National Aeronautics and
Space Administration

Headquarters
Washington, D.C. 20546-0001

Reply to Attn of: W

June 27, 2003

TO: M/Associate Administrator for Space Flight

Johnson Space Center
Attn: AA/Director

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Improving Management of the Astronaut Corps (G-01-035)

This report was scheduled to be released in final form in February 2003. However, when the Space Shuttle Columbia and its crew were lost we decided to delay the release of the report until a more appropriate time. Now that NASA is working to recruit an Astronaut Candidate Class of 2004 that includes pilots, mission specialists, and educator astronauts, we believe that our recommendations will aid the decision-making process. The substance of this report has not been adjusted to reflect the loss of the Columbia or its crew.

EXECUTIVE SUMMARY

The NASA Office of Inspector General (OIG) evaluated the size and utilization of the astronaut corps.[1] The OIG considered whether the NASA astronaut corps was being used effectively, was supportive of the Agency's current and future mission, and was managed in accordance with governing policies and procedures. We found that overly optimistic predictions of future flight rates, minimal regulation of astronaut candidate selection, and the need to staff engineering positions at Johnson Space Center to be factors in the Agency's astronaut hiring process. As a result, costs for the astronaut program were higher than necessary and individuals trained to be astronauts were not all being used in a manner commensurate with their expensive training. To assist the Agency in assuring that the size of the corps is more closely aligned with mission and program needs, we recommended that the Agency establish formal guidelines for certain aspects of the astronaut candidate selection process, conduct more realistic analyses of astronaut corps size needs, document reasons for deviating from those analyses, and establish formal criteria for astronaut technical assignments.

[1] The findings and recommendations contained in this report are based, in part, on interviews we conducted with senior NASA employees, astronaut candidates, current astronauts, management astronauts, and former astronauts.

Report Based on Pre-February 1, 2003 Data

BACKGROUND

NASA has hired 18 groups of astronauts, called classes, since the astronaut program began in 1959. Since 1978, when NASA hired the first class of Space Shuttle astronauts, 237 astronauts have been brought into the corps to fly on the Space Shuttle and to be part of International Space Station (ISS) Expedition crews. NASA recently announced that a new class of astronauts would be hired in 2004.

As defined by the Astronaut Office, astronauts fall into one of the following four categories as they progress through their career:

- *Astronaut candidates (ASCAN's*) are astronauts in the process of completing basic training.
- *Active astronauts* include unflown astronauts in advanced training and astronauts (flown and unflown) who are qualified to fly in space as commanders, pilots, and mission specialists. Active astronauts not involved in flight-specific training work in technical assignments.[2]
- *Management astronauts* have flown in space and are working in rotational or permanent management assignments throughout the Agency. Management astronauts on rotational assignment are not typically involved in any spaceflight training, but some are eligible to return to active astronaut status and participate in a Space Shuttle or ISS mission.[3]
- *Former astronauts* (including deceased astronauts) are no longer working at NASA.

As of December 2002, the corps included 116 flown and unflown active astronauts and 38 management astronauts[4] for a total of 154 astronauts. These astronauts were either pilots or mission specialists.[5,6] The 57 civilians in the astronaut corps were mission specialists, while the 97 active or retired military personnel in the corps included 40 mission specialists and 57

[2] A technical assignment was any job an astronaut performed when not training for a particular spaceflight.

[3] Management astronauts, a term which had been recently re-defined, included all the astronauts who were still working at NASA and who were not ASCAN's or active astronauts.

[4] The re-definition of management astronauts (see footnote 3) added back into the corps 11 individuals who had previously been listed as former members of the astronaut corps.

[5] Pilot astronauts served as both Space Shuttle commanders and pilots. During flight, the commander had onboard responsibility for the vehicle, crew, mission success, and safety of the flight. The pilot assisted the commander in controlling and operating the vehicle. In addition, the pilot might have assisted in the deployment and retrieval of satellites, in extravehicular activities, and in other payload operations. Pilots could also serve as Space Station crew.

[6] Mission specialists, working with the commander and pilot, had overall responsibility for the coordination of Space Shuttle operations in the areas of crew activity planning, consumables usage, and experiment and payload operations. Mission specialists were required to have detailed knowledge of Space Shuttle systems as well as detailed knowledge of the operational characteristics, mission requirements and objectives, and supporting systems and equipment for each payload element on their assigned missions. Mission specialists performed extravehicular activities, handled payloads using the remote manipulator system, and performed or assisted in specific experiment operations. Each Space Shuttle crew included three or more mission specialists. Mission specialists could also serve as Space Station crew.

pilots.[7] For the purposes of this report, which focuses on astronauts selected by NASA, the term "astronaut corps" does not include international astronauts or payload specialists.[8]

Active astronauts and ASCAN's were programmatically located in the Astronaut Office within the Flight Crew Operations Directorate (FCOD) at Johnson Space Center (Johnson).[9] The Astronaut Office was directly responsible for many aspects of an astronaut's career, including determining where members of the corps work and when they fly in space. Senior astronauts rotated through management of the Astronaut Office, which had three Chiefs during 1995-2002.

I. SIZE AND COST OF THE ASTRONAUT CORPS

In December 2002, 53 of the 116 active members of the astronaut corps had not yet flown in space.[10] Astronauts required at least 28 months of training before their first Shuttle flight and at least 3½ years of training before they could become ISS Expedition crewmembers.[11] However, astronauts selected in 1996, 1998, and 2000 were waiting and were expected to wait for their first flight for years longer than astronauts in previous classes. Table 1 shows average actual and average projected first flight wait times for mission specialists and pilots in post-Challenger astronaut classes.

[7] Both the civilian and the military members of the astronaut corps were Federal employees. Civilians became civil service employees, while active members of the military were temporarily detailed to NASA from their branch of the Armed Forces.

[8] Payload specialists were selected and trained by commercial or research organizations (rather than by NASA) to fly with a specific payload on a spaceflight mission. International astronauts were selected by their respective space agencies and served as mission specialists with NASA.

[9] For the most part, management astronauts were not located in the Astronaut Office.

[10] Information in this section is based on crew composition of the 87 flights since the loss of Challenger and its crew. This information, complete through December 2002, can be found at http://spaceflight.nasa.gov/shuttle.

[11] Twenty-eight months of training included 18 months for basic training, a variable amount of time to complete advanced training, and 10 months for flight-specific training. Three-and-a-half years of training included 18 months for basic training, an unspecified amount of time for advanced training, and approximately 2 years for flight-specific ISS Expedition crewmember training.

Table 1. Average First-Flight Wait Times by Class

Class Year	Class Size	Unflown Astronauts	Average Actual[12] and Average Projected[13] Wait for First Flight (Months)	
			Mission Specialists	Pilots
1987	15	-	50	54
1990	23	-	38	45
1992	19	-	36	39
1995	19	-	32	41
1996	35	12 [14]	72 (projected)	63
1998	25	24 (1 deceased)	94 (projected)	73 (projected)
2000	17	17	105 (projected)	85 (projected)

NASA typically assembled mixed-experience crews that included an average of 1.53 first-time flyers on each of the 87 Space Shuttle flights since the loss of Challenger and its crew (see Appendix A). As of December 2002, NASA expected to fly the Space Shuttle 6 times in 2003 and 4 times each year thereafter. Given this rate of flight for new astronauts, the last unflown astronaut from the class of 2000 was not expected to fly in space until 2010.[15]

The size of the astronaut corps has an impact on cost. Although Johnson was unable to determine the full cost of the astronaut corps using the cost accounting system available in 2002, astronauts clearly cost more than other civil servants.[16] Astronauts received extensive training supported by a broad array of training facilities and a network of contractor and civil service employees (see Appendix B). Because of the critical role astronauts play in the multi-billion dollar Space Shuttle and Space Station programs, paying more for astronauts than for

[12] This information is based on Space Shuttle crew composition data through December 2002.

[13] The NASA OIG derived the "Projected" average numbers based on 4 factors: actual Space Shuttle crew composition through the end of 2002; projection of 6 Space Shuttle flights in 2003 including a total for the year of 6 unflown mission specialists and 3 pilots; projection of 4 Space Shuttle flights in 2004 and each year thereafter including an annual total of 4 unflown mission specialists and 2 unflown pilots; and NASA's flying one unflown astronaut on ISS (alternating between pilots and mission specialists) each year. See Appendix A for more information about average Space Shuttle crew composition.

[14] The Astronaut Office tried to assign all unflown astronauts from earlier classes to fly before assigning unflown astronauts from subsequent classes. However, because pilots were in demand, unflown pilots from the 1998 class were likely to fly before all the unflown mission specialists from the 1996 class had their first flight.

[15] Although the average wait for a class of 2000 mission specialist was projected to be 105 months, the last mission specialist in that class was not projected to fly for the first time until April 2010 (116 months after joining the astronaut corps).

[16] Johnson did not wholly track costs associated with the astronaut corps. We found no effective mechanism to accumulate these costs. Astronaut corps costs were distributed throughout Johnson. Although the eventual implementation of the Integrated Financial Management Program should alleviate the difficulty of pulling together astronaut corps costs, Johnson did not appear to be able to effectively track and manage astronaut-related costs associated with planned-for reductions in the Space Shuttle flight rate and in ISS staffing. The Agency was generally aware of the need to improve cost accounting (*Integrated Financial Management Program: Core Financial Project Plan*, February 14, 2001).

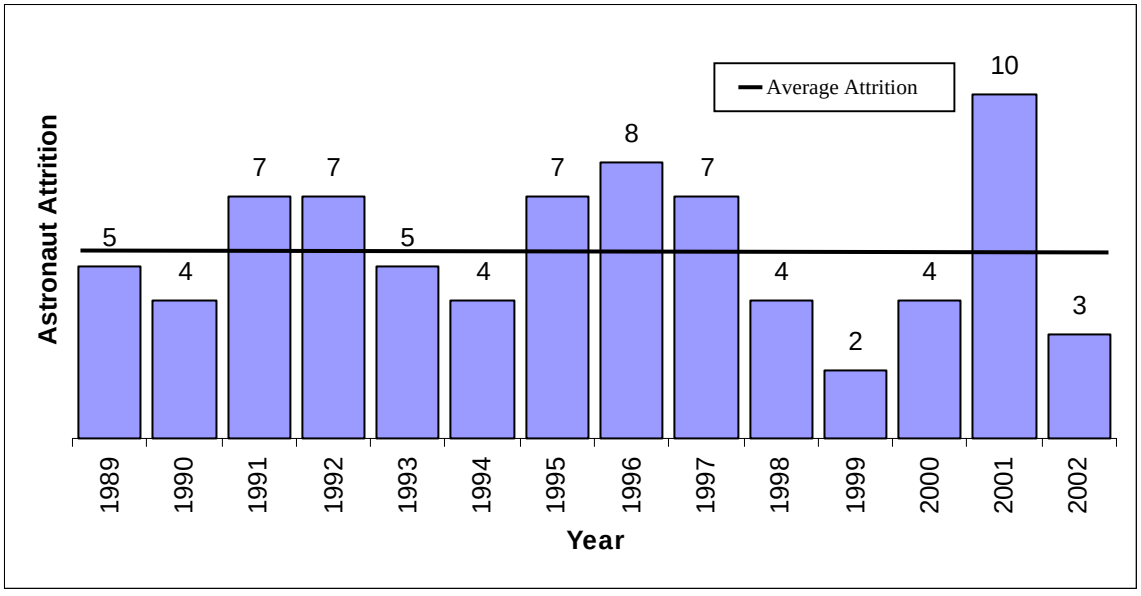
other Federal employees is reasonable. However, the significant costs associated with training and maintaining the astronaut corps indicate that great care should be taken in determining when the astronaut corps needs to be augmented. The astronaut corps should be sized so that the number of astronauts is sufficient to perform duties that can be performed only by astronauts, but is not so large that astronauts are hired to staff tasks that could be performed more cost-effectively by non-astronauts.

II. PREVENTING FUTURE PROBLEMS WITH THE SIZE OF THE ASTRONAUT CORPS

NASA officials told us that long astronaut selection and training timelines created a difficult situation in which they had to bring astronauts into the corps years ahead of time for needs that may actually change annually. We were told that NASA recruited as many astronauts as it had to address a multi-year planning problem that included lower-than-expected attrition and unanticipated reductions in ISS crews and the Space Shuttle flight rate. However, neither attrition nor planning problems adequately explained the situation.

The solid line on Chart 1 shows that since 1989, when Shuttle flights resumed after the loss of Challenger, an average of 5.5 astronauts left the corps per year. Average attrition remained nearly the same before and after NASA hired the large astronaut class of 1996. From 1989 to 1995 the average attrition rate was 5.6 astronauts per year. From 1996 to 2002 the average attrition rate was 5.4 astronauts per year.

Chart 1. Astronaut Attrition Per Year



Unanticipated changes in the number of astronauts needed to crew the ISS and the Space Shuttle also did not fully explain why NASA recruited as many astronauts as it had. First, the Space Shuttle flight rate declined in the late 1990's, but remained at 3-6 Space Shuttle flights per year since 1998. This reduction occurred before the class of 2000 was hired. Second, while we were told that the size of the astronaut corps was increased to support 6-7 person

ISS crews, the classes of 1996, 1998, and 2000, were hired before training timelines would indicate that they should be hired to support the ISS.[17] Finally, even if the Space Shuttle had flown seven times each year and if the ISS had reached a full crew size in 2002, there would likely still be a large surplus of unflown astronauts because NASA typically flies only a small number of new astronauts.[18]

The size of the corps in 2002 stemmed largely from Johnson's tendency in the previous 7 years to hire more astronauts than actually needed to perform astronaut duties, rather than from unanticipated slowdowns in the ISS assembly and Space Shuttle flight rates, or from low attrition. In the 11 astronaut classes since the 1978 inception of the Space Shuttle Program, NASA hired an average of 21 astronauts per class, with actual class sizes ranging from 13-35 individuals (see Appendix C). We were told during our interviews that in the recent past NASA hired more astronauts than needed. In particular, we were told that while Astronaut Office needs indicated that a 1996 astronaut class of 15-20 individuals should have been hired, Johnson instead chose to hire 35 U.S. ASCAN's that year. The 1996 hiring, which came on the heels of a 1995 astronaut class, was followed by additional astronaut classes in 1998 and 2000.

We found three factors (discussed in detail below) that led to Johnson's hiring more astronauts than needed:

- Assessments of Astronaut Office corps size needs were based on overly optimistic predictions of future flight rates.
- The process by which astronaut classes were sized and selected was only minimally regulated and was not tied to a rigorous corps size needs analysis.
- Astronauts may have been hired, at least in part, to bolster Johnson's engineering workforce.

[17] When the large increase in the number of astronauts began in 1996, NASA's earliest timeframe to launch a 6-7 person crew to the ISS was June 2002. Given a 3½-year lead-time for training, NASA would not have needed to increase the size of the astronaut corps until 1998 to support the expanded mission. By the time the 1998 class was hired, the predicted date for the 6-7 person crew had been further delayed. ISS Assembly Sequence Revision C, dated September 1997, showed a 6-person capability in April 2003. Revision D, dated May 1998, placed the 6-person capability in June 2003. Later revisions to the ISS assembly sequence pushed the need for a 6-7 person crew even further into the future. Revision E, dated March 2000, placed the 6-person capability in March 2005. Revision F, dated August 2000, placed the 6-person capability in January 2006.

[18] Based on the current flight rates for pilots and mission specialists, if NASA had continued to fly 7 Space Shuttle flights per year from 1998-2001, only 13-14 more unflown astronauts (4-5 pilots and 9 mission specialists) than were actually needed during that period would have been required. No additional new astronauts would have been needed to support 6-7 person ISS crews during that period because, beginning with the September 1994 inception of the original ISS assembly sequence, NASA anticipated having a 6-7 person crew on ISS no earlier than June 2002.

A. Needs Analyses

The Astronaut Office conducted annual analyses to determine how resources matched up with projected attrition and with the need to fill technical, management, and spaceflight assignments. However, the annual analysis process and related documents we reviewed were informal and were not the product of rigorous analysis. In 1998, 1999, 2000, and 2001, both the Astronaut Office and NASA budget planners projected more Space Shuttle flights than actually occurred. In that same period, the Astronaut Office was even more optimistic about the Space Shuttle flight rate than NASA budget planners. Table 2 shows that, from 1998 to 2002, the Astronaut Office needed 20-25 fewer new astronauts than predicted.

Table 2. Flight Projections

Year	Actual Space Shuttle Flights	NASA Budget Projection	Astronaut Office Projection	Astronaut Office Over-projection	Projected Number of First-time Astronauts Not Flown[19]
1998	5	7-8	7	2	3
1999	3	7-8	8-9	5-6	8-9
2000	5	7-8	8-9	3-4	5-6
2001	6	7-8	8-9	2-3	3-5
2002	5	6-7	6	1	1-2
					20-25

NASA had no requirement for the Astronaut Office to perform or to document a thorough needs analysis and no requirement for the Center Director, who decided which potential ASCAN's to hire, to tie the selection to a needs analysis. A more rigorous needs analysis that considers the number of astronauts already available to fly, the reduced Space Shuttle flight rate, and diminished ISS crew needs would provide valuable input regarding the need for hiring astronauts in the future. Such an analysis should increase the likelihood that ASCAN selections correspond with actual astronaut corps needs based on realistic projections about flight rates and technical assignment staffing needs. The lack of formal guidelines with regard to the role and importance of a thorough needs analysis leaves open the possibility that a class of astronauts may be selected that is inappropriately sized and thus incurs additional cost.

Recommendation 1: The Chief of the Astronaut Office should perform and document a thorough needs analysis based, at least in part, on more realistic estimates of technical assignment needs, attrition rates, and spaceflight rates.

[19] The numbers in this column are derived by multiplying the Astronaut Office's flight rate over-projection in the previous column by 1.53 (the historical average number, as detailed in Appendix A, of first-time pilots and first-time mission specialists on a given Space Shuttle mission) and rounding to the nearest whole number.

B. Astronaut Candidate Selection Process

Members of FCOD began the ASCAN selection process with a series of informal discussions about flight rates, corps attrition, technical assignment needs, and the ability of training facilities to handle additional ASCAN's. The FCOD decided what ASCAN skill mix was needed to supplement the corps. The Johnson Center Director approved the composition decision. The Center Director was officially responsible for the decision to hire a new class of astronauts and officially established the selection process timeline (see Appendix D). Approximately 2 years before applications were due, NASA notified the Department of Defense (DoD) about the application closing date for the next astronaut selection. The DoD screened potential military ASCAN's and sent their applications to NASA. NASA accepted civilian applications to the astronaut corps at any time and, every 2 years, notified civilians with applications on file about the need to keep their application up to date.

After the application closing date, the Center Director convened an Astronaut Candidate Selection Rating Panel (Rating Panel) to screen the several thousand civilian and military applicants to the astronaut corps. In the past, the Rating Panel included approximately 20 individuals. Johnson operated within the context of the laws and regulations governing civil servant hiring and followed the limited Code of Federal Regulations (CFR) guidance for establishing the Rating Panel (see Appendix D). However, our review found no evidence of internal implementation policies or guidance with regard to the composition and responsibility of the Rating Panel. The work of the Rating Panel was based largely on historical precedent instead of on a documented process. Although the Rating Panel was typically composed of senior astronauts and a few senior administrators, the Center Director could appoint anyone inside or outside of the Government to the Rating Panel.

Once the Rating Panel reviewed and reduced the candidate applicant pool, the Center Director convened an Astronaut Candidate Selection Board (Selection Board) to conduct interviews (see Appendix D). The Selection Board operated in accordance with the limited guidance contained in the CFR. The FCOD told the Chair of the Selection Board what the composition of the next astronaut class should be, including at least the number of pilots and mission specialists needed. Like the members of the Rating Panel, the dozen or so individuals who made up the Selection Board were typically senior astronauts and senior administrators. However, the Center Director could appoint anyone inside or outside of the Government to the Selection Board. Our review found no evidence of internal implementation policies or guidance with regard to the composition and responsibility of the Selection Board. The work of the Selection Board was generally based on historical precedent.

The Selection Board's work was done when it recommended ASCAN's to the Center Director, who made the final decision about which potential ASCAN's to hire and how many. No formal documentation was required to support the Board's recommendations or the Center Director's final decisions. The Center Director could consult with anyone or with no one about the final hiring decision. Historically, the Center Director, who did not participate on the selection working level, consulted with members of the Selection Board about the final selection decision.[20] Although limited guidance was contained in the CFR, Johnson had no

[20] In the most recent final selection decision, the Center Director consulted with at least the Chair and Deputy Chair of the Selection Board, the Chief of the Astronaut Office, and a personnel specialist.

written guidance about the Center Director's role or responsibility in the selection process.

In summary:

- Johnson had not created implementation guidelines for the selection process and instead relied on historical precedent.
- The work of the Rating Panel and the Selection Board was not clearly connected to the ultimate selection of ASCAN's.
- No documentation was required to support decisions about astronaut selection.

The establishment of formal, documented guidelines pertaining to decision-making authorities and to the composition and responsibility of both the Rating Panel and the Selection Board would encourage consistent, fair, transparent, and accountable management of the ASCAN selection process. This type of internal control is entirely consistent with the Agency's commitment to implement the President's Management Agenda with regard to human capital. Such guidelines would help define and track critical workforce competencies and would identify imbalances in a vital and highly skilled part of the NASA workforce.

Recommendation 2: The Johnson Center Director should establish formal guidelines pertaining to the composition and responsibilities of the Astronaut Candidate Selection Rating Panel and the Astronaut Candidate Selection Board.

Recommendation 3: The Johnson Center Director should document the astronaut class selection decision as it relates to class size and composition. Documentation should include justification for any astronaut class selections that deviate from astronaut support requirements expressed in the needs analyses conducted by the Astronaut Office.

C. Technical Assignments

A technical assignment was any job an astronaut performed when not training for a particular spaceflight. Most technical assignments fell into the following categories: Space Shuttle operations, robotics, extra-vehicular activities, advanced vehicles, safety, capsule communications (communications with astronauts flying missions), and ISS. The Astronaut Office's seven Branch Chief positions were also considered technical assignments.

Astronaut candidates typically worked in technical assignments for several years before being assigned to their first spaceflight.[21] Subsequent flights were usually interspersed with technical assignments on approximately a 2-3 year cycle. We were told that technical assignments were intended to help reduce burnout, fill staffing needs for astronauts, and allow astronauts the opportunity to develop skills for use later in their careers when they were no

[21] We received comments during our interviews that astronauts would like to begin flight-specific training further in advance of a flight, but could not because of the need to staff technical assignments. Experienced Space Shuttle crewmembers typically began training for a spaceflight and ended technical assignments 6 months before launch. New Space Shuttle crewmembers often made the transition to training approximately 10 months before launch.

longer active astronauts.[22] The Astronaut Office anticipated that an astronaut could move back into a technical assignment 6-8 weeks after completing a spaceflight.

Astronauts and ASCAN's in technical assignments aided in project design, linked design to operation, and functioned as project implementers and evaluators. Appropriately utilized, members of the astronaut corps in technical assignments also served important safety functions by fostering day-to-day communication and by officially representing astronaut interests in panels and committees. For example, we were told that ISS design input from members of the astronaut corps was very important, especially early in the design period. We received numerous reports that the relevance attributed to an astronaut's or an ASCAN's opinion was significantly greater than the relevance attributed to the opinion of an engineer trying to make the same arguments.

The Astronaut Office used formal and informal mechanisms to determine technical assignments for members of the astronaut corps and to assess how many ASCAN's and astronauts were needed to fill those positions. Within the Astronaut Office, the Chief, the Deputy Chief, and the Branch Chiefs met weekly to assess technical assignment activity levels, to determine which technical jobs needed to be staffed, and to reassign members of the astronaut corps as necessary. Most members of the astronaut corps who were not training for a flight and who were not on a permanent management assignment reported to one of the seven Branch Chiefs. Once a year, the Chief, the Deputy Chief, and the Branch Chiefs participated in a 1-day retreat to re-evaluate all the technical assignments. The Astronaut Office also created formal annual program operating plans to describe their staffing needs. These annual assessments were used to estimate the need for new astronauts and were based on projections about future Space Shuttle and ISS crews, management assignments, technical assignments, and attrition.

We observed that the stated need for technical support arising from the formal needs analyses appeared to change according to how many astronauts were available. For example, Table 3 shows that the number of "Technical Assignment Needs" jumped from 60 to 105 as the large class of 1996 completed training.

[22] Astronaut and ASCAN opinions about the costs and benefits of flying more frequently varied. The advantage of back-to-back flights without interruption by technical assignments was that skills were kept fresh. The disadvantage of back-to-back flights was the negative impact on personal time.

Table 3. Astronaut Office Technical Assignment Needs Projections[23]

Year Of Projection	Astronaut Office Projected Technical Assignment[24] Needs												
	'96	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**
1995	49	49	49	49	49	49							
1996		75	75	75	75	75	75						
1997			60	60	60	60	60	60					
1998				105	105	105	105	105	105				
1999					124	124	124	124	124	124			
2000						113	113	113	113	113	113		
2001							111	111	111	111	111	111	
2002[25]								90	90	90	90	90	90

We found that some astronauts worked in technical assignments that did not require astronauts and could have been performed by less-expensive engineers. Although it makes sense to use available astronauts to support engineering tasks, the increased use of astronauts in technical assignments since 1998 may have been an ineffective use of resources. Also, the practice of filling open engineering positions with astronauts (because contractors or civil servants were not available) may have been used to continue to justify the large size of the astronaut corps, despite negative implications for cost. We were told that the 1996 astronaut class, brought into the astronaut corps during a period when Johnson was under a hiring freeze for non-astronaut employees, was larger than necessary in order to make up for a shortfall in engineering staffing. Without reform, this type of situation may recur in the future because budget constraints at NASA continue to restrict the availability of contractor and civil servant engineering support.

Budget constraints have reduced the availability of contractor and civil servant engineers, the traditional sources of technical continuity in programs. Several sources expressed the concern that, given budget constraints and the abundance of astronauts, technical assignments for astronauts may shift away from interface and integration functions toward engineering positions. Members of the astronaut corps moving into and out of technical assignments traditionally serve as an interface between design and operations, not as long-term sources of a program's technical continuity. Astronauts in rotational technical assignments may have served in engineering positions in which technical continuity was actually needed.

Regularly using astronauts for tasks that could be performed by non-astronauts would be

[23] Sources: Astronaut Office Program Support Requirements April 11, 1995; Astronaut Office Program Support Requirements May 21, 1996; Astronaut Office Program Support Requirements May 9, 1997; Astronaut Office Program Operating Plan April 10, 1998; Astronaut Office Program Operating Plan April 8, 1999; Astronaut Office Program Operating Plan April 13, 2000; Astronaut Office Program Operating Plan March 26, 2001; Astronaut Office Program Operating Plan March 27, 2002.

[24] For the years 1995-2001, these numbers included general technical assignments, management assignments, and detached assignment before the re-definition of these terms (see footnote 3). A detached assignment referred to work being done by astronauts assigned to full-time, temporary work outside of the Astronaut Office. Detached astronauts did not provide technical support to the Astronaut Office and were not assigned to crews.

[25] Astronaut Office projections for 2002 did not include detached assignments, which were projected at 13 the previous year.

inefficient and would result in high costs. Establishing formal criteria for which technical assignments require astronauts would encourage the best utilization of astronauts in the future and would provide assurance that members of the astronaut corps are not doing work that could be done less expensively or more realistically by others. Establishing formal criteria would also encourage more accurate technical assignment needs analyses.

Recommendation 4: The Chief of the Astronaut Office should establish formal criteria regarding which technical assignments should be staffed by members of the astronaut corps and what level of staffing is appropriate.

SUMMARY AND EVALUATION OF NASA MANAGEMENT RESPONSE

NASA management concurred with our recommendations (see Appendix E) and their planned corrective actions are responsive to our recommendations. The Johnson Center Director, in a February 24, 2003, memorandum (also see Appendix E), established criteria pertaining to the composition of the Astronaut Candidate Selection Rating Panel and Selection Board. Our recommendations will remain open until the Agency has fully completed corrective actions.

CONCLUSION

NASA's process for selecting new astronauts is critical to the success of the Agency's Human Spaceflight Program. The process aims to bring into NASA's workforce the most talented, skilled, and motivated employees available. Our findings demonstrate the need to make several changes to ensure that the planning process for astronaut candidate selection is documented appropriately and is based on mission-oriented and cost-effective criteria. We believe the recommendations in this report will help to ensure that NASA has an astronaut corps that is appropriately sized to carry out the Agency's current and future mission.

[Original Signed By Alan J. Lamoreaux] for
David M. Cushing

7 Enclosures:
Appendix A: Average Post-Challenger Crew Composition
Appendix B: Astronaut Training
Appendix C: Astronaut Program Applicants, Interviewees, and Selectees
Appendix D: Code of Federal Regulations, 14 CFR 1214, NASA Astronaut Candidate Recruitment and Selection Program
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NASA Office of Inspector General Reader Survey

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Appendix A

Average Post-Challenger Crew Composition

Report Based on Pre-February 1, 2003 Data

Table 4. Average Post-Challenger Crew Composition[1]

Crew Member Type	Average Number of Crew Members
Non-Shuttle Astronauts[2]	0.11
Non-NASA Astronauts[3]	0.91
Shuttle-Experienced Flyers Excluding Non-Shuttle Astronauts and Non-NASA Astronauts	3.43
First-Time Mission Specialist Flyers Excluding Non-Shuttle Astronauts and Non-NASA Astronauts	0.97
First-Time Pilots Flyers Excluding Non-Shuttle Astronauts and Non-NASA Astronauts	0.56
Astronauts Traveling to ISS or Mir (Experienced Flyers and First-Time Flyers)	0.47
Average Total Crew Size	6.45

[1] Averages in this section were based on crew compositions in the 87 flights since the loss of Challenger and include completion of all Space Shuttle missions through December 2002. This information can be found at http://spaceflight.nasa.gov/shuttle.

[2] Non-Shuttle astronauts were those individuals selected to join the astronaut corps before 1978.

[3] Non-NASA astronauts included payload specialists and international astronauts.

Appendix B

Astronaut Training

Report Based on Pre-February 1, 2003 Data

Typically in July or August of the year they were selected, ASCAN's began 18 months of basic training for spaceflight and non-spaceflight duties. (The length of ASCAN training increased from 12 to 18 months because of the need for additional ISS training.) Before being assigned to a spaceflight, members of the astronaut corps often proceeded through five levels of training: (1) basic; (2) advanced; (3) flight-similar; (4) proficiency, review, and refresher; and (5) load-specific.

Basic training generally included flight training, Space Shuttle systems training, ISS training, applied sciences training, familiarization with NASA, educational enrichment, and other training about the media, the Russian language, swimming, and SCUBA qualification. Within basic training, flight training included physiological training, land survival training, water survival training, T-38 aircraft training/flying checkout, mission specialist aviation ground school, and Space Shuttle Training Aircraft flying (for pilots only). As their basic training ended, ASCAN's moved into technical assignments and worked toward completing advanced training while keeping their aircraft operation skills current. Advanced training built upon the work done in basic training, but did not necessarily immediately follow the completion of basic training. ASCAN's were assigned priority to access training systems according to how close they were to a spaceflight. ASCAN's not yet assigned to a flight had the lowest training priority. ASCAN's were qualified for assignment to a spaceflight when advanced training was complete.

During the time that flight-qualified members of the astronaut corps were not assigned to a spaceflight, they would keep their skills up to date by completing Astronaut Continuation Training Minimum Currency Requirements (currency training). Currency training was designed to enable members of the astronaut corps to reduce both the re-familiarization period and the use of resources when they were first assigned to a crew training flow. Currency training was meant to more easily enable members of the astronaut corps to gain system proficiency when flight-specific training began. FCOD was attempting to reduce the cost of some aspects of currency training by making portions of it computer-based.

The astronaut corps and the instructors who train them used T-38, KC-135, and G-2 aircraft to fulfill flight requirements. NASA maintained 32 T-38's for high-performance jet training, 1 KC-135 for heavy-aircraft training, and 4 G-2's (Space Shuttle Training Aircraft) to teach astronauts how to fly and land a Space Shuttle. These 3 types of aircraft were used almost exclusively by the astronaut corps and their instructors. Pilots and commanders had requirements to fly the Space Shuttle Training Aircraft and the KC-135's. Mission specialists could fly in these aircraft for the experience, but were not required to do so. Pilots and commanders used T-38's to refine their aircraft operation skills. As backseat flyers in T-38's, mission specialists primarily learned how to work with other people in the dynamic environment of a two-seat, high-performance jet.[1] We were told that aircraft training for mission specialists was designed to mentally condition astronauts for changing, stressful situations they may encounter during spaceflight.

After completing basic ASCAN training, which included initial aircraft operation proficiency, mission specialists were required to keep their aircraft skills current by flying 4 hours a month

[1] Six mission specialists were qualified to fly in the front-seat (the pilot's seat) in T-38's.

in the back seat of a T-38. Astronaut corps pilots who completed basic training were required to fly 15 hours a month. Although both mission specialists and pilots were not supposed to let more than 45 days elapse between flights, we were told that such lapses often occurred for a variety of reasons.

Appendix C

Astronaut Program Applicants, Interviewees, and Selectees

Report Based on Pre-February 1, 2003 Data

Table 5. Astronaut Program Applicants, Interviewees, and Selectees

		Applicants		Selectees		
Group	Date	Applied	Interviewed	Military	Civilian	Total
1	Apr-59	508	69	7	0	7
2	Sep-62	250	32	7	2	9
3	Oct-63	720	136	12	2	14
4	Jun-65	909	16	1	5	6
5	Apr-66	510	158	15	4	19
6	Aug-67	900	69	0	11	11
7	Aug-69	MOL[1]	13	7	0	7
8	Jul-78	8,079	208	21	14	35
9	Jul-80	3,465	121	13	6	19
10	Jul-84	4,934	128	12	5	17
11	Aug-85	166[2]	59	8	5	13
12	Aug-87	2,061	117	10	5	15
13	Jul-90	2,424	106	12	11	23
14	Aug-92	2,236	87	10	9	19
15	Mar-95	2,962	122	13	6	19
16	Aug-96	2,451	123	20	15	35
17	Aug-98	2,621	121	12	13	25
18	Aug-00	3,015	123	12	5	17
Total		38,211	1,808	192	118	310

[1] Several astronauts from the Air Force's Manned Orbiting Laboratory (MOL) program, which was terminated in 1969, were brought into NASA's astronaut corps.

[2] NASA used the previous year's lists to choose interviewees instead of accepting new applicants to the corps.

Appendix D

Code of Federal Regulations,
14 CFR 1214,
NASA Astronaut Candidate Recruitment and Selection Program

Report Based on Pre-February 1, 2003 Data

Code of Federal Regulations
Title 14, Chapter V, Part 1214
Subpart 1214.11 – NASA Astronaut Candidate Recruitment and Selection Program

SOURCE: 54 FR 37940, Sept. 14, 1989, unless otherwise noted.

§ 1214.1100 Scope.

It is NASA policy to maintain an integrated Astronaut Corps. This subpart 1214.11 sets forth NASA procedures and assigns responsibilities for recruitment and selection of astronaut candidates. It applies to all pilot and mission specialist astronaut candidate selection activities conducted by the National Aeronautics and Space Administration.

§ 1214.1101 Announcement.

(a) Astronaut candidate opportunities will be announced nationwide by the Johnson Space Center (JSC) and publicized periodically unless specifically canceled by NASA.
(b) Civilian applicants may apply at any time.
(c) JSC is responsible for implementing and refining the astronaut candidate application process to minimize the effort required to file and/or update applications.
(d) Military personnel on active duty must apply through and be nominated by the military service with which they are affiliated. Military nominees will not be part of the continuing pool of applicants. The military services will convene their internal selection boards and provide nominees to NASA. The military nominees will be evaluated by NASA and the military services will be notified promptly of those nominees who are finalists.
(e) The Assistant Administrator for Equal Opportunity Programs, NASA Headquarters, will provide assistance in the recruiting process.

§ 1214.1102 Evaluation of applications.

(a) All incoming applications will be reviewed by the JSC Human Resources Office to determine whether or not applicants meet basic qualifications. Those not meeting the basic qualification requirements will be so notified in writing and will not be eligible for further consideration. Those meeting the basic qualification requirements will have their applications retained for review by a designated rating panel.
(b) The JSC Director, or designee, will appoint the rating panel composed of discipline experts who will review and rate qualified applicants as “Qualified” or “Highly Qualified.
(c) Efforts will be made to assure that minorities and females are included among these discipline experts.
(d) The criteria for each level will be developed by JSC and will serve as the basis for the ratings. The evaluation will be based on the quality of the individual’s academic background and experience and the extent to which the individual’s academic achievements, experience, and special qualifications relate to the astronaut candidate position. Reference information on those rated “Highly Qualified” will normally be obtained. The JSC Director of Human Resources will monitor this process to assure adherence to applicable rules and regulations.
(e) Those rated “Highly Qualified” may be required to obtain a Class I or Class II

physical. Only medically qualified applicants will be referred for final evaluation and possible interview and selection. Those who are not medically qualified will be so informed and will not be eligible for further consideration.

§ 1214.1103 Application cutoff date.

(a) The JSC Director, or designee, is responsible for identifying the need for additional astronaut candidates and for obtaining necessary approval to make selections.

(b) Once such approval has been obtained, the JSC Director will establish a cutoff date for the acceptance of applications. Applications received after the date of the request will be maintained and processed for the next selection. The cutoff date will normally occur every 2 years on or about July 1.

§ 1214.1104 Evaluation and ranking of highly qualified candidates.

(a) The JSC Director will appoint a selection board consisting of discipline experts and such other persons as appropriate to further evaluate and rank the "Highly Qualified" applicants.

(b) Efforts will be made to assure that minorities and females are included on this board.

(c) The "Highly Qualified" applicants who are determined to be the "Best Qualified" will be invited to the Johnson Space Center for an interview, orientation, and detailed medical evaluation.

(d) Background investigations will normally be initiated on those applicants rated "Best Qualified."

§ 1214.1105 Final ranking.

Final rankings will be based on a combination of the selection board's initial evaluations and the results of the interview process. Veteran's preference will be included in this final ranking in accordance with applicable regulations.

§ 1214.1106 Selection of astronaut candidates.

The selection board will recommend to the JSC Director its selection of candidates from among those finalists who are medically qualified. The number and names of candidates selected to be added to the corps will be approved, as required, by JSC/NASA management and the Associate Administrator for Space Flight, prior to notifying the individuals or the public.

§ 1214.1107 Notification.

Selectees and the appropriate military services will be notified and the public informed. All unsuccessful qualified applicants will be notified of nonselection and given the opportunity to update their applications and indicate their desire to receive consideration for future selections.

Appendix E

NASA Management Response

Report Based on Pre-February 1, 2003 Data

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: M-2

February 24, 2003

TO: W/Assistant Inspector General for Inspections and Assessments

FROM: M/Associate Administrator for Space Flight

SUBJECT: The size of the Astronaut Corps – Improving Future Planning, G-01-035, Draft Report for Management Response

Thank you for the opportunity to provide comments to the draft report concerning the size of the astronaut corps. The following are our responses to the specific recommendations provided in the report.

Recommendation 1:
The Chief of the Astronaut Office should perform and document a thorough needs analysis based, at least in part, on more realistic estimates of technical assignment needs, attrition rates, and space flight rates.

Response:
Concur. The size of the astronaut corps will be driven by mission needs. To manage the size of the astronaut corps to an appropriate level supporting the NASA mission, the Chief of the Astronaut Office will ensure that a thorough and realistic needs analysis is conducted annually coincident with the Program Operating Plan (POP) cycle. Analysis will be conducted based upon the following:

- Current Shuttle and International Space Station (ISS) flight manifests and flight rates;
- Planned number of ISS crew rotations per year;
- Number of qualified United States (U.S.) crew members (including backup crew members) required for each flight, based on assessed ISS and Shuttle Program flight requirements;
- Length of applicable training flows (e.g., astronaut candidate training, ISS crew training, etc.), which drives timing of astronaut selection;
- Projected number of international astronauts assigned at the Johnson Space Center which affects U.S. astronaut corps requirements;
- Anticipated astronaut attrition rates as indicated from past trends;
- Programmatic requirements for technical support from the astronaut corps.

Report Based on Pre-February 1, 2003 Data

Once the analysis has been completed and approved by the Chief of the Astronaut Office, the results will be reviewed and approved by the Director, Flight Crew Operations Directorate (FCOD). The analysis will be documented as part of the POP process and maintained by the Astronaut Office and FCOD.

Recommendation 2:
The Johnson Space Center (JSC) Director should establish formal guidelines pertaining to the composition and responsibilities of the Astronaut Candidate Selection Rating Panel and Astronaut Candidate Selection Board.

Response:
Concur. We will prepare an internal procedure, to be signed by the JSC Center Director, to restate and amplify the requirements of 14CFR 1214, concerning the assignment of individuals to the rating panel and selection board. We plan to have this document completed by April 2003.

Recommendation 3:
The Johnson Center Director should document the astronaut class selection decision as it relates to class size and composition. Documentation should include justification for any astronaut class selections that deviate from astronaut support requirements expressed in the need analysis conducted by the Astronaut Office.

Response:
Concur. During the next Astronaut Candidate selection cycle, we will prepare documentation to relate the number of selections made with the needs analysis conducted by the Astronaut Office.

Recommendation 4:
The Chief of the Astronaut Office should establish formal criteria regarding which technical assignments should be staffed by members of the astronaut corps and what level of staffing is appropriate.

Response:
Concur. To ensure that astronauts are used effectively, the Chief of the Astronaut Office will chair a team to establish the criteria for determining which technical assignments will be supported by astronauts. This team will consist of the Chief and Deputy Chief of the Astronaut Office, the Astronaut Office Branch Chiefs, the Technical Assistant to the Chief of the Astronaut Office, FCOD budget personnel, and FCOD human resources personnel. The initial meeting of the team will be in March 2003 to define the formal criteria for determining those technical assignments that should be staffed by members of the astronaut corps and the appropriate level of expertise. Once the analysis is complete, the findings will be documented and presented to the Director, FCOD for review and approval. The Director, FCOD, will

review the proposed criteria, as well as any future changes, with the JSC Center Director for final approval.

Updates to the criteria and technical staffing assignments will be made at the weekly Astronaut Office Staff Meetings where attendance includes the Chief of the Astronaut Office, the Deputy Chief of the Astronaut Office, the Astronaut Office Branch Chiefs, and the Technical Assistant to the Chief of the Astronaut Office. A thorough review of the criteria and assignments will be conducted on an annual basis to ensure that the criteria have not changed or been affected by significant changes in programmatic technical requirements.

Should you have any questions regarding our comments, please contact Bob Cabana at the Johnson Space Center at 281-483-2724.

William Readdy

William F. Readdy

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696

February 24, 2003

Reply to Attn of: AHX

TO: AH/Director of Human Resources
CA/Director of Flight Crew Operations

FROM: AA/Director

SUBJECT: Astronaut Candidate Selection

The Code of Federal Regulations, Title 14, Chapter V, Part 1214, Subpart 1214.11, assigns the responsibility for designating the Rating Panel and the Selection Board for Astronaut Candidate selection to the Director of the Johnson Space Center. Therefore, I am establishing the following criteria for assignment to those entities:

- The Chair of the Rating Panel and the Selection Board will be the Director of Flight Crew Operations or a senior astronaut with experience in the selection process.
- The Deputy Chair will be a senior astronaut or a senior management official with experience in the selection process.
- The Chief of the Astronaut Office will be a member.
- The Manager, Astronaut Selection Office, will be a member.
- The Director, Equal Opportunity Programs Office, will be a member.
- Senior astronauts will be members, including both pilots and mission specialists. The mission specialist members will include individuals with backgrounds in both engineering and the sciences. When making these appointments, flight assignments and other technical assignments will be taken into consideration to assure those appointed will have the necessary time to spend on this important activity.
- Senior management officials from within NASA may also be assigned at the discretion of the Director, providing they have a background in space flight engineering, science, operations, or other needed disciplines.
- The membership of the Rating Panel and the Selection Board will be appropriately diverse.

These criteria are effective immediately.

Jefferson D. Howell, Jr.

Report Based on Pre-February 1, 2003 Data

Appendix F

Report Distribution

Report Based on Pre-February 1, 2003 Data

Distribution

National Aeronautics and Space Administration (NASA) Officials:

A/Administrator
AD/Deputy Administrator
AA/Chief of Staff and White House Liaison
ADI/Associate Deputy Administrator for Institutions and Asset Management
ADT/Associate Deputy Administrator for Technical Programs
AO/Chief Information Officer
B/Acting Chief Financial Officer
F/Assistant Administrator for Human Resources
G/General Counsel
H/Assistant Administrator for Procurement
J/Assistant Administrator for Management Systems
JM/Director, Management Assessment Division
L/Assistant Administrator for Legislative Affairs
N/Associate Administrator for Education
P/Assistant Administrator for Public Affairs
Q/Associate Administrator for Safety and Mission Assurance
W/Program Manager, Financial Statement Audit Oversight, Training, and Policy

NASA Advisory Officials:

Chair, NASA Advisory Council
Chair, Aerospace Safety Advisory Panel

Non-NASA Federal Organizations and Individuals:

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Branch Chief, Science and Space Programs Branch, Energy and Science Division, Office of Management and Budget
Managing Director, Acquisition and Sourcing Management Team, General Accounting Office
Senior Professional Staff Member, Senate Subcommittee on Science, Technology, and Space

Chairman and Ranking Minority Member – Congressional Committees and Subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on VA, HUD, and Independent Agencies
Senate Committee on Commerce, Science, and Transportation
Senate Subcommittee on Science, Technology, and Space
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on VA, HUD, and Independent Agencies
House Committee on Government Reform
House Subcommittee on Government Efficiency and Financial Management
House Subcommittee on Technology, Information Policy, Intergovernmental Relations, and the Census
House Committee on Science
House Subcommittee on Space and Aeronautics

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Report Based on Pre-February 1, 2003 Data

NASA Office of Inspector General Reader Survey

The NASA Office of Inspector General has a continuing interest in improving the quality of our reports. Could you help us by completing our reader survey? Please mail your completed questionnaire to the Office of Inspector General, NASA Headquarters, Code W, Room 8Z78, Washington, D.C. 20546-0001.

Report: The Size of the Astronaut Corps – Improving Future Planning, G-01-035

Please circle the appropriate rating for the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
1. The report was clear and readable	5	4	3	2	1	N/A
2. The report was logically organized	5	4	3	2	1	N/A
3. The report was concise and to the point	5	4	3	2	1	N/A
4. The facts were presented fairly and accurately	5	4	3	2	1	N/A
5. The report contained sufficient information to support the finding(s) in a balanced and objective manner	5	4	3	2	1	N/A
6. The recommendation(s) made sense and were relevant	5	4	3	2	1	N/A
7. The recommendation(s) were timely	5	4	3	2	1	N/A

Overall, how would you rate the report?

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

How could we improve the report? _____

_____

_____

Are there steps we should have taken, but didn't? _____

_____

_____

Is there anything else we should have done differently? _____

_____

_____

How did you use the report? _____

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Can you suggest any additional (related or unrelated) issues that the NASA Office of Inspector General should review? (You can also call our anonymous 24-hour Hotline at 1-800-424-9183) _____

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Additional comments _____

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Your occupation

- ☐ Congressional Staff
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May we contact you about your comments?

Yes: _____ **No: _____**
Name: _____
Telephone: _____

Thank you for completing this survey.