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National Capital Section

Bio

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 2
To Chris Cleary	From NCS
Co. OSTP	Co. A Moran
Dept.	Phone # 301 937 7762
Fax # 202 395 3261	Fax # 301 937 5423

September 9, 1993

Mr. Lionel Johns
Associate Director, OSTP
The White House
17th & Pennsylvania Ave, N.W.
Washington, DC 20500

Yes

301-937-5423 fax

Dear Mr. Johns:

The National Capital Section of the American Institute of Aeronautics and Astronautics (AIAA) is the largest of this national professional association. As part of our annual program, the Section hosts monthly luncheons featuring prominent speakers on topics of significant importance to our membership in the Washington, DC Metropolitan areas. Our initial luncheon guest speaker for September is the NASA Administrator, Daniel Goldin.

Under the present Clinton Administration it is certainly timely to afford the local membership the opportunity to listen to remarks from the Office of Science, Technology, and Policy. Section representatives are most interested in directives emanating from the Chief Executive's Office on new programs and initiatives, especially those activities dealing with the aerospace industry.

With this thought in mind, I invite you to address the Section's lunch meeting on Thursday, October 21, 1993. The luncheon will be conducted at the Pier 7 Restaurant, Chanel Inn, 650 Water Street, SW., Washington. Depending on your schedule and availability, we do have some flexibility in working with you around this date.

Our luncheon meetings begin at 11:30am with a short reception and cash bar, followed by lunch at 12:15pm. Your talk would begin about 1:00pm, last approximately 15-20 minutes, followed by a short question and answer period. We try to complete our luncheon activities no later than 1:30pm. We are most willing to accommodate you or modify this format to meet any time constraints you might have.

National Capital Section • American Institute of Aeronautics and Astronautics
11529 Montgomery Road • Beltsville, MD 20705 • (301) 595-4177 • Fax (301) 937-5423

I trust that your schedule permits you to be our October luncheon speaker. I assure you that your remarks will be well received by our membership and of great interest to the Washington, DC aerospace community. To provide adequate time for planning and publicity, it is essential that our Section finalize arrangements for the October luncheon as soon as possible. The Section's Vice President for Programs is Jack Koletty. Jack will contact your staff within the next couple of days regarding your availability. If you have any questions or concerns, please contact either Jack Koletty (301-306-7861), or our Executive Secretary, Alberta Moran (301-595-4177).

Thank you in advance for your time and favorable consideration regarding this invitation to address the National Capital Section.

Sincerely,

Dan Kennedy
Chairman

October 21, 1993

Remarks by Mr. Lionel S. Johns to the National Capital Section of the AIAA
Associate Director for Technology
Office of Science and Technology Policy

Thank you for the opportunity to share with you the Administration's policies and strategy for space and aeronautics. It is always a pleasure to address a distinguished group such as this.

I'd like to begin by noting that upon taking office, one of President Clinton's first actions was to formulate a major new technology initiative as part of his plan to strengthen our country's economy. This initiative is contained in the Administration's publication, Technology for America's Economic Growth.

Why did the President put such an immediate and dramatic emphasis on technology policy in his administration?

It's simple.

Technology drives economic growth. Advances in technology created two-thirds of the productivity growth in the United States over the past 60 years.

The knowledge-based, growth industries of the future depend on continuous generation of new technological innovations and rapid transformation of those innovations into marketable products.

The technology strategy outlined by President Clinton and Vice President Gore offers a comprehensive blueprint to focus American technology on 3 central goals:

-- Long-term economic growth that creates jobs and protects the environment;

-- Making government more efficient and more responsive; and

-- World leadership in basic science, mathematics, and engineering.

With this initiative, we take a critical step toward ensuring that the federal investment in science and technology becomes a key instrument for promoting U.S. economic growth and for satisfying other national goals.

All of this leads to the question, I want to focus on: How do our aeronautics and space programs fit into this technology strategy?

I will start with the role of OSTP. The President directed Dr. Gibbons to take the lead role for the Administration in terms of coordinating space policy. The approach we propose to take is to handle this responsibility through a new council, the National Science and Technology Council, that will absorb the functions of the Federal Coordinating Council for Science, Engineering, and Technology, the National Space Council, and the National Critical Materials Council. NSTC will be chaired by the President, and the Vice President in his absence, Dr. Gibbons will manage the council's day-to-day affairs. This council was recommended in the report from the National Performance Review, and we believe there is wide support for it within the White House and in other Executive Branch agencies and departments..

We are in the process of obtaining views from Executive Departments and Agencies, the Congress, and the private sector on the NSTC. Obviously, I will be working closely with the National Security Adviser on those occasions when national security concerns properly dominate the policy development process.

As we move forward to put the NSTC in place, we have also begun a series of interagency reviews of specific space programs,leading, in the new year, to a general reassessment of US space policy. The first of these reviews -- in aeronautics, weather satellite convergence, and space transportation -- are already underway.

Through the aeronautics review the Administrations will develop its priorities for investing in a new generation of aeronautics technologies. In developing these priorities we will be working closely with the aircraft manufacturers to ensure that our priorities match those of industry. The second review, focused on the convergence of DOD/NOAA weather systems, is a critical element of the Vice Presidents "Reinventing government initiative. At present, NOAA and DOD operated separate weather systems. OSTP is working with NOAA and DOD to see how we can safely and cost effectively eliminate this redundancy Finally, the United States relies for its critical civil and national security space missions and space systems that cost too much and take to long to prepare. The United States needs to chart a new course in space transportation. This review will be an important first step on this new course.

The President submitted a budget for NASA for 1994 that demonstrated the Administration's strong commitment to the civil aeronautics and space program. The President asked Congress to fund NASA at a level that allows an increase in science, space technology, and aeronautics. This is an extraordinary vote of confidence in a budget that is focused on deficit-cutting.

This investment does not signal a "business as usual" approach to running this Nation's space program. The resources dedicated to the civilian space program must be focused on issues critical to the nation. Let me articulate the five principal ways this country's investment in civil space exploration and technology development can and should contribute to the long term security and well-being of this nation.

First, the aeronautics and space program will create new knowledge and enhance our understanding of the environment here on earth and of our place in the universe. Space systems and advanced high altitude aircraft provide indispensable tools for understanding how human actions influence the complex workings of our planet. Similarly, space science and robotic planetary exploration can provide us with otherwise unobtainable knowledge and insights regarding our home planet and the universe in which we live. Insights gained from these technologies can enrich our lives and provide an essential type of wealth for this Nation.

Second, aeronautics and space investments must make important contributions to the U.S. economy. I refer not just to serendipitous "spin-offs," but to prudent, industry-led investments, such as the government/industry cooperation in aeronautics and in satellite communications that helped to achieve and sustain U.S. leadership in these critical areas.

Although the economic health of this nation is the uppermost consideration for the Administration, it is not the only guiding principle in our aeronautics and space activities.

Third, research in aeronautics and space can help build good international relations.

Research in aeronautics and space international relations should complement our foreign policy objectives, not only in terms of our access to global markets but also in terms of recognizing the new opportunities that exist in the past Cold War era. Working with our traditional partners in Europe, Japan, and Canada, and soon with Russia and other parts of the emerging democratic world, we can forge additional relationships that contribute to global peace and prosperity. International cooperation in space science, exploration, and commerce can provide an important lesson on how nations, working together, define challenges and solve problems that no one nation alone could accomplish.

Fourth, the space program is important because it generates and sustains interest in math and science education. The excitement generated by the space program can be used to interest young people in math and science education. Enthusiasm for the space program yields scientists, engineers, and educators who are the key to the future economic competitiveness of our nation, and increases the understanding of science and technology in the general population -- a critical need for the continued strength of our democracy.

Finally, human space flight is and will continue to be a significant element of our domestic and international space program. Humans can make a unique contribution, as part of a balanced program of robotic and human exploration, to our scientific and technical knowledge, as well as our understanding of the benefits and limitations of humans living and working in space.

I believe that these principles will guide development and implementation of the aeronautics and space programs of this Administration.

The increased funding for aeronautics in the FY '94 budget will be used to work with industry to develop the technologies that will improve U.S. competitiveness in civil aviation and enhance the safety and capacity of our National Aviation System. Today the aeronautics industry is one of the biggest in the country, employing nearly one million people, generating almost a hundred billion dollars in annual sales, and tens of billions of dollars in exports. It is one of our last surviving crown jewels of high technology, and one of the few areas where we still enjoy a positive balance of trade.

That is why, under the Clinton Administration, NASA is ramping up its investment in specific areas of aeronautical technology and in the facilities like wind tunnels that service the industry. This year, there is a substantial increase in aeronautics funding within the FY '94 NASA budget request. And with President Clinton's support and his Technology Reinvestment Initiative, we will increase that funding by more than 50% over the next five years. By the time we reach the 100th anniversary of the Wright Brothers' first powered fight, we intend to have a strong and growing aeronautical industry in this country once again.

The technology we produce in aeronautics can not only help our competitive posture with this critical industry, it can spin off into other areas of the economy as well. The advanced composite structures we are working on provide an example.

For 20 years now, we have been steadily advancing the state of the art in composite materials. The goal at first was just to learn how to fabricate these new lightweight materials and take advantage of the fuel savings. Now our goal is to make composite materials 25% cheaper than aluminum.

How? Well one technology involves actually weaving the structures, just like the textile industry might weave a suit. Rather than laying up a section ply-by-ply, we would weave the fibers and epoxies together in the desired shape, and NASA is now working with five textile companies to pursue the idea. It's very promising, both for the aeronautics and the textile industries.

Another high priority in the Clinton Administration' space policy is NASA's Mission to Planet Earth. I think in many ways it may well be the most important space science program we have ever done. And it could represent one of NASA's greatest contributions to society.

Humans have begun to change the face of the planet at an ever increasing rate, and that change is not always healthy. We must use our technology to study the ecosystem, to understand the effects humans are having on the atmosphere and the land and the water. The goal of NASA's Mission to Planet

Earth program is to provide definitive scientific data so that policy makers 10 or 20 years from now can make the right decisions in safeguarding the health of our home planet.

With these core programs, and with a new determination to make our investments in air and space payoff of the American people, we have a bright and promising future ahead.

Let me now turn my attention to a subject that has received a considerable amount of attention recently -- the space station.

In March of this year, the President requested a review of the Space Station Freedom Program in order to examine whether the program's development, operations, and utilization costs could be significantly reduced while still achieving our scientific research goals and fulfilling our international commitments. On June 17, following a review of NASA's study by an independent panel of experts headed by Dr. Charles Vest, President of MIT, President Clinton announced his support for a scaled-down, modular version of

Space Station Freedom that meets these objectives -- the "Alpha Station" program as it has come to be known. The President also called for pursuing expanded international involvement in the space station with the possible participation of Russia.

As you know, the Alpha space station program is the result of an intensive review and redesign of the Space Station Freedom conducted over the last six months. Alpha is a streamlined version of the original Space Station Freedom. It is designed to accommodate much of the Space Station Freedom hardware, will have power, scientific laboratory space, and microgravity levels comparable or better than Space Station Freedom, and incorporates the interests of our international partners. It will cost significantly less than Space Station Freedom. At the direction of the White House, NASA is currently finalizing the Alpha Station baseline program design.

The Administration has requested a total of $2.1 billion in FY94 to be used to continue development of the reduced cost Alpha Station program as an international facility to be built and operated by the United States, Canada, Japan, and the European Space Agency. I believe strongly that this is an important science and technology investment for the United States.

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In the interim, the United States and Russia have signed an historic agreement to pursue space cooperation in the areas of earth observation, space science, and space flight, possibly leading to a Russian role in the international space station. Russian participation could add a positive new dimension to the development of an international space station, and, as Vice President Gore stated, would be an important symbol that we have put the Cold War behind us. The Administration is requesting $100 million in FY94 in order to pursue these mutually beneficial space activities in cooperation with the Russian space program.

A crucial element of the redesigned space station program is the implementation of management changes at NASA to reduce overhead, increase efficiency, and streamline the bureaucracy. NASA has taken significant steps to implement these reforms, including selecting a single prime contractor to oversee program development and a single host facility to consolidate the program.

Beyond the space station and the aeronautics program, NASA has a broader role to play in the President's technology initiative, including areas such as High Performance Computing and Communications, space science and exploration, and environmental monitoring and earth observation.

We believe that the President's technology initiative -- for space and aeronautics, as well as other science and technology programs, for NASA and the other Federal agencies -- constitutes a major, positive departure from the programs of the past. Organized around broad, national goals, it abandons the notion that we can depend on "spin-offs" and "trickle down from space and defense R&D for future well-being and instead adopts an ambitious, integrated approach to civil and defense R&D spending in order to ensure national, economic, and environmental security.

I hope these comments have given you a brief picture of the direction we are headed and have illuminated the priorities we are pursuing.

National Capital Section

September 9, 1993

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Mr. Lionel Johns
Associate Director, OSTP
The White House
17th & Pennsylvania Ave, N.W.
Washington, DC 20500

Dear Mr. Johns:

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Thank you in advance for your time and favorable consideration regarding this invitation to address the National Capital Section.

Sincerely,

Dan Kennedy

Dan Kennedy
Chairman

October 20, '93

~~September 16, 19~~93

"A National Space and Aeronautics Strategy"

Remarks by ~~Dr. John H. Gibbons~~, Mr. Lionel S. Johns (title)
~~Assistant to the President for Science and Technology~~ to
~~Delivered to SPACETALK '93~~

Thank you for the opportunity to share with you ~~I am very pleased to be here today, and I welcome this opportunity to discuss~~ the ~~Clinton~~ Administration's ~~technology~~ policies and strategy for space and aeronautics. ~~with such a distinguished group.~~ ~~Today I would like to talk briefly about the Clinton Administration's overall technology policies and initiatives, and then focus specifically on the role of our aeronautics and space programs.~~ It is always a pleasure to address a distinguished group such as this.

I'd like to begin by noting that Upon taking office, one of President Clinton's first actions was to formulate a major new technology initiative as part of his plan to strengthen our country's economy. This initiative, is contained in the administration's publication Technology for America's Economic Growth, ~~was announced in San Jose, California -- Silicon Valley -- and I was pleased to join the President and the Vice President in California for that event.~~

Why did the President put such an immediate and dramatic emphasis on technology policy in his administration?

It's simple.

Technology drives economic growth. Advances in technology created two-thirds of the productivity growth in the United States over the past 60 years. The knowledge-based, growth industries of the future depend on continuous generation of new technological innovations and rapid transformation of those innovations into marketable products.

The technology strategy outlined by President Clinton and Vice President Gore offers a comprehensive blueprint to focus American technology on 3 central goals:

-- Long-term economic growth that creates jobs and protects the environment;

-- Making government more efficient and more responsive; and

-- World leadership in basic science, mathematics, and engineering.

With this initiative, we take a critical step toward ensuring that the federal investment in science and technology becomes a key instrument for promoting U.S. economic growth and for satisfying other national goals.

All of this leads ~~us~~ to the question I want to focus on:

~~An important question to ask is:~~ How do our aeronautics and space programs fit into this technology strategy?

JHG

I will start with ~~my own role~~ the role of OSTP. The President ~~has~~ directed ~~me~~ to take the lead role for the Administration in terms of coordinating space policy. ~~I plan to~~ The approach we propose to take is to handle this responsibility through a new council, the National Science and Technology Council, that will absorb the functions of the Federal Coordinating Council for Science, Engineering, and Technology, the National Space Council, and the National Critical Materials Council. NSTC will be chaired by the President, and the Vice President in his absence, ~~and I~~ Dr. Gibbons will manage the council's day-to-day affairs. This council was recommended in the report from the National Performance Review, and ~~I~~ we believe there is wide support for it within the White House and in other Executive Branch agencies and Departments.

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We are ~~establishing a process to ensure that~~ views from Executive Departments and Agencies, the Congress, and the private sector on the NSTC, ~~are considered during policy development.~~ Obviously, I will be working closely with the National Security Adviser on those occasions when national security concerns properly dominate the policy development process.

As we move forward to put the NSTC in place, we have also begun

~~In the months ahead, I will also be leading~~ a series of interagency reviews of specific space programs,leading, in the new year, to a general reassesment of US space policy. The first of these reviews -- in aeronautics, weather satellite convergence, and space transportation -- are already underway.

Through the aeronautics review the Administrations will develop its priorities for investing in a new generation of aeronautics technologies. In developing these priorities we will be working closely with the aircraft manufacturers to ensure that our priorities match those of industry. The second review, focused on the convergence of DOD/NOAA weather systems, is a critical elemennt of the Vice Presidents "Reinventing governm,ent initiateive. At present, NOAA and DOD operated seperate wheather systems. OSTP is working with NOAA and DOD to see how we can safely and cost effectively eliminate this redundancty Finally, the United States relies for its critical civil and national security space missions and space systems that cost too much and take to long to prepare. The United States needs to chart a new course in space tranportation. This review will be an important first step on this new course.

~~The President believes a strong and forward-looking space program is an important investment in our national future. The Administration's policy seeks to expand on traditional American strengths in that arena, and to propel us into a new century by expanding partnerships, playing to our strengths, and investing in our people.~~

The President submiited a budget for NASA for 1994 that demonstrated the Administration's strong commitment to the civil aeronautics and space program. The President asked Congress to fund NASA at a level that allows an increase in science, space technology, and aeronautics. This is an extraordinary vote of confidence in a budget that is focused on deficit-cutting.

This investment does not signal a "business as usual" approach to running this Nation's space program. The resources dedicated to the civilian space program must be focused on issues critical to the nation. ~~I believe there are~~ Let me articulate the five principal ways this country's investment in civil space exploration and technology development can and should contribute to the long term security and well-being of this nation.

First, the aeronautics and space program will create new knowledge and enhance our understanding of the environment here on earth and of our place in the universe. Space systems and advanced high altitude aircraft provide indispensable tools for understanding how human actions influence the complex workings of our planet. Similarly, space science and robotic planetary exploration can provide us with otherwise unobtainable knowledge and insights regarding our home planet and the universe in which we live. Insights gained from these technologies can enrich our lives and provide an essential type of wealth for this Nation.

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This leads me to my second ~~point:~~ aeronautics and space investments must make important contributions to the U.S. economy. I refer not just to serendipitous "spin-offs," but to prudent, industry-led investments, such as the government/industry cooperation in aeronautics and in satellite communications that helped to achieve and sustain U.S. leadership in these critical areas.

Third, A

Although the economic health of this nation is the uppermost consideration for the Administration, it is not the only guiding principle in our aeronautics and space activities. ~~Our third principle holds that~~ research in aeronautics and space ~~can help build good~~ international relations.

should complement our foreign policy objectives, not only in terms of broaden our access to global market but also in terms of recognize the new opportunities that exist in the post-Cold War era.

We are acutely ~~aware that international cooperation in space activities can help the international community move beyond the Cold War.~~ Working with our traditional partners in Europe, Japan, and Canada, and soon with Russia and other parts of the emerging democratic world, we can forge additional relationships that contribute to global peace and prosperity. International cooperation in space science, exploration, and commerce can provide an important lesson on how nations, working together, define challenges and solve problems that no one nation alone could accomplish.

Fourth, the space program is important because it generates and sustains interest in math and science education. The excitement generated by the space program can be used to interest young people in math and science education. Enthusiasm for the space program yields scientists, engineers, and educators who are the key to the future economic competitiveness of our nation, and increases the understanding of science and technology in the general population -- a critical need for the continued strength of our democracy.

Finally, human space flight is and will continue to be a significant element of our domestic and international space program. Humans can make a unique contribution, as part of a balanced program of robotic and human exploration, to our scientific and technical knowledge, as well as our understanding of the benefits and limitations of humans living and working in space.

I believe that these principles will guide development and implementation of the aeronautics and space programs of this Administration.

The increased funding for aeronautics in the FY '94 budget will be used to work with industry to develop the technologies that will improve U.S. competitiveness in civil aviation and enhance the safety and capacity of our National Aviation System. Today the aeronautics industry is one of the biggest in the country, employing nearly one million people, generating almost a hundred billion dollars in annual sales, and tens of billions of dollars in exports. It is one of our last surviving crown jewels of high technology, and one of the few areas where we still enjoy a positive balance of trade.

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With these core programs, and with a new determination to make our investments in air and space payoff of the American people, we have a bright and promising future ahead.

Let me now turn my attention to a subject that has received a considerable amount of attention recently -- the space station. Let me state from the outset that I believe that the space station program -- properly structured -- can make a number of very important contributions to this nation. For example:

- The economic strength of the United States depends on our scientific and technological leadership. Space Station Alpha will provide unprecedented opportunities to develop new wealth and new scientific breakthroughs for this nation.

- The ability to routinely live and work in space and to pursue new investigations in advanced materials processing and manufacturing will be essential to our competitive position in the high-technology markets that will define the next century. Through the space station, we can also achieve breakthroughs in medical research and other critical technologies that will create new jobs and improve the quality of life here on Earth.

- o Commitment to Space Station Alpha means a commitment to tens of thousands of good, high-paying US jobs. These jobs will help to offset the effects of the down-turn in defense spending and will maintain a strong technology base essential to the economic and national security of this nation.

- o Space Station Alpha is also a model of peaceful international cooperation, offering a vision of a new world in which confrontation can be replaced by cooperation. Through the Space Station Alpha program, we will continue to work with our current partners in Europe, Canada, and Japan, while allowing the possibility for meaningful participation by Russian.

In March of this year, the President requested a review of the Space Station Freedom Program in order to examine whether the program's development, operations, and utilization costs could be significantly reduced while still achieving our scientific research goals and fulfilling our international commitments. On June 17, following a review of NASA's study by an independent panel of experts headed by Dr. Charles Vest, President of MIT, President Clinton announced his support for a scaled-down, modular version of Space Station Freedom that meets these objectives -- the "Alpha Station" program as it has come to be known. The President also called for pursuing expanded international involvement in the space station with the possible participation of Russia.

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In the interim, the United States and Russia have signed an historic agreement to pursue space cooperation in the areas of earth observation, space science, and space flight, possibly leading to a Russian role in the international space station. Russian participation could add a postive new dimension to the development of an international space station, and, as Vice President Gore stated, would be an important symbol that we have put the Cold War behind us. The Administration is requesting $100 million in FY94 in order to pursue these mutually beneficial space activities in cooperation with the Russian space program. I ~~believe this, too, is a wise investment for the United States.~~

A crucial element of the redesigned space station program is the implementation of management changes at NASA to reduce overhead, increase efficiency, and streamline the bureaucracy. NASA has taken significant steps to implement these reforms, including selecting a single prime contractor to oversee program development and a single host facility to consolidate the program.

Beyond the space station and the aeronautics program, NASA has a broader role to play in the President's technology initiative, ~~I can give you some examples:~~ including areas such as

o ~~NASA will have a key role in the implementation of the~~ High Performance Computing and Communications ~~initiative and creation of the "information superhighways" that the President and the Vice President have envisioned for our country.~~

o NASA's space and aeronautical technologies should contribute to the President's initiatives in advanced manufacturing, including the clean car initiative.

~~o~~ Space science and exploration ~~is an invaluable means to help maintain U.S. leadership in basic science, mathematics, and engineering.~~

and environmental monitoring and earth observation.

o ~~NASA's Earth Observing System (EOS)~~ program ~~will also ensure that our~~ inv~~estments in innovative space and aeronautical technologies will be used~~ to s~~olve high-priority problems in the environment.~~

We believe that the President's ~~The plans embodied in President Clinton's~~ technology initiative -- for space and aeronautics, as well as other science and technology programs, for NASA and the other Federal agencies -- constitutes a major ~~departure~~ positive departure from the programs of the past. Organized around broad, national goals, it abandons the notion that we can depend on "~~serendipitous~~ spin-offs" ~~from~~ space and defense and "trickle down" R&D for future wellbeing and instead adopts an ambitious, integrated approach to civil and defense R&D spending in order to ensure national, economic, and environmental security.

I hope these comments have given you a brief picture of the direction we are headed and have illuminated the priorities we are pursuing.

~~I thank you for your attention today and~~ look forward to working with you as we develop and implement the science and technology programs of the Clinton Administration.

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Design of a Hypersonic Waverider-Derived Airplane

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INTRODUCTION

The current global political situation suggests that long-range aircraft operating at high speeds would be of great potential benefit to the United States after the turn of the century (Ref. 1). The research presented in this paper represents a preliminary assessment of a long-range cruise waverider vehicle. This work was done by NASA Langley Research Center (LaRC) and NASA Lewis Research Center (LeRC) in conjunction with General Dynamics (GD) for the airframe structure and Pratt & Whitney (P&W) for the propulsion system. The NASA Langley Systems Analysis Office coordinated the work and technically monitored the efforts of GD and P & W which were provided under the Mach 5 cruise portion of the HiMate Program. The waverider planform was chosen as the basis for this study because it has low drag characteristics, reasonable volumetrics, (Ref. 2 and 3) and is computationally easy to derive and optimize. Recent advances in high temperature materials, light-weight structures and high thrust-to-weight ratio propulsion systems indicate that low hypersonic speed aircraft are feasible. A maximum airspeed of Mach 5.0 was chosen so that a practical "near-term" design could be formulated that uses hydrocarbon endothermic fuels.

For hypersonic vehicles with long-range missions, the fuel load becomes a sizeable percentage of the overall weight. Thus, the installed thrust-to-weight ratio and the installed specific fuel consumption become important factors in the design of this class of aircraft. Hypersonic cruise vehicles generally experience a thrust-to-drag "pinch" at transonic and low supersonic Mach numbers. Inlets and nozzles, sized for thrust and efficiency at high speeds, operate off-design with high losses in this Mach regime. The accelerator and ramduct must be sized to offset these losses, thus, increasing fuel burn during acceleration. This paper will address some of the issues involved in the airframe and propulsion system integration required to optimize a vehicle for maximum range. This report presents the initial iteration of an ongoing design process. Not all disciplines are closed: powerplant selection has not been optimized, and the aircraft has not been scaled. Take-off requirements were considered for purposes of propulsion, landing gear sizing and determining maximum takeoff weight.

Finally, some question exists as to the ability of the aeroanalysis methods employed here to accurately analyze waveriders. These methods require approximating the geometry as a wing section, not taking into account the contained conical shock flowfield generated by the waverider, and most likely will overpredict wave drag and underpredict lift. An effort is presently underway at LaRC to wind-tunnel test a similarly derived waverider-based vehicle, validate CFD methods, and provide a data base for calibrating other aeroanalysis methods. It was decided to use best engineering judgment for this paper and wait for this database before performing a more time consuming and costly CFD-based analysis.

MISSION DEFINITION

The mission on which this study is based was a tanker-to-tanker mission. The mission begins at Mach 0.8 and

30,000 feet. The vehicle accelerates to Mach 1.2 at constant altitude then to Mach 5 while climbing to approximately 90,000 feet. The entire acceleration takes place at a dynamic pressure below 1,000 psf, while maintaining duct pressures below 100 psi. A cruise/climb profile was then established to obtain the maximum range at the best-range altitudes. A deceleration was then initiated that allowed the aircraft to establish thermal equilibrium at flight idle-power settings back to a 30,000-foot altitude and Mach 0.8 airspeed. Reserve fuel, sufficient to maintain a time of 20 minutes loiter, would enable rendezvous with the tanker. Figure 1 shows this mission profile.

DESCRIPTION OF VEHICLE

This research effort is directed towards achieving an aircraft with maximum range at a cruise Mach number of 5.0. A waverider shape was selected for this study because of its good blend of volumetric efficiency and high lift-to-drag (L/D) at the design cruise Mach number. The basic shape was formed using the Quickwave code (Ref. 4). Modifications to this shape were necessary so that practical design considerations could be integrated into the aircraft. Figure 2 shows a three-view drawing of the aircraft. Blending of the engines, tails, and cockpit are indicated in figure 3 which shows the well-shaped area distribution curve for the aircraft. Pertinent vehicle dimensions and areas are given in table 1. Other integration issues that have been addressed are discussed in reference 5. A comparison of the size of the proposed waverider aircraft is presented in figure 4. Even though the vehicle has the approximate weight of a B-767 transport, the actual size is considerably smaller.

It was assumed that the airplane would be powered by four turboramjet engines. The STRJ-1011 powerplant system was supplied by Pratt & Whitney and is based on current technology (gen 5) using endothermic fuel. The turbojet would operate from take-off to turbojet/ramjet transition (approximately Mach 2.0-3.0). The ramjet engine is to be started at a low supersonic Mach number and operated in parallel with the turbojet through transition, after which the ramjet would operate alone to complete the high-Mach acceleration and cruise.

AERODYNAMIC ANALYSIS

The geometry definition was developed using the computer-aided design (CAD) tool ACAD. Preliminary aerodynamic data for the Mach 5 cruise aircraft was generated using Aerodynamic Preliminary Analysis System (APAS II) (Ref. 6) which features Unified Distributive Panels (UDP) for subsonic, transonic, and low supersonic analysis and Hypersonic Arbitrary Body Program (HABP) for hypersonic analysis. Data generated include aerodynamic forces and moments for all Mach numbers as well as heating rates and temperatures for hypersonic cases. Aerodynamic lift coefficient is shown in figure 5 for 0 and 6 degrees angle-of-attack.

Transonic analysis for this type of configuration pushes the limits of applicability of the UDP code, which is based on slender body theory. Additionally, in order to account for the engine cowl's external wetted surface, while excluding the inlet ramps and nozzle, (which were bookkept in the propulsion calculations), the aircraft had to be modelled as a wing-type geometry (i.e. streamwise cross-sections) using a relatively coarse panelling. This resulted in unreasonably high wave drag. A comparison between wind-tunnel data for a similar waverider shape (Mach 4 design point, Fig. 6 from data in Ref.7) and UDP analysis of these shapes indicate that while lift is predicted reasonably well, drag is overpredicted by 50 percent to 100 percent. Correction factors were therefore applied to the drag coefficients that were calculated by UDP up to Mach 3.0. Figure 7 shows the drag coefficient as a function of Mach number for angles-of-attack of 0.0 and 6 degrees. All drag coefficients shown in figure 7 were calculated for 50,000 feet. Note that all of these figures depict airframe lift and drag only (i.e. ignoring inlet ramps, internal engine and external nozzle surfaces).

Data at Mach 4 and above were derived using HABP. For a confined flowfield configuration such as the waverider-like design herein, at the on-design condition ($M=5.0$, $\alpha = 0$ deg.), the HABP doesn't predict the static pressure on flow-aligned surfaces, thus possibly underestimating lift for the present configuration at the design point. For a Mach 6 waverider configuration vehicle (Ref. 8), this neglected L/D increment was a positive 15 percent assuming a fully turbulent boundary layer (any portion of laminar flow would increase this increment). Therefore, the L/D performance at the design cruise conditions based on the HABP could be conservative.

Tables of lift, pitching moment, and drag coefficients were calculated for several sets of Mach numbers, altitudes, and angles-of-attack, to be used for trajectory analysis. Control surface effectiveness was calculated by physically deflecting the aileron flap geometry and generating a new configuration for each angle desired. The resulting force and moment data were then subtracted from the undeflected case data to produce tables of "deltas" for use in trimming the aircraft (pitch plane) during trajectory analysis.

PROPULSION INTEGRATION

The integration of the propulsion system is a primary driver in developing the layout of the configuration.

The entire length of the vehicle undersurface can be considered part of the propulsion system. The waverider forebody is the first compression ramp and provides a clean, uniform compression flowfield for the propulsion system. The engine modules must be integrated in such a way as to fully utilize this beneficial waverider characteristic. Complicating this integration is the need for a high expansion area nozzle for efficient high-speed performance. The installed propulsion configuration presented here is a result of a synergistic optimization of several design parameters. These are (1) achieving a prescribed inlet-to-exit area ratio, (2) integration of an external expansion nozzle with an optimum expansion ratio, (3) the minimization of aft body base area for transonic efficiency, and (4) a desire to efficiently capture the conical inlet flow while utilizing highly efficient, easily optimized 2-D (right rectangular cross-section) inlets and nozzles.

In an attempt to reduce the complexity of the design as much as possible, an over/under turboramjet (the Pratt & Whitney STRJ-1011) with a subsonic splitter was selected. This choice simplifies the analysis process as well as reduces mechanical complexity. Future iterations of this design may incorporate more advanced propulsion concepts if the benefit potential is great enough to offset the risk.

Inlet Design. Theoretically, the conical shock waverider forebody provides a near-perfect flowfield for ingestion into a propulsion system. Unfortunately, the realities of propulsion design create a disconnect between the 3-D conical flowfield and the convex cross section of the waverider forebody and the probability that only 2-D variable geometry inlets can be built within reasonable weight limitations. Figure 8 indicates the complexity (potential weight gain) of a 2-D inlet is extensive. The increase in complexity and weight required for a 3-D inlet system, however, would add unacceptable risk to the design. A practical solution to this problem was devised that allows the use of 2-D modules to capture the 3-D flow from the waverider without a significant sacrifice in performance.

Preliminary analysis of the inlet flowfield indicated a need for compression beyond what was provided by the waverider flowfield. This additional compression requires an external inlet ramp system to be devised that not only provides the needed compression ratio but transitions the inlet flowfield from 3-D to 2-D. Inlet strakes are incorporated to isolate each inlet in case of an unstart or engine-out condition in one module. The outboard strakes are extended forward to the first auxiliary inlet ramp to control side spillage. The cowl is fixed so flow control in the inlet is to be accomplished by the variable ramp system. A splitter that controls the capture flow division between the turbojet and ramjet is located behind the inlet throat.

A boundary-layer diverter was integrated just forward of the first external inlet ramp to remove the low energy boundary-layer flow during turbojet operation only. This may not preclude the need for bleed internal to the inlet but will minimize the volume required, thus, simplifying the bleed system. Installed engine performance includes penalties for the forward bleed system and for eight percent internal inlet bleed even though no internal system is shown at this time.

To better optimize the inlet system on this vehicle, the inlets conform to the 3-D flowfield and convex cross-sectional shape of the waverider body at the inlet station. However, it was found desirable to use a completely 2-D (horizontal cross-section) external nozzle design. A way of integrating these seemingly incompatible design drivers was devised which benefited other aspects of the vehicle optimization. A long subsonic diffuser was used to transition the flow from the wrap-around arrangement of the inlet modules to the 2-D horizontal nozzle arrangement. The long diffuser also brought the inlet further forward on the waverider forebody, thus, pulling the engine and nozzle up. This reduced both the maximum cross-sectional area and the aft base area of the vehicle, significantly improving the transonic performance of the design.

Nozzle Design. The turbojet, turbojet augmenter, turbojet nozzle, ramburner, ramjet-nozzle, and external expansion nozzle were aligned in a 2-D arrangement, resulting in a simplified nozzle design, as well as structural design. The external nozzle is designed as a single, large expansion surface with a 15:1 expansion ratio. Sidewalls were incorporated only on the outer edges of the nozzle with no inter-module separators used beyond the internal ramjet nozzle.

For low-speed operation, the design incorporates some features to maximize the turbojet nozzle efficiency and decrease the boat-tail drag. As seen in figure 8, a door opens to allow the turbojet nozzle flow to exit to the external nozzle just above the ramjet nozzle. The low-pressure diverter air is dumped into the external nozzle just above the turbojet exit, and high-pressure air, taken off the turbojet, is injected between the turbojet exit and diverter flow to create a slip stream between these flows. As conceived, the ramjet will be started at approximately Mach 2.0. When the turbojet shuts down at Mach 2.5, the turbojet nozzle exit doors seal shut, leaving a large, unobstructed expansion surface.

PROPULSION SYSTEM INSTALLED PERFORMANCE

The choice of the over/under turboramjet propulsion system, with the accompanying variable geometry inlet and internal flow divider, allows proper airflow control (airflow split, etc.) for the turboramjet combination. Assuming this airflow control capability, LeRC generated the installed performance (including engine flowpath moments) for the Mach 0 to 2.5 flight region using uninstalled turboramjet performance data furnished by P&W. No angle-of-attack effects were calculated for this data. For the ascent, the turbojets are operating at maximum throttle until they are shut off at about Mach 2.5. The inlet/engine system size was controlled by the Mach 1.0 to 1.2 vehicle drag levels which produced a turbojet engine with 34,000 pounds of installed sea-level static thrust at maximum afterburner. Turbojet engine performance was also generated for idle power settings for the descent portion of the trajectory. The ramjet performance (including engine flowpath moments) from Mach 2.5 to 5.0 was generated at LaRC using a version of the SRGULL code (Ref. 9). This code was used to generate the airflow values for the conical flowfield of the on-design Mach 5.0 waverider. For the Mach 2.5 to 5.0 ramjet performance, the off-design effects of angle-of-attack and Mach number were estimated assuming a conical forebody to approximate the flow distribution entering the 2-D ramp system. The minimum Mach number and maximum fuel equivalence ratio at which the ramjet can operate is controlled by the available combustor area ratio. Within these limits, ramjet operation is assumed to begin about Mach 2.0 with the ramjet side of the flow being used essentially for turbojet flow control below Mach 2.0 and to minimize capture flow spillage. For the ascent, the ramjet is operating at maximum fuel equivalence ratio and enthalpy level of the capture flow.

The maximum-thrust ascent produces minimum time to Mach 5.0, but the acceleration rate of the vehicle is too low for efficient performance. Values of thrust and specific impulse for the optimized trajectory are shown in figures 9 and 10. Thrust and specific impulse computations, when both the turbojet and ramjet are operating simultaneously, are problematic because it is difficult to decide how much of the inlet and nozzle losses to bookkeep to each system.

THERMAL CONTROL AND FUELS

Endothermic fuels are needed to provide the necessary heat sink for cruise at Mach 5.0 and deceleration. Methylcyclohexane (MCH) and an advanced paraffin fuel were considered. The paraffin fuel was chosen because it had a much higher flash-point temperature.

Both direct and indirect fuel cooling were used in the design. In either case, a catalyst is needed to promote the endothermic chemical reaction of the fuel. The thermal management system is shown in figure 11. Direct fuel cooling is used in the ramburner and nozzle where the heat load is highest. For these areas, the catalyst is installed on the inside of the superalloy cooling panels. The location of panels with direct fuel cooling is shown in figure 12. Indirect cooling is used for the inlet, avionics, and turbojet engine bay, and a catalytic heat exchanger reactor (CHER) is employed to transfer heat from the secondary fluid to the fuel and promote the chemical reaction. The secondary fluid is Syltherm 800, a low viscosity, heat-transfer liquid and is described in reference 10. The inlet has integral titanium alloy cooling panels with insulation and a cobalt L-605 heat shield. The inlet cooling concept is shown in figure 13.

A schematic of the cooling system, as modeled in the thermal management system, is shown in figure 14. Power for the fuel pump and other aircraft systems requirements are derived from the turbine shaft while the turbojet is operating and from a fuel expansion turbine when the ramjet is operating. Both sources are available during transition. Analysis has shown that the power generated by the fuel turbine is much greater than the power needed to drive the fuel pump during Mach 5.0 cruise. Engine start and engine-out power will be obtained from an auxiliary power unit (APU). Results of the weight optimization study of the inlet cooling concept are shown in figure 15. The ramjet combustor and nozzle cooling circuit was analyzed using a computer program called NASP/SINDA (Ref. 11). Fuel properties were obtained from the Supertrapp fluid properties software (Ref. 12).

One of the most difficult problems for the thermal management system is cooling of the aircraft during high-speed deceleration. Thrust must be reduced which results in less fuel needed for combustion, while the heat loads remain high. The heat load to the combustor is reduced by turning off the outer fuel injectors. A layer of air would act as film cooling near the wall with combustion taking place in the center core of the ramjet combustor.

AIRFRAME STRUCTURE DESIGN AND ANALYSIS

Structural Concept and Materials. The Mach 5 cruise aircraft was designed as a hot structure with integral tanks lined with insulation and containing flexible fuel cells. This concept was selected by GD for its simplicity, high structural efficiency, light weight and leak-free fuel containment.

Honeycomb sandwich panels were selected for airframe skins because they provide a lightweight structural solution requiring only modest ringframes between the major frames and bulkheads. This concept uses skin panels typically 42 inches wide by several feet in length that are welded to intermediate frames to create large panel assemblies. This approach provides lighter joints and improved vehicle smoothness which should reduce drag and local heating. Figure 16 illustrates the structural wall concept for the airframe.

Material choice for the airframe structure was driven by the maximum structural temperatures resulting from aerodynamic heating (mostly 800-900°F). This allowed the use of a monolithic titanium alloy, Ti 6242, which provides reasonable strength and modulus of elasticity. Wing and tail leading edges are more severely heated (1,300-1,500°F), so a metal matrix material is used which has silicon carbide fibers in a titanium-aluminide alloy matrix with a maximum temperature capability to 1,500°F.

Fuel Tank Concept and Materials. The chosen design uses flexible fuel cells within the integral tank. This allows the airframe to be completely assembled before installing the fuel cells, simplifying construction. Also, these tanks will be lighter than an equivalent, conformal graphite epoxy tank. Finally, since standard fuel cell materials can be used at the desired operating temperature (<250°F), their use will further reduce cost and weight. Rigid insulation will be used to protect the fuel cells from the hot airframe. The insulation scheme selected is depicted conceptually in figure 17.

Structural Analysis. Structural analysis of the Mach 5 cruise aircraft was accomplished using the finite-element structural analysis code, MSC/NASTRAN. The finite-element model (FEM) described here was developed from the configuration surface geometry with additional features for the internal structure obtained from the structural design layout within the CAD database. The resulting FEM surface definition also provided the model for use in developing inertial and aerodynamic load data.

The aircraft mass distribution was applied to the entire vehicle model as a function of cross-sectional area versus length. The distributed mass included all of the initially predicted dry weight. The fuel masses were applied in the location of the fuel tanks as a function of the volume of each tank. Fuel was assumed to be burned uniformly from all tanks.

Loads analysis was done with the objective of reasonably bounding the required vehicle design envelope. Simplifying assumptions were made to limit the extent of analysis to a level consistent with advanced conceptual design. Therefore, twelve load conditions were selected from taxi through Mach 5.0 to represent the design envelope. The structural FEM, as shown in figure 18, consisted of 2,291 elements with 4,446 degrees of freedom (D.O.F.).

Structural panel sizing was accomplished using GD proprietary computer codes, which work with the NASTRAN FEM data and force output, to size each structural element. The panel sizing code uses temperature dependant material properties and generates panel forces due to the applied thru-thickness temperature gradients. Initially, the 0.020 inch minimum facesheet thickness of the Ti 6242 honeycomb sandwich panels appeared thick, but the combination of heavy biaxial loads and tank pressurization resulted in reasonable utilization of the material and the costly practice of chemical milling to get thinner gages was thereby avoided. Additionally, the extensive use of welded-in-place frames reduced the amount of parasitic panel close-out material normally associated with joints in mechanically fastened honeycomb sandwich-panel construction.

Finally, a study was made to determine optimum frame spacing. This study evaluated the weights for the honeycomb skin, as well as the frame, based on strength and global buckling checks at frame spacings of 36, 42, and 48 inches. It was determined that a spacing of 42 inches was optimum.

Aeroheating Analysis. Aerothermal analysis of the vehicle consisted of two primary tasks: Providing local heat transfer data at specific locations on the fuselage and generating acreage heating data over the majority of the external vehicle surface for the entire design mission. Initial aerothermal analysis centered around providing preliminary heating data to allow determination of forward, middle, and aft tank bulk fuel temperatures. For most of this analysis, the GD ASHAB code was used to determine heating to the midpoint of each fuel tank on both the upper and lower fuselage surfaces. All predictions for the lower forebody portion of the preliminary fuel tank insulation analysis, the detailed thermal modeling, and the global heating analysis were performed using the new GD BART engineering code. BART is similar in concept to the NASA MINIVER code (Ref. 13) but provides additional flexibility in input and output.

A number of assumptions were required in performing the aeroheating analysis. Air was assumed to behave as a perfect gas in all flowfield calculations. The boundary-layer transition criterion was based on flow over a cone under the assumption that transition starts when momentum-thickness Reynolds number divided by local Mach number equals 150. The length of transition was assumed to be 1.5 times the Reynolds number based on the length from the nose at transition. The Eckert reference enthalpy-turbulent heating method was used for turbulent acreage regions. For leading edge heating calculations, the laminar heating method of Fay & Riddell was employed. Radiation equilibrium wall temperatures (RETs) were calculated assuming a surface emissivity of 0.80. Calculations were made for 880 body locations at each time step in the trajectory.

Conical flow Mangler transformation factors were used over the entire geometry and raised peak RETs by approximately 30°F in turbulent regions, and by almost 300°F in the laminar regions compared to the flat plate assumption. Tangent cone pressures were used for all locations. Initially, discrete conical shocks were employed for each of the compression ramps in the inlet, but due to the reduction in local Mach number through the series of shock waves off each ramp, it was discovered that the resulting surface pressures were actually lower than if the shocks were ignored. For conservatism, the inlet ramps were treated simply as body panels without additional treatment for ramp shocks.

Preliminary heating analyses for discrete geometric locations were performed on both the upper and lower fuselage. Figure 19 shows peak RETs for the upper and lower centerlines of the vehicle. Boundary-layer transition occurred relatively early for both centerlines, near fuselage station (FS)135. The propulsion flowpath compression ramps were considered part of the inlet structure and were actively cooled, so the RETs shown in that region were not used to size insulation. The upper centerline showed an initial peak of 1,022°F as the flow became turbulent on the face of the cockpit bulge, but as the flow expanded over the top, the RETs decreased to approximately 590°F at the end of the bulge. By FS 906, a recompression had taken place which increases RETs to approximately 750°F on the aft upper fuselage. A final expansion occured at the trailing edge of the vehicle, dropping RETs sharply. Heating was reasonably uniform on the lower forebody, with a drop in RETs inboard of the leading edge where the boundary layer remained laminar.

Figure 20 shows representative equilibrium temperature time histories for four spanwise locations at or near FS 500. Of primary interest in this figure are the rapid heat-up and cool-down rates near the beginning and end of the mission and the very long cruise time during which the vehicle is exposed to near-maximum heating. The slow decrease in lower-surface RETs and increase in upper-surface RETs during the cruise phase was due to a steady drop in angle-of-attack as the vehicle fuel load was consumed.

Thermal Analysis. The thermal modeling effort consisted of two tasks. The first was a preliminary evaluation of insulation requirements to maintain fuel temperatures below vaporization levels for the tank pressurization schedule. The second focused on detailed thermal modeling of the proposed structural concept to ensure that internal structural temperature limits for the fuel tank bladder were not exceeded and to determine temperature gradients in the honeycomb structure for vehicle structural analysis.

A preliminary analysis was conducted to determine insulation requirements to limit fuel temperatures to the lowest saturation temperature consistent with the in-flight tank pressurization scheme. The insulation selected was Manville Min-K (Type 1301). The lowest saturation temperature corresponded to 280F which would occur at a minimum tank pressurization of 4 psia.

A one-dimensional, transient SINDA model was formulated for each of the three regions of the tank: forward, middle and aft. The decrease of fuel mass in the tanks due to fuel consumption was considered in the analysis. The lower fuel cell surfaces of the tanks were assumed to be completely wetted by the fuel for the duration of the mission. The upper fuel cell surfaces of the tanks were assumed to be uncovered by the fuel and could only radiate to the lower surface and subsequently to the fuel. The final results indicated an insulation thickness of 0.75 inches for the bottom surfaces of the vehicle and 0.50 inches for the top surfaces. The resulting fuel temperatures did not exceed 260°F, except marginally in the nozzle region late in the flight.

The second thermal analysis task was to calculate the outer honeycomb facesheet temperatures, the inner honeycomb facesheet temperatures and the average temperatures for the joint/frame members. A primary concern was the variation in honeycomb core height throughout the vehicle. The variation was required to meet local structural requirements. To predict the required temperatures and gradients, a thermal/structural analysis was performed.

The structural wall concept is shown in figure 16. A major concern was the choice of insulation for use between the honeycomb panel and the fuel tank. The purpose of this insulation was to minimize the heat absorbed by the fuel and to maintain the flexible fuel cell under its temperature limit. Structurally the insulation must be capable of compressive loading from fuel weight and tank pressure, which focused attention away from conventional blanket insulations to moldable insulations. A moldable form of Min-K 1301 was chosen for use as the primary insulation. It is suitable for continuous use at temperatures up to 1,300°F. To protect the moldable insulation from mechanical abrasion or erosion, the insulation was wrapped with quartz fiber bagging to minimize direct contact between the insulation and the vehicle structure. Additionally, 1/4 inch of Pyropel MD-12 insulation was substituted immediately next to the flexible fuel cell. This material is a rigidized polyimide fiber felt and will assist in evenly distributing the compressive loading on the Min-K. MD-12 is usable up to 550°F for continuous operation.

A review of external heating conditions and honeycomb panel requirements identified five locations on the vehicle which bounded the range of heating conditions and the thru-thickness gradients due to the heating. They were FS 435 (upper surface), FS 514 (lower surface), FS 559 (lower surface), FS 900 (upper surface) and FS 1,400 (upper surface). These locations were thermally modelled and analyzed considering honeycomb core heights of 0.5 inches, 1.0 inches and 1.5 inches. A two dimensional SINDA thermal model was constructed of the joint/frame area of the vehicle. The model had approximately 300 nodes and 550 conductors.

Heat transfer through the honeycomb core was modeled utilizing an effective thermal conductivity which accounts for combined conduction and radiation effects. Modeling the fuel presence was necessary because it moderates the bladder temperature response. It was assumed that the upper portion of a fuel cell could only radiate to the fuel mass or through the fuel to the bladder portion of the tank underneath it. For the lower portion of the bladder, a convection coefficient of 25 BTU/hr*sq.ft.*°F was used to thermally connect the bladder to the fuel temperature.

The detailed thermal modeling confirmed the results of the earlier insulation sizing. An insulation thickness of 0.5" was used in modeling the upper portions of the fuel tanks. This thickness maintained fuel cell temperatures below their limit. Likewise, an insulation thickness of 0.75" was found to be adequate for the lower surface. Substitution of MD-12 insulation for a portion of the Min-K insulation had no significant impact on overall structural temperatures.

Results of the detailed thermal analysis indicate that the previously calculated RETs were only about 20°F to 50°F higher than the predicted surface temperatures from the thermal model. Therefore, the RETs could be conservatively used for outer facesheet temperatures at all locations on the vehicle. Analysis results from the run matrix were tabulated as honeycomb core gradients versus outer facesheet temperature. A nearly ideal linear variation of thru-thickness gradient with outer facesheet temperature was observed for any given core height. Figure 21 shows a typical set of those plots. These relationships were utilized to define the structural temperature gradients as a function of core height for use in the structural analysis. In a similar manner, a gradient was defined between the outer surface temperature and a point located at the center of the splice/frame support.

PROPULSION STRUCTURE DESIGN AND ANALYSIS

Figure 8 shows the two-dimensional layout of the propulsion geometry. The propulsion structure must provide integrated loadpaths and must also be designed to accommodate the kinematics and react the loads of the variable geometry. In order to compute internal forces and moments used for structural design, a complex finite-element model (FEM) of this geometry was created as shown in figure 22, except for turbojet inlet and afterburner ducts which are addressed in a following section. The completed FEM consisting of 2,205 elements and 6,000 D.O.F. was loaded and analyzed for Mach 2.5 and 5.0 flight conditions and every structural panel was loaded with the appropriate operating pressure and temperature. The temperature of the structure was set equal to the backside temperature of the cooling panel which was calculated in the thermal management system analysis.

The MSC/NASTRAN model was used to compute internal forces and moments for each load case. These loads were utilized in ST-SIZE, a LaRC developed code (Ref. 14), to perform the structural sizing of every element in the FEM. Resulting element sizes were used to create new FEM properties and the analysis repeated in an iterating fashion until the structural weight converged. All analysis was performed using temperature-dependent material properties (from Mil Handbook 5) for the titanium alloy material, Ti 6242.

Final structural weights are determined by estimating those weights not directly addressed by the structural model. These weights include such components as actuators, insulation, heat exchanger panels, and manifolds and plumbing. Actuator weights were estimated based on current technology ball-screw actuators.

The turbojet inlet and afterburner ducts were not included in the main FEM because they were each designed of different materials and required statically determinate, independent mounting schemes to allow for the differential thermal growth. These ducts were sized with independent FEM's. With the duct pressures encountered, the minimum weight design is a ringframe stiffened honeycomb. The inlet duct was chosen to be unprotected graphite polyimide with a 20 inch nominal ringframe spacing.

The afterburner pressure case was constructed of Inconel 718 with a 10 inch ringframe spacing. Inconel 718 has excellent properties to about 1,200°F so the afterburner will be cooled with fuel to keep it below this limit. The resulting afterburner design required ringframes on a 10 inch spacing to contain the maximum internal pressure of approximately 60 psi.

WEIGHTS

The weight input for the aircraft is shown below in equations 1-6.

Dry weight,

$$W_D = W_{ST} + W_{PR} + W_{LDG} + W_{SUB} \qquad (1)$$

where $W_{ST}, W_{PR}, W_{LDG}, \text{and} W_{SUB}$ are the weights for the structure, propulsion system, landing gear, and subsystems, respectively.

Empty weight, $W_E = W_D + W_U$ (2)

where W_U is the useful load and is composed of the crew weight of 250 pounds, the payload of 10,000 pounds and trapped fuel.

Gross flight weight, $W_G = W_E + W_{PROP}$ (3)

where W_{PROP} is the propellant weight.

The structural analysis performed on the aircraft provides the basis for calculated structural weights; propulsion weights were provided by P&W. Empirical weight relationships are used on other areas such as subsystems, landing gear and trapped fuel. These weight algorithms were taken, in part, from reference 15 and are given below as:

$$W_{LDG} = .055\, W_E \qquad (4)$$

$$W_{SUB} = W_E^{.85} \qquad (5)$$

$$W_{TF} = 3.66 W_G^{.5} \qquad (6)$$

Table 2 provides a summary of the individual weights for the aircraft (with inlet bleed) with a gross weight of 551,052 pounds. This yields a gross propellant weight of 408,946 pounds. An assumed ullage factor of 4 percent gives a useable propellant load of 392,588 pounds and a propellant fuel fraction of 71.2 percent.

PERFORMANCE

To facilitate the analysis, the tanker-to-tanker mission was broken into three main segments: ascent, cruise and descent. The simulation was run using the NASA LaRC developed CSOTAV code. This breakdown facilitated the use of an energy method for ascent, a Breguet method for cruise and a reverse energy method for descent. A prescribed Mach-altitude profile was input for ascent observing the transonic dynamic pressure and the ramjet duct pressure limits. The cruise leg was to be flown at optimum altitude for maximum specific range, closely approximating a traditional Breguet cruise-climb profile. However, the ramjet duct pressure limit forced the vehicle to fly at altitudes higher than optimum initially, but as vehicle weight decreased, the optimum altitude eventually rose above this constraint. Descent was flown, upon a brief pull-up maneuver to lower dynamic pressure, from end of cruise to Mach 0.8 at 30,000 feet using minimum power settings. The vehicle was trimmed during the entire mission using elevons.

Start of mission gross weight and empty weight used in the performance analysis was 551,052 pounds and 142,106 pounds, respectively. Total useable fuel quantity for this design has been calculated at 392,588 pounds. Inlet boundary-layer bleed of 8 percent was assumed for the ramjet mode. This turns out to have a significant impact on range and will be discussed later.

Propulsive moments for the turbojet and turboramjet combinations were provided by LeRC up to Mach 3.0. The SRGULL code was used to generate moments for the ramjet mode from Mach 3.0 to 5.0. Basic untrimmed aerodynamic moments were provided by GD from Mach 0.8 to 3.0 and by in-house analysis from Mach 3.0 to 5.0.

Figure 23 shows the Mach-altitude schedule for this mission. Angle-of-attack and elevon deflection histories for ascent are shown in figure 24. Maximum elevon deflection during cruise was -5.9 degrees (trailing edge up) which was well within acceptable limits. Net thrust and drag histories and installed Isp and effective Isp histories can be seen in figures 25 and 26.

Maximum cruise range was achieved by operating at conditions where specific range (Rsp=V*L/D/sfc) was maximum. This entailed continuously adjusting the altitude as the vehicle weight decreased and resulted in a climbing cruise flight profile. As noted earlier however, the intial part of the cruise was done at constant altitude. Throttle settings were therefore a fallout for cruise by setting thrust equal to drag, where throttle setting is the fuel equivalence ratio (phi) for the ramjet. Equivalence ratio and altitude histories for cruise are shown in figure 27. Minimum phi at which burning can be sustained for the ramjet is .3.

Descent was performed by throttling back to minimze power setting. Due to the fact that the engines were sized to provide adequate thrust during acceleration, their minimum thrust levels were relatively high, resulting in low deceleration rates, and in turn led to a significant range for descent. It may be more efficient, however, to generate range during cruise using some of this descent fuel. This would require reducing minimum thrust somehow, thereby increasing deceleration rate and reducing deceleration time.

Total mission range for the case with ramjet inlet bleed is 5,905 nm where 740 nm is accrued during ascent, 3,769 nm is accrued during cruise and 1,396 nm is accumulated during descent as shown in figure 28. Fuel usage breakdown can be seen in figure 29. The mission was also flown assuming no inlet boundary layer bleed for the ramjet mode. The total range for this case is 7,600 nm. This, of course, is unrealistic because the inlet would have serious operability problems without bleed and only represents a limiting case. Shown in figure 30 are mission ranges for partially filled "as-drawn" vehicles for both ramjet bleed and no-bleed cases and are represented by the solid lines. This was a crude attempt at determining the range for smaller sized vehicles. The lines represent a lower limit since these vehicles carry excess weight and drag to contain the empty volume. The shaded area above these lines represent potential range improvements for down-sized vehicles.

A preliminary takeoff and landing analysis was performed to see if the vehicle meets the general requirements of MIL-C5011A. An empirical approach was used to determine the "balanced field length" distance (Ref. 16). This showed that for a gross takeoff weight of 400,000 pounds and a takeoff lift coefficient of .58, a takeoff distance to clear a 50-foot obstacle was 7,500 feet. The takeoff speed was calculated to be 209 knots which is well within the present tire design capability. A landing speed was calculated assuming a landing weight 5 percent greater than the empty weight and a 10° angle-of-attack. This resulted in an approach speed of 181 knots over a 50-foot obstacle clearance. Although this preliminary analysis does not include stability and control effects at high angles-of-attack, it does indicate a vehicle which has normal takeoff and landing characteristics.

CONCLUDING REMARKS

This effort represents the first iteration of a waverider-derived Mach 5 airplane design using fuselage integrated-underslung over/under turboramjets with endothermic fuel. This design study is comprehensive in that all major disciplines are considered and coupled, at least to first order. The initial results are promising in that a maximum tanker-to-tanker range (without inlet bleed) of approximately 7,600 nm was achieved for a gross weight of 550,000 pounds, an empty weight of 141,000 pounds and a vehicle length of 135 feet. The focus of this study was on an "as drawn" vehicle. No attempt has yet been made to scale down the aircraft to find the optimum range. Initial examination of range potential with reduced fuel load indicates downsizing may be desireable.

Much optimization is yet required to establish the full potential of this class of aircraft. The shape evolved mainly through aerodynamic considerations. Aerodynamic prediction methods that fully capture the waverider lift at the design point must be utilized. Also, the engine integration and engine sizing must be more influential in designing the vehicle in the next iteration, and overall vehicle sizing must be put into "play."

The impact of advanced technologies on the design must also be considered. For instance, the transonic drag, which sizes the turbojets, could be reduced dramatically if external burning of the endothermic fuel is a viable option. The engine weight and complexity could also be reduced with more advanced combined cycle propulsion concepts which would have higher thrust-to-weight potential. Redesigning the inlet to spread the shocks and thus eliminate or reduce the bleed would be a tremendous asset.

The airframe structural design/weight was based on monolithic, state-of-the-art, titanium material. Advanced composite titanium-aluminide materials being developed by the National Aero-Space Plane program would reduce the airframe structural weight substantially.

ACKNOWLEDGEMENTS

* Denis Medwick and the Hypersonic Aero Group at Pratt & Whitney for their work on the turboramjet propulsion system and engine cooling.

* Mike Barnhart and his Structures Technology team at General Dynamics, Fort Worth, for their effort developing the vehicle structural design.

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Overall Dimensions

Length	134.73 ft.
Span	74.70 ft.
Height	26.67 ft.

Areas

Body, planform	5744.0 ft^2
Body, wetted	9112.0 ft^2
Nozzle, wetted	442.0 ft^2
Inlet, wetted	223.0 ft^2
Nacelle, wetted	926.0 ft^2
Tail (ea), wetted	370.9 ft^2
Tail (ea), planform	180.7 ft^2
Elevon (ea)	238.0 ft^2

Tails

Aspect ratio	.347
Taper ratio	.212
t/c rout	.054
t/c tip	.089

Table 1. Basic aircraft dimensions

STRUCTURE		72,037
Vertical tails	1,850	
Airframe	42,125	
Engine primary structure	13,500	
Thermal	14,562	
Landing gear		7,816
Propulsion		25,314
Fuel system	1,127	
Ramjets	9,214	
Turbojets	14,973	
Subsystems		23,972
Dry weight		129,139
Useful load		12,967
Crew	250	
Residual fluid	2,717	
Payload	10,000	
Empty weight		142,106
Propellant weight		408,946
Gross weight		551,052

Table 2. Weight statement (with inlet bleed)

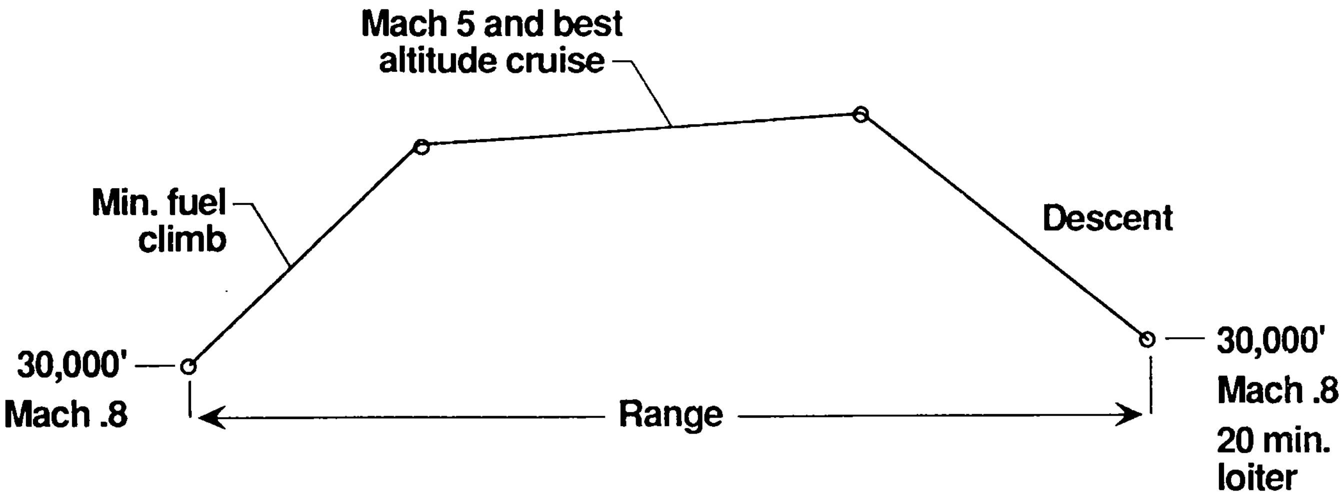

Figure 1. Tanker-to-tanker mission profile

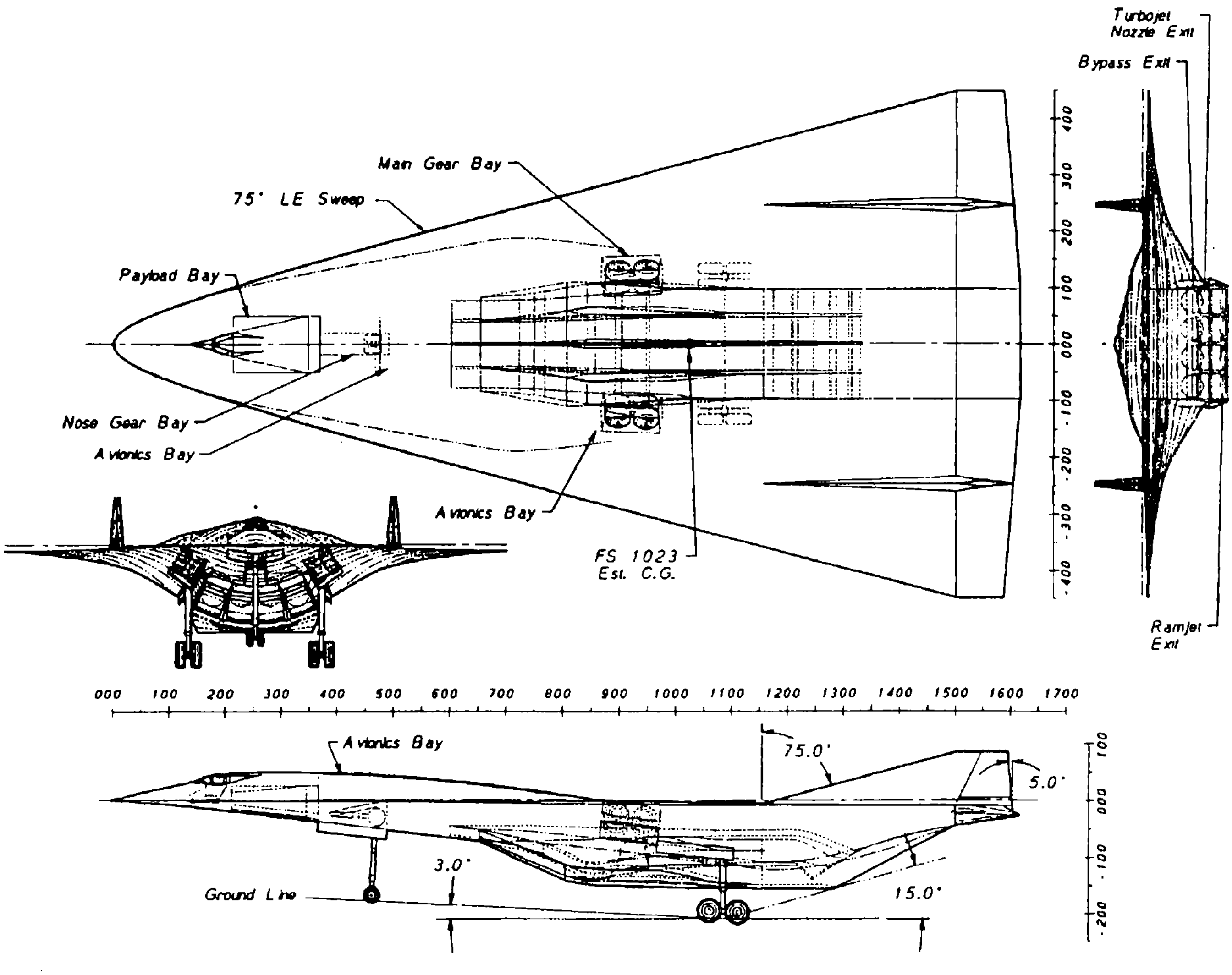

Figure 2. Aircraft three-view

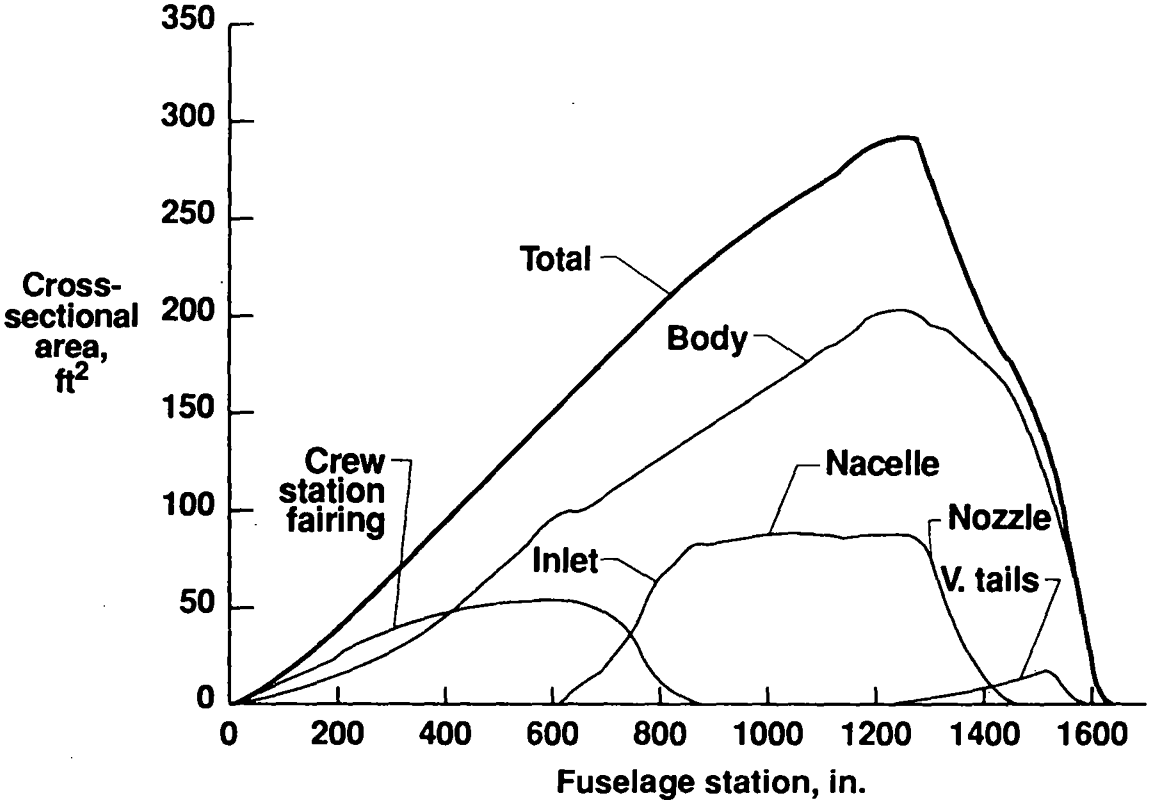

Figure 3. Aircraft area distribution

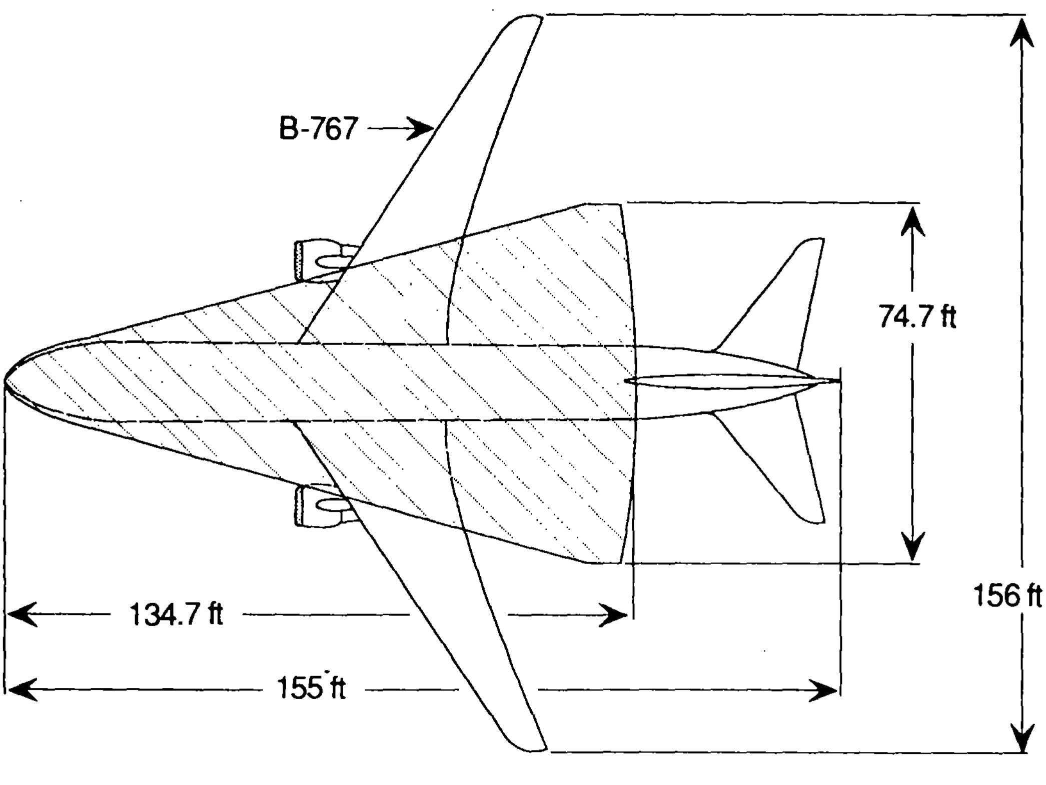

Figure 4. Vehicle size comparison

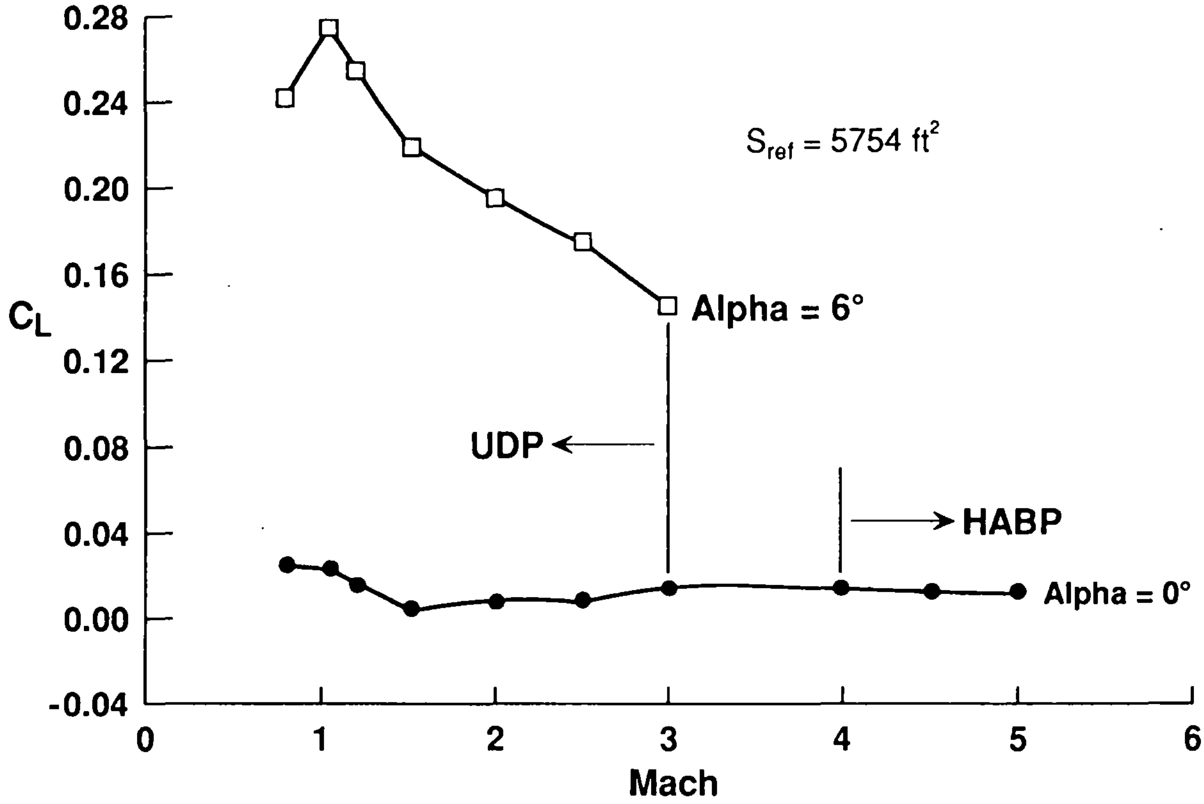

Figure 5. Airframe C_L vs Mach

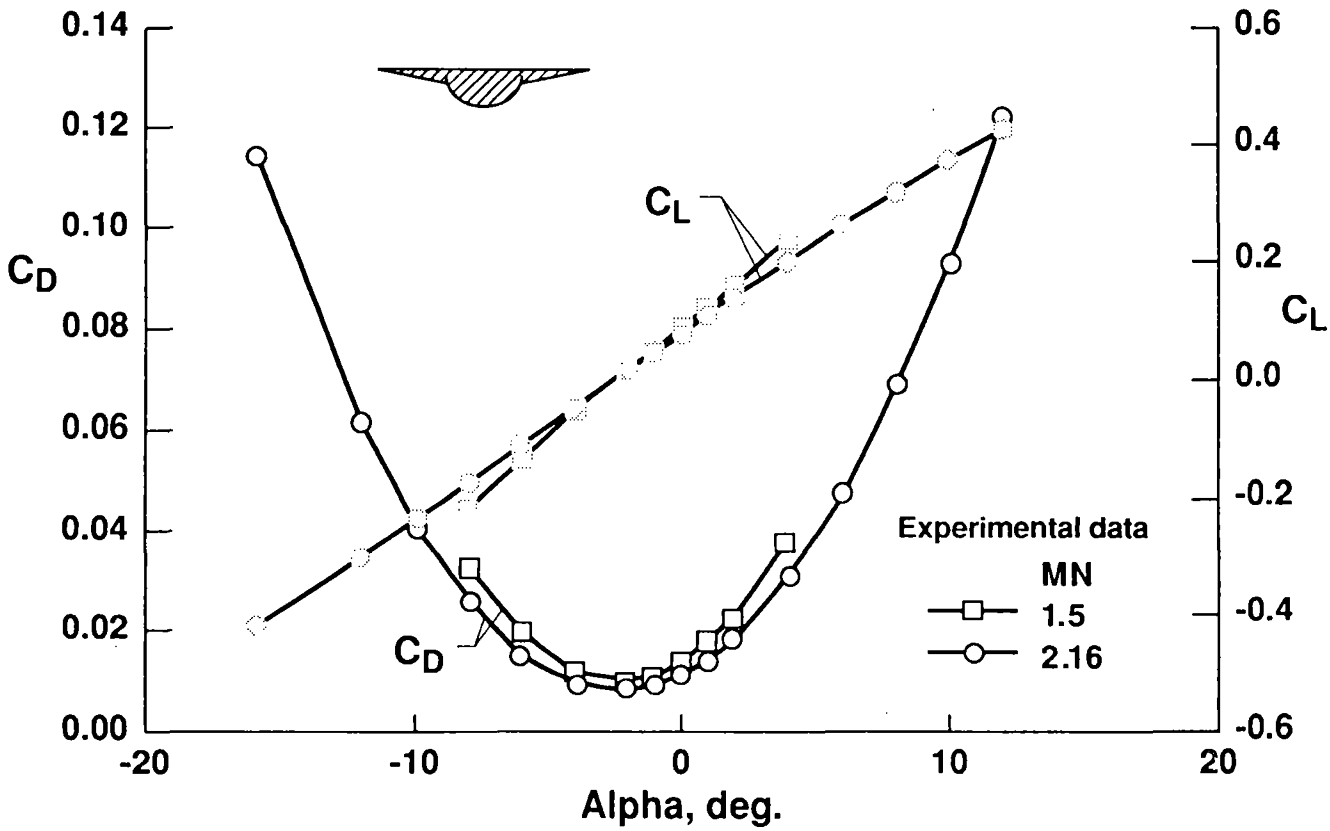

Figure 6. Reference flat top waverider windtunnel lift and drag characteristics

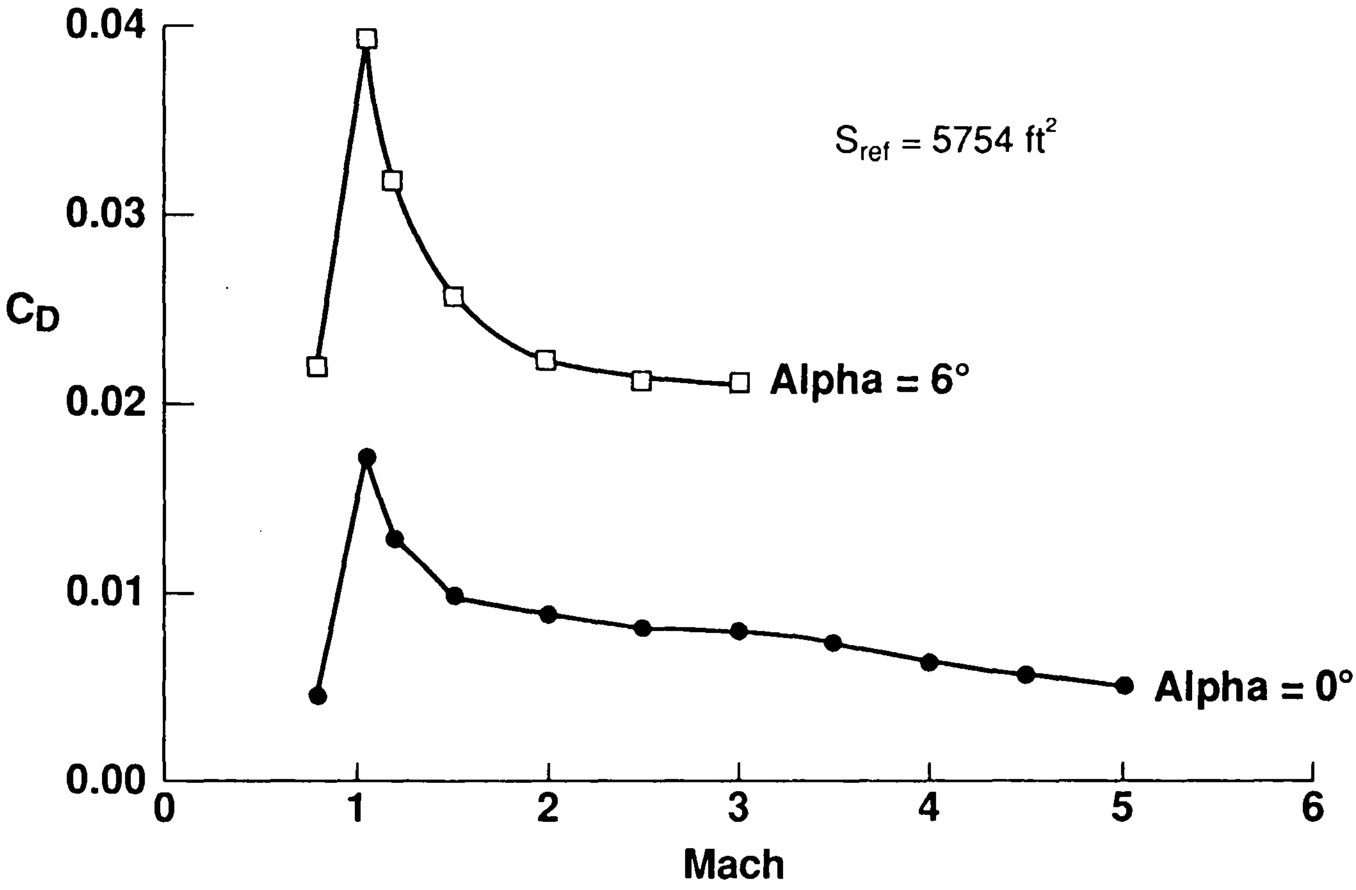

Figure 7. Adjusted airframe C_D vs Mach

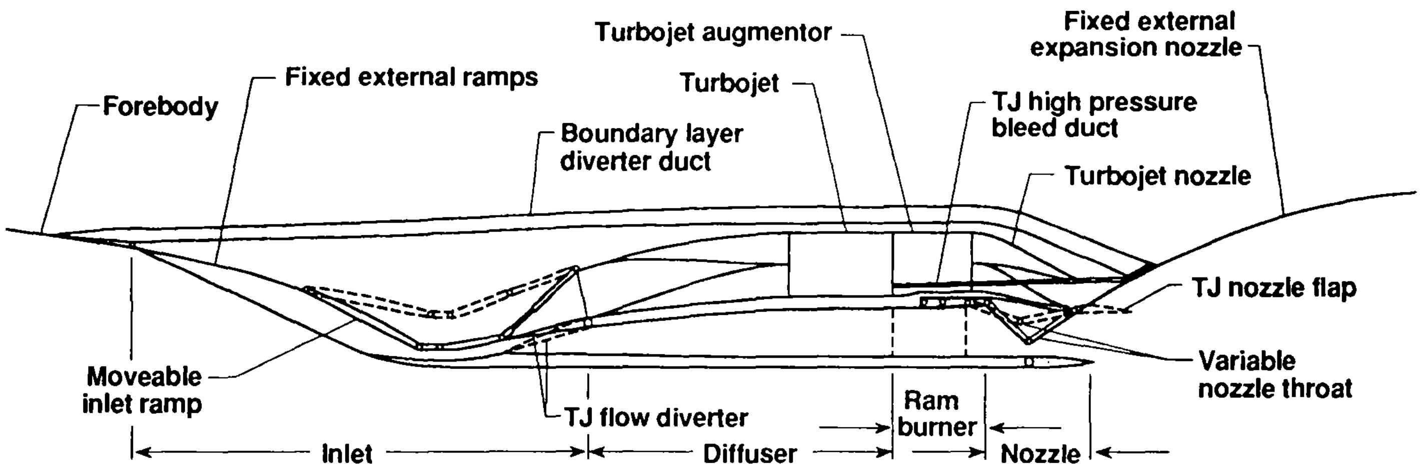

Figure 8. Propulsion system schematic

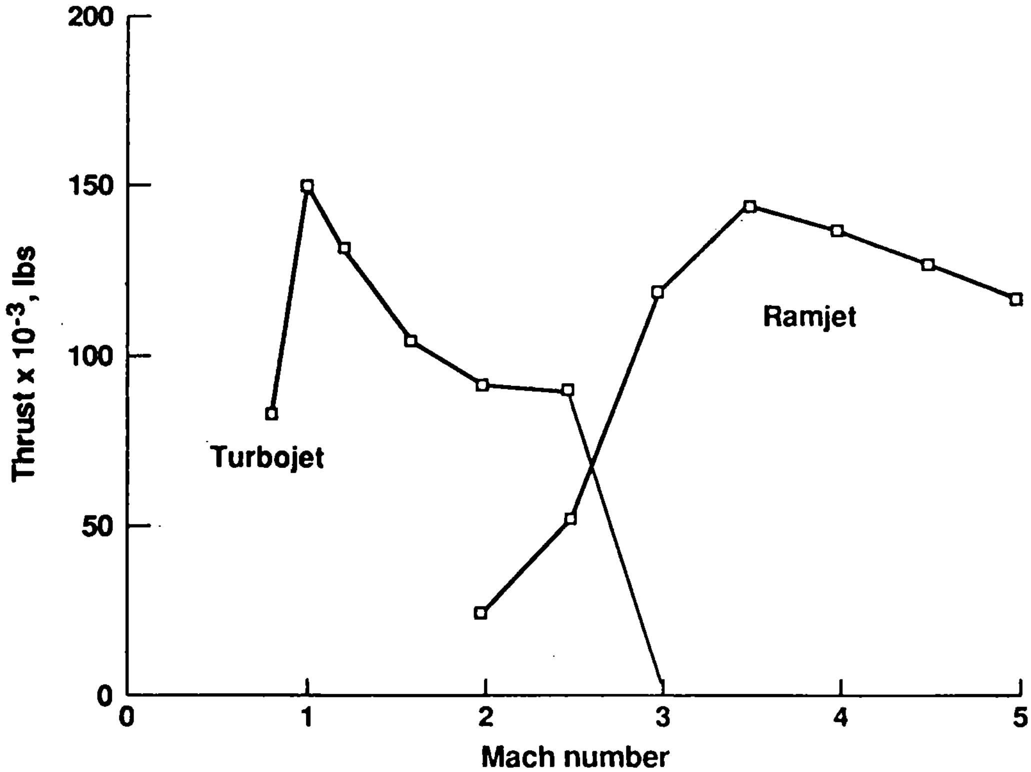

Figure 9. Ascent thrust

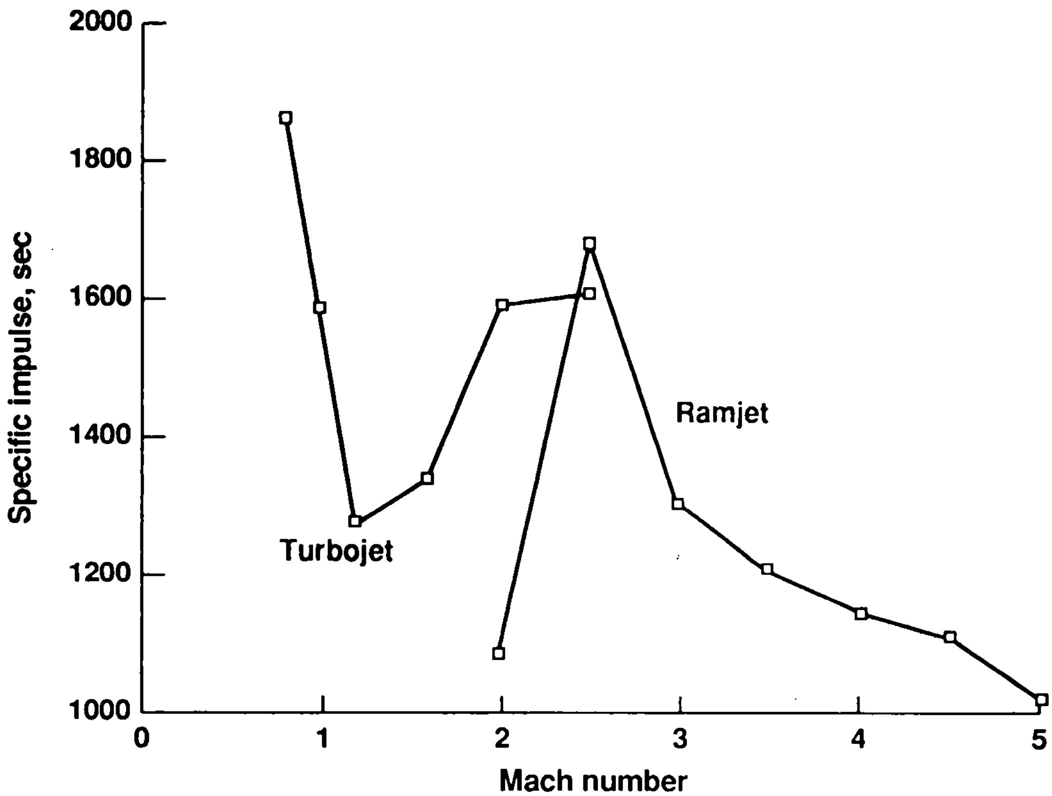

Figure 10. Ascent specific impulse

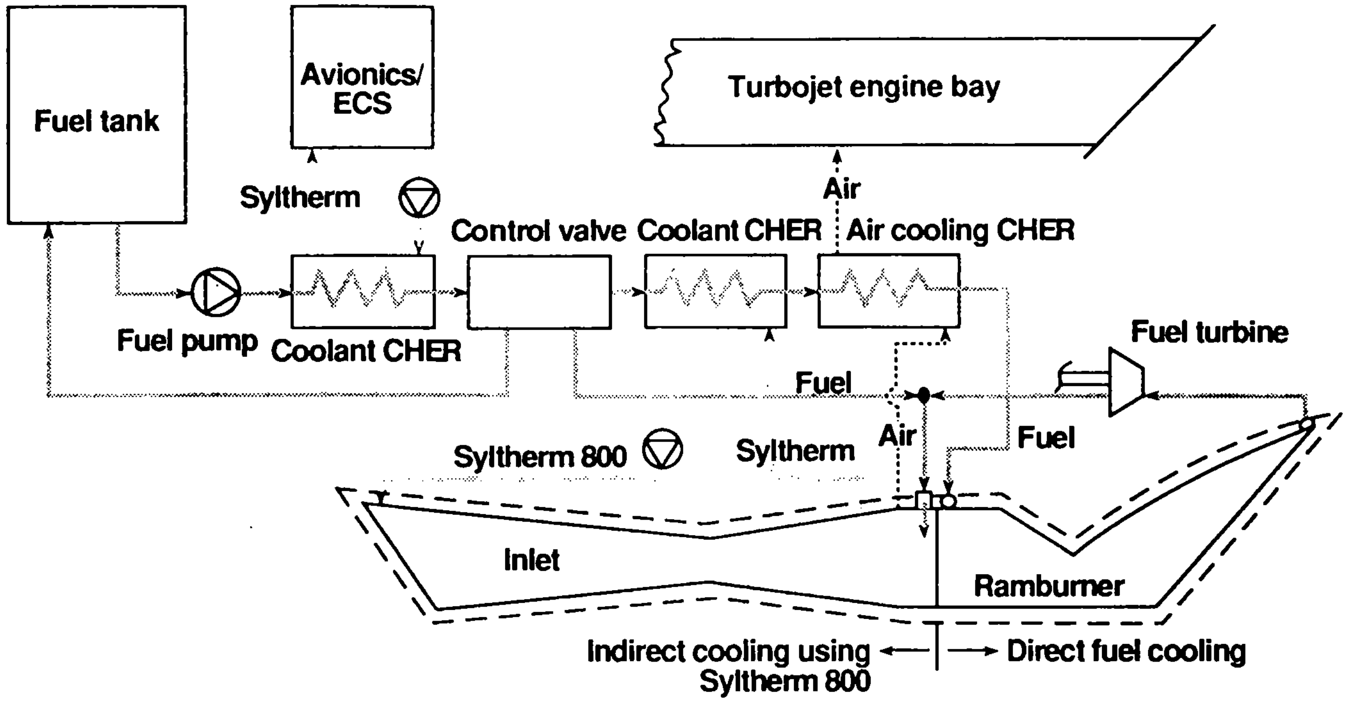

Figure 11. Thermal management system

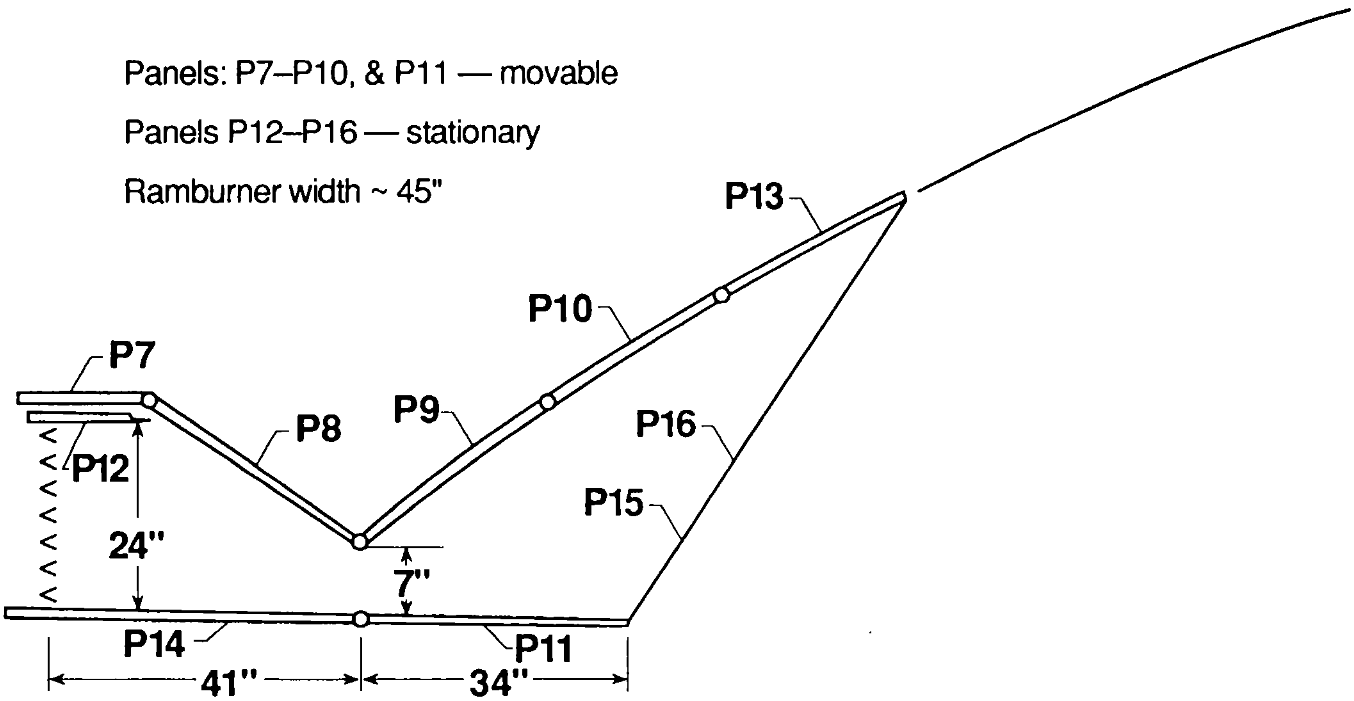

Figure 12. Location of cooling panels for ramburner and nozzle

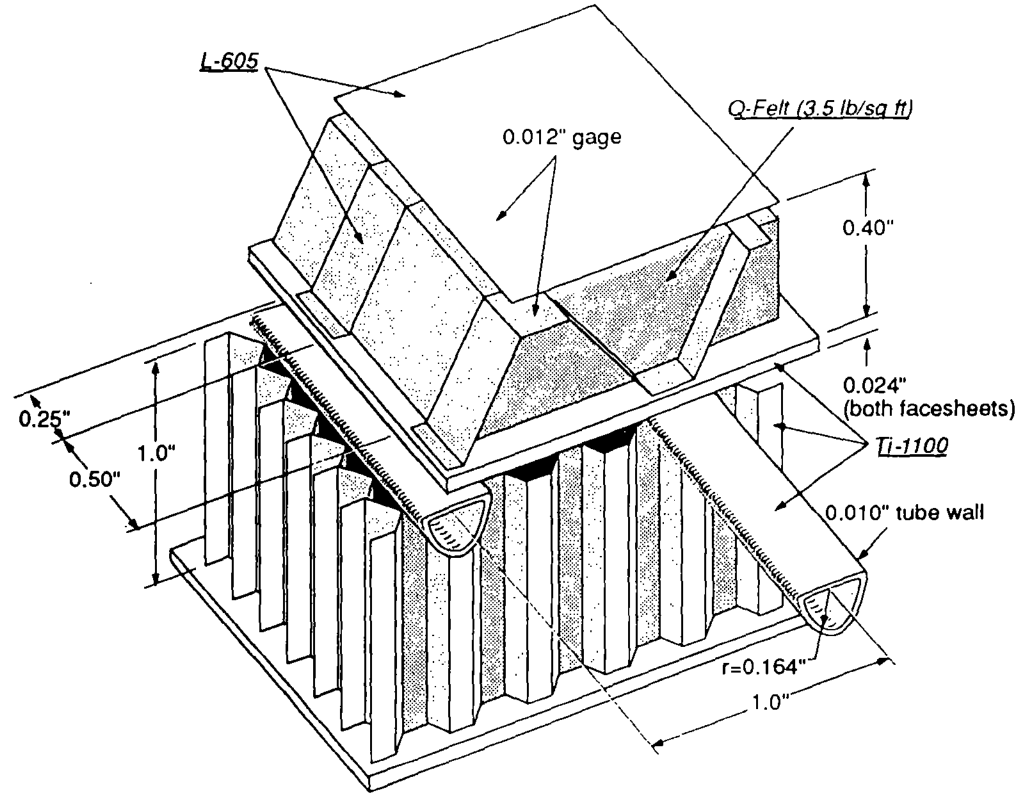

Figure 13. Inlet cooling panel over honeycomb structure

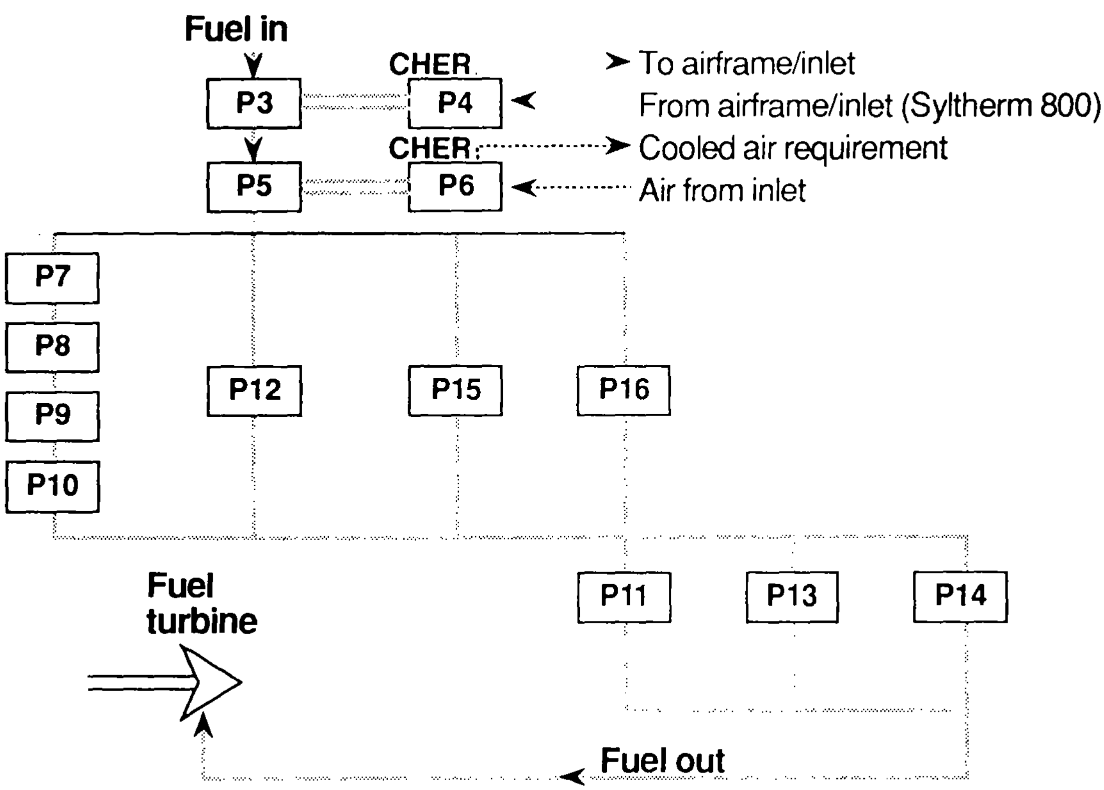

Figure 14. Active cooling system details

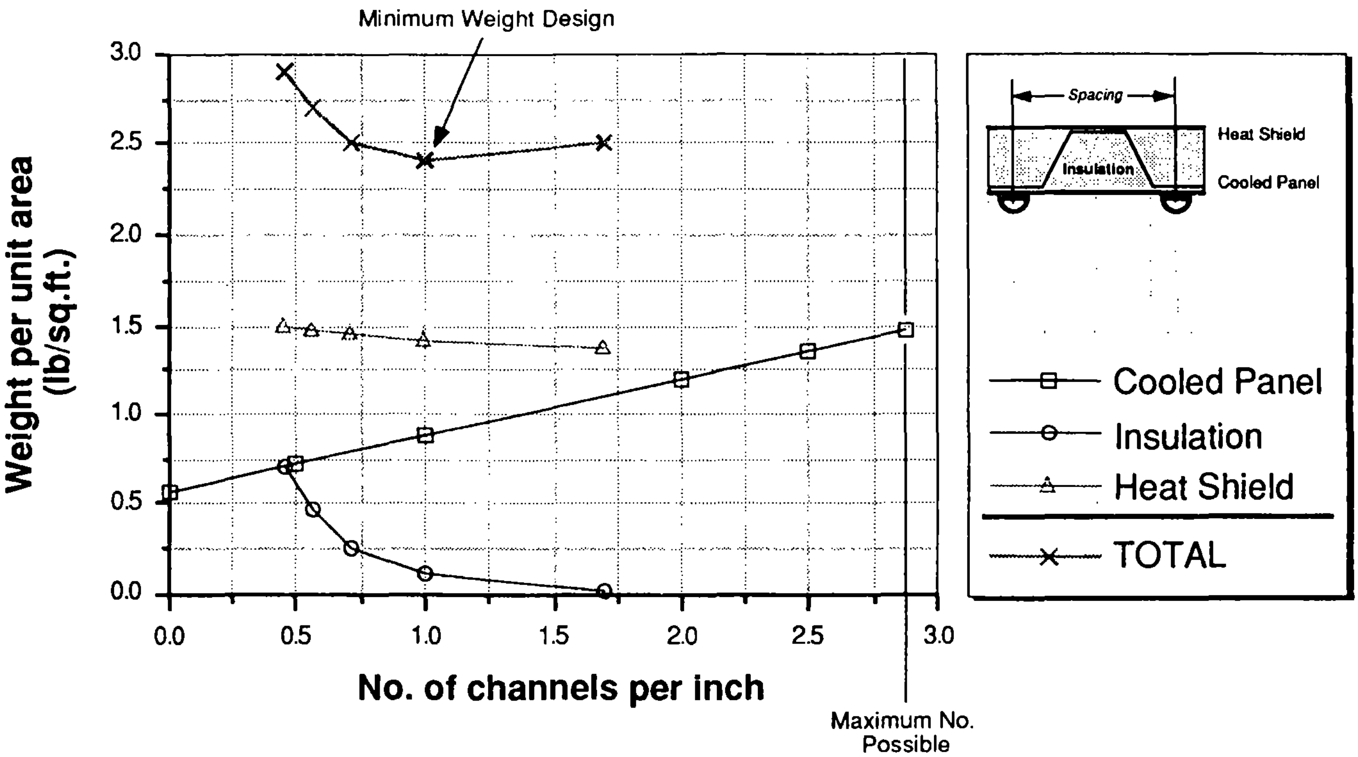

Figure 15. Weight optimization results for actively cooled inlet

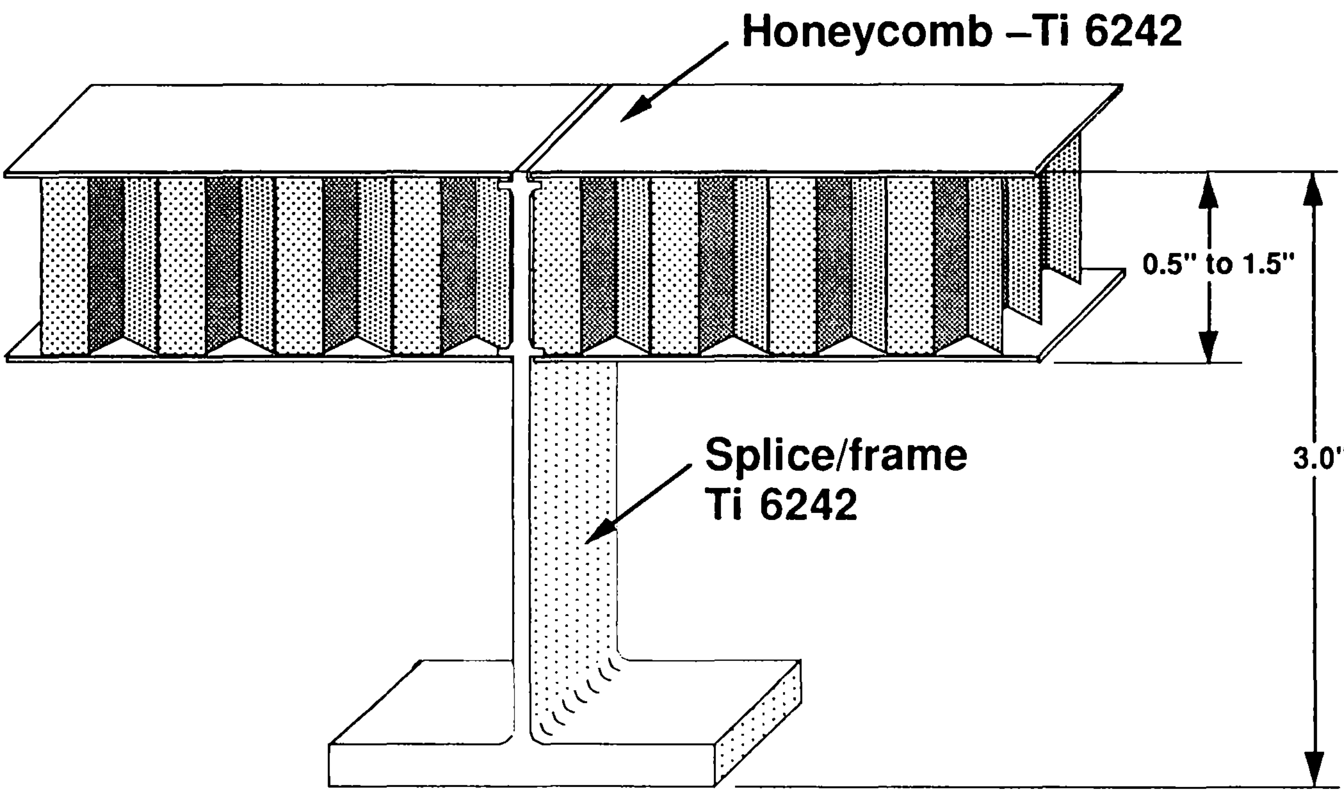

Figure 16. Structural wall concept

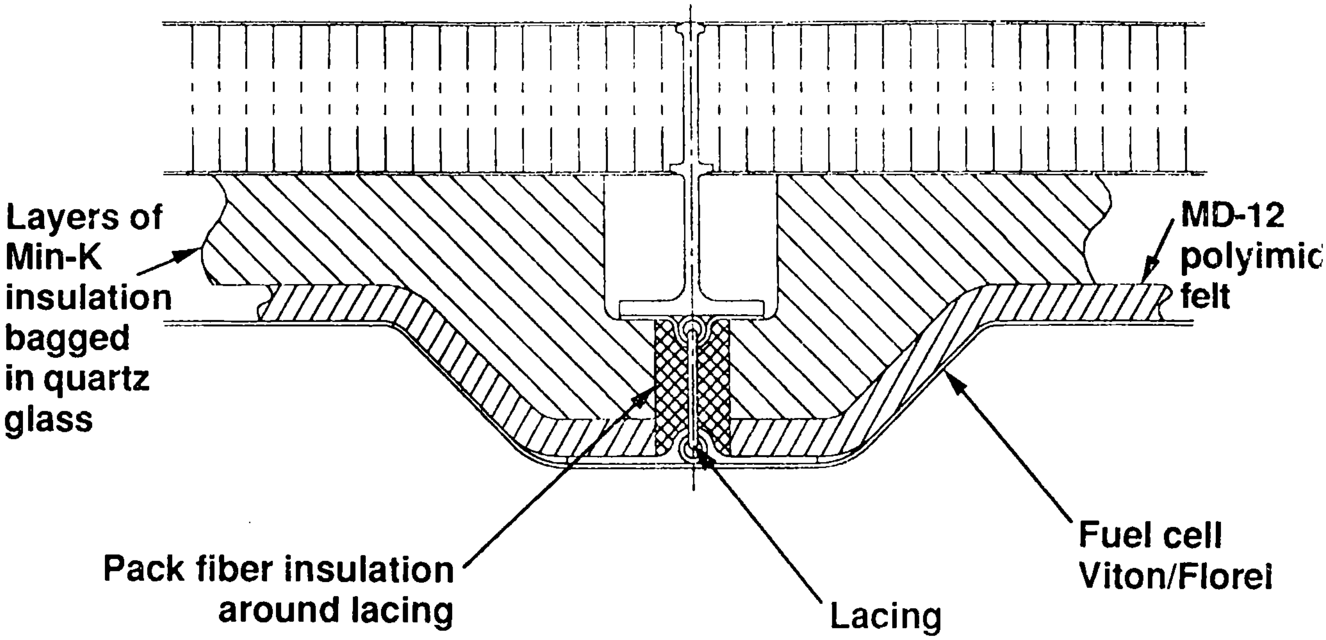

Figure 17. Tank wall concept

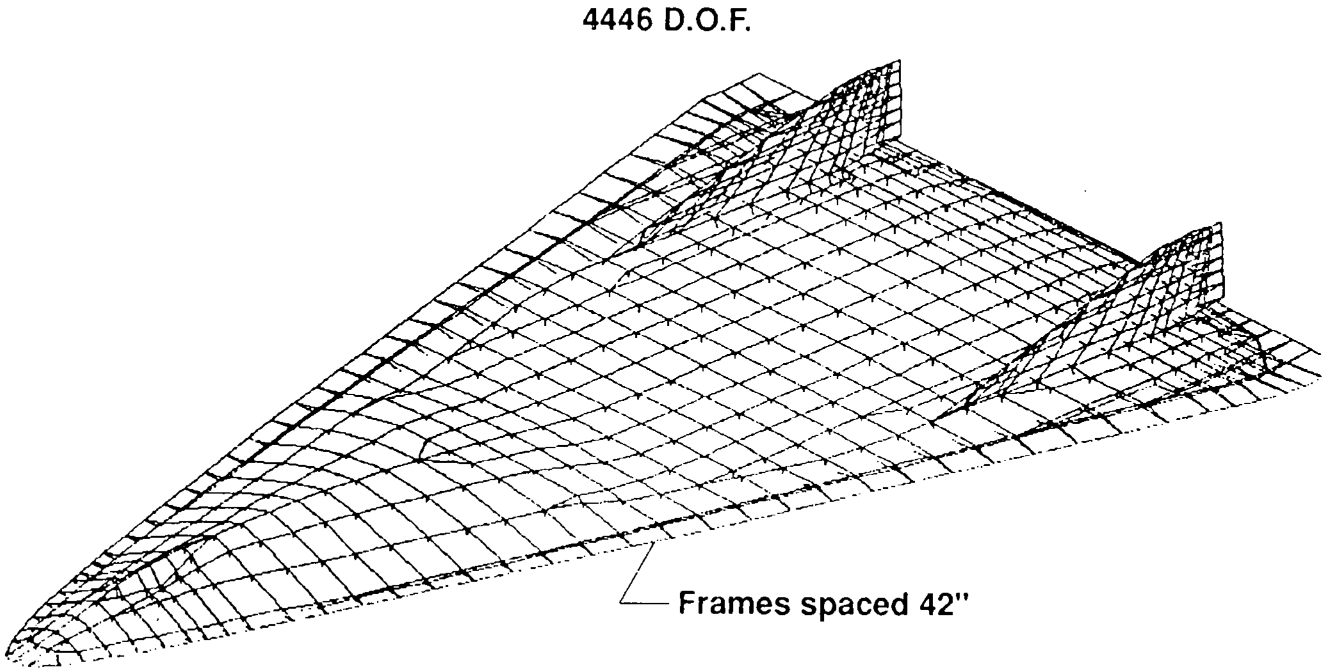

Figure 18. Airframe MSC/NASTRAN FEM

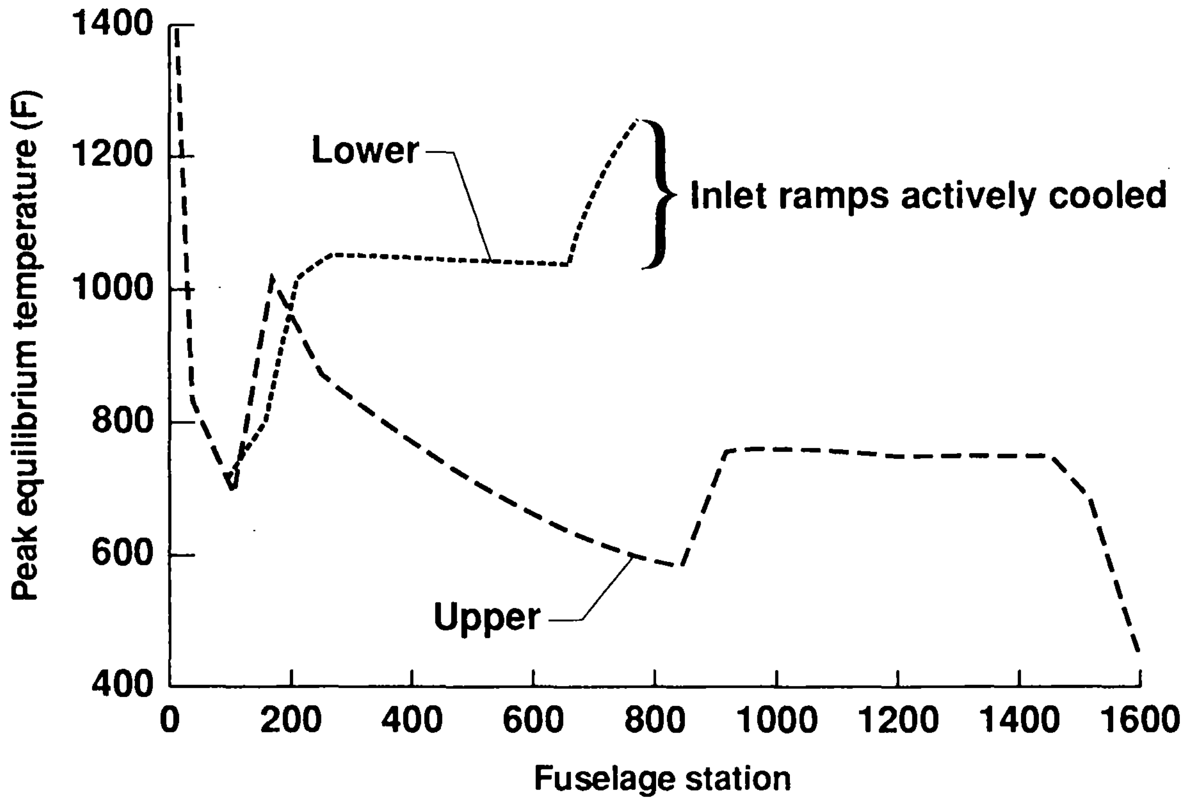

Figure 19. Centerline peak radiation equilibrium wall temperatures

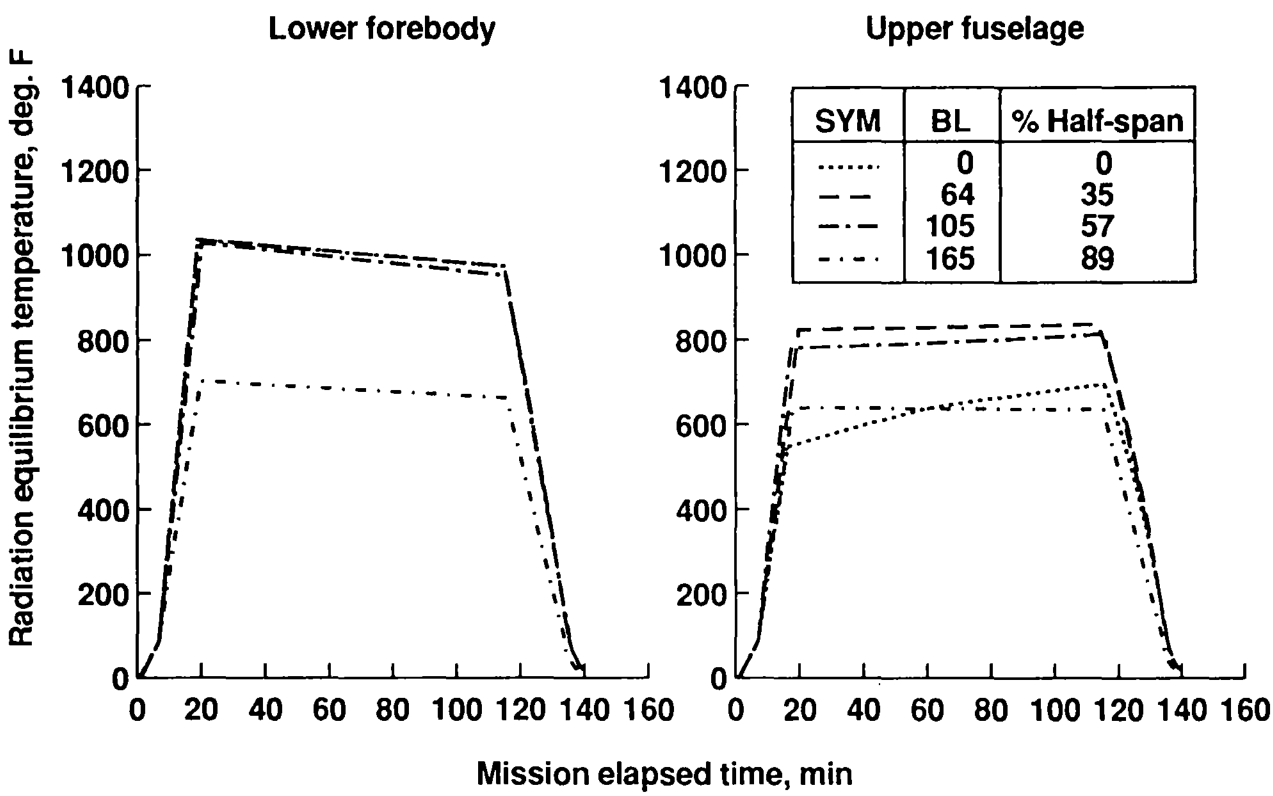

Figure 20. Equilibrium temperature time histories at FS 500

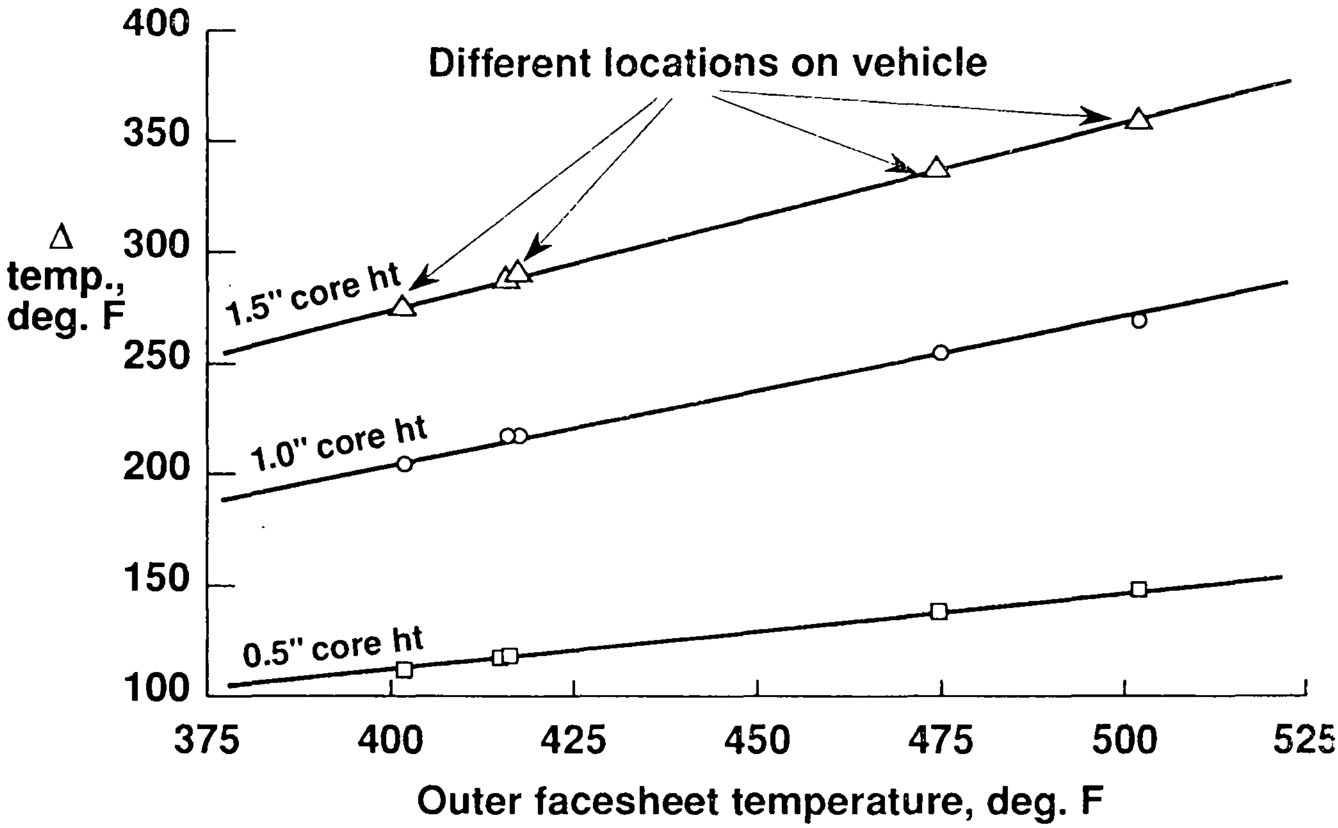

Figure 21. Predicted core gradients vs temperature at 12.5 minutes

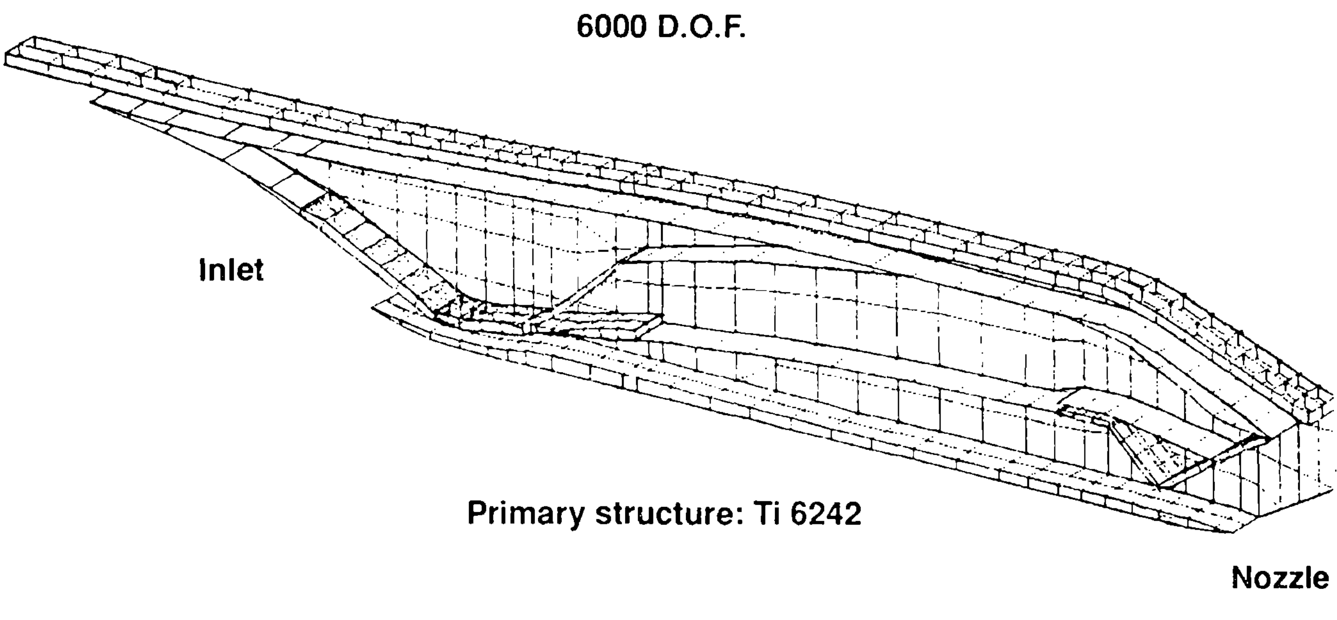

Figure 22. Propulsion system MSC/NASTRAN FEM

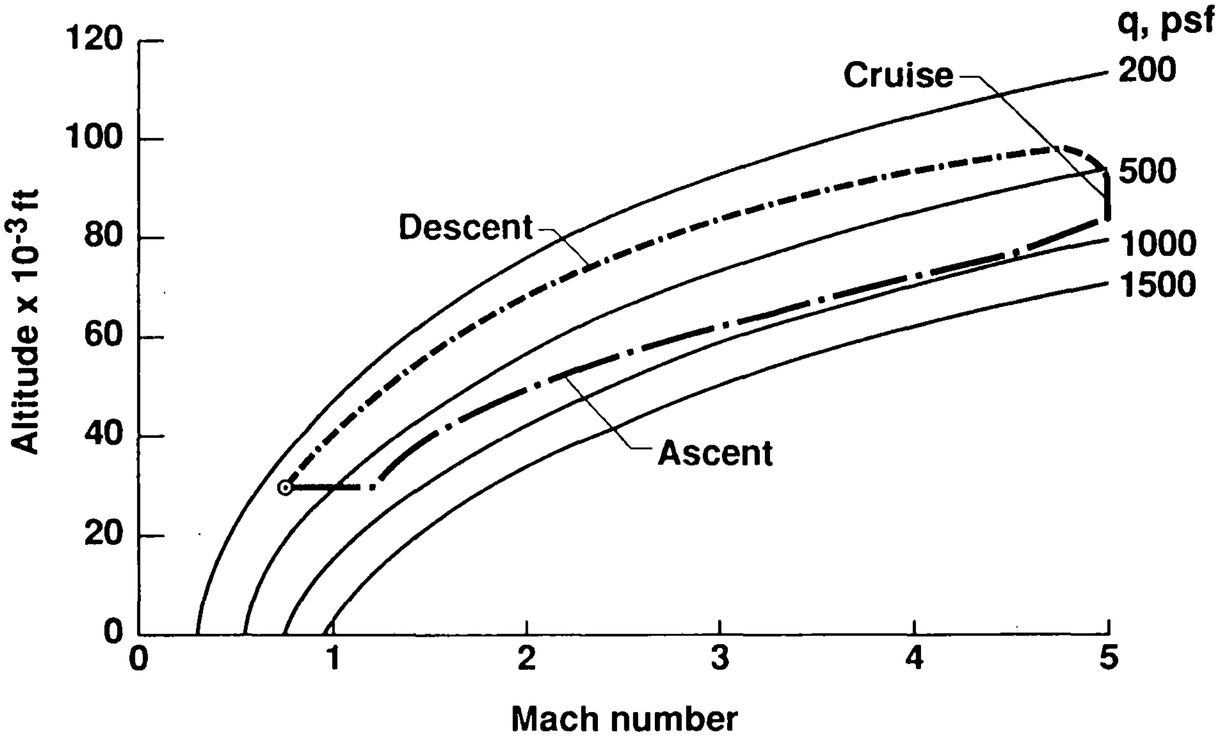

Figure 23. Flight envelope

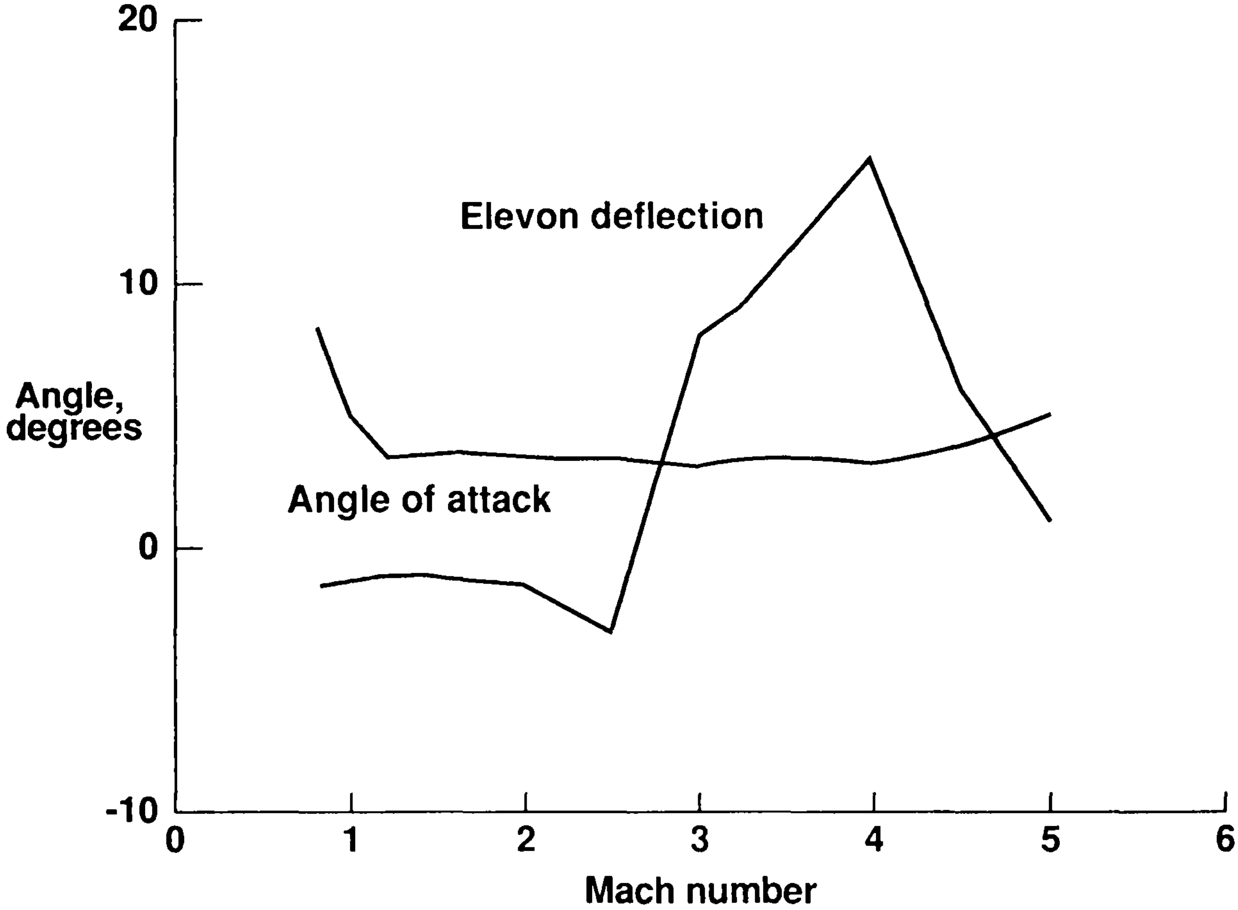

Figure 24. Angle of attack and trim deflection time histories

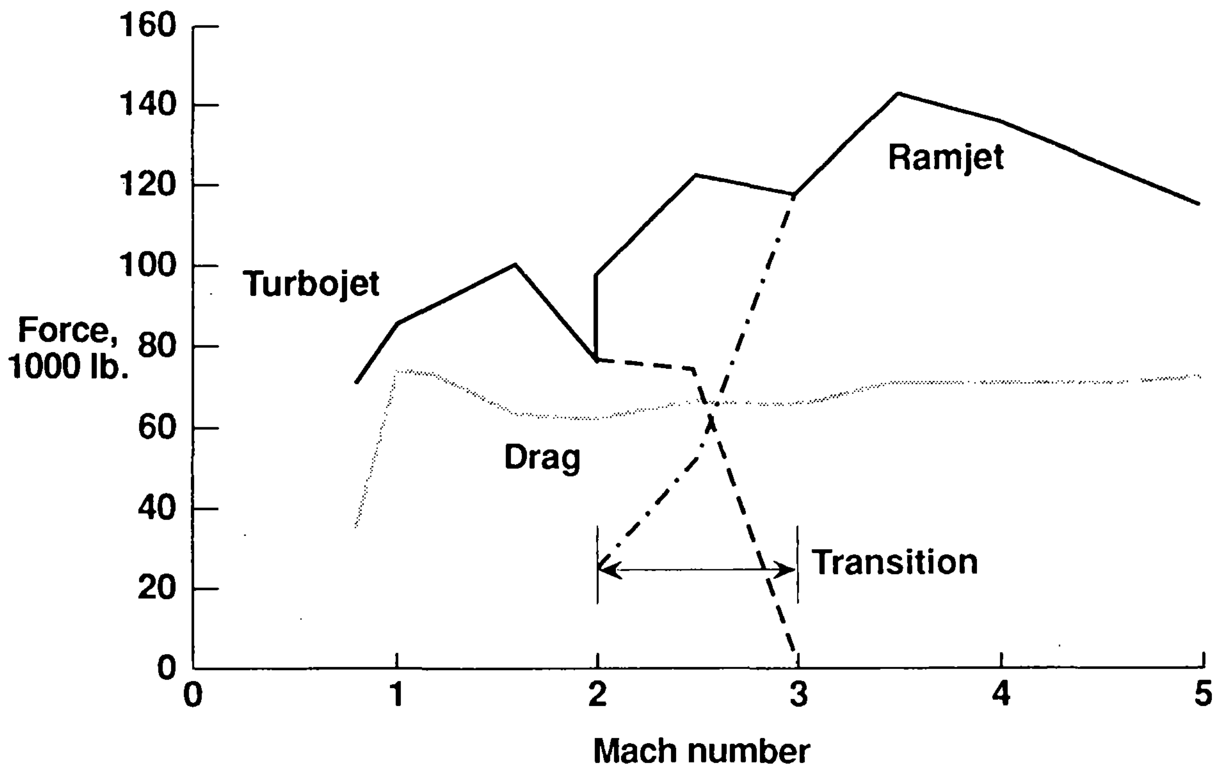

Figure 25. Ascent thrust and drag histories

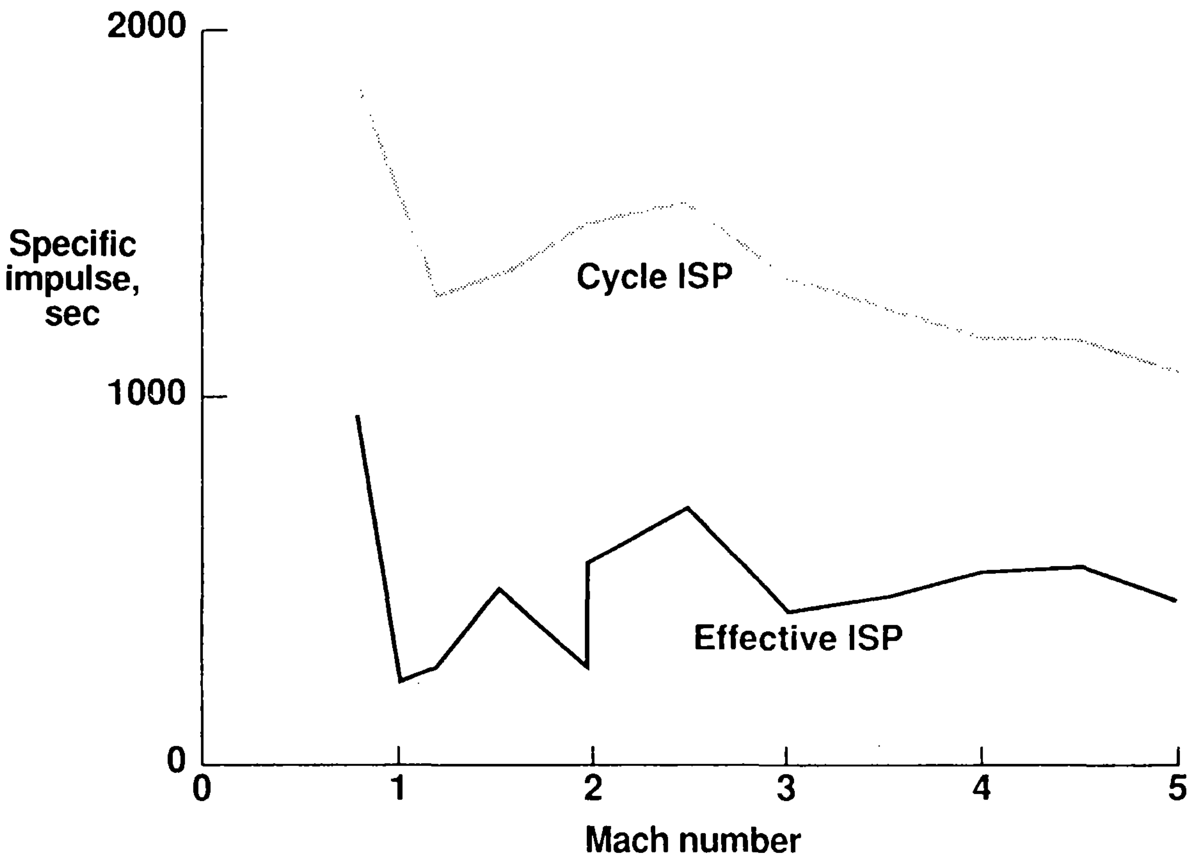

Figure 26. Cycle and effective specific impulse for ascent

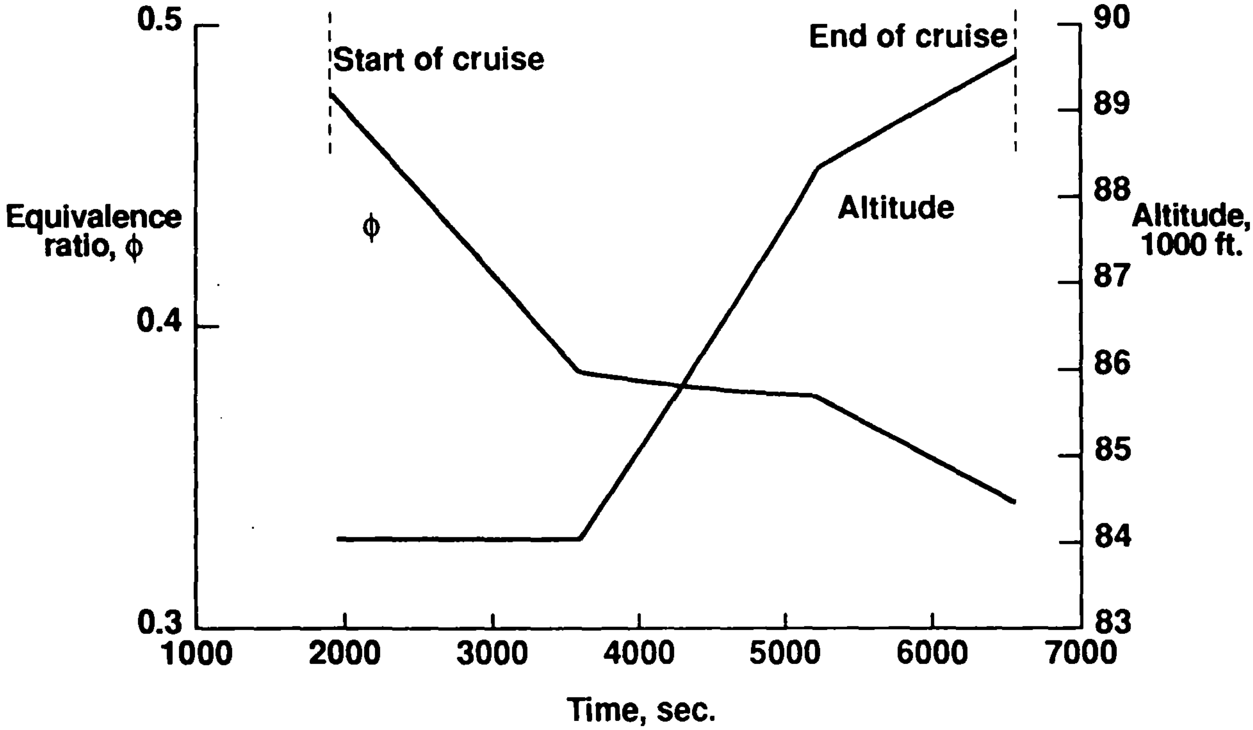

Figure 27. Cruise mission profile and ramjet equivalence ratio schedule

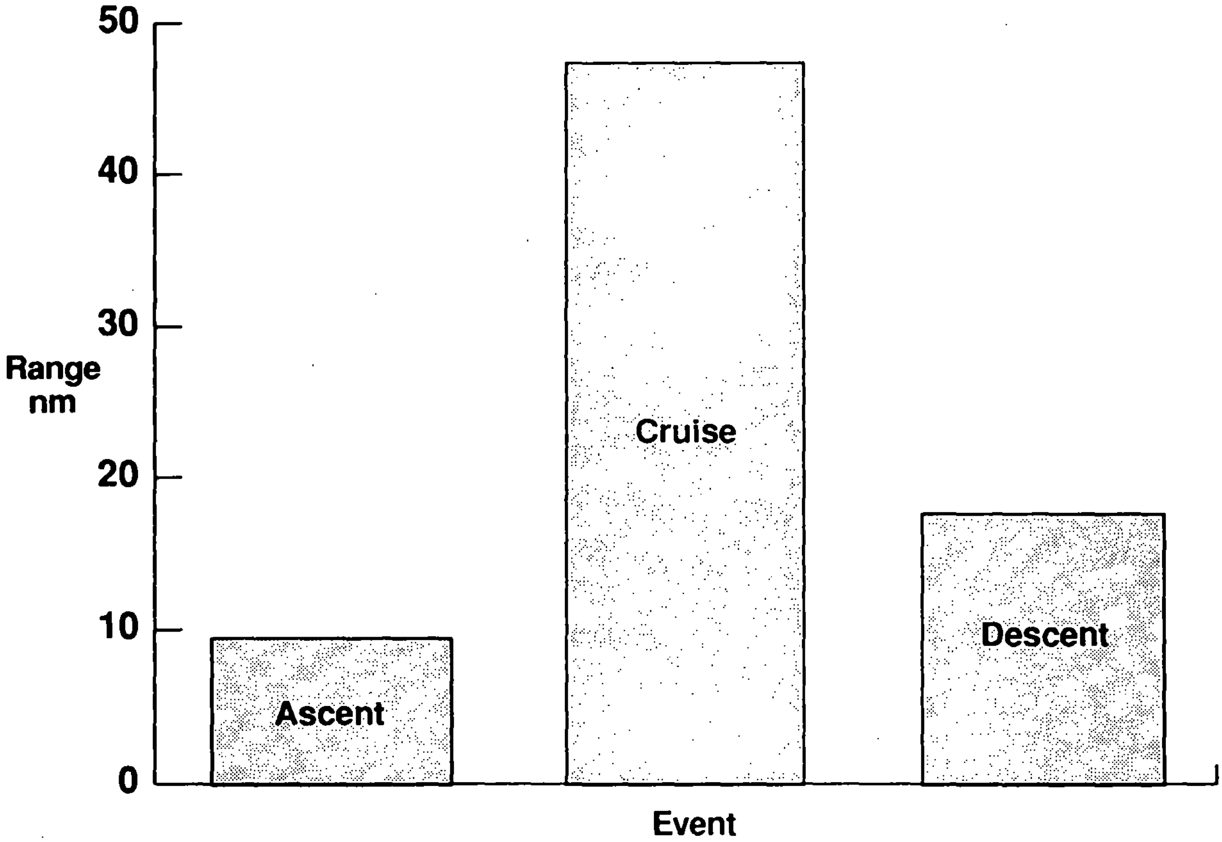

Figure 28. Mission range breakdown

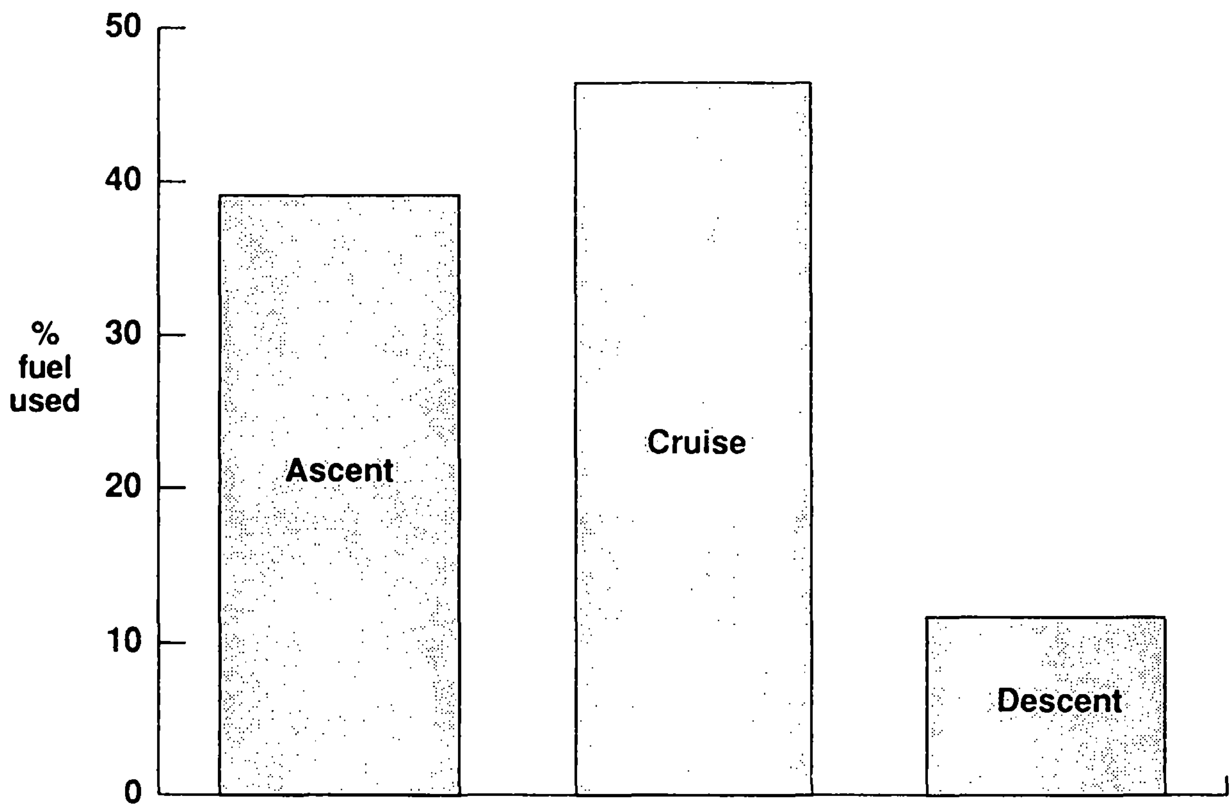

Figure 29. Fuel usage breakdown for mission

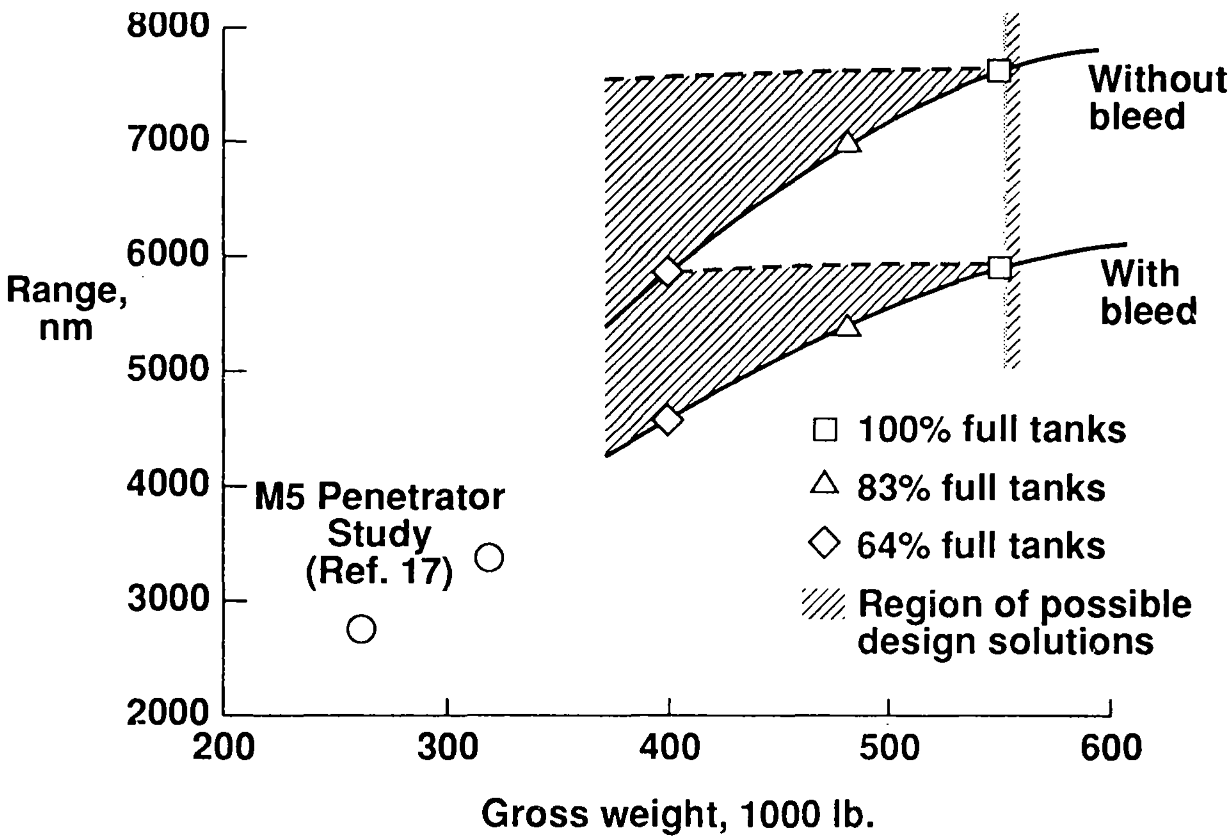

Figure 30. Mission range parametrics

October 21, 1993

Remarks by Mr. Lionel S. Johns to the National Capital Section of the AIAA
Associate Director for Technology
Office of Science and Technology Policy

Thank you for the opportunity to share with you the Administration's policies and strategy for space and aeronautics. It is always a pleasure to address a distinguished group such as this.

I'd like to begin by noting that upon taking office, one of President Clinton's first actions was to formulate a major new technology initiative as part of his plan to strengthen our country's economy. This initiative is contained in the Administration's publication, Technology for America's Economic Growth.

Why did the President put such an immediate and dramatic emphasis on technology policy in his administration?

It's simple.

Science Drives technology

Technology drives economic growth. Advances in technology created two-thirds of the productivity growth in the United States over the past 60 years.

The knowledge-based, growth industries of the future depend on continuous generation of new technological innovations and rapid transformation of those innovations into marketable products.

The technology strategy outlined by President Clinton and Vice President Gore offers a comprehensive blueprint to focus American technology on 3 central goals:

-- Long-term economic growth that creates jobs and protects the environment;

-- Making government more efficient and more responsive; and

-- World leadership in basic science, mathematics, and engineering.

With this initiative, we take a critical step toward ensuring that the federal investment in science and technology becomes a key instrument for promoting U.S. economic growth and for satisfying other national goals.

All of this leads to the question, I want to focus on: How do our aeronautics and space programs fit into this technology strategy?

I will start with the role of OSTP. The President directed Dr. Gibbons to take the lead role for the Administration in terms of coordinating space policy. The approach we propose to take is to handle this responsibility through a new council, the National Science and Technology Council, that will absorb the functions of the Federal Coordinating Council for Science, Engineering, and Technology, the National Space Council, and the National Critical Materials Council. NSTC will be chaired by the President, and the Vice President in his absence, Dr. Gibbons will manage the council's day-to-day affairs. This council was recommended in the report from the National Performance Review, and we believe there is wide support for it within the White House and in other Executive Branch agencies and departments..

We are in the process of obtaining views from Executive Departments and Agencies, the Congress, and the private sector on the NSTC. Obviously, ~~I~~ we will be working closely with the National Security Adviser on those occasions when national security concerns properly dominate the policy development process.

As we move forward to put the NSTC in place, we have also begun a series of interagency Working Group reviews of specific space programs,l~~eading, in the new year, to a general reassessment of US space policy~~. The first 3 of these reviews -are in aeronautics, weather satellite convergence, and space transportation -- ~~are already underway.~~

Through the aeronautics review the Administrations will develop its priorities for investing in a new generation of aeronautics technologies. In developing these priorities we will be working closely with the aircraft manufacturers to ensure that our priorities ~~match~~ are consistent with those of industry. The second review, focus~~ed~~es on the convergence of DOD/NOAA weather systems, is a critical element of the Vice Presidents "Reinventing government initiative. At present, NOAA and DOD operated separate weather systems. OSTP is working with NOAA and DOD to see how we can safely and cost effectively eliminate this redundancy, ~~Finally,~~ P the United States relies, ~~for~~ its critical civil and national security space missions ~~and~~ space systems that cost too much and take to long to prepare. The United States needs to chart a new course in space transportation. This review will be an important first step on this new course.

START here

The President submitted a budget for NASA for 1994 that demonstrated the Administration's strong commitment to the civil aeronautics and space program. The President asked Congress to fund NASA at a level that allows an increase in science, space technology, and aeronautics. This is an extraordinary vote of confidence in a budget that is focused on deficit-cutting.

This investment does not signal a "business as usual" approach to running this Nation's space program. The resources dedicated to the civilian space program must be focused on issues critical to the nation. Let me articulate the five principal ways this country's investment in civil space exploration and technology development can and should contribute to the long term security and well-being of this nation.

First, the aeronautics and space program will create new knowledge and enhance our understanding of the environment here on earth and of our place in the universe. Space systems and advanced high altitude aircraft provide indispensable tools for understanding how human actions influence the complex workings of our planet. Similarly, space science and robotic planetary exploration can provide us with otherwise unobtainable knowledge and insights regarding our home planet and the universe in which we live. Insights gained from these technologies can enrich our lives and provide an essential type of wealth for this Nation.

Second, aeronautics and space investments must make important contributions to the U.S. economy. I refer not just to serendipitous "spin-offs," but to prudent, industry-led investments, such as the government/industry cooperation in aeronautics and in satellite communications that helped to achieve and sustain U.S. leadership in these critical areas.

Although the economic health of this nation is the uppermost consideration for the Administration, it is not the only guiding principle in our aeronautics and space activities.

Third, research in aeronautics and space can help build good international relations.

Research in aeronautics and space ~~international relations should~~ should complement our foreign policy objectives, not only in terms of our access to global markets but also in terms of recognizing the new opportunities that exist in the past Cold War era. Working with our traditional partners in Europe, Japan, and Canada, and soon with Russia and other parts of the emerging democratic world, we can forge additional relationships that contribute to global peace and prosperity as well as market development. International cooperation in space science, exploration, and commerce can provide an important lesson on how nations, working together, define challenges and solve problems that no one nation alone could accomplish.

<u>Fourth, the space program is important because it generates and sustains interest in math and science education.</u> The excitement generated by the space program can be used to interest young people in math and science education. Enthusiasm for the space program yields scientists, engineers, and educators who are the key to the future economic competitiveness of our nation, and increases the understanding of science and technology in the general population -- a critical need for the continued strength of our democracy.

Finally, human space flight is and will continue to be a significant element of our domestic and international space program. Humans can make a unique contribution, as part of a balanced program ~~of robotic and human~~ exploration, to our scientific and technical knowledge, as well as our understanding of the benefits and limitations of humans living and working in space.

I believe that these principles will guide development and implementation of the aeronautics and space programs of this Administration.

The increased funding for aeronautics in the FY '94 budget will be used to work with industry to develop the technologies that will improve U.S. competitiveness in civil aviation and enhance the safety and capacity of our National Aviation System. Today the aeronautics industry is one of the biggest in the country, employing nearly one million people, generating almost a hundred billion dollars in annual sales, and tens of billions of dollars in exports. It is one of our ~~last surviving~~ crown jewels of high technology, and one of the few areas where we still enjoy a positive balance of trade.

That is why, under the Clinton Administration, NASA is ramping up its investment in specific areas of aeronautical technology and ~~in the~~ facilities. ~~like wind tunnels~~ that serve the industry. This year, there is a substantial increase in aeronautics funding within the FY '94 NASA budget request. ~~And with President Clinton's support and his Technology Reinvestment Initiative, we will increase that funding by more than 50% over the next five years.~~ ~~By the time we reach the 100th anniversary of the Wright Brothers' first powered fight, we intend to have a strong and growing aeronautical industry in this country once again.~~

The technology we produce in aeronautics can not only help our competitive posture with this critical industry, it can spin off into other areas of the economy as well. The advanced composite structures we are working on provide an example.

For 20 years now, we have been steadily advancing the state of the art in composite materials. The goal at first was just to learn how to fabricate these new lightweight materials and take advantage of the fuel savings. ~~Now our goal is to make composite materials 25% cheaper than~~ aluminum.

How? Well one technology involves actually weaving the structures, just like the textile industry might weave a suit. Rather than laying up a section ply-by-ply, we would weave the fibers and epoxies together in the desired shape, and NASA is now working with five textile companies to pursue the idea. It's very promising, both ~~for the~~ aeronautics and the textile industries.

Another high priority in the Clinton Administration' space policy is NASA's Mission to Planet Earth. I think in many ways it may well be the most important space science program we have ever done. And it will ~~could~~ represent one of NASA's greate~~st~~ contributions to society.

Humans ~~have begun to~~ change the face of the planet at an ever increasing rate, and that change is not always healthy. We must use our technology to study the change ~~ecosystem~~, to understand the effects humans are having on the atmosphere and the land and the water. The goal of NASA's Mission to Planet

Earth program is to provide definitive scientific data so that policy makers not only now but 10 or 20 years from now can make the right decisions in safeguarding the health of our ~~home~~ planet.

With these core programs, and with a new determination to make our investments in air and space payoff of the American people, we have a bright and promising future ahead.

Let me now turn my attention to a subject that has received a considerable amount of attention recently -- the space station.

In March of this year, the President requested a review of the Space Station Freedom Program in order to examine whether the program's development, operations, and utilization costs could be significantly reduced while still achieving our scientific research goals and fulfilling our international commitments. On June 17, following a review of NASA's study by an independent panel of experts headed by Dr. ~~Charles~~ Vest, President of MIT, President Clinton announced his support for a scaled-down, modular version of

Space Station Freedom that meets these objectives -- the "Alpha Station" program as it has come to be known. The President also called for pursuing expanded international involvement in the space station with the possible participation of Russia.

As you know, the Alpha space station program is the result of an intensive review and redesign of the Space Station Freedom conducted over the last six months. Alpha is a streamlined version of the original Space Station Freedom. It is designed to accommodate much of the Space Station Freedom hardware, will have power, scientific laboratory space, and microgravity levels comparable or better than Space Station Freedom, and incorporates the interests of our international partners. It will cost significantly less than Space Station Freedom. At the direction of the White House, NASA is currently finalizing the Alpha Station baseline program design.

The Administration has requested a total of $2.1 billion in FY94 to be used to continue development of the reduced cost Alpha Station program as an international facility to be built and operated by the United States, Canada, Japan, and the European Space Agency. I believe ~~strongly~~ that this is an important science and technology investment for the United States.

While the Alpha Station has been designed to be built and operated by the United States and its current international partners, it has been configured to accommodate significant Russian participation in the event that becomes possible. Since the President's commitment in June to explore increased international participation in the space station, U.S. and Russian teams have been working together to develop ~~possible~~ options for Russian involvement in the Alpha Station program. While significant progress has been achieved, it will be necessary for the U.S. and Russia to continue to work together and with our international partners to develop ~~technical~~ those options. ~~for possible Russian participation~~. Until these planning ~~exercises~~ efforts conclude ~~in early November~~, it will be impossible to finalize plans for Russian participation.

In the interim, the United States and Russia have signed an historic agreement to pursue space cooperation in the areas of earth observation, space science, and ~~space~~ flight. possibly ~~leading~~ to a ~~Russian role in the international~~

space station. Russian participation could add a positive new dimension to the development of an international space station, and, as Vice President Gore stated, would be an important symbol that we have put the Cold War behind us. The Administration is requesting $100 million in FY94 in order to pursue these mutually beneficial space activities ~~in~~ cooperation with the Russian space program.

A crucial element of the redesigned space station program is the implementation of management changes at NASA to reduce overhead, increase efficiency, and streamline the bureaucracy. NASA has taken significant steps to implement these reforms, including selecting a single prime contractor to oversee program development and a single host facility to consolidate the program.

Finally, Beyond ~~the space station and the aeronautics program~~ all of the activities I've ~~launched~~ cited, NASA has a broader role to play in the President's technology initiative, including areas such as High Performance Computing and Communications, space science and exploration, and environmental monitoring and earth observation.

We believe that the President's technology initiative -- f~~or space and aeronautics, as well as other science and technology programs~~, for NASA and the other Federal agencies -- constitutes a major, positive departure from the programs of the past. ~~Organized around broad, national goals,~~ It abandons the notion that we can depend on "spin-offs" and "trickle down from space and defense and energy R&D for future well-being and instead adopts an ambitious, integrated approach to civil and defense R&D spending in order to ensure national, economic, and environmental security.

I hope these comments have given you a brief picture of the direction we are headed and have illuminated the priorities we are pursuing.

National Capital Section

September 9, 1993

11:30 - 1:30

Mr. Lionel Johns
Associate Director, OSTP
The White House
17th & Pennsylvania Ave, N.W.
Washington, DC 20500

Dear Mr. Johns:

The National Capital Section of the American Institute of Aeronautics and Astronautics (AIAA) is the largest of this national professional association. As part of our annual program, the Section hosts monthly luncheons featuring prominent speakers on topics of significant importance to our membership in the Washington, DC Metropolitan areas. Our initial luncheon guest speaker for September is the NASA Administrator, Daniel Goldin.

Under the present Clinton Administration it is certainly timely to afford the local membership the opportunity to listen to remarks from the Office of Science, Technology, and Policy. Section representatives are most interested in directives emanating from the Chief Executive's Office on new programs and initiatives, especially those activities dealing with the aerospace industry.

With this thought in mind, I invite you to address the Section's lunch meeting on Thursday, October 21, 1993. The luncheon will be conducted at the Pier 7 Restaurant, Chanel Inn, 650 Water Street, SW., Washington. Depending on your schedule and availability, we do have some flexibility in working with you around this date.

Our luncheon meetings begin at 11:30am with a short reception and cash bar, followed by lunch at 12:15pm. Your talk would begin about 1:00pm, last approximately 15-20 minutes, followed by a short question and answer period. We try to complete our luncheon activities no later than 1:30pm. We are most willing to accommodate you or modify this format to meet any time constraints you might have.

National Capital Section • American Institute of Aeronautics and Astronautics
11529 Montgomery Road • Beltsville, MD 20705 • (301) 595-4177 • Fax (301) 937-5423

I trust that your schedule permits you to be our October luncheon speaker. I assure you that your remarks will be well received by our membership and of great interest to the Washington, DC aerospace community. To provide adequate time for planning and publicity, it is essential that our Section finalize arrangements for the October luncheon as soon as possible. The Section's Vice President for Programs is Jack Koletty. Jack will contact your staff within the next couple of days regarding your availability. If you have any questions or concerns, please contact either Jack Koletty (301-306-7861), or our Executive Secretary, Alberta Moran (301-595-4177).

Thank you in advance for your time and favorable consideration regarding this invitation to address the National Capital Section.

Sincerely,

Dan Kennedy

Dan Kennedy
Chairman