FY 1990 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by Joyce E. Turner
Management Operations Office

October 1990

NASA
Technical Memorandum

NASA TM - 103520
This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY90. It also includes papers of MSFC contractors.

After being announced in STAR, all of the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available.
FOREWORD

In accordance with the NASA Space Act of 1958, the MSFC has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when the George C. Marshall Space Flight Center was organized, the reporting of scientific and engineering information has been considered a prime responsibility of the Center. Our credo has been that "research and development work is valuable, but only if its results can be communicated and made understandable to others."

The N number shown for the reports listed is assigned by the NASA Scientific and Technical Information Facility, Baltimore, Maryland, indicating that the material is unclassified and unlimited and is available for public use. These publications can be purchased from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. The N number should be cited when ordering.
# FY 1990 Scientific and Technical Reports, Articles, Papers, and Presentations

## Table of Contents

<table>
<thead>
<tr>
<th>Category</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA Technical Memoranda</td>
<td>1</td>
</tr>
<tr>
<td>NASA Technical Papers</td>
<td>10</td>
</tr>
<tr>
<td>MSFC Conference Publications</td>
<td>13</td>
</tr>
<tr>
<td>NASA Contractor Reports</td>
<td>14</td>
</tr>
<tr>
<td>MSFC Papers Cleared for Presentation</td>
<td>29</td>
</tr>
</tbody>
</table>
NASA TECHNICAL MEMORANDUM

TM-100382 December 1989
Main Propulsion System Test Requirements for the Two-Engine Shuttle-C. E.E. Lynn and G.K. Platt. Propulsion Laboratory. N90-14282

The Shuttle-C is an unmanned cargo-carrying derivative of the space shuttle with optional two or three space shuttle main engines (SSME's), whereas the shuttle has three SSME's. Design and operational differences between the Shuttle-C and shuttle were assessed to determine requirements for additional main propulsion system (MPS) verification testing. Also, reviews were made of the shuttle main propulsion test (MPT) program objectives and test results and shuttle flight experience.

It was concluded that, if significant MPS modifications are not made beyond those currently planned, then main propulsion system verification can be concluded with an on-pad propellant loading and countdown demonstration test plus a long duration on-pad flight readiness firing.

TM-100383 December 1989

This report presents results from the comparison study of two computer codes for crack growth analysis—NASCRAC and NASA/FLAGRO. The two computer codes gave compatible conservative results when the part through crack analysis solutions were analyzed versus experimental test data. Results showed good correlation between the codes for the through crack at a lug solution. For the through crack at a lug solution, NASA/FLAGRO gave the most conservative results.

TM-100384 October 1989

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 89. It also includes papers of MSFC contractors.

After being announced in STAR, all of the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available.

TM-100385 December 1989

The JPL has completed a test program, using multisection BATES and 5 x 10-in batch-check motors, with the objectives of measuring the effects of the parameters that were considered to most strongly influence the transition to, or threshold conditions for, erosive burning rate augmentation. A statistical analysis was performed on the test data to explore the possible relationships among the parameters believed to influence the rate of erosive burning. Multivariate methods and simple and multiple regressions were used, and a model for predicting erosive burning rates in small PBAN circular perforated grains was developed.

TM-100386 July 1990

This report presents a summary of selected atmospheric conditions observed near Space Shuttle STS-28 launch time on August 8, 1989, at Kennedy Space Center, Florida. STS-28 carried a Department of Defense payload and the flight azimuth in this report will be denoted by a reference flight azimuth, since the actual flight azimuth is not known. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of prelaunch Jimsphere-measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-28
vehicle ascent has been constructed and represents the best estimate of the launch environment to 400,000 ft altitude that was traversed by the STS-28 vehicle. The STS-28 ascent atmospheric data tape has been constructed by Marshall Space Flight Center's Earth Science and Applications Division to provide an internally consistent data set for use in post-flight performance assessments.

TM-100387 January 1990


The global optimization of protective structural designs for spacecraft subject to hypervelocity meteoroid and space debris impacts is presented. This nonlinear problem is first formulated for weight minimization of the space station core module configuration using the Nysmith impact predictor. Next, the equivalence and uniqueness of local and global optima is shown using properties of convexity. This analysis results in a new feasibility condition for this problem. The solution existence is then shown, followed by a comparison of optimization techniques. Finally, a sensitivity analysis is presented to determine the effects of variations in the systemic parameters on optimal design. The results show that global optimization of this problem is unique and may be achieved by a number of methods, provided the feasibility condition is satisfied. Furthermore, module structural design thicknesses and weight increase with increasing projectile velocity and diameter and decrease with increasing separation between bumper and wall for the Nysmith predictor.

TM-100388 February 1990


This document presents a computer program used to translate PATRAN finite element model data into STAGS (Structural Analysis of General Shells) input data. The program supports translation of nodal, nodal constraints, element, force, and pressure data. The subroutine UPRESS required for the readings of live pressure data into STAGS is also presented.

TM-100389 February 1990


A digital computer simulation is used to determine if the extreme ultraviolet explorer (EUVE) reaction wheels can provide sufficient torque and momentum storage capability to meet the space infrared telescope facility (SIRTF) maneuver requirements. A brief description of the pointing control system (PCS) and the sensor and actuator dynamic models used in the simulation is presented. A model to represent a disturbance such as fluid sloshing is developed. Results developed with the simulation, and a discussion of these results are presented.

TM-100390 March 1989

Rolling Contact Fatigue of Surface Modified 440C Using a “Ge-Polymet” Type Disc Rod Test Rig. R.L. Thom. Materials and Processes Laboratory. N90-20200

Through hardened 440C martensitic stainless steel test specimens were surface modified and tested for changes in rolling contact fatigue using a disc on rod test rig. The surface modifications consisted of nitrogen, boron, titanium, chromium, tantalum, carbon, or molybdenum, ion implantation at various ion fluences and energies. Tests were also performed on specimens reactively sputtered with titanium nitride.

TM-100391 February 1990


Drop weight impact testing was utilized to inflict damage on eight-ply bidirectional and unidirectional samples of carbon/epoxy and carbon/PEEK (polyetheretherketone) test specimens with impact energies ranging from 0.80 J to 1.76 J. The impacting tup was of a smaller diameter (4.2-mm) than those used in most previous studies, and the specimens were placed over a hole 10.3 mm in diameter to obtain a puncture.
type of impact. The specimens were cut with a diamond wheel wafering saw through the impacted area perpendicular to the outer fibers. Photographs at 12 x magnification were taken of these cross-sections and examined. The results on the bidirectional samples show little damage until 1.13 J, at which point delaminations were seen in the epoxy specimens. The PEEK specimens showed less delamination than the epoxy specimens for a given impact energy level. The unidirectional specimens displayed more damage than the bidirectional samples for a given impact energy, with the PEEK specimens showing much less damage than the epoxy material.

This report presents fracture mechanics analysis results from the following structures/components analyzed at Marshall Space Flight Center (MSFC) between 1982 and 1989: space shuttle main engine (SSME), Hubble Space Telescope (HST), external tank attach ring, B-1 stand lox inner tank, and solid rocket booster (SRB). Results from the SSME high pressure fuel turbopump (HPFTP) second stage blade parametric analysis determined a critical flaw size for a wide variety of stress intensity values. The engine 0212 failure analysis was a time-dependent fracture life assessment. Results indicated that the disk ruptured due to an overspeed condition. Results also indicated that very small flaws in the curvic coupling area could propagate and lead to failure under normal operating conditions. It was strongly recommended that a nondestructive evaluation inspection schedule be implemented. The main ring of the HST, scheduled to launch in 1990, was analyzed by safe-life and fail-safe analyses. First safe-life inspection criteria curves for the ring inner and outer skins and the fore and aft channels were derived. Afterwards the skins and channels were determined to be fail-safe by analysis. A conservative safe-life analysis was done on the 270 redesign external tank attach ring. Results from the analysis were used to determine the nondestructive evaluation technique required. A leak before burst analysis of the B-1 stand lox inner tank indicated that leakage would be detected well before burst conditions developed.

This document is to be revised occasionally as improvements to the Facility are made and as the summary bibliography grows.

TM-100393 April 1990
Compendium of Fracture Mechanics Problems.
R. Stallworth, C. Wilson, and C. Meyers. Structures and Dynamics Laboratory. N90-21414
The corrosion protection of 6061-T6 anodized aluminum afforded by a newly patented polyurethane seal has been studied using the ac impedance technique. Values of the average corrosion rates over a 27-day exposure period in 3.5% NaCl solutions at pH 5.2 and pH 9.5 compared very favorably for Lockheed-prepared polyurethane-sealed and dichromate-sealed coats of the same thickness. Average corrosion rates for both specimens over the first 7 days of exposure compared well with those for a hard anodized, dichromate-sealed coat, but rose well above those for the hard anodized coat over the entire 27-day period. This is attributed both to the greater thickness of the hard anodized coat, and possibly to its inherently better corrosion protective capability.

TM-100395 April 1990


One of four major areas of project Pathfinder is in-space assembly and construction. The task of in-space assembly and construction is to develop the requirements and the technology needed to build elements in space.

This paper identifies a 120-ft diameter tetrahedral aerobrake truss as the focus element. A heavily loaded mechanical joint is designed to robotically assemble the defined aerobrake element. Also, typical large components such as habitation modules, storage tanks, etc., are defined, and attachment concepts of these components to the tetrahedral truss are developed.

TM-100396 December 1989


This report presents a summary of selected atmospheric conditions observed near space shuttle STS-34 launch time on October 18, 1989, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere-measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-34 vehicle ascent has been constructed. The STS-34 ascent atmospheric data tape has been constructed by Marshall Space Flight Center's Earth Science and Applications Division to provide an internally consistent data set for use in post-flight performance assessments and represents the best estimate of the launch environment to the 400,000-ft altitude that was traversed by the STS-34 vehicle.

TM-100397 April 1990

The Temperature Variation of Hydrogen Diffusion Coefficients in Metal Alloys. M.D. Dandford. Materials and Processes Laboratory. N90-21836

Hydrogen diffusion coefficients have been measured as a function of temperature for a few metal alloys using an electrochemical evolution technique. Results from these measurements are compared to those obtained by the time-lag method. In all cases, diffusion coefficients obtained by the electrochemical method are larger than those by the time-lag method by an order of magnitude or more. These differences are attributed mainly to hydrogen trapping.

TM-100398 April 1990


Gamma-ray bursts display a wide range of temporal and spectral characteristics, but typically last several seconds and emit most of their energy in the low-energy, gamma-ray region. The burst sources appear to be isotropically distributed on the sky. Several lines of evidence suggest magnetic neutron stars as sources for bursts. A variety of energy sources and emission mechanisms have been proposed.

TM-100399 March 1990


This report presents a summary of selected atmospheric conditions observed near space shuttle STS-33 launch time on November 22, 1989, at Kennedy Space Center, Florida. STS-33 carried a Department of Defense payload and the flight azimuth in this report will be denoted by a reference flight azimuth, since the
actual flight azimuth is not known. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere-measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-33 vehicle ascent has been constructed. The STS-33 ascent atmospheric data tape has been constructed by Marshall Space Flight Center’s Earth Science and Applications Division to provide an internally consistent data set for use in postflight performance assessments and represents the best estimate of the launch environment to the 400,000-ft altitude that was traversed by the STS-33 vehicle.

This report presents a summary of selected atmospheric conditions observed near space shuttle STS-32 launch time on January 9, 1990, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere-measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-32 vehicle ascent has been constructed. The STS-32 ascent atmospheric data tape has been constructed by Marshall Space Flight Center’s Earth Science and Applications Division to provide an internally consistent data set for use in postflight performance assessments and represents the best estimate of the launch environment that was traversed by the STS-32 vehicle.

This memorandum develops approaches for forecasting the cost of major hardware development programs while these programs are in the design and development C/D phase. Three approaches are developed: a schedule assessment technique for bottom-line summary cost estimation, a detailed cost estimation approach, and an intermediate cost element analysis procedure. The schedule assessment technique was developed using historical cost/schedule performance data.

Equivalent Circuit Models for AC Impedance Data Analysis. M.D. Danford. Materials and Processes Laboratory. N90-25277

A least-squares fitting routine has been developed for the analysis of AC impedance data. It has been determined that the checking of the derived equations for a particular circuit with a commercially available electronics circuit program is essential. As a result of the investigation described in this report, three equivalent circuit models have been selected for use in the analysis of AC impedance data at this laboratory.

This report presents a summary of selected atmospheric conditions observed near space shuttle STS-36 launch time on February 28, 1990, at Kennedy Space Center, Florida. STS-36 carried a Department of Defense payload, and the flight azimuth in this report will be denoted by a reference flight azimuth, since the actual flight azimuth is not known. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere-measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-36 vehicle ascent has been constructed. The STS-36 ascent atmospheric data tape has been constructed by Marshall Space Flight Center’s Earth Science and Applications Division to provide an internally consistent data set for use in postflight performance assessments and represents the best estimate of the launch environment to the 400,000-ft altitude that was traversed by the STS-36 vehicle.

NASA TECHNICAL MEMORANDUM

J.E. Smith. Space Science Laboratory.
N90-25923

This report provides a description of the NASA Marshall Space Flight Center's Solar Vector Magnetograph Facility and gives a summary of its observations and data reduction during January–December 1989. The systems that make up the facility are a magnetograph telescope, an H-alpha telescope, a Questar telescope, and a computer code. The data are represented by longitudinal contours with azimuth plots.

TM-100405 July 1990
N90-26741

The Advanced X-Ray Astrophysics Facility (AXAF) will be subject to several sources of charged particle radiation during its 15-year orbital lifetime: geomagnetically-trapped electrons and protons, galactic cosmic ray particles, and solar flare events. The purpose of this report is to estimate these radiation levels for the AXAF orbit for use in the design of the observatory's science instruments.

TM-103505 August 1990
A Transient Response Analysis of the Space Shuttle Vehicle During Liftoff. J.A. Brunty. Structures and Dynamics Laboratory.
N90-27735

A proposed transient response method is formulated for the liftoff analysis of the space shuttle vehicle. The proposed method uses a power series approximation with unknown coefficients for the interface forces between the space shuttle and mobile launch platform. This allows the equations of motion of the two structures to be solved separately with unknown coefficients at the end of each time step. The unknown coefficients are obtained by enforcing the interface compatibility conditions between the two structures. Once the unknown coefficients are determined, the total response is computed for that time step. The method is validated by a numerical example of a cantilevered beam and by the liftoff analysis of the space shuttle vehicle. The proposed method is compared to an iterative transient response analysis method used by Martin Marietta for their space shuttle liftoff analysis. It is shown that the proposed method uses less computer time than the iterative method and does not require as small a time step for integration. The space shuttle vehicle model is reduced using two different types of component mode synthesis (CMS) methods, the Lanczos CMS method and the Craig and Bampton CMS method. By varying the cutoff frequency of the Craig and Bampton method it was shown that the space shuttle interface loads can be computed with reasonable accuracy. Both the Lanczos CMS method and Craig and Bampton CMS method give similar results. A substantial amount of computer time is saved using the Lanczos CMS method over that of the Craig and Bampton method. However, when trying to compute a large number of Lanczos vectors, input/output computer time increased and increased the overall computer time. The application of several liftoff release mechanisms that can be adapted to the proposed method are discussed.

TM-103506 August 1990
N90-27731

A test bed for a large space power system breadboard for the Hubble Space Telescope (HST) was designed and built to test the system under simulated orbital conditions. A discussion of the data acquisition and control subsystems designed to provide for continuous 24-hour per day operation and a general overview of the test bed is presented. The data acquisition and control subsystems provided the necessary monitoring and protection to assure safe shutdown with protection of test articles in case of loss of power or equipment failure over the life of the test (up to 5 years).

TM-103507 July 1990

Various aspects of residual acceleration data are of interest to low-gravity experimenters. Maximum and mean values and various other statistics can be obtained from data as collected in the time domain. Additional information may be obtained through manipulation of the data. Fourier analysis is discussed as a means of obtaining information about dominant
The Weibull process, identified as the non-homogeneous Poisson process with the Weibull intensity function, is used to model the reliability growth assessment of the space shuttle main engine test and flight failure data. Additional tables of percentage-point probabilities for several different values of the confidence coefficient have been generated for setting (1-α)100-percent two-sided confidence interval estimates on the mean time between failures. The tabled data pertain to two cases: (1) time-terminated testing and (2) failure-terminated testing. The critical values of the three test statistics, namely Cramer-von Mises, Kolmogorov-Smirnov, and chi-square, have been calculated and tabled for use in the goodness-of-fit tests for the engine reliability data. Numerical results are presented for five different groupings of the engine data that reflect the actual responses to the failures.

TM-103512 August 1990

This report provides a description of the NASA Marshall Space Flight Center’s Solar Vector Magnetograph Facility and gives a summary of its observations and data reduction during January–June 1990. The systems that make up the facility are a magnetograph telescope, an H-alpha telescope, a Questar telescope, and a computer code. The data are represented by longitudinal contours with azimuth plots.

TM-103513 July 1990
Mesoscale Lightning Experiment (MLE): A View of Lightning as Seen From Space During the STS-26 Mission. O.H. Vaughan, Jr. Space Science Laboratory.

This report provides information on the data obtained from the Mesoscale Lightning Experiment (MLE) flown on STS-26. The experiment used onboard TV cameras and a 35-mm film camera to obtain data. Data from the 35-mm film camera are presented. During the mission, the crew had difficulty locating the various targets of opportunity with the TV cameras. To obtain as much data as possible in the short observational timeline allowed due to other commitments, the crew opted to use the hand-held 35-mm camera.
This report presents an updated NASA atmospheric turbulence model, from 0- to 200-km altitude, which was developed to be more realistic and less conservative when applied to space shuttle reentry engineering simulation studies involving control system fuel expenditures. The prior model used extreme turbulence ($3\sigma$) for all altitudes, whereas in reality severe turbulence is patchy within quiescent atmospheric zones. The updated turbulence model presented in this report is designed to be more realistic. The prior turbulence statistics ($\sigma$ and $L$) have been updated and have been modeled accordingly.

Large solid rocket motors release large quantities of hydrogen chloride and aluminum oxide exhaust during launch or testing. This report summarizes measurements and analysis of the interaction of this material with the deluge water spray and other environmental factors in the near field (within 1 km of the launch or test site). Measurements of mixed solid and liquid deposition (typically 2 normal HCl) following space shuttle launches and 6.4 percent scale model tests are described. Hydrogen chloride gas concentrations measured in the hours after the launch of STS 41D and STS 51A are reported. Concentrations of 9 ppm, which are above the 5 ppm exposure limits for workers, were detected an hour after STS 51A. A simplified model which explains the primary features of the gas concentration profiles is included.

A linear elastic solution to the problem of minimum weight design of cantilever beams with variable width and depth is presented. The solution shown
is for the specific application of the Hubble Space Telescope maintenance mission hardware. During these maintenance missions, delicate instruments must be isolated from the potentially damaging vibration environment of the space shuttle cargo bay during the ascent and descent phases. The leaf springs are designed to maintain the isolation system natural frequency at a level where load transmission to the instruments is a minimum.

Nonlinear programming is used for the optimization process. The weight of the beams is the objective function with the deflection and allowable bending stress as the constraint equations. The design variables are the width and depth of the beams at both the free and the fixed ends.

Space Station Freedom environmental control and life support system testing has been conducted at Marshall Space Flight Center since 1986. The phase III simplified integrated test (SIT) conducted from July 30, 1989, through August 11, 1989, tested an integrated air revitalization system. During this test, the trace contaminant control subsystem (TCCS) was directly integrated with the bleed stream from the carbon dioxide reduction subsystem. The TCCS performed as expected with minor anomalies. The test set the basis for further characterizing the TCCS performance as part of advance air revitalization system configurations.

TM-4202 October 1990
TP-2926 December 1989


N90-13444

This paper presents a new method for determining the transient response of a discrete coordinate model of a linear structural system composed of substructures. The method is applicable to systems consisting of any number of substructures, both determinate and indeterminate interface boundaries, and any topological arrangement of the substructures. The method is simple to implement from a computational point of view because the equations of motion of each of the substructures are solved independently, and the interface boundary compatibility conditions are enforced at each integration time step by a matrix multiplication. The method is demonstrated for a structural system consisting of two beam segments and acted upon by a time dependent force. The numerical results from the demonstration problem validates the accuracy of the method. The application of this method to structural systems with changing interface boundary conditions between substructures is discussed.

TP-2948 October 1989


N90-12456

El Niño is conventionally defined as an anomalous and persistent warming of the waters off the coasts of Ecuador and Peru in the eastern equatorial Pacific, having onset usually in southern hemispheric summer/fall. Examined here are some of the statistical aspects of El Niño occurrences, especially as they relate to the normal distribution and to possible associations with volcanic, solar, and geomagnetic activity.

With regard to the “very strong” El Niño of 1982–83, it is noted that, although it may very well be related to the 1982 eruptions of El Chichón, the event occurred essentially “on time” (with respect to the past behavior of elapsed times between successive El Niño events; a moderate-to-stronger El Niño was expected during the interval 1978 to 1982, assuming that El Niño occurrences are normally distributed, having a mean elapsed time between successive onsets of 4 years and a standard deviation of 2 years and a last known occurrence in 1976). Also, although not widely recognized, the whole of 1982 was a record year for geomagnetic activity (based on the aa geomagnetic index, with the aa index registering an all-time high in February 1982), perhaps, important for determining a possible “trigger” for this and other El Niño events.

A major feature of this study is an extensive bibliography (325 entries) on El Niño and volcanic-solar-geomagnetic effects on climate. Also, included is a tabular listing of the 94 major volcanic eruptions of 1835 to 1986.

TP-2976 January 1990


N90-14256

This study analyzed planned payload crew utilization on Spacelab missions for the primary purpose of establishing trends and guidelines. The study included missions that have flown to date as well as those in planning. Available data were analyzed on the basis of four major timeline iterations that occur during mission design. Data were categorized and assessed by crewmember, flight day, and mission. Based on the results of this analysis it was recommended that for the Requirements Review (RR) and Preliminary Design Review (PDR) iterations the maximum utilization per shift should be 75 percent for the Payload Specialist (PS) and 65 percent for the Mission Specialist (MS); and for the basic and final iterations, the maximum utilization per shift should be 85 percent for the PS and 75 percent for the MS. Additional recommendations include limiting the amount of activity during the first two shifts whenever possible and establishing a common set of guidelines for the calculation of crew utilization.

TP-2981 January 1990


N90-16007

Instrumented drop weight impact testing was utilized to examine a puncture-type impact on thin
carbon/epoxy coupons. Four different material systems with various eight-ply lay-up configurations were tested. Specimens were placed over a 10.3-mm diameter hole and impacted with a smaller tup (4.2-mm diameter) than those used in previous studies. Force-time plots as well as data on absorbed energy and residual tensile strength were gathered and examined. It was found that a critical impact energy level existed for each material tested, at which point tensile strength began to rapidly decrease with increasing impact energy.

TP-3013 May 1990

This paper describes a general-purpose balloon-borne pointing system for accommodating a wide variety of solar scientific instruments. It is designed for precise pointing, low cost, and quick launch. It offers the option of three-axis control, pitch-yaw-roll, or two-axis control, pitch-yaw, depending on the needs of the solar instrument. Simulation results are presented that indicate good pointing capability at Sun elevation angles ranging from 10 degrees to 80 degrees.

TP-3023 June 1990

A high power CO₂ laser beam is known to deteriorate after a few microseconds due to a mode-medium instability (MMI) which results from an intensity dependent heating rate related to the vibrational-to-translational decay of the upper and lower CO₂ lasing levels. An iterative numerical technique is developed to model the time evolution of the beam as it is affected by the MMI. The technique is used to study the MMI in an unstable CO₂ resonator with a hard-edge output mirror for different parameters like the Fresnel number and the gas density. The results show that the mode of the hard-edge unstable resonator deteriorates because of the diffraction ripples in the mode. We use a Gaussian-reflectivity mirror to correct the MMI. This mirror produces a smoother intensity profile which significantly reduces the effects of the MMI. Quantitative results on peak density variation and beam quality are presented.

TP-3028 June 1990

This report details the loads testing on in-house-fabricated flight configuration SRM outer boot ring segments. The tests determined the bending strength and bending stiffness of these beams and showed that they compared well with the hand analysis. The bending stiffness test results compared very well with the finite element data.

TP-3029 July 1990

Low velocity drop weight instrumented impact testing was utilized to examine the damage resistance of four recently developed carbon fiber/epoxy resin systems. A fifth material, T300/934, for which a large data base exists, was also tested for comparison purposes. A 16-ply quasi-isotropic lay-up configuration was used for all the specimens. Force/absorbed energy-time plots were generated for each impact test. The specimens were cross-sectionally analyzed to record the damage corresponding to each impact energy level. Maximum force of impact versus impact energy plots were constructed to compare the various systems for impact damage resistance. Results show that the four new damage tolerant fiber/resin systems far outclassed the T300/934 material. The most damage tolerant material tested was the IM7/1962 fiber/resin system.

TP-3030 June 1990
This paper presents a new method for scanning balloon-borne experiments, free-flying spacecraft, and gimbaled experiments mounted to the space shuttle or the space station. It uses rotating-unbalanced-mass (RUM) devices for generating circular, linear, or raster scan patterns and an auxiliary control system for target acquisition, keeping the scan centered on the target, and producing complementary motion for raster scanning. It is ideal for applications where the only possible way to accomplish the required scan is to physically scan the entire experiment or spacecraft as in x-ray and gamma-ray experiments. In such cases, this new method should have advantages over prior methods in terms of either power, weight, cost, performance, stability, or a combination of these.

TP-3031  
Forbidden Tangential Orbit Transfers Between Intersecting Keplerian Orbits. R.E. Burns. Systems Analysis and Integration Laboratory.  
N90-26028

The classical problem of tangential impulse transfer between coplanar Keplerian orbits is addressed. A completely analytic solution which does not rely on sequential calculation is obtained and this solution is used to demonstrate that certain initially chosen angles can produce singularities in the parameters of the transfer orbit. A necessary and sufficient condition for such singularities is that the initial and final orbits intersect.

TP-3042  
N90-27876

An examination of low velocity impact damage to glass/phenolic and aluminum core honeycomb sandwich panels with carbon/epoxy facesheets is presented. An instrumented drop weight impact test apparatus was utilized to inflict damage at energy ranges between 0.7 and 4.2 Joules. Specimens were checked for extent of damage by cross-sectional examination. The effect of core damage was assessed by subjecting impact-damaged beams to four-point bend tests. Skin-only specimens (facings not bonded to honeycomb) were also tested for comparison purposes. Results show that core buckling is the first damage mode, followed by delaminations in the facings, matrix cracking, and finally fiber breakage. The aluminum honeycomb panels exhibited a larger core damage zone and more facing delaminations than the glass/phenolic core, but could withstand more shear stress when damaged than the glass/phenolic core specimens.

TP-3058  

This study analyzed long-term orbital lifetime predictions. Predictions were made for three satellites: the Solar Max Mission (SMM), the Long Duration Exposure Facility (LDEF), and the Pegasus Boiler Plate (BP). A technique is discussed for determining an appropriate ballistic coefficient to use in the lifetime prediction. The orbital decay rate should be monitored regularly. Ballistic coefficient updates should be done whenever there is a significant change in the actual decay rate or in the solar activity prediction.
NASA CONFERENCE PUBLICATIONS

CP-3085 July 1990

CP-3088 August 1990
Measurement and Characterization of the Acceleration Environment on Board the Space Station. Charles R. Baugher, Editor.

CP-3089 September 1990
Current Collection from Space Plasmas. N. Singh, K.H. Wright, Jr., and N.H. Stone, Editors.

CP-3091 September 1990
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-4260 November 1989

CR-4267 January 1990

CR-4273 January 1990

CR-4293 May 1990

CR-4313 August 1990
Size, Duration, and Rate of Growth of Nocturnal Lightning Events Appearing on Space Shuttle Video Tapes. NAS8-32893. C. Breslawski. State University of New York at Albany.

CR-4318 August 1990

CR-183771 July 1989

CR-183772 August 1989
Minuteman Pressure Transducer Burst Test Final Test Report. NAS8-30490. Thiokol Corp.

CR-183773 August 1989

CR-183774 August 1989

CR-183775 October 1989
Atmospheric Cloud Physics Laboratory (ACPL) Simulation System Mathematical Description. NAS8-32668. General Electric.

CR-183776 August 1989

CR-183777 May 1989

CR-183778 August 1989
Solid Propulsion Integrity Program Nozzle Third Quarterly Review. NAS8-37801. Hercules Industry Team.

CR-183779 August 1988

CR-183780 July 1989
CR-183797 March 1989

CR-183798 March 1989

CR-183799 March 1989
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) Systems Study. Appendix M. Preliminary Hazard Analysis for the LRB. NAS8-37136. Martin Marietta. N90-70608

CR-183800 March 1989

CR-183801 June 1989

CR-183802 August 1989

CR-183803 August 1989
The Effect of Impurity Gases on Plasma Arc Welded 2219 Aluminum. NAS8-37425. The University of Texas at El Paso. N90-26935

CR-183804 October 1989

CR-183805 October 1989

CR-183806 November 1989

CR-183807 September 1989

CR-183808 August 1989

CR-183809 August 1989

CR-183810 August 1989

CR-183811 June 1989

CR-183812 September 1987

CR-183813 September 1987
CR-183814  September 1987

CR-183815  March 1987
Advanced Recovery Systems Study for the Next Generation Space Transportation System. Mid-Term Review. NAS8-36631. Pioneer Systems, Inc. X90-70302

CR-183816  September 1987

CR-183817  September 1989

CR-183818  September 1989

CR-183819  September 1989

CR-183820  September 1989

CR-183821  February 1989

CR-183822  March 1989

CR-183823  October 1989

CR-183824  September 1989

CR-183825  July 1987

CR-183826  September 1989
Cable Coupling Lightning Transient Qualification Final Test Report. NAS8-30490. Thiokol Corp. N90-13405

CR-183827  September 1989
Qualification of Improved Joint Heaters Final Test Report. NAS8-30490. Thiokol Corp. N90-13594

CR-183828  September 1989
Evaluation of Newly Formulated Dow Corning 321 Dry Film Lubricant Final Test Report. NAS8-30490. Thiokol Corp. N90-13661

CR-183829  September 1989

CR-183830  October 1989

CR-183831  September 1989
CR-183832  August 1989
Systems Tunnel Linear Shaped Charge Lightning Strike Final Test Report. NAS8-30490. Thiokol Corp. N90-13404

CR-183833  May 1989
Space Shuttle Production Verification Motor 1 (PV-1) Static Fire Final Test Report, Volume 1 (Revision A). NAS8-30490. Morton Thiokol, Inc.

CR-183834  July 1989

CR-183835  October 1989
Risk-Based Fire Safety Experiment Definition for Manned Spacecraft. NAS8-37750. University of California. N90-14262

CR-183836  September 1989

CR-183837  December 1989
Research Reports – 1989 NASA/ASEE Summer Faculty Fellowship Program. NGT-01-008-021. The University of Alabama in Huntsville and The University of Alabama in Tuscaloosa. N90-19390

CR-183838  October 1989

CR-183839  May 1989

CR-183840  October 1989
Space Station Simulation Computer System (SCS) Study for NASA/MSFC. SCS Study Report, Volume 1, Overview and Summary, Final Report. NAS8-37745. TRW. N90-20113

CR-183841  October 1989

CR-183842  October 1989

CR-183843  October 1989

CR-183844  October 1989

CR-183845  October 1989

CR-183846  November 1989

CR-183847  September 1989

CR-183848  August 1989
Extra-Vehicular Activity Welding Experiment. NAS8-37753. Rockwell International. N90-14608

CR-183849  August 1989
Out-Reach In-Space Technology Experiments Program. Control of Flexible Robot Manipulators in Zero Gravity Experiment Definition Phase August 16, 1988 Through August 15,
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)


CR-183850 October 1989

CR-183851 November 1989

CR-183852 November 1989

CR-183853 September 1989
Investigation of X-Ray Variability in Highly Active Cool Stars (Ginga Visiting Investigator Program) Final Report. NAS8-37655. Lockheed

CR-183854 December 1989

CR-183855 December 1988
First Incremental Buy for Increment II of the Space Transportation System (STS) – Contractor’s Final Documentation Report. NAS8-30490. Thiokol Corp.

CR-183856 December 1988

CR-183857 August 1989

CR-183858 November 1989

CR-183859 October 1989

CR-183860 December 1989

CR-183861 November 1989
Use of Solvent Vacuum Cleaning System on RSRM Casting Tooling (FINS) Final Report. NAS8-30490. Thiokol Corp. N90-90300

CR-183862 December 1989

CR-183863 November 1989

CR-183864 November 1989

CR-183865 December 1989

CR-183866 December 1989

CR-183867 December 1989

CR-183868 September 1989
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

NAS8-37801. Hercules Aerospace Co.

CR-183869  September 1989
X90-10192

CR-183870  September 1989
X90-10190

CR-183871  December 1989
N90-28590

CR-183872  August 1989
N90-70537

CR-183873  January 1990
X90-10188

CR-183874  January 1990
X90-10189

CR-183875  January 1990

CR-183876  January 1990
N90-70538

CR-183877  January 1990
Thiokol/Wasatch Installation Evaluation of the

Redesigned Field Joint Protection System (Concepts 1 and 1C) Final Test Report. NAS8-30490. Thiokol Corp.
N90-70589

CR-183878  April 1990
Shelf Life Extension for the Lot AAE Nozzle Severance LSC’s Final Test Report. NAS8-30490. Thiokol Corp.
N90-21813

CR-183879  November 1989
N90-70539

CR-183880  December 1989
N90-70535

CR-183881  December 1989
N90-71177

CR-183882  October 1989
The Effects of Autoclave Cure Temperatures on Nonsilicone Teflon Tape With EPDM Rubber, Final Report. NAS8-30490. Thiokol Corp.
N90-70701

CR-183883  December 1989
RSRM Forward Dome Inhibitor Region Improvement, Final Report. NAS8-30490. Thiokol Corp.
N90-70535

CR-183884  December 1989
N90-71178

CR-183885  November 1989
N90-71176

CR-183886  October 1989
N90-70588
CR-183887 September 1989

CR-183888 July 1989

CR-183889 September 1989

CR-183890 November 1989
Development of New Materials for Turbopump Bearings – Phase II. Final Report. NAS8-36180. SKF MRC Bearings. X90-10329

CR-183891 November 1989
The Effects of Reynolds Number, Rotor Incidence Angle and Surface Roughness on the Heat Transfer Distribution in a Large-Scale Turbine Rotor Passage. NAS8-37351. United Technologies Research Center. N90-23731

CR-183892 December 1989

CR-183893 February 1990
Direct Arc Attachment Test Final Test Report. NAS8-30490. Thiokol Corp. N90-91144

CR-183894 January 1990

CR-183895 March 1990

CR-183896 February 1990

CR-183897 January 1990

CR-183898 January 1990
M-120 Aluminum Feeder Investigation Final Report. NAS8-30490. Thiokol Corp. N90-70590

CR-183899 February 1990

CR-183900 March 1990

CR-183901 March 1990

CR-183902 October 1989

CR-183903 February 1990

CR-183904 February 1990

CR-183905 January 1990
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-183906 April 1990

CR-183907 February 1990
Payload Training Methodology Study Final Report. NAS8-37737. Essex Corp.

CR-183908 March 1990
Qualification for the 8U75686 Field Joint Assembly Fixture (FJAF) Final Test Report. NAS8-30490. Thiokol Corp. N90-91145

CR-183909 February 1990

CR-183910 January 1990
Advanced Launch System Solid Rocket Booster Systems Definition Study (Phase A) Final Study Report, Volume I – Executive Summary. NAS8-38131. Thiokol Corp.

CR-183911 January 1990

CR-183912 January 1990

CR-183913 January 1990
Advanced Launch System Solid Rocket Booster Systems Definition Study (Phase A) Work Breakdown Structure (WBS) and WBS Dictionary. NAS8-38131. Thiokol Corp.

CR-183914 January 1990
Advanced Launch System Solid Rocket Booster Systems Definition Study (Phase A) Environmental Studies. NAS8-38131. Thiokol Corp.

CR-183915 January 1990
Advanced Launch System Solid Rocket Booster Systems Definition Study (Phase A) Program Cost Estimates. NAS8-38131. Thiokol Corp.

CR-183916 January 1990
Advanced Launch System Solid Rocket Booster Systems Definition Study (Phase A) Design Graphics. NAS8-38131. Thiokol Corp.

CR-183917 February 1990

CR-183918 February 1990

CR-183919 February 1990

CR-183920 January 1990

CR-183921 February 1990

CR-183922 February 1990

CR-183923 February 1990
Advanced Launch System Solid Rocket Booster
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)

CR-183924 March 1990

CR-183925 November 1989
Modification of ET Nose Cone to Become a Line Replacement Unit. NAS8-36200. Martin Marietta. N90-91147

CR-183926 March 1990

CR-183927 March 1990

CR-183928 March 1990
OPT EMI Test Final Test Report. NAS8-30490. Thiokol Corp. N90-91148

CR-183929 March 1990
Investigation of Teflon Topcoat Peeling From the SRM Pathfinder Core Final Report. NAS8-30490. Thiokol Corp. N90-91149

CR-183930 March 1990
Transportation Monitoring Unit Qualification Final Test Report. NAS8-30490. Thiokol Corp.

CR-183931 March 1990
Qualification of the RSRM Field Joint CF Case-to-Insulation Bondline Inspection Using the Thiokol Corporation Ultrasonic RSRM Bondline Inspection System Final Test Report. NAS8-30490. Thiokol Corp.

CR-183932 March 1990

CR-183933 March 1990

CR-183934 March 1990

CR-183935 March 1990

CR-183936 March 1990

CR-183937 March 1990

CR-183938 March 1990

CR-183939 March 1990

CR-183940 April 1990
Qualification of the RSRM Field Joint Pinhole Case-to-Insulation Bondline Inspection Using the Thiokol Corporation Ultrasonic RSRM Bondline Inspection System. NAS8-30490. Thiokol Corp.

CR-183941 November 1989
Probabilistic Model for Fracture Mechanics


CR-183959 April 1990 Qualification of the RSRM Case Membrane Case-to-Insulation Bondline Inspection Using the Thiokol Corporation Ultrasonic RSRM
CR-183960  
December 1989  
Thrust Chamber Performance Prediction Using the Navier-Stokes Solution. NAS8-36899. Lockheed Missiles and Space Co., Inc.

CR-183961  
April 1990  

CR-183962  
March 1990  

CR-183963  
May 1990  

CR-183964  
April 1990  

CR-183965  
December 1989  

CR-183966  
May 1990  
TEM-6 Fixed Housing Transducer Qualification and EA934NA Retaining Agent Usage Final Test Report. NAS8-30490. Thiokol Corp. N90-91174

CR-183967  
December 1989  
Evaluation of Berkshire Lab Tips™ Polyurethane (Cleanroom) Swabs (Model No. LT003163R) for Precision Cleaning on RSRM Cases. Final Report. NAS8-30490. Thiokol Corp. N90-91173

CR-183968  
May 1990  
Technical Evaluation Motor No. 6 (TEM-6) Final Test Report. NAS8-30490. Thiokol Corp. N90-91169

CR-183969  
April 1990  

CR-183970  
February 1990  

CR-183971  
May 1990  
Field Joint Assembly Fixture Paint Sensitivity on Painted Outer Clevis Leg, Final Test Report. NAS8-30490. Thiokol Corp. N90-91175

CR-183972  
November 1989  

CR-183973  
November 1989  

CR-183974  
December 1989  

CR-183975  
October 1989  

CR-183976  
July 1988  

CR-183977  
July 1988  
DRIRU II Quality Plan. NAS8-37741. Teledyne Systems Co.
CR-183978 April 1990
Proceedings Advisory Committee on Standardization of Carbon-Phenolic Test Methods and Specifications. NAG8-545. Mississippi State University.

CR-183979 June 1990
Flight Motor Set 360L007 (STS-33R) Final report. NAS8-30490. Thiokol Corp.

CR-183980 May 1990
Qualification of the Installation Links for the RSRM Field Joint Heater Retention Strap Tensioning Tool Final Test Report. NAS8-30490. Thiokol Corp.

CR-183981 May 1990

CR-183982 June 1990

CR-183983 March 1990

CR-183984 March 1990

CR-183985 June 1990

CR-183986 May 1990

CR-183987 June 1990
Final Report for Certification of IU51703 Pyrotechnic Basket Lot AAD. NAS8-30490. Thiokol Corp.

CR-183988 May 1990

CR-183989 June 1990
EA-934NA Adhesive With Cab-O-Sil to Primer Bond Strength Test. Final Report. NAS8-30490. Thiokol Corp.

CR-183990 November 1989

CR-183991 June 1989
Space Radiation Studies – Final Report. NAS8-35354. The University of Alabama in Huntsville.

CR-183992 June 1990

CR-183993 June 1989

CR-183994 March 1990
Lox Manifold Tee Analysis Final Report. NAS8-37285. SECA, Inc.

CR-183995 June 1990

CR-183996 May 1990

CR-183997 June 1990
External Tank Aerothermal Design Criteria
NASA CONTRACTOR REPORTS
(Abstracts for these reports may be obtained from STAR)


CR-183998 March 1990

CR-183999 March 1990

CR-184000 May 1990

CR-184001 July 1990
QM-6 Final Performance Evaluation Report Igniter. NAS8-30490. Thiokol Corp.

CR-184002 June 1990
Igniter Adapter-to-Igniter Chamber Deflection Test Final Report, Revision A. NAS8-30490. Thiokol Corp.

CR-184003 July 1990
Final Report for the M-52 Spray Booth Qualification Test. NAS8-30490. Thiokol Corp.

CR-184004 June 1990
Nylon and Teflon Scribe Effect on NBR to Chemlok 233 and NBR to NBR Bond Interfaces Final report. NAS8-30490. Thiokol Corp.

CR-184005 June 1990
Evaluation of EA-934NA with 2.5% Cab-O-Sil Final Report. NAS8-30490. Thiokol Corp.

CR-184006 July 1990

CR-184007 February 1990

CR-184008 June 1990

CR-184009 April 1990
Heat Treatment Study II. H-80579B. The University of Alabama in Huntsville.

CR-184010 July 1990

CR-184011 June 1990
Asbestos Bag Drying Final Report. NAS8-30490. Thiokol Corp.

CR-184012 December 1988
Historical Annotated Bibliography: Space Station Documents. NAS8-35900. Compiled by Management Operations Office.

CR-184013 December 1988

CR-184014 December 1988

CR-184015 July 1990

CR-184016 August 1990
PV-1 Final Performance Evaluation Report Igniter. NAS8-30490. Thiokol Corp.
CR-184017       May 1990
STS-33R, RSRM-007, 360L007 KSC Processing Configuration and Data Report. NAS8-30490. Thiokol Corp.

CR-184018       July 1990

CR-184019       August 1990

CR-184020       July 1990
Automated Ultrasonic Thickness Gauge of Case and Nozzle Components, Final Test Report. NAS8-30490. Thiokol Corp.

CR-184021       August 1990
ANDERSON, B.J. ES44
SMITH, R.E. FWG
SUGGS, R.J. ES44
HICKEY, M. USRA

ANDERSON, B.J. ES44
SMITH, R.E. FWG
Natural Environment Definitions for Design of the Space Station. For presentation at the ESA Space Environment Analysis Workshop, Noordwijk, The Netherlands, October 9-12, 1990.

ANDERSON, J.R. EH12
WILBUR, P.J.
CARRUTH, R.

ANDRE, M. ES53
CREW, G.B.
PETerson, W.K.
PERSOON, A.M.
POLLOCK, C.J.
ENGEBRETSON, M.J.
Ion Heating by Broadband Low-Frequency Waves in the Cusp/Cleft. For publication in the Journal of Geophysical Research, Washington, DC.

ASHWORTH, B. Martin Marietta
WALLS, B. EB12
Autonomous Operation of a Space Station Freedom Type Power Testbed. For presentation at the Artificial Intelligence and Advanced Automation Techniques for Fault Diagnosis Recovery Workshop, Houston, TX, June 18, 1990.

AUSTIN, G. PT31
VINOPAL, T. Boeing
BANGOUND Boeing
Designing the Space Transfer Vehicle. For presentation at the International Astronautical Federation (IAF), Malaga, Spain, October 9-13, 1989.

AVANS, S.L. ED52
HORN, J.R.
WILLIAMSEN, J.E.
Shielding Requirements for Space Station Habitability Modules. For presentation at the Orbital Debris Conference, Baltimore, MD, April 16-19, 1990.

BACCHUS, D.L. ED33

BAGDIGIAN, R.M. ED62

BAKER, M. EH14

BALASUBRAMANIAM, K.S. ES52
WEST, E.A.

BALASUBRAMANIAM, K.S. ES52
WEST, E.A.
BAMBERGER, S.  

BANKSTON, C.D.  
Co-op UAH PD12

GILBERT, J.A.

GREGUSS, P.


BARBEE, T.W.

HOOVER, R.B.

SHEALY, D.L.


BARNETT, M.B.


BARNUM, L.R.  
ES43 (USRA)

BAILEY, J.C.

MACH, D.M.

STEWARD, M.F.

CHRISTIAN, H.J.


BARRET, C.


BEARDEN, D.B.

LOLAR, L.F.


BERANEK, R.  
PS02

KOCZOR, R.


BERTERO, G.A.  
ES75

HOFMEISTER, W.H.

ROBINSON, M.B.

BAYUZICK, R.J.

Rapid Solidification of Nb-Si Alloys in the Nb-Rich Eutectic Range. For publication in Metallurgical Transactions A. Pittsburg, PA.

BHAT, B.N.  
EH23

McPHERSON, W.B.

PANDA, B.  
IITRI


BHAT, B.N.  
EH23

Advanced Materials Research and Development at MSFC. For presentation at the Graduate Seminar, University of Tennessee Space Institute, Tullahoma, TN. January 17, 1990.

BOARDSEN, S.  
ES53

GALLAGHER, D.L.


BOWDLE, D.  
ES43

ROOTHERMEL, J.

ARNOLD, J.


BOWER, C.R.

DIETZ, K.L.

RAMSEY, B.D.
WEISSKOPE, M.C.

BRANDON, L.B.

BREWER, J.C.
JACKSON, L.G.

BROOKE, T.Y.
TOKUNAGA, A.T.
CARR, J.C.
SELLGREN, K.
KNACKE, R.F.
ALLAMANDOLA, L.J.
SANDFORD, S.A.
TAPIA, M.
Detection of Strong 3.4 μm and 2.8 μm Emission Features in Comet p Borsen-Metcalf. For publication in the Proceedings of the 21st Meeting Division of Planetary Sciences, American Astronomical Society, Providence, RI.

BROWN, D.G.
HORWITZ, J.L.
WILSON, G.R.
GALLAGHER, D.L.

BRYAN, T.C.
ANDERSON, R.
TSUGAWA, R.
DRAZININ, M.
Autonomous Proximity and Docking Technologies. For presentation at the Autonomous Rendezvous and Docking Conference, Houston, TX, August 15–16, 1990.

BUCHLER, D.E.
WRIGHT, P.D.
GOODMAN, S.J.
Lightning/Rainfall Relationships During COHMEX. For presentation at the AMS Conference on Atmospheric Electricity, Kananaskis Provincial Park, Canada, October 22–26, 1990.

BUCHLER, D.E.
NIELSEN, K.E.
GOODMAN, S.J.
Cloud-to-Ground Lightning and Rainfall Volumes in Midlatitude Mesoscale Convective Systems. For presentation at the AMS Conference on Atmospheric Electricity, Kananaskis Provincial Park, Canada, October 22–26, 1990.

BUITEKANT, A.
ROBERTS, B.

BURLAGA, L.F.
WILSON, R.M.
Reply to "Comment on the Polarity of Magnetic Clouds." For publication in the Journal of Geophysical Research, Washington, DC.

BURNETT, T.H.
FOUNTAIN, W.F.
PARNELL, T.A.
ROBERTS, F.E.
DERRICKSON, J.H.
WATTS, J.W.

CACIOPOPO, E.
MUNSON, S.
PUSEY, M.L.
Protein Solubilities Determined by a Rapid Technique and Modification of That Technique to a Micro-Method. For publication in the Journal of Crystal Growth, The Netherlands.
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

CALVERT, J.A. EP63

CAMPBELL, J. ES52
DAVIS, J.
EMSLIE, A.G.

CAMPINS, H. ES63
DECHER, R.
TELESCO, C.M.
LIEN, J.J.
Ground-based Thermal IR Images of Comet Tempel 2. For publication in Icarus, Ithaca, NY.

CARDELINO, B.H. ES74
MOORE, C.E.
STICKEL, R.E.
Static First-Order Hyperpolarizability Calculations for Large Molecular Systems. For publication in the Journal of Physical Chemistry, Columbus, OH.

CARDELINO, B.H. ES74
MOORE, C.E.
STICKEL, R.E.

CARPENTER, D.L. ES53
GILES, B.L.
CHAPPELL, C.R.
Observations of Plasmaspheric Bulge Dynamics. For presentation at the Workshop on Plasmaspheric Refilling, Huntsville, AL, October 15–16, 1990.

CARRINGTON, C.K. PD12

CARRINGTON, C.K. PD12

CARRUTH, M.R. EH12
VAUGHN, J.

CARRUTH, M.R. EH12
DeHAYE, R.F.
NORWOOD, J.K.
WHITAKER, A.F.

CARTER, D.C. ES76
HE, X.-M.
Structure of Human Serum Albumin. For publication in Science, Washington, DC.

CASALE, E. ES76
WENISCH, E.
HE, X.-M.
RIGHETTI, P.G.
SNYDER, R.S.
JUNGBAUER, A.
TAUER, C.
RUKER, F.
CARTER, D.C.

CHANDLER, M.O. WAITE, J.H., JR. MOORE, T.E.
Observations of Polar Ion Outflows. For publication in the Journal of Geophysical Research, Washington, DC.

CHANDLER, M.O.
Circulation of Core Ions Within the Plasmasphere. For presentation at the 1990 Spring Meeting of the American Geophysical Union, Baltimore, MD, May 31–June 1, 1990.

CHANDRASEKAR, V. GOODMANN, S.J.
Intercomparison of Techniques to Estimate Rainfall by Radar. For presentation at the AGU Spring Meeting, Baltimore, MD, May 29–June 1, 1990.

CHEN, C.P. SCHAFER, C.
Three-Dimensional Computations of Flow Passages in SSME. For publication in the Journal of Propulsion.

CHOU, S.-H.

CHOU, S.-H.
On Amplitude Modulation of Topographically Forced Baroclinic Disturbances. For publication in the Journal of Atmospheric Science, Washington, DC.

CHOU, S.-H. LOESCH, A.Z.
Supercritical Baroclinic Disturbances Under the Influence of Topography. For publication in the Journal of Atmospheric Sciences, New York, NY.

CHRISTIAN, D.C.

CHRISTIAN, H.J.
Lightning Observations From Space. For presentation at the 15th General Assembly of the European Geophysical Society, Copenhagen, Denmark, April 23–27, 1990.

CHRISTIAN, H.J.

CHYLEK, P. JARZEMBSKI, M. SRIVASTAVE, V. PINNICK, R.
Pressure Dependence of the Laser-Induced Breakdown Thresholds of Gases and Droplets. For publication in the Applied Optics Journal, Atlanta, GA.

CIKANEK, H.A., III

CLARK, B. WATTS, J.W., JR.

CLELAND, J.G. KORNFELD, D.M.
Optimization of the Parameters for a Rotating.
Mixed-Phase Reactor. For publication in Transactions of the ASME Fluids Engineering, Kingston, RI.

CLINTON, R.G. TURNER, J.E.

COHEN, L.M. CERNOCH, L. MATHEWS, G. STALLCUP, M.

COMFORT, R.H. RICHARDS, P.G. CRAVEN, P.D.
GALLAGHER, D.L. CHAPPELL, C.R.

COMFORT, R.H. RICHARDS, P.G. CHANDLER, M.O. CRAVEN, P.D. CHAPPELL, C.R. KOZYRA, J.U.
Ion Characteristics of Thin Plasmasphere Boundary Layers: Observations Versus Theory. For presentation at the 1990 Spring Meeting of the American Geophysical Union, Baltimore, MD, May 28-June 1, 1990.

COMFORT, R.H. RICHARDS, P.G. CRAVEN, P.D.

COMFORT, R.H. CHANDLER, M.O.

COOK, J. DUMBACHER, D. ISE, M. SINGER, C.

COOK, J. DUMBACHER, D. ISE, M. SINGER, C.
Test Results of the Modified SSME at the MSFC Technology Test Bed Facility. For presentation at the 1990 JANNAF Propulsion Meeting, Anaheim, CA, October 2-4, 1990.

COOK, W.R. PRINCE, T.A. GRINDELAY, J.E. RAMSEY, B.D. WEISSKOPF, M.C. SKINNER, G.K.

CRAFT, H.G., JR. WICKS, T.G.
Space Station Transition Through Spacelab. For presentation at AIAA, Huntsville, AL, September 25, 1990.

CRAVENS, T.E. WU, D. SHINAGAWA, H.

CREMIN, J.W.  ES42
LESLIE, F.W.

CURRELL, P.A.  ES75

DALINS, I.  EH22
Violent Oxidation of Lithium Containing Aluminum Alloys in Liquid Oxygen. For presentation at the Fifth International Conference on Solid Films and Surfaces, Providence, RI, August 13–17, 1990.

DAVIS, J.M.  ES52
HUDSON, H.S.

DAVIS, J.M.  ES52

DAVIS, J.M.  ES52
Ideas for a Lunar-Based Solar Observatory. For presentation at the Workshop on Astrophysics From the Moon, Annapolis, MD, February 5–7, 1990.

DEAN, N.F.  ES75
RUSSELL, K.C.
CURRELL, P.A.
Publication: Solidification Processing of Monotectic Alloy Metal Matrix composites (TMS-AIME), Warrendale, PA.

DELCOURT, D.C.  ES53
MOORE, T.A.
PEDERSEN, A.
SAUVAUD, J.A.

DELCOURT, D.C.  ES53
SAUVAUD, J.A.
MOORE, T.E.
Cleft Contribution to Ring Current Formation. For publication in the Journal of Geophysical Research, Washington, DC.

DERRICKSON, J.H.  ES62
DAKE, S.
DONG, B.

DERRICKSON, J.H.  ES62
PARNELL, T.A.
ROBERTS, F.E.
WATTS, J.W.

DeSANCTIS, C.E.  PS02
Science and Application Payloads in the 90’s. For presentation at the 27th Space Congress, Cocoa Beach, FL, April 24–27, 1990.

DeSANCTIS, C.E.  PS02
DEWBERRY, B.S. EB42

DOBSON, C.C. EP55
ESKRIDGE, R.H.

DOLLMAN, T.S. ES44
Software Support Environment Design Knowledge Capture. For presentation at the Space Station Evolution – Beyond the Baseline, Houston, TX, February 6, 1990.

DORESWAMY, R. EB12

DOUGHERTY, N.S.
HOLT, J.B. Rockwell
NEMAN, T.E. ED33
FARR, R.A. ED33

DOWDY, J.F., JR. ES52

DUGAL-WHITEHEAD, N.R. EB12
LOLLAR, L.F.

DUMBACHER, D.L. EP01

ELAM, S. EP62
LINDSAY, J. University of Michigan
KOBLISH, T. Textron Corp.
LEE, P. Textron Corp.
McAULIFFE, D. Textron Corp.

ELLIS, H.B., JR. ES63
LESTER, D.F.
HARVEY, P.M.
JOY, M.
TELESCO, C.M.
DECHER, R.
WERNER, M.W.
High Spatial Resolution Mapping of the Cepheus a Region at 20 μm and 100 μm. For publication in the Astrophysical Journal, Tucson, AZ.

ELSNER, R.F. ED65
WEISSKOPF, M.C.

ELSNER, R.F. ES65
WEISSKOPF, M.C.
KAARET, P.
NOVICK, R.
SILVER, E.
EMRICH, W. PD13
YOUNG, A.
MULQUEEN, J.

ESKRIDGE, R.H. EP55
DOBSON, C.C.

ETHRIDGE, E.C. ES75
JOHNSON, B.
FENG, C.

EUDY, R.G. PF24

EUEDY, R.G. PF24

EZELL, T.G. EL64

FENNELLY, J.A. ES51
TORR, D.G.
RICHARDS, P.G.
TORR, M.R.
SHARP, W.E.

FERNANDEZ, K. EB44
An Update on the Use of Simulation in the Development of Robotic Systems. For presentation at the 41st International Aerospace Federation, Dresden, German Democratic Republic. October 6, 1990.

FICHTL, G.H. ES01

FINCKENOR, M. EH15

FINESCHI, S. ES52
FONTENLA, J.M.
LJEPOJEVIC, N.N.

FINESCHI, S. ES52
DEGL’INNOCENTI, L.

FISHMAN, G.J. ES62
HARMON, B.A.
PARNELL, T.A.

FISHMAN, G.J. ES62 et al.

Observation of Be on the Surface of the LDEF Spacecraft. For publication in Nature, Washington, DC.

FISHMAN, G.J. ES62
BATSE: The Burst and Transient Source Experiment on the Gamma Ray Observatory. For presentation at the Los Alamos Workshop on Gamma-Ray Bursts. Taos, NM, July 29–August 3, 1990.

FONTENLA, J.M. ES52
DAVIS, J.
3-D Description of Vertical Current Sheets With Application to Solar Flares. For publication in The Astrophysical Journal, Chicago, IL.

FUNSTON, K.M. ED14

GALLAGHER, D. ES53
CRAVEN, P.
COMFORT, R.

GARY, G.A. ES52

GARY, G.A. ES52

GARY, G.A. ES52

GERLACH, L. EB13
EDGE, T.M.

GOLBEN, J. ES74
VLASSE, M.
MITCHELL, T.
Aligned Sintered Compacts: Routes Toward Higher Jc’s in Bulk High Tc Superconductors. For presentation at the Second World Congress on Superconductivity, Houston, TX, September 10–13, 1990.

GOLDEN, H. EO01
SAENGER, E. McDonald Douglas

GOODMAN, H.M. ES44
DODGE, J.
STAR, J.
The WETNET Project. For presentation at the Sixth International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, Anaheim, CA, February 4–9, 1990.

GOODMAN, H.M. ES44
SMITH, M. USRA
LaFONTAINE, V. USRA
MOSS, D. UAH

GOODMAN, S.J. ES44
KNUPP, K.R.
Tornadogenesis via Squall Line and Supercell Interaction Revisited: The 15 November 1989 Huntsville Tornado. For presentation at the AMS 16th Conference on Severe Local Storms.
GOODMAN, S.J. ES44
WRIGHT, P.D.
Lightning and Precipitation Characteristics of New Mexico Thunderstorms. For presentation at the AGU Fall Meeting, San Francisco, CA, December 4–8, 1989.

GOODMAN, S.J. ES44
CHRISTIAN, H.J.

GOODMAN, S.J. ES44
BUECHLER, D.

GRANT, R.L. Boeing
HOPSON, G.D. KA01
Space Station Freedom Pressurized Element Designs. For presentation at the 41st International Astronautical Congress, German Democratic Republic, October 6–13, 1990.

GRANT, R.L. Boeing
HOPSON, G.D. KA01
Space Station Freedom Pressurized Element Designs. For presentation at the 41st International Astronautics Congress, Dresden, Germany, October 6–13, 1990.

GREGORY, J.C. ES63
PETERS, P.N.

HAGYARD, M.J. ES52
HENZE, W., JR.

HALE, J.P. II EO23

HALE, J.P. II EO23

HALE, J.P. II EO23

HALE, J.P. II EO23
Dining in Space, II. For publication in the
HALL, D.K.  
LOLLAR, L.F.

HARRISON, J.K.  
RUPP, C.C.  
CARROLL, J.A.  
MARIN, D.

HATHAWAY, D.H.  
HARVEY, K.L.
Analysis of a 116 Year Record of Sunspot Positions and Sizes. For presentation at the 175th Meeting of the American Astronomical Society, Albuquerque, NM, June 10-14, 1990.

HAYES, B.C.

HE, X.M.  
CARTER, D.C.  
TWIGG, P.D.  
MUNSON, S.H.
Modeling Absorption of Area-Detector Data Using Spherical Harmonics – A Fortran Scaling Program SPHAB. For publication in ACTA Crystallographica, Munksgaard, DK-370 Copenhagen K, Denmark.

HEAMAN, J.P.
Design and Performance of an Air Preheater for Aerodynamic Facilities. For presentation at the 73rd Semiannual Meeting of the Supersonic Tunnel Association, Urbana-Champaign, IL, March 26-27, 1990.

HERREN, K.  
LINTON, R.  
WHITAKER, A.
In Situ Measurements of Scattering from Contaminated Optics in the Vacuum Ultraviolet. For presentation at the 20th International Conference on Environmental Systems, Williamsburg, VA, July 9-12, 1990.

HICKEY, M.P.
Gravity Wave Modulations of the Mesopause OH Nightglow. For presentation at the American Geophysical Union Fall Meeting, San Francisco, CA, December 4-8, 1989.

HIGGINBOTHAM, H.K.
ECLS Resupply for Space Station Freedom. For presentation at the 20th International Conference on Environmental Systems, Williamsburg, VA, July 9-12, 1990.

HINMAN, E.M.
Physical and Digital Simulations for Space Robotics. For presentation at the Southeastern Simulation Conference ‘90, Huntsville, AL, October 22-23, 1990.

HINMAN, E.M.
Robot-Tended Crystal Growth in a Space-Based Laboratory. For presentation at the International Symposium on Laboratory Automation and Robotics, Boston, MA, September 16-18, 1990.

HO, C.W.  
HORWITZ, J.L.  
WILSON, G.R.  
SINGH, N.  
MOORE, T.E.
The Outer Magnetic Field. For publication in Memorie della Societa Astronomica Italiana, Rome, Italy.


Design and Analysis of Aspherical Multilayer Imaging X-Ray Microscope. For publication in Optical Engineering, Bellingham, WA.


HOOVER, R.B.  
ES52  

HOOVER, R.B.  
ES52  

HOOVER, R.B.  
ES52  

HOOVER, R.B.  
ES52  

HOOVER, R.B.  
ES52  

HORWITZ, J.L.  
ES53  
MOORE, T.E. et al.  

HORWITZ, J.L.  
ES53  
COMFORT, R.H.  
CHAPPELL, C.R.  

HUETER, U.  
PT21  
SUMRALL, P.  
PT21  
HOLDRIDGE, J.  
SHEPARD, K.  

HUFFAKER, C.F.  
PT31  
KELLEY, D.  
Martin Marietta  

HUMPHRIES, W.  
ED62  
HUMPHRIES, W.R.  
ED62  
WIELAND, P.O.  

HUNG, R.J.  
ES42  
LEE, C.C.  
LESLEI, F.W.

HUNG, R.J. LEE, C.C. LESLIE, F.W.
Gravit

HUNG, R.J. LEE, C.C. LESLIE, F.W.

HUNG, R.J. LEE, C.C. LESLIE, F.W.

HUNG, R.J. TSAO, Y.D.
LESLE, F.W.

HUTT, J.J. DENNIS, H.J., JR.

JARZEMBSKI, M.A. SRIVASTAVA, V.
The Electromagnetic Field Enhancement in Small Liquid Droplets Using Geometrical Optics. For publication in Applied Optics Journal, Atlanta, GA.

JARZEMBSKI, M.A. SRIVASTAVA, V.
Comparison of Laser-Induced SRS in the Forward Direction of a Droplet with Mie Theory. For publication in Optics Letters, Lexington, MA.

JEDLOVEC, G.J.
JAMES, M.W.
ATKINSON, R.J.

JEDLOVEC, G.J. WILLIAMS, S.T.

JOHNSON, C.W. JARZEMBSKI, M.A.
Spacelab – Beyond Development. For presentation at AIAA, Huntsville, AL, September 25, 1990.

JOHNSON, Y.B.

JONES, J.A.
JONES, L.W.

JONES, J.A. BERKOPEC, F.
JOY, M. 
HARVEY, P.M. 
TOLLESTRUP, E.V. 
McGREGOR, P.J. 
HYLAND, A.R. 


JOY, M. 
HARVEY, P.M. 
TOLLESTRUP, E.V. 
SELLGREEN, K. 
McGREGOR, P.J. 
HYLAND, A.R. 


JUSTUS, C.G. 
JAMES, B. 


KAARET, P. 
NOVICK, R. 
MARTIN, C. 
SHAW, P. 
HAMILTON, T. 
SUNYADEV, R. 
LAPSHOV, L. 
WEISSKOPF, M.C. 
ELSNER, R.F. 
et al. 


KAUKLER, W.F. 
ROLIN, T. 
ETHRIDGE, E. 

Glass Formability in BSCCO Superconductors. For presentation at the Symposia - 1990 Southeast-Southwest Region Meeting of the ACS, New Orleans, LA. December 5-7, 1990.

KEHTARNAVAZ, H. 
DANG, A.L. 
CHIU, H.H. 
GROSS, K.W. 


KELLER, V. 
LEE, J. 


KIM, J. 
SHINAGAWA, H. 


KIM, J. 
NAGY, A.F. 
CRAVENS, T.E. 
SHINAGAWA, H. 

Temperatures of Individual Ion Species and Heating Due to Charge Exchange in the Ionosphere of Venus. For publication in the Journal of Geophysical Research, Washington, DC.

KINTNER, P.M. 
SCALES, W. 
VAGO, J. 
YAU, A. 
WHALEN, B. 
ARNOLDY, R. 
MOORE, T. 

Harmonic H+ Gyrofrequency Structures in Auroral Hiss Observed by High Altitude Auroral Sounding Rockets. For publication in the Journal of Geophysical Research, Washington, DC.

KISSEL, R. 

Auburn Neural Network Panel Discussion
KUSUNOSE, M. ES65

LANGFORD, G.K. EP53
PRICE, D.E.
GALLAHER, M.

LAPENTA, W. ES42
SEAMAN, N.L.

LAPENTA, W.M. ES42
SEAMAN, N.L.

LEDBETTER, F.E. III EH33
BOWER, M.

LEHOCZKY, S.L. ES75

KNACKE, R.F. ES63
LARSON, H.P.

KNACKE, R.F.
LARSON, H.P.
Water Vapor in the Orion Molecular Cloud. For publication in the Astrophysical Journal, Tucson, AZ.

KNOWLTON, S.F. ES53
POLLOCK, C.J.
CHAPPELL, C.R.
Transverse Energization of O+ in Magnetospheric Upwelling Ion Events Observed by Dynamics Explorer 1. For presentation at the 1989 Fall AGU Meeting, San Francisco, CA, December 4-8, 1989.

KOCZOR, R.J. ES41

KOCZOR, R.J. ES41
JEDLOVEC, G.J.

KOCZOR, R.J. ES41
LETSON, M.A. Thiokol Corp.  
BUNKER, R.C. Thiokol Corp.  
CLINTON, R.G. EH34  
  
LI, H. EB24  
WORKMAN, G.  
HINMAN, E.  
Characterization and Improvement of Robot Dynamics Through Simulation. For presentation at the Southeastern Simulation Conference '90, Huntsville, AL, October 22-23, 1990.  
  
LINTON, R. EH12  
  
LIU, B.L.  
O'FARRELL, J.M. Rockwell  
JONES, J.H. ED33  
  
LOLLAR, L.F. EB12  
  
LOWERY, J.E. EB12  
LANIER, J.R., JR.  
HAI L., C.I.  
WHITT, T.H.  
  
LYNE, J.E. ES76  
CARTER, D.C.  
HE, X.M.  
STUBBS, G.  

HASH, J.  
Preliminary Crystallographic Examination of a Novel Fungal Lysozyme From Chalaropsis. For publication in the Journal of Biological Chemistry. Baltimore, MD.  
  
McCABE, D.E. EH21  
ERNST, H.A.  
NEWMAN, J.C.  
  
McCARTY, J.P. EP01  
HAWK, C.W.  
  
McCONNAUGHHEY, H.V. ED32  
BROWN, G.B.  
OLIVE, T.A.  
  
McCONNAUGHHEY, P. ED32  
LEE, H.  
MOORE, C.  
Supercomputing and the Redesign of Space Shuttle Propulsion Elements. For publication in Cray Channels, Minneapolis, MN. Spring 1988 Issue.  
  
McCOOL, A.A. CR01  
ROSS, P.A. Rocketdyne  
  
McDONNELL, J.J. ES42  
A Proposed Mechanism for Old Water Discharge Via Macropores in a Steep, Humid
Catchment. For publication in Water Resources Research, Washington, DC.

McDONNELL, J.J. ES42
COSTES, N.C.

McDONNELL, J.J. ES42
BONELL, M.
STEWART, M.K.
PEARCE, A.J.
Deuterium Variations in Storm Rainfall: Implications for Stream Hydrograph Separation. For publication in Water Resources Research, Washington, DC.

McKEAGNEY, D. ES75
ANDREWS, R.N.
WALCK, S.D.
LEHOCZKY, S.L.
SZOFRAN, F.R.

McKEAGNEY, D.B. ES75
ANDREWS, R.N.
LEHOCZKY, S.L.
SZOFRAN, F.R.
The Microstructural and Defect Characterization of $H_{2}O_{8}Cd_{0.2}Te$ As a Function of Growth Rate. For presentation at the ACCG-8 Conference, Vail, CO, July 15-20, 1990.

McPHERSON, W.B. EH23
MOORE, D.R.
VESELY, E.J.
JACOBS, R.K.

MAHAFFEY, W.A.
MUKERJEE, T.
COSTES, N.C.
Simulation of Cold Flow Test in Rockwell Axisymmetric Turn Around Duct. For publication in the AIAA Journal, San Diego, CA.

MAHORTER, L.J. ED35
McDANIELS, D.
CHIK, J.
DILL, C.C.
Airflow Model Testing to Determine the Distribution of Hot Gas Flow and O/F Ratio Across the SSME Main Injector. For presentation at the 1990 JANNAF Propulsion Meeting, Anaheim, CA, October 2-4, 1990.

MAYNARD, N.C.
AGGSON, T.L.
BASINSKA, E.M.
BURKE, W.J.
CRAVEN, P.
PETERSON, W.K.
SUGIURA, M.
WEIMER, D.R.
WINNINGHAM, J.D.

MAYNARD, W.F. EJ63
Ground and Flight Operations. For presentation at the Fourth International Conference on Tethers in Space, Florence, Italy, October 1-5, 1990.

MILLER, T.L.
CHOU, S.-H.

MILLER, T.L. ES42
PAYNE, K.
A Numerical Study of the Transition Between Axisymmetric Flow and Wave in the Baroclinic Annulus. Including Hysteresis. For publication
MOORE, C. ES74
CARDELINO, B.
Static Second-Order Polarizabilities of Amino-
and Nitro-Benzophenones. For publication in
the Journal of Molecular Structure. New York,
NY.

MOORE, R.L. ES52
AN, C.-H.
SUESS, S.T.
MUSIELAK, Z.E.
Alfvén Speed and Heating in Solar Coronal
Holes. For presentation at the 175th Meeting of
the American Astronomical Society, Wash-
ington, DC, January 9–12, 1990.

MOORE, R.L. ES52
Sunspots and Active Regions: Observed Proper-
ties. For publication in The Reference
Encyclopedia of Astronomy and Astrophysics.
Van Nostrand Reinhold, New York, NY.

MOORE, R.L. ES52
Hallmarks of the Magnetic Field in the Solar
Atmosphere: Structure, Evolution, Heating, and
Flaring. For publication in Memorie della
Societa Astronomica Italiana, Rome, Italy.

MOORE, R.L. ES52
Magnetic Loops in the Chromospheric Network.
For presentation at the 175th Meeting of the
American Astronomical Society, Albu-
erquerque, NM, June 10–14, 1990.

MOORE, T.E. ES53
GARBE, G.P.
ARNOLDY, R.L.
KINTNER, P.M.
Topside Ionospheric Heating in an Auroral Arc.
For presentation at the 1990 Spring Meeting of
the American Geophysical Union, Baltimore,
MD, May 28–June 1, 1990.

MOORE, T.E. ES53
The Earth’s Ionosphere (Book Review). For
Publication in Science Magazine. Washington,
DC.

MOORE, T.E. ES53
POLLOCK, C.J.
ARNOLDY, R.L.
CAHILL, L.J.
KINTNER, P.M.
Three-Dimensional Thermal/Superthermal Ion
Composition Measurements Obtained During
the ARCS IV Sounding Rocket Flight. For
presentation at the 1990 Fall Meeting American
Geophysical Union, San Francisco, CA,

MORGAN, S.H. ES01
Science From a Lunar Base. For presentation at
TABES ‘90 Symposia and Workshops,

MOWERY, D.K. ED13
TOMLIN, D.D.
Tethered Satellite System Dynamics and Con-
trol. For presentation at the International Confer-
ence on Dynamics of Flexible Structures in
Space, Cranfield, Bedford, UK, May 15–18,
1990.

MULLINS, L.D. EL58
Calculating the Entry/Exit Positions and Times
of an Earth Satellite Passing Through the Umbra
and Penumbra of the Earth’s Shadow. For pub-
lication in the Journal of Astronautical Sciences,
Springfield, VA.

MUSIELAK, Z.E. ES52
FONTENLA, J.M.
MOORE, R.L.
Do Any White Dwarfs Have X-Ray Coronae?
For presentation at the 175th Meeting of the
American Astronomical Society, Washington,

MYERS, W.N. EP64
WEIR, R.A.
Electromechanical Propellant Control System
Actuator. For presentation at the AIAA/SAE/
ASME/ASEE Joint Propulsion Conference,
MSFC PAPERS CLEARED FOR PRESENTATION
(Available only from authors. Dates are presentation dates.)

MYERS, W.N. EP64
FORBES, J.C.
BARNES, W.L.

NAUMANN, R. ES71

NEIN, M.E. PA01
FIKES, J.C.

NETTLES, A.T. EH33
HODGE, A.J.

NOEVER, D.A. USRA/ES76
Bioconvective Patterns. For publication of Environmental Science and Health, Baton Rouge, LA.

NOEVER, D.A. ES76
The Ternary Baroeffect With a Nondiffusing Component. For publication in Physical Review Letters, New York, NY.

NOEVER, D.A. ES76
A Note on the No-Slip Condition Applied to Diffusing Gases. For publication in Physics Letters, American Institute of Physics, New York, NY.

NOEVER, D.A. ES76

NOLL, K.S. ES63
LARSON, H.P.
The Spectrum of Saturn from 1990–2230 Cm⁻¹: Abundances of AsH₃, CH₃D, CO, GeH₄, NH₃, and PH₃. For publication in Icarus, New York, NY.

NORWOOD, J. EH12

O’FARRELL, J.M.
LIU, B.L.
LOWREY, G.A.
NESMAN, T.E. ED33
Reduction of Vortex-Induced Vibration in Vane Geometries. For presentation at the International Congress on Recent Development in Air and Structure Borne Sound and Vibration, Auburn University, Auburn, AL, March 6–8, 1990.

OWEN, J.W. ED64
PAGE, A.
GOODE, B.
Analysis of Coolant Flow and Heat Transfer in the SSME HPOTP No. 4 Bearing Assembly. For publication in the AIAA Journal, San Diego, CA.


A Survey of Upwelling Ion Event Characteristics. For publication in JGR, Washington, DC.
HORWITZ, J.L.
WINNINGHAM, J.D.

POLLOCK, C.J.
MARTINEZ, N.J.
MOORE, T.E.
SLOAN, M.A.

PORTER, J.G.
MOORE, R.L.

PORTER, J.G.
DERE, K.P.
The Magnetic Network Location of Explosive Events Observed in the Solar Transition Region. For publication in the Astrophysical Journal, Chicago, IL.

PORTER, L.Z.
DeMAR, P.

POWERS, W.T.
ZACCARDI, V.A.

POWERS, W.T.
ZACCARDI, V.A.

PRESTWICH, A.H.
JOY, M.

PRESTWICH, A.H.
JOSEPH, R.D.

PRICE, M.W.
ANDREWS, R.N.
SU, C.-H.
LEHOCZKY, S.L.
SZOFRAN, F.R.

PRIEST, C.C.
SUMRALL, P.
WOODCOCK, G.
PRIEST, C.C. PT01
WOODCOCK, G.

PRINCE, A.S. Thiokol
BUNKER, R.C. Thiokol
LAWRENCE, T. EH34

PRZEKVAS, A.J.
CHUECH, S.G.
GROSS, K.W. EP55

PUSEY, M.L. ES76
MUSSON, S.
A Micro Apparatus for Rapidly Determining Protein Crystalline-Soluble Phase Equilibrium Concentrations. For publication in the Journal of Analytical Chemistry, San Diego, CA.

RAMACHANDRAN, N. USRA/ES42

RAMSEY, B.D. ES65
BOWER, C.R.
DIETZ, K.
WEISSKOPF, M.C.

RAMSEY, B.D. ES65
BOWER, C.R.
DIETZ, K.
WEISSKOPF, M.C.

RAO, D.K. ES63
DILL, J.F.
DECHER, R.
PETERS, P.N.
Application of Superconducting Magnetic Suspensions in Space. For presentation at the World Congress on Superconductivity, Houston, TX, September 9–13, 1990.

RANDOLPH, J.L. TA51
SHEPARD, K.E.

RATHZ, T. ES75
ROBINSON, M.
HOFMEISTER, W.
BAYUZICK, R.

REASONER, D.L. ES53
Rapid Thermalization of Pickup Ions Created in the Shuttle Orbiter Outgassing Cloud. For publication in the Journal of Geophysical Research, Washington, DC.

REASONER, D.L. ES53
Rapid Thermalization of Pickup Ions Created in
the Shuttle Orbiter Outgassing Cloud. For publication in the Journal of Geophysical Research, Washington, DC.

REASONER, D.I.


REDUS, J.R.

HUFFAKER, C.F.

KELLEY, D.L.

STV Engine Requirements. For presentation at the AIAA Space Programs and Technologies Conference and Exhibit, Huntsville, AL, September 25–27, 1990.

REYNOLDS, N.D.

Storm Tracks in a Linear Two-Layer Model With Topography. For publication in the Journal of Atmospheric Sciences, New York, NY.

REYNOLDS, N.D.

A Note on Linear Baroclinic and Orographic Instability. For publication in the Journal of Atmospheric Sciences, New York, NY.

REYNOLDS, N.D.


RICHMAN, M.W.

OYEDIRAN, A.A.


RICHMOND, R.J.


RIDGWAY, S.E.

JEWITT, D.

CAMPINS, H.

LUU, J.

JOY, M.

SISK, C.

TELESERCO, C.


ROBERTS, B.

CARRASQUILO, R.

DUBLIE, M.

OGLE, K.

PERRY, J.

WHITLEY, K.


ROBERTSON, F.R.

PERKEY, D.J.


ROBERTSON, F.R.


ROBERTSON, F.R.

PERKEY, D.J.


ROCKER, M.

CFD Simulation of Liquid Oxygen in a SSME Preburner Injector Element. For presentation at

RODGERS, E.B. EH32
HUFF, T.L.
OBENHUBER, D.C.
Microbial Contamination of the Environmental Control and Life Support System for Space Station. For presentation at the Microcontamination '90 Conference, Santa Clara, CA, October 30–November 2, 1990.

ROTHINGEL, J. ES43
JONES, W.D.
HAMPTON, D.
SRIVASTAVA, V.
JARZEMBSKI, M.
Airborne Coherent Continuous Wave CO2 Doppler Lidars for Aerosol Backscatter Measurement. For presentation at the Fourth Airborne Geoscience Workshop, LaJolla, CA, January 20–February 1, 1991.

ROTHINGEL, J. ES43
BOWDLE, D.A.
VAUGHAN, J.M.
BROWN, D.W.
WOODFIELD, A.A.
Calculation of Aerosol Backscatter From Airborne CW Focused CO2 Doppler Lidar Measurements. 1. Algorithm Description. For publication in the Journal of Geophysical Research–Atmospheres, Washington, DC.

ROTHINGEL, J. ES43
BOWDLE, D.A.
VAUGHAN, J.M.

ROTHINGEL, J. ES43
JONES, W.D.
SRIVASTAVA, V.
JARZEMBSKI, M.
HAMPTON, D.

ROTHINGEL, J. ES43
JONES, W.D.
SRIVASTAVA, V.
JARZEMBSKI, M.
HAMPTON, D.

RUPP, C.C. PS04

RYAN, R.S. ED01
Lessons Learned in Engineering. For presentation at the Pressure Vessel and Piping Conference, Nashville, TN, June 18–21, 1990.

SAFIE, F.M. CT13
HAGE, R.T.

SAFIE, F.M. CT13

SAKURAI, H. ES65
NIIZEKI, H.
NOMA, M.
A Hard X-Ray Polarimeter Utilizing Compton Scattering. For publication in SPIE – The International Society of Optical Engineering, Bellingham, WA.
SCHMIDT, G.R. EP53
VAUGHN, D. MMC
Analytical Modeling of No-Vent Fill Process.
For presentation at the AIAA/ASME/SAE/ASEE 26th Joint Propulsion Conference,

SCHMIDT, G.R. EP53
JONES, O.
MESEROLE, J. Boeing

SCHONBERG, W.P. EH15
DARZI, K.

SCHONBERG, W.P. EH15
BEAN, A.J.

SCHUBERT, G. ES44
WALTERScheid, R.L.
HICKEY, M.
Gravity Wave-Driven Fluctuations in the OH Nightglow From an Extended, Dissipative Emission Region. For publication in the Journal of Geophysical Research, Washington, DC.

SCHUTZENHOFER, L.A. ED32
McCONNAUGHEY, H.V.
McCONNAUGHEY, P.K.

SCHWINGHAMER, R.J. ES01
Productivity—TQM’s Alter Ego. For presentation at the 27th Space Congress, Cocoa Beach, FL, April 24–27, 1990.

SEAFO RD, M. ED33
SALADINO, A.
PRAHARAJ, S.
Upgrade of PARC2D to Include Real Gas Effects. For presentation at the AIAA 28th Aerospace Science Meeting, Reno, NV, January 8–11, 1990.

SEAFO RD, M. ED33
LIVER, P.
PRAHARAJ, S.

SHEALY, D.L. ES52
HOOVER, R.B.

SHELTON, B.W. PD01
STS Derivative Cargo Vehicles for the 1990's Decade and Beyond. For presentation at the 27th Space Congress, Cocoa Beach, FL, April 24–27, 1990.

SHINAGAWA, H. ES53

SHINAGAWA, H. ES53
KIM, J.
NAGY, A.F.
CRAVENS, T.E.
Silver, E. ES65
Holley, J.
Ziock, K.
Novick, R.
Kaaret, P.
Weisskopf, M.
Elsner, R.
Beeman, J.

Bragg Crystal Polarimeters. For publication in the Journal of Optical Engineering, Bellingham, WA.

Smith, R.E. FWG
Anderson, B.J. ES44
Catlett, K. FWG


Snyder, R.S. ES76
Rhodes, P.H.
Roberts, G.O.


Spencer, R. ES43
Christy, J.

Hood, R.

Spencer, R.W. ES43

Global Tropospheric Temperature Monitoring With Passive Microwave Radiometers. For presentation at the 14th Climate Diagnostics Workshop, LaJolla, CA, October 16–20, 1989.

Spencer, R.W. ES43
Christy, J.R.

Precise Monitoring of Global Temperature Trends From Satellites. For publication in Science, Washington, DC.

Spencer, R.W. ES43
Christy, J.R.


Springer, W.T. ET53
Coleman, A.D.
Driskill, T.C.


Stone, N.H. ES53


Su, C.-H. ES75
Lehoczyk, S.L.
Zoefran, F.R.

Directional Solidification of HgCdTe and HgZnTe in a Transverse Magnetic Field. For publication in the Journal of Crystal Growth, The Netherlands.

Su, C.-H. ES75
Lehoczyk, S.L.
Zoefran, F.R.

Directional Solidification of HgCdTe and HgZnTe in a Transverse Magnetic Field. For presentation at The Eighth American Conference on Crystal Growth, Vail, CO, July 15–20, 1990.

Suess, S.T. ES52
McIntosh, P.S.
Mai, J.

SULLIVAN, R.M. ED24
SALAMON, N.J.

SUSKO, M. ES44
Space Shuttle’s Externally-Induced Environment (Rocket Exhaust) Compared With Skylab’s Natural Environment (Micrometeoroids). For presentation at the Fifth Annual Technical and Business Exhibition and Symposium (TABES), Huntsville, AL, May 16–17, 1989.

Convective Effects in the Compositional Redistribution During Solidification of HgZnTe and Related Materials. For presentation at the Eighth American Conference on Crystal Growth, Vail, CO, July 15–20, 1990.

SZOFRAN, F.R. ES75
PERRY, G.L.
LEHOCZKY, S.L.

TAYLOR, K.R. PS05
Space Station Payload Adaptation System. For presentation at the 27th Space Congress, Canaveral Council of Technical Societies, Cocoa Beach, FL, April 23–27, 1990.

TELESCO, C.M. ES63
BENSON, C.M.
CAMPINS, H.
TEGLER, S.C.
Comet Austin. For publication in the IAU Circular, Cambridge, MA.

TELESCO, C.M. ES63
CAMPINS, H.
JOY, M.
DIETZ, K.
DECHER, R.
Infrared Mapping of M82: A Starburst in an Edge-on Barred Galaxy. For publication in the Astrophysical Journal, Tucson, AZ.

TELESCO, C.M. ES63
CAMPINS, H.
JOY, M.
DIETZ, K.
DECHER, R.
Infrared Mapping of M82: A Starburst in an Edge-on Barred Galaxy. For presentation at the

TEPOOL, R.E. EP71

THOMAS, F. ED52
FINCKENOR, J.

TINKER, M.L. ED22
CLAYTON, J.P.

TUCKER, D.S. EH34
SPARKS, J.S.
ESKER, D.C.
Publication in the Bulletin of the American Ceramic Society, Westerville, OH.

TUCKER, M.W. PS04
THRASHER, D.
Space Station Freedom Evolution Logistics. For presentation at the Society of Allied Weight Engineers 15th Annual Southeastern Regional Conference, Lake Guntersville, AL, October 5–6, 1990.

TORR, M.R. ES51
TORR, D.G.
RICHARDS, P.G.
YUNG, S.P.
Mid- and Low-Latitude Model of Thermospheric Emissions: $1.0 + (2p)$ 7320Å and $N_2(2P)$ 3371Å. For publication in the Journal of Geophysical Research, Washington, DC.

TUCKER, S.P. PD22
HONKONEN, S.C.
LIGGETT, N.W.
TAYLOR, W.J.
WILLIAMS, G.E.
The Cryogenic On-Orbit Liquid Analytical Tool: A Program for Evaluating Thermodynamic Performance of Orbital Cryogenic Storage Facilities. For presentation at the AIAA 29th

TURNER, R.E. ES44
HILL, C.K.
FROST, W.
DURHAM, A.S.
THEON, C.J.
Environmental Criteria Guidelines for the National Aerospace Plane (NASP) Space Vehicle and Space Design. For publication in the Bulletin American Meteorological Society, Boston, MA.

VAUGHAN, O.H., JR. ES43
VONNEGUT, B.
Recent Observations of Lightning Discharges From the Top of a Thundercloud Into the Clear Air Above. For presentation at the IEEE IGARSS 1990 Symposium, College Park, MD, May 20–24, 1990.

VAUGHAN, O.H., JR. ES43
VONNEGUT, B.

VAUGHAN, W.W. UAH
ANDERSON, B.J. ES44
Management of Environmental Risk. For presentation at the Workshop on Environmental Risk Analysis, Indian Institute of Technology, New Delhi, India, December 12–16, 1989.

VAUGHN, J.A. EH12

VIKRAM, C.S. ES74
WITHEROW, W.K.

VOLZ, M.P. ES74
SZOFRAN, F.R.
SU, C.-H.
LEHOCZKY, S.L.
Far Infrared Characterization of Directionally Solidified Hg$_{1-x}$Zn$_x$Te. For presentation at the Eighth American Conference on Crystal Growth, Vail, CO, July 15–20, 1990.

VOLZ, M.P. ES75
SZOFRAN, F.R.
LEHOCZKY, S.L.
SU, C.-H.
Lattice Vibration Spectra of Hg$_{1-x}$Zn$_x$Te Alloys. For publication in Solid State Communications, Paris, France.

VON PRAGENAU, G.L. ED14

VON PRAGENAU, G.L. ED14

WALKER, A.B.C. ES52
HOOVER, R.B.
et al.
The Multispectral Solar Telescope Array. For publication in Optical Engineering, Bellingham, WA.

WALKER, A.B.C. ES52
HOOVER, R.B.
et al.
The Ultra High Resolution XUV Spectrohelio-
WALKER, A.B.C.  
CHUPP, E.  
HOOVER, R.B.  
et al.  
The Advanced Solar Observatory. For presentation at the Society of Photo Optical Instrumentation Engineering (SPIE), San Diego, CA, July 8–13, 1990.

WALLS, B.  
RIEDESEL, J.  

WANG, T.-S.  
CHEN, Y.-S.  

WATSON, J.K.  
SCHNITZGRUND, G.D.  
NUNES, A.C., JR.  
DICKINSON, D.W.  
Welding for In-Space Construction. For publication in the Journal of Aerospace Engineering.

WATTS, J.W.  

WEBSTER, K.L.  
SUNG, C.C.  
University of Alabama  
Mode-Medium Instability and Its Correction With a Gaussian Reflectivity Mirror. For publication in Applied Optics, Mid 1990.

WEEKS, D.J.  
Summary of Astronaut Inputs Concerning Automation. For presentation at the Space Station Evolution Beyond the Baseline Symposium, League City, TX, February 6–8, 1990.

WEEKS, D.J.  
Astronaut Community Inputs on Automation and Robotics. For presentation at the Workshop on Neural Networks, Auburn, AL, February 5–6, 1990.

WEEKS, D.J.  
BECHTEL, R.T.  
WALLS, B.K.  
Automation of the Space Station Module PMAD. For presentation at the OAST Technology for Space Station Evolution Workshop, Dallas, TX, January 16–19, 1990.

WEEKS, D.J.  
Summary of Astronaut Inputs on Automation and Robotics for Space Station Freedom. For presentation at the XXXXIIth International Astronautical Congress (IAF), Dresden, German Democratic Republic, October 6–13, 1990.

WEEKS, D.J.  
WALLS, B.K.  
BECHTEL, R.T.  
Autonomous Operation of the Space Station Freedom Hab/Lab Module Power Management and Distribution System. For presentation at the XXXXIIth International Astronautical Congress (IAF), Dresden, German Democratic Republic, October 6–13, 1990.

WEEKS, D.J.  
Summary of Astronaut Inputs on Automation and Robotics for Space Station Freedom. For presentation at the International Symposium on Artificial Intelligence, Robotics, and Automation in Space (I-SAIRAS), Kobe, Japan, November 18–20, 1990.
WEISSKOPF, M.C. ES65

WEISSKOPF, M.C. ES65

WEISSKOPF, M.C. ES65
ELSNER, R.F.
NOVICK, R.
KAARET, P.
SILVER, E.

WEISSKOPF, M.C. ES65
JOY, M.
KAHN, S.
High Energy, High Resolution X-Ray Optics. For publication in the proceedings of "Astrophysics in the 21st Century," Taos, NM.

WEISSKOPF, M.C. ES65

WEISSKOPF, M.C. ES65
ELSNER, R.
HOLLEY, J.
SILVER, E.
ZIOCK, K.P.
NOVICK, R.
KAARET, P.
BEEMAN, J.

WEST, E.A. ES52
BHALAIA, S.S.

WEST, E.A. ES52

WEST, E.A. ES52

WHITAKER, A.F. EH11

WHITAKER, A.F. EH11
Effects of RF Oxygen Plasma on Materials. For presentation at the Southeastern Section of the American Physical Society, Tuscaloosa, AL, November 8-11, 1989.

WHITT, T.H. EB12
BUSH, J.R., JR.

WICKS, T.G. JA61
ARNOLD, R.R.
Earth Science and Applications Attached
payloads on space station. for presentation at aiaa. huntsville, al. september 26, 1990.

wieland, p. ed62
environmental control and life support evolution. for presentation at technology for space station evolution – a workshop. dallas/fort worth, tx. january 16–19, 1990.

wilcynska, b. es62
parnell, t.a.
observation of associated beauty production and decay in a high energy hadron interaction. for publication in physical review c. new york, ny.

williamsen, j.e. ed52
tipton, j.
freedom station wall design using hydrodynamic modeling. for presentation at the aiaa space programs and technology conference and exhibit. huntsville, al. september 25–27, 1990.

wilson, c.d. ed25
effective crack lengths by compliance measurement for arall-2 laminates. for presentation at the astm third symposium on composite materials: fatigue and fracture. orlando, fl. november 5–9, 1989.

wilson, g.r. es53
gallagher, d.l.
electrostatic oscillations in thin dense dust clouds. for presentation at the fourth workshop on dusty plasma. iowa city, ia. september 11–13, 1990.

wilson, g.s. es41
photo for cover of proceedings book. for publication in the 12th conference on weather analysis and forecasting proceedings. american meteorological society. boston, ma.

wilson, r.m. es52
geomagnetic storms in relation to magnetic clouds. for presentation at the agu and msa 1990 spring meeting. baltimore, md. may 29–june 1, 1990.

wilson, r.m. es52
monitoring the sunspot cycle: how close is solar maximum? for publication in the geophysical research letters. washington, dc.

wojtalik, f.s. ta01

workman, g.l. uah
wang, m.
bryon, c. eh13

workman, g.l. uah
hinman, e.m. eb24
robot dynamics in reduced gravity environment. for presentation at the fifth conference on artificial intelligence for space applications. huntsville, al. may 23, 1990.

yates, i.c., jr. ja83
flight furnace development in the usa. for presentation at the aiaa 29th aerospace sciences meeting. reno, nv. january 7–10, 1990.

young, a. pd32
space station requirements and transportation options for lunar outpost. for presentation at the 27th space congress. cocoa beach, fl. april 24–27, 1990.

zukic, m. es51
torr, d.g.
spann, j.f.
torr, m.r.
vacuum ultraviolet all-dielectric narrowband filters. for publication in applied optics. new york, ny.
ZUKIC, M. ES51
TORR, D.G.
SPANN, J.F.
TORR, M.R.

Optical Constants of BaF_2, CaF_2, LaF_3, MgF_2,
Al_2O_3, HfO_2. Thin Films in the VUV. For pub-
lication in Applied Optics, New York, NY.
AAPPROVAL

FY 1990 SCIENTIFIC AND TECHNICAL REPORTS,
ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by Joyce E. Turner

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

C.D. Bean
Director, Administrative Operations Office

* U.S. GOVERNMENT PRINTING OFFICE 1990–531–081/20263