

GAO

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AEROSPACE TESTING

Promise of Closer NASA/DOD Cooperation Remains Largely Unfulfilled



**National Security and
International Affairs Division**

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The Honorable William H. Frist
Chairman
The Honorable John D. Rockefeller, IV
Ranking Minority Member
Subcommittee on Science, Technology and Space
Committee on Commerce, Science and Transportation
United States Senate

The National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD) operate several types of aerospace test facilities, including wind tunnels and rocket engine test stands. Since the end of the Cold War, Congress has been appropriating less money for aerospace programs. In response to declining budgets and reductions in personnel, NASA and DOD agreed in 1995 to perform essential aerospace testing on a more cooperative basis.¹ The agencies recommended, in April 1996, that they establish joint working groups, or alliances, to assess and make recommendations on investments and other issues.

As requested, we are providing you with the results of our review of NASA's and DOD's cooperation since May 1996 to develop a national perspective on aerospace test facilities.² Specifically, to assess the progress of cooperative efforts we determined (1) the extent to which NASA/DOD working groups ("alliances") on major test facilities have been operating on a regular basis, (2) NASA's and DOD's actions in response to a future need to test an engine for new Air Force rockets, (3) whether NASA and DOD prepared a congressionally required joint plan on rocket propulsion test facilities, and (4) whether NASA and DOD are implementing a DOD assessment team's recommendation in March 1997 to jointly manage with NASA certain aeronautical test facilities.

This report includes a matter for congressional consideration.

¹A framework within which changes to the federal research, development, test, and evaluation infrastructure can be accomplished was discussed in Best Practices: Elements Critical to Successfully Reducing Unneeded RDT&E Infrastructure (GAO/NSIAD/RCED-98-23, Jan. 8, 1998).

²NASA/DOD cooperation on test facilities was previously discussed in NASA Infrastructure: Challenges to Achieving Reductions and Efficiencies (GAO/NSIAD-96-187, Sept. 9, 1996) and (GAO/T-NSIAD-96-238, Sept. 11, 1996).

Background

In June 1995, NASA and DOD agreed to identify cooperative actions that could lead to significant reductions in investments and cost of operations.³ The agencies identified seven areas of mutual interest, one of which was major aerospace test facilities—specifically, wind tunnels, aeropropulsion test cells, rocket engine test stands, space environmental simulation chambers, arc-heaters, and hypervelocity gas guns and ballistic ranges.⁴ The cooperation initiative was done under the auspices of the joint NASA/DOD Aeronautics and Astronautics Coordinating Board (AACB).⁵ Figure 1 shows the location of these test facilities.

³Final Report on the 1995-1996 DOD/NASA Cooperation Initiative (AACB, May 1996).

⁴See appendix I for information about these types of test facilities.

⁵The AACB is chaired by the Under Secretary of Defense for Acquisition and Technology and NASA's Deputy Administrator. The purpose of the AACB is to facilitate coordination of aeronautics and space activities of mutual interest.

Figure 1: Location of Major NASA and DOD Test Facilities



The number of active major test facilities declined from 260 in 1993 to 186 in 1996. The AACB's major test facilities study team concluded that, in most areas, the present number of major test facilities "very nearly represents the minimum required to conduct the aeronautical- and space-related research and development programs identified for this country."⁶ The study team further stated that (1) closing facilities without eliminating programs does not generate big savings, (2) NASA and DOD are not on a common track to developing comparable facility-cost accounting, (3) there is inadequate coordination of investments, upgrades, and operations between NASA and DOD, and (4) NASA and DOD's rocket propulsion test facilities have excess capacity for current and future workload. To address these issues, the team recommended in April 1996 that NASA and DOD form six cooperative alliances⁷ to

- coordinate investment to avoid unnecessary duplication,
- coordinate test schedules to spread the workload across facilities, and
- develop standardized and common business processes.

Notwithstanding a history of NASA/DOD cooperation on aerospace test facility-related issues prior to 1996,⁸ these goals collectively represent an effort to develop a broader national perspective on such issues. In September 1996, Congress added to this effort by requiring NASA and DOD to prepare a joint plan on rocket propulsion test facilities.

Results in Brief

The promise of closer NASA/DOD cooperation and the development of a national perspective on aerospace test facilities remains largely unfulfilled because NASA and DOD (1) have not yet convened most test facility alliances, (2) compete with each other to test engines for new rockets, and (3) did not prepare a congressionally required joint plan on rocket propulsion test facilities. Although NASA and DOD have agreed to go beyond cooperative alliances in aeronautics and jointly manage their aeronautical test facilities, they have not yet reached agreement on key aspects of a management organization.

⁶The study team documented a 30-percent reduction in active aeronautical facilities since 1993, with an annual saving of \$14.2 million.

⁷In the summer of 1995, NASA officials met several times to discuss cooperation on rocket propulsion testing on a national basis, and the major test facilities study team's proposal to form alliances drew on the discussions of this group.

⁸For example, DOD relies on NASA to meet all of its subsonic wind tunnel testing requirements. Also, research and test centers such as NASA's Lewis Research Center, Ohio, and DOD's Arnold Engineering Development Center, Tenn., cooperate in several areas, including testing the effects of icing on aircraft wings and engines.

NASA and DOD took 20 months (May 1996 through Dec. 1997) to negotiate and sign agreements formally establishing the six test facility-related cooperative alliances.⁹ During that time, only the space environmental simulation alliance met regularly and conducted business. The already established rocket propulsion alliance met only once during this period despite a desire by some members to meet regularly. NASA and DOD officials did not regularly convene the other four alliances in the absence of approved charters.¹⁰

Despite the formation of the rocket propulsion alliance, NASA and DOD compete against each other to test engines for new rocket programs. A principal arena of competition is the next phase of the Air Force's Evolved Expendable Launch Vehicle (EELV) program.¹¹ In particular, the Air Force has spent millions of dollars to upgrade a test stand on the assumption that it, not NASA, would test EELV engines.

DOD did not prepare a legislatively mandated joint plan with NASA to coordinate rocket propulsion test facilities.¹² In a letter to congressional committee chairs and other members, DOD said that the bases of such a plan are (1) on-going activities such as Vision 21,¹³ (2) the May 1997 Quadrennial Defense Review of defense strategy,¹⁴ and (3) activities of the rocket propulsion alliance. However, these efforts are unlikely to form the basis of a joint plan because NASA is not participating in either Vision 21 or the Defense Review. Further, DOD prepared, but did not submit, a legislative package for Vision 21, and instead opted to include

⁹The charters were signed by DOD on December 24, 1997, and by NASA on January 9, 1998. See appendix II for the charter of the National Rocket Propulsion Test Alliance.

¹⁰Between November 1996 and October 1997, NASA and DOD officials participated in workshops and meetings on wind tunnel test technology and joint management of aeronautics test facilities. Agency officials consider these meetings to be functionally equivalent to alliance meetings. The Airbreathing Propulsion Test Facilities alliance held its first meeting on October 23, 1997. Also, NASA and Air Force officials held four discussions on rocket propulsion test-related issues during the May 1996-November 1997 period.

¹¹Additional information on the EELV program can be found in Access to Space: Issues Associated With DOD's Evolved Expendable Launch Vehicle Program (GAO/NSIAD-97-130, June 24, 1997).

¹²Section 211(c) of the National Defense Authorization Act for Fiscal Year 1997 (P.L. 104-201, Sept. 23, 1996).

¹³Vision 21 responds to sections 277 and 265 of the National Defense Authorization Act of 1996 (P.L. 104-106, Feb. 10, 1996). Section 277 requires a 5-year plan to consolidate and restructure DOD's laboratories and test and evaluation centers by 2005. Section 265 requires DOD to conduct a comprehensive review of U.S. aeronautical research and test facilities.

¹⁴The review of the defense program (potential threats, strategy, force structure, readiness posture, military modernization programs, and defense infrastructure) was required by the Military Force Structure Review Act of 1996 (title IX, subtitle B of P.L. 104-201, Sept. 23, 1996).

consolidation of its laboratories and test and evaluation centers in future “Base Realignment and Closure” (BRAC) rounds. But Congress, so far, has not accepted the need for such rounds. As a consequence, Vision 21’s future is unclear until Congress either changes its position on BRAC or new guidelines for Vision 21 are developed.

In October 1997, NASA and Air Force officials took a step toward creating a national perspective on test facilities in the aeronautics area. Specifically, they reached an understanding on the scope and approach for joint strategic management of their aeronautical test facilities, including a new management organization. However, they have not yet resolved basic issues, such as the organization’s structure and authority. Ultimately, if joint strategic management of aeronautics test facilities is successfully established, its adaption to other types of test facilities could be considered.

Most NASA/DOD Alliances Would Not Meet Without Approved Charters

The institutional centerpiece of future NASA/DOD cooperation on aerospace test facilities is six alliances approved by the AACB in April 1996. Twenty months later, NASA and DOD signed agreements formally establishing these alliances. However, with one exception, the new alliances did not meet regularly during that time, and the rocket propulsion alliance—which predates the cooperation initiative—met only once. The one exception was the space environmental simulation alliance, which met four times and evaluated a proposed new investment at Kennedy Space Center. The rationale given by most alliances for not meeting was the lack of an approved charter.

Only One Alliance Met Regularly

Despite not having official charters, the space environmental simulation alliance met four times and the rocket propulsion test alliance met once between May 1996 and October 1997. The other alliances could have conducted business without formal charters, but did not. At its inaugural meeting in November 1996, the space environmental simulation alliance noted the absence of a charter, but agreed to conduct business deemed to be in the “best national interest.” The alliance also met in February, May, and August 1997.

Similarly, the rocket propulsion test alliance met in October 1996 and members noted other alliances “do not appear to be meeting,” but agreed the rocket propulsion alliance “cannot wait.” As of November 30, 1997, this alliance has not met again. A NASA official told us the alliance did not meet

because there was little business to discuss until NASA implemented its plan, as discussed below, to consolidate NASA's management of rocket propulsion testing. In addition, NASA and DOD officials disagreed over who in their respective agencies should sign the alliance's charter.

Alliance Helped Eliminate Proposal to Build Vacuum Chamber

An example of how the promise of closer cooperation on test facility-related issues can be met by alliances was provided by the space environmental simulation alliance in March 1997. In early 1997, officials at NASA's Kennedy Space Center proposed to build a vacuum chamber to (1) test for leaks in the pressurized parts of the International Space Station prior to their launch and assembly in space and (2) support an environmental test capability at Kennedy. In February 1997, NASA headquarters officials asked the space environmental simulation alliance to evaluate the proposal. In March 1997, the alliance's evaluation team concluded that there was "no compelling reason" to construct such a facility to support space station requirements. With regard to Kennedy's proposed test capability, the team recommended a "rigorous" thermal vacuum chamber requirements and cost-benefits analysis that, in part, would include determination of the national thermal vacuum chamber capabilities.

On June 25, 1997, the Kennedy Space Center introduced another approach to justify acquiring a vacuum chamber. This time, Kennedy officials solicited comments from industry, for planning purposes only, on the design, construction, and procurement methodology for a thermal vacuum chamber to simulate environments on other planets. Kennedy officials estimated the chamber would cost from \$35 million to \$60 million. NASA's Office of the Inspector General is currently doing a review to determine whether (1) the alliance's recommended cost-benefit analysis was performed, (2) the vacuum chamber is needed to support present and future NASA missions and programs, and (3) funding will be available for the project's construction, installation, and operation. The Inspector General has not set a completion date for this review.

NASA and DOD Compete to Test Rocket Engines

Despite the formation of the rocket propulsion alliance, NASA's and DOD's relationship over this type of testing has been recently marked by competition. Partly to improve its competitive position, NASA has consolidated rocket propulsion test management in one center, but is struggling to define the center's authority for this role. Testing engines in the next phase of the EELV program was the focus of NASA and Air Force

competition. In July 1997, an EELV engine contractor provisionally selected NASA's Stennis Space Center to test engines in the next phase of the program. Consequently, the future role of the Air Force's test center for this program is uncertain.

NASA Consolidates Management of Rocket Propulsion Test Facilities

NASA tests rocket engines in four locations: Stennis Space Center, Mississippi; Marshall Space Flight Center, Alabama; White Sands Test Facility, New Mexico; and Lewis Research Center's Plum Brook Station, Ohio. According to Stennis officials, these four test locations have

“resulted in facility duplication and higher overall infrastructure-related costs. Substantial investments have been made in facilities based on local insight and local funding provided by programs, institutions, and non-NASA customers rather than on an Agency-wide perspective.”

In May 1996, NASA's Associate Administrator for Space Flight unilaterally designated Stennis Space Center the center of excellence “not only for NASA, but DOD, other government agencies, academia and industry.” He noted, the “unique capabilities currently in place” at Stennis “permit us to centralize the major propulsion test facilities of NASA, DOD, and industry.” NASA's rocket propulsion testing is managed by the Rocket Propulsion Test Management Board.¹⁵ It determines the location of each test, reviews investment recommendations, and establishes annual budget requirements.¹⁶ For example, in November 1996, the Board accepted a recommendation to relocate a 5,000 gallon high pressure liquid hydrogen tank from a component test stand at Marshall to the one at Stennis, as part of NASA's plan to complete this facility and consolidate test capabilities at Stennis.¹⁷ The Board has also decided to move four other liquid oxygen tanks from Marshall.

NASA Rejects Internal Plan to Reduce Rocket Propulsion Test Facilities

Although NASA has consolidated management of rocket propulsion testing at Stennis, it has struggled to define Stennis' authority to make investment decisions. For example, the early goals of consolidation went beyond

¹⁵Board members are from Stennis, Marshall, White Sands, and Lewis. The Board's chair is from Stennis.

¹⁶According to a Stennis official, Stennis has authority, in principle, to establish the rocket propulsion test budget on a NASA-wide basis, but details of how it will do so are incomplete.

¹⁷NASA requested \$45.5 million to complete this partially constructed facility. The funds were appropriated by the Omnibus Appropriations Act for Fiscal Year 1996 (P.L. 104-134, Apr. 26, 1996). The facility was started in 1989 in support of the Advanced Launch System program and stopped when the program was canceled in 1992.

relocation to include mothballing and abandoning test assets as necessary to reduce or eliminate unnecessary duplication and lower costs. In January 1997, Stennis officials proposed a plan that would have greatly reduced testing at Marshall and Plum Brook; some stands would have been abandoned and others would have had their capabilities reduced and transferred to Stennis and White Sands. The draft plan was based on known requirements for NASA's test services. But, by June 1997, NASA's management decided to abandon Stennis' plan rather than the test stands at other centers. Nearly all of the test stands and facilities that would have been deactivated by the January plan will remain open. According to Stennis officials, the June plan is based on possible future customers, which are estimated to be more plentiful than funded customers.¹⁸

Air Force Tries to Improve Competitive Position

The Air Force tests rocket engines at Phillips Laboratory, Edwards Air Force Base, California; and Arnold Engineering Development Center, Tennessee.¹⁹ In April 1997, the Air Force established the Air Force Research Laboratory consisting of Phillips Laboratory, three other laboratories, and the Air Force Office of Scientific Research.²⁰ However, Arnold, as a test center, is not part of the consolidation.

Phillips Laboratory's Test Stand 1A was built in the late 1950s and has recently been altered to give it a liquid oxygen/liquid hydrogen capability. Phillip's Test Stand 2A also has been changed for a high-pressure liquid oxygen/liquid hydrogen capability for testing engine components. So far, changes to these stands have cost about \$49 million.²¹ Test stand 1A's changes are for EELV engine testing and 2A for the government—and industry—sponsored Integrated High Payoff Rocket Propulsion Technology program to boost engine performance over the next 15 years.²²

¹⁸An unfunded but possible future customer is a liquid fuel engine for the Space Shuttle's reusable boosters. The current boosters use solid fuel. Congress has not approved new types of boosters for the Shuttle.

¹⁹Phillips Laboratory's headquarters is Kirtland Air Force Base, N.Mex. The Navy and Army test rocket engines at the Naval Air Warfare Center, China Lake, Calif.; and Redstone Technical Test Center, Redstone Arsenal, Ala., respectively.

²⁰This reorganization is being conducted in phases between March 1997 and 2001. Besides Phillips Laboratory, the other laboratories affected by the consolidation are Armstrong, Rome, and Wright.

²¹The cost to change Test Stand 1A has been about \$14 million and Test Stand 2A about \$35 million.

²²NASA and DOD have participated in this program since 1993 to develop new propulsion technologies in three phases with goals set for 2000, 2005, and 2010. For example, at the end of phase I in 2000, new propulsion technologies are to cut existing expendable launch vehicle costs by 38 percent and increase payloads by an average of 40 percent.

Air Force May Have Lost Competition to Test New Engine

The federal government currently uses a fleet of expendable launch vehicles—Delta, Atlas, and Titan—to transport national security and civil satellites into space. According to DOD, these vehicles currently operate at or near their maximum performance capability. In 1994, Congress directed DOD to develop a space launch modernization plan that led to the initiation of the EELV program. On December 20, 1996, the Air Force selected McDonnell Douglas’ Delta IV and a Lockheed Martin proposal for the “preliminary engineering and manufacturing development” phase of the competition to build the Air Force’s EELVs consisting of small, medium, and heavy launchers. Lockheed Martin’s EELV will use the Russian-designed RD-180 engine to be built by Pratt and Whitney. Rocketdyne Division of Boeing North American is building the Delta IV’s first-stage RS-68 engine.²³ In November 1996, Rocketdyne selected Phillips to test its engines in the second, or pre-engineering and manufacturing development, phase of the program. Originally, a single contractor for the third, or engineering and manufacturing development, phase of the EELV program was to have been selected in June 1998.²⁴ The anticipated contract value for the third phase was \$1.6 billion over approximately 6 years. However, on November 6, 1997, the Air Force announced a change in acquisition strategy to fund both Boeing’s and Lockheed Martin’s EELVs in the third phase of the program.

Testing EELV engines in the next phase of the program is important to Stennis and Phillips. According to a Stennis official, Stennis has two test stands available for EELV engine testing in 1998, but without EELV engine testing, there are no identifiable customers starting in 1999 for these and another of its large test stands.²⁵ And, as noted previously, the Air Force refurbished Phillip’s Test Stand 1A for EELV engine testing. This test stand has no other funded customers.

Despite the Air Force’s efforts, it may have lost its EELV engine customer to NASA. On July 19, 1997, Boeing stated that it had selected Stennis to conduct development, certification, and production acceptance testing of the RS-68 engine. Boeing has not yet fully defined its test requirements, and its intention to test at Stennis is conditional pending a satisfactory resolution of such issues as the amount of Stennis’ user fees. Boeing may

²³The Boeing Company and McDonnell Douglas Corporation began operations as a single company on August 4, 1997.

²⁴EELV acquisition is in three phases—low-cost concept validation (Aug. 1995-Dec. 1996), pre-engineering and manufacturing development (Dec. 1996-June 1998), and engineering, and manufacturing development (June 1998-2004).

²⁵Testing the engines for Lockheed’s Reusable Launch Vehicle is scheduled to start in 2004.

also test this engine on Phillip's Test Stand 1A, but it has not made a formal commitment to do so.

Rocket Propulsion Alliance Not Yet Playing an Active Role

The rocket propulsion alliance last met in October 1996 but did not discuss such major current issues as (1) consolidation of propulsion testing at NASA or elsewhere, (2) competition between NASA and the Air Force to test engines, and (3) investment decisions.

According to NASA officials, the alliance is likely to be reactive and unlikely to initiate a consolidation-related evaluation on its own. At the October meeting, NASA described the reasons for making Stennis NASA's center of excellence for rocket propulsion testing and noted its consolidation plan would be completed by early 1997.

At the time of the alliance meeting in October, NASA and the Air Force were competing to test EELV engines in the current phase of the program. Upgrades to Phillips' test stands for EELV testing were noted at the meeting, but this investment was not critically discussed. Also not discussed was the role the alliance might play in evaluating future investment decisions or NASA's effort to complete the component test facility at Stennis after the Air Force had started to refurbish its own component test stand at Phillips. According to a DOD official associated with the alliance, a test of its effectiveness is the ability of alliance members to review a proposed investment in test facilities.

Required Joint Rocket Propulsion Test Facilities Plan Was Not Submitted

In September 1996, Congress enacted legislation requiring NASA and DOD to submit within 90 days a

"joint plan for coordinating and eliminating unnecessary duplication in the operations and planned improvements of rocket engine and rocket engine component test facilities managed by the [Air Force and NASA]. The plan shall provide, to the extent practical, for the development of commonly funded and commonly operated facilities."²⁶

In a January 1997 response to congressional committees, DOD acknowledged that although NASA and the Air Force "do not yet have a formal plan," a range of efforts was underway that would "form the basis for such a plan." The efforts cited were Vision 21, the Quadrennial Defense Review, and the rocket propulsion alliance.

²⁶Public Law 104-201, section 211(c).

The first two efforts cited are unlikely to form the basis of a joint plan because NASA is not a formal part of the Vision 21 review, and DOD does not intend that its 5-year plan to consolidate and restructure its laboratories and test and evaluation centers be a joint plan with other federal agencies. NASA also was not a formal part of the Quadrennial Defense Review of defense strategy. Nevertheless, NASA concurred with DOD's response. DOD did not state in its letter whether it would prepare a joint plan for submission to Congress in the future.

The rocket propulsion test alliance's possible role in joint planning is problematical at this time in as much as the alliance has not met since October 1996 and the requirement for a joint plan was not formally discussed at the meeting.

There is an additional reason why Vision 21 cannot serve as the basis of the joint plan. DOD prepared, but did not submit, a legislative package for Vision 21; instead, it opted to include consolidation of its laboratories and test and evaluation centers in future BRAC rounds. But Congress, so far, has not accepted the need for such rounds. As a consequence, Vision 21's future is unclear until Congress either changes its position on BRAC or new guidelines for Vision 21 are developed.

NASA and DOD Move Toward Joint Strategic Management of Aeronautical Test Facilities

NASA and DOD took a step toward creating a national perspective on testing in the area of aeronautics by agreeing in May 1997 to consider joint strategic management of their test facilities. And in October 1997, NASA and Air Force officials reached a verbal understanding on the scope and approach for joint strategic management, but have yet to agree on key aspects of a management organization. Ultimately, if joint strategic management of aeronautics testing is successfully established, its adaption to other types of test facilities could be considered.

NASA and DOD Officials' Concepts of Joint Management Differ

The October understanding was preceded by an agreement on May 5, 1997, between senior NASA and DOD officials to discuss issues associated with joint strategic management. In so doing, they rejected the two aeronautical alliances (wind tunnels and aeropropulsion) as the way to address a variety of management and investment issues.

This agreement, in turn, followed a DOD assessment team's report, which noted in March 1997:

“Each agency and Service manages its wind tunnel facilities independently. There is no structured oversight of the various facilities in the nation As a result, there is no focused approach to what the national needs are for the various facilities.”²⁷

The DOD assessment team was skeptical that the two aeronautical alliances could effectively overcome this tradition of independence and recommended, in part, that DOD (1) establish a new office with NASA to manage the investment and test-technology-related funds for the nation’s core government wind tunnel facilities and (2) immediately initiate with NASA and industry a long-term program to build a new transonic wind tunnel.²⁸

The DOD assessment team proposed a new organization—National Aeronautical Facility Base—with members from the three military departments and NASA.²⁹ The members would reside within their parent agencies, and, in ad hoc fashion, comprise the new organization. The organization would not have authority over operations and maintenance funds, which would remain under the separate authorities of DOD and NASA. But the management organization would “make investments based on a national perspective without regard to whether the wind tunnel facility is DOD- or NASA-owned.”

NASA’s aeronautical officials also were doubtful about the adequacy of the cooperative alliances, and in November 1996, before the AACB’s aeronautics panel, recommended formation of an independent organization to strategically manage selected NASA and DOD wind tunnels and aeropropulsion test cells.³⁰ However, in NASA’s proposal, the new organization would receive funding from participating agencies and possibly industry, and its staff would be full-time members of the organization.

²⁷DOD Aeronautical Test Facilities Assessment (Mar. 1997), p. 60.

²⁸This recommendation revives a recommendation of the April 1994 report of the “National Facilities Study” team, which recommended that two major new wind tunnels be developed with the primary objective of strengthening U.S. industry’s capability to compete effectively in the international market for commercial jet transports. In 1996, NASA terminated this program due to budget constraints. See David P. Radzanowski, *Wind Tunnels: Proposal for a New National Wind Tunnel Complex* (Congressional Research Service, Jan. 4, 1995).

²⁹The model for this organization is DOD’s Major Range and Test Facility Base, which is comprised of 21 test installations, facilities, and ranges, including, for example, Arnold Engineering Development Center.

³⁰Aside from Aeronautics, the AACB’s other panels are Launch Systems Development, Spacecraft Technology, and Space Communications and Operations.

In proposing their different versions of joint management, NASA and DOD officials noted that in 1994 seven European aeronautical research establishments had combined to form a joint management organization called the Association of European Research Establishments in Aeronautics, which now manages five wind tunnels in four countries. NASA and DOD officials believe relatively new European wind tunnels and the association of research establishments have combined to make Europe's facilities especially competitive in attracting new test-related business.³¹

In October 1997, NASA and Air Force officials reached a verbal understanding on a scope and approach for a joint strategic management organization. The understanding proposes that NASA and DOD will continue to own, operate, and fund their own test facilities. The purpose of the new management organization will be to provide strategic management in four areas: (1) planning (includes making foreign competitive assessments and developing an associated strategy), (2) test technology (includes advocacy for resources), (3) operations policy (includes reviewing, coordinating, and recommending facilities' test schedules), and (4) business management (includes, as discussed below, cost accounting and charging policy). The new organization will be under the review authority of the AACB.

However, basic questions remain about strategic joint management, including the new organization's structure and authority to make binding decisions and recommendations. NASA and DOD officials have not agreed on a charter for the new management organization.

Cost Issues Remain Unresolved

The major facilities study team recognized that consolidation of test facilities depended on the development of "consistent/comparable" cost models because currently NASA and DOD differ on the issues of how much and whom to charge for testing. Generally, NASA does not charge for use of its aeronautical test facilities, while DOD does.

The major facilities study team developed some information on cost models. The team noted that although NASA's and DOD's "direct" and "indirect" costs were comparable at summary levels, differences over what

³¹European Aeronautics: Strong Government Presence in Industry Structure and Research and Development Support (GAO/NSIAD-94-71, Mar. 23, 1994).

to charge users of test services remained.³² In 1993, Congress gave DOD increased flexibility to adjust charges for indirect costs for commercial users of its Major Range and Test Facility Base.³³ NASA does not charge customers of its aeronautical facilities unless they receive “special benefits” over and beyond those which accrue to the public at large. For example, NASA charges commercial customers to use its wind tunnels if their tests are not officially supported by a government contract or letter of intent, or, if so supported, they are beyond the scope of testing requested by the government. On the other hand, DOD’s Major Range and Test Facility Base charges other federal agencies and commercial customers 100 percent of direct costs and a portion of indirect costs.

Conclusions

By agreeing to the recommendation to establish cooperative alliances, the AACB accepted the proposition that institutionalizing cooperative behavior in this way would add value to the already established cooperative relationship between NASA and DOD. Progress towards validating this proposition has been slow and sporadic. The alliances appear to offer the opportunity for an ongoing evaluation of test-related issues and cost-saving efficiencies of mutual interest to NASA and DOD, and thereby, create the basis for the testing community itself to construct a national perspective on these issues. While this perspective may be emerging in some cases, it is essentially absent in others. By not convening most alliances, the development of a national perspective from the bottom up remains largely untested. While the effect of such a delay is unclear, it may indicate that some NASA and DOD test officials do not see the alliances as having practical value, and that, with few exceptions, they would not object to continuing the pre-alliance status quo.

In 1996, Congress began to push for a national perspective with the requirement for joint planning, common funding, and common operations of NASA and DOD’s rocket propulsion test facilities. NASA’s and DOD’s formal reply to this requirement was not responsive. Consequently, it may be appropriate to reaffirm and extend the search for a national perspective on test facility issues begun in the 1996 legislation.

³²Direct costs are those that can be linked to specific activities in using a facility itself. Indirect costs are those common to various programs using a facility, plus an allocated share of the general and administrative costs of doing business at a research center or base.

³³Section 846 of the Fiscal Year 1994 National Defense Authorization Act (P.L. 103-160, Nov. 30, 1993).

Matter for Congressional Consideration

Congressional intent, as reflected in the statutory requirement for joint planning of rocket propulsion test facilities, is not being fully met by NASA and DOD. Congress may wish to consider reaffirming its intention in this regard and extend its joint planning requirement to other types of aerospace test facilities, including a requirement that NASA and DOD assess the possible extension of joint management of aeronautical facilities to other types of test facilities, especially rocket propulsion.

Agency Comments and Our Evaluation

In written comments on a draft of this report, DOD concurred that NASA and DOD need to coordinate more on infrastructure planning, but partially concurred that progress in institutionalizing cooperation was slow and sporadic. While DOD agreed that progress was slow in some areas, it believed we should give more credit to the progress that has been made. DOD noted that, without formal alliance charters, increases have occurred in interagency communications, interagency meetings on coordination of test technology, joint management alternatives and data bases, and the agencies' understanding of each other's policies and capabilities. DOD also partially concurred with our suggestion that Congress may wish to consider reaffirming its intention for joint planning of rocket propulsion test facilities and assess the possible extension of joint planning to other types of aerospace test facilities. DOD emphasized that it fully intends to meet congressional requirements and said that further legislation is either not needed or premature. DOD's comments and our evaluation of them are included in appendix III.

While an objective of our report is to determine the extent to which cooperative alliances have been operating on a regular basis, we recognized cooperative activities that preceded the signing of the alliances' charters in January 1998. For example, we noted cooperation on (1) testing in subsonic wind tunnels, (2) testing the effects of icing on aircraft, (3) developing wind tunnel test technology plans, (4) discussing rocket engine test issues, and (5) boosting rocket engine performance over the next 15 years. In particular, one activity cited by DOD—joint management alternatives—is discussed in some detail.

In responding to our conclusion and matter for congressional consideration, DOD did not state when it intends to comply with the statutory requirement. Therefore, because DOD and NASA have not been responsive to the congressional requirement, we believe that a reaffirmation of congressional intent, which would not necessarily require additional legislation, might be appropriate. We did not suggest that

Congress extend joint management to other types of aerospace test facilities, only that Congress consider requiring an assessment of that possibility. We believe our matter for congressional consideration remains valid.

In its written comments, NASA said the report could be strengthened by including updated information and identifying past cooperative activities made by the alliances. As discussed previously, we believe our report identified past cooperative activities. We updated the report where appropriate. NASA's comments are reprinted in appendix IV.

NASA and DOD also provided technical comments which we have incorporated where appropriate.

Scope and Methodology

To accomplish our objectives, we obtained documents from and interviewed officials at NASA headquarters in Washington, D.C.; NASA's Langley Research Center, Virginia; Goddard Space Flight Center, Maryland; and John C. Stennis Space Center, Mississippi. We also held discussions with and obtained documents from officials in the Office of the Under Secretary of Defense for Acquisition and Technology, the Air Force's Test and Evaluation Directorate, Washington, D.C.; the Air Force's Phillips Laboratory Propulsion Directorate, Edwards Air Force Base, California (now part of the Air Force Laboratory, Wright Patterson Air Force Base, Ohio); the Air Force's EELV program office, Los Angeles Air Force Base, California; and the Air Force Materiel Command's Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

To evaluate NASA and DOD's formal cooperation, we interviewed cognizant officials about the chartering and perceived value of the test facility alliances and reviewed the minutes of all formal alliance and AACB panel meetings held between May 1996 and August 1997.

With regard to competition to test EELV rocket engines, we interviewed cognizant officials and reviewed documents at Stennis Space Center and the Propulsion Directorate of Phillips Laboratory on the perceived advantages and disadvantages of each test facility in relation to EELV testing. We also discussed EELV testing with officials at the Air Force's EELV program office and with officials of one of the EELV engine contractors.

To evaluate NASA and DOD's response to a congressional requirement to prepare a joint plan on rocket propulsion test facilities, we interviewed

officials about DOD's response and analyzed documents obtained at the Office of the Under Secretary of Defense for Acquisition and Technology.

To review proposals for joint management of wind tunnels, we interviewed cognizant officials about the perceived need for a new management arrangement and reviewed joint-management proposals at the Langley and Arnold centers.

We performed our work between November 1996 and December 1997 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the NASA Administrator; the Secretary of Defense; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

If you or your staff have any questions, I can be reached at (202) 512-4841. Major contributors to this report are listed in appendix V.



Allen Li
Associate Director,
Defense Acquisition Issues

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Abbreviations

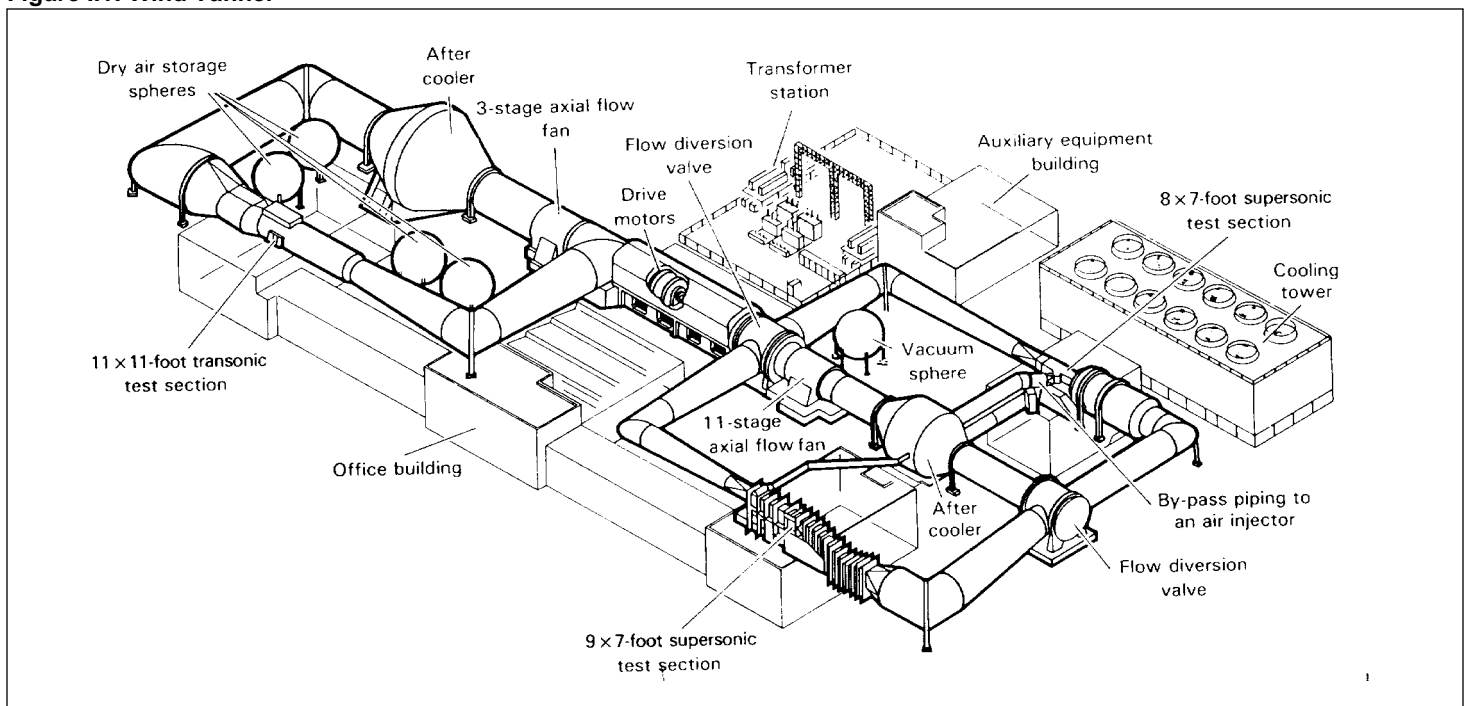
AACB	Aeronautics and Astronautics Coordinating Board
BRAC	Base Realignment and Closure
DOD	Department of Defense
EELV	Evolved Expendable Launch Vehicle
NASA	National Aeronautics and Space Administration

Major Test Facilities

The National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD) formed cooperative alliances for the following types of test facilities:

Wind tunnels are used to test aerodynamic forces (lift, drag, and side force) acting on scale models of air and spacecraft in a controlled airstream at different airspeeds. The challenge to testing in a wind tunnel is the applicability of results obtained with a scale model to full-sized air and spacecraft. Figure I.1 depicts a NASA wind tunnel that consisted of three test sections fed by one power source consisting of 4 coupled electric motors capable of 180,000 horsepower when operating on a continuous basis.

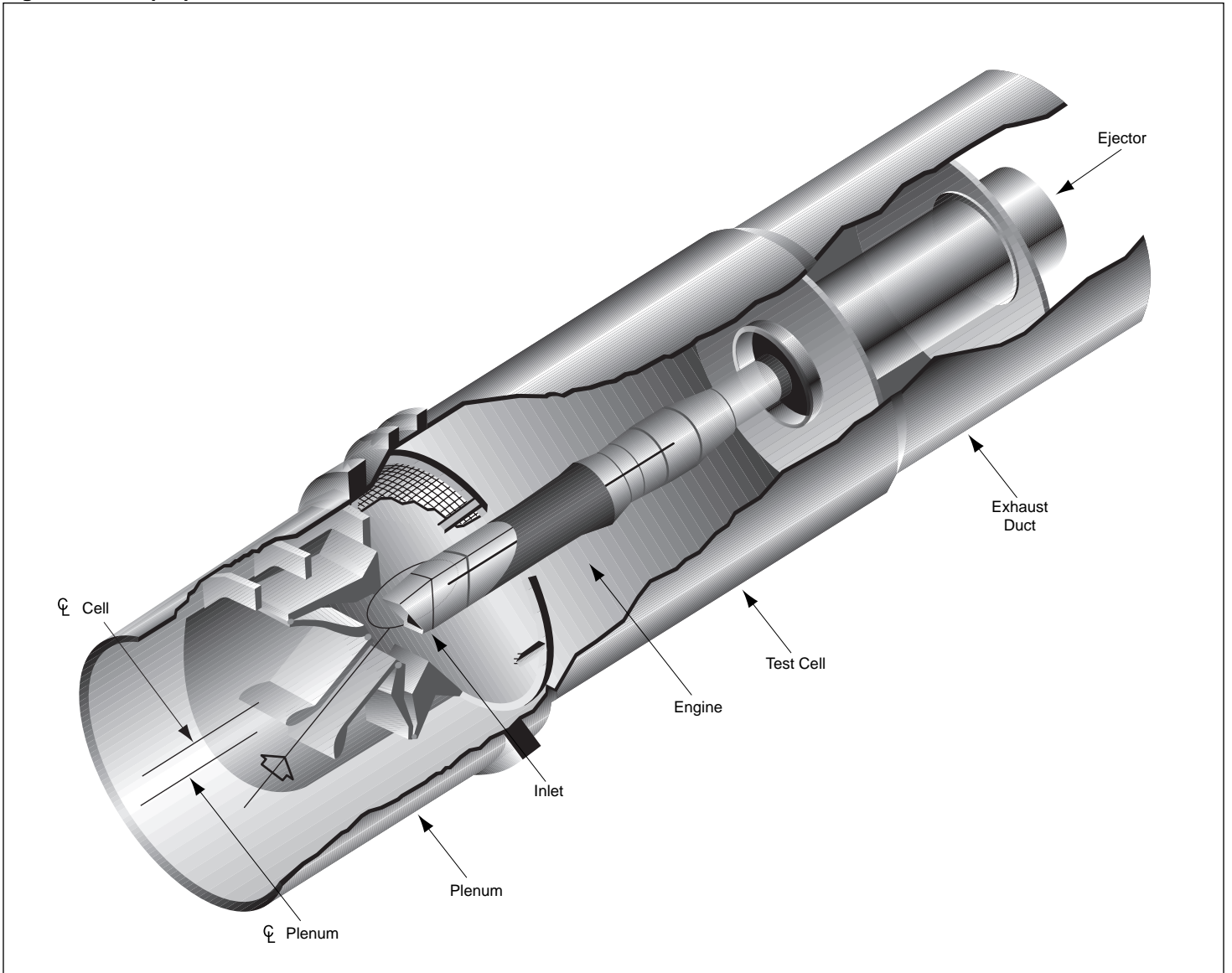
Figure I.1: Wind Tunnel



Source: NASA.

Aeropropulsion test cells are used to test air-breathing engines under simulated flight conditions. (See fig. I.2.)

Figure I.2: Aeropropulsion Test Cell



Source: Arnold Research Center.

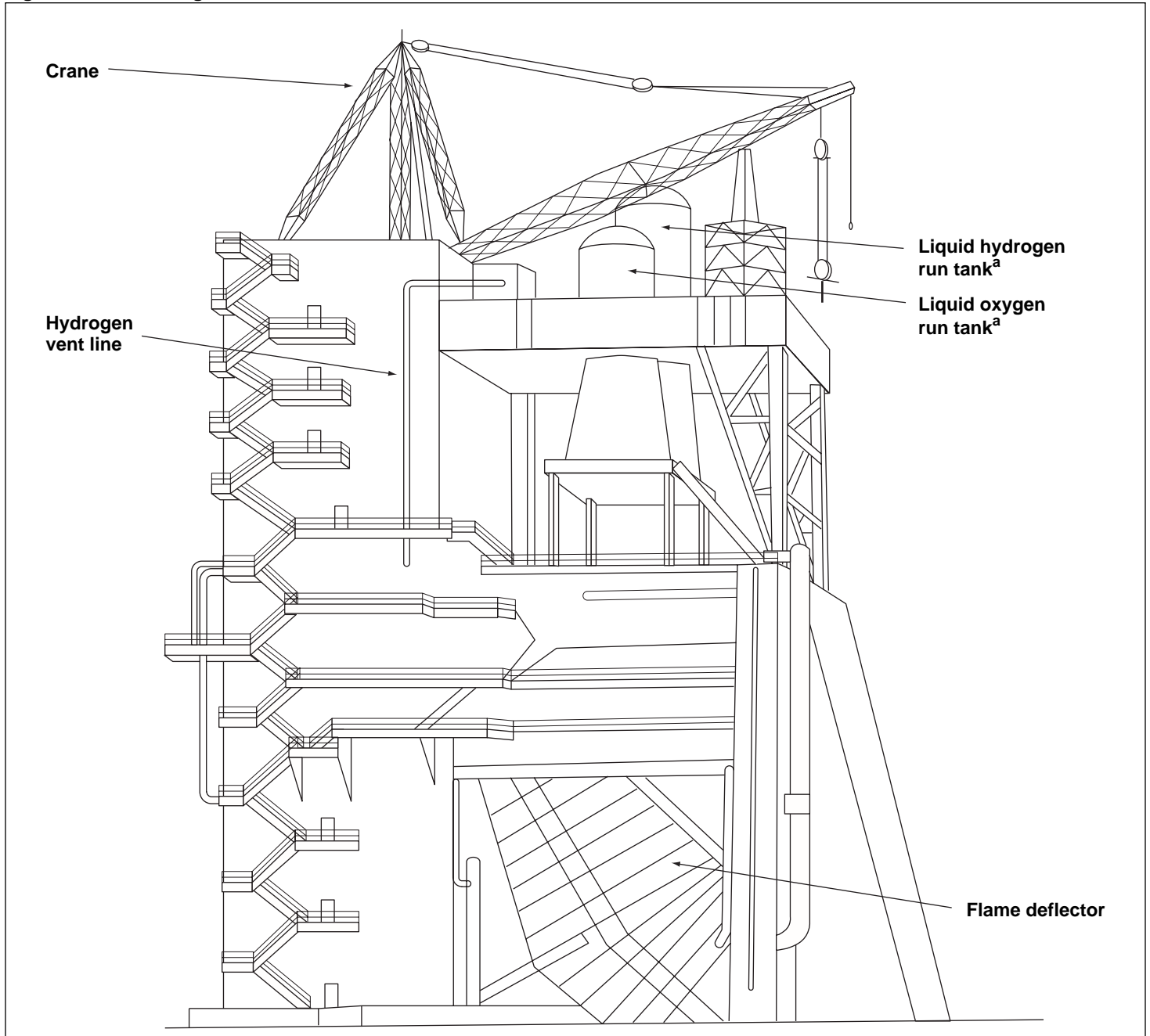
Rocket engine test stands are used to test chemical, solar, electric, and other types of rocket engines, and engine components such as fuel pumps and injector systems. Some test stands can simulate high altitudes. The

Appendix I
Major Test Facilities

test stand in figure I.3 is 160 feet high and can test engines capable of producing 1.5 million pounds of thrust.

**Appendix I
Major Test Facilities**

Figure I.3: Rocket Engine Test Stand

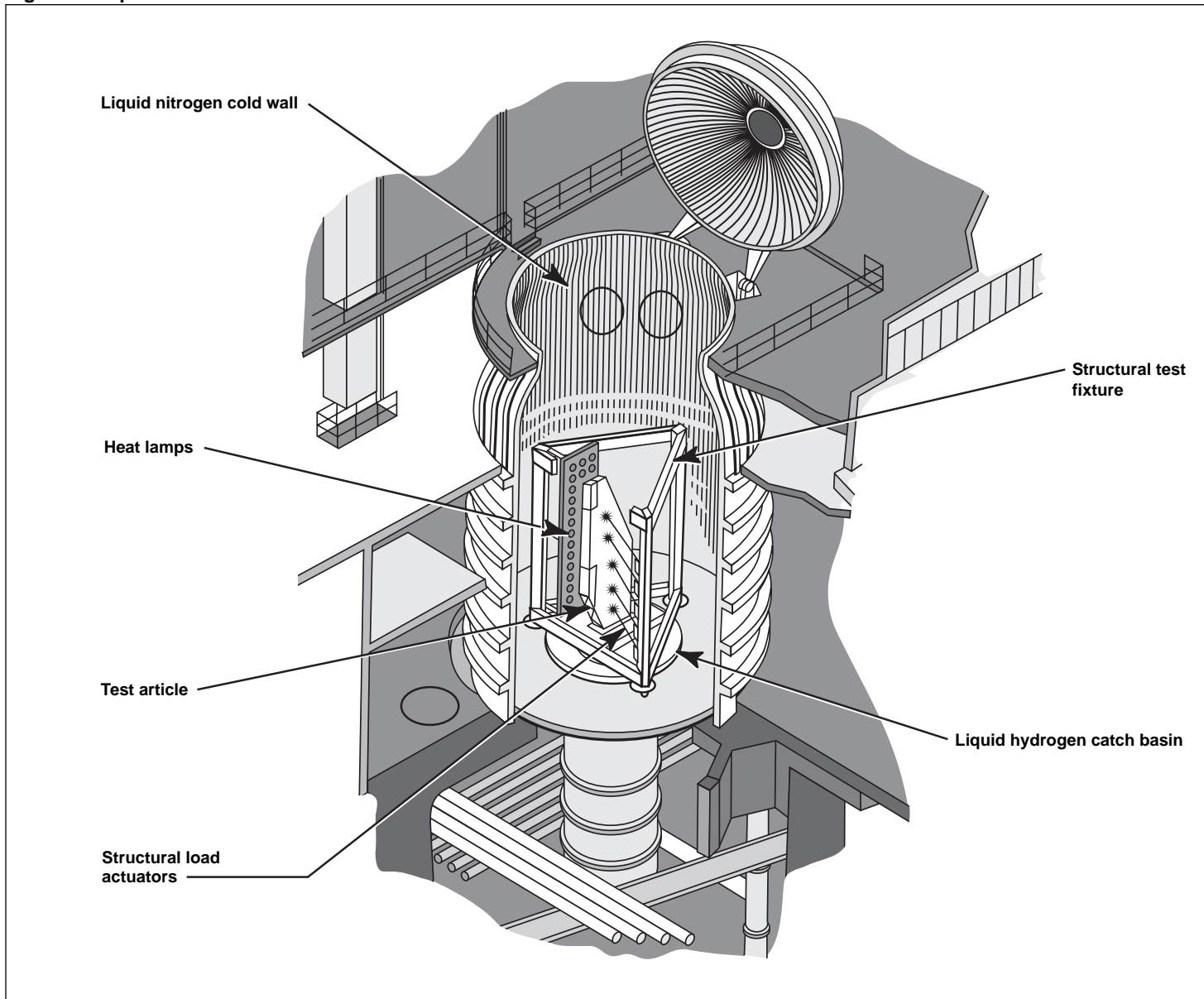


^aRun tanks directly supply engine with fuel and oxydizer from near-by storage tanks.

Source: NASA.

Space environmental simulation chambers are used to test spacecraft, instruments and components in ground handling, launch, and powered and orbital flight environments. Test facilities include acoustic and thermal vacuum chambers. Some simulation chambers are capable of creating a vacuum of less than one billionth of atmospheric pressure. (See fig. I.4.)

Figure I.4: Space Environmental Simulation Chamber



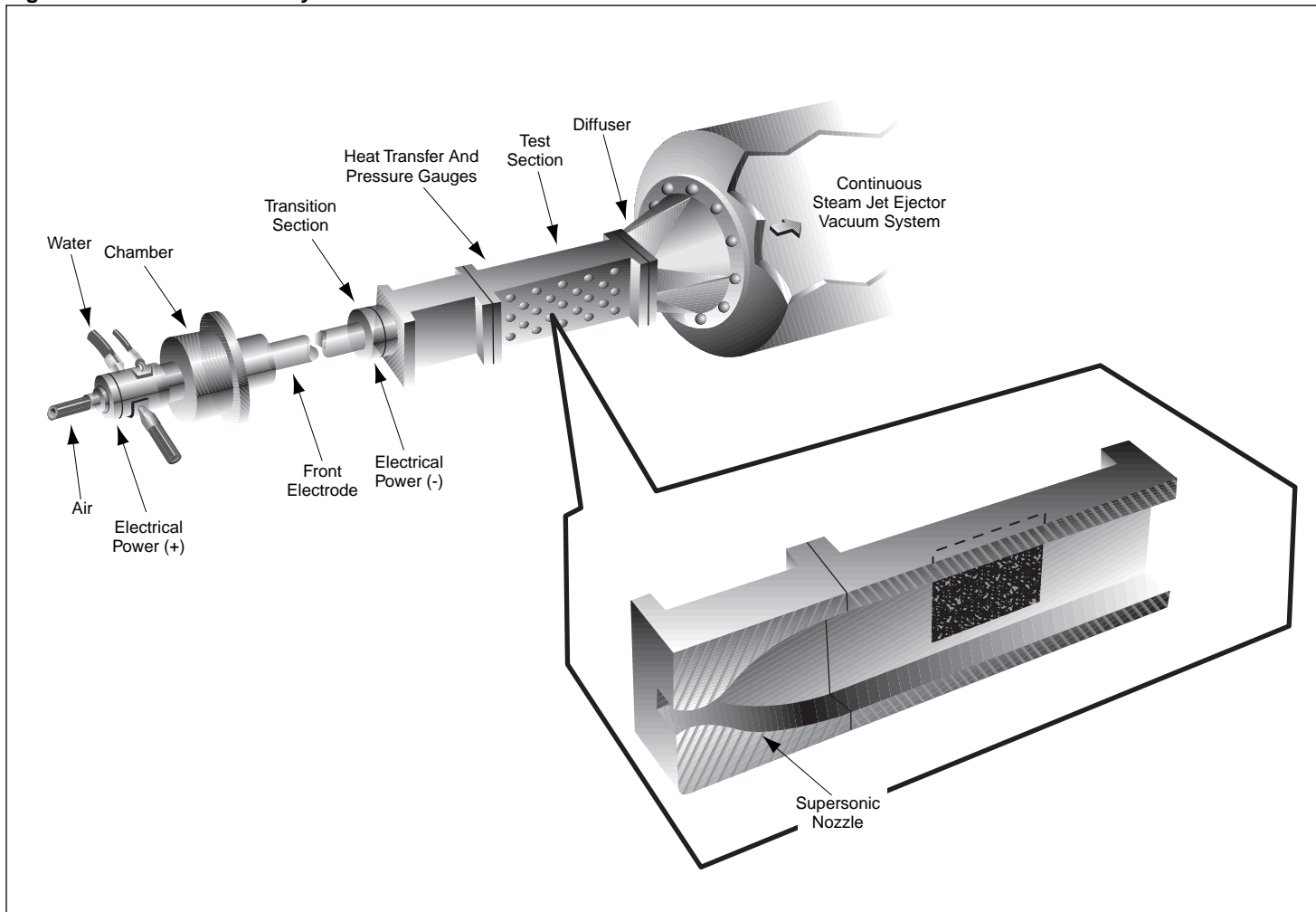
Source: NASA.

Arc-heated facilities are used for two fundamental purposes: aerothermal testing of materials and structures to simulate the aerodynamic heating

Appendix I
Major Test Facilities

environment of hypersonic flight, and aeropropulsion testing of engines that operate at high velocities and temperatures. NASA tests heating of Earth and planetary entry vehicles, and DOD tests heating of ballistic and other types of missiles. The arc heated facility illustrated in figure I.5 is capable of heating gas to more than 10,000 degrees Fahrenheit and directing it under pressure at an object or material to be tested.

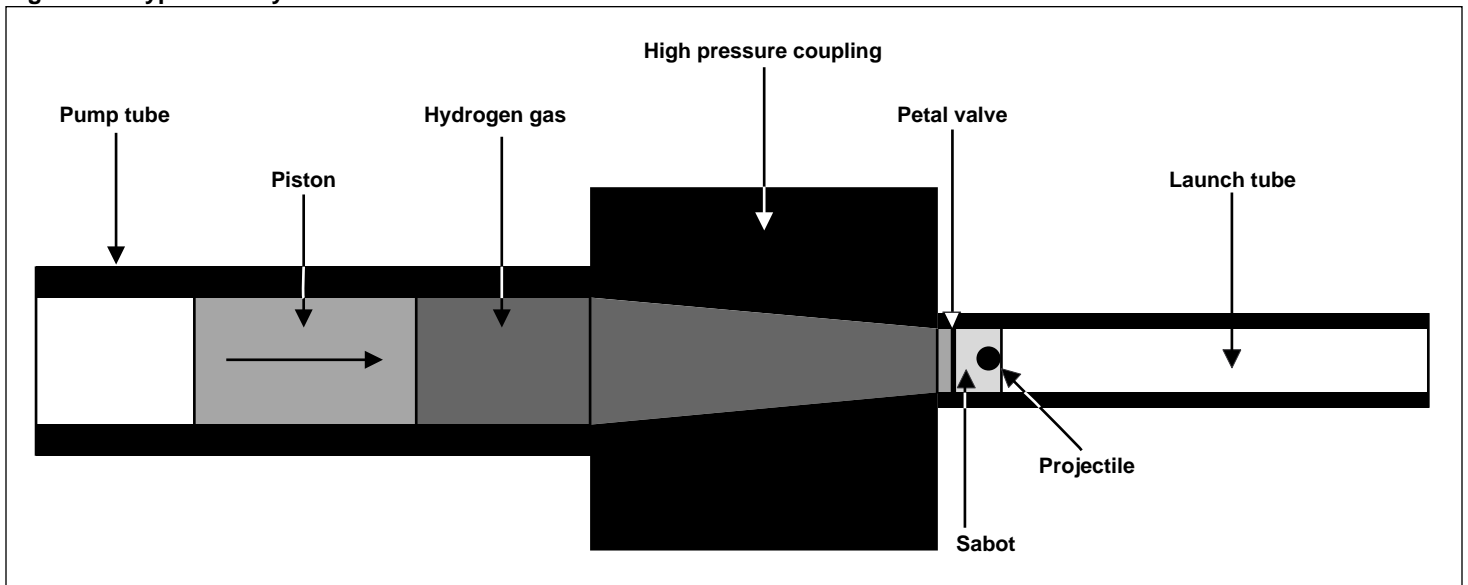
Figure I.5: Arc-Heated Facility



Source: NASA.

Hypervelocity gas guns are used for impact testing. NASA tests meteoroid/orbital debris-sized particles impacting on space structures such as the international space station. DOD tests ballistic missile intercept systems. In figure I.6, a powder charge drives the piston into trapped hydrogen, compressing it. The petal valve ruptures, forcing the projectile and sabot down the launch tube. The sabot is machined plastic that protects the launch tube from the projectile.

Figure I.6: Hypervelocity Gas Gun



Source: NASA.

Charter of National Rocket Propulsion Test Alliance

**MEMORANDUM OF AGREEMENT
BETWEEN
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
AND
DEPARTMENT OF DEFENSE (DoD)**

SUBJECT: National Rocket Propulsion Test Alliance (NRPTA)

1. **Purpose:** To establish the National Rocket Propulsion Test Alliance (NRPTA) for shaping the government's rocket propulsion test capability to efficiently meet national test needs through intra- and inter-agency cooperation.
2. **Background:**
 - a. The establishment of an aggressive civil space program and the conduct of the Cold War produced a robust and duplicative set of U.S. Government rocket propulsion test facilities and supporting infrastructure. With maturation of the civil space program, the end of the Cold War and shrinking Government resources, it is appropriate to assure that this capability is configured to meet current and future national needs in an efficient and cost-effective manner.
 - b. New Developments such as the Air Force Evolved Expendable Launch Vehicle program, the NASA Reusable Launch Vehicle program, and commercial launch vehicle business sectors are in the process of developing propulsion devices and systems that will rely on government capability for testing. Government capability must be available and prepared to respond to the unique needs of this new customer community.
 - c. The Administrator of NASA and the Secretary of Defense have agreed to re-activate the Aeronautics and Astronautics Coordinating Board (AACB) to identify, study and implement cost-saving efficiencies between NASA and the DoD.
3. **Scope:**
 - a. This Memorandum of Agreement applies to both joint and individual agency efforts to optimize the effectiveness, responsiveness, and efficiency of major rocket propulsion test facilities.
 - b. "Major rocket propulsion test facilities," as used in this MOA, refers to facilities representing a significant investment performing any testing on rocket propulsion sub-system elements (turbo-pumps, tanks, combustion devices, materials, etc.) or rocket propulsion systems (engines, stages, etc.). This includes DoD/NASA Centers and other Government Laboratories and private parties with a significant Government investment.

**Appendix II
Charter of National Rocket Propulsion Test
Alliance**

c. The NRPTA will:

- (1) Develop and maintain standardized facility description/data so that potential users will be able to select the best test facility to meet their requirements. These data will be documented in the Major Facilities Inventory data base which was developed during the conduct of the DoD/NASA Cooperation Initiative. (Responsibility of the accuracy of the facility description remains with the facility owner.)
- (2) Collect, analyze, and distribute propulsion test needs and propulsion technology trend data.
- (3) Develop and recommend guidelines for reporting utilization of facilities based on appropriate metrics; forecast facility utilization.
- (4) Develop a test capability map, master plan and investment strategy to efficiently meet national needs and eliminate unwarranted duplication.
- (5) Review significant facility modifications, upgrades, and new construction and make formal recommendations to ensure alignment with the master plan and investment strategy.
- (6) Identify common propulsion test cost elements.
- (7) Promote exchange of techniques and information; serve as clearinghouse and information source.
- (8) Advise agency and program management and the customer community on propulsion test and facility utilization matters.
- (9) Conduct special assessments and studies of rocket propulsion test requirements and capabilities when tasked by the AACB or its designee.

d. The NRPTA will be jointly chaired by NASA and the DoD. The NASA co-chair will be from the Stennis Space Center, the NASA lead center for rocket propulsion testing, and the initial DoD co-chair will be from Arnold Engineering Development Center. The term of the initial DoD co-chair will be two years. Subsequent terms will be one year and will be rotated among Alliance DoD organizations.

e. The Alliance membership will consist of both NASA and DoD organizations that are associated with major rocket propulsion test facilities as defined above. The initial member organizations of the NRPTA are:

Initial NASA Members

John C. Stennis Space Center - NASA Lead Center for Rocket Propulsion Test
Lewis Research Center
Lyndon B. Johnson Space Center

**Appendix II
Charter of National Rocket Propulsion Test
Alliance**

George C. Marshall Space Flight Center

Initial DoD Members

Arnold Engineering Development Center
Propulsion Directorate, Air Force Phillips Laboratory
Army Redstone Technical Test Center
Naval Air Warfare Center, Weapons Division (China Lake)

- f. The NRPTA will meet as required, but will meet at least twice each year. Meeting sites will be rotated among member organizations.
- g. Any participation by industry in the activities of the Alliance will be ad hoc and by invitation. Industry participation shall be to provide information to the members of the Alliance. All decisions or recommendations by the Alliance will be made strictly by the government members.

4. Responsibilities:

a. NRPTA member organizations will:

- (1) Conduct test programs within the established test capability map, master plan and investment strategy as referenced in paragraph 3.C.4; obtain Alliance recommendation if a test program or capability is contemplated outside these guidelines.
- (2) Notify the Alliance of modifications to a facility or unique equipment investments for a test program if they exceed \$1.0M in one year or \$5.0M total.
- (3) Provide the Alliance up-to-date site information required for the NRPTA facility data base.
- (4) Provide the Alliance potential test needs and trends in propulsion technology derived from discussions with agency and other test customers.
- (5) Furnish the Alliance an annual forecast of facility utilization.
- (6) Furnish the Alliance specified performance and capacity metrics data.
- (7) Share with Alliance members best practices, test technology, cost element structure, funding source, incident investigations and other information to increase community efficiency, effectiveness and understanding.
- (8) Establish permanent communication path with other Test Alliances, (Commercial NRPTA, Rocket Test Facility Working Group (RTFWG)), to ensure maximum information dissemination.

Appendix II
Charter of National Rocket Propulsion Test
Alliance

- b. The NRPTA, as a group, will integrate, review and approve products from Alliance member inputs including:
 - (1) Propulsion test investment recommendations to agency management and the AACB, especially in the areas of significant facility modifications, facility utilization.
 - (2) A test capability map, master plan and investment strategy for significant investments.
 - (3) Metrics to assess Alliance performance.
- c. The NRPTA co-chairs, with support of a small permanent staff, will:
 - (1) Schedule meetings, distribute data and information and coordinate Alliance activities.
 - (2) Maintain and integrate products that are generated by the Alliance.
 - (3) Represent the NRPTA in agency and other forums.
- 5. **Funding:** Each agency's ability to perform its obligations under this Agreement is subject to the availability of appropriated funds. If adequate appropriated funding is not available, either agency may unilaterally terminate this agreement. However, each agency shall use its best efforts to obtain needed funding.
- 6. **Recommendations and Disagreements:** Recommendations beyond the authority of the Alliance to enact will be forwarded to Agency management in the form of recommendations. Similarly, items not resolvable within the Alliance will be forwarded via the same avenues. Recommendations or issues should be forwarded with majority and minority viewpoints, if appropriate, and supporting rationale. If disagreements cannot be resolved, but are considered by either agency to be of sufficient importance, they may be brought to the AACB for disposition.
- 7. **Essential Operations:** Each agency will provide for continuing support for facilities on which the other agency has agreed to rely on—such a facility will not be closed or diminished in capability without prior coordination between the agencies. When any furlough, stand down, etc. is declared that will affect reliance support to the other agency, the Alliance will address each situation on a case-by-case basis and decide whether to recommend essential status to the appropriate management level.
- 8. **Reporting:** The Alliance will report annually to the AACB or its designee on the status of implementation and key activities.
- 9. **Patents, Proprietary and Classified Information:** Consistent with other joint usage agreements, each of the parties and their contractors shall retain unaffected all rights

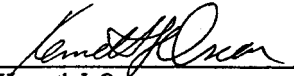
**Appendix II
Charter of National Rocket Propulsion Test
Alliance**

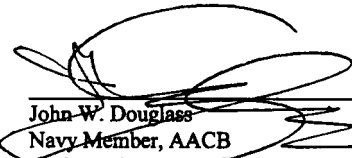
which they may have with respect to any patents, proprietary or classified information. Where it is mutually determined that patentable, proprietary or classified information shall be transferred in the interest of successfully implementing a cooperative program, this may be done under arrangements which fully recognize and protect the rights involved.

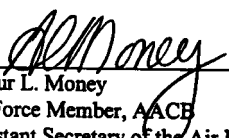
10. Duration: This Memorandum of Agreement (MOA) will become effective upon the last approving signature, and will be reviewed annually (or at the request of any signatory) to determine the need for continuation, amendment, supersedure, or termination. Amendments to this MOA, renewals, or a superseding MOA may be made at any time as a joint action by both parties. This MOA will remain in effect for five years until superseded, or terminated. It may be renewed for additional five-year periods.

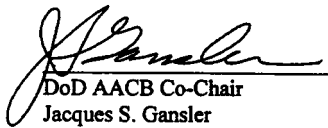
**MAJOR FACILITIES
MEMORANDUM OF AGREEMENT
BETWEEN
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND
DEPARTMENT OF DEFENSE
ON THE NATIONAL ROCKET PROPULSION TEST ALLIANCE**

DoD CONCURRENCE AND APPROVAL

 Date 5 Dec 97
Kenneth J. Oscar
Army Member, AACB
Acting Assistant Secretary of the Army (Research,
Development and Acquisition)

 Date DEC 02 1997
John W. Douglass
Navy Member, AACB
Assistant Secretary of the Navy
(Research, Development and Acquisition)

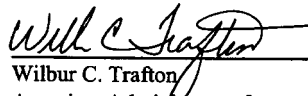
 Date 16 Dec 97
Arthur L. Money
Air Force Member, AACB
Assistant Secretary of the Air Force (Acquisition)

 Date DEC 24 1997
DoD AACB Co-Chair
Jacques S. Gansler
Under Secretary of Defense for Acquisition
and Technology, DoD


**Appendix II
Charter of National Rocket Propulsion Test
Alliance**

CONCURRENCE AND APPROVAL

NATIONAL ROCKET PROPULSION TEST ALLIANCE

 date 12/5/97

Wilbur C. Trafton
Associate Administrator for
Space Flight

 date 1.9.98

NASA AACB Cochair
J. R. Dailey
NASA Acting Deputy Administrator

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND TECHNOLOGY

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

23 DEC 1997

Mr. Allen Li
Associate Director, Defense Acquisition Issues
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Li:

See comment 1.

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "AEROSPACE TESTING: Promise of Closer NASA/DOD Cooperation Remains Largely Unfulfilled," dated November 26, 1997 (GAO Code 707250/OSD Case 1499). The Department has reviewed and generally concurs with the report's main thrust that more needs to be done on coordinated infrastructure planning between NASA and DoD. The Department disagrees with the interpretation of the Evolved Expendable Launch Vehicle (EELV) and rocket propulsion alliance activities, the report's conclusions, and the matter presented for congressional consideration.

See comment 2.

While the report recognizes that activities have been pursued by DoD and NASA to further interagency cooperation, it should provide a balanced view of these efforts. The two agencies initiated the 1995-1996 Cooperation Initiative, conducted studies, developed recommendations, and are proceeding with implementing the recommendations. Without formal memorandums of agreement, there have been increases in interagency communications; interagency meetings on coordination of test technology, joint management alternatives; joint databases; and a general increase in understanding of each other's policies and capabilities. Credit should be given to the progress that has been made. Significant progress has been made in the last few years and, in spite of some areas where progress is slower than the others, we have come a long way toward establishing the culture and trust needed to institutionalize interagency cooperation.

See comment 3.

The discussion of the EELV program appears to be out of context with the thrust of the report, but if used, significant corrections should be made. The report should reflect the EELV Program Office's account about activities of the EELV program, Phillips Laboratory, and the rocket propulsion alliance. We have enclosed the actual events for your consideration to delete or edit this discussion in the report.

DoD management comments on the conclusion and the matter for congressional consideration are enclosed. Also enclosed are suggestions to add balance to the report. Technical corrections have been provided separately.



Appendix III
Comments From the Department of Defense

The Department appreciates the opportunity to comment on the draft report. The DoD primary action officer for this case is Mr. Irvin Boyles at (703) 697-7933.

Sincerely,



Patricia Sanders
Director, Test, Systems
Engineering and Evaluation

Enclosure:
As stated

GAO DRAFT REPORT – DATED NOVEMBER 26, 1997
(GAO CODE 707250) OSD CASE 1499

“AEROSPACE TESTING: PROMISE OF CLOSER NASA/DOD COOPERATION
REMAINS LARGELY UNFULFILLED”

DEPARTMENT OF DEFENSE COMMENTS

* * * *

RESULTS IN BRIEF

PAGE 4: The GAO used a metric for measuring success of the NASA/DoD alliances as regularly convened meetings, and cataloged the number of regularly convened meetings for each of the six alliances.

See comment 2.

DOD RESPONSE: The metric used does not recognize the significance of the deliberately scheduled “irregular” business meetings of some alliance parties. The report discussion also unfairly accuses the other alliances of not pursuing the intentions of the MOAs. It is true that the space environmental and rocket alliances were the only ones that officially convened as “alliance meetings.” There were meetings, however, regarding the joint strategic management of the wind tunnel and airbreathing propulsion areas. There were meetings regarding cooperative wind tunnel test technology efforts. These meetings were not officially called alliance meetings, but did conduct business in line with the scope and spirit of the appropriate MOAs. The arc heater and aeroballistic range alliances did not meet. This information should be acknowledged in the report.

See comment 1.

NASA AND DOD COMPETE TO TEST ROCKET ENGINES

PAGES 8 to 15: The GAO describes events related to the determination of test facilities for the EELV program and actions taken both by Air Force Phillips Laboratory (now part of Air Force Research Laboratory) and NASA’s Stennis Space Center.

See comment 3.

DoD RESPONSE: The GAO report is overly negative about activities of the EELV program and its relationship with Phillips Laboratory, and the investment made to support the program. The EELV decision to upgrade Phillips Lab was taken long before the Rocket Propulsion Alliance formed in 1995, and resulted from a survey of the available U.S. rocket test facilities. Construction had already been underway for a year when the Rocket Propulsion Alliance met October 2, 1996. Within the four EELV teams that existed at the time the Phillips Lab upgrade decision was made, there were a significant number of test requirements involving at least two proposals from each team; as many as four engines in each proposal; requirements for component testing, integration testing, short duration and long duration testing at ambient launch conditions and at altitude. The sizes of the engines ranged from 20,000 pounds of thrust to 1.4 million

**Appendix III
Comments From the Department of Defense**

See comment 4.

pounds of thrust, fueled by one of many mixtures of liquid or solid propellants. Thus, the acquisition process, to reduce technical risk in a launch vehicle family, places a heavy burden on the test infrastructure. In addition, the October 1996 rocket propulsion alliance meeting determined that there was no excess test capacity within the alliance for the next two years, with the potential for increasing workload if industry shifts from their own facilities to government infrastructure.

CONCLUSION

CONCLUSION: The GAO concluded that the progress toward institutionalization of cooperative behavior was slow and sporadic, and that the development of a national perspective from the bottom up remains largely untested. The GAO also concluded that DoD and NASA were not responsive to congressional requirements for joint planning, common funding, and common operations in rocket propulsion test facilities. (Pages 19-20/GAO Draft Report)

See comment 1.

DoD RESPONSE: Partially Concur. While the DoD has not yet provided the joint planning for rocket propulsion test facilities requested by Congress in Section 211 of the National Defense Authorization Act for Fiscal Year 1996, we had advised Congress, in the January 1997, that we would meet the congressional requirement in concert with other congressional requirements for plans and actions concerning the DoD laboratory and test infrastructure (Sections 265 and 277 of the National Defense Authorization Act for Fiscal Year 1996). The DoD still intends to do so.

MATTER FOR CONGRESSIONAL CONSIDERATION

SUGGESTION 1: The GAO asserted that the congressional intent, as reflected in the statutory requirement for joint planning of rocket propulsion test facilities, is not being fully met by the National Aeronautics and Space Administration (NASA) and DoD. Therefore, the GAO suggested that the Congress may wish to consider reaffirming its intention in this regard and extend its joint planning requirement to other types of aerospace test facilities, including a requirement that NASA and DoD assess the possible extension of joint management of aeronautical facilities to other types of test facilities, especially rocket propulsion. (P. 20/GAO Draft Report)

See comment 1.

DoD RESPONSE: Partially Concur. As stated above, the DoD fully intends to meet the congressional requirement in concert with other congressional requirements for plans and actions concerning the DoD laboratory and test infrastructure. DoD is also exploring opportunities with the private sector that also has concerns about the potential for over-capacity in rocket propulsion test facilities. Both NASA and Air Force officials have challenged the assumption that there is excess rocket test capacity within the two agencies. The October 2, 1996 Rocket Propulsion Alliance meeting determined that there was no excess test capacity in the alliance for the next two years. There are many mothballed test stands—but it would be cost prohibitive and unwise to destroy them. It appears that industry is already shrinking its infrastructure, and therefore looks to government facilities for its testing, not only for military markets, but also for civilian and commercial systems as well. Future activity will provide a final plan that should include a

See comment 4.

Appendix III
Comments From the Department of Defense

“national perspective” for industry needs as well, and would go beyond that suggested by the GAO—additional statutory requirements are not needed, but legislative assistance may be needed to enact the final plan.

See comment 5.

On the point of expanding “joint management” to other types of test facilities beyond aeronautical test facilities, the Department’s position is that the joint management that is being proposed needs to be tried and validated and the legislative issues worked, before the approach is expanded to other types of facilities. The organizations that operate aeronautical test facilities have a long-standing history of communications and cooperation, and this continuing relationship will provide the best arena for implementation and refining the joint management approach. Once the experience of the aeronautical facilities alliance is understood, DoD would become enthusiastic to pursue similar benefits in other categories of facilities. The premature expansion to other areas may produce undesirable results.

See comment 1.

The Department recommends against further legislation on the grounds that DoD already has a statutory requirement to develop a plan for rocket test facility management, and that it is premature to extend the joint management approach to other types of facilities. Furthermore, it is suspected that most other test facilities will involve other government agencies and the private sector as well. Any addition legislation might unintentionally constrain the options that are to be considered.

The following are GAO's comments on DOD's letter dated December 23, 1997.

GAO Comments

1. Refer to the "agency comments and our evaluation" section of the report.
2. We do not indicate that the alliances were not pursuing the intentions of their charters.
3. We did not review the basis of the Air Force's decision to upgrade some of Phillips Laboratory's test stands, nor did we evaluate the EELV program. The point of our discussion of EELV engine testing was to establish that the NASA/DOD relationship on rocket engine testing is defined by both competitive and cooperative behavior. We used EELV engine testing to illustrate the competitive aspect of this relationship. The congressional requirement for joint planning of rocket propulsion test facilities establishes the context of our discussion because joint planning is one possible way to manage the NASA/DOD relationship in this area. With respect to DOD's comment on the rocket propulsion alliance, we did not state that the alliance should have reviewed the decision to upgrade Phillip's test stands. Our point is that, in the opinion of some alliance members, a test of the alliance's future relevance is its determination and ability to evaluate investment issues of the type that had been made at Phillips and Stennis Space Center.
4. Determining test capacity of rocket engines was not an objective of our report. We note that when DOD states that "Both NASA and Air Force officials have challenged the assumption that there is excess rocket test capacity with the two agencies," it is, in fact, disagreeing with the conclusion of its own May 1996 report on NASA/DOD cooperative initiatives. DOD's response does not provide specific information as to why NASA's and DOD's perception changed from May 1996 to October 1996 when DOD says the rocket propulsion alliance determined that there was no excess test capacity in the alliance for the next 2 years. Subsequent to DOD's response, we analyzed the minutes of the October 1996 meeting of the rocket propulsion alliance and concluded that these minutes do not clearly reflect that a discussion on test capacity took place or that a determination about capacity was made.
5. We share DOD's concern about the premature expansion of joint strategic management to other types of test facilities. As we stated in the

Appendix III
Comments From the Department of Defense

report, ultimately, if joint strategic management of aeronautics test facilities is successfully established, its adaption to other types of test facilities could be considered.

Comments From the National Aeronautics and Space Administration

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001



December 17, 1997

AE

U.S. General Accounting Office
Attn: Mr. Allen Li
Washington, D.C. 20548

Subject: Review Comments on the draft GAO Report (Code 707250)

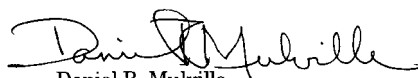
NASA management's comment on the draft GAO evaluation report on NASA/DOD cooperation on major aerospace testing facilities are enclosed. Memorandum of Agreements are completed for NASA and a duplicate set of agreements are in the final review and signature phase at DOD. Since the November 3, 1997, review, and your incorporation of some of the comments from that review, there has been further progress in the alliances.

The National Aeronautical Test Alliance (NATA) has agreed to the operation and composition of NATA. NATA includes strategic management of the U.S. aeronautical ground test facilities in order to ensure world-class capability in support of DOD and NASA missions and U.S. industry requirements. We recommend the GAO draft be updated to reflect this achievement.

The joint Agency cooperation between NASA and DOD were described in detail in our November 3, 1997, letter to your office. These previous comments enclosed with the letter, regarding the cooperation activities of the alliances, still remain valid for this GAO Report and we recommend they be incorporated into the report to highlight the cooperation between NASA and DOD.

In conclusion, the report can be strengthened by updating the report to include the recent accomplishments and identifying past cooperative activities made by the Alliances. Thank you for the opportunity to review this draft GAO Report.

**Appendix IV
Comments From the National Aeronautics
and Space Administration**



Daniel R. Mulville
Chief Engineer

4 Enclosures

1. Review Comments on GAO Draft
2. Department of the Air Force Letter, National Aeronautical Test Alliance, 13 Nov 1997
3. Thermal -Vacuum Chamber Illustration
4. Figure XX: Location of Major NASA and DOD Test Facilities

Major Contributors to This Report

National Security and
International Affairs
Division, Washington,
D.C.

Frank Degnan
Tom Mills
Dan Hoagland

Denver Field Office

Maria Durant
Mark McClarie

Los Angeles Field
Office

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