oversight and mission assurance at centers that operate aircraft, it's NASA Mission Directorates that fund their operational requirements for aircraft. The AMD, within the Office of Strategic Infrastructure, is designated as the Agency-level capability lead for NASA's aircraft operations. Fulfilling its roles and responsibilities, the AMD continually reviews NASA's aircraft fleet against program and project requirements to ensure the efficient and effective management and use of Agency aviation assets. In accordance with NPR 7900.3, both the Mission Directorates and Center Directors are required to review their aircraft missions and program requirements, use, and associated costs and project those requirements (including UAS) over a five-year horizon. While the previous sections of the report provided an after-the-fact review of past aircraft operation accomplishments, this requirements analysis in this section provides a forward look of funded aircraft requirements and their linkage to NASA's missions.

NASA's aircraft management and operations have continuously evolved. Nine years ago, under the authority of the NASA Associate Administrator, NASA assembled the Technical Capabilities Assessment Team (TCAT). This team developed a process for a comprehensive technical capability assessment to identify and evaluate Center technical capabilities, including aircraft, against the current and future needs of the Agency. This comprehensive assessment, which began in July 2012, evaluated Center capabilities against Agency strategic goals and long-term needs. Specific to the Agency's aircraft operations, the TCAT recommended the coordination and integration of flight operations throughout NASA. Based on this recommendation, the Mission Support Council expanded the AMD's responsibilities and accountability in order to enable a single Agency-level portfolio coordinating body for aircraft operations. The scope of this responsibility included the full range of NASA aircraft needs, including science, testing, training, chase, and other mission support.

To discharge this new "Capability Lead" responsibility, the AMD in FY 2015 inserted the Aircraft Advisory Committee (AAC) into the AMD's continuous requirements review process. The Agency chartered the AAC, with AMD as the chair and the Inter-Center Aircraft Operations Panel as core members, to advise the AMD regarding identification of aircraft requirements, prioritization of capability verses requirements, performance of gap analysis for strategic investment, and development of aircraft capability roadmaps. The AAC's membership also includes representatives from the following organizations:

a. Aeronautics Research Mission Directorate

b. Science Mission Directorate

c. Human Exploration and Operations Mission Directorate

d. Space Technology Mission Directorate

e. Office of Safety and Mission Assurance

f. Office of the Chief Engineer

The AAC employs a top-down systems approach in concert with the Agency strategy to build a framework to efficiently manage and prioritize aircraft assets. Roles and responsibilities of the AAC include:

a. Produce an Agency-level baseline of aircraft requirements, including for UAS.

b. Balance requirements to aircraft capability and determine areas for fleet right-sizing and strategic investment.

c. Establish roadmap/plans to provide guidance for management of the Agency aircraft fleet.

d. Recommend policy regarding resource sharing, acquisition and disposal, use of other government aircraft/CAS, and fleet optimization.

e. Review and recommend procedures and methods for effective inter-Center aircraft operations.

An annual aircraft requirements assessment became the Agency standard since FY 2006 and facilitated aircraft resource decision-making. The AMD collected FY 2021 aircraft requirements and projected outyear funding from the Mission Directorates and validated them with Center inputs. This FY 2021 requirements analysis, with the AAC's inputs, verified that all active NASA aircraft were operated for funded requirements that were linked to the strategic plan per Appendix 5. This requirements review ensured that all aircraft operational requirements corresponded with stated Agency goals in NASA Strategic Plan 2018.

NASA's aircraft support all four of the Agency's strategic goals: *"(1) Expand Human Knowledge through New Scientific Discoveries, (2) Extend Human Presence Deeper into Space and to the Moon for Sustainable Long-Term Exploration and Utilization, (3) Address National Challenges and Catalyze Economic Growth, and (4) Optimize Capabilities and Operations."* To enable airborne science, space exploration, and aeronautic research missions consistent with Agency's strategic goals, NASA continually adjusts the mix and usage of unique aircraft to efficiently meet the changing requirements. The funding for these requirements comes from a variety of sources, both internal and external to NASA.

Figures 36 and 37 illustrate the main requirements owners for aircraft operations in FY 2020 and FY 2021, respectively. As depicted in these two figures, the primary sources of internal funding for NASA's aircraft operations are still through the SMD and the Human Explorations and Operations Mission Directorate (HEOMD). As a result of a major DoD research program that is funding Armstrong's Global Hawk UAS operations at more than $20 million a year until FY 2022, both Figures 36 and 37 show reimbursable funding making up a substantial portion of the overall aircraft operations funding. Conspicuously missing from both figures is the Science and Technology Mission Directorate (STMD). With the elimination of Reduced Gravity Program requirements, the STMD currently does not have identifiable aircraft requirements. It also bears pointing out that much of the Aeronautics Research Mission Directorate (ARMD) funding actually goes to basic aviation research and not all are for aircraft operations.

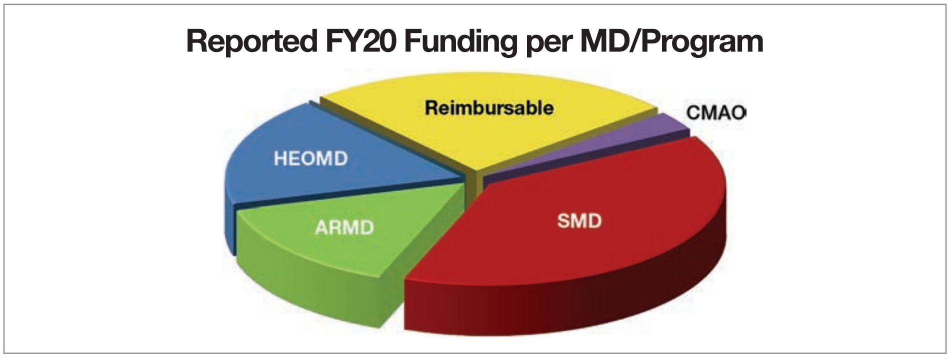

Figure 36—FY20 Aircraft Funding

In FY 2021, as a part of NASA's MAP, the AMD in the Office of Strategic Infrastructure began funding the core aircraft function at centers that operated manned aircraft. This core aircraft function ensures program-independent safety and mission assurance oversight of aircraft operations and consists of the functions of a Chief of Flight Operations, an Aviation Safety Officer, the Chief of Maintenance, and the Chief of Quality Assurance. With MAP implementation, what CMO was funding has also been recategorized into Center Engineering, Safety, and Operations (CESO) funding and Infrastructure and Technical Capabilities (I&TC) funding, with OSI now managing the I&TC funding and CESO funding still under Center management control.

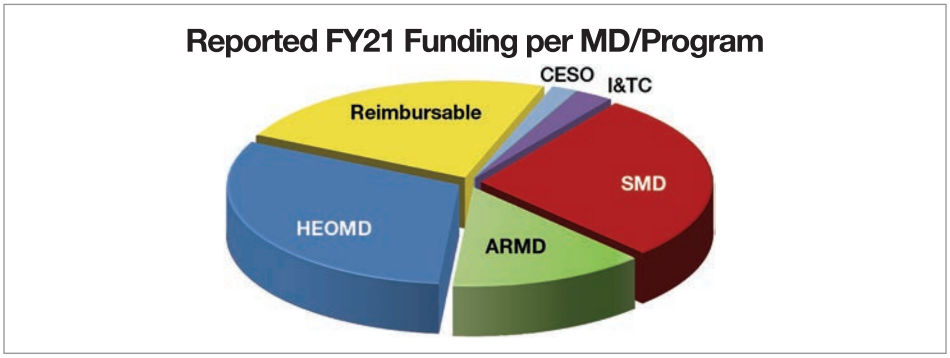

Figure 37—FY21 Aircraft Funding

Figure 38 depicts budget projections from both Center and Mission Directorate perspectives over the FY 2021 to FY 2026 horizon. The precipitous decline from FY 2021 to FY 2023 in the figure is almost entirely the result of a major DoD reimbursable project with Armstrong's Global Hawk UAS coming to an end in two years. The projections beyond FY 2022 are also deceptive in that the data only includes confirmed and funded requirements for aircraft use. For example, HEOMD is likely to continue funding the Wallops C-130 beyond FY 2021, but that possibility is not reflected in Figure 38.

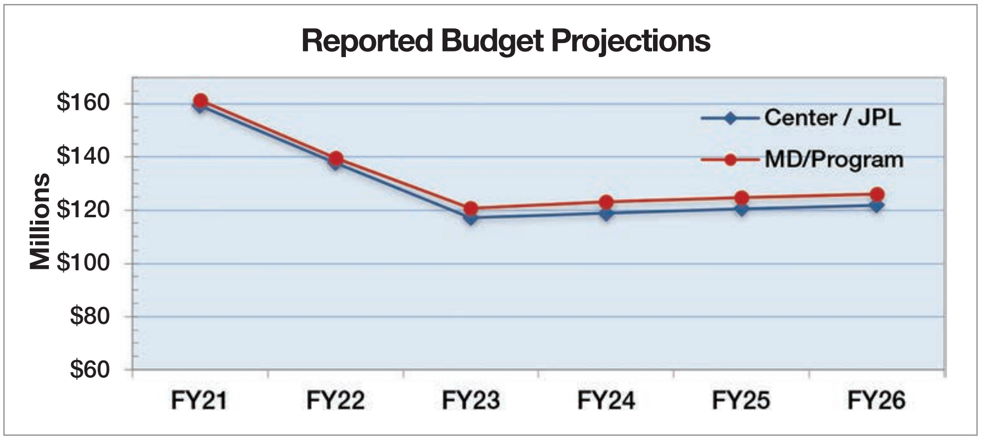

Figure 38—Aircraft Budget Projections

Aircraft Requirements by Mission Directorate

NASA's aircraft are support assets that directly or indirectly enable the Agency's Mission Directorates to accomplish their program and project objectives. As such, the Agency's aircraft operations are almost entirely funded by programs and projects, with CESO and I&TC funds constituting less than 5 percent of all funding sources for NASA's aircraft operations. Next to HEOMD, SMD has been the largest funding source of the Agency's aircraft operations, as seen in Figure 39. The SMD's funding in the outyears is projected to decline in FY 2022 and FY 2023, but to rise gradually thereafter.

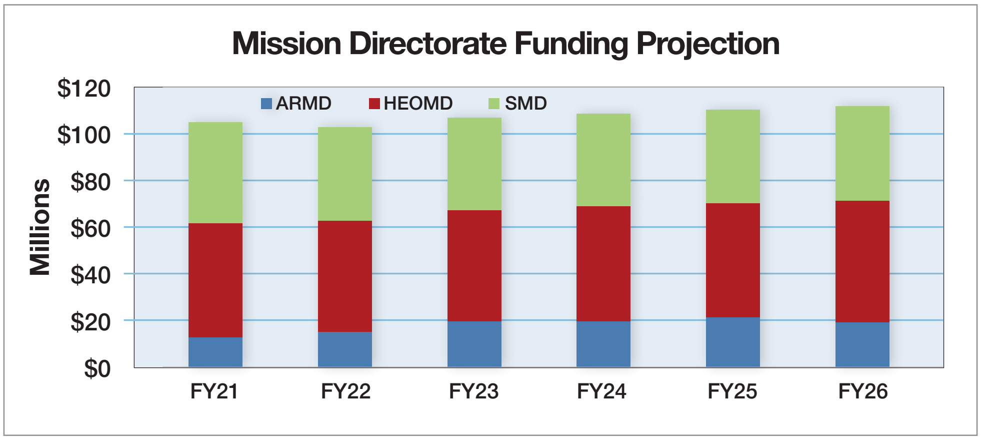

Figure 39—Outyear Aircraft Budget Projections

Aeronautics Research Mission Directorate

Requirements of the ARMD restructured into four mission programs: the Airspace Operations and Safety Program (AOSP), the Advanced Air Vehicles Program (AAVP), the Integrated Aviation Systems Program (IASP), and the Transformative Aeronautics Concepts Program (TACP). The objective of these four programs is to clearly define the most compelling technical challenges facing the aviation industry and overcome these challenges in a time frame that is supported by the stakeholders and required by NASA's customers.

The AOSP works with the FAA, industry, and academic partners to conceive and develop NextGen technologies to improve the intrinsic safety of current and future aircraft. Today's radar-based air traffic control system will transition to one that is satellite-based. NextGen satellite-based technologies will significantly improve safety, capacity, and efficiency on runways and in the Nation's skies while providing environmentally friendly procedures and technologies that reduce fuel burn, carbon emissions, and noise. By moving key concepts and technologies from the laboratory into the field, the AOSP helps to make air travel as safe and efficient as possible.

The AAVP studies, evaluates, and develops technologies and capabilities that can be integrated into aircraft systems, as well as explores far-future concepts that hold promise for revolutionary improvements to air travel. Environmentally friendly NextGen fixed-wing and vertical-lift aircraft will be needed as growth accelerates in both domestic and international air transportation. The goal of the AAVP is to enable new aircraft to fly safer, faster, cleaner, and quieter and use fuel far more efficiently.

The IASP is focused on the rigorous execution of highly complex flight tests and related experiments. The flight tests will support all phases of research, not just the culmination of research activities. For technologies at low TRL, the IASP flight research will accelerate the feasibility assessment and/or maturation of those technologies. For higher TRL technologies, it will reduce the risk and accelerate transition of those technologies to industry. The Program will also maintain Flight Demonstrations and Capabilities (FDC) to meet the ARMD, other NASA Mission Directorate, and National flight test requirements.

Lastly, the TACP cultivates multi-disciplinary, revolutionary concepts to enable aviation transformation. Although the scope of the TACP is on narrowly focused research, the Program provides flexibility for innovators to explore technology feasibility and provides the knowledge base for radical transformation.

The ARMD's total aircraft funding for the five-year budget horizon, as shown in Figure 40, is almost entirely invested in the IASP. For the AAVP and the AOSP combined, only half-a-million or less of annual funding each FY is projected for the budget cycle, and no funding has been forecasted for the TACP beyond FY 2021.

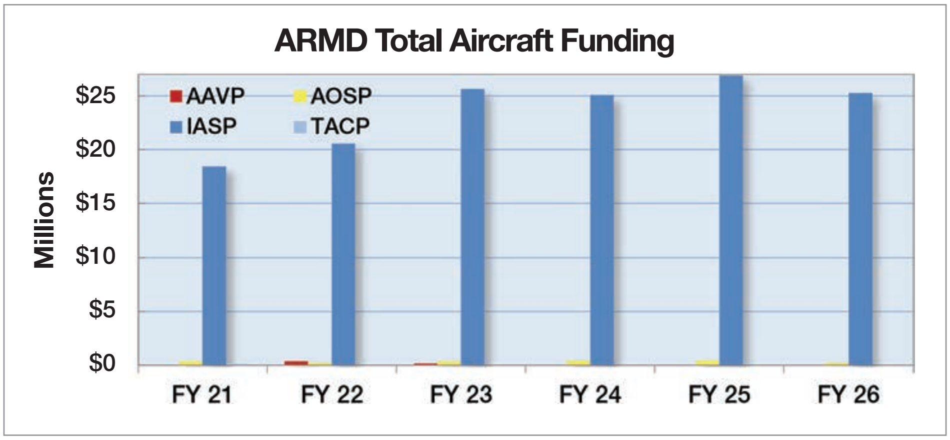

Figure 40—ARMD Aircraft Funding

The ARMD's overall strategic plan is to pursue long-term, cutting-edge research across all its programs and projects so as to provide the foundation for future aviation technology development. Overall, the ARMD is forecasting the following aircraft requirement:

Aircraft	Project	Center
B-200 (N7NA, N801NA)	IASP/FDC	AFRC
F-15 (N836NA, N884NA, N897NA)	IASP/FDC	AFRC
F-18 (N846NA, N867NA, N868NA)	IASP/FDC	AFRC
G-III (N804NA)	IASP/FDC	AFRC
PC-12 (TBD)	AOSP/ATM-X	GRC
T-34C (N865NA)	IASP/FDC	AFRC
TG-14 (N856NA)	IASP/FDC	AFRC
X-59 QueSST	Commercial Supersonic Aircraft	AFRC
X-57 Maxwell	IASPFDC	AFRC

Science Mission Directorate

NASA's SMD supports flight missions that range from suborbital projects—including balloons, sounding rockets, and airplanes—to interplanetary probes and flagship observatories. The SMD, at this time, funds two major scientific research flight programs in NASA: the Airborne Science Program (ASP) and the SOFIA Program. The ASP supports both manned and unmanned aircraft operations, including a range of NASA-owned and contracted aircraft, for the Agency's Earth Science missions. These assets are used in worldwide campaigns to investigate extreme weather events, observe Earth system processes, obtain data for Earth-modeling activities, and calibrate instruments flying aboard Earth science spacecraft. The SOFIA Program, on the other hand, operates a heavily modified Boeing 747SP for astrophysics research.

NASA plays an important National and global role in understanding the Earth System through the collection and analysis of data on ozone, carbon dioxide, fires, dust and aerosols, point source pollution, precipitation and storms, hurricanes, atmospheric trace gases, polar ice, and land changes. While much of this data comes from satellites, airborne systems will continue to play an essential role in gathering data at critical spatial and temporal points for understanding of geophysical processes and interpreting satellite information.

As the world's premier aircraft program supporting Earth Science investigations, the ASP collects and validates requirements in partnership with the three key stakeholders within the Earth Science community: (1) mission scientists and space flight mission managers, (2) engineers and developers of new instruments, and (3) scientists in need of airborne observations. The online Science Operations Flight Request System (SOFRS) primarily gathers near-term requirements, as well as inputs from mission science teams, conferences, and scientific literature. The need for airborne observations related to priority SMD missions is tracked using a five-year plan, updated annually, and with frequent communications with the Earth Science Program Managers.

Based on SMD inputs, NASA's aircraft operations community remains well positioned overall to support the data-gathering needs of the science community. The SMD's budget horizon shows consistent funding for its major science aircraft in the outyears. Capital investments in replacing unique aging aircraft, such as the DC-8 research platform at AFRC, are becoming ever more urgent in the coming years, however.

While the ASP budget is projected to decline from $30.4 million in FY 2021 to $24.6 million in FY 2023 and stabilizing thereafter, the SMD is annually funding the DC-8, ER-2 and P-3 aircraft at $6 million each across the FYs in Figure 41. This stable funding reflects the ASP's continued need for those one of a kind aircraft in its global Earth Science campaigns. Although the C-130 at Wallops and the B-200 and HU-20 are not funded by the ASP beyond FY2021 and FY 2022, respectively, that is not the entire story for Airborne Science flight operations, however. It is looking more and more likely that HEOMD will continue to use the Wallops C-130 for cargo transport missions. Langley, on the other hand, has already proposed replacing the Center's B-200 and HU-25 aircraft with an excess DoD Gulfstream G-IV aircraft in meeting evolving ASP missions, with obvious ramifications to the funding profile presented by Figure 41 beyond FY 2022.

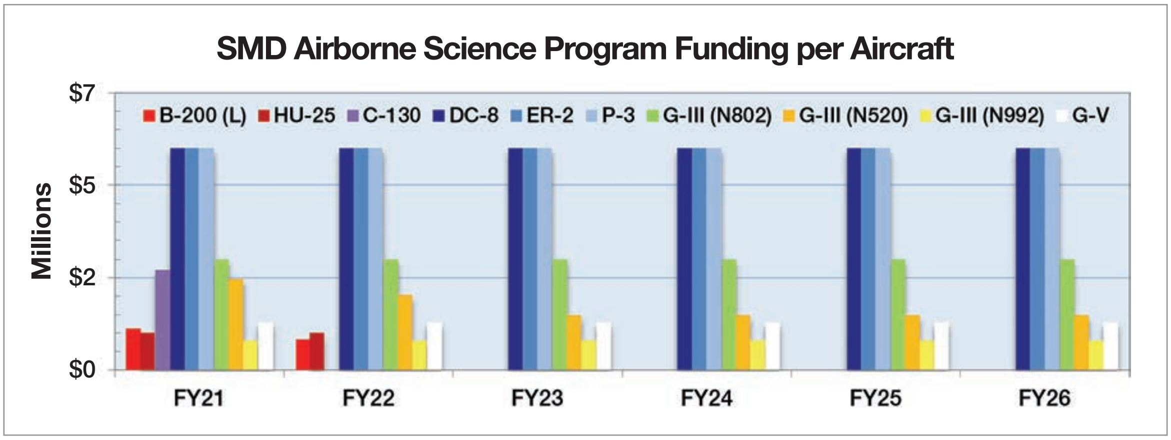

Figure 41—Airborne Science Program Funding

The SOFIA aircraft is the largest airborne observatory in the world and complements NASA's space telescopes, as well as major Earth-based telescopes in astrophysics research. It is capable of making observations that are impossible for even the largest and highest ground-based telescopes. Armstrong operates the aircraft, while Ames manages SOFIA's science and mission operations in cooperation with the Universities Space Research Association (USRA) and the German SOFIA Institute (DSI). The scientific value of the SOFIA platform is readily apparent as funding for the aircraft is projected to rise steadily from $13.5 million in FY 2021 to $15.7 million in FY 2026, as shown in Figure 42.

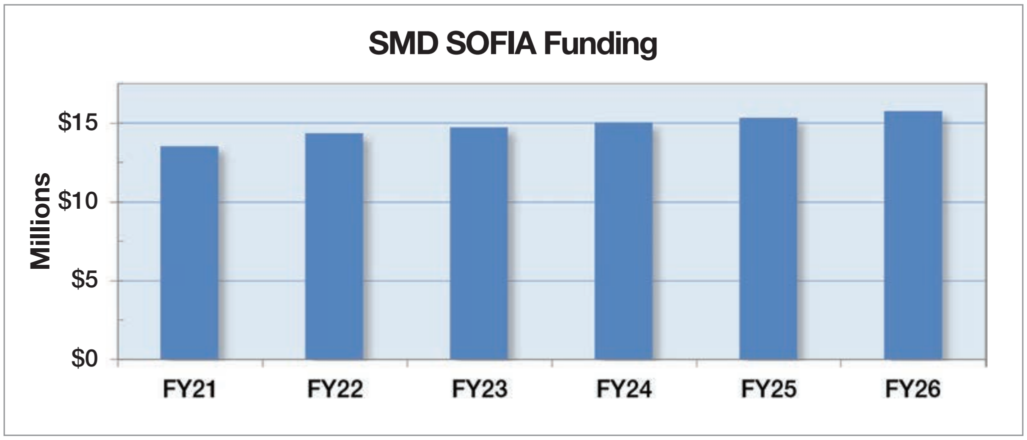

Figure 42—SOFIA Program Total Funding

With steadily rising funding for the SOFIA Program offsetting the projected decline in ASP funding, the total SMD aircraft budget forecast looks to be stable from FY 2023 to FY 2026, as shown in Figure 43. While its budget is stable after FY 2022, the projected annual ASP funding of $24.6 million is significantly less than the $35.1 million budget back in FY 2017, reflecting NASA's shifting scientific priorities.

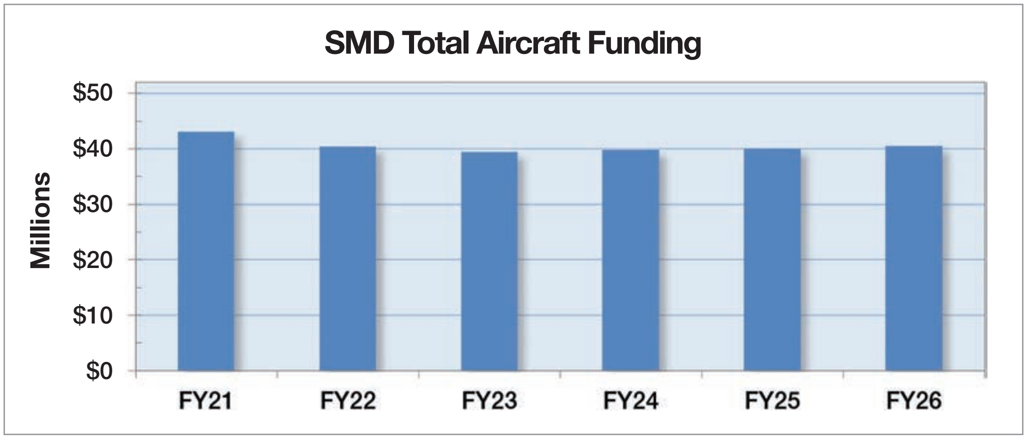

Figure 43—SMD Total Aircraft Funding

Combining Center inputs with SMD projections, the SMD overall has the following funded flight requirements for NASA aircraft between FY 2021 and FY 2026:

Aircraft	Program	Center
DC-8 (N817NA)	ASP	AFRC
ER-2 (N806NA, N809NA)	ASP	ARFC
G-III (N802NA)	ASP	ARFC
G-III (N992NA)	ASP	JSC
G-III (N520NA)	ASP	LaRC
G-V (N95NA)	ASP	JSC
P-3 (N426NA)	ASP	GSFC (WFF)
SOFIA (N747NA)	Astrophysics	AFRC

Human Exploration and Operations Mission Directorate

The use of aircraft in support of NASA's human space flight programs began with using high-performance jet aircraft to maintain the mental and manual skills of the test pilots selected as the first astronauts. Over the years, however, new requirements led to an expansion of the types of aircraft missions funded by the HEOMD, which can be summarized into three areas:

- Support astronaut training
- Support NASA's human space flight programs' aircraft and mission requirements
- Support Agency's human research and outreach programs

Besides a baseline funding that is applied to generic aircraft support services for all aircraft operated by Johnson, the HEOMD also provide demand-based funding that are specific to aircraft programs that support the Agency's space initiatives. Space Flight Readiness Training (SFRT) is, by far, the single largest HEOMD-funded program. Launch and landing support, such as Direct Astronaut Return from Kazakhstan, and unique cargo transport rounding out the remaining HEOMD aircraft operational requirements.

Space Flight Readiness Training

The HEOMD requires the use of the high-performance T-38 jet aircraft in support of SFRT to maintain the mental and manual skills of astronauts as spacecraft crew members. The SFRT develops the prioritization, discipline, communication, and crew coordination skills needed for high-stress, multi-task operations, including launch and landing aboard any vehicle, rendezvous and docking, robotics and Extravehicular Activity events, and emergency scenarios inside or outside a spacecraft. While these skills can be partly trained and exercised in simulators, an important component of achieving and maintaining these skills requires recurring training in an operational environment that demands real-time, critical decision-making with real consequences, where the effects of a wrong decision cannot be reversed, only mitigated. The Human Space Flight Office plans to annually fund the operations of T-38 aircraft at $20.8 million each year beyond FY 2021 as depicted in Figure 44.

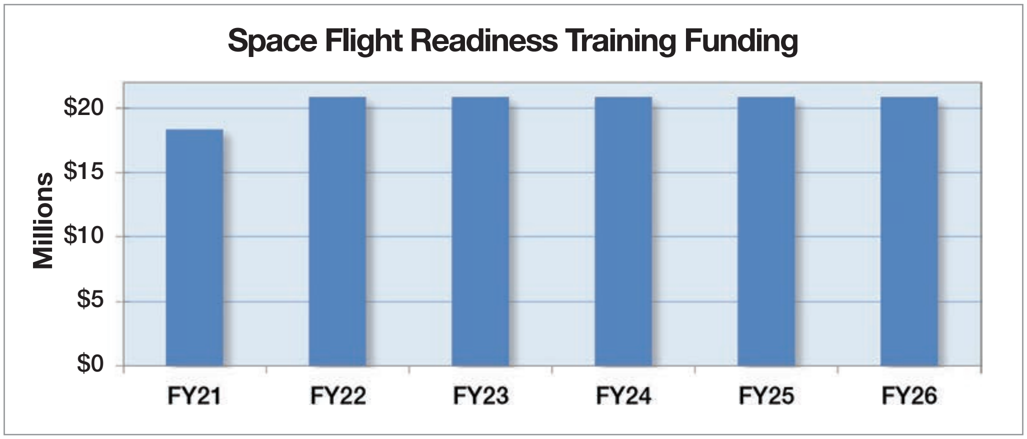

Figure 44—Space Flight Readiness Training Funding

Large Cargo Transport

The ISS Program entered into an agreement with the European Space Agency to transport all the major U.S. modules of the ISS from their development sites to the launch site in Florida using the Super Guppy aircraft. The Flight Crew Operations Directorate's expertise in safely planning, piloting, loading, and unloading unique cargo allowed the HEOMD to provide transportation flights at a competitive cost and also enabled the Mission Directorate to be a smart buyer for large cargo transportation needs. In addition, the FAA Reauthorization Act of 2018 also made it possible for NASA to operate the Super Guppy and transport oversized spacecraft components for commercial space activities, making the aircraft indispensable to the Nation's commercial space industry. More recently, HEOMD used the Wallops C-130 in support of the Agency's Sounding Rocket Program and will continue to subscribe the aircraft in support the Commercial Crew Program's airdrop missions.

As shown in Figure 45, the HEOMD plans to fund the Super Guppy at a level sufficient to ensure this unique asset is available for future outsized cargo missions. Figure 45 does not, however, forecast the potential reimbursable activity to be funded by commercial customers. In addition, the figure does not show the planned C-130 support activities to be funded by the HEOMD in the outyears.

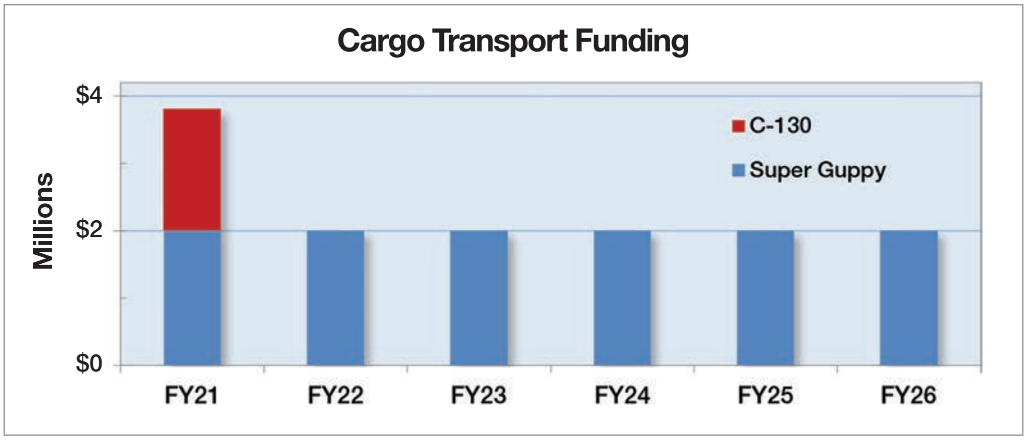

Figure 45—Super Guppy Aircraft Funding

Direct Astronaut Return

The Direct Astronaut Return Missions are a smaller, but vital, aircraft need for human space flight programs. Johnson's Gulfstream G-V, with the Center's G-III as a backup aircraft, provides this critical capability. Figure 46 shows a stable funding outlook for the Direct Astronaut Return Missions at $2.5 million a year beyond FY 2021.

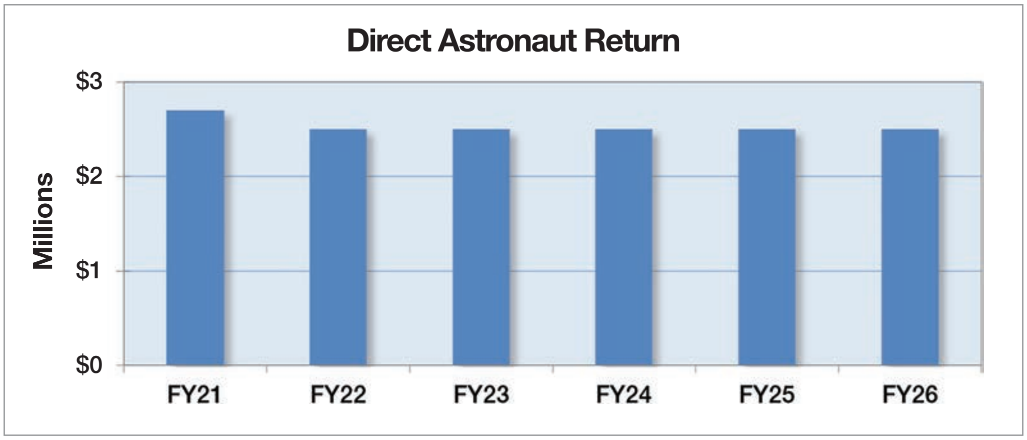

Figure 46—Direct Astronaut Return Funding

The HEOMD's total aircraft program budget for FY 2021 and the outyears is displayed in Figure 47. The HEOMD's aircraft operational requirements are projected to be stable, as the ripple effects from the Space Shuttle Program termination finally wanes away. With the future of Commercial Crew Program looking bright and the Moon to Mars Program getting underway, aircraft operational requirements for the HEOMD may actually increase beyond FY 2026.

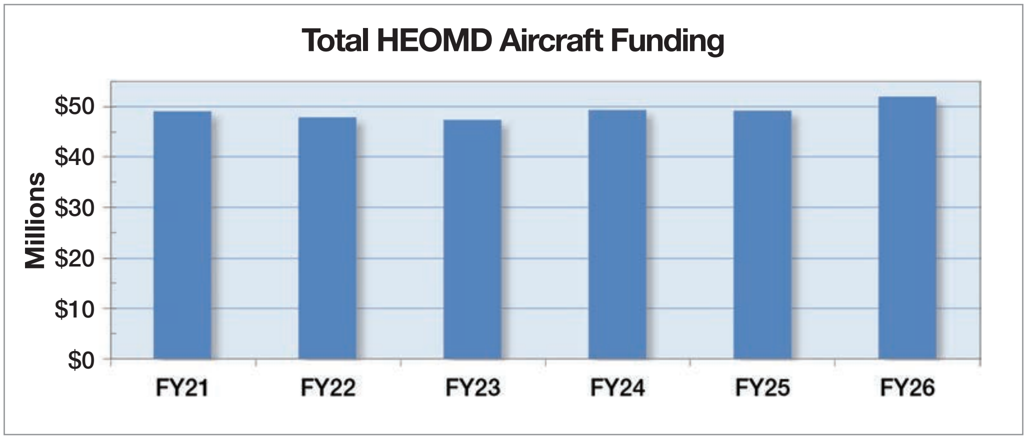

Figure 47—Total HEOMD Aircraft Funding

Based on inputs from Johnson, as well as from the Mission Directorate itself, the HEOMD has current requirements for the following active NASA aircraft:

Aircraft	Program	Center
T-38 (20)	Space Flight Readiness Training	JSC
G-III/G-V	Pilot Proficiency/Astronaut Direct Return	JSC
C-130	Large Cargo Transport	WFF
Super Guppy	Large Cargo Transport	JSC
WB-57	Commercial Crew Program Support	JSC

Center-Funded Requirements

Several Centers have internal requirements for aircraft, and these requirements are funded through CESO budgets at each Center. Kennedy, for example, operates three helicopters in support of space launch/landing security requirements. Most Center aircraft requirements are driven by the need for cost effective pilot proficiency training aircraft with adequate avionics and instrument flight capabilities. These aircraft help maintain a cadre of highly experienced and proficient research and test pilots capable of safely and precisely piloting a variety of manned and unmanned research and test aircraft. The heavy lift, long-range research aircraft do not fly sufficiently and have long down times to accommodate the mission uploads, modifications, and maintenance activity to provide sufficient pilot proficiency flight time. The Centers' pilot proficiency trainers are also ideal for project support aircraft such as launch range surveillance and low-speed chase, including UAS chase.

Total FY 2021 CESO funding budgeted for these aircraft is approximately $2.8 million across the Agency, or less than 2 percent of NASA total aircraft funding for the FY. Beyond FY 2021, the CESO funding for aircraft operations is expected to remain a minute contributor, around $3 million annually, to the Agency's overall aircraft operations. The various aircraft to be supported primarily via CMAO funding are:

Aircraft	Requirements	Center
T-34	Pilot Proficiency	GRC
H-135 (3)	Launch Support/Security/Emergency Management	KSC
SR-22	Pilot Proficiency/Research	LaRC

Aircraft Requirements Summary

For the ARMD, while funding priorities continually shift amongst the Mission Directorate's four programs, its overall aircraft budget is expected to rise from $19.1 million in FY 2021 to $27.2 million in FY 2025, before dropping back down in FY 2026, driven primarily by the Mission Directorate's two major X-plane projects. While the ASP appears to be in decline for the next 2 years, overall annual aircraft funding for the SMD will gradually rise from $39.3 million in FY 2023 to $40.3 million in FY 2026. As for aircraft requirements in support of NASA's space programs, the outlook of total HEOMD funding for aircraft operations is stable and is projected to increase from the $47.7 million in FY 2022 to $51.8 million in FY 2026. NASA's overall requirements for aircraft operations are projected to be stable. Highly dynamic reimbursable requirements, such as the multi-year, multi-million-dollar Global Hawk UAS Project, however, will always inject an unpredictable variable in the Agency's aircraft requirements horizon.

Appendix 1—Fiscal Year 2020 Year-End Aircraft Inventory

Fiscal Year 2020
Year-End Active Aircraft Inventory

Appendix 1—Fiscal Year 2020 Year-End Aircraft Inventory

NASA FY20 Year End Active Aircraft Inventory				
LOCATION	AIRCRAFT	PRIMARY UTILITY DESIGNATION	QTY	PPES AIRCRAFT VALUE
ARC	Sierra UAS #2	R&D	1	$499,000
Subtotal ARC			**1**	**$499,000**
AFRC	B-200 (N801NA) - N7NA placed into storage	PS/R&D	1	$3,126,280
	C-20A (Gulfstream G-III: N802NA)	R&D	1	$22,200,000
	DC-8 (N817NA)	R&D	1	$21,383,925
	ER-2 (N806NA and N809NA)	R&D	2	$25,890,033
	F-15B (N836NA)	R&D	1	$40,000,000
	F-15D (N884NA and N897NA)	PS	2	$29,900,000
	F/A-18 (N846NA, N867NA, and N868NA)	PS	3	$71,100,000
	Global Hawk (N872NA and N874NA)	R&D	2	$40,000,000
	Gulfstream (G-III (N804NA)	R&D	1	$22,200,000
	Gulfstream (G-III (N808NA)	PS	1	$1,250,000
	SOFIA (N747NA)	R&D	1	$12,200,000
	T-34C (N865NA)	PS	1	$500,000
	TG-14 (N856NA)	PS	1	$75,000
	X-56 UAS	R&D	1	$1,350,000
Subtotal AFRC			**19**	**$291,175,238**
GRC	DHC-6 (N607NA)	R&D	1	$256,422
	S-3B (N601NA) - awaiting final transfer to museum	R&D	-	$26,559,998
	T-34C (N605NA and N608NA)	PS	2	$2,000,000
Subtotal GRC			**3**	**$28,816,420**
GSFC	B-200 (N8NA)	PS	1	$1,399,544
	C-130 (N436NA)	R&D	1	$11,759,427
	P-3 (N426NA)	R&D	1	$1,582,458
Subtotal GSFC			**3**	**$13,158,971**
JSC	B-377 Super Guppy (N941NA)	PS	1	$6,000,000
	Gulfstream G-III (N992NA)	PS/R&D	1	$10,143,925
	Gulfstream G-V (N95NA)	PS/R&D	1	$12,900,000
	T-38 Astronaut Trainer	PS	20	$14,487,711
	WB57 (N926NA, N927NA, and N928NA)	R&D	3	$25,206,040
Subtotal JSC			**26**	**$68,737,676**
KSC	H-135 (N425NA and N435NA)	PS	2	$14,591,991
	UH-1H (N416NA, N418NA, and N419NA) - awaiting exchange	PS	3	$9,000,000
Subtotal KSC			**5**	**$23,591,991**
LaRC	B-200 (N528NA and N529NA)	PS	2	$5,159,540
	Cessna C206 (N504NA) - placed into storage at WFF	R&D	-	$400,616
	Cirrus SR-22 (N501NA)	R&D	1	$341,954
	Gulfstream G-III (N520NA)	R&D	1	$16,000,000
	HU-25 (N524NA)	R&D	1	$5,219,488
	LC40 (N507NA)	R&D	1	$419,135
Subtotal LaRC			**6**	**$27,540,733**
Total NASA			**63**	**$453,520,029**

Note: KSC UH-1H helicopters picked up by Airbus in FY 2021 as an exchange/sale agreement in the acquisition of Airbus H-135 helicopters.

R&D = Research and Development
PS = Program/Project Support
PPES = Plant, Property, and Equipment System

NASA
Aircraft Information Sheets

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Ratheon Be-200 Super King Air Program Support Aircraft

General Characteristics

Twin engine pressurized turboprop aircraft. Typical seating is for 6-8 passengers.

Length (ft):	43.8	*Range/Endurance:*	1490 NM
Span (ft):	54.5	*Cruise Speed (Kts):*	272
Max Weight (lb):	12,500	*Altitude (ft):*	30,000
Payload (lb):	1,850		

Utilization

Current Role:	Program Support, Pilot Proficiency, Pax Transport
Quantity:	2
Total Hours FY20:	103.1
Aircraft Age:	36~39
Suitability:	Excellent. Good Balance for Mission. Economical.
Estimated Service Life:	15+ years
Future Role(s):	Same
Servicibility Expectation:	Excellent
Projected Utilization:	200

Replacement Aircraft Requirements

Replace When:	Not Recommended
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

C-20 (Gulfstream Aerospace G-III) Research Aircraft

General Characteristics

Large twin-engine, 12-passenger business jet modified for flight research.

Length (ft):	83.2	*Range/Endurance:*	3700 NM
Span (ft):	77.8	*Cruise Speed (Kts):*	459
Max Weight (lb):	69,700	*Altitude (ft):*	45,000
Payload (lb):	4,500		

Utilization

Current Role:	Flight Research, Science Mission Pods w/ Extremely Accurate, Repeatable Autopilot.
Quantity:	1
Total Hours FY20:	160.0
Aircraft Age:	37
Suitability:	Excellent. Economical for Mission.
Estimated Service Life:	10 years with suitable engine solution
Future Role(s):	Same
Servicibility Expectation:	Fair
Projected Utilization:	200

Replacement Aircraft Requirements

Replace When:	When Engines Become Unsupportable Due to Noise Requirements.
Replacement Justification:	Noise Requirements
Replacement Criteria:	Mid-Size, Fuel Efficient.
Recommed Replacement:	G-V or Global Express

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Boeing (Douglas) DC-8 Earth Science Research Aircraft

General Characteristics

Versatile airborne science platform based on the 4-engine DC-8 transport airliner. Re-engined with fuel-eficient DFM-56 engines.

Length (ft):	157	*Range/Endurance:*	5,400 NM
Span (ft):	148.5	*Cruise Speed (Kts):*	490
Max Weight (lb):	350,000	*Altitude (ft):*	41,000
Payload (lb):	30,000		

Utilization

Current Role:	Airborne Science Research Platform
Quantity:	1
Total Hours FY20:	0.0
Aircraft Age:	35
Suitability:	Excellent
Estimated Service Life:	5~7 years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	500

Replacement Aircraft Requirements

Replace When:	TBD
Replacement Justification:	Supportability
Replacement Criteria:	Large Cabin, Mid Altitude, Long Range/Endurance
Recommed Replacement:	Must Meet Research Requirement

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Lockheed-Martin ER-2 High Altitude Research Aircraft

General Characteristics

High altitude research aircraft derived from the U-2 military reconnaissance aircraft.

Length (ft):	62.1	*Range/Endurance:*	6,000 NM
Span (ft):	103.3	*Cruise Speed (Kts):*	410
Max Weight (lb):	40,000	*Altitude (ft):*	70,000+
Payload (lb):	2,600		

Utilization

Current Role:	High Altitude Research for Earth Science & Remote Sensing
Quantity:	2
Total Hours FY20:	151.8
Aircraft Age:	33~40
Suitability:	Excellent
Estimated Service Life:	>15 years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	150

Replacement Aircraft Requirements

Replace When:	When No Longer Supportable
Replacement Justification:	Supportability
Replacement Criteria:	High Altitude; Long Endurance
Recommed Replacement:	Possible Global Hawk or similar UAV

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Boeing F-15B/D Research and Program Support Aircraft

General Characteristics

Modified supersonic tactical fighter aircraft.

Length (ft):	64	*Range/Endurance:*	Refuelable
Span (ft):	43	*Cruise Speed (Kts):*	Mach 2+
Max Weight (lb):	42,000	*Altitude (ft):*	60,000
Payload (lb):			

Utilization

Current Role:	High Performance Flight Research and Safety Chase
Quantity:	3
Total Hours FY20:	17.9
Aircraft Age:	43~47
Suitability:	Excellent
Estimated Service Life:	5~10 years
Future Role(s):	Same
Servicibility Expectation:	B Model Becoming Difficult to Support & Maintain.
Projected Utilization:	75

Replacement Aircraft Requirements

Replace When:	N836 Needs to Be Replaced Soon.
Replacement Justification:	Supportability
Replacement Criteria:	High Performance, Supersonic Tactical Fighter.
Recommed Replacement:	Replace with Excess USAF F-15D.

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Boeing F/A-18A/B Program Support Aircraft

General Characteristics

High performance supersonic tactical fighter/attack aircraft.

Length (ft):	56	*Range/Endurance:*	1546 NM
Span (ft):	40.3	*Cruise Speed (Kts):*	Mach 1.7+
Max Weight (lb):	23,400	*Altitude (ft):*	50,000+
Payload (lb):			

Utilization

Current Role:	Program Support: Safety Chase, Aerial Photo, Pilot Proficiency R&D: High Performance Flight Research
Quantity:	3
Total Hours FY20:	70.4
Aircraft Age:	30~38
Suitability:	Excellent
Estimated Service Life:	10+ years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	150

Replacement Aircraft Requirements

Replace When:	As practicable
Replacement Justification:	Supportability
Replacement Criteria:	> M 1.8 and Supportability.
Recommed Replacement:	Transitioned to all F/A-18Bs.

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Gulfstream Aerospace G-III Research and Program Support Aircraft

General Characteristics

Twin-engine, long range, 12-passenger business jet.

Length (ft):	83.1	*Range/Endurance:*	3,700 NM
Span (ft):	77.8	*Cruise Speed (Kts):*	459
Max Weight (lb):	69,700	*Altitude (ft):*	45,000
Payload (lb):	4,500		

Utilization

Current Role:	Aeronautics Research and Proficiency Training.
Quantity:	2
Total Hours FY20:	132.1
Aircraft Age:	37~39
Suitability:	Well Suited
Estimated Service Life:	10+ years
Future Role(s):	Aeronautics Research, Pilot Proficiency Training, & Pax Transport.
Servicibility Expectation:	Good
Projected Utilization:	150

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Northrop Grumman RQ-4 Global Hawk

General Characteristics

Long Endurance Unmanned Aerial System (UAS)

Length (ft):	44	*Range/Endurance:*	14K NM / 42 hrs
Span (ft):	116	*Cruise Speed (Kts):*	343
Max Weight (lb):	25,600	*Altitude (ft):*	65,000
Payload (lb):	1,900		

Utilization

Current Role:	Reimbursable Research
Quantity:	2
Total Hours FY20:	33.4
Aircraft Age:	9~15
Suitability:	Excellent
Estimated Service Life:	15+ years
Future Role(s):	Reimbursable Research
Servicibility Expectation:	Excellent
Projected Utilization:	100

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Stratospheric Observatory for Infrared Astronomy (SOFIA) Research Aircraft

General Characteristics

Modified Boeing 747SP carrying a 9-ft diameter, 24-ton telescope for night-time infrared astronomy.

Length (ft):	185	*Range/Endurance:*	7,650 NM
Span (ft):	196	*Cruise Speed (Kts):*	535
Max Weight (lb):	670,000	*Altitude (ft):*	40,000+
Payload (lb):	-		

Utilization

Current Role:	High Altitude Infrared Astronomy, Heavy Aircraft Training
Quantity:	1
Total Hours FY20:	661.5
Aircraft Age:	44
Suitability:	Good
Estimated Service Life:	10+ years
Future Role(s):	Same
Servicibility Expectation:	Satisfactory
Projected Utilization:	750

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Beech T-34C Mentor Program Support Aircraft

General Characteristics

Un-pressurized, two-place, tandem cockpit, low-wing, single-engine, turbo-prop monoplane.

Length (ft):	28.5	*Range/Endurance:*	~600 NM
Span (ft):	33.3	*Cruise Speed (Kts):*	223
Max Weight (lb):	4,400	*Altitude (ft):*	25,000
Payload (lb):	-		

Utilization

Current Role:	Safety Chase; Pilot Training; Aerial Photography; Low Speed Flight Research.
Quantity:	1
Total Hours FY20:	52.4
Aircraft Age:	45
Suitability:	Adquate
Estimated Service Life:	10+ years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	100

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

Aeromot TG-14 Power Glider Program Support Aircraft

General Characteristics

Motroized glider.

Length (ft):	26.5	*Range/Endurance:*	400 NM / 5 hrs
Span (ft):	57.3	*Cruise Speed (Kts):*	111
Max Weight (lb):	1,775	*Altitude (ft):*	20,000
Payload (lb):	-		

Utilization

Current Role:	Low Speed Flight Research. UAS Surrogate and Safety Chase.
Quantity:	1
Total Hours FY20:	40.0
Aircraft Age:	18
Suitability:	Good
Estimated Service Life:	20+ years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	50

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Armstrong Flight Research Center

X-56 Multi-Utility Technology Testbed

General Characteristics

Experimental UAS to support Fundamental Aeronautics Research.

Length (ft):	7.5	*Range/Endurance:*	
Span (ft):	28	*Cruise Speed (Kts):*	150
Max Weight (lb):	480	*Altitude (ft):*	10,000
Payload (lb):	-		

Utilization

Current Role:	To advance aeroservoelastic technology through flight research.
Quantity:	1
Total Hours FY20:	0.5
Aircraft Age:	9
Suitability:	Good
Estimated Service Life:	5 years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	10

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Ames Research Center

Scientific Instrumentation Evaluation Remote Research Aircraft (SIERRA)

General Characteristics

Medium range UAS. Manual takeoff and land; Piccolo autopilot for GCS operation.

Length (ft):	11.8	*Range/Endurance:*	600 nm
Span (ft):	20	*Cruise Speed (Kts):*	55
Max Weight (lb):	350	*Altitude (ft):*	10,000
Payload (lb):	50+		

Utilization

Current Role:	Earth science missions. Capture multispectral imagery of land, sea and ice.
Quantity:	1
Total Hours FY20:	15.3
Aircraft Age:	4
Suitability:	Excellent
Estimated Service Life:	10+ years
Future Role(s):	Same
Servicibility Expectation:	Excellent
Projected Utilization:	25

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Glenn Research Center

DeHavilland DHC-6 "Twin Otter" Research Aircraft

General Characteristics

Twin-engine, fixed landing gear, non-pressurized commuter aircraft, modified for flight research.

Length (ft):	51.9	*Range/Endurance:*	400 NM
Span (ft):	65	*Cruise Speed (Kts):*	150
Max Weight (lb):	11,000	*Altitude (ft):*	12,500+
Payload (lb):	3,600		

Utilization

Current Role:	Research
Quantity:	1
Total Hours FY20:	23.2
Aircraft Age:	55
Suitability:	Good
Estimated Service Life:	5 years
Future Role(s):	Same
Servicibility Expectation:	Fair
Projected Utilization:	Due to be retired.

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Glenn Research Center

Lockheed Martin S-3B Viking Research Aircraft

General Characteristics

US Navy all weather, carrier based, S-3B aircraft modified for icing research.

Length (ft):	53	*Range/Endurance:*	2,300 NM
Span (ft):	69	*Cruise Speed (Kts):*	450
Max Weight (lb):	52,500	*Altitude (ft):*	40,000
Payload (lb):	15,000		

Utilization

Current Role:	UAS/NAS, Earth Science, & Reimbursable Projects.
Quantity:	1
Total Hours FY20:	34.4
Aircraft Age:	41
Suitability:	Fair
Estimated Service Life:	5 years
Future Role(s):	To be Retired by FY21
Servicibility Expectation:	Becoming Challenging to Sustain
Projected Utilization:	Due to be retired.

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	Supportability
Recommed Replacement:	Must Meet Research Requirements

Appendix 2—Aircraft Information Sheets

Glenn Research Center

Beechcraft T-34C TurboMentor Aircraft

General Characteristics

Program Support aircraft used for aerial photography, pilot proficiency training, and safety chase for slower research aircraft.

Length (ft):	28	*Range/Endurance:*	750 NM
Span (ft):	33	*Cruise Speed (Kts):*	214
Max Weight (lb):	4,300	*Altitude (ft):*	25,000
Payload (lb):	500		

Utilization

Current Role:	Pilot Proficiency, Airborne Science, Aero Research
Quantity:	2
Total Hours FY20:	47.4
Aircraft Age:	43
Suitability:	Fair
Estimated Service Life:	10 years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	75

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Johnson Space Center

Aero Spacelines B-377SG "Super Guppy" Support Aircraft

General Characteristics

Boeing 377 modified for oversized cargo for the International Space Station.

Length (ft):	144	*Range/Endurance:*	1,700 NM
Span (ft):	156	*Cruise Speed (Kts):*	250
Max Weight (lb):	170,000	*Altitude (ft):*	25,000
Payload (lb):	52,500		

Utilization

Current Role:	Oversized Cargo Transport for International Space Station and Reimbursable Customers.
Quantity:	1
Total Hours FY20:	84.9
Aircraft Age:	41
Suitability:	Good
Estimated Service Life:	5~10 years
Future Role(s):	Same
Servicibility Expectation:	Good
Projected Utilization:	125

Replacement Aircraft Requirements

Replace When:	As Practicable
Replacement Justification:	Enhanced Transport Capability
Replacement Criteria:	Enhanced Transport Capability
Recommed Replacement:	Beluga

Appendix 2—Aircraft Information Sheets

Johnson Space Center

Gulfstream Aerospace G-III Research Aircraft

General Characteristics

Twin-engine, long range, 12-passenger business jet.

Length (ft):	83.1	*Range/Endurance:*	3,700 NM
Span (ft):	77.8	*Cruise Speed (Kts):*	459
Max Weight (lb):	69,700	*Altitude (ft):*	45,000
Payload (lb):	4,500		

Utilization

Current Role:	Backup to G-V for Direct Astronaut Return and Airborne Science Research.
Quantity:	1
Total Hours FY20:	187.5
Aircraft Age:	41
Suitability:	Not Stage III Compliant
Estimated Service Life:	10+
Future Role(s):	Airborne Science Research and Back Up for Direct Astronaut Return
Servicibility Expectation:	Fair
Projected Utilization:	300

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Johnson Space Center

Gulfstream Aerospace G-V Program Support Aircraft

General Characteristics

Twin-engine, long range, 12-passenger business jet.

Length (ft):	96.4	*Range/Endurance:*	5,500 NM / 15 Hrs
Span (ft):	93.45	*Cruise Speed (Kts):*	Mach 0.83
Max Weight (lb):	90,500	*Altitude (ft):*	51,000
Payload (lb):	8,100		

Utilization

Current Role:	Direct Astronaut Return from Kazakhstan, Airborne Science Research, and Pax Transport.
Quantity:	1
Total Hours FY20:	393.8
Aircraft Age:	21
Suitability:	Well suited.
Estimated Service Life:	20+
Future Role(s):	Direct Astronaut Return Mission and Airborne Science Research.
Servicibility Expectation:	Fair
Projected Utilization:	350

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Johnson Space Center

Northrup-Grumman T-38N Program Support Aircraft

General Characteristics

Twin-engine, high performance tactical aircraft

Length (ft):	46	*Range/Endurance:*	930 NM
Span (ft):	21	*Cruise Speed (Kts):*	Mach 1.08
Max Weight (lb):	12,800	*Altitude (ft):*	40,000+
Payload (lb):	4,500+		

Utilization

Current Role:	Program Support: Astronaut Space Flight Readiness Training Aircraft
Quantity:	20
Total Hours FY20:	2,209.2
Aircraft Age:	51~61
Suitability:	Well Suited to Role
Estimated Service Life:	10~15 years
Future Role(s):	Same
Servicibility Expectation:	Good. Nearly All Maintenance Is In House.
Projected Utilization:	3,000

Replacement Aircraft Requirements

Replace When:	When Training Requirement Is Redefined
Replacement Justification:	TBD
Replacement Criteria:	TBD
Recommed Replacement:	Must Meet Astronaut Training Requirements

Appendix 2—Aircraft Information Sheets

Johnson Space Center

General Dynamics WB-57F High Altitude Research Aircraft

General Characteristics

50's vintage bomber converted to high altitude research platmform.

Length (ft):	69	*Range/Endurance:*	2,500 NM
Span (ft):	122	*Cruise Speed (Kts):*	410
Max Weight (lb):	63,000	*Altitude (ft):*	60,000+
Payload (lb):	6,000		

Utilization

Current Role:	High Altitude Launch and Re-entry Imagery and Reimbursable Requirements
Quantity:	3
Total Hours FY20:	106.4
Aircraft Age:	48~58
Suitability:	Well Suited to Role. One of A Kind Capability.
Estimated Service Life:	Indefinite
Future Role(s):	Reimbursable Research
Servicibility Expectation:	Good
Projected Utilization:	150

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	Supportability
Replacement Criteria:	50-65K Altitude, 5,000+ lb Scientific Payload
Recommed Replacement:	Possible Global Hawk or Similar UAV

Appendix 2—Aircraft Information Sheets

Kennedy Space Center

Airbus H-135 Program Support Aircraft

General Characteristics

Commercial twin turboshaft engine, light multi-utility helicopter with bearingless main rotor, shrouded tail rotor, and digital controls.

Length (ft):	40.2	*Range/Endurance:*	340NM / 2+ hours
Span (ft):	34.1	*Cruise Speed (Kts):*	139
Max Weight (lb):	6,570	*Altitude (ft):*	7,200
Payload (lb):	2,937		

Utilization

Current Role:	Space Launch Contingency; Security; Wildfile Control; Surveillance; and Emergency Response
Quantity:	2
Total Hours FY20:	244.9
Aircraft Age:	2
Suitability:	Well suited.
Estimated Service Life:	20~30 years
Future Role(s):	Same
Servicibility Expectation:	Large Commercial Base for Maintenance and Support
Projected Utilization:	300

Replacement Aircraft Requirements

Replace When:	N/A - New Aircraft
Replacement Justification:	Enhanced Operability and Supportability
Replacement Criteria:	Enhanced Operability and Supportability
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Kennedy Space Center

Bell UH-1H "Huey II" Program Support Aircraft

General Characteristics

US Army light-lift utility helicopters. Single turboshaft engine. Recently remanufactured into Huey II's.

Length (ft):	44.5	*Range/Endurance:*	2+ hours
Span (ft):	48	*Cruise Speed (Kts):*	120 / 100
Max Weight (lb):	10,500 / 9,500	*Altitude (ft):*	10,000
Payload (lb):	4,000 / 3,000		

Utilization

Current Role:	Space Launch Contingency; Security; Wildfile Control; Surveillance
Quantity:	3
Total Hours FY20:	13.3
Aircraft Age:	48~50
Suitability:	Adequate. Single Engine Limits Overwater Ops.
Estimated Service Life:	5 ~10 years
Future Role(s):	N/A
Servicibility Expectation:	Increasingly Costly to Maintain
Projected Utilization:	Replaced by H-135

Replacement Aircraft Requirements

Replace When:	Replaced by H-135
Replacement Justification:	Enhanced Operability and Supportability
Replacement Criteria:	Enhanced Operability and Supportability
Recommed Replacement:	Replaced by H-135

Appendix 2—Aircraft Information Sheets

Langley Research Center

Raytheon Be-200 Super King Air Program Support Aircraft

General Characteristics

Twin-engine pressurized turboprop aircraft. Seating modified to accommodate one pilot and four researchers.

Length (ft):	43.8	*Range/Endurance:*	1,250 NM / 6.2 hrs
Span (ft):	54.5	*Cruise Speed (Kts):*	260
Max Weight (lb):	13,500	*Altitude (ft):*	35,000
Payload (lb):	4,100		

Utilization

Current Role:	Earth Science Research
Quantity:	2
Total Hours FY20:	266.3
Aircraft Age:	39~42
Suitability:	Good
Estimated Service Life:	5-10 years
Future Role(s):	Earth Science Research and Possibly Aeronautics
Servicibility Expectation:	Good. Parts Available from Hawker Beechcraft.
Projected Utilization:	250

Replacement Aircraft Requirements

Replace When:	When Not Required
Replacement Justification:	Supportability
Replacement Criteria:	TBD
Recommed Replacement:	Meet Mission Requirements

Appendix 2—Aircraft Information Sheets

Langley Research Center

Cessna 206 Stationair Research Aircraft

General Characteristics

All-metal, six-place, single-engine aircraft used for flight research. Modified to seat one pilot and two researchers.

Length (ft):	28.3	*Range/Endurance:*	700 NM / 5.7 hrs
Span (ft):	36	*Cruise Speed (Kts):*	150
Max Weight (lb):	3,600	*Altitude (ft):*	15,700
Payload (lb):	1,175		

Utilization

Current Role:	Aviation Safety Programs; General Aviation Programs
Quantity:	1
Total Hours FY20:	7.1
Aircraft Age:	21
Suitability:	Good
Estimated Service Life:	30+ years
Future Role(s):	To be dispositioned upon completion of FY21 project
Servicibility Expectation:	Excellent
Projected Utilization:	25

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Langley Research Center

Lancair Columbia 300 Research Aircraft

General Characteristics

New generation light, single-engine, composite construction, 4-place, fixed gear aircraft.

Length (ft):	25.2	*Range/Endurance:*	1,000 NM / 7.2 hrs
Span (ft):	35.8	*Cruise Speed (Kts):*	180
Max Weight (lb):	3,400	*Altitude (ft):*	18,000
Payload (lb):	1,026		

Utilization

Current Role:	General Aviation Programs.
Quantity:	1
Total Hours FY20:	37.8
Aircraft Age:	21
Suitability:	Excellent
Estimated Service Life:	30+ years
Future Role(s):	Aeronautics Research.
Servicibility Expectation:	Excellent
Projected Utilization:	50

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Langley Research Center

Gulfstream Aerospace G-III Research Aircraft

General Characteristics

Twin-engine, long range, 12-passenger business jet.

Length (ft):	83.1	*Range/Endurance:*	3,700 NM
Span (ft):	77.8	*Cruise Speed (Kts):*	459
Max Weight (lb):	69,700	*Altitude (ft):*	45,000
Payload (lb):	4,500		

Utilization

Current Role:	Airborne Science Research.
Quantity:	1
Total Hours FY20:	6.9
Aircraft Age:	35
Suitability:	Excellent
Estimated Service Life:	15+
Future Role(s):	Airborne Science Research
Servicibility Expectation:	Fair
Projected Utilization:	100

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Langley Research Center

Cirrus HU-25 Research Aircraft

General Characteristics

Twin turbofan US Coast Guard aircraft modified for Airborne Science Research.

Length (ft):	56.3	*Range/Endurance:*	1900 NM
Span (ft):	53.5	*Cruise Speed (Kts):*	430
Max Weight (lb):	32,000	*Altitude (ft):*	42,000
Payload (lb):	3,000		

Utilization

Current Role:	Scientific Research
Quantity:	1
Total Hours FY20:	173.0
Aircraft Age:	40
Suitability:	Good
Estimated Service Life:	10+
Future Role(s):	Being Replaced by G-III. Retire when scheduled mission are complete.
Servicibility Expectation:	Fair
Projected Utilization:	150

Replacement Aircraft Requirements

Replace When:	Being replaced with G-III.
Replacement Justification:	
Replacement Criteria:	
Recommed Replacement:	

Appendix 2—Aircraft Information Sheets

Langley Research Center

Cirrus SR-22 Research Aircraft

General Characteristics

New generation light, single-engine, composite construction, 4-place, fixed gear aircraft. Modified to carry one pilot and two researchers.

Length (ft):	26	*Range/Endurance:*	970 NM / 6.1 hrs
Span (ft):	38.3	*Cruise Speed (Kts):*	175
Max Weight (lb):	3,400	*Altitude (ft):*	17,500
Payload (lb):	932		

Utilization

Current Role:	General Aviation Programs
Quantity:	1
Total Hours FY20:	9.7
Aircraft Age:	20
Suitability:	Excellent
Estimated Service Life:	30+ years
Future Role(s):	Same
Servicibility Expectation:	Excellent
Projected Utilization:	25

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Goddard Space Flight Center - Wallops Flight Facility

Raytheon Be-200 Super King Air Program Support Aircraft

General Characteristics

Twin-engine pressurized turboprop aircraft. Typical seating is for 6-8 passengers.

Length (ft):	43.8	*Range/Endurance:*	1,490
Span (ft):	54.5	*Cruise Speed (Kts):*	272
Max Weight (lb):	12,500	*Altitude (ft):*	30,000
Payload (lb):	1,850		

Utilization

Current Role:	Pilot Proficiency Training, Range Surveillance, & Pax Transport.
Quantity:	1
Total Hours FY20:	70.0
Aircraft Age:	40
Suitability:	Good Balance for Mission. Economical.
Estimated Service Life:	10+ years
Future Role(s):	Placed in Storage
Servicibility Expectation:	Good
Projected Utilization:	N/A

Replacement Aircraft Requirements

Replace When:	N/A
Replacement Justification:	N/A
Replacement Criteria:	N/A
Recommed Replacement:	N/A

Appendix 2—Aircraft Information Sheets

Goddard Space Flight Center - Wallops Flight Facility

C-130 Hercules Research Aircraft

General Characteristics

Four-engine turboprop aircraft extensively modified to support Airborne Science.

Length (ft):	97.8	*Range/Endurance:*	3000 NM / 12 hrs
Span (ft):	132.6	*Cruise Speed (Kts):*	290
Max Weight (lb):	155,000	*Altitude (ft):*	33,000
Payload (lb):	36,500		

Utilization

Current Role:	Scientific Research and Cargo Carriage
Quantity:	1
Total Hours FY20:	116.1
Aircraft Age:	34
Suitability:	Excellent. Good Balance for Mission. Economical.
Estimated Service Life:	10+ years
Future Role(s):	Cargo Transport
Servicibility Expectation:	Excellent
Projected Utilization:	100

Replacement Aircraft Requirements

Replace When:	No future missions.
Replacement Justification:	
Replacement Criteria:	
Recommed Replacement:	

Appendix 2—Aircraft Information Sheets

Goddard Space Flight Center - Wallops Flight Facility

Lockheed Martin P-3B Research Aircraft

General Characteristics

Former US Navy long endurance, 4-engine maritime patrol aircraft. Converted to multi-function Earth Science research platform.

Length (ft):	116.5	*Range/Endurance:*	13+ hours
Span (ft):	99.5	*Cruise Speed (Kts):*	330
Max Weight (lb):	127,500	*Altitude (ft):*	28,300
Payload (lb):	15,000		

Utilization

Current Role:	Earth Science Research
Quantity:	1
Total Hours FY20:	115.1
Aircraft Age:	54
Suitability:	Excellent
Estimated Service Life:	10-15 years
Future Role(s):	Same
Servicibility Expectation:	Fair
Projected Utilization:	300

Replacement Aircraft Requirements

Replace When:	Not Required
Replacement Justification:	Supportability
Replacement Criteria:	Equal Payload & Range. Better Speed & Altitude.
Recommed Replacement:	Must Meet Research Requirements.

NASA Missions Supported in Fiscal Year 2020

Appendix 3—Fiscal Year 2020 Aircraft Missions

NASA Missions Supported in FY20				
LOCATION	AIRCRAFT	PRIMARY UTILITY DESIGNATION	QTY	PROGRAMS/PROJECTS/CAMPAIGNS SUPPORTED
ARC	Sierra UAS Ship B	R&D	1	Flight Qualification, UAS/NAS, and Science.
Subtotal ARC			1	
AFRC	B-200 (N7NA and N801NA) - N7NA in storage	PS	1	Ops Enable Mission and Pilot Proficiency.
	C-20A (Gulfstream G-III: N802NA)	R&D	1	UAVSAR and Mars 2020 Project Support.
	DC-8 (N817NA)	R&D	1	Major Engine Maintenance Inspection and Repair.
	ER-2 (N806NA and N809NA)	R&D	2	IMPACTS, Western Diversity, and Pilot Proficiency.
	F-15B (N836NA)	R&D	1	Aeronautics Technology Research Testbed.
	F-15D (N884NA and N897NA)	PS / R&D	2	High Performance Safety Chase.
	F/A-18 (N843NA, N846NA, and N868NA)	PS	3	Pilot Proficiency Training, High Performance Safety Chase, and Sonic Boom Mitigation Flight Research.
	Global Hawk (N872NA and N874NA)	R&D	2	DOD Research (Reimbursable).
	Gulfstream (G-III (N808NA)	PS	1	Pilot Proficiency Training and Mars 2020 Project Support.
	Gulfstream (G-III (N804NA)	R&D	1	Aeronautics Technology Development.
	SOFIA (N747NA)	R&D	1	Infrared Astronomy.
	T-34C (N865NA)	PS	1	Pilot Proficiency Taining and Low Speed Safety Chase.
	TG-14	PS	1	Sonic Boom Research Support.
	X-56	R&D	1	Aeronautics Technology Research Testbed.
Subtotal AFRC			19	
GRC	DHC-6 (N607NA)	R&D	1	Great Lakes Algae.
	S-3B (N601NA) - awaiting final transfer to museum	R&D	-	
	T-34C (N602NA and N608NA)	PS	2	UAS-NAS, Pilot Proficiency, and USAF Reimbursable Work.
Subtotal GRC			3	
GSFC	B-200 (N8NA)	PS	1	Pilot Proficiency, Range Security, and Pax. Transport.
	C-130 (N439NA)	R&D	1	Sounding Rocket Program Support and CCP Air Drop.
	P-3 (N426NA)	R&D	1	CAMPEX, IMPACTS, and Pilot Proficiency.
Subtotal GSFC			3	
JSC	B-377 Super Guppy (N941NA)	PS	1	Outsized Cargo Transport for HEOMD and DOD.
	Gulfstream G-III (N992NA)	PS	1	SnowEx, CCP Mission Support, CCP Astronaut Training, Astronaut Direct Return, and Pilot Proficiency.
	Gulfstream G-V (N95NA)	PS	1	Astronaut Direct Return, CCP Mission Support, ISS Support, and Pilot Proficiency.
	T-38	PS	20	Astronaut Space Flight Readiness Training (SFRT).
	WB57 (N926NA, N927NA, and N928NA)	R&D	3	Space Launch Imaging and MUDLAN.
Subtotal JSC			26	
KSC	H-135 (N425NA and N435NA)	PS	2	Space Launch Security and KSC Center Support.
	UH-1H (N416NA, N418NA, and N419NA) - awaiting exchange	PS	3	
Subtotal KSC			5	
LaRC	B-200 (N528NA and N529NA)	PS	2	ACT America, ACTIVATE, IPDA, XVS, and Pilot Proficiency.
	Cessna C206 (N504NA) - placed into storage at WFF	R&D	-	EPA TEROS and Pilot Proficiency.
	Cirrus SR-22 (N501NA)	R&D	1	ACTIVATE, ICAROUS, AFSS/MGL, and Pilot Proficiency.
	Gulfstream G-III	R&D	1	Science Modifications and Instrumentation.
	HU-25 (N525NA)	R&D	1	Sounding Rocket Support, ACTIVATE, and Pilot Proficiency.
	Lancair (N507NA)	R&D	1	ICAROUS, AFSS/MGL, XVS, and Pilot Proficiency.
Subtotal LaRC			6	
Total NASA			63	

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

Aircraft Mishaps from Fiscal Years 2004 to 2019

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

FY04 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type B	Flight	T-38 bird strike during day Visual Flight Rules (VFR) flight.
		T-38 bird strike during night VFR flight.
Type C	Flight	NASA 1 right windshield cracked during landing approach.
		Shuttle Trainer Aircraft (STA) lost thrust reverser in flight.
		T-38 struck approach lights during touch and go.
		DC-8 departed runway during takeoff roll.
	Ground	DC-8 cabin lights damaged due to improper power handling while on ground.
Type D	Flight	NASA 1 lost nose wheel steering due to shearing of steering wheel actuator while landing.
		STA nose gear warning light illuminated during shuttle simulation approach.
	Ground	DC-9 flap drooped and impacted maintenance stand in hangar overnight.
		T-38 engine overheated during ground high-power run.
		T-38 canopy found damaged on the floor in sheet-metal shop.
		B-52 nitrogen hose damaged during maintenance.
		Lift strikes DC-8 during maintenance.

FY05 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Ground	DFRC DC-8 engine inspection required as a result of improper ground transportation.
		JSC T-38 engine FOD during ground run.
		JSC G-II (STA) nose gear door closed on pilot.
Type D	Flight	JSC T-38 bird strike compressor damage after takeoff.
		JSC G-II (Mission Management Aircraft (MMA)) bird strike on landing approach.
		JSC G-II (MMA) aircraft radome damage in flight.
	Ground	JSC T-38 aircraft struck by lightning on ground.
		DFRC B-52B wing strike of ground vehicle during tow.
		LaRC C-206 rolled over open tie-down pit during tow.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

FY06 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	JSC T-38 in-flight bird strike resulting in engine damage.
		MSFC G-II flight aborted due to cross wind and questionable directional control causing damage.
	Ground	JSC T-38 engine damage.
		JSC T-38 maintenance stand hydraulic hose ruptured.
		JSC T-38 ground aborted due to engine FOD.
Type D	Flight	GRC DHC-6 right engine inlet heater overheated in flight, damaging engine cowling.
		JSC T-38 in-flight bird strike to landing gear.
		JSC T-38 engine damage due to FOD.
		JSC T-38 in flight lightning strike.
		JSC Shuttle Carrier Aircraft (SCA) had an engine fire on initial climb after takeoff.
		WFF DC-8 in-flight lightning strike.
	Ground	JSC T-38 maintenance personnel injured scalp after hitting aircraft radio antenna.
		JSC Super Guppy flight engineer slipped on cargo pallet during loading.

FY07 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type B	Flight	JSC Gulfstream G-III heat damage to pylon.
Type C	Flight	DFRC B-200 engine FOD.
		JSC T-38 bird strike.
		JSC T-38 bird strike during rotation. Takeoff aborted.
		KSC Gulfstream G-II compressor stalled during takeoff.
	Ground	JSC WB-57 brake fire.
		JSC STA ground towing incident.
Type D	Flight	KSC Gulfstream G-II bird strike during landing.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

FY08 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	T-38 bird strike during takeoff.
		N912 T-38 bird strike during practice approaches.
	Ground	N941 Super Guppy struck by tow tractor during towing.
		P-3 struck model aircraft while being towed into hangar.
		N941 Super Guppy #2 engine damaged during installation.
Type D	Flight	N924 T-38 struck threshold lights during landing.
		STA struck tree during landing approach.
		N966 T-38 entered a storm and suffered hail damage.
	Ground	NASA 4 (G-II) compressor stalled on takeoff roll.
		Fuel tank and engine mount failure prevented Sierra UAS from takeoff.
		N908 T-38 engine damage due to bird ingestion on run up to Military Power.
		N911 SCA elevator struck by manlift during repair of vertical stabilizer.
		N955 T-38 cockpit canopy separated during ground mx. and damaged windscreen.

FY09 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	All four engines rolled back as Super Guppy aircraft cleared the runway.
	Ground	B-747SP (SOFIA) vertical stab damaged during removal.
		Global Hawk UAS CAMA (Common Aircraft Modem Assembly) mishap in hangar.
		Huey II helicopter struck platform and ground mechanic fell and got injured.
Type D	Flight	T-38 aircraft (N912NA) had an engine flame out due to FOD.
		Vulture impacted Huey II helicopter while in flight.
	Ground	During inspection on T-38 aircraft, it was noted that #1 engine had FOD damage.
		Gulfstream G-II aircraft (N949NA) damaged by B1 Stand.
		T-38 suffered a bird strike on T-38 ramp during maintenance ground run.
		T-38 aircraft (N918NA) was dented by blade of concrete cutter.
		Gulfstream G-II (N949NA) nose gear door damaged by steering pin retainer clip.
		SOFIA Upper Rigid Door seal and seal retainer damaged.
		SOFIA Emergency Slide Door 2 left lower cell aspirator turbine disintegrated and exited its housing, throwing turbine blades into observers.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

Fiscal Year 2010 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type B	Ground	F-18 engine FOD.
Type C		ER-2 towing incident.
Type D	Flight	Bird ingested into T-38 engine.
		T-38 landing light lost during flight.
		T-38 bird strike.
		In flight damage to SCA engine panel.
	Ground	T-38 engine FOD.
		WB-57 pitot tube dropped and bent.
		T-38 lap belt initiator lanyard snag.
		T-38 engine blade damage discovered during flight inspection on ground.
		T-38 electrical problem on the ground,
		Manlift impacted SCA engine cowling.
		STA aircraft wing damaged during tire change.
		T-38 right wing assembly damaged on the ground.
		T-38 battery shunt damaged while being prepared for towing.
		Dual output seat initiator fired during T-38 seat removal.

Fiscal Year 2011 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	T-38 engine flame out on takeoff.
		T-38 bird strike on touch & go takeoff.
		T-38 bird strike on takeoff.
Type D	Flight	T-38 engine FOD.
		T-38 tire blew during landing.
		T-38 canopy jettison actuation.
		T-38 bird strike during landing.
	Ground	SOFIA bleed air leak.
		B-377 Supper Guppy throttle cable failure.
		T-38 cockpit display crack discovered.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

Fiscal Year 2012 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	T-38 bird strike on touch and go climb out.
	Ground	ER-2 main gear door damaged during phase maintenance.
		F-18 cockpit “heads-up” display damaged during shipment to depot.
Type D	Flight	DC-8 #1 engine flameout at FL250.
		Super Guppy grazed pole-mounted security camera during taxi.
		T-38 suffered a lightning strike.
		T-38 lighting strike.
	Ground	ER-2 tail wheel door damaged by tow bar #1.
		ER-2 tail wheel door damaged by tow bar #2.
		SOFIA unannounced power cut off during INF pump down.
		ER-2 damage to canopy thruster pin.
		SOFIA transformer overheated during power test of new wire installation.
		DC-8 air-stair impacted a Cessna 172.
		C-9 severe corrosion due to water intrusion to Air Data Display Unit.
		B747 (SOFIA) aircraft tow bar broke.
		T-38 T-5 motor harness torn in half during engine removal.
		Data plates to two UH-1H main rotor head drag braces were destroyed.

Fiscal Year 2013 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	T-38 bird strike on takeoff.
		Loss of engine thrust resulted in the SIERRA UAS gliding into the ocean.
Type D	Flight	WB-57 engine structural component/panel lost in flight.
		PODEX GISS RSP science sensor damaged in flight on ER-2.
	Ground	Global Hawk (N872NA) right-hand wing damage during ground handling.
		SOFIA aircraft systems failure of Telescope Assembly Power Unit "B," which provided power to the TA bearing float system pump.
		DC-8 experimenter probe damaged.
		Rudder rig pin not removed during C-20A aircraft service change and subsequent flight control checks, causing damage to hat channel and web.
		C-9 heat exchanger dropped ruing scheduled maintenance.
		C-9 aft evacuation slide inflation.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

Fiscal Year 2014 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Ground	Employee got index finger on right hand caught in spring on aircraft hatch door as he was stepping down.
Type D	Flight	Power supply failed in flight.
		Power supply failed in flight.
		Missing Tool located in Telescope Assembly Cavity.

Fiscal Year 2015 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	Contractor X-56 Buckeye UAS entered pogo mode during landing and crashed.
	Ground	Global Hawk UAS impacted guard-rail during tow.
Type D	Flight	GL-10 multi-rotor, tilt-wing UAS crashed into trees surrounding UAS runway.

Fiscal Year 2016 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Ground	Employee injured rotator cuff and tendons in right shoulder due to pulling nose gear to turn the wheel on an aircraft.
Type D		On preflight, found ER-2 M-11 thruster body had come loose.

Fiscal Year 2017 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Ground	Post-flight inspection found FOD damage to engine compressor at intake of C-130.
Type D	Flight	Bird strike damage to an F-18 engine.
	Ground	Pitot-static damaged during test; no injuries.

Appendix 4—Fiscal Year 2004 to 2019 Aircraft Mishaps

Fiscal Year 2018 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
Type C	Flight	In flight electrical short in the external Unmanned Aerial Vehicle Search and Rescue (UAVSAR) instrument pod on AFRC C-20.
	Ground	AFRC maintainer fell while ER-2 crew access platform was being moved.
		JSC maintainer injured knee while taping lower intake (RH) paper to paint strips.
		JSC maintainer sustained lower back injury while disconnecting power cord.
		Maintainer fell from 3-foot ladder during aircraft maintenance.
Type D	Flight	In flight hypoxia event in LaRC B-200 as a result of operator error.
	Ground	AFRC maintainer hit by a propeller blade while working in hangar.
		JSC maintainer fell after removing aircraft from tow bar equipment.
		AFRC maintainer hit his head on G-III nose gear door.
		JSC maintainer hit his head on T-38 antenna
		AFRC maintainer hit his head on F-15D antenna.

Fiscal Year 2019 Aircraft Mishaps

MISHAP TYPE	MISHAP CATEGORY	MISHAP DESCRIPTION
TBD	Flight	Scheduled maintenance inspection discovered accelerated wear and/or damage to DC-8 high pressure compressor incurred during Airborne Science research flight campaign.
Type C	Flight	WB-57 (N928NA) departed runway in an aborted takeoff.
		Left, outboard main landing gear tire on Gulfstream G-III shredded during takeoff. Mission aborted with safe RTB.
	Ground	Employee's hand injured by drill bit during maintenance.
		Employee working on T-38 reported chemical burn after spilling fuel on his pants.
		Employee suffered cut to the head bumping into T-38.
		Mechanic pinched index finger between scissor lift handrail and C-130 pitot tube.
		Mechanic cut and fractured the tip of right pinky finger closing G-III main cabin door.

NASA Aircraft Requirements and Link to Strategic Plan

Appendix 5—Aircraft Linkage to NASA's Strategic Plan

LOCATION	ACTIVE AIRCRAFT	MD/PROG REQUIREMENTS	STRATEGIC GOALS SUPPORTED
ARC	Sierra UAS (N701NA)	ARMD/SMD Research Data Collection	1, 3, 4
AFRC	B-200 (N7NA, N801NA)	Pilot Proficiency Training	1, 3, 4
	B-747 (SOFIA (N747NA))	SMD Stratospheric Observatory for IR Astronomy (SOFIA)	1, 3, 4
	DC-8-72 (N817NA)	SMD Heavy Research/Data Collection (1K - 40K'), Long Range	1, 3, 4
	Global Hawk UAS (N872NA and N874NA)	Reimbursable DOD Research	3, 4
	G-III (N802NA)	SMD Research/Data Collection Using UAVSAR	1, 3
	G-III (N804NA)	ARMD Reseach/Data Collection	3, 4
	G-III (N808NA)	ARMD/ATP Pilot Proficiency Training	3, 4
	ER-2 (N806NA, N809NA)	SMD High Altitude Research/Data Collection (70K+), Long Duration	1, 3
	F-15B (N836NA)	ARMD/FA High Speed/Performance Research	3, 4
	F-15D (N884NA and N892NA)	ARMD/FA High Speed/Performance Research	3, 4
	F/A-18A/B (N846NA, N867NA, and N868NA)	ARMD/FA High Speed Chase/Support and Proficiency Training	1, 4
	T-34C (N865NA)	ARMD/FA Pilot Proficiency Training Slow UAS Chase	3, 4
	TG-14 (N856NA)	Motor Glider	3, 4
	X-56 Multi-Utility Technology Testbed (MUTT)	Aeronautics Technology Testbed	3
	X-57 Maxwell	All Electric X-plane	3
	X-59 Low Boom Flight Demonstrator (LBFD)	Low Boom Sonic Flight Demonstration	3
GRC	PC-12 (Proposed Acquisition)	ARMD AvSafety/SMD and Reimbursable Research	1, 3, 4
	T-34C	Pilot Proficiency Training	1
WFF	C-130 (N436NA)	Cargo Transport	1, 4
	P-3 (N426NA)	SMD Research/Data Collection	1, 3
JSC	B-377 Super Guppy (N941NA)	HEOMD Large Space Vehile Component	2, 3, 4
	G-III (N992NA)	SMD UAVSAR Research/ISS Astronaut Transport	1, 2, 3, 4
	G-V (N95NA)	Astronaut Direct Return Missions	1, 2, 3, 4
	T-38 Fleet	HEOMD Space Flight Readiness Training (SFRT)	1, 2, 3, 4
	WB-57 (N926NA, N927NA, and N928NA)	SMD High Altitude, Large Payload Science	1, 2, 3, 4
KSC	H-135 (N425NA, N435NA, and N442NA)	Launch and Range Security. Bio and Environmental Compliance	1, 2, 3, 4
LaRC	B-200 (N528NA and N529NA)	SMD Research/Data Collection	1
	C-20B (N520NA)/Falcon HU-25 (N525NA)	SMD Research	1
	Cessna C-206 (N504NA)	SMD Research	1
	Cirrus SR-22 (N501NA)	ARMD research and Pilot Proficiency	3
	LC40 Cessna (N507NA)	ARMD-V&V Cockpit Display Technology Demonstration	3

NOTE: AFRC Global Hawk UAS to be dispositioned after completion of reimbursable requirements.