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MANEUVERING AEROTHERMAL TECHNOLOGY (MAT) PROGRAM

DATA BIBLIOGRAPHY

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APPLIED MECHANICS OPERATION
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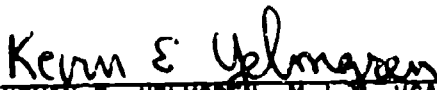
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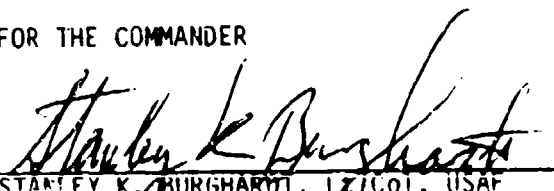
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of MaRV aerothermodynamic data sources, (2) review data sources to identify data of specific benefit for validation of analytic/numerical codes (including the 3-D Parabolized Navier-Stokes (PNS) codes, the 3-D coupled inviscid-viscid codes, and the general empirical design codes), (3) critique data sources to identify technology data deficiencies, and (4) document results of prominent data sources by configuration/test condition/data obtained.

The results are presented herein and, in addition to fulfilling the aforementioned objectives, provide information for use in the selection of advanced MaRV configurations which meet the MAT program Technical Requirements Document (TRD) performance goals. The results of this task also provide a basis for assisting in the definition of the MAT program experimental ground test plan.

FOREWORD

This report presents a bibliography of data references concerned with maneuvering reentry vehicles. This bibliography was compiled as part of Task 2 of Contract F04701-80-C-0033 entitled the "Maneuvering Aerothermal Technology (MAT)" program. The study is being conducted by personnel of Science Applications, Inc., Valley Forge, Pennsylvania for the Ballistic Missile Office, Norton Air Force Base, California. The project officer for this effort is Captain John Keesee, BMO/MNRTE.

This report is submitted in partial fulfillment of the requirements for Task 2 - Technology Base, specifically Task 2.1 - Configuration Review and Task 2.2 - MaRV Flight Data Review (CDRL - A003). The review of empirical techniques and correlations, also required as part of Tasks 2.1 and 2.2 will be provided in a separate document.

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TERMINOLOGY AND NOMENCLATURE

For reference purposes, the terminology and nomenclature utilized in Section 4 is summarized as follows:

<u>NOSETIP</u>	A	Asymmetric geometry
	G	Gasjet
	S	Symmetric geometry
	TC	Transpiration cooled
<u>CONTROL</u>	DSN	Double swivel nose
	EB	External burning
	F	Flap
	JI	Jet interaction
	MF	Multiple flaps
	SN	Swivel nose
<u>FACILITY</u>	AEDC	Arnold Engineering Development Center von Karman Gas Dynamic Facility
	AEDC-A	Supersonic Wind Tunnel
	AEDC-B	Hypersonic Wind Tunnel
	AEDC-C	Hypersonic Wind Tunnel
	AEDC-E	Blowdown Hypersonic Wind Tunnel
	AEDC-F	Hotshot Hypervelocity Wind Tunnel
	AEDC-G	Hypervelocity Range
	ARL	Air Force Wright Aeronautical Lab (AFWAL) 20" Hypersonic Wind Tunnel
	CAL	CALSPAN Hypervelocity Shock Tunnel
	MDAC	McDonnell-Douglas Trisonic Wind Tunnel
	NASA/LaRC	NASA Langley Research Center Continuous Flow Hypersonic Tunnel (CFHT)
	NSWC	Naval Surface Weapons Center
	NSWC-2	Blowdown Supersonic Tunnel No. 2
	NSWC-8A	Blowdown Hypervelocity Research Tunnel
	NSWC-9	Blowdown Hypersonic Tunnel
	PIBAL	Polytechnic Institute of Brooklyn Blowdown Tunnel
	RPL	Rocket Propulsion Laboratory
	5MW	AEDC HEAT Arc Facility
	50MW	AFWAL RENT Arc Facility

TERMINOLOGY AND NOMENCLATURE (Cont'd)

ANGLE OF ATTACK RANGE

0 indicates a ballistic vehicle (small α); otherwise the maximum value of α is specified. If sideslip data is involved, the maximum value of β is specified (e.g., β_{10} if $\beta_{\max} = 10^\circ$).

DATA TYPE

F&M	Force and moment
LTA	Low temperature ablator
P	Surface pressure
q	Heat transfer

SECTION 1
INTRODUCTION AND SUMMARY

INTRODUCTION AND SUMMARY

This report presents an extensive bibliography of experimental ground and flight test data primarily for strategic maneuvering reentry vehicles. The compilation and review of pertinent data sources was performed as a part of the Maneuvering Aerothermal Technology (MAT) program. The overall objective of the MAT program is to assess and extend the current state-of-the-art of technology for predicting MaRV aerothermal performance for current and next generation vehicles in flight regimes characteristic of future mission requirements. The specific objective of this data search and review task was to:

- (1) assemble a compendium of MaRV aerothermodynamic data sources
- (2) review data sources to identify data of specific benefit for validation of analytic/numerical codes (including the 3-D Parabolized Navier Stoke (PNS) codes, the 3-D coupled inviscid-viscid codes, and the general empirical design codes)
- (3) critique data sources to identify technology data deficiencies
- (4) document results of prominent data sources by configuration/test condition/data obtained.

The results are presented herein and, in addition to fulfilling the aforementioned objectives, provide information for use in the selection of advanced MaRV configurations which meet the MAT program Technical Requirements Document (TRD) performance goals. The results of this task also provide a basis for assisting in the definition of the MAT program experimental ground test plan.

This report is organized in five major sections as follows:

- General bibliography
- Major systems programs Bibliography
- Bibliography cross reference by data category
- Tables of data summaries for a limited set of references
- Detailed review/critique of the MAT related significant data sources

The data reports cited in the bibliographies were obtained from searches conducted through the Defense Technology Information Center (DTIC), the National Technical Information Services (NTIS), the Air Force Wright Aeronautical Laboratories (AFWAL), the Arnold Engineering Development Center (AEDC), McDonnell-Douglas Corporation (MDAC), General Electric Re-entry Systems Division (GE-RSD), TRW, Aerospace Corporation, and the Lockheed Missiles and Space Company (LMSC).

The search was restricted to data sources for configurations of interest to BMO. Consequently, manned lifting bodies, blunt lifting bodies (i.e., those with low L/D potential), and configurations with slender wings were excluded a priori. Even with this restriction, data on MaRV type configurations have been obtained over several decades and as a result the compilation has been organized chronologically in Section 2 by year and month, with the oldest references listed first.

There have been some specific systems programs which have generated large quantities of data for configuration definition and to fulfill specific systems requirements. The most notable of these are the Air Force's Maneuvering Ballistic Reentry Vehicle (MBRV), Advanced Control Experiment (ACE), Advanced Maneuvering Reentry Vehicle (AMaRV), and the Navy MK 500. The aerodynamic and aerothermodynamic data generated under the auspices of these programs are presented chronologically, by subsets, in Section 3. Also provided for the user is a cross reference of data by category or data type. The specific categories cross referenced in Section 4 are:

- Sharp and Blunted Bicones
- Sliced Cones/Bicones
- Elliptic Cross Section Cones
- Bent Axis Configurations
- Asymmetric/Nonspherical Noses
- Transpiration Cooled Nosetips (TCNT)
- Jet Interaction (JI) and External Burning (EB)
- Configuration with Shock Layer Surveys
- Mass Transfer/Roughness Effects
- Dynamic Stability
- Flight Data

It should be noted that a large portion of the data cited, especially those for specific systems programs, are classified. Where the specific classification is known it is so noted on the reference. From some of the data retrieval sources the only information available was that the report was classified but the level was not given; these are so noted in the compilation as Classified. In addition certain of the CONFIDENTIAL reports may have been downgraded since they were published and the current listing may not be correct in this regard.

It should further be noted that Science Applications, Inc. (SAI) does not possess many of the documents referenced in this bibliography. Those reports which appeared to be of specific interest to the MAT program were reviewed at the data source and summary information is listed in the tables of Section 5. Those that would potentially be useful in aerothermal technique validation were then reviewed in some detail and critiqued. This information is contained in Section 6.

GENERAL SUMMARY AND OBSERVATIONS

It is evident from this search that a wealth of data exist for high performance lifting reentry bodies. Approximately six hundred reference sources of data or comparisons of data with theory were found. The preponderance of the references contain total configuration force and moment data. The next major source of data are for surface pressure, followed by heat transfer. In general there is a paucity of dynamic stability and shock/boundary layer survey data. Relatively few sources contain complete sets of data (i.e., force and moment, surface and shock layer properties) which could be used by analysts for diagnostic checks on the accuracy of prediction techniques. The limited data sets are useful for ascertaining the accuracy of a "working" code but do not provide sufficient information to pinpoint the source of problem when agreement is not good in a developmental code. For example some reports define detailed maps of surface heating but do not define the complementary surface pressure field. Thus if agreement with data is poor, it may not be evident whether the boundary layer method is lacking or whether the pressure field prediction is inaccurate.

Ground test data are generally obtained for flow conditions far short of those expected in the flight environment of BRVs and MaRVs. Thus viscous effects evident in ground test are different than those in flight for comparable Mach numbers. Two sources of ground test data for $M > 8$ that were extensively used in the past were the AEDC VKF Tunnels C and F. Care must be exercised in the use of some of the older test data (i.e., nominally before 1975) for two primary reasons. In Tunnel C data were reported to be obtained at Mach 12 whereas it was later discovered that condensation effects were present such that the true Mach number was actually closer to 10. In Tunnel F the use of conical nozzles produced axial pressure gradients in the tunnel flow, and caused the data to be different from those which would have been measured at the same stated Mach number in a contoured nozzle flow. Because of the significant usage of these facilities these results were resolved, documented and later circumvented. The basic question is what is the quality of the data from tunnels which are only infrequently used or not calibrated. In this regard, the data users must be cautious.

A major test series was sponsored by BMO and run at AEDC/VKF primarily to provide a complete diagnostic set of ground test data to validate the HYTAC parabolized Navier-Stokes (PNS) code. The configurations tested were sharp and blunt cones, blunt bicones and bicones with slices. Data were obtained under laminar and turbulent flow conditions. The data obtained were force and moment, surface pressure and heating, and shock layer surveys where total temperature, Pitot pressure, Preston tube, and Mach/flow angularity were measured. These data, although limited in Mach number range, provide an extremely useful set to assist the analyst in code development. Data sets such as this are not generally available. The first MAT program test will augment these data by providing measurements on a sliced bicone under turbulent flow conditions to angles of attack of 20° including data on a flap. These data provide information on a configuration which is locally non-circular in cross-section.

Data obtained on configurations with general non-circular cross-sections are primarily for force and moment. In certain cases limited pressure and surface heating (usually the windward ray centerline of symmetry) also were obtained. For codes which are being developed to compute the flow field details on these 3-D bodies the available data are generally not sufficient to check out the code. The myriad of data obtained on the Space Shuttle configuration (not included here for reasons cited earlier in this report) is one exception. One other notable exception is for the data obtained on the AFWAL X-24C configuration. This configuration, strictly speaking, does not fit into the current study since it represents a manned configuration. It is included because it is a relatively sharp body {compared to the Shuttle) and does provide a useful data set for code validation and configuration performance. However, the detailed check out of computational tools such as the parabolized Navier Stokes (PNS) codes, with complex body transformation potential, requires a more diversified data set before one can generalize on its computational ability, accuracy, and efficiency. These data are lacking.

The increased cost of acquiring experimental data requires that maximum utility be made of (1) the existing data and of (2) the recent advances made in computational fluid dynamics (CFD) to assist in vehicle design. Detailed computational tools such as the PNS solutions or the inviscid flow field codes can be utilized to provide accurate numerical results which will reduce the need for wind tunnel testing. However this requires that the computer codes be validated against sufficient data so that the accuracy and limitations of the codes can be ascertained. As stated earlier, force and moment data do provide a check on the integrated accuracy of a computer tool but do not provide the diagnostic data required to check a computer code where agreement is unsatisfactory. For this purpose surface pressure, heat transfer and flow survey measurements can be used to pinpoint where problems exist and provide a quantitative basis for assessment of code improvements. Data for these diagnostic purposes are clearly lacking.

Flight test provides data for the total environment (i.e., Mach number/Reynolds number) including the effects of real gas, mass transfer, surface roughness, and shape change. The difficulty here is that all of these effects occur simultaneously and consequently it is difficult to interpret each of them independently. Select flights such as AMaRV-1 where some of these influences were minimized does provide some insight and consequently is extremely useful for ascertaining total code predictive capability for a select configuration. Flight test with adequate measurements, when coupled with a complete ground test data set does provide an unsurpassed source of information for configuration performance and computer code validation. For complex configurations of future interest, a complete set of ground test must suffice for code validation. In this regard the Aerodynamically Configured Maneuvering Reentry Vehicle (ACMRV) wind tunnel tests to be performed as a part of the MAT test program will provide the necessary diagnostic ground test data to establish system performance and to check and validate prediction techniques.

SECTION 2
CHRONOLOGICAL BIBLIOGRAPHY

MANEUVERING AEROTHERMAL TECHNOLOGY (MAT)
BIBLIOGRAPHY

1958

1. Jorgensen, L. H., "Elliptic Cones Alone and with Wings at Supersonic Speeds," NACA Report 1376, 1958.

1959

1. Zakkay, V. and Visich, M., Jr., "Experimental Pressure Distributions on Conical Elliptical Bodies at $M_\infty = 3.09$ and 6.0 ," AFOSR TN 59.10, PIBAL Report No. 467 (AD208 591), March 1959.
2. Chapkis, R. L., "Hypersonic Flow over an Elliptic Cone Theory and Experiment," Guggenheim Aeronautical Laboratory, California Institute of Technology Memo No. 49, May 1959.
3. Martellucci, A., "An Extension of the Linearized Characteristics Method for Calculating the Supersonic Flow Around Elliptic Cones," AFOSR TN 59-632, PIBAL Report No. 517, June 1959, Journ. Aero. Sci., September 1960.

1960

1. Engel, M. J., et al, "Aerodynamic Force, Heat Transfer, and Pressure Measurements on a Lifting Body Configuration at Mach Number 17," GE-MSVD Requisition No. 214-142, April 1960.
2. Armstrong, W. O., Stainback, P. C., and McLellan, C. H., "The Aerodynamic-Force and Heat-Transfer Characteristics of Lifting Reentry Bodies," (U) NASA-TMX-352, August 1960 (Confidential).
3. Dennis, D. H., and Edwards, G. G., "The Aerodynamic Characteristics of Some Lifting Bodies," (U) NASA TM X-376, September 1960 (Confidential).
4. Reller, J. O., Jr., and Seegmiller, H. L., "Convective Heat Transfer to a Blunt Lifting Body," (U) NASA TM X-378, September 1960 (Confidential).
5. Sarabia, M. F., "Aerodynamic Characteristics of a Blunt, Half-Cone Entry Configuration at Mach Numbers from 3 to 6," (U) NASA TM X-393, October 1960 (Confidential).
6. Ridyard, H. W., Robert, M. L., and Storer, E. M., "Comparative Analysis of the Aerodynamic Characteristics of a Half Sphere Cone at Hypersonic Speeds," GE-ADM No. 1:31, November 1960.

1961

1. Grimaud, J. E., "Wind Tunnel Investigation at a Mach Number of 2.91 of Stability and Control Characteristics of Three Lifting Reentry Configurations at Angles of Attack up to 90° ," (U) NASA TM X-455, March 1961 (Confidential).
2. Armstrong, W. O., "Hypersonic Aerodynamic Characteristics of Several Series of Lifting Bodies Applicable to Reentry Vehicle Design," (U) NASA TM X-536, June 1961 (Confidential).
3. Woodcock, R. J., "Control Surface Design for a Hypersonic Vehicle," ASD TR-61-394, Volume I, September 1961.
4. Chapkis, R. L., "Hypersonic Flow Over an Elliptic Cone: Theory and Experiment," Journ. Aero. Sci., November 1961.
5. Kayser, L. D., and Morris, S. D., "Force, Pressure, and Heat Transfer Tests on a Flap Controlled Reentry Vehicle at Mach 8," (U) AEDC-TN-61-143, November 1961 (Secret).
6. Stivers, L. S., Jr., and Levy, L., Jr., "Longitudinal Force and Moment Data at Mach Numbers from 0.60 to 1.40 for a Family of Elliptic Cones with Various Semiapex Angles," NASA TN D-1149, December 1961.
7. Malvestuto, et. al., "Study to Determine the Aerodynamic Characteristics on Hypersonic Re-entry Configurations," WADD TR 61-56, Vol. 1 - Experimental Report M = 2, Part I - Experimental Phase (AD 325 215), Vol. 2 - Experimental Report M = 5 (AD 324 904), Vol. 3 - Experimental Report M = 8 (AD 325 286), Vol. 4 - High Angle of Attack Force Data M = 8 (AD 332 900), Part II - Analytical Phase, Vol. 1 - Analysis (AD 329 910), Vol. 2 - Design Charts (AD 286 890), Part III - Pressure Distribution Studies, Vol. 1 - Experimental Report (AD 332 072), Vol. 2 - Analysis Report (AD 332 776), 1961.

1962

1. Geiger, R. E. and Harris, C. J., "Experimental Investigation of the Hypersonic Characteristics of a Series of Basic Lifting Shapes," GE-DIN: R62SD3, January 1962 (Classified).
2. Wornom, D. E. and Olstad, W. B., "Static Longitudinal Aerodynamic Characteristics of a Right Triangular Pyramidal Lifting Reentry Configuration at Mach Numbers of 3.00, 4.50, and 6.00 for Angles of Attack up to 56° ," (U) NASA TM X-675, March 1962 (Confidential).
3. "Force Tests of Three Re-entry Shapes at Mach Numbers 2 to 5," (U) AEDC-TDR-62-135, July 1962 (Confidential).
4. Berman, R., et. al., "Re-entry Control Study," GE Document No. 62SD637, July 1962.
5. Berman, R., et. al., "Aerodynamics Operation Input to the Re-entry Control Study, Advanced Mark 6, Task A-5," GE ADM No. 1:84, August 1962 (GE Proprietary).
6. Holloway, P. F., "Pressure Distribution on a Flat-Bottom Canted-Nose Half-Cone Reentry Configuration at a Mach Number of 6.0," NASA TM X-736, August 1962 (Confidential).
7. Schiff, J., "A Hypersonic Study to Determine Fin Effectiveness and the Effect of Combined Angles of Attack and Yaw on the Static Aerodynamic Characteristics of the RVX-2C Configuration," GE Document No. 62SD550, September 1962.
8. Schiff, J., "A Transonic Investigation to Determine the Static and Dynamic Stability and Control Effectiveness of the RVX-2C Configuration in the NASA Ames 14' Transonic Wind Tunnel," GE Document No. 62SD652, September 1962.
9. "Experimental Study of Aerodynamic Parameters of Unsymmetrical Nose Cone Configurations at Mach Numbers 0.8 to 5.0," (U) AEDC-TDR-62-154, October 1962 (Confidential).
10. Hobbs, R. B., "A Transonic-Supersonic Wind Tunnel Investigation of Static Stability and Control Effectiveness of a Re-entry Nose Cone with Trailing Flaps," GE Document No. 62SD884, November 1962 (GE Proprietary).
11. Wells, W. R. and Armstrong, W. O., "Tables of Aerodynamic Coefficients Obtained from Developed Newtonian Expressions for Complete and Partial Conic and Spheric Bodies at Combined Angles of Attack and Sideslip with Some Comparisons with Hypersonic Experimental Data," NASA TR R-127, 1962.

1963

1. "Longitudinal Aerodynamic Characteristics of Three Families of Lifting Re-entry Bodies," (U) AEDC-TDR-63-4 (AD 334 088), January 1963 (Confidential).
2. Berman, R. J., et. al., "Maneuvering Re-entry Vehicles - Flap Control Study, Status Report," (U) GE-ATDM No. 1:00, January 1963 (GE Proprietary).
3. Berman, R. J., et. al., "Aerodynamics Input to the Semi Annual Progress Report for GE-ARP, Task Aero 15 - Stability and Control Effectiveness of Terminally Guided Re-entry Vehicles," (U) GE-ATDM No. 1:04, February 1963 (Classified) (GE Proprietary).
4. Holloway, P. F., "Comparison of Experimental Control Effectiveness of a Flat-Bottom Canted-Nose Half-Cone Reentry Configuration with that Obtained by Several Methods of Prediction for Various Types of Local Flow at a Mach Number of 6.0," (U) NASA TM X-767, March 1963 (Confidential).
5. Staylor, W. F., Sterrett, J. R., and Goldberg, T. J., "Pressure Distributions on a Blunt-Nose Lifting Reentry Body with Flaps at a Mach Number of 6.0 with Emphasis on the Nature of the Local Flow," (U) NASA TM X-766, March 1963 (Confidential).
6. Kahn, S. F., and Steck, H. J., "Aerodynamic Characteristics of a Flap Controlled Slender Body Re-entry Vehicle - DA 85 Study," (U) GE-ATDM No. 1:06, March 1963 (Classified) (GE Proprietary).
7. Fuller, D. E., Shaw, D. S., and Wassum, D. L., "Effect of Cross-Section Shape on the Aerodynamic Characteristics of Bodies at Mach Numbers from 2.50 to 4.63," NASA TN D-1620, March 1963.
8. Hobbs, R. B., "An Experimental Wind Tunnel Evaluation of the Static Stability & Control Effectiveness of a Re-entry Nose Cone with Trailing Flaps at M = 10," (U) GE-DIN-63SD531, March 1963 (Classified)(GE Proprietary).
9. Goebel, T. P., Martin, J. J., and Boyd, J. A., "Factors Affecting Lift-Drag Ratios at Mach Numbers from 5 to 20," AIAA Journal, March 1963.
10. Berman, R. J., et. al., "Maneuvering Re-entry Vehicles - Flap Control Study (DA-85) - Aerodynamics Final Report," (U) GE-DIN-63SD254, April 1963 (Classified) (GE Proprietary).
11. Wolfe, J., "Final Data Report on Heat Transfer and Pressure Distribution for an 11° Cone with Control Surfaces (DA - LO 3-35)," (U) Vol. 1, GE-TDM-9151-008-1, April 1963 (Classified) (GE Proprietary).

1963 (Cont'd)

12. "Experimental Wind Tunnel Results for the Static Stability and Control Effectiveness of a 90° Cone with Trailing Flaps at M = 8.0," (U) GE-Document No. 63SD761, April 1963 (Classified).
13. "Experimental Wind Tunnel Evaluation of Stability and Control Effectiveness for a 90° Sphere Cone with Trailing Flaps at M = 10," (U) GE-Document No. 63SD762, April 1963 (Classified).
14. Sullivan, P. J. and Onspaugh, C. M., "Analytical and Experimental Investigation of Hypersonic Lifting Re-entry Vehicles," Part 1. Experimental Phase, Volume 3 - Mach Numbers 10 and 18.6, AFFDL ASD-TDR-62-789, May 1963.
15. "Analytical and Experimental Investigation Hypersonic Lifting Re-entry Vehicles," ASD TDR 62-789, Part I - Experimental Phase, Vol. 1 - Mach Number 5 (AD 338 103), Vol. 2 - Mach Number 8 (AD 337 411), Vol. 3 - Mach Number 10 and 18.6 (AD 337 412), Part II - Analytical Phase, Vol. 1 - Analysis, May 1963.
16. Terry, J. E. and Miller, R. J., "Aerodynamic Characteristics of a Truncated-Cone Lifting Reentry Body at Mach Numbers from 10 to 21," NASA TM X-786, August 1963 (Confidential).
17. Buck, M. L. and McLaughlin, E. J., "A Technique for Predicting Pressure Distributions and Aerodynamic Force Coefficients for Hypersonic Winged Re-Entry Vehicles," ASD-TDR-63-522 (AD 341 888), August 1963.
18. Blattner, C. J., "Background and Supplementary Data in Support of Boost-Glide Re-entry Vehicle Study Program Plan," (U) MDAC A-096 (AD 344 840), August 1963 (Classified).
19. Palko, R. L., and Ray, A. D., "Pressure Distribution and Flow Visualization Tests of a 1.5 Elliptic Cone at Mach 10," AEDC-TDR-63-163, August 1963.
20. Charczenko, N., and Babb, C. D., "Static Longitudinal and Lateral Stability and Control Characteristics of a Right Triangular Pyramidal Lifting Reentry Configuration at Mach Numbers from 2.36 to 4.65," (U) NASA TM X-831, September 1963 (Confidential).
21. Donaldson, J. C., "Hypersonic Control Effectiveness Tests of a Blunted, Triangular-Pyramid Re-entry Configuration at Mach 5 and 8," AEDC-TDR-63-250, December 1963.
22. Benson, B., Nash, R., "Constant L/D Re-entry Study," AFFDL-FDM TM 63-11, 1963.
23. MANEUVERING BALLISTIC REENTRY VEHICLE (MBRV) SEE SEPARATE LISTING.
24. Spencer, B., Jr., "Longitudinal Aerodynamic Characteristics at Mach Numbers from 0.40 to 1.10 of a Blunted Right Triangular Pyramidal Lifting Reentry Configuration Employing Variable-Sweep Wing Panels," NASA TN-D 1518, 1963.
25. "USAF Stability and Control DATCOM," Douglas Aircraft Co., Inc., Revisions by AF Wright Patterson Air Force Base, July 1963, 2 volumes.
15.

1964

1. Clark, E. L., "Hypersonic Stability and Performance Characteristics of a Family of Modified Conoids," (U) AEDC-TDR-64-20 (AD 346 817), January 1964 (Confidential).
2. Edenfield, E. E. and Eaves, R. H., Jr., "Longitudinal Stability and Control Tests of an ASD-NORAIR Blunt-Lifting Body Re-entry Configuration at Mach Number 20 (U)," AEDC-TDR-64-15, January 1964 (Confidential).
3. Burchfield, C. G. and Rippey, J. O., "Aerodynamic & Heat-Transfer Characteristics of a Super-Orbital Lifting-Body Re-Entry Vehicle at Mach 3 & 10," AEDC-TR-64-10, February 1964.
4. Hillsamer, M. E. and Rhudy, J. P., "Heat-Transfer and Shadowgraph Tests of Several Elliptical Lifting Bodies at Mach 10," AEDC-TDR-64-19 (AD 429 931), February 1964.
5. Miller, D. S. and Hijman, R., "Mach 8 to 22 Studies of Flow Separations Due to Deflected Control Surfaces," AIAA Journal, February 1964.
6. Usselton, J. C., "Force Test Results on a Series of Boost Glide Re-entry Vehicles at Mach Numbers from 1.5 to 10," (U) AEDC-TR-64-70, April 1964 (AD 349 280) (Confidential).
7. Abbey, P., "Maneuvering Re-Entry Vehicle VS 2 Inept," (U) Defense Research Corporation DRC-IMR-106, April 1964 (Classified).
8. Licciardello, M. R., "Development of Frontal Section for Super-Orbital, Lifting, Re-entry Vehicles Volume III: Asset Nose Cap," RTD-FDL-TDR-64-59, May 1964.
9. Whitcomb, C. F., "Static Stability and Control Characteristics of a Right Triangular Pyramid Lifting Reentry Configuration at a Mach Number of 10.03," (U) NASA TM X-962, May 1964 (Confidential).
10. Little, H. R., "Aerodynamic Force Tests of the Asset Re-entry Configuration in Tunnel F," (U) AEDC-TDR-64-116 (AD 350 337), June 1964 (Confidential).
11. Roberts, J. F. and Boudreau, A. H., "Longitudinal Static Stability and Roll Control on a Maneuverable Re-Entry Vehicle at Mach 19," (U) AEDC-TDR-64-130 (AD 351 015), June 1964 (Secret).
12. "Ninth Tri-Annual Progress Report on Asset," (U) MDAC A-788, June 1964 (Classified).
13. "Boost-Glide Re-Entry Vehicle Study," (U) MDAC A-883 (AD 352 221), July 1964 (Classified).

1964 (Cont'd)

14. "Boost-Glide Re-Entry Vehicle Study (U) Final Report Volume I, Technical Results, Part 2," MDAC A-983 (AD 356 873), July 1964 (Classified).
15. "Tenth Tri-Annual Progress Report on Asset," MDAC B086 (AD 355 220L), August 1964 (Classified).
16. Jones, J. H., Jenke, L. M., and Lucas, E. J., "Force and Pressure Tests on a Lifting Type Re-Entry Configuration at Mach 10," AEDC-TR-64-189, (AD 353 376), September 1964.
17. Rhudy, J. P., Magnan, J. D., "Heat-Transfer Tests of a Transpiration-Cooled Booster Glide Re-entry Vehicle Nose Cone," (U) AEDC-TDR-64-179, September 1964 (Confidential).
18. "Asset, ASV-1, Final Flight Test Report," (U) MDAC A973, September 1964 (Classified).
19. Sullivan, P. J., et. al., "Analytical and Experimental Investigation of Hypersonic Lifting Re-entry Vehicles," Part II - Analytical Phase, Volume I - Analysis, AFFDL-ASD-TDR-62-789, September 1964.
20. Draper, A. C., Buck, M. L., Grover, L., "Performance Potential and Aerodynamic Aspects of Very High L/D Entry Vehicles," (U) AFFDL-FDMS-TM-64-37, September 1964 (Secret).
21. Axelson, J. A., "Pressure Distributions for the M-2 Lifting Entry Vehicle at Mach Numbers of 0.23, 5.2, 7.4, and 10.4," (U) NASA TM X-997, September 1964 (Confidential).
22. Uselton, J. C., "Pressure Distribution Tests on a Boost-Glide Re-entry Vehicle at Mach Numbers from 1.5 to 10," AEDC-TR-64-204 (AD 354 244), October 1964.
23. Molloy, J. K., "Hypersonic Static Longitudinal Characteristics of a Slender Lifting Configuration with Various Afterbody Flares," (U) NASA TM X-1021, October 1964 (Confidential).
24. Roberts, M. L. and Storer, E. M., "An Experimental Investigation of Transitional Boundary Layer Separation at Mach 3 as Related to the Boundary Layer Upstream of Separation," (U) Part I - Summary of Results, Part II-Pressure Distributions, GE-ATDM 1:66, November 1964 (Classified).
25. Freed, L. E., "Final Report Maneuvering Re-Entry Vehicle for Low Level Penetration (MRVLP) Study," (U) Hughes Aircraft Company (AD 356 036), November 1964 (Classified).
26. Harmon, D. B., Jr., "Maneuvering Re-Entry Controls and Ablation Studies (MARCAS) First Quarterly Progress Report," (U) USAF/BSD/TR-64-173 (AD 356 4591), December 1964 (Classified).
27. McLaughlin, E., "Force and Pressure Tests on Several Hypersonic Configurations at Mach Number 19," AFFDL FDMG TM 64-7, 1964.

1964 (Cont'd)

28. Dahlem, V., "Static Aerodynamic Characteristics of Three Blunt Elliptical Bodies at Subsonic to Hypersonic Speeds," AFFDL-FDMG TM 64-23, June 1964.
29. Knott, P., Johnson, D., "Determination of Positions and Orientation Angles for a High L/D Glide Re-entry to Lift a Predetermined Earth Target," AFFDL FDMG TM 64-36, 1964.

1965

1. "Asset ASV-3 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B251 (AD 357 523L), January 1965 (Confidential).
2. Keyes, J. W., "Aerodynamic Characteristics of Lenticular and Elliptic Shaped Configurations at a Mach Number of 6," NASA TN D-2606, February 1965.
3. Landes, P. E., Marks, C. D., "Asset AEV-1 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B520 (AD 359 562L), February 1965 (Confidential).
4. Griffith, B. J. and Shelton, P. C., "Static Stability and Drag Characteristics of Five AFFDL High Lift to Drag Configurations at Mach 19," AEDC-TR-65-23 (AD 357 148), February 1965 (Confidential).
5. Levine, J. N. and Roberts, M. L., "An Experimental Investigation of Flap Induced Transitional Boundary Layer Separation on a Flat Plate at Mach 4.5," (U) Part II - Pressure Distributions, GE-ATDM 1:76, February 1965.
6. Hallowell, F., Spampinato, J., and Camerson, J., "Maneuvering Ballistic Reentry Vehicle Technology," (U) LMSC-B160, Pen-X Paper 46, March 1965 (SRD).
7. Dunkin, O. L. and Trimmer, L. L., "Hypersonic Aerodynamic Characteristics of Two Elliptic Half-Cones at $M = 8$ and Angles of Attack to 90 Degrees," AEDC-TR-65-46 (AD 458 753), March 1965.
8. Barnes, J. W., "Maneuvering Re-Entry Controls and Ablation Studies (MARCAS) Second Quarterly Progress Report," (U) USAF/BSD-TR-65-154 (AD 358 705L), March 1965 (Classified).
9. Vinson, P. W., "Extension of Reaction Control Effectiveness Criteria to Mach 10: Experiment and Theory," AIAA Journal, March 1965.
10. "Asset AEV-2 Flight Test Report," (U) MDAC B-551 (AD 358 763L), March 1965 (Confidential).
11. Lorenz, G. C., "Heat-Transfer Measurements of Entry Cones with Maneuvering Surfaces," AIAA Journal, April 1965.
12. Browne, P. D., "Results of DA-27 Fluid Injection Control Test Program at $M = 17$," GE-ATDM 1:85, April 1965 (GE Proprietary).
13. Boudreau, A. H., Jr., "Aerodynamic Characteristics of Four AFFDL High Lift-to-Drag Ratio Re-Entry Vehicles at Mach 19 and Free-Stream Reynolds Numbers up to 1.0×10^6 per Foot," AEDC-TR-65-93 (AD 360 238), May 1965 (Confidential).

1965 (Cont'd)

14. Burke, G. L., "Heat Transfer and Pressure Distributions about Sharp and Blunt Elliptic Cones at Angles of Attack and High Mach Numbers," AFFDL-TR-64-172 (AD 465 939), May 1965.
15. "Multiple Reentry Vehicle Guidance Study - Final Report," (U) USAF/BSD-TR-65-280, May 1965 (Classified).
16. Landes, P. E., Marks, C. D., "Asset ASV-4 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B707 (AD 366 546L), May 1965 (Classified).
17. Merz, G. H., "Static Force Tests on Two AFFDL High Lift-to-Drag Models at Hypersonic Mach Numbers," AEDC-TR-65-137 (AD 361 861), June 1965.
18. Myers, J. R. and Spurlin, J. R., "Static Stability Characteristics of a Sleigh Ride Configuration at Supersonic and Hypersonic Mach Numbers," AEDC-TR-65-135 (AD 362 022), June 1965 (Secret).
19. Magnan, J. D., Jr., Carman, J. B., and Rhudy, J. P., "Effects of Transpiration Cooling on the Aerodynamic Heating of a Boost Glide Re-Entry Vehicle Nose Cone at Mach 10," AEDC-TR-65-134 (AD 361 972), June 1965 (Secret).
20. Burk, J. L. and Burdette, J. E., "Pressure Distribution on the Final Control Surface Configuration of a Maneuverable Re-entry Flight Test Vehicle at Mach 20," AEDC-TR-65-129, June 1965 (Confidential).
21. Steck, H. J., "Aerodynamic Input to the Dashound Feasibility Study," (U) GE-ATDM 65-3, June 1965 (Classified).
22. "Flight Test Report Asset ASV-4 Volume III," (U) McDonnell Aircraft Corporation, MAC B707 (AD 373 532L), July 1965 (Classified).
23. Johnson, G. P., "Maneuvering Reentry Control and Ablation Studies (MARCAS) Final Report Volume III Investigation of Pressure and Enthalpy on Ablative Materials," (U) USAF/BSD-TR-65-312 (AD 362 656L), July 1965 (Classified).
24. Rinn, S. W., "An Investigation of Heat Transfer on the Asset Vehicle at a Mach Number of 10 and Angle of Attack," (U) RTD-FDL-TR-65-72, August 1965 (Classified).
25. Dunkin, O. L., "Static Stability Characteristics of a Boost Glide Re-Entry Vehicle at Mach 8," AEDC-TR-65-205 (AD 365 789), September 1965 (Confidential).
26. Feryn, M. O. and Kyle, R. G., "Static Stability and Control Characteristics of a Lifting-Body Entry Vehicle at Mach Numbers from 2.30 to 4.63," NASA TM X-1138, September 1965 (Confidential).

1965 (Cont'd)

27. Rhudy, R. W. and Merz, G. H., "Heat Transfer and Pressure Distribution on a Scale Model SV-5D at Mach 10," AEDC-TR-65-194 (AD 365 040), September 1965 (Confidential).
28. Bloomquist, R. E., "Maneuvering Reentry Control and Ablation Studies (MARCAS) II First Quarterly Technical Progress Report," (U) USAF BSD TR 65-462 (AD 367 315L), September 1965 (Classified).
29. Lloyd, J. T., and Sieron, T. R., "Development of High Lift/Drag Configurations," (U) AFFDL-TR-66-22, September 1965 (Confidential).
30. Schindel, L. H., "Effect of Vortex Separation on Lifting Bodies of Elliptic Cross Section," AEDC-TR-65-212 (AD 628 224), September 1965.
31. Boudreau, A. H., and White, J. L., "Effects of Configuration Refinements on the Static Stability and Drag Characteristics of Two AFFDL High Lift-to-Drag Models at Mach 19," (U) AEDC-TR-65-212 (AD 365 823), September 1965 (Confidential).
32. Kemp, J. H., Jr., Holdaway, G. H., and Polek, T. E., "Characteristics of an Aerodynamic Control System for Use with Blunt Entry Configurations at Mach Numbers of 10.7 in Helium," NASA TM X-1153, October 1965 (Confidential).
33. Bernot, P. T., "Static Stability Characteristics of Several Raked-Off Circular and Elliptical Cones at Mach 6.7," NASA TN D3053, October 1965.
34. Knox, E. C., "Pressure and Heat-Transfer Distributions on an AFFDL High Lift-to-Drag Ratio Re-entry Configuration at Angles of Attack for Free-Stream Mach Number of 19 and Unit Reynolds Number to 600,000 per Foot," AEDC-TR-65-220, October 1965 (Confidential).
35. Crosthwait, E. L., "Aerodynamic Characteristics of Storable Wings on Reentry Vehicles," (U) RTD-FDL-TR-65-175, October 1965 (Classified).
36. Browne, P. D., "A Test Program to Obtain Aerodynamic Force and Pressure Data at $M = 10$ on the Dashound Configuration," (U) GE ATDM ATPR 50-65 Addendum, October 1965 (Classified).
37. Wagner, R. E., "Asset, Volume V. Structural Criteria and Loads - Flight Data Correlation," RTD-FDL TR 65-31 (AD 370 071), November 1965 (Classified).
38. Volker, R. E., "Aeroelastic and Dynamic Experiments Flight Results and Correlations," (U) RTD/FDL TR 65-31, Vol. 13 (AD 375 681), November 1965 (Classified).

1965 (Cont'd)

39. Trescot, C. D., Jr., Spencer, B., Jr., "Hypersonic Aerodynamic Characteristics of a Lifting Reentry Vehicle Model with Four Types of Longitudinal Control Surfaces," (U) NASA TM X-1173, November 1965 (Confidential).
40. Merz, G. H. and Rhudy, R. W., "Mach 10 Heat Transfer and Pressure Distribution on a Delta Wing with Split Flap," AEDC-TDR-65-198, December 1965 (Confidential).
41. Kinroth, G. D. and Pawlikowski, T. P., "Asset - Volume III. Final Aerodynamics and Performance," AFFDL-TR-65-31 (AD 372 211), December 1965.
42. Furnish, J. F., "Aeroelastic and Dynamic Experiments Preflight Investigation and Ground Test Results Volume XII," (U) RTD-FDL-TR-65-31 (AD 374 412), December 1965 (Classified).
43. "BSD/GE-Dashound Force Test Data," GE DIN-IG 7883-33, December 1965 (Secret).
44. Johnson, D., "Performance Estimation of Unpowered High Lifting Reentry Vehicles," AFFDL-FDMG TM 65-16, 1965.
45. Ashby, G. C., Jr. and Cary, A. M., Jr., "A Parametric Study of the Aerodynamic Characteristics of Nose-Cylinder-Flare Bodies at a Mach Number of 6.0," NASA TN-D-2854, June 1965.
46. Fetterman, D. E., "Favorable Interference Effects on Maximum Lift Drag Ratios of Half-Cone Delta-Wing Configurations at Mach 6.86," NASA TN-D-2942, August 1965.
47. Lamb, Graham, Romere, "Newtonian Aerodynamic Characteristics of Right Elliptical Raked-Off Cones for Cone Thickness Ratios of 0.25 to 3," NASA TN-D-2947, August 1965.

1966

1. White, J. L., Jr., "Static Stability and Drag Characteristics Tests on Two Lockheed High Lift-to-Drag Configurations at Mach 19," AEDC-TR-66-5, January 1966.
2. Burt, R. H., "Static Stability and Control Flap Pressure Distributions on the Dashound Configuration at Mach 10," AEDC-TR-66-56 (AD 370 839), March 1966 (Confidential).
3. "Proceedings of Asset/Advanced Lifting Re-Entry Technology Symposium," AFFDL-TR-66-22 (AD 375 139), March 1966 (Confidential).
4. Mort, K. W., Gamse, B., "Full-Scale Wind-Tunnel Investigation of the Longitudinal Aerodynamic Characteristics of the M2-F1 Lifting Body Flight Vehicle," NASA TN D-3330, March 1966.
5. Boylan, D. E., "An Experimental Study of Aerodynamic Forces on Lifting Bodies Under the Influence of Strong Viscous Interaction," (U) AEDC-TR-66-45 (AD 371 288), April 1966 (Confidential).
6. Pagel, L. L., Beardsley, P. P., Gaumer, G. R., "Asset Volume IV Correlative Analysis of Heat Transfer Data," (U) RTD-FDL-TR-65-31 (AD 376 185), April 1966 (Classified).
7. Sullivan, T. O., "Advanced Antiaircraft Defense vs. Gliding Maneuvering Reentry Vehicle," DRC-66-8712, DRC-TM-393 (AD 380 362L), April 1966 (Classified).
8. Gaumer, G. R., "Asset Volume XIV. Heat Flux Calculation Procedures," RTD/FDL/TR-65-31 (AD 480 814), April 1966.
9. Allen, A. A., "Feasibility of an MRV Skip in Penetrating Area Defense," (U) DRC-66-7805, DRC-TM-371 (AD 380 357L), May 1966 (Classified).
10. Ray, A. D., "Static Stability and Pressure Distributions on a 9-Degree Cone with Reaction-Jet Controls at Mach 6 and 10," AEDC-TR-66-94 (AD 371 917), May 1966 (Confidential).
11. Spurlin, C. J., "Static Force Tests of Five High L/D Configurations at Mach 6 and 8," AEDC-TR-66-119 (AD 373 493), June 1966 (Confidential).
12. Meschler, P. A., "Differential Game Theoretic Analysis of Maneuvering Threats," DRC/TM-346/1 (AD 819 791), June 1966.
13. Yates, E. H., "Maneuvering Reentry Vehicle Cost Model," DRC-66-8189, DRC-TM-395 (AD 380 363L), June 1966 (Classified).
14. Furman, G. G., "Preferential Area Defense Capability and Defense Effectiveness: City and Equal Values Targets," (U) DRC-66-8825, DRC-TM-408 (AD 380 366L), June 1966 (Classified).

1966 (Cont'd)

15. Jago, W. H., "Soviet Air Defense Interceptor and Form Requirements against a Gliding Maneuvering R/V," (U) DRC-66-8111, DRC-TM-359 (AD 380 356L), June 1966 (Secret Restricted).
16. Cleary, J. W., "Effects of Angle of Attack and Nose Bluntness on the Hypersonic Flow Over Cones," AIAA Paper 66-414, June 1966.
17. Abbey, P. K., "MRV Glide Footprint vs. Terminal Evasion," (U) DRC-66-8615, DRC-TM-375 (AD 380 360L), July 1966 (Classified).
18. Moore, R. C., "Minuteman Payload Possibilities Employing a Maneuvering Reentry Vehicle," (U) DRC-66-8387, DRC-TM-402 (AD 380 364L), August 1966 (Classified).
19. Abbey, P. K., "Analytical Computations of Terminal Maneuvering R/V Performance," (U) DRC-66-8727, DRC-TM-436 (AD 380 314L), August 1966, (Confidential).
20. "MARCAS-2 Re-Entry Vehicle," (U) DDC-ARB-N-58454, September 1966 (Classified).
21. Steck, H. J., "Final Summary Report - Aerodynamics Testing of High W/CpA Maneuvering Re-Entry Vehicles - DA-LO-35," (U) GE66SD9033, September 1966 (Classified).
22. Spurlin, C. J., "Static Force Tests of a High L/D Configuration at Mach 2.5," AEDC-TR-66-175 (AD 376 057L), October 1966 (Confidential).
23. Boudreau, A. H., Jr., "Effects of Reynolds Number Variation and Elevator Deflection on Two AFFDL High Lift-to-Drag Re-Entry Vehicles at Hypersonic Speeds," (U) AEDC-TR-66-193 (AD 376 909), November 1966 (Confidential).
24. Ceresuela, R., "Wind-Tunnel Study of a Hypersonic Lifting Re-entry Body," NASA TT F-10813, 1966.
25. Murphy, J. S., Bloomquist, R. E., and Spaid, F. W., "Maneuvering Reentry Control and Ablation Studies (Marcas II) Final Report Vol. 1 - Summary," BSD-TR-66-246, 1966 (Secret).
26. Spaid, F. W., Davis, J. G., Barnes, J. W., and Sayano, S., "Maneuvering Reentry Control and Ablation Studies (Marcas II) Final Report Vol. II - Jet Interaction Investigation," (U) BSD-TR-66-246, 1966 (Secret).
27. Spencer, B., Jr., "Transonic Aerodynamic Characteristics of a Series of Related Bodies with Cross-Sectional Ellipticity," NASA TN-D-3203, 1966.
28. Maddalon, D. V., "Longitudinal Aerodynamic Characteristics of Two Blunted Cone Reentry Configurations at Mach Numbers from 17.6 to 22.2 Including Some Reynolds Number Effects, NASA TN D-3320, March 1966.

1966 (Cont'd)

29. Fournier, R. H., Spencer, B., Jr., and Corlett, W. A., "Supersonic Aerodynamic Characteristics of a Series of Related Bodies with Cross-Sectional Ellipticity," NASA TN-D-3539, 1966.
30. Pernot, P. T., "Static Stability Characteristics of Cone and Half-Cone-Pyramid Configurations at Mach 6.83," NASA TN-D-3544, August 1966.

1967

1. Meschler, P. A., "Refined Game-Theoretic Analysis of Maneuvering Threats," DRC/TM-477 (AD 811 041), January 1967.
2. Sterhardt, J. A., Jr., "S-V-5D Prime Preliminary Flight Evaluation Test Flight No.-1," (U) Martin Company/ER-14301 (AD 378 856), January 1967 (Classified).
3. Nordsieck, R. A., "MRV Engagements in Hard Point Defense," (U) DRC-67-9950, DRC/TM-478 (AD 380 057L), January 1967 (Classified).
4. Barte, G. R., "Estimated Loads, Hinge Moments, and Pressure Distributions for the Single-Flap of the Basic Slamast Configuration," GE-ATDM 67-01, January 1967.
5. Herrick, R., "Operational MRV Concepts Study Program-Program Plan," GE67SD460 Rev. A, January 1967 (Classified).
6. Carman, J. B and Strong, M. G., "Aerothermodynamic Characteristics of a Multipurpose Entry Vehicle at Mach No. 10," AEDC-TR-68-276, February 1967.
7. Boylan, D. E. and Potter, J. L., "Aerodynamics of Typical Lifting Bodies under Conditions Simulating Very High Altitudes," AIAA Journal, February 1967.
8. Abbey, P. K., "Lower Bound on Maneuvering Vehicle Performance," DRC-66-9419, DRC-TM-500 (AD 389 483L), March 1967 (Classified).
9. Wolfe, J. A., "An Experimental Program to Obtain Pressure Data in Support of MRV Program," (U) GE67SD665, March 1967 (Classified).
10. Chmielewicz, L., "Scout Launched Advanced Materials and Structures Test-Bed (SLAMAST) Systems Requirements Analysis," GE67SD613, March 1967.
11. Saydah, A. R., "An Experimental Program to Obtain Convective Heat Transfer Data for the MRV Configuration," (U) GE67SD598, March 1967, (Classified).
12. Sterhardt, J. A., "Prime Test Flight #1, Flight Analysis," (U) Martin Co/ER-14461 (AD 381 380), March 1967 (Classified).
13. Sterhardt, J. A., "Prime Test Flight #1, Flight Analysis," (U) Martin Co/ER-14461-Appendices (AD 381 381), March 1967 (Classified).
14. "Project Press Operation and Data Summary Prime Flight No. 1," (U) MIT LL POD 85, March 1967 (Classified).

1967 (Cont'd)

15. Putegnatt, J., "Manned Reentry and Recovery," AAS Paper No. 67-36, March 1967.
16. Steck, H., "Aerodynamics Phase A Summary Report MRV Operational Concepts Study," GE ATDM 67-19, April 1967 (Classified).
17. "Preliminary Design Study of Slamast Scout-Launched Advanced Materials and Structures Test-Bed Volumes I - NASA CR-66397, Volume II - NASA CR-66398 and Volume III - NASA CR-66399, April 1967.
18. "Preliminary Design Study of Slamast Scout-Launched Advanced Materials and Structures Test-Bed," GE67SD661, April 1967.
19. Fedele, M., "Reliability Estimate Analysis for the MRV Phase A System and Subsystem Conceptual Designs," (U) GE67SD717, April 1967 (Classified).
20. "Operational Maneuvering Reentry Vehicle Concepts Study - Phase A - Volume 3 - Appendices," (U) BSD-TR-67-144, May 1967 (SRD).
21. Sullivan, T. O., "Gliding Maneuvering Reentry Vehicle Effectiveness," (U) DRC-67-10394, DRC-TM-586 (AD 390 844L), May 1967 (Classified).
22. Herrick, R., "Operational Maneuvering Reentry Vehicle Concept Study Technical Progress Report - Phase A," (U) Volume 1-Rev. 1, Volume 2-Rev. 1, Volume 3-Rev. 1, GE67SD742, May 1967 (Classified).
23. "Project Press Operation and Data Summary Prime Flight No. 2," (U) MIT/LL/POD91, May 1967 (Classified).
24. Barte, G. R., "Slamast Wind Tunnel Data and Analysis Report," GE/ATDM 67-27, May 1967.
25. Lohneiss, W. H., "Terminal Engagements of Maneuvering Reentry Vehicles Following Intermediate-Range Flight," (U) GRC-IMR-653 (AD 388 647), July 1967 (Classified).
26. Lewis, H. F., "Maneuvering Reentry Control and Ablation Studies (MARCAS II) Facility Calibration and Ablation Testing Results," (U) AEDC-TR-67-118 (AD 382 755), July 1967 (Classified).
27. Little, H. R. and Griffith, B. J., "Mass Injection Studies on Slender Cones & a Flat Plate with Trailing-Edge Ramp at Mach Nos. from 9 to 21," AEDC-TR-67-109, August 1967.
28. "Operational Maneuvering Reentry Vehicle Concepts Study," Volume 1 USAF/BSO-TR-67-200 Vol. 1 MDAC F-701 (AD 384 535L) and Volume 2 USAF/BSO/TR-200-Vol. 2 MDAC F-701 (AD 384 536L), August 1967 (SRD).

1967 (Cont'd)

29. Burt, R. H., "Static Stability, Axial-Force, and Roll Control Characteristics of the Dashound Configuration at Mach Number 8," (U) AEDC-TR-67-114, August 1967 (Confidential).
30. Schindel, L. H., Chamberlain, T. E., "Vortex Separation on Slender Bodies of Elliptic Cross Section," MIT-TP-138 (AD 662 689), August 1967.
31. Fedele, M., "Reliability Estimates Analysis for the MRV Phase "B" System and Subsystem Conceptual Designs," (U) GE67SD7088, August 1967 (Classified).
32. Herrick, R. R., "Operational Maneuvering R/V Concept Study Technical Progress Report Phase B," (U) Volumes 1, 2, and 3, GE67SD7019, August 1967 (Classified).
33. Dolis, J. J., "Results of a Static Stability Drag Test of the Dashound Configuration in Support of the MRV Program," (U) GE/ATDM 67-39, August 1967 (Classified).
34. Herrick, R. R., "Operational MRV-R&D Program Plan," (U) GE67SD7071, August 1967 (Classified).
35. Penland, J. A. and Bernot, P. T., "Aerodynamic Characteristics of Three Axisymmetric Low-Fineness-Ratio Reentry Shapes at Mach 6.9," NASA TN D-4122, August 1967.
36. "SV-5D Prime, Final Flight Test Summary," (U) Martin Marietta, ER-14465 (AD 387 702), September 1967 (Confidential).
37. Steinmetz, H. F., "Operational Maneuvering Reentry Vehicle Concepts Study Final Report," (U) USAF/SAMSO TR-67-70, MDAC F-839 (AD 386 479L), September 1967 (Classified).
38. "Final Flight Test Summary," (U) Martin Co/ER-14465 (AD 387 702), September 1967 (Classified).
39. Thoennes, C. M., "Operational Maneuvering Reentry Vehicle Concept Study CEI System Specification Reentry Vehicle, Part I," (U) Preliminary, GE67SD873, September 1967 (Classified).
40. Deibueno, R., "Hypersonic Force, Moment and Trim Data Analysis for a Slender Body with Aerodynamic Control Surfaces," (U) GE67SD7097, September 1967 (Classified).
41. Rhudy, R. W., "Mach No. 6 and 8 Heat-Transfer Tests of Several 80-Degree Swept Delta Wings," AEDC-TR-67-190, October 1967.
42. Winchenbach, G. L. and Lawrence, W. R., "Free-Flight Range Tests of a Boost Glide Re-Entry Vehicle Configuration at Hypervelocities," AEDC-TR-67-233 (AD 385 428), November 1967 (Confidential).

1967 (Cont'd)

43. Herrick, R. R., "Operational Maneuvering Reentry Vehicle Concept Study Final Report," (U) GE67SD7316, December 1967 (SRD).
44. Carman, J. B., Jr., "Pressure and Heat-Transfer Measurements on the Marcos III Vehicle at Mach Numbers 6 and 10," AEDC-TR-67-244 (AD 386 017), December 1967 (Confidential).
45. "RVTO Phase 1B, CCN No. 15 Roll Control Development Final Report," (U) Volume II, GE67SD7317, December 1967 (SRD).
46. Johnson, D., Nash, R., Rinn, S., "High L/D Performance Study on Technology Demonstration," FDM TM 67-4, 1967.
47. Spencer, B., Jr., "Hypersonic Aerodynamic Characteristics of Minimum Wave Drag Bodies Having Variations in Cross-Sectional Shape," NASA TN-D-4079, 1967.
48. Stivers, L. S., Jr., and Spencer, B., Jr., "Studies of Optimum Body Shapes at Hypersonic Speeds," NASA TN-D-4191, 1967.

1968

1. "SV-5D Prime Follow-on Program, Additional Aerodynamic and Thermodynamic Data Analyses," (U) Martin Marietta, ER-14686 (AD 386 983), January 1968 (Confidential).
2. Goldman, R. L., Morkovin, M. V., and Schumacher, R. N., "Unsteady Control Surface Loads of Lifting Re-Entry Vehicles at Very High Speeds," AIAA Journal, January 1968.
3. Draper, A. C. and Buck, M. L., "Assessment of the Factors Affecting Advanced Lifting Entry Vehicles," AFFDL TR-67-137, January 1968.
4. Dahlem, V. and Buck, M. L., "Experimental and Analytical Investigations of Vehicle Designs for High Lift-to-Drag Ratios in Hypersonic Flight," (U) AFFDL TR-67-138, February 1968.
5. Iannuzzi, F. A., Boudreau, A. H., Jr., and Eaves, R. H., Jr., "Force, Pressure, and H-T Measurements on Scale Models of the AFFDL-5A High L/D Unmanned Configuration at Mach Nos. 14 & 20," AEDC-TR-67-248, January 1968 Revised February 1968.
6. Johnston, P. J. and Witcofski, R. D., "Experimental Stability and Control Results at Mach 19 on an Entry Vehicle Designed for an Intermediate Lift-Drag Ratio," NASA TN D-4337, February 1968.
7. Uselton, B. L. and Mansfield, A. C., "Dynamic Stability Characteristics of the Mark 17 Configuration at Mach Numbers from 2 through 10," AEDC-TR-68-8, February 1968 (Confidential).
8. Pfaff, L. J., "Static Force Tests on a High L/D Configuration at Mach Numbers 1.5 to 8.0," AEDC-TR-68-29, March 1968.
9. Nordsieck, R. A., "Advanced Sprint Performance in Hardsite Defense Against an MRV," (U) TM-851, DRC/68-12718, April 1968 (Classified).
10. Gentry, A. E., Oliver, W. R., Smyth, D. N., "Hypersonic Aerodynamic Analysis of High Lift-Drag Ratio Reentry Vehicles," (U) AFFDL-TR-68-40 (AD 391 226), April 1968 (Confidential).
11. Kent, R., "Results of a Hypersonic Ground Test Program to Determine the Spin Characteristics of Several Fin Configurations in Support of the RVTO Program," (U) GE-ATDM 68-62, April 1968 (Classified).
12. Nordsieck, R. A., "MRV Penetration of the Strat-X Radar Defense," (U) DRC/68-12844, TM-858, May 1968 (Classified).
13. "An Experimental Investigation of the Aerodynamic Characteristics of Slender Hypersonic Vehicles at High Angles of Attack," NOLTR 68-52, May 1968.
14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR-68-77 (AD 394 438L), May 1968 (Secret).

1968 (Cont'd)

15. Iannuzzi, F. A., "Measurements of the Heat-Transfer Distribution on a Scale Model of the AFFDL-7MC Unmanned Supersonic Configuration at Mach Number 19," (U) AEDC-TR-68-93, June 1968 (Classified).
16. Holleman, E. C., "Stability and Control Characteristics of the M2-F2 Lifting Body Measured During 16 Glide Flights," (U) NASA TM X-1593, June 1968 (Confidential).
17. Mort, K. W., Gamse, B., "Full-Scale Wind-Tunnel Investigation of the Aerodynamic Characteristics of the M2-F2 Lifting Body Flight Vehicle," (U) NASA TM X-1588, June 1968 (Confidential).
18. Fuller, G. M., "Advanced Concepts for High L/D Hypersonic Vehicles Task 3 - Advanced Concepts Configuration Analysis," AFFDL TR-68-110, (AD 843 066), August 1968.
19. Fitzgerald, M. B., "Interceptors for Hard-Point Defense," (U) IMR-862, DRC/68-12904, August 1968 (Classified).
20. "Boost Glide Re-entry Vehicle," Final Report, SAMSO-TR-68-456, Volume I - Analysis (AD 506 414L), Volume II - Test Program (AD 506 415L), September 1968 (Secret).
21. Biche, P. W., "Maneuvering Reentry Vehicle Studies," (U) Volume 4, LOGICON/SEA-8034-ATS-430 (AD 395 827L), October 1968 (Classified).
22. Axelson, J. A., Mellenthin, J. A., "Hypersonic Aerodynamic Characteristics of the M2-F2 Lifting Entry Configuration," NASA TM X-1690, November 1968, (Confidential).
23. Seegmiller, H. L., "Convective Heat Transfer to the Ames M2 and M2-F2 Lifting Entry Vehicles," (U) NASA TM X-1691, December 1968 (Confidential).
24. "Lifting Reentry Vehicle Applications," Vol. I - Lifting Re-entry Vehicle Applications (AD 394 230), Vol. II - Operations Analysis (AD 394 231), Vol. III - Point Reconnaissance Operation (AD 394 232), Vol. IV - Defense of the US Operation (AD 394 233), Vol. V - Other Military Operations (AD 394 234), AFFDL-TR-68-64, 1968 (Secret).
25. Johnson, P. J., "Experimental Stability and Control Results at Mach 19 of an Entry Vehicle Designed for an Intermediate Lifting Drag Ratio," NASA TN D-4337, February 1968.
26. Stone, D. R., and Ashby, G. C., Jr., "Effects of Lee-Surface Volume Addition on Longitudinal Aerodynamics of a High-Lift-Drag-Ratio Wing-Body Configuration at Mach 6.0," NASA TN-D-4361, March 1968.

1969

1. Ball, K. O., "Effects of Flap Length and Slot Suction on Separated Laminar Boundary Layers," AIAA Paper 69-36, January 1969.
2. Warneke, C. H., Kinroth, G. D., Steinmeyer, T. J., Wawrzyndik, M. E., Jr., "Lifting Reentry Test Vehicle Preliminary Designs for FDL-7MC and FDL-5MA Configurations, Volume IV - Configuration Evolution, Design Approach Investigations and Supporting Analyses," AFFDL-TR-68-97, January 1969 (Confidential).
3. Fehrman, A. L., "Lifting Reentry Test Vehicle Preliminary Designs for FDL-7MC and FDL-5MA Configurations, Volume VI - FDL-7MC Thermodynamic Test Data," AFFDL-TR-68-97, January 1969 (Confidential).
4. Kinroth, G. D., Parks, D. L., Steinmeyer, T. J., Warneke, C. H., "Lifting Reentry Test Vehicle Preliminary Designs, Volume VII - Unmanned Hypersonic Test Vehicle Design and Analysis (FDL-5MA)," (U) AFFDL-TR-68-97, January 1969 (Confidential).
5. Carman, J. B., Jr., Strong, M. G., "Aerothermodynamic Characteristics of a Multipurpose Entry Vehicle at Mach Number 10," AEDC-TR-68-276, February 1969.
6. Ericsson, L. E. and Reding, J. P., "Dynamic Stability Problems Associated with Flare Stabilizers and Flap Controls," J. Spacecraft, February 1969.
7. Jetta, N., "ARV-Study Program, Revised Program Plan," (U) GE69SD675, May 1969 (Classified).
8. Spurlin, C. J. and Hube, F. K., "Pressure Distributions on a Multipurpose Entry Vehicle at Mach Nos. 1.5, 3.0 and 5.5," AEDC-TR-69-104, May 1969.
9. Hahn, J. S., "Force Tests on a 1.05 Elliptic Cone at Mach Nos. from 3 to 6," AEDC-TR-69-97 (AD 501 567L), May 1969.
10. Jenke, L. M., "Wind Tunnel Tests of the FDL-7MD Unmanned Supersonic Test Vehicle (UTSV) at Mach Nos. from 1.5 to 4.0," AEDC-TR-69-101, June 1969.
11. Martindale, W. R., "Aerodynamic Characteristics of the FDL-5B High L/D Configuration at Mach Nos. 1.5 to 10," AEDC-TR-69-107, June 1969.
12. Stetson, K. F. and Friberg, E. G., Capt., "Communication Between Base and Leeward Region of a Cone at Angle of Attack in a Hypersonic Flow," ARL-69-0115 (AD 696 584), July 1969.

1969 (Cont'd)

13. Burt, R. H., "Static Force and Moment Tests of Several Maneuvering Reentry Vehicle Configurations at Mach Nos. 2, 4, & 6," LMSC-B263740, (AD 503 873), August 1969.
14. Murphy, J. S., Copper, J. A., Meehan, D. L., and Rausch, R. B., "MARCAS III Final Report," (U) USAF/SAMSO TR-69-308, MDAC G-1130 (AD 506 241L), August 1969 (Secret).
15. George, O. L., Jr., "An Experimental Investigation of the Flow Field Around an Inclined Sharp Cone in Hypersonic Flow," Sandia Laboratories SC-RR-69-577, September 1969.
16. Koern, T., "ARV Task 10.2.2 Final Report," (U) GE69SD935, September 1969 (Classified).
17. Rau, K. W., "Mass Properties Status of ARV Study Program," (U) GE 69SD992, October 1969 (Classified).
18. Feldhuhn, R. H., "An Experimental Investigation of the Flow Field Around a Yawed Cone," NOLTR 69-187, November 1969.
19. Coble, J. G., "Force Measurements to Determine Elevon Control Effectiveness on the AFFDL-5B High Lift-to-Drag Unmanned Configuration at Mach Numbers from 15 to 19," (U) AEDC-TR-69-147, November 1969 (Confidential).
20. Copper, J. A., "Marcas III Control Effectiveness Wind Tunnel," (U) MDC-G1224, November 1969 (Secret).
21. Saunders, K. V., "Assessing the Attractiveness of Maneuvering Reentry Vehicles," (U) RAND/RM-6196-PR, December 1969 (Classified).
22. Buck, M., "High L/D Design," (U) AFFDL-TR-69-82, 1969 (Confidential).

1970

1. Martindale, W. R., "Nose-Cant Effects on the Aerodynamic Characteristics of an 8-Degree Cone at Mach No. 8," AEDC-TR-69-267 (AD 506 502), January 1970 (Confidential).
2. Wagner, W. E., "Formulation on Statistical Trajectory Estimation Programs," NASA CR-1482, January 1970 (Classified).
3. Stallings, R. L. and Campbell, J. T., "An Approximate Method for Predicting Pressure Distributions on Blunt Bodies at Angle of Attack," AIAA Paper No. 70-208, January 1970.
4. "Advanced Re-entry Vehicle Design and Analysis Report," Control System Design and Analysis Report (S-3), GE Document No. 69SD7061, January 1970 (SRD).
5. Abbey, P. K., "A Maneuvering Reentry Vehicle Review," (U) General Research Corporation IMR-1283, March 1970 (Classified).
6. "Advanced Reentry Vehicles Study Final Report, Vol. 1, Vol. 2, and Appendix," (U) GE70SD481 (AD 399 930), April 1970 (Secret).
7. Ladson, C. L., "Hypersonic Aerodynamic Characteristics of DL-4 Lifting Entry Vehicle," (U) NASA TM X-1994, April 1970 (Confidential).
8. Knox, E. C., and Brahinsky, H. S., "Static-Force Tests on Two High L/D Configurations at Mach Numbers 8 and 10," (U) AEDC-TR-70-91, May 1970 (Confidential).
9. Feldhuhn, R. H., Winkelmann, A. E., and Pasiuk, L., "An Experimental Investigation of the Flow Field Around a Yawed Cone," AIAA Paper No. 70-766, June 1970.
10. Rhudy, J. P., "Flow Field Investigation on the Windward Surface of Highly Swept Blunted Delta Wings at Moderate Angles of Attack," AEDC-TR-70-46, June 1970.
11. Little, H. R., Burt, R. H., and Coble, J., "Force and Static Characteristics of an Asymmetric Glide Reentry Vehicle at Mach Numbers from 6 to 21," AEDC-TR-70-22 (AD 871 198), July 1970.
12. Hobbs, R. B., Jr., "Preliminary Results of Spoiler Tests in the AEDC Tunnel A & B At Mach 2 and 8," GE-ALDM #70-92, July 1970.
13. Kaattari, G. E., "A Method for Predicting Pressures on Elliptic Cones at Supersonic Speeds," NASA-TN D-5952, August 1970.
14. Stokes, T. R., Jr., Timmer, H. G., "Ablation Aerodynamics for Slender Reentry Bodies," Volume II, AFFDL-TR-70-27 (AD 878241), September 1970.

1970 (Cont'd)

15. Buchanan, T. D., "Heat Transfer Test on a McDonnell Douglas Lifting Re-entry Vehicle at Mach 12 with Laminar Transitional and Turbulent Boundary Layers," AEDC-TR-70-242, October 1970 (Confidential).
16. Dahlem, V., Shereda, D. E., and Gord, P. R., "Experimental Investigation at Hypersonic Speed on Increasing Usable Volume of Lifting Bodies," (U) AFFDL-TR-70-86, October 1970 (Confidential).
17. Arrington, J. P., and Ashby, G. C., "Hypersonic Aerodynamic Characteristics Associated with the Evolution of an Entry Configuration with Maximum Lift-Drag Ratio of 3," NASA TM X-2090, November 1970 (Confidential).
18. Steck, H., Harris, T., "Aerodynamic Stability and Control Data Analysis for an MRV Controlled About 2 Axes," (U) GE/ALDM-70-98, December 1970 (Secret-GE Proprietary).
19. Gray, J., Baer, A. L., and Burt, R. H., "An Analysis and Summary of The Static Aerodynamic Characteristics of Three Classes of ABRES Configurations at Mach Numbers from 2 to 12," AEDC-TR-70-283, December 1970 (Secret).
20. Bazzhin, A. P., Trusova, O. N., and Chelysheva, I. F., "The Influence of Real Properties of Air on Flow Parameters Around an Elliptical Cone. The Aerodynamic Characteristics of Elliptical Cones at Large Angles of Attack," FTD-MT-24-0006-72, 1970.

1971

1. Gray, J. D., Baer, A. L., Burt, R. H., "An Analysis and Summary of the Static Aerodynamic Characteristics of Three Classes of ABRES Configurations at Mach Numbers from 2 to 12," (U) AEDC-TR-70-283 (AD 513 171L), January 1971 (Secret).
2. Decker, J. P., "Some Effects of Ablation Surface Roughness on the Aerodynamic Characteristics of a Reentry Vehicle at Mach Nos. from 0.30 to 1.00," NASA/TMSX 2050, February 1971.
3. Widhopf, G. F., "Turbulent Heat Transfer Measurements on a Blunt Cone at Angle of Attack," SAMS0-TR-71-75, February 1971.
4. Eaves, R. H., Jr., "Static Stability and Drag Characteristics of Various SAMS0-Aerospace Advanced Reentry Vehicles (ARV) with Turbulent Boundary Layers at Mach Numbers 12," (U) AEDC-TR-71-17 (AD 514 088L), March 1971 (Secret).
5. Reggiori, A., "Lift and Drag of a Wing-Cone Configuration in Hypersonic Flow," AIAA Journal, Vol. 9, No. 4, p. 744, April 1971.
6. Zakkay, V., Calarese, W., and Sakell, L., "An Experimental Investigation of the Interaction Between a Transverse Sonic Jet and a Hypersonic Stream," AIAA Journal, Vol. 9, No. 4, p. 674, April 1971.
7. Feldhuhn, R. H., Winkelmann, A. E., Pasiuk, L., "An Experimental Investigation of the Flowfield around a Yawed Cone," AIAA Journal, Vol. 9, No. 6, p. 1074, June 1971.
8. DeJarnette, F. R., and Jones, M. H., "Calculation of Inviscid Surface Streamlines and Heat Transfer on Shuttle Type Configurations Part II - Description of Computer Program," North Carolina State University NASA-CR-111922, August 1971.
9. Lindsay, E. E., "Static Aerodynamic Characteristics of Two Classes of ABRES Configurations at Mach Nos. from 2 to 10," (U) AEDC-TR-71-164 (AD 517 034L), September 1971 (Secret).
10. Widhopf, G. F., "Heat-Transfer Correlations for Blunt Cones at Angle of Attack," Journal of Spacecraft and Rockets, Vol. 8, No. 9, p. 1002, September 1971.
11. Ziemer, R. W., "Analysis and Correlation of Reentry Boundary Layer Transition Data," (U) TRW 06488-6519-R3-00 (AD 517 488L), September 1971 (Classified).
12. Klunker, E. B., South, J. C., Jr., and Davis, R. M., "Calculation of Nonlinear Conical Flows by the Method of Lines," NASA TR-R-374, October 1971.
13. "Maneuvering Re-entry Vehicle Trajectories," DDC/ARB-071464, October 1971.

1971 (Cont'd)

14. McDevitt, J. B., "Hypersonic Aerodynamic Characteristics of a Delta Body Space Shuttle Orbiter," NASA TM X-62, 034, May 1971.
15. Platus, D., "Dynamic Instability of Finned Missiles Caused by Unbalanced Fin Forces," AIAA J., March 1971, pp. 378-381.

1. "Technical Proposal - Operational Vehicle Final Report - Small Evader Experiment Study PGM," (U) Pt 2, Vol. 2, Bk 2, LMSC-B270, January 1972 (SRD).
2. Klunker, E. B., South, J. C., Jr., and Davis, R. M., "Computer Program for Calculating Supersonic Flow About Circular Elliptic, and Bielliptic Cones by the Method of Lines," NASA TM X-2437, February 1972.
3. Hube, F. K., "Static Aerodynamic Characteristics of the Advanced Reentry Vehicles (ARV) at Mach Numbers from 2 to 8," (U) AEDC-TR-72-24 (AD 519 393L), February 1972 (Classified).
4. Winchenbach, G. L., "Hyperballistic Range Tests of a High Performance Reentry Configuration (RVTO-3B)," (U) AEDC-TR-72-15, February 1972 (Secret).
5. Knox, E. C., and Siler, L. G., "Static Stability and Drag Characteristics of a SAMSO Aerospace Advanced Reentry Vehicle (ARV) at Mach Numbers 12 and 16," AEDC-TR-72-23 (AD 519 421L), February 1972.
6. Shreeve, R. P., and Oates, G. C., and Ahlstrom, H. G., "Investigation of a Supersonic Surface Jet-Hypersonic Flow Interaction with Axial Symmetry," AIAA Journal, Vol. 10, No. 5, p. 589, May 1972.
7. Alexander, B. T., "UpSTAGE Technology Report: Vehicle Aerodynamics and Thermodynamics", Vol. 1, Sections 1 through 12, (U) MDC-G3229, May 1972.
8. Lindsay, E. E., "Wind Tunnel Tests of a Proposed Reentry Vehicle Concept at Mach Numbers 2, 4, and 8," (U) AEDC-TR-72-83 (AD 521 245L), June 1972. (Secret).
9. Cothran, L. E., "UpSTAGE Technology Report: EB Control System," Vol. 2, Sections 7 through 11, (U) MDC-G3232, July 1972 (Confidential).
10. Dahlem, V., "Summary of Aerodynamic Characteristics of the FDL-6 High L/D Configuration," (U) AFFDL-TR-72-48, July 1972 (Confidential).
11. Walchner, O., Sawyer, F. M., and Yelmgren, K. E., "Aerodynamics of a Slender Cone with Asymmetric Nose Bluntness at Mach 14," AIAA Journal, Vol. 10, No. 8, p. 1121, August 1972.
12. Hopkins, D. F., "UpSTAGE Technological Report: Jet Interaction Control System," Vol. 1, Sections 1 through 5, (U) MDC-G3237, September 1972 (Confidential).
13. Branch, W. H., "UpSTAGE Experiment Final Technical Report," (U) MDC G3263, September 1972 (Confidential).

1972 (Cont'd)

14. Lindsay, E. E., "Force, Pressure, and Heat-Transfer Tests of Several Biconic Configurations at Mach Numbers from 2 to 8," (U) AEDC-TR-72-115 (AD 522 172L), September 1972 (Secret).
15. Widhopf, G. F., "Laminar, Transitional, and Turbulent Heat Transfer Measurements on a Yawed Blunt Conical Nosedip," SAMSO-TR-72-209, September 1972.
16. Widhopf, G. F., Hall, R., "Transitional and Turbulent Heat-Transfer Measurements on a Yawed Blunt Conical Nosedip," AIAA Journal, October 1972.
17. Hoyt, T. L., "Small Evader Vehicle (SEE) Feasibility Study Aerodynamic Final Report," (U) GE-ALDM 72-120, November 1972 (Secret).
18. "SAMSO-MDAC SEV Tunnel B Heat Transfer and Pressure Data," AEDC Report 6036615-2, December 1972.
19. Buchancan, T. D., "Aerodynamic Force Test on the SAMSO/Aerospac MMRV Biconic Configuration at Mach Numbers 10 to 19," (U) AEDC-TR-72-179 (AD 523 4601), December 1972 (Secret).
20. Hube, F. K., "Wind Tunnel Tests of the Multi-Mode Reentry Vehicle (MMRV) at Mach Number 10," (U) AEDC-TR-72-186 (AD 523 577L), December 1972 (Secret).
21. Marcillat, J., Roux, B., "Experimental and Theoretical Study of Supersonic Viscous Flow over a Yawed Circular Cone," AIAA Journal, December 1972.
22. "Small Evader Vehicle Program Final Report," (U) Volume 1 - Summary, Volume IV - Analyses and Studies - Flight Mechanics, Aerodynamics, and Controls (U), SAMSO-TR-72-294 (AD 523 941), December 1972 (Secret).
23. "Final Report SEE II Pre-Design Study Program," (U) Volumes I - IV, GE72SD2198, December 1972 (SRD).
24. ADVANCED CONTROL EXPERIMENT (ACE) - SEE SEPARATE LISTING.

1973

1. Jorgensen, L. H., "Estimation of Aerodynamics for Slender Bodies Alone and with Lifting Surfaces at α 's from 0° to 90° ," NASA Ames Research Center, Moffett Field, California, AIAA Journal, Vol. 11, No. 3, p. 409, March 1973.
2. Watson, G. H., Pond, J. E., and McCormick, P. O., "Geometric and Attitude Effects on Boundary Layer Transition," AFFDL-TR-73-28, March 1973.
3. "RVTO-3B SEE Study Tasks Final Report," (U) Volume I & II, GE73SD2049, March 1973 (Secret).
4. Hube, F. K., "Wind Tunnel Test Results for the Small Evader Vehicle (SEV) at Mach Numbers from 3 to 10," (U) AEDC TR-73-79 (AD 525 226L), April 1973 (Secret).
5. Lemmon, E. C., and Coleman, H. W., "Turbulent Heat Transfer to a Fin Leading Edge - Flight Test Results," Sandia Laboratories, Livermore, California, April 1973.
6. Lindsay, E. E., "Static Force Tests of Nose Segments of a Reentry Type Vehicle at Mach Numbers of 4 and 8," (U) AEDC-TR-73-48, April 1973 (Secret).
7. Harris, C., "Mach 18 Hypersonic Stability Test Program," (U) GE/PIR 9153-002, April 1973.
8. Winchenbach, G. L., "Hyperballistic Range Tests of a High Performance Reentry Configuration (RVTO-3B) Phase II," (U) AEDC-TR-73-51, April 1973 (Secret).
9. "Advanced Terminal Interceptor Technology Program," (U) OR 12,393 Vol. 1 Summary, Vol. 4 Subsystems Trade Studies, April 1973 (SRD).
10. "ABMDA Project ATITP (Advanced Terminal Interceptor Technology Program)," (U) Vol. 1 - 2, MDC G4485, May 1973 (Secret Restricted).
11. Houwink, R. and Richards, B. E., "Experimental Study of a High Lift Re-entry Vehicle Configuration," von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese, Belgium, AIAA Journal, Vol. 11, No. 5, p. 749, May 1973.
12. Tang, M. H., Pearson, G. P. E., "Flight-Measured X-24A Lifting Body Control-Surface Hinge Moments and Correlation with Wind-Tunnel Predictions," NASA TM X-2816. June 1973.
13. Feldhuhn, R., Winkelmann, A., and Pasiuk, L., "An Experimental Investigation of the Hypersonic Aerodynamic Characteristics of Slender Bodies of Revolution at High Angles of Attack," 8th Navy Symposium of Aeroballistics, Vol. 1, July 1973.

1973 (Cont'd)

14. Goldman, R. L. and Obremski, H. J., "Experimental Investigation of Hypersonic Buzz on a Delta Configuration," AIAA Journal, Vol. 11, No. 10, p. 1361, October 1973.
15. DeBorde, D., "MK 500 Ballistics Range Ablation Tests-Nosetip Modeling Phase II," GE/PIR 9153-027, October 1973.
16. Tompkins, J. E., "MK 500 Nosetip Performance Characterization Test Program," GE/PIR 9153-023, October 1973.
17. "SEE Extended Technology Activity Final Report," (U) Volumes I & II GE73SD2184-I, October 1973 (SFRD).
18. Welsh, C. J., "Free Flight Investigation of the Aerodynamic Characteristics of the Small Evader Vehicle," AEDC-TR-73-196 (AD 528 006L), November 1973.
19. Dienemann, M. W., "Small Evader Experiment Design and Development Program," Volumes I and II, GE73SD2197, USAF/SAMSO/TR 74-6 (AD 528 943), (AD 528 944), November 1973 (SRD).
20. "Draft of Final Flight Evaluation Report for the Re-entry Vehicle Technology and Observables Flight Test Program - Phase 3B Vehicle 104," (U) GE73SD2255P, November 1973 (Secret).
21. Sliski, N., "An Analytical and Experimental Investigation of Hypersonic Viscous Interaction Effects," AFFDL-TR-73-58, 1973.
22. Gentry, A. E., Smyth, D. N., and Oliver, W. R., "The Mark IV Supersonic Hypersonic Arbitrary Body Program" (Volumes I, II and III), AFFDL-TR-73-159, 1973.
23. Spencer, B., Jr., "Supersonic Aerodynamic Characteristics of a Variable Geometry Spacecraft Designed for High Hypersonic Performance," NASA TM X-2703, January 1973.

1974

1. Fischer, M. C. and Weinstein, L. M., "Turbulent Compressible Three-Dimensional Mean Flow Profiles," NASA, AIAA Journal, Vol. 12, No. 2, February 1974.
2. Wortman, A., "Foreign Gas Injection at Windwardmost Meridians of Yawed Sharp Cones," Northrop Corporation, California, AIAA Journal, Vol. 12, No. 6, June 1974.
3. Matthews, R. K., "An Experimental Investigation of the Effects of Control Surface Deflection on the Pressure and Heat-Transfer-Rate Distributions on Conical Models at Mach 8," (U) AEDC-TR-74-49, June 1974 (Secret).
4. Lubard, S. C., "Calculation of the Hypersonic Flow on a Sharp 7° Cone at Angle of Attack," RDA-TR-5004-002, July 1974.
5. Zakkay, V., Economos, C., and Alzner, E., "Leeside Flow Field Description over Cones at Large Incidence," AFFDL-TR-74-19, July 1974.
6. Pond, J. E. and Watson, G. H., "An Analytical and Experimental Investigation of Control Surface Heating on Advanced Control Experiment-Like Reentry Vehicle Configurations," (U) AFFDL-TR-74-79 (AD C001 583L), August 1974 (Secret).
7. McElderry, E. D., Jr., "An Experimental Study of Sharp and Blunt 6 Degree Cones at Large Incidence with a Turbulent Boundary Layer at Mach 6," AFFDL-TM-74-170, September 1974.
8. Lindsay, E. E., "Aerodynamic Characteristics of the AFFDL X-24B Configuration at Mach Numbers from 1.5 to 5.0," AEDC-TR-74-87, September 1974.
9. Boudreau, A. H. and Crain, W. K., "Results of the AFFDL Control Surface Heating Test at Mach Number 10.5," (U) AEDC-TR-74-100, October 1974 (Secret).

1975

1. Lubard, S. C. and Rakich, J. V., "Calculation of the Flow on a Blunted Cone at a High Angle of Attack," AIAA Paper 75-149, January 1975.
2. Reinecke, W. G., "Penetration of a Lateral Sonic Gas Jet Into a Hypersonic Stream," AIAA Journal, Vol. 13, No. 2, February 1975.
3. "Maneuvering Reentry Vehicles, NASA Literature Search," NASA/LS-28536, March 1975.
4. Yengst, W. C., "ARPA-Long-Range R&D Program - Systems Study - Final Report," (U) SAI-75-512-LJ (AD C001 219), March 1975 (SRD CNWDI).
5. Strike, W. T., O'Hare, J. E., and Templeton, W. L., "Development of Holographic Interferometric Applications in the VKF Supersonic and Hypersonic Wind Tunnels," AEDC-TR-75-1, April 1975.
6. Miner, E. W., and Lewis, C. H., "Computer User's Guide for a Chemically Reacting Viscous Shock-Layer Program," NASA CR-2551, Virginia Polytechnic Institute and State University, May 1975.
7. Lindsay, E. E., Jordan, J. L., Carter, L. D., "Results of Wind Tunnel Tests of the AFFDL 8H, X-24C-14, and X-24C-16 Models at Mach Numbers from 1.5 to 6.0," AEDC-DR-75-50, Volumes I and II, May 1975.
8. Chaussee, D. S., Holtz, T., Kutler, P., "Inviscid Supersonic/Hypersonic Body Flowfields and Aerodynamics from Shock-Capturing Technique Calculations," AIAA Paper No. 75-837, June 1975.
9. Lindsay, E. E., Jordan, J. L., "Wind Tunnel Test Results of the AFFDL X-24C-16 Model at Mach Numbers from 1.5 to 5.0," AEDC-DR-75-74, July 1975.
10. "Effects of Mass Transfer into Laminar and Turbulent Boundary Layers over Cones at Angle of Attack," AEDC-TR-75-55, August 1975.
11. Agopian, K., Collins, J., Helliwell, W., Lubard, S., and Swan, J., "NASA Viscous 3-D Flowfield Computations," RDA-TR-6100-007, October 1975.
12. "Material Performance Assessment for Maneuvering Reentry Vehicles," (U) Volume IV - Control Surface Ablation Testing Requirements (U), AFML-TR-75-134 (AD C004 949L), November 1975 (Secret).
13. Adams, J. C., Martindale, W. R., Mayne, A. W., Jr., and Marchand, E. O., "Real Gas Scale Effects on Hypersonic Laminar Boundary-Layer Parameters Including Effects of Entropy-Layer Swallowing," AEDC-TR-75-2, December 1975.

1975 (Cont'd)

14. Sliski, N., "Control Surface Heating on Slender Conical Bodies," (U) AFFDL-TR-75-141, 1975 (Secret).
15. ADVANCED MANEUVERING REENTRY VEHICLE (AMaRV) SEE SEPARATE LISTING.

1976

1. Harvey, D. W. and Hopkins, D. F., "Fluid Mechanics of Jet Interaction and External Burning Controls," (U) MDC G6174, January 1976 (Confidential).
2. Pijawka, W., "PGRV System Design Review Report," (U) GE 75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
3. Barrett, J. E., "PGRV System Design Study-Tradeoff, Parametric Studies and Analysis Leading to SDR," USAF/SAMSO-TR-75-271, Vol. 1, Book 1 (AD C006 577L), January 1976 (SRD).
4. Barrett, J. E., Cooper, D. L., Copper, J. A., Greene, R. B., and Murphy, J. S., "PGRV System Design Study - Final Studies and Technical Backup Material," USAF/SAMSO-TR-75-271, Vol. 2 (AD C006 564L), January 1976 (SRD).
5. Brown, R. M., "PGRV System Design Study-Ground Test Plan," Volume 3, USAF/SAMSO-TR-75-271 (AD C006 565L), January 1976 (SRD).
6. McRae, D. S., "A Numerical Study of Supersonic Viscous Cone Flow at High Angle of Attack," AIAA Paper No. 76-97, January 1976.
7. Nomura, S., "Similar Boundary Layer Analysis for Lee-Surface Heating on Yawed Blunted Cone," AIAA Paper No. 76-122, January 1976.
8. "Experimental Determination of MRV Aerodynamics," (U) The Aerospace Corporation EX-76-02866, April 1976 (Secret).
9. Agopian, K. G., "Calculation of the Flow on the Space Shuttle at Mach Number 7.3 and Angle-of-Attack of 30° ," RDA-TR-6100-010, May 1976.
10. Adams, J. C., Jr., "Calculated Hypersonic Viscous Aerodynamics of a Sharp 7-Degree Cone at Incidence," AIAA Paper No. 76-361, July 1976.
11. Adams, J. C., Jr. and Griffith, B. J., "Hypersonic Viscous Static Stability of a Sharp 5-Degree Cone at Incidence," AIAA Journal, Vol. 14, No. 8, August 1976.
12. Nebbeling, C., and Bannink, W. J., "Experimental Investigation of the Supersonic Flow Field about a Slender Cone at High Incidences," Delft-The Netherlands Report LR-233, November 1976.
13. Williams, J. E., Vukelich, S. R., "The USAF Stability and Control Digital DATCOM, Vol. I, Users Manual, Vol. II, Implementation of Datcom Methods," AFFDL-TR-76-45, November 1976.
14. Przirembel, C., "Aerodynamics of Slender Bodies at Angles of Attack - A Critical Review," AFFDL TM-76-92-FXG, 1976.
15. Adams, J. C., Jr., "Numerical Calculation of the Three-Dimensional Hypersonic Viscous Shock Layer on a Sharp Cone at Incidence," Proceedings of the 1976 Heat Transfer and Fluid Mechanics Institute, 1976.

1977

1. "Viscous Shock Layer Solutions for Hypersonic Sphere-Cones," AEDC-TR-77-20, January 1977.
2. Sliski, N. J., "A Description of the AFFDL Version of the Streamline and Heat Transfer Program Developed by DeJarnette," AFFDL-TM-77-9-FXG, January 1977.
3. Mayne, A. W., Jr., "Calculation of the Laminar Viscous Shock Layer on a Blunt Biconic Body at Incidence to Supersonic and Hypersonic Flow," AIAA Paper No. 77-88, January 1977.
4. Daywitt, J., Kutler, P., Anderson, D., "Supersonic Flow About Circular Cones at Large Angles of Attack; A Floating Discontinuity Approach," AIAA Paper No. 77-86, January 1977.
5. Gord, P. R. and Brigalli, A. J., "Experimental Test Results from the First Entry X-24C-10D Force and Moment Tests at Mach Numbers from 0.4 to 5.95," AFFDL-TM-77-26-FXG, February 1977.
6. Adams, J. C., Jr., "Hypersonic Viscous Shock Layer Calculation of Leeward Vortex-Induced Heat Transfer on a Sharp Cone at a High Angle of Attack," Journal of Heat Transfer, Vol. 99, No. 2, May 1977.
7. Fikes, D. H., "Results of Wind Tunnel Tests to Determine the Effects of Representative Bent Nosetips Shapes and Non-Metric Roll Control Jets on the Static Stability and Axial Force Characteristics of a Conical Re-entry Configuration at Mach Number 8," AEDC-DR-77-39, May 1977.
8. Yanta, W. J., Wardlaw, A. B., "Laser Doppler Velocimeter Measurements of Leeward Flowfields on Slender Bodies at Large Angle-of-Attack," AIAA Paper No. 77-660, June 1977.
9. Boylan, D. E., Strike, W. T., and Shope, F. L., "A Direct Comparison of Analytical and Experimental Surface and Flow-Field Data on a 4-Degree Cone at Incidence in a Hypersonic Stream with Laminar Boundary Layers," AIAA Paper No. 77-668, June 1977.
10. Hirsh, R. S. and Cebeci, T., "Calculation of Three-Dimensional Boundary Layers with Negative Cross Flow on Bodies of Revolution," AIAA Paper No. 77-683, June 1977.
11. Srivastava, B. N., Werle, M. J., and Davis, R. T., "Viscous Shock Layer Solutions for Hypersonic Sphere-Cones," AIAA Paper No. 77-693, June 1977.
12. Patterson, J. L., "Investigation of Test Facility Effects on the Three-Dimensional Boundary Layer Interaction," AFFDL-TR-77-113, June 1977.

1977 (Cont'd)

13. Laganelli, A. L. and Howe, J. R., "Prediction of Pressure Fluctuation Associated with Maneuvering Re-entry Weapons," (U) AFFDL-TR-77-59, Volumes I & II, July 1977 (SFRD).
14. Narenda, K., Gupta, K., and Hail, W. E., Jr., "Development of an Advanced System Identification Technique for Maneuvering Reentry Vehicle Aerodynamic Modeling," SAMSO-TR-77-86, August 1977 (Secret).
15. "Annex N Trident C4X-08 Launch," USAF/ETR/OD#801, September 1977.
16. Neumann, R. D., Hayes, J. R., "Prediction Techniques for Three-Dimensional Shock-Wave/Turbulent Boundary-Layer Interactions," AIAA Journal, Vol. 15, No. 10, October 1977.
17. Graves, E. B., "Aerodynamic Characteristics of a Monoplanar Missile Concept with Bodies of Circular and Elliptical Cross Sections," NASA Technical Memorandum 74079, December 1977.
18. Baily, A. B. and Shope, F. L., "Hypersonic Viscous Shock Layer Analysis of Sharp and Spherically Blunted Slender Reentry Vehicle Drag Under Nominal Flow Conditions," (U) AEDC-TR-77-109, 1977 (Secret).
19. Moore, F. G. and Swanson, R. C., Jr., "Aerodynamics of Tactical Weapons to Mach Number 3 and Angle-of-Attack 15° ," NSWC/DL-TR-3584, February 1977.

1978

1. Waskiewicz, J. D., Lewis, C. H., "Hypersonic Viscous Flows Over Sphere-Cones at High Angles of Attack," AIAA Paper No. 79-64, January 1978.
2. Murray, A. L., and Lewis, C. H., "Viscous Shock-Layer Flows Over Bodies During Reentry," AIAA Paper No. 78-259, January 1978.
3. Hopkins, D. F. and Harvey, D. W., "Advanced Interceptor Control and Base Burning Technology Study," (U) Volume I: Interaction Controls, MDC G7341, February 1978 (Confidential).
4. Srivastava, B. N., Werle, M. J., and Davis, R. T., "Viscous Shock-Layer Solutions for Hypersonic Sphere Cones," AIAA Journal, Vol. 16, No. 2, February 1978.
5. Waskiewicz, J. D., Murray, A. L., and Lewis, C. H., "Hypersonic Viscous Shock-Layer Flow over a Highly Cooled Sphere," AIAA Journal, Vol. 16, No. 2, February 1978.
6. Bailey, A. B., and Shope, F. L., "Hypersonic Viscous Shock Layer Analysis of Sharp and Spherically Blunted Slender Reentry Vehicle Drag Under Laminar Flow Conditions," (U) AEDC-TR-77-109, February 1978 (Secret).
7. Griffith, B. J., Adams, J. C., Marchand, E. O., Bailey, A. B., and Edenfield, E. E., "An Experimental and Theoretical Evaluation of the Sandia MIV-II Aerodynamic Characteristics above 80,000 Ft.," (U) AEDC-TR-77-118, March 1978 (Secret).
8. Murray, A. L., and Lewis, C. H., "Heat and Mass-Transfer Effects on Three-Dimensional Viscous Shock-Layer Flows," AIAA Paper No. 78-844, May 1978.
9. Hube, F. K., "Heat-Transfer, Surface-Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach Number 6 - Phase I," AEDC-TSR-78-V24, July 1978.
10. Hube, F. K., "Heat Transfer, Surface Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach 6 - Phase II," AEDC-TSR-78-V25, July 1978.
11. Gogineni, P. R., Murray, A. L., and Lewis, C. H., "Viscous Flows over Slender Spherically Blunted Cones at Large Angles of Attack Including Mass-Transfer and Low Reynold Number Effects," AIAA Paper No. 78-1188, July 1978.
12. Grossman, B., "A Numerical Procedure for the Computation of Supersonic Conical Flows," AIAA Paper No. 78-1213, July 1978.
13. Lee, T. G., "Ballistic Range Test Coordination Program - Final Report, Volume II: Transpiration Cooled Nosedip Evaluation," (U) SAMSO-TR-78-140, September 1978 (Secret).

1978 (Cont'd)

14. Hahn, J. S., "Static Force Tests of Conic and Biconic Bodies at Mach Number 10," AEDC-TSR-78-V40, November 1978.
15. Washington, E. S., "Wind Tunnel Tests of the Hypersonic Technology Integration Demonstrator (HYTID) and the Maneuverable Reentry Research Vehicle (MRRV) Models at Subsonic and Transonic Mach Numbers," AEDC-TSR-78-P43 (AD B032 353), November 1978.
16. Lee, H. M., and Rasmussen, M. L., "Hypersonic Flow Past a Slender Elliptic Cone," University of Oklahoma, Research Report No. OU-AMNE 78-2, November 1978.
17. Fikes, D. H., and Porter, J. H., "Static Force Tests of the HYTID and MRRV Hypersonic Configurations at Mach Numbers 2 through 8," AEDC-TSR-78-V35 (AD B032 564L), November 1978.
18. Rasmussen, M. L., "Lifting Bodies Derived from Supersonic Flows Past Inclined Circular and Elliptic Cones," University of Oklahoma Research Report No. OU-AMNE-78-11, December 1978.

1979

1. Barrett, J. E., "PGRV System Design Study-Tradeoff, Parametric Studies and Analysis Leading to SDR," USAF/SAMSO-TR-75-271, Vol. 1 - Book 1 (AD C006 561L), Vol. 1 - Book 3 (AD C006 539L), Vol. 1 - Book 7 (AD C006 563L), January 1979 (Secret).
2. Gray, W. A., Cramer, C. R., "Gasjet Nose Tip Flight Evaluation," (U) DNA 4722F, January 1979 (Confidential).
3. Rasmussen, M. L., and Lee, H. M., "Approximation for Hypersonic Flow Past a Slender Elliptic Cone," AIAA Paper No. 79-0364, January 1979.
4. Waskiewicz, J. D. and Lewis, C. H., "Hypersonic Viscous Flows over Sphere Cones at High Angles of Attack," AIAA Journal, Vol. 17, No. 2, February 1979.
5. Williams, J. E., Vukelich, S. R., "The USAF Stability and Control Digital DATCOM Volume I, User's Manual, Volume II, Implementation of Datcom Methods, Volume III, Plot Module," AFFDL-TR-79-3032, April 1979.
6. Helliwell, W. S., Dickinson, R. P., Lubard, S. C., "HYTAC Phase I Report: Viscous Flow over Arbitrary Geometries at High Angle of Attack," SAMSO-TR-79-51, April 1979.
7. Walberg, G. D., "Aerothermodynamics for Future Space Systems," AIAA Conference on Advanced Technology for Future Space Systems, NASA Langley, Hampton, Virginia, May 1979.
8. DeJarnette, F. R., "Aerodynamic Heating on Complex Configurations," AIAA Paper No. 79-0891, May 1979.
9. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Survey Tests on a Blunt Biconic Model at Mach Number 10 - Phase V," AEDC-TSR-79-V36, June 1979.
10. Kutler, P., "Computation of the Inviscid Supersonic Flow Over Adjacent Unequally Deflected Wedges," AIAA Paper 79-1512, July 1979.
11. DeJarnette, F. R., Ford, C. P., and Young, D. E., "A New Method for Calculating Surface Pressures on Bodies at an Angle of Attack in Supersonic Flow," AIAA Paper 79-1552, July 1979.
12. Carver, D. B., "Mach Number/Flow Angle Surveys Within the Bow Shock of the X-24C Model at Mach Number 6," AEDC-TSR-79-V47, August 1979.
13. Lindsay, E. E., "Static Force Tests of the Advanced Ballistic Reentry Vehicle (ABRV) Configuration at Mach Numbers 6 and 10," AEDC-TSR-79-V22 (AD B040 842L), August 1979.
14. "Accurate Vehicle Experimental Dynamics Program, Final Report," Cal-span Corporation, Buffalo, New York, SAMSO-TR-79-47, August 1979.

1979 (Cont'd)

15. Florence, D. E., "Selection of Hypersonic L/D to Minimize Thermal Protection System Weight and Meet Cross Range Requirements," General Electric Company, AIAA Paper 79-1627, August 1979.
16. Cassel, L. A., Traci, R. M., McMillen, L. D., "Flowfield Chemistry Effects on Stability of Blunted Slender Cones," AIAA Paper 79-1630, August 1979.
17. Rasmussen, M., "Lifting-Body Configurations Derived from Supersonic Flows Past Inclined Circular and Elliptic Cones," AIAA Paper 79-1665, August 1979.
18. Porter, J. H., Jr., "Static Force Tests of the MRRV Hypersonic Configuration at Mach Numbers 2-5," AEDC-TSR-79-V-43 (AD 8040 451L), August 1979.
19. Ikawa, H., "Real Gas Laminar Boundary-Layer Separation Prediction Methodology," AIAA Journal, Vol. 17, No. 11, November 1979.
20. Fivel, H. J., "Numerical Flow Field Program for Aerodynamic Heating Analysis," Volume 1, AFFDL-TR-79-3128, December 1979.

1980

1. Rosen, R., Pavish, D. L., and Anderson, W. A., "Correlation Technique for Predicting Attached Turbulent Boundary-Layer/Flap Interaction Pressures," AIAA Journal, Vol. 18, No. 1, January 1980.
2. Wang, C. R., Zakkay, V., and Parikh, H., "An Experimental and Analytical Investigation of a Hypersonic Cruising Vehicle at Mach 6," AIAA Paper 80-0004, January 1980.
3. Gogineni, P. R. and Lewis, C. H., "Three-Dimensional Viscous Hypersonic Flows Over General Bodies," AIAA Paper 80-0029, January 1980.
4. Kutler, P., Pedelty, J. A., Pulliam, T. H., "Supersonic Flow Over Three-Dimensional Ablated Nostips Using an Unsteady Implicit Numerical Procedure," AIAA Paper 80-0063, January 1980.
5. Hellwell, W. S., Dickinson, R. P., and Lubard, S. C., "Viscous Flow Over Arbitrary Geometries at High Angle of Attack," AIAA Paper 80-0064, January 1980.
6. Welsh, C. J., Lawrence, W. R., and Watt, R. M., "Real Gas Effects on the Aerodynamics of Blunt Cones as Measured in a Hypervelocity Range," AIAA Paper 80-0373, January 1980.
7. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Surveys on Conic and Biconic Models with Boundary Layer Trips at Mach Number 8 - Phases IV & VI," AEDC-TSR-80-V14, March 1980.
8. Johnston, K. L., "Mach Number/Flow Angle Surveys Within the Bow Shock of the X-24C Model at Mach Number 6, Part II," AEDC-TSR-80-V22 (AD B048 343L), April 1980.
9. Spampinato, J., "Nose Control Study Program," (U) Final Report, GE-80SDR2051, May 1980 (SFRD).
10. Cassel, L. A., Jarrett, T. W., "Hypersonic Flow Over Small Span Flaps in a Thick Turbulent Boundary Layer," AIAA Paper 80-1475, July 1980.
11. Szema, K. Y. and Lewis, C. H., "Three-Dimensional Hypersonic Laminar, Transitional and/or Turbulent Shock-Layer Flows," AIAA Paper 80-1457, July 1980.
12. Hellwell, W. S., et al., "HYTAC Phase II Report: Turbulent Flow Over Arbitrary Geometries at High Angle of Attack," AR-80-193-TR, July 1980.
13. Cassel, L. A., McMillen, L. D., and Taylor, S., "Finite Span Effects on Flap Heating and Effectiveness in a Turbulent Boundary Layer," AFWAL-TR-80-3090, August 1980.

1980 (Cont'd)

14. Varner, M. O., "A Compilation and Analysis of Hypersonic Turbulent Flow-Field Data for Sharp and Blunt Conic and Biconic Bodies at Zero Angle of Attack," AEDC-TR-80-14, August 1980.
15. Bursey, C., Johnson, D., Nash, R., "Lifting Entry Vehicle Performance Analysis Methods, AIAA Paper 80-1665, August 1980.
16. Usselton, B. L. and Cyran, F. B., "Sting Interference Effects as Determined by Measurements of Dynamic Stability Derivatives, Surface Pressure, and Base Pressure for Mach Numbers 2 through 8," AEDC-TR-79-89, October 1980.
17. Lundy, T. C., "Aeromechanics Lifting Reentry Technology Analysis Methods," Lockheed Missile and Space Corp., November 1980.
18. Stalling, D., "Wind Tunnel Investigation of the Heating on a Sandia RV Configuration at Mach Number 8," AEDC-TSR-80-V54, November 1980.
19. Devan, L., "Aerodynamics of Tactical Weapons to Mach Number 8 and Angle of Attack 180°, Part 1, Theory and Application," NSWC-TR-80-346-PT-1 (AD A099795), October 1980.
20. "SWERVE" Data Package II," Secret Document, Sandia Corp., Report RS5623/80/68, June 1980.

1981

1. Chaussee, D. S., et al., "A Numerical Simulation of Hypersonic Viscous Flows over Arbitrary Geometries at High Angle of Attack," AIAA-81-0050, January 1981.
2. Lin, T. C., "A Two-Layer Model for Coupled Three Dimensional Viscous and Inviscid Flow Calculations," AIAA-81-0118, January 1981.
3. Li, C. P., "Application of an Implicit Technique to the Shock-Layer Flow Around General Bodies," AIAA-81-0191, January 1981.
4. Lin, A. and Rubin, S. G., "Three-Dimensional Supersonic Viscous Flow Over a Cone at Incidence," AIAA-81-0192, January 1981.
5. Mason, L., Devan, L., Moore, F. G., and McMillan, D., "Aerodynamic Design Manual for Tactical Weapons," NSWC TR-81-156 (AD A109180), July 1981.
6. Lindsay, E. E., "Static Force Test of the SWERVE III Configuration at Mach Numbers 3 and 8," AEDC-TSR-81-V34 (AD B061201), September 1981.
7. Devan, L. and Mason, L. A., "Aerodynamics of Tactical Weapons to Mach Number 8 and Angle of Attack 180° , Part II, Computer Program and User's Guide," NSWC TR-81-358 (AD B061071L). September 1981.

SECTION 3
CHRONOLOGICAL BIBLIOGRAPHY
PER MAJOR SYSTEM PROGRAM

- MBRV
- ACE
- AMARV
- MK500
- BGRV
- ASSET
- SWERVE

MBRV

MANEUVERING BALLISTIC REENTRY VEHICLE

1. Arnold, J. W., "Static Stability and Control Effectiveness Tests on a Maneuverable Reentry Vehicle in the Mach Number Range of 0.8 to 4.8," HSWT Test 86, December 1962.
2. Burk, J. L. and Merz, G. H., "Static Stability Tests of a Maneuverable Re-entry Vehicle at Mach 8 and 10," (U) AEDC-TDR-63-184, September 1963 (Classified).
3. Burk, J. L., and Merz, G. H., "Pressure Distribution on a Maneuverable Re-entry Vehicle at Mach 8 and 10," (U) AEDC-TDR-63-208 (AD 342 869), September 1963 (Confidential).
4. Cox, D. P., "Results of Wind Tunnel Program for Studying Nose Bluntness and Flap Geometry Effects on Aerodynamic Stability and Control Parameters of a MBRV Configuration," (U) GE ATDM (R1) 1:26, November 1963 (Classified).
5. "Program Plan for Maneuvering Ballistic Re-entry Vehicle Study," (U) Revision No. 1, GE64SD478, January 1964 (Classified).
6. Larmour, R., "In Plane Maneuvering Capability of MBRV," (U) GE FDDM 2:4, February 1964 (Classified).
7. Saydah, A. R., "Hypersonic Heat Transfer on a Maneuvering Ballistic Re-entry Vehicle," (U) GE64SD526, February 1964 (Classified).
8. Burk, J. L., and Merz, G. H., "Nose Bluntness Effects and Roll Control on a Maneuverable Re-entry Vehicle at Mach 2, 6, and 10," (U) AEDC-TDR-64-9 (AD 347 008), February 1964 (Confidential).
9. Hobbs, R. B., "An Experimental Investigation of the Static Stability and Control Effectiveness for the MBRV Ablated Shape at $M = 10$," (U) GE ATDM 1:34, March 1964 (Classified).
10. Roberts, J. F., "Static Stability Test of a Maneuvering Ballistics Re-entry Vehicle at Mach 19," (U) AEDC-TDR-64-52 (AD 348 051), March 1964 (Confidential).
11. Kahn, S. F., "MBRV Aerodynamics Stage 2 Release," (U) GE ATDM 1:35, April 1964 (Classified).
12. Roberts, J. F., Boudreau, A. H., "The Effects of Control Flaps on Stability Characteristics of a Maneuverable Re-entry Vehicle at Mach 19," (U) AEDC-TDR-64-90 (AD 349 661), May 1964 (Confidential).
13. Hobbs, R. B., "Wind Tunnel Results for the Dynamic Stability Characteristics of MBRV Configurations at $M = 10$," (U) GE ATDM 1:39, June 1964 (Classified).

MBRV (Cont'd)

14. Kahn, S. F., "MBRV Aerodynamics Stage III Release, Volume I - Basic Axial Force, Normal Force and Pitching Moment Characteristics," (U) GE ATMD 1:42, Volume II - "Side Force Characteristics and Yawing Moment Characteristics," (U), Volume III - "Rolling Moment Characteristics," (U), Volume IV - "Toed Aerodynamic Characteristics Flap Hinge Moments, Panel Loads and Pressure Distributions," (U), July 1964 (Classified).
15. Hodapp, A. E., Jr., and Burt, G. E., "Dynamic Stability Tests of a Maneuvering Ballistic Re-entry Vehicle at Mach 10," (U) AEDC-TDR-64-136 (AD 351 593), July 1964 (Confidential).
16. Burk, J. L., and Merz, G. H., "An Investigation of the Static Stability Characteristics of an Ablated Maneuverable Re-entry Vehicle at Mach 10," (U) AEDC-TDR-64-141 (AD 351 580), July 1964 (Classified).
17. Decker, R. E., "Results of Supersonic Wind Tunnel Program for Obtaining Force and Moment Data and Flap Hinge Moments on the MBRV Configuration, Volumes I, II," (U) GE ATDM 1:44, August 1964 (Classified).
18. Hobbs, R. B., "Experimental Evaluation of Mass Addition Effects on the Static Stability and Control Effectiveness of the MBRV Configuration at $M = 10$," (U) GE ATDM 1:46, September 1964 (Classified).
19. Browne, P. D., "Results of a Wind Tunnel Program in AEDC's Tunnel C for Obtaining Pressure Distributions on the MBRV Configuration," (U) GE ATDM (R2) 1:52, September 1964 (Classified).
20. Cox, D. P., "Results of a Wind Tunnel Program in AEDC's Tunnel C to Evaluate the Effect of Control Surface Gap Size on the MBRV Configuration's Stability and Control Characteristics," (U) GE ATDM (R2) 1:53, September 1964 (Classified).
21. Cox, D. P., Browne, P. D., "Results of Hypersonic Study at $M=8$ to Determine the Influence of a Control Surface on 3-Dimensional Flow Separation," (U) GE ATDM 1:51, September 1964 (Classified).
22. Roberts, J. F., Boudreau, A. H., and Wasson, R. A., Jr., "Pressure Distributions at Mach 19 on a Maneuverable Re-entry Vehicle," (U) AEDC-TDR-64-188 (AD 353 324), September 1964 (Confidential).
23. Cox, D. P., "Results of Hypersonic Wind Tunnel Program in AEDC's Tunnel F for Obtaining Stability and Control Data on the MBRV Configuration," (U) GE ATDM (R2) 1:48, September 1964 (Classified).
24. Cox, D. P., "Results of a Wind Tunnel Program in AEDC's Tunnel C for Obtaining Stability and Control Characteristics and Control Hinge Moment Data on the MBRV Configuration, Volumes I and II," (U) GE ATDM 1:49, September 1964 (Classified).

MBRV (Cont'd)

25. Decker, R. E., "Results of a Supersonic Wind Tunnel Program for Obtaining Pressure Distribution on the MBRV Configuration," (U) GE ATDM (R2) 1:47, September 1964 (Classified).
26. Cox, D. B., "Results of a Wind Tunnel Program in AEDC's Tunnel F for Obtaining Pressure Distributions on the MBRV Configuration," GE ATDM 1:50, September 1964.
27. Herrick, R. R., "Maneuvering Ballistic Re-entry Vehicle Study, Final Report," (U) GE64SD759, September 1964 (Classified).
28. Burk, J. L., Carmen, J. B., "Effects of Mass Addition on the Static Stability Characteristics of a Maneuverable Re-entry Vehicle at Mach 10," (U) AEDC-TDR-64-205 (AD 354 562), October 1964 (Confidential).
29. Schmidt, L. E., "Flight Dynamics of an MBRV Decoy," (U) GE ATDM 1:16, October 1964 (Classified).
30. Cox, D. P., "Results of a Wind Tunnel Program in Ling Temco Vought's High Speed Wind Tunnel to Obtain Stability and Control Data on the MBRV-FTV Configuration," (U) GE ATDM 1:56, October 1964 (Classified).
31. Burk, J. L., Morris, S. D., Merz, G. H., "Aerothermodynamic Characteristics of a Maneuverable Re-entry Vehicle at Supersonic and Hypersonic Mach Numbers," (U) AEDC-TDR-64-223 (AD 354 883), November 1964 (Confidential).
32. Welsch, R., "Maneuvering Ballistic Re-entry Vehicle, Feasibility Flight Test Program, Program Plan," (U) GE64SD5175, December 1964 (Classified).
33. Cox, D. P., "Results of the Roll Control Geometry Force Test at $M = 10$ on the MBRV-FTV Configuration," (U) GE ATDM (R3) 1:65, December 1964 (Classified).
34. Burk, J. L. and Carman, J. B., "An Investigation of the Static Stability & Roll Control Characteristics of a Maneuverable Re-entry Flight Test Vehicle at Mach 2, 6, and 10," AEDC-TDR-64-274 (AD 355 873), December 1964 (Secret).
35. Roberts, J. F., and Boudreau, A. H., "An Investigation of Static Stability and Roll Control Characteristics of a Maneuverable Flight Test Re-entry Vehicle at Mach 19," (U) AEDC-TDR-65-3 (AD 356 599), January 1965 (Secret).
36. Steck, H. J., "MBRV Operational Vehicle Tradeoffs," (U) GE ATDM 1:77, February 1965 (Classified).

MBRV (Cont'd)

37. Browne, P. D., "Results of Final Verification Wind Tunnel Program at M = 10 on the MBRV - FTV Configuration, Volumes I & II," (U) GE ATDM (R3) 1:78, February 1965 (Classified).
38. Cox, D. P., and Browne, P. D., "Results of Lateral Stability and Control Wind Tunnel Program at M = 19 on the MBRV - FTV Configuration," (U) GE ATDM (R3) 1:81, February 1965 (Classified).
39. Kahn, S. F., "Maneuvering Ballistic Re-entry Vehicle-Flight Test Vehicle (MBRV-FTV)-Aerodynamics Stage 4 Release," (U) GE ATDM 1:83, March 1965 (Classified).
40. Burk, J. L., and Burdette, J. E., "Evaluation of the Static Stability and Control Characteristics of a 9-degree Cone Using Fluid Injection as a Control Device," (U) AEDC-TR-65-106 (AD 360 760), May 1965 (Confidential).
41. Yeager, D. R., "A Mach 10 Wind Tunnel Test Program for Evaluating the Drag and Static Stability Characteristics of a 9° Cone Employing Fluid Injection as a Control in Support of MBRV," (U) GE ATDM 1:88, June 1965 (Classified).
42. Browne, P. D., "Results of Wind Tunnel Program at M = 10 for Obtaining Pressure Distributions on the MBRV-FTV Final Control Surface Configuration," (U), GE ATDM (R3) 1:98, June 1965 (Classified).
43. Kahn, S. F., "Supplementary Information for the Maneuvering Ballistic Re-entry Vehicle (MBRV-FTV) - Aerodynamics Stage 4 Release," (U) GE ATDM 1:83A, July 1965 (Classified).
44. Dickstein, D., "Maneuvering Ballistic Re-entry Vehicle Extended Analysis Plan," (U) GE65SD892, November 1965 (Classified).
45. Kahn, S. F., "Third Addendum to the MBRV Aerodynamics Stage 4 Release," (U) GE ATDM 1:83C, November 1965 (Classified).
46. Steck, H. J., "Addendum to ATDM 1:77 - Aerodynamic Characteristics of Operational MBRV Configuration at High Angles of Attack," (U) GE ATDM 1:77A, November 1965 (Classified).
47. "Maneuvering Ballistic Re-entry Vehicle; Actual Mass Properties Report Vehicle Flight No. 1, Re-entry Vehicle and Spacer Serial No. 600," (U) GE65SD7084, December 1965 (Classified).
48. Steck, H. J., "Fourth Addendum to MBRV Stage 4 Release - Revised Flap Hinge Moment and Panel Load Characteristics," (U) GE ATDM 1-83D, April 1966 (Classified).

MBRV (Cont'd)

49. Austein, E., "MBRV Flight Performance," GE65SD5263-1, July 1966 (Classified).
50. "Flight Evaluation Report for MBRV No. 5778600," GE66SD5258, September 1966 (Classified).
51. Dixon, M., "Flight Evaluation Report for MBRV No. 5778600," GE66SD5258-A, December 1966 (Classified).
52. Clark, J., "MBRV 601 Data Analysis," (U) GE ATDM 67-29, June 1967 (Classified).
53. Grasier, R. W., "RV/601 - Flight Dynamics Post Flight Analysis," (U) GE-DIN-8153-1972, June 1967 (Secret).
54. Steck, H. J., "Aerodynamic Input to the MBRV Phase "B" Study," (U) GE ATDM 67-45, September 1967 (Classified).
55. "Final Flight Evaluation Report for MBRV No. 5778602 (30 Day FER for MBRV Flight No. 3)," (U) GE67SD5243, October 1967 (Classified).
56. Steck, H. J., "Aerodynamics Input to the 30 Day FER MBRV 602," (U) GE ATDM 68-54, December 1967 (Classified).
57. Case, C. T., "R/V 603 Evaluation Report," (U) GE67SD5254, December 1967 (Secret).
58. Case, C. T., "MBRV Flight Test Summary Report," (U) GE68SD5200, January 1968 (Secret).
59. Steck, H. J., "Aerodynamic Input to the MBRV 603 30 Day Report," (U) GE ATDM 68-56, January 1968 (Classified).
60. Welsch, R. F., "MBRV Feasibility Flight Test Program, Final Report, Volumes I - IV," (U) USAF/SAMSO TR-68-60 (AD 387 247), February 1968 (Classified).
61. Augustine, F. E. and Huber, V. L., "Maneuvering Ballistic Reentry Vehicle (MBRV) 602 Postflight Trajectory Reconstruction," (U) Aerospace Report TOR-0158(S3935-12)-2, June 1968 (Secret).
62. Yungman, A., "Maneuvering Ballistic Reentry Vehicle CCN23 Final Evaluation Report," (U) GE68SD800, June 1968 (Classified).
63. "MBRV Quick Look Data Requirements," GE66SD5243, July 1968.
64. Kent, R., "Results of a Wind Tunnel Test Program to Obtain Stability and Control Data on an MRV Configuration," (U) GE-ALDM-69-74, January 1969 (Secret).
65. Yungman, A. J., "A Review of the MBRV Program," (U) GE-DIN-V055-15-1, June 1980 (Classified).

ACE
ADVANCED CONTROL EXPERIMENT

1. Hube, F. K., "Wind Tunnel Tests of the Preliminary Advanced Control Experiment (ACE) Vehicle at Mach Numbers from 2 to 8," (U) AEDC-TR-72-99 (AD 521 335L), July 1972 (Secret).
2. Hube, F. K., "Tests of the Final Advanced Control Experiment (ACE) Configuration at Mach Numbers from 2 to 8," (U) AEDC-TR-72-117 (AD 522 112L), September 1972 (Secret).
3. Siler, L. G., "Static Stability and Drag Characteristics of a SAMSO-McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Numbers 12, 15, and 16," (U) AEDC-TR-72-130 (AD 522 370L), September 1972 (Secret).
4. Buchanan, T. D., and Hube, F. K., "Heat Transfer and Pressure Tests on the SAMSO-McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Numbers 8, 11, and 14.5," (U) AEDC-TR-72-138 (AD 522 553L), October 1972 (Secret).
5. Boylan, D. E., and Haberman, D. R., "Additional Heat-Transfer and Pressure Tests on the SAMSO/McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Numbers near 7.5, 11 and 14," (U) AEDC-TR-73-50 (AD 524 946L), April 1973 (Secret).
6. Siler, L. G., "Static Stability and Drag Characteristics of Final SAMSO/McDonnell Douglas Advanced Control Experiment (ACE) Vehicle Configuration at Mach Numbers 16 and 19," (U) AEDC-TR-73-63 (AD 525 047L), April 1973 (Secret).
7. "SAMSO-MDAC ACE II," (U) AEDC Data Package, April 1973 (Secret).
8. "Wind Tunnel Measurements of Aeroheating and Pressure for a 30% Model of the ACE Vehicle at Mach Numbers of 8, 11, and 14," (U), Volume I, Parts 1-4, and Volume II, Parts 1-5, MDC-G4889, September 1973 (Secret).
9. Buchanan, T. D., "Aerodynamic Force Test on the SAMSO/MDAC ACE Biconic Configuration at Mach Number 16," (U) AEDC-TR-73-146 (AD 526 962L), September 1973 (Secret).
10. Haberman, D. R., "Pressure and Heat-Transfer-Rate Best Results on the SAMSO/McDonnell Douglas Biconic Advanced Control Experiment (ACE) Vehicle at Mach Numbers 8, 12, and 14," (U) AEDC-DR-74-6, January 1974 (Secret).
11. Hube, F. K., "Static-Stability Characteristics of the Advanced Control Experiment (ACE) Biconic Vehicle at Mach Numbers from 3 to 10," (U) AEDC-TR-74-25 (AD 529 481L), April 1974 (Secret).
12. "Pressure and Heat Transfer Tests on the SAMSO/McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Number 12," (U) AEDC-DR-74-50, June 1974 (Secret).

ACE (Cont'd)

13. "Static-Stability Characteristics of the Advanced Control Experiment (ACE) Biconic-Phase II Vehicle at Mach Number from 3 to 10," AEDC-DR-74-51, June 1974 (Secret).
14. Matthews, R. K., "An Experimental Investigation of the Effects of Control Surface Deflection on the Pressure and Heat-Transfer Rate Distributions on Conical Models at Mach 8," (U) AEDC-TR-74-49 (AC 530 142L), June 1974 (Secret).
15. Pond, J. E., and Watson, G. H., "An Analytical and Experimental Investigation of Control Surface Heating on Advanced Control Experiment-Like Reentry Vehicle Configurations," (U) AFFDL-TR-74-79 (AD C001 583L), August 1974 (Secret).
16. "Lateral Static Stability Tests of the Advanced Control Experiment (ACE) Vehicle at High Angle of Attack and Mach Numbers 16 and 19," (U) ARO Project No. V41F-18A, August 1974 (Secret).
17. "Lateral Static Stability Tests of the Advanced Control Experiment (ACE) Vehicle at High Angle of Attack and Mach Numbers 15 and 20," (U) ARO Project V41F-18A, September 1974 (Secret).
18. "Examination of Viscous Effects in ACE High-Angle-of-Attack Directional-Stability Wind Tunnel Data," MDC-G5531, October 1974 (Secret).
19. Holtz, T., Rosen, R., Saperstein, J. L., "ACE Reentry Vehicle High Mach Number Flap Effectiveness Wind Tunnel Test," MDC-G5532, October 1974 (Secret).
20. Boudreau, A. H. and Crain, W. K., "Results of the AFFDL Control Surface Heating Test at Mach Number 10.5," (U) AEDC-TR-74-100 (AD 531 718L), October 1974 (Secret).
21. "Project ACE Findings and Progress Report December 1974," USAF/SC, December 1974 (Secret).
22. Magill, D. V., "ACE Program Final Report," (U) Vol. 1, "Summary" (AD C000 748L), Vol. 2, "Program Description" (AD C000 749L), Vol. 3, "Design Analysis and Flight Test Results" (AD C000 750L), USAF/SAMSO-TR-75-23, January 1975 (Secret).
23. "ACE Biconic Configuration Refinement Aerodynamic Testing in the ARL 20 Inch Hypersonic Wind Tunnel," MDC-G5731, January 1975 (Secret).
24. Magill, D. V., "ACE Biconic Configuration Refinement Aerodynamics Testing at Low Hypersonic Mach Numbers," (U) MDC-G4997, January 1975 (Secret).
25. "ACE Biconic Aerodynamics and Requirements Study, Final Report," Volumes I, II, and III, (U) MDC-G5725 (AD C018 054), January 1975 (Secret).

ACE (Cont'd)

26. "Biconic Reentry Vehicle Flap Effectiveness Tests at Mach Numbers of 8, 12, and 14," (U) MDC-G5726, January 1975 (Secret).
27. "Wind Tunnel Tests of the ACE II Model in AEDC-VKF Tunnel F (VA-283-27FA)," (U) MDC-G5727, January 1975 (Secret).
28. Buchanan, T. D., and Crain, W. K., "Mach Number and Viscous Effects on the Static Stability of the Advanced Control Experiment (ACE) Vehicle at Mach Numbers 16 and 19," (U) AEDC-TR-75-23 (AD C001 334L), March 1975 (Secret).
29. Baker, S. S., "Static Stability Characteristics of the Advanced Control Experiment (ACE) Biconic Vehicle at Mach Numbers 5 and 8," AEDC-DR-75-27, March 1975 (Secret).
30. Coats, J. D. and Haberman, D. R., "Static Stability Tests of the ACE Biconic Reentry Configuration at Nominal Mach Numbers of 8 and 12," (U) AEDC-TR-75-81 (AD C002 395L), June 1975 (Secret).
31. Lawrence, W. L., "Free-Flight Range Tests of an ACE Biconic Configuration at Mach Numbers of 11.9 to 14.3," (U) AEDC-TR-75-101 (AD C002 818L), August 1975 (Secret).
32. Griffith, B. J., Eaves, R. H., and Majors, B. M., "An Analysis of Viscous Effects on the AEDC Wind Tunnel Data of the ACE FTV Flight Configuration," (U) AEDC-TR-75-79 (AD C002 862L), August 1975 (Secret).
33. Holmes, J. E. and Knott, J., "Static Stability Tests of the ACE Biconic Configuration at Mach 18," (U) November 1975 (Secret).
34. Hill, J. A. F., Pronchick, S. W., and Holmes, J. E., "Hypervelocity Tunnel Tests of the ACE Configuration at Mach 14," (U) NSWC-Wind-Tunnel Report No. 115, November 1976 (Secret).
35. Shaw, W. J., "Aerodynamics Data Package, CDR Baseline Configuration," McDonnell Douglas, Aerospace Corporation, EX-78-01461, March 1978 (Secret).

AMaRV
ADVANCED MANEUVERING REENTRY VEHICLE

1. "Wind Tunnel Measurements of Aeroheating and Pressure for a 52% Model of the AMaRV Vehicle at Mach Numbers of 9 and 13," MDC-G7608, May 1975 (Secret).
2. Harris, C. J., George, F. C., and Harris, T. B., "Static Stability and Pressure Tests Results on a GE-SWF Biconic Configuration," GE-9154-TDM-76-005, May 1976 (GE-Proprietary).
3. Keel, A. G., Jr. and Knott, J., "Static Stability Testing and Pressure Testing of AMaRV Configurations in the White Oak Mach 18 Hypervelocity Research Tunnel: Part 1. Force Tests," (U) NSWC-Wind-Tunnel Report No. 113, May 1976 (Secret, GE Proprietary).
4. "Test Plan for AMaRV Parametric and Configuration Refinement Wind Tunnel Test Series," Aerospace EX-76-08760, November 1976 (Secret).
5. Smith, P. "AMaRV Data Package," Aerospace 76-05232, November 1976 (Secret).
6. Cox, W. S and Shaw, W. J., "Aerodynamic Data Package Design Specification-AMaRV," (U) LMSC-L512723 Rev. A., December 1976 (Secret).
7. "Advanced Maneuvering Reentry Vehicle (AMaRV) OPV Baseline Report," (U) MDC-G6608, December 1976 (Secret).
8. "Parametric Tests of the AMaRV Configuration at Mach 18 in NSWC/WOL Tunnel 8a," NSWC WTR 1291, February 1977 (Secret).
9. "SAMSO/MDAC AMaRV Force Tests," 3 Books, AEDC Test Data, March 1977 (Secret).
10. Baker, S. S., "Static-Stability Characteristic of the AMaRV Prototype at Mach Number 8," (U) AEDC-DR-77-30, April 1977 (Secret).
11. Stallings, D. W., "SAMSO/MDAC AMaRV IR Heat Transfer," (U) AEDC-Document Control No. IG-17781, March 1977 (Secret).
12. Haberman, D., "Pressure Test Results on the Advanced Maneuvering Reentry Vehicle (AMaRV) at Mach 13," AEDC-DR-77-33, May 1977 (Secret).
13. Pronchick, S. W., Hill, J. A. F., Holmes, J. E., "Parametric Tests of the AMaRV At $M_{\infty} = 14$ in the NSWC/WOL Hypervelocity Tunnel 9," NSWC WTR 1290, May 1977 (Secret).
14. Shaw, W. J., Jr., "AMaRV Aerodynamics Analyses," (U) MDC-G 7017, May 1977 (Secret).
15. "AMaRV Aerodynamics Testing Report, Parametric Test Phase," MDC-G7035, June 1977 (Secret).

AMaRV (Cont'd)

16. "AMaRV-Preliminary Design Review," (U) (Pres) LMSC-L512728, June 1977 (Secret).
17. "Post Test Report-AEDC/VKF Tunnel B, AMaRV Thermodynamic Survey Wind Tunnel Tests 181 and Piggyback," AMaRV CDRL A033, MDC-DCN W00975, July 1977 (Secret).
18. Baker, S. S., and Jordan, J., "SAMSO/MDAC AMaRV Documentation Tests - Groups 1-124, Groups 133-181, Groups 182-224, Groups 225-271, Groups 274-332, Groups 341-401, Groups 402-437, Groups 438-532, Groups 533-572," 9 Books, AEDC Data Package and "Rerun of Groups 26, 28, 106, 107, and 108," August 1977 (Secret).
19. Wagner, J. T., "MARV/Interceptor Data Package," Aerospace 77-04159, September 1977 (Secret).
20. Baker, S. S., "Documentation Test Results for the AMaRV Prototype At Mach Numbers 3.5, 5.0, 8.0," (U) AEDC-DR-77-96, October 1977 (Secret).
21. "Review of MARV Programs," LMSC-L032165, December 1977 (SRD).
22. "AMaRV Reentry Vehicle Preflight and Postflight Analysis Preflight Predictions Report," MDAC G7285, December 1977 (Secret).
23. Sporing, R. W., "AMaRV Control Analysis - Vol. 1, book 2," MDC G-7017, December 1977 (Secret).
24. Shaw, W. J. and Rausch, R. B., "AMaRV Aerodynamic Analysis, Book I," MDC G-7017, December 1977 (Secret).
25. Berger, M. D., and Bradfield, C. R., "AMaRV Aerothermodynamics Analysis," MDC G-7020, December 1977 (Secret).
26. Copper, J. A., "AMaRV Aerothermodynamics Analysis, Interim Report," (U) MDC G-7020 (AD C018 053L), December 1977 (Secret).
27. Copper, J. A., "AMaRV Requirements Analyses," (U) MDC G-7011A, December 1977 (Secret).
28. Siler, L. G., "SAMSO/MDAC AMaRV Force [Final Force Data Runs 5844-5889, 5891-5895]," (U) AEDC Data Package, December 1977 (Secret).
29. "AMaRV Critical Design Review - Part 1," (U) MDAC, LMSC-L512753, Vol. 1, January 1978 (SRD).
30. Greene, R. B., "Advanced Maneuvering Reentry Vehicle (AMaRV) Flight Plan Approval Package," MDC-G7404, January 1978 (Secret).
31. Siler, L. G., "Test Results on the AMaRV at Mach 12.8," (U) AEDC-DR-78-8, February 1978 (Secret).

AMaRV (Cont'd)

32. "AMaRV Aerodynamics Testing Report," Documentation Test Phase, MDC-G7424 (DCN X00181), February 1978 (Secret).
33. Pronchick, S. W., and Hill, J. A., "Documentation Tests of the AMaRV at $M_\infty = 14$ in the NSWC/WOL Hypervelocity Tunnel 9," NSWC/WOL MP 78-7, February 1978 (Secret).
34. Haberman, D. R., "SAMSO/MDAC AMaRV Heat Test," (U) AEDC-Document Control No. IG-18059, March 1978 (Classified).
35. Griffith, B. J., "AMaRV Control Effectiveness and Drag Update," March 1978 (Secret).
36. Shaw, W. J., "AMaRV Aerodynamic Analyses - Book II," Final Report, MDC-G7017 (AD C018 058L), May 1978 (Secret).
37. Bailey, A. B., and Griffith, B. J., "A Summary of the AMaRV Pitch Plane Wind Tunnel Data and Comparison with Theory with Limited Flight Analysis," (U) AEDC-TMR-78-G3, May 1978 (Secret).
38. Haberman, D. R., "Heat Transfer and Pressure Test Results on the AMaRV Configuration at Mach 9 and 13," (U) AEDC-TSR-78-V1, May 1978 (AD C014 271L) (Secret).
39. Tolliver, R. J., Berger, M. D., and Bradfield, C. R., "AMaRV Aerothermodynamics Analysis Final Technical Report," (U) MDC-G7645 (AD C018 060L), July 1978 (Secret).
40. Griffith, B. J., Bailey, A. B. and Stansbury, K. R., "An Analysis of the AMaRV Control Surface Characteristics in Turbulent Flow," AEDC-TMR-79-G1, January 1979 (Secret).
41. "AMaRV Aerodynamic Characteristics," Aerospace Corporation Report TOR-0079 (4550-44-1), April 1979 (Secret).
42. "Report on ABRES (U) A Report Bibliography," DDC/PA 0052, March 1979 (Secret).
43. Shaw, W. J., "AMaRV Aerodynamics Analyses - Book III," (U) (AD C018 059L), May 1979 (Secret).
44. Rausch, R. B., "AMaRV Aerothermodynamics Analysis," MDC-G8052, July 1979 (Secret).
45. Rausch, R. B., "Advanced Maneuvering Reentry Vehicle (AMaRV) Preflight Predictions Report, Volumes I and II," (U) MDC-G7285A, August 1979 (Secret).
46. Griffith, B. J., Bailey, A. B., and Martindale, W. R., "Longitudinal Stability of AMaRV Under Tunnel and Flight Conditions in Turbulent Flow," AEDC-TMR-79-G6, August 1979 (Secret).

AMaRV (Cont'd)

47. Griffith, B. J., Bailey, A. B., and Spinetti, R. L., "Longitudinal and Directional Stability AMaRV Under Selected Flight and Tunnel Conditions," (U) AEDC-TMR-80-G15, April 1980 (Secret).
48. "AMaRV-1 Post Flight Report Volumes 1, 2, and Appendix, " BMO-TR-80-14, Vol. 1 (AD C021 744), Vol. 2 (AD C021 745), Appendix (AD B047 491), March 1980 (Secret).

MK 500

1. "Development Test Report (Quick Look) Dynamic Stability Tests-NOL & AEDC," (U) GE-PW-74-91-30A, April 1974 (SFRD).
2. Jenke, L. M. and Burt, G. E., "Experimental Pitch- and Yaw-Damping Characteristics of Several Mark 500 Configurations at Mach Numbers 2 through 8," (U) AEDC-TR-74-19, April 1974 (Secret).
3. "Mark 500 Development Test Report - Pressure Distribution - NOL 8 and 8A," (U) GE-A708-43-1, July 1974 (SFRD).
4. "Development Test Report - (Quick Look) Static Stability AEDC," (U) GE-PW-74-91-11C, September 1974 (SFRD).
5. "Development Tests Report - Dynamic Stability Tests - Final Report," (U) GE-A711-09-1, October 1974 (SFRD).
6. "Development Test Reports - Static Stability Ground Test Analysis Final Report," (U) GE-AEDM-74-9151-002, November 1974 (SFRD).
7. Ragsdale, W. C. and Chien, K.-Y., "MK 500 Aeroheating Tests - Part I," (U) NSWC Wind-Tunnel Report No. 95, December 1974 (SFRD).
8. "MK 500 Aerodynamic Data Exchange on Asymmetric Nose Tips," (U) GE-A712-36-3, January 1975 (SFRD).
9. Harris, C., "MK 500 Nosetip and Collar Testing in the RPL Rocket Test Facility," (U) GE-TDM-9154-75-004, January 1975 (SFRD).
10. Harris, C., "MK 500 Ablated Nose Tip Shock Interaction Heating Study," (U) GE-TDM-9154-75-006, January 1975 (SFRD).
11. Hube, F. K. and Baker, S. S., "Static Stability and Surface Pressure Results for the Navy/GE Mark 500 Vehicle at Mach Numbers from 2 to 10," (U) AEDC-TR-75-4 (AD C000 801L), February 1975 (SFRD).
12. Komito, E. H., "MK 500 Surface Pressure Ground Test Final Report," GE-AEDM-75-91-002, February 1975.
13. "MK 500 ADP Aerodynamic & Thermodynamic Ground Test Program Review," (U) GE-A709-32-3, March 1975 (SFRD).
14. "Preliminary Flight Evaluation Report for Mark 500 Advanced Development Program RB 101," (U) GE-SH048-A2C-C4-001, April 1975 (SFRD).
15. "Preliminary Flight Evaluation Report for Mark 500 Advanced Development Program RB 102," (U) GE-SH048-A2C-C4-002, June 1975 (SFRD).

MK 500 (Cont'd)

16. Truncellito, N. T., Harris, C. J., Komito, E. H., "Final Report on MK 500 Calspan Hypersonic Shock Tunnel Tests," (U) GE-C9154-75-91-636, June 1975 (SFRD).
17. Truncellito, N. T., Harris, C. J., "Final Report on MK 500 NSWC Aerodynamic Heating Test Program - Part 1," (U) GE-C9154-PW-75-91-665, July 1975 (SFRD).
18. "Final Flight Test Report MK 500 SFT Re-entry Body 102," (U) LMSC-L016727, August 1975 (SFRD).
19. "Final Flight Test Report MK 500 SFT Re-entry Body 104," (U) LMSC-L020999, November 1975 (SFRD).
20. "Final Report on the Extraction of Aerodynamic Coefficients from MK 500 RB 101 Flight Test Data," (U) GE-9510-038, December 1975 (SFRD).
21. Ragsdale, W. C., "MK 500 Aeroheating Tests - Part II," (U) NSWC Wind-Tunnel Report No. 111, February 1976 (SFRD).
22. "MK 500 RB 102 Aero Coefficient Flight Test Report," (U) GE-9510-062 April 1976 (SFRD).
23. "Final Flight Test Report MK 500 SFT Re-entry Body 105," (U) LMSC-L024100, April 1976 (SFRD).
24. Oberholtzer, N., "MK 500 RB104 Flight Dynamics Post Flight Analysis," (U) GE-DIN-9510-063, June 1976 (SFRD).
25. "Mark 500 Advanced Development Program MM1-WTR Flight Test Summary Report," (U) GE-SE-086-A2A-C4-001, July 1977 (SFRD).
26. "Mark 500 Advanced Development Program Final Flight Evaluation Report for RB 207," (U) LMSC/L029418, September 1977 (SFRD).

BOOST GLIDE REENTRY VEHICLE (BGRV)

- 63-18. Blattner, C. J., "Background and Supplementary Data in Support of Boost-Glide Re-entry Vehicle Study Program Plan," (U) MDAC A-096 (AD 344 840), August 1963 (Classified).
- 64-6. Uselton, J. C., "Force Test Results on a Series of Boost Glide Re-entry Vehicles at Mach Numbers from 1.5 to 10," (U) AEDC-TR-64-70, April 1964 (AD 349 280) (Confidential).
- 64-13. Boost-Glide Re-Entry Vehicle Study," (U) MDAC A-883 (AD 352 221), July 1964 (Classified).
- 64-14. "Boost-Glide Re-Entry Vehicle Study (U) Final Report Volume I, Technical Results, Part 2," MDAC A-883 (AD 356 873), July 1964 (Classified).
- 64-17. Rhudy, J. P., Magnan, J. D., "Heat-Transfer Tests of a Transpiration-Cooled Booster Glide Re-entry Vehicle Nose Cone," (U) AEDC-TDR-64-179, September 1964 (Confidential).
- 64-22. Uselton, J. C., "Pressure Distribution Tests on a Boost-Glide Re-entry Vehicle at Mach Numbers from 1.5 to 10," AEDC TR-64-204 (AD 354 244), October 1964.
- 65-19. Magnan, J. D., Jr., Carman, J. B., and Rhudy, J. P., "Effects of Transpiration Cooling on the Aerodynamic Heating of a Boost Glide Re-Entry Vehicle Nose Cone at Mach 10," AEDC-TR-65-134 (AD 361 972), June 1965 (Secret).
- 65-25. Dunkin, O. L., "Static Stability Characteristics of a Boost Glide Re-Entry Vehicle at Mach 8," AEDC-TR-65-205 (AD 365 789), September 1965 (Confidential).
- 67-42. Winchenbach, G. L. and Lawrence, W. R., "Free-Flight Range Tests of a Boost Glide Re-Entry Vehicle Configuration at Hypervelocities," AEDC-TR-67-233 (AD 385 428), November 1967 (Confidential).
- 68-14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR-68-77 (AD 394 438L), May 1968 (Secret).
- 68-20. "Boost Glide Re-entry Vehicle," Final Report, SAMSO TR-68-456, Volume I-Analysis (AD 506 414L), Volume II-Test Program (AD 506 415L), September 1968 (Secret).

ASSET PROGRAM

- 64-10. Little, H. R., "Aerodynamic Force Tests of the Asset Re-entry Configuration in Tunnel F," (U) AEDC-TDR-64-116 (AD 350 337), June 1964 (Confidential).
- 64-12. "Ninth Tri-Annual Progress Report on Asset," (U) MDAC A-788, June 1964 (Classified).
- 64-15. "Tenth Tri-Annual Progress Report on Asset," MDAC B086 (AD 355 220L), August 1964 (Classified).
- 64-18. "Asset, ASV-1, Final Flight Test Report," (U) MDAC A973, September 1964 (Classified).
- 65-1. "Asset ASV-3 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B251 (AD 357 523L), January 1965 (Confidential).
- 65-10. "Asset AEV-2 Flight Test Report," (U) MDAC B-551 (AD 358 763L), March 1965 (Confidential).
- 65-16. Landes, P. E., Marks, C. D., "Asset ASV-4 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B707 (AD 366 546L), May 1965 (Classified).
- 65-22. "Flight Test Report Asset ASV-4 Volume III," (U) McDonnell Aircraft Corporation, MAC B707 (AD 373 532L), July 1965 (Classified).
- 65-24. Rinn, S. W., "An Investigation of Heat Transfer on the Asset Vehicle at a Mach Number of 10 and Angle of Attack," (U) RTD-FDL-TR-65-72, August 1965 (Classified).
- 65-37. Wagner, R. E., "Asset, Volume V. Structural Criteria and Loads - Flight Data Correlation," RTD-FDL TR 65-31 (AD 370 071), November 1965 (Classified).
- 65-41. Kinroth, G. D. and Pawlikowski, T. P., "Asset - Volume III. Final Aerodynamics and Performance," AFFDL-TR-65-31 (AD 372 211), December 1965.
- 66-6. Pagel, L. L., Beardsley, P. P., Gaumer, G. R., "Asset Volume IV Correlative Analysis of Heat Transfer Data," (U) RTD-FDL-TR-65-31 (AD 376 185), April 1966 (Classified).
- 66-8. Gaumer, G. R., "Asset Volume XIV. Heat Flux Calculation Procedures," RTD/FDL/TR-65-31 (AD 480 814), April 1966.

SANDIA WINGED ENERGETIC REENTRY VEHICLE (SWERVE)

- 80-18. Stalling, D., "Wind Tunnel Investigation of the Heating on a Sandia RV Configuration at Mach Number 8," AEDC-TSR-80-V54, November 1980.
- 80-20. "SWERVE Data Package II," Secret Document, Sandia Corp., Report RS5623/80/68, June 1980.
- 81-6. Lindsay, E. E., "Static Force Test of the SWERVE III Configuration at Mach Numbers 3 and 8," AEDC-TSR-81-V34 (AD B061201), September 1981.

SECTION 4
BIBLIOGRAPHY CROSS REFERENCE
BY DATA CATEGORY

- SHARP AND BLUNTED BICONES
- SLICED CONES/BICONES
- ELLIPTIC CROSS SECTION CONES
- BENT AXIS CONFIGURATIONS
- ASYMMETRIC/NONSPHERICAL NOSES
- TRANSPIRATION COOLED NOSETIPS (TCNT)
- JET INTERACTION (JI) AND EXTERNAL BURNING (EB)
- CONFIGURATIONS WITH SHOCK LAYER SURVEYS
- MASS TRANSFER/ROUGHNESS EFFECTS
- DYNAMIC STABILITY
- FLIGHT DATA

SHARP AND BLUNTED BICONES

- 64-20. Draper, A. C., Buck, M. L., Grover, L., "Performance Potential and Aerodynamic Aspects of Very High L/D Entry Vehicles," (U) AFFDL-FDMS-TM-64-37, September 1964 (Secret).
- 65-25. Dunkin, O. L., "Static Stability Characteristics of a Boost Glide Re-Entry Vehicle at Mach 8," AEDC-TR-65-205 (AD 365 789), September 1965 (Confidential).
- 67-43. Herrick, R. R., "Operational Maneuvering Reentry Vehicle Concept Study Final Report," (U) GE67SD7316, December 1967 (SRD).
- 68-14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR-68-77 (AD 394 438L), May 1968 (Secret).
- 68-20. "Boost Glide Re-entry Vehicle," Final Report, SAMSO TR-68-456, Volume I - Analysis (AD 506 414L), Volume II - Test Program (AD 506 415L), September 1968 (Secret).
- 72-3. Hube, F. K., "Static Aerodynamic Characteristics of the Advanced Re-entry Vehicles (ARV) at Mach Numbers from 2 to 8," (U) AEDC-TR-72-24 (AD 519 393L), February 1972 (Classified).
- 72-8. Lindsay, E. E., "Wind Tunnel Tests of a Proposed Reentry Vehicle Concept at Mach Numbers 2, 4, and 8," (U) AEDC-TR-72-83 (AD 521 145L), June 1972 (Secret).
- 72-14. Lindsay, E. E., "Force, Pressure, and Heat-Transfer Tests of Several Biconic Configurations at Mach Numbers from 2 to 8," (U) AEDC-TR-72-115 (AD 522 172L), September 1972 (Secret).
- 72-17. Hoyt, T. L., "Small Evader Vehicle (SEE) Feasibility Study Aerodynamic Final Report," (U) GE-ALDM-72-120, November 1972 (Secret).
- 72-18. "SAMSO-MDAC SEV Tunnel B Heat Transfer and Pressure Data," AEDC Report 6036615-2, December 1972.
- 72-19. Buchanacan, T. D., "Aerodynamic Force Test on the SAMSO/Aerospace MM. Biconic Configuration at Mach Numbers 10 to 19," (U) AEDC-TR-72-179 (AD 523 4601), December 1972 (Secret).
- 72-20. Hube, F. K., "Wind Tunnel Tests of the Multi-Mode Reentry Vehicle (MMRV) at Mach Number 10," (U) AEDC-TR-72-186 (AD 523 577L), December 1972 (Secret).
- 72-22. "Small Evader Vehicle Program Final Report," (U) Volume 1 - Summary, Volume IV - Analyses and Studies - Flight Mechanics, Aerodynamics, and Controls (U), SAMSO TR-72-294 (AD 523 941), December 1972 (Secret).

SHARP AND BLUNTED BICONES (Cont'd.)

- 72-23. "Final Report SEE II Pre-Design Study Program," (U) Volumes I - IV, GE72SD2198, December 1972 (SRD).
- 73-3. "RVTO-3B SEE Study Tasks Final Report," (U) Volume I & II, GE73SD2049, March 1973 (Secret).
- 73-4. Hube, F. K., "Wind Tunnel Test Results for the Small Evader Vehicle (SEV) at Mach Numbers from 3 to 10," (U) AEDC TR-73-79 (AD 525 226L), April 1973 (Secret).
- 73-17. "SEE Extended Technology Activity Final Report," (U) Volumes I & II, GE73SD2184-I, October 1973 (SFRD).
- 73-18. Welsh, C. J., "Free Flight Investigation of the Aerodynamic Characteristics of the Small Evader Vehicle," AEDC-TR-73-196 (AD 528 006L), November 1973.
- 73-19. Dieremann, M. W., "Small Evader Experiment Design and Development Program," Volumes I & II, GE73SD2197, USAF/SAMSO/TR 74-6 (AD 528 943), (AD 528 944), November 1973 (SRD).
- 76-2. Pijawka, W., "PGRV System Design Review Report," (U) GE 75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
- 76-4. Barrett, J. E., Cooper, D. L., Copper, J. A., Greene, R. B., and Murphy, J. S., "PGRV System Design Study - Final Studies and Technical Backup Material," USAF/SAMSO TR-75-271, Vol. 2 (AD C006 564L), January 1976 (SRD).
- 77-13. Laganelli, A. L. and Howe, J. R., "Prediction of Pressure Fluctuation Associated with Maneuvering Re-entry Weapons," (U) AFFDL-TR-77-59, Volumes I & II, July 1977 (SFRD).
- 78-9. Hube, F. K., "Heat-Transfer, Surface-Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach Number 6 - Phase I," AEDC TSR-78-V24, July 1978.
- 78-10. Hube, F. K., "Heat Transfer, Surface Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach 6 - Phase II," AEDC-TSR-78-V25, July 1978.
- 78-14. Hahn, J. S., "Static Force Tests of Conic and Biconic Bodies at Mach Number 10," AEDC-TSR-78-V40, November 1978.
- 79-6. Helliwell, W. S., Dickinson, R. P., Lillard, S. C., "HYTAC Phase I Report: Viscous Flow over Arbitrary Geometries at High Angle of Attack," SAMSO TR-79-51, April 1979.

SHARP AND BLUNTED BICONES (Cont'd.)

- 79-9. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Survey Tests on a Blunt Biconic Model at Mach Number 10 - Phase V," AEDC-TSR-79-V36, June 1979.
- 80-7. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Surveys on Conic and Biconic Models with Boundary Layer Trips at Mach Number 8 - Phases IV & VI," AEDC-TSR-80-V14, March 1980.
- 80-9. Spampinato, J., "Nose Control Study Program," (U) Final Report, GE-80SDR2051, May 1980 (SFRD).
- 80-14. Varner, M. O., "A Compilation and Analysis of Hypersonic Turbulent Flow-Field Data for Sharp and Blunt Conic and Biconic Bodies at Zero Angle of Attack," AEDC-TR-80-14, August 1980.
- ACE Advanced Control Experiment (Complete Listing).
- AMaRV Advanced Maneuvering Reentry Vehicle (Complete Listing).

SLICED CONES/BICONES

- 64-11. Roberts, J. F. and Boudreau, A. H., "Longitudinal Static Stability and Roll Control on a Maneuverable Re-Entry Vehicle at Mach 19," (U) AEDC-TDR-64-130 (AD 351 015), June 1964 (Secret).
- 66-2. Burt, R. H., "Static Stability and Control Flap Pressure Distributions on the Dashound Configuration at Mach 10," AEDC-TR-66-56 (AD 370 839), March 1966 (Confidential).
- 67-28. "Operational Maneuvering Reentry Vehicle Concepts Study," Volume 1 USAF/BSD-TR-67-200 Vol. 1 MDAC F-701 (AD 384 535L) and Volume 2 USAF/BSD/TR-200-Vol. 2 MDAC F-701 (AD 384 536L), August 1967 (SRD).
- 67-29. Burt, R. H., "Static Stability, Axial-Force, and Roll Control Characteristics of the Dashound Configuration at Mach Number 8," (U) AEDC-TR-67-114, August 1967 (Confidential).
- 67-43. Herrick, R. R., "Operational Maneuvering Reentry Vehicle Concept Study Final REport," (U) GE67SD7316, December 1967 (SRD).
- 69-13. Burt, R. H., "Static Force and Moment Tests of Several Maneuvering Reentry Vehicle Configurations at Mach Nos. 2, 4, & 6," LMSC-B263740, (AD 503 873), August 1969.
- 71-1. Gray, J. D., Baer, A. L., Burt, R. H., "An Analysis and Summary of the Static Aerodynamic Characteristics of Three Classes of ABRES Configurations at Mach Numbers from 2 to 12," (U) AEDC-TR-70-283 (AD 513 171L), January 1971 (Secret).
- 71-4. Eaves, R. H., Jr., "Static STability and Drag Characteristics of Various SAMSO-Aerospace Advanced Reentry Vehicles (ARV) with Turbulent Boundary Layers at Mach Numbers 12," (U) AEDC-TR-71-17 (AD 514 088L), March 1971 (Secret).
- 71-10. Widhopf, G. F., "Heat-Transfer Correlations for Blunt Cones at Angle of Attack," Journal of Spacecraft and Rockets, Vol. 8, No. 9, p. 1002, September 1971.
- 72-3. Klunker, E. B., South, J. C., Jr., and Davis, R. M., "Computer Program for Calculating Supersonic Flow About Circular Elliptic, and Bielliptic Cones by the Method of Lines," NASA TM X-2437, February 1972.
- 72-5. Knox, E. C. and Siler, L. G., "Static Stability and Drag Characteristics of a SAMSO Aerospace Advanced Reentry Vehicle (ARV) at Mach Numbers 12 and 16," AEDC-TR-72-23 (AD 519 421L), February 1972.
- 72-14. Lindsay, E. E., "Force, Pressure, and Heat-Transfer Tests of Several Biconic Configurations at Mach Numbers from 2 to 8," (U) AEDC-TR-72-115 (AD 522 172L), September 1972 (Secret).
- 72-20. Hube, F. K., "Wind Tunnel Tests of the Multi-Mode Reentry Vehicle (MMRV) at Mach Number 10," (U) AEDC-TR-72-186 (AD 523 577L), December 1972 (Secret).

SLICED CONES/BICONES (Cont'd)

- 73-4. Hube, F. K., "Wind Tunnel Test Results for the Small Evader Vehicle (SEV) at Mach Numbers from 3 to 10," (U) AEDC TR-73-79 (AD 525 226L), April 1973 (Secret).
- 73-18. Welsh, C. J., "Free Flight Investigation of the Aerodynamic Characteristics of the Small Evader Vehicle," AEDC-TR-73-196 (AD 528 006L), November 1973.
- 74-6. Pond, J. E. and Watson, G. H., "An Analytical and Experimental Investigation of Control Surface Heating on Advanced Control Experiment-Like Reentry Vehicle Configurations," (U) AFFDL-TR-74-79 (AD C001 583L), August 1974 (Secret).
- 76-2. Pijawka, W., "PGRV System Design Review Report," (U) GE 75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
- 78-14. Hahn, J. S., "Static Force Tests of Conic and Biconic Bodies at Mach Number 10," AEDC-TSR-78-V40, November 1978.
- 79-9. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Survey Tests on a Blunt Biconic Model at Mach Number 10 - Phase V," AEDC-TSR-79-V36, June 1979.
- 79-14. "Accurate Vehicle Experimental Dynamics Program, Final Report," Calspan Corporation, Buffalo, New York, SAMSO-TR-79-47, August 1979.
- 80-12. Helliwell, W. S., et al., "HYTAC Phase II Report: Turbulent Flow Over Arbitrary Geometries at High Angle of Attack," AR-80-193-TR, July 1980.
- 30-14. Varner, M. O., "A Compilation and Analysis of Hypersonic Turbulent Flow-Field Data for Sharp and Blunt Conic and Biconic Bodies at Zero Angle of Attack," AEDC-TR-80-14, August 1980.
- NBRV Maneuvering Ballistic Reentry Vehicle (Complete Listing).
- ACE Advanced Control Experiment (Complete Listing).
- AMaRV Advanced Maneuvering Reentry Vehicle (Complete Listing).

ELLIPTIC CROSS SECTION CONES

- 58-1. Jorgensen, L. H., "Elliptic Cones Alone and with Wings at Supersonic Speeds," NACA Report 1376, 1958.
- 59-1. Zakkay, V. and Visich, M., Jr., "Experimental Pressure Distributions on Conical Elliptical Bodies at $M_\infty = 3.09$ and 6.0," AFOSR TN 59.10, PIBAL Report No. 467 (AD 208 591), March 1959.
- 59-2. Chapkis, R. L., "Hypersonic Flow over an Elliptic Cone Theory and Experiment," Guggenheim Aeronautical Laboratory, California Institute of Technology Memo No. 49, May 1959.
- 59-3. Martellucci, A., "An Extension of the Linearized Characteristics Method for Calculating the Supersonic Flow Around Elliptic Cones," AFOSR TN 59-632, PIBAL Report No. 517, June 1959, Journ. Aero. Sci., September 1960.
- 61-4. Chapkis, R. L., "Hypersonic Flow Over an Elliptic Cone: Theory and Experiment," Journ. Aero. Sci., November 1961.
- 61-6. Stivers, L. S., Jr. and Levy, L., Jr., "Longitudinal Force and Moment Data at Mach Numbers from 0.60 to 1.40 for a Family of Elliptic Cones with Various Semiapex Angles," NASA TN D-1149, December 1961.
- 63-1. "Longitudinal Aerodynamic Characteristics of Three Families of Lifting Re-entry Bodies," (U) AEDC-TDR-63-4 (AD 334 088), January 1963 (Confidential).
- 63-19. Palko, R. L. and Ray, A. D., "Pressure Distribution and Flow Visualization Tests of a 1.5 Elliptic Cone at Mach 10," AEDC-TDR-63-163, August 1963.
- 64-4. Hillsamer, M. E. and Rhudy, J. P., "Heat-Transfer and Shadowgraph Tests of Several Elliptical Lifting Bodies at Mach 10," AEDC-TDR-64-19 (AD 429 931), February 1964.
- 64-28. Dahlem, V., "Static Aerodynamic Characteristics of Three Blunt Elliptical Bodies at Subsonic to Hypersonic Speeds," AFFDL-FDMG TM 64-23, June 1964.
- 65-2. Keyes, J. W., "Aerodynamic Characteristics of Lenticular and Elliptic Shaped Configurations at a Mach Number of 6," NASA TN D-2606, February 1965.
- 65-7. Dunkin, O. L. and Trimmer, L. L., "Hypersonic Aerodynamic Characteristics of Two Elliptic Half-Cones at $M = 8$ and Angles of Attack to 90 Degrees," AEDC-TR-65-46 (AD 458 753), March 1965.
- 65-14. Burke, G. L., "Heat Transfer and Pressure Distributions about Sharp and Blunt Elliptic Cones at Angles of Attack and High Mach Numbers," AFFDL-TR-64-172 (AD 465 939), May 1965.
- 65-30. Schindel, L. H., "Effect of Vortex Separation on Lifting Bodies of Elliptic Cross Section," AEDC-TR-65-212 (AD 628 224), September 1965.

ELLIPTIC CROSS SECTION CONES (Cont'd)

- 65-33. Bernot, P. T., "Static Stability Characteristics of Several Raked-Off Circular and Elliptical Cones at Mach 6.7," NASA TN D3053, October 1966.
- 65-47. Lamb, Graham, Romere, "Newtonian Aerodynamic Characteristics of Right Elliptical Raked-Off Cones for Cone Thickness Ratios of 0.25 to 3," NASA TN-D-2947, August 1965.
- 66-27. Spencer, B., Jr., "Transonic Aerodynamic Characteristics of a Series of Related Bodies with Cross-Sectional Ellipticity," NASA TN-D-3203, 1966.
- 66-29. Fournier, R. H., Spencer, B., Jr., and Corlett, W. A., "Supersonic Aerodynamic Characteristics of a Series of Related Bodies with Cross-Sectional Ellipticity," NASA TN-D-3539, 1966.
- 67-30. Schindel, L. H., Chamberlain, T. E., "Vortex Separation on Slender Bodies of Elliptic Cross Section," MIT-TR-138 (AD 662 689), August 1967.
- 69-9. Hahn, J. S., "Force Tests on a 1.85 Elliptic Cone at Mach Nos. from 3 to 6," AEDC-TR-69-97 (AD 501 567L), May 1969.
- 70-13. Kaattari, G. E., "A Method for Predicting Pressures on Elliptic Cones at Supersonic Speeds," NASA-TN D-5952, August 1970.
- 70-20. Bazzhin, A. P., Trusova, O. N., and Chelysheva, I. F., "The Influence of Real Properties of Air on Flow Parameters Around an Elliptical Cone. The Aerodynamic Characteristics of Elliptical Cones at Large Angles of Attack," FTD-MT-24-0006-72, 1970.
- 72-2. Klunker, E. B., South, J. C., Jr., and Davis, R. M., "Computer Program for Calculating Supersonic Flow About Circular Elliptic, and Bielliptic Cones by the Method of Lines," NASA TM X-2437, February 1972.
- 72-13. Branch, W. H., "UpSTAGE Experiment Final Technical Report," (U) MDC G3263, September 1972 (Confidential).
- 73-2. Watson, G. H., Pond, J. E., and McCormick, P. O., "Geometric and Attitude Effects on Boundary Layer Transition," AFFDL-TR-73-28, March 1973.
- 77-17. Graves, E. B., "Aerodynamic Characteristics of a Monoplanar Missile Concept with Bodies of Circular and Elliptical Cross Sections," NASA Technical Memorandum 74079, December 1977.

ELLIPTIC CROSS SECTION CONES (Cont'd)

- 78-16. Lee, H. M. and Rasmussen, M. L., "Hypersonic Flow Past a Slender Elliptic Cone," University of Oklahoma, Research Report No. OU-AMNE 78-2, November 1978.
- 78-18. Rasmussen, M. L., "Lifting Bodies Derived from Supersonic Flows Past Inclined Circular and Elliptic Cones," University of Oklahoma Research Report No. OU-AMNE-78-11, December 1978.
- 79-3. Rasmussen, M. L. and Lee, H. M., "Approximation for Hypersonic Flow Past a Slender Elliptic Cone," AIAA Paper No. 79-0364, January 1979.
- 79-17. Rasmussen, M., "Lifting-Body Configurations Derived from Supersonic Flows Past Inclined Circular and Elliptic Cones," AIAA Paper 79-1665, August 1979.

BENT AXIS CONFIGURATIONS

- 63-4. Holloway, P. F., "Comparison of Experimental Control Effectiveness of a Flat-Bottom Canted-Nose Half-Cone Reentry Configuration with that Obtained by Several Methods of Prediction for Various Types of Local Flow at a Mach Number of 6.0," (U) NASA TM X-767, March 1963 (Confidential).
- 70-1. Martindale, W. R., "Nose-Cant Effects on the Aerodynamic Characteristics of an 8-Degree Cone at Mach No. 8," AEDC-TR-69-267 (AD 506 502), January 1970 (Confidential).
- 70-11. Little, H. R., Burt, R. H., and Coble, J., "Force and Static Characteristics of an Asymmetric Glide Reentry Vehicle at Mach Numbers from 6 to 21," AEDC-TR-70-22 (AD 871 198), July 1970.
- 76-2. Pijawka, W., "PGRV System Design Review Report," (U) GE75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
- 80-9. Spampinato, J., "Nose Control Study Program," (U) Final Report, GE-80SDR2051, May 1980 (SFRD).
- MK500 MK500 (Complete Listing).

ASYMMETRIC/NONSPHERICAL NOSES

- 62-9. "Experimental Study of Aerodynamic Parameters of Unsymmetrical Nose Cone Configurations at Mach Numbers 0.8 to 5.0," (U) AEDC-TDR-62-154, October 1962 (Confidential).
- 70-1. Martindale, W. R., "Nose-Cant Effects on the Aerodynamic Characteristics of an 8-Degree Cone at Mach No. 8," AEDC-TR-69-267 (AD 506 502), January 1970 (Confidential).
- 71-10. Widhopf, G. F., "Heat-Transfer Correlations for Blunt Cones at Angle of Attack," Journal of Spacecraft and Rockets, Vol. 8, No. 9, p. 1002, September 1971.
- 72-8. Lindsay, E. E., "Wind Tunnel Tests of a Proposed Reentry Vehicle Concept at Mach Numbers 2, 4, and 8," (U) AEDC-TR-72-83 (AD 521 245L), June 1972 (Secret).
- 72-11. Walchner, O., Sawyer, F. M., and Yelmgren, K. E., "Aerodynamics of a Slender Cone with Asymmetric Nose Bluntness at Mach 14," AIAA Journal, Vol. 10, No. 8, p. 1121, August 1972.
- 72-14. Lindsay, E. E., "Force, Pressure, and Heat-Transfer Tests of Several Biconic Configurations at Mach Numbers from 2 to 8," (U) AEDC-TR-72-115 (AD 522 172L), September 1972 (Secret).
- 72-22. "Small Evader Vehicle Program Final Report," (U) Volume I - Summary, Volume IV - Analyses and Studies - Flight Mechanics, Aerodynamics, and Controls (U), SAMSO-TR-72-294 (AD 523 941), December 1972 (Secret).
- 73-4. Hube, F. K., "Wind Tunnel Test Results for the Small Evader Vehicle (SEV) at Mach Numbers from 3 to 10," (U) AEDC TR-73-79 (AD 525 226L), April 1973 (Secret).
- 73-15. DeBorde, D., "MK 500 Ballistics Range Ablation Tests-Nosetip Modeling Phase II," GE/PIR 9153-027, October 1973.
- 73-16. Tompkins, J. E., "MK 500 Nosetip Performance Characterization Test Program," GE/PIR 9153-023, October 1973.
- 76-4. Barrett, J. E., Cooper, D. L., Copper, J. A., Greene, R. B., and Murphy, J. S., "PGRV System Design Study - Final Studies and Technical Backup Material," USAF/SAMSO-TR-75-271, Vol. 2 (AD C006 564L), January 1976 (SRD).
- 80-4. Kutler, P., Pedelty, J. A., Pulliam, T. H., "Supersonic Flow Over Three-Dimensional Ablated Nosetips Using an Unsteady Implicit Numerical Procedure," AIAA Paper 80-0063, January 1980.

TRANSPIRATION COOLED NOSETIPS (TCNT)

- 64-17. Rhudy, J. P., Magnan, J. D., "Heat-Transfer Tests of a Transpiration-Cooled Booster Glide Re-entry Vehicle Nose Cone," (U) AEDC-TDR-64-179, September 1964 (Confidential).
- 65-19. "Multiple Reentry Vehicle Guidance Study - Final Report," (U) USAF/BSD-TR-65-280, May 1965 (Classified).
- 67-28. "Operational Maneuvering Reentry Vehicle Concepts Study," Volume 1 USAF/BSD-TR-67-200 Vol. 1 MDAC F-701 (AD 384 535L) and Volume 2 USAF/BSD-TR-200-Vol. 2 MDAC F-701 (AD 384 536L), August 1967 (SRD).
- 67-43. Herrick, R. R., "Operational Maneuvering Reentry Vehicle Concept Study Final Report," (U) GE67SD7316, December 1967 (SRD).
- 68-14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR-68-77 (AD 394 438L), May 1968 (Secret).
- 68-20. "Boost Glide Re-entry Vehicle," Final Report, SAMSO-TR-68-456, Volume I - Analysis (AD 506 414L), Volume II - Test Program (AD 506 415L), September 1968 (Secret).
- 70-11. Little, H. R., Burt, R. H., and Coble, J., "Force and Static Characteristics of an Asymmetric Glide Reentry Vehicle at Mach Numbers from 6 to 21," AEDC-TR-70-22 (AD 871 198), July 1970.
- 76-2. Pijawka, W., "PGRV System Design Review Report," (U) GE 75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B, (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
- 76-4. Barrett, J. E., Cooper, D. L., Copper, J. A., Greene, R. B., and Murphy, J. S., "PGRV System Design Study - Final Studies and Technical Backup Material," USAF/SAMSO-TR-75-271, Vol. 2 (AD C006 564L), January 1976 (SRD).
- 78-13. Lee, T. G., "Ballistic Range Test Coordination Program - Final Report, Volume II: Transpiration Cooled Nostip Evaluation," (U) SAMSO-TR-78-140, September 1978 (Secret).
- 79-2. Gray, W. A., Cramer, C. R., "Gasjet Nose Tip Flight Evaluation," (U) DNA 4722F, January 1979 (Confidential).

JET INTERACTION (JI) AND EXTERNAL BURNING (EB)

- 65-9. Vinson, P. W., "Extension of Reaction Control Effectiveness Criteria to Mach 10: Experiment and Theory," AIAA Journal, March 1965.
- 65-12. Browne, P. D., "Results of DA-27 Fluid Injection Control Test Program at $M = 17$," GE-ATDM 1:85, April 1965 (GE Proprietary).
- 66-10. Ray, A. D., "Static Stability and Pressure Distributions on a 9-Degree Cone with Reaction-Jet Controls at Mach 6 and 10," AEDC-TR-66-94 (AD 371 917), May 1966 (Confidential).
- 66-26. Spaid, F. W., Davis, J. G., Barnes, J. W., and Sayano, S., "Maneuvering Reentry Control and Ablation Studies (Marcas II) Final Report Vol. II - Jet Interaction Investigation," (U) BSD-TR-66-246, 1966 (Secret).
- 67-44. Carman, J. B., Jr., "Pressure and Heat-Transfer Measurements on the Marcas III Vehicle at Mach Numbers 6 and 10," AEDC-TR-67-244 (AD 386 017), December 1967 (Confidential).
- 68-14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR-68-77 (AD 394 438L), May 1968 (Secret).
- 68-20. "Boost Glide Re-entry Vehicle," Final Report, SAMS0-TR-68-456, Volume I - Analysis (AD 506 414L), Volume II - Test Program (AD 506 415L), September 1968 (Secret).
- 69-14. Murphy, J. S., Copper, J. A., Meehan, D. L., and Rausch, R. B., "MARCAS III Final Report," (U) USAF/SAMS0 TR-69-308, MDAC G-1130 (AD 506 241L), August 1969 (Secret).
- 72-6. Shreeve, R. P., Oates, G. C., and Ahlstrom, H. G., "Investigation of a Supersonic Surface Jet-Hypersonic Flow Interaction with Axial Symmetry," AIAA Journal, Vol. 10, No. 5, p. 589, May 1972.
- 72-9. Cothran, L. E., "UpSTAGE Technology Report: EB Control System," Vol. 2, Sections 7 through 11, (U) MDC-G3232, July 1972 (Confidential).
- 72-12. Hopkins, D. F., "UpSTAGE Technological Report: Jet Interaction Control System," Vol. 1, Sections 1 through 5, (U) MDC-G3237, September 1972 (Confidential).
- 72-13. Branch, W. H., "UpSTAGE Experiment Final Technical Report," (U) MDC G3263, September 1972 (Confidential).
- 74-2. Wortman, A., "Foreign Gas Injection at Windwardmost Meridians of Yawed Sharp Cones," Northrop Corporation, California, AIAA Journal, Vol. 12, No. 6, June 1974.
- 75-2. Reinecke, W. G., "Penetration of a Lateral Sonic Gas Jet Into a Hypersonic Stream," AIAA Journal, Vol. 13, No. 2, February 1975.

JET INTERACTION (JI) AND EXTERNAL BURNING (EB) (Cont'd)

- 76-1. Harvy, D. W. and Hopkins, D. F., "Fluid Mechanics of Jet Interaction and External Burning Controls," (U) MDC G6174, January 1976 (Confidential).
- 76-2. Pijawka, W., "PGRV System Design Review Report," (U) GE75SDR2353, Books 1-1 (AD C008 816), Book 1-2 (AD C008 817), Book 2A, Book 2B (AD C008 823), Book 3 (AD C008 824), and Book 4, January 1976 (SRD).
- 77-7. Fikes, D. H., "Results of Wind Tunnel Tests to Determine the Effects of Representative Bent Nosed Tips Shapes and Non-Metric Roll Control Jets on the Static Stability and Axial Force Characteristics of a Conical Reentry Configuration at Mach Number 8," AEDC-DR-77-39, May 1977.
- 78-3. Hopkins, D. F. and Harvey, D. W., "Advanced Interceptor Control and Base Burning Technology Study," (U) Volume I: Interaction Controls, MDC G7341, February 1978 (Confidential).

CONFIGURATIONS WITH SHOCK LAYER SURVEYS

- 69-15. George, O. L., Jr., "An Experimental Investigation of the Flow Field Around an Inclined Sharp Cone in Hypersonic Flow," Sandia Laboratories SC-RR-69-577, September 1969.
- 69-18. Feldhuhn, R. H., "An Experimental Investigation of the Flow Field Around a Yawed Cone," NOLTR 69-187, November 1969.
- 70-9. Feldhuhn, R. H., Winkelmann, A. E., and Pasiuk, L., "An Experimental Investigation of the Flow Field Around a Yawed Cone," AIAA Paper No. 70-766, June 1970.
- 71-7. Feldhuhn, R. H., Winkelmann, A. E., and Pasiuk, L., "An Experimental Investigation of the Flowfield Around a Yawed Cone," AIAA Journal, Vol. 9, No. 6, p. 1074, June 1971.
- 74-5. Zakkay, V., Economos, C., and Alzner, E., "Leeside Flow Field Description over Cones at Large Incidence," AFFDL-TR-74-19, July 1974.
- 78-9. Hube, F. K., "Heat-Transfer, Surface-Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach Number 6 - Phase I," AEDC-TSR-78-V24, July 1978.
- 78-10. Hube, F. K., "Heat-Transfer, Surface-Pressure, and Boundary-Layer Surveys on Conic and Biconic Bodies with Boundary-Layer Trips at Mach 6 - Phase II," AEDC-TSR-78-V25, July 1978.
- 79-9. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Survey Tests on a Blunt Biconic Model at Mach Number 10 - Phase V," AEDC-TSR-79-V36, June 1979.
- 79-11. DeJarnette, F. R., Ford, C. P., and Young, D. E., "A New Method for Calculating Surface Pressures on Bodies at an Angle of Attack in Supersonic Flow," AIAA Paper 79-1552, July 1979.
- 80-7. Carver, D. B., "Heat-Transfer, Surface Pressure, and Flow-Field Surveys on Conic and Biconic Models with Boundary Layer Trips at Mach Number 8 - Phases IV & VI," AEDC-TSR-80-V14, March 1980.
- 80-8. Johnston, K. L., "Mach Number/Flow Angle Surveys Within the Bow Shock of the X-24C Model at Mach Number 6, Part II," AEDC-TSR-80-V22 (AD B048 343L), April 1980.
- 80-14. Varner, M. O., "A Compilation and Analysis of Hypersonic Turbulent Flow-Field Data for Sharp and Blunt Conic and Biconic Bodies at Zero Angle of Attack," AEDC-TR-80-14, August 1980.

MASS TRANSFER/ROUGHNESS EFFECTS ON MaRVs

- 67-27. Little, H. R. and Griffith, B. J., "Mass Injection Studies on Slender Cones & a Flat Plate with Trailing-Edge Ramp at Mach Nos. from 9 to 21," AEDC-TR-67-109, August 1967.
- 71-2. Decker, J. P., "Some Effects of Ablation Surface Roughness on the Aerodynamic Characteristics of a Reentry Vehicle at Mach Nos. from 0.30 to 1.00," NASA/TMSX 2050, February 1971.
- 74-2. Wortman, A., "Foreign Gas Injection at Windwardmost Meridians of Yawed Sharp Cones," Northrop Corporation, California, AIAA Journal, Vol. 12, No. 6, June 1974.
- 75-10. "Effects of Mass Transfer into Laminar and Turbulent Boundary Layers over Cones at Angle of Attack," AEDC-TR-75-55, August 1975.
- 78-8. Murray, A. L., and Lewis, C. H., "Heat and Mass-Transfer Effects on Three-Dimensional Viscous Shock-Layer Flows," AIAA Paper No. 78-844, May 1978.
- 78-11. Gogineni, P. R., Murray, A. L., and Lewis, C. H., "Viscous Flows over Slender Spherically Blunted Cones at Large Angles of Attack Including Mass-Transfer and Low Reynold Number Effects," AIAA Paper No. 78-1188, July 1978.
- 79-14. "Accurate Vehicle Experimental Dynamics Program, Final Report," Calspan Corporation, Buffalo, New York, SAMSO-TR-79-47, August 1979.

DYNAMIC STABILITY

- 62-8. Schiff, J., "A Transonic Investigation to Determine the Static and Dynamic Stability and Control Effectiveness of the RVX-2C Configuration in the NASA Ames 14' Transonic Wind Tunnel," GE Document No. 62SD652, September 1962.
- 68-7. Usselton, B. L. and Mansfield, A. C., "Dynamic Stability Characteristics of the Mark 17 Configuration at Mach Numbers from 2 through 10," AEDC-TR-68-8, February 1968 (Confidential). ✓
- 63-6. Ericsson, L. E. and Reding, J. P., "Dynamic Stability Problems Associated with Flare Stabilizers and Flap Controls," J. Spacecraft, February 1969.
- 80-16. Usselton, B. L. and Cyran, F. B., "Sting Interference Effects as Determined by Measurements of Dynamic Stability Derivatives, Surface Pressure, and Base Pressure for Mach Numbers 2 through 8," AEDC-TR-79-89, October 1980.

FLIGHT DATA

- 64-18. "Asset, ASV-1, Final Flight Test Report," (U) MDAC A973, September 1964 (Classified). A
- 65-1. "Asset ASV-3 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B251 (AD 357 523L), January 1965 (Confidential). ✓
- 65-3. Landes, P. E., Marks, C. D., "Asset AEV-1 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B520 (AD 359 562L), February 1965 (Confidential). ✓
- 65-10. "Asset AEV-2 Flight Test Report," (U) MDAC B-551 (AD 358 763L), March 1965 (Confidential). ✓
- 65-16. Landes, P. E., Marks, C. D., "Asset ASV-4 Flight Test Report," (U) McDonnell Aircraft Corporation, MAC B707 (AD 366 546L), May 1965 (Classified).
- 65-22. "Flight Test Report Asset ASV-4 Volume III," (U) McDonnell Aircraft Corporation, MAC B707 (AD 373 532L), July 1965 (Classified). ✓
- 65-41. Kinroth, G. D. and Pawlikowski, T. P., "Asset - Volume III. Final Aerodynamics and Performance," AFFDL-TR-65-31 (AD 372 211), December 1965.
- 66-6. Pagel, L. L., Beardsley, P. P., Gaumer, G. R., "Asset Volume IV Correlative Analysis of Heat Transfer Data," (U) RTD-FDL-TR-65-31 (AD 376 185), April 1966 (Classified). ✓
- 66-8. Gaumer, G. R., "Asset Volume XIV. Heat Flux Calculation Procedures," RTD/FDL/TR-65-31 (AD 480 814), April 1966.
- 66-25. Murphy, J. S., Bloomquist, R. E., and Spaid, F. W., "Maneuvering Reentry Control and Ablation Studies (Marcas II) Final Report Vol. 1 - Summary," BSD-TR-66-246, 1966 (Secret). ✓
- 66-26. Spaid, F. W., Davis, J. G., Barnes, J. W., and Sayano, S., "Maneuvering Reentry Control and Ablation Studies (Marcas II) Final Report Vol. II - Jet Interaction Investigation," (U) BSD-TR-66-246, 1966 (Secret). ✓
- 67-12. Sterhardt, J. A., "Prime Test Flight #1, Flight Analysis," (U) Martin Co/ER-14461 (AD 381 380), March 1967 (Classified). ✓
- 67-13. Sterhardt, J. A., "Prime Test Flight #1, Flight Analysis," (U) Martin Co/ER-14461-Appendices (AD 381 381), March 1967 (Classified). ✓

FLIGHT DATA (Cont'd)

- 68-14. Masek, R. J., Levine, B. M., and Philpott, D. D., "Methods for Reducing and Evaluating BGRV Flight Aerodynamic Heating Data," (U) AFFDL TR 68-77 (AD 394 438L), May 1968 (Secret). ✓
- 68-16. Holleman, E. C., "Stability and Control Characteristics of the M2-F2 Lifting Body Measured During 16 Glide Flights," (U) NASA TM X-1593, June 1968 (Confidential). ✓
- 69-14. Murphy, J. S., Copper, J. A., Meehan, D. L., and Rausch, R. B., "MARCAS III Final Report," (U) USAF/SAMSO TR-69-308, MDAC G-1130 (AD 506 241L), August 1969 (Secret). ✓
- 72-9. Cothran, L. E., "UpSTAGE Technology Report: EB Control System," Vol. 2, Sections 7 through 11, (U) MDC-G3232, July 1972 (Confidential). ✓
- 72-12. Hopkins, D. F., "UpSTAGE Technological Report: Jet Interaction Controls System," Vol. 1, Sections 1 through 5, (U) MDC-G3237, September 1972 (Confidential). ✓
- 72-13. Branch, W. H., "UpSTAGE Experiment Final Technical Report," (U) MDC G3263, September 1972 (Confidential). ✓
- 72-22. "Small Evader Vehicle Program Final Report," (U) Volume 1 - Summary, Volume IV - Analyses and Studies - Flight Mechanics, Aerodynamics, and Controls (U), SAMSC-TR-72-294 (AD 523 941), December 1972 (Secret). ✓
- 73-20. "Draft of Final Flight Evaluation Report for the Re-entry Vehicle Technology and Observables Flight Test Program - Phase 3B Vehicle 104," (U) GE73SD2255P, November 1973 (Secret). ✓
- MBRV Maneuvering Ballistic Reentry Vehicle (Complete Listing).
- ACE Advanced Control Experiment (Complete Listing).
- AMaRV Advanced Maneuvering Reentry Vehicle (Complete Listing).
- MK500 MK500 (Complete Listing).

SECTION 5
DATA SUMMARY OVERVIEWS

DATA SUMMARY OVERVIEWS

Summarized in the following tables are highlights of the ground or flight test data contained in select reports that, during the review cycle of this effort, were thought to contain information that potentially would be of specific interest to analysts for computer code validation. A general description of the geometry, the test conditions and facility, and the data obtained are presented. From this cursory review, the data reports that contain a sizeable quantity of data or data of special interest for detailed code validation (e.g., shock layer profile data) are reviewed, summarized, and critiqued in Section 5.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
59-1	Elliptic Cone	S	--	PIBAL	3, 6	20°	P	Sharp nose configurations. a/b = 1.78, 1.39. Plots of results.
63-1	Elliptic Cone Half Cone	S	--	AEDC-B AEDC-E	8	30° 815°	F&M	Plots of data.
63-19	Elliptic Cone	S	--	AEDC-C	10	60°	P	Plots of results. Oil flow and schlieren data. Poor flow in Tunnel C (condensation).
64-1	Half-Cone	S	--	AEDC-B	8	100°	F&M	3 different cross-sections. Plots of results
64-4	Elliptic Cone	S	--	AEDC-C	10	60°	q	Sharp and blunt noses. a/b = 2.00, 1.43. Limited plots of results.
64-6	Cone	S	--	AEDC-A AEDC-C	1.5 to 10	15°	F&M	BGRV Flare angle and fineness ratio variations. Limited plots of results.
64-11	Cone with Slice	S	MF	AEDC-F	19	15°	F&M	Conical nozzle. Flap effectiveness tests. Limited plots of data -- roll control data.
64-17	Cone	S TC	--	AEDC-C	10	20°	q	BGRV Effects of transpiration on down- stream q. Limited data presented.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M_∞	α		
64-20	Cone Tricone	S	--	AEDC-A AEDC-C	5 10	14°	P	BGRV. Variations in flare angle.
55-18	Cone	S	F	AEDC-A AEDC-C	5 10	25°	F&M	Biconic nose. Base domes (2 versions). 90° cone.
65-19	Cone	S TC	--	AEDC-C	10	20°	q	BGRV. Effects of transpiration on down- stream q. Plots of results.
65-25	Tricone	S	--	AEDC-B	8	20°	F&M	BGRV. Variation in flare angle. Limited plots of results.
66-2	Cone with Slice	S	MF	AEDC-C	10	20° 85°	F&M P	Effects of flats and control size on static stability. Flap pressures. Some plots of results.
66-5	Cone Half Cone Delta Wing	S	--	AEDC-L	10	30°	F&M	Viscous interaction effects. Transition flow regime. Some plots of results.
66-10	Cone	S	JI	AEDC-B AEDC-C	6,10	30°	F&M P	MARCAS II. Tripped turbulent flow. Variations in nose bluntness. Limited plots of data.
67-28 (Vol. I)	Bicone with Slice	TC	MF	--	--	--	--	Maneuvering RV concepts study. Glide LLRI MRV design. No Data - studies only.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
67-28 (Vol. II)	Bicone with Slice	TC	MF	--	--	--	--	Maneuvering RV concepts study. Design summary. No data.
67-29	Cone Cone with Slice	S	MF	AEDC-B	8	20°	F&M	Tripped turbulent flow. Trailing controls. Roll control studied. R _N variations. Limited plots of results.
67-42	Tricone	S	--	AEDC-G	7 to 16	0°	F&M	BGRV flared tricone. Ballistic range test. Plots and tabulation of results.
67-43	Bicone with Slice	TC	MF	--	--	--	--	Maneuvering RV concepts study. Final report. Low level run-in concept. No data.
67-44	Cone	S	JI	AEDC-B AEDC-C	6 to 10	27°	q	MARCAS III. q for JI induced separated flow regions. Sharp and blunt noses.
68-14	Bicone	TC	Flare JI	CAL AEDC-C	6 to 10	20°	q	Methods for evaluating aero heating data on BGRV. Some ground, flight data on heating. Brief flight summaries.
68-20 (Vol. I)	Bicone	TC	Flare JI	--	--	--	--	BGRV final report - test program. Ground, flight test descriptions. No data.
68-20 (Vol. II)	Bicone	TC	Flare JI	AEDC-A AEDC-C MDAC CAL	4 to 10	20°	F&M p	BGRV final report - analysis. Some ground test data presented.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
69-9	Elliptic Cone	S	--	AEDC-A	3-6	16°	F&M	UpStage. a/b = 1.85. Limited plots of results.
69-13	Cone with Double Slice	S	SWF	AEDC-A AEDC-B	2,4,6	28°	F&M	Tripped Turbulent flow. Trailing control hinge moments measured. Different afterbodies. Rounded base.
69-14	Cone	S	JI	--	--	--	--	MARCAS III final report. 2 vehicles flown. Flight data and very limited ground data.
69-18	Sharp Cone	--	--	NSWC-2	5	only 24°	P, Survey	Sharp cone tested at α = 24° Leeside shock layer surveyed in separated flow region.
70-1	Cone	S	--	AEDC-B	8	14° 86°	F&M P, q	Bent-nosed cones (δN = 6°) Sharp biconic nosetips with varying bluntness.
70-11	Canted-base cone	S TC	FBN	AEDC-B AEDC-C AEDC-F	6 to 21	25°	F&M	Bluntness & cant angle variations. Base pressure data. Plots of results. Conical nozzle (Tunnel F)
71-1	Cone with Slice	S	SWF MF RAKE	AEDC-A AEDC-B AEDC-F	2 to 12	27° 86°	F&M	Plots of results. Conical nozzle (Tunnel F)
71-4	Cone with Double Slice	S	F	AEDC-F	12	25°	F&M	Tripped turbulent flow. Conical nozzle. Static stability with various control deflections. Rounded base shoulder. Plots and data tabulations.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
71-9	Cone with Slice	S,A	SWF MF	AEDC-A AEDC-B AEDC-C	10.6	25° 86°	F&M	Tripped turbulent flow. Trailing controls. Various R _N , biconic & ablated noses. Plots and results.
72-3	Cone with Slice Cone with Double Slice	S	SWF	AEDC-A AEDC-B	2 to 8	24° 85°	F&M	Tripped turbulent flow. Variations in forecone, R _N , cuts, δF; static stability data for biased- based vehicles with controls.
72-5	Cone with Double Slice	S	SWF	AEDC-F	12 16	20° 85°	F&M	Conical nozzle. Variable split control deflections. Pitch stability, roll control, limited plots. Data summary (corrected for source flow).
72-8	Cone Bicone	S	RAKE	AEDC-A AEDC-B	2 4 8	24° 84°	F&M q	Tripped turbulent flow. Aft leeside rake. Variations in R _N , Rake geometry q from paint; LTA test for nose, rake Plots of results.
72-13	Elliptic Cone	S	EB JI	AEDC-A MDAC	3 to 8	30°	F&M	UpSTAGE final report, a/b = 1.83. Summary of tests (basic body & controls). Some thermal tests (RENT, CAL).
72-14	Bicone Bicone with Slice	S,A	SN	AEDC-A AEDC-B	2 to 8	24° 82°	F&M p q	Variation of forecone angles, blunt- ness, nose shape. Nose slice, deflection variations. Plots of data.
72-19	Bicone	S	--	AEDC-F	10 to 19	20°	F&M	Conical nozzle. Paint for transition data. Viscous effects (laminar & turbulent) found to be significant. Plots of results.
72-20	Bicone Bicone with Slice Bicone with Double Slice	S	F	AEDC-C	10	20° 85°	F&M	Trailing controls (wind and lee). Plots of results.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
72-22	Bicone	S	SWF	AEDC-A AEDC-B	3,5, 8	25°	F&M	SEV Fnl Rpt-Vol. IV-other volumes not of interest. Analyses-aero.flt. mechs., controls; Data presented. Non circ.x-sections.
73-4	Cone Cone with Slice Cone with Double Slice	S,A	F	AEDC-A AEDC-B AEDC-C	3 to 10	24° 86°	F&M P q	Tripped turbulent flow. Parametric geometry variations. Lee & wind slices. Plots of data - <u>SEV</u>
73-18	Cone with Double Slice	S	F	AEDC-G	~12	10°	F&M	Effects of forecone angle on x_{cp}, α_T . Plots and summaries of results. <u>SEV</u>
73-19 Vol. I	Bicone	S	DSN	--	--	--	--	SEE-design & development. Control system design, traj., flight mech.
73-19 Vol. II	Bicone	S	DSN	AEDC-B AEDC-F	8 12	20°	F&M q	SEE-design & development. Configuration aero. Ground test summary (aero & thermo). Refs. for data.
75-12	Flat Plate	--	F	5MW 50MW	--	--	LTA Ablation	Analyses & experiments for nosetip ablation at high α; analysis of flap ablation. ATJ and C/C materials.
76-2 Vol. I	Bicone	S TC	FBN MF SWF JI DSN	--	--	--	--	GE PGRV SDR-Studies and analysis only Various controls analyzed. No data.
76-2 Vol. II	Bicone	--	FBN MF SWF JI DSN	--	--	--	--	GE PGRV SDR-OPV analysis & studies. Aero & traj. analyses.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
76-2 Vol. III	Bicone with Slice	S	MF	--	--	--	--	GE PGRV flight test vehicle SDR.
76-2 Vol. IV	Bicone with Slice	S	MF	--	--	--	--	GE PGRV SDR - flight test planning. Instrumentation, safety, etc. Def'n of flight test objectives.
76-4	Bicone	S, A TC	FYS MF SWF	AEDC-A AEDC-B AEDC-F, G CAL NSWC-9	3.5 8 12 12	25°	F&M p	MDAC final studies for PGRV Limited tests.
78-3	Cone	S	J1 EB	CAL	7.0 to 13.7	20° 812°	P, q	Interaction controls effectiveness. Forces from pressure integration. Data evaluation and application to advanced interceptors.
78-13	Nosetip Only	TC	--	AEDC-G	16000 fps	0	Dust Erosion	TCNT tests in range/Track G. Dust tests.
79-2	Nosetip Only	6	--	5MW 50MW NASA/LARC Martin	2 to 10	0	P, q	Dust test failed. Plasma tests & wind tunnel tests. Flight tests on SAMS/TATER, FLAME, MSV-ATHENA.
79-9	Bicone w/slice ("HYTAC" model)	S	--	AEDC-C	10	14°	F&M, q, p, survey	Complete data set for laminar flow conditions on a blunted bicone. Suitable for computer code validation.
79-11	X-24C Config'n	S	--	AEDC-B	6	6°	Survey	Local Mach number and flow angle survey within bowshock. Data at one model station only.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M_∞	α		
79-16	Cone	S	--	AEDC-G	14	0°	F&M	Ballistic range tests. Real gas effects on stability. Plots of results.
80-6	Cone	S	--	AEDC-G	14	0°	F&M	Ballistic range tests. Real gas effects on stability. Plots of results.
80-7	Cone and Bicone	S	--	AEDC-B	8	10°	F&M, $\dot{q}$, P , and Surveys	Obtain turbulent flow data base on sharp and blunt cone, and blunt bicones-b.l. trips used.
80-8	X-24C Config'n	S	--	AEDC-B	6	20°	Flow Survey	Local Mach number & flow angle. Survey within bow shock. Data at 2 model stations.
80-9	Bicone	S	SN	NSWC-9 RPL	14, ~3	30° { 62°	F&M Ablation	GE Nose Control study. Analysis and wind tunnel data.
80-10	Flat Plate	--	F	NASA/LaRC	10	0°	P , $\dot{q}$	Finite span trailing flaps. Turbulent flow. Chord-and spanwise data at $\delta_F=0^\circ-15^\circ$ Plots of results.
80-13	Flat Plate	--	F	NASA/LaRC	10	0°	P , $\dot{q}$	Finite span trailing flaps. Turbulent flow. Chord-and spanwise data at $\delta_F=0^\circ-15^\circ$ Plots of results.
80-14	Cone Bicone	S	--	AEDC-B	6	0°	$\dot{P}$, $\dot{q}$, BL Survey	Turbulent boundary layer measurements. Surface data and mean flow profiles. Sharp and blunt noses. Extensive data plots and tabulations.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
MBRV-2	Cone with Slice	S	MF	AEDC-B AEDC-C	8 10	27° 810°	F&M	Laminar & turbulent flow. Flap effectiveness. Variations in control geometries and bluntness. Some plots of data - Tunnel C data bad (condensation).
MBRV-3	Cone with Slice	S	MF	AEDC-B AEDC-C	8 10	15°	P	Variations in bluntness, δf. Boundary layer surveys. Oil flow to define separation regions. Tunnel C data bad (condensation).
MBRV-8	Cone with Slice	S	MF	AEDC-A AEDC-C	2.6 10	18°	F&M	Nose bluntness, roll control tests. Limited plots of data. Tunnel C data bad (condensation).
MBRV-10	Cone Cone with Slice	S	MF	AEDC-F	19	15°	F&M	Conical nozzle; w & w/o flaps. Limited plots of results.
MBRV-12	Cone with Slice	S	MF	AEDC-F	19	15°	F&M	Conical nozzle. δf variations for trailing flap. Limited plots of results.
MBRV-15	Cone with Slice	S	MF	AEDC-C	10	~0°	Dynamic Stability	Forced oscillation tests. Tunnel C data bad (condensation).
MBRV-16	Cone with Slice	S	MF	AEDC-C	10	20° 850°	F&M	"Ablated" frustum and contoured controls. Limited plots of results. Tunnel C data bad (condensation).
MBRV-22	Cone with Slice	S	MF	AEDC-F	15	30°	P	Conical nozzle. Limited body and flap data.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		Mach	α		
MBRV-28	Cone with Slice	S	MF	AEDC-C	10	15°	F&M	Stability and control with in through porous frustum. Limited plots of results. Tunnel C data bad (condensation).
MBRV-31	Cone with Slice	S	MF	AEDC-A AEDC-B AEDC-C	5 8 12	27° 15°	F&M p, q B.L. Survey	Plots of results from many tests, including hinge moments, boundary layer surveys. Tunnel C data bad (condensation).
MBRV-34	Cone with Slice	S	MF	AEDC-A AEDC-C	2 5 10	18° 10°	F&M	Trapezoidal and rectangular flaps. Tunnel C data bad (condensation).
MBRV-35	Cone with Slice	S	MF	AEDC-F	2 6 10	12° 10°	F&M	Differential control deflections for roll control on FTV configurations. Plots of results. <u>Conical Nozzle</u> .
MBRV-60 Vol. I	Cone with Slice	S	MF	--	--	--	p F&M	MBRV flight test program. Introduction and summary. Limited flight test data.
MBRV-60 Vol. II	Cone with Slice	S	MF	--	--	--	--	MBRV flight test program. Flight test vehicle design. No data.
MBRV-60 Vol. III	Cone with Slice	S	MF	AEDC-A AEDC-B AEDC-C AEDC-F	2 6 10 20	20°	F&M p, q B.L. Survey	MBRV flight test program. Analytical & ground studies. Summary of ground test data. Also thermo tests (5MW, MALTA).
MBRV-60 Vol. IV	Cone with Slice	S	MF	--	--	--	--	MBRV flight test summary. Emphasis on FTV-602, 603 (w/maneuvers) Flight test data included.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M_∞	α		
ACE-1	Cone with Slice Cone with Double Slice	S,A	F	AEDC-A AEDC-B	2 to 8	24° 33°	F&M	Static stability. Variations in nosetip, slices, split controls. Plots of results.
ACE-2	Cone with Slice Cone with Double Slice	S	F	AEDC-A AEDC-B	2 to 8	24° 810°	F&M	Trip effects on stability. Pitch and yaw stability with differing control deflections. Plots of results.
ACE-3	Cone with Slice Cone with Double Slice	S	--	AEDC-F	12 15 16	25° 83°	F&M	Conical nozzle. Effects of lee slice on pitch and yaw stability. Plots and tabulations of results.
ACE-4	Cone with Slice Cone with Double Slice	S	F	AEDC-B AEDC-F	8 11 14.5	20°	p, q	Tripped turbulent flow. Conical nozzle in F, p, q on controls (nominal and contoured). Paint for leeside heating. Plots of results.
ACE-5	Cone with Double Slice	S	F	AEDC-F	7.5 11 14	20°	p, q	Tripped turbulent flow. Contoured nozzle. Paint used on control box. Goal: q near SWF; ablated controls tested. Plots of data.
ACE-6	Cone with Double Slice	S	F	AEDC-F	16 19	25° 83°	F&M	Laminar flow, conical nozzle. Lateral stability w/different control deflec- tions. Plots and summary of data.
ACE-9	Bicone Bicone with Double Slice	S	F	AEDC-F	16	20° 82.5°	F&M	Conical nozzle. Pitch and yaw stability at low α ; 2 forecone angles. Limited conical deflections. Limited plots of data.
ACE-10	Cone with Double Slice		F	AEDC-F	8 12 14	10°	p, q	Turbulent flow. Some paint data. Contoured nozzle $M_\infty = 8$, conical nozzle ($M_\infty = 12, 14$). Rectangular and trapezoidal controls.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M_∞	α		
ACE-11	Cone with Double Slice	S, A	F	AEDC-A AEDC-B AEDC-C	3 to 10	24° 20° 16°	F&M	Geometric variations: (R/Rg, θ), nose cant effects. Elliptic & super-circle flares. Plots of data.
ACE-14	Cone with Slice	S	F	AEDC-B	8		p, $\dot{q}$ Survey	Sharp & blunt 7° cone. Phase change paint for $\dot{q}$ pitot pressure probe. Some data included.
ACE-15	Cone with Slice	S	F	AEDC-B	8	20°	p, $\dot{q}$ Survey	Analysis & experiments on slice & flap. Plots of data.
ACE-20	Cone with Slice	S	F	AEDC-F	10.5	20°	p, $\dot{q}$	Tripped turbulent flow. Conical nozzle. R_g & δf variations. Thermocouples & paint for $\dot{q}$. Plots of data.
ACE-22 (Vol. I)	Cone with Slice Cone with Double Slice	S TC	F	--	--	--	--	ACE final report - summary. 3 flight tests; some flight data. Ground tests on TCNT.
ACE-22 (Vol. II)	Cone with Slice Cone with Double Slice Bicone with Slice Bicone with Double Slice	S TC	F	--	--	--	--	ACE final report-program description. Summary of flight, ground tests. Summary of biconic stuides.
ACE-22 (Vol. III)	Cone with Slice	S	F	--	--	--	--	ACE Final Report. Flight test summary FTV-1,2,3.
ACE-25 (Vol. II)	Bicone with Double Slice	A	F	AEDC-B AEDC-F	8	20°	F&M, p, $\dot{q}$	ACE-Bicone Aero Study. Thermo control & traj. analyses. Control predictions & data. Rect. & trapezoidal flaps.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	RODY	NOSE	CONTROL		M _∞	α		
ACE-25 (Vol. I)	Bicone with Double Slice	S	F	AEDC-B	8	20°	F&M	ACE Bicone Aero Study. Aero design, limited data shown.
ACE-25 (Vol. III)	Bicone with Double Slice	S	F	ARL NSWC-9 AEDC-B AEDC-F	3 to 18	20°	F&M	ACE Biconic Aero Study. Describes wind tunnel tests. Contains limited data.
ACE-28	Cone with Slice Cone with Double Slice	S	F	AEDC-F	16 19	25° 85°	F&M	Conical nozzle. Viscous and M _∞ effects on lateral stability. Plots of results.
ACE-30	Bicone with Double Slice	S	F	AEDC-F	8 12	25° 84°	F&M	Contoured nozzles (quoted M _∞ , Re _∞ (incorrect). Data with & w/o slice, flap. Some plots (also limited data from A, B, C).
ACE-31	Bicone with Double Slice	A	F	AEDC-G	12 14	0° ~0°	F&M	α _T = 0°. Some nosetip asymmetry de- veloped in one shot. 2 control de- flections tested.
ACE-32	Cone with Slice Cone with Double Slice	S	F	AEDC-A AEDC-B AEDC-C AEDC-F	3 to 18	30° 83°	F&M	Viscous effects on ACE FTV wind tun- nel data. Examination of viscous effects on data. Some data presented.
ACE-33	Bicone	S, A	F	--	--	--	--	3D0F, 6D0F, aero estimates based on documentation wind tunnel tests. Uncertainty analysis.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
AMaRV-4	Bicone with Double Slice	S,A	FYS F	AEDC-B AEDC-F NSWC-8A NSWC-9	--	--	--	AMaRV test plan-parametric & config. refinement w.t. test series. No data.
AMaRV-10	Bicone with Double Slice	S,A	FYS F	AEDC-B	8	27° B24°	F&M	Configuration variations. FYS, ablated control contours, cut modifications, "ablated" forecone. Nosetip. R _N variations.
AMaRV-12	Bicone with Double Slice	S,A	FYS F	AEDC-F	12.5	10°	P, q	Tripped turbulent flow. Contoured nozzle. Control surface effects. Various FYS, controls & nosetips.
AMaRV-20	Bicone	S,A	FYS F	AEDC-A AEDC-B	3.5 5 8	27° B10°	F&M	Tripped turbulent flow. Controls. FYS, w&w/o slices. Nosetips rolled 0°, 90°, 180°, 270°. Sample data only. Two balances (high, low α) for accurate λ_{app} .
AMaRV-24	Bicone with Double Slice	S,A	FYS F	AEDC-A AEDC-B AEDC-F NSWC-9	3.5 to 14	25°	F&M	AMaRV aero analyses. Ground test summary; Predictions & results prior to CDR.
AMaRV-26	Bicone with Double Slice	S,A	FYS F	--	--	--	--	AMaRV aerothermal analyses at CDR (iterim rpt). Analyses for thermal protection system.
AMaRV-31	Bicone with Double Slice	S,A	FYS F	AEDC-F	12.8	20° B2.5°	F&M	Turbulent flow. Contoured nozzle. FTV configuration. Control effectiveness with ablated nosetips (N/A, rolled 0°, 180°), controls, w&w/o FYS.
AMaRV-35	Bicone with Double Slice	S	FYS F	AEDC-A AEDC-B	3.5 5 8	25°	F&M	AMaRV aero analyses. Aero analyses since CDR. Comparisons to data for control effectiveness.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
AMaRV-38	Bicone with Double Slice	S	FYS F	AEDC-F	9 13	25° 85°	P, q	Tripped turbulent flow. Contoured nozzle: 8% & 15% blunt. Unablated & ablated FYS, controls. Sample data only.
AMaRV-39	Bicone with Double Slice	S,A	FYS F	--	--	25°	--	AMaRV aerothermo analysis. Final report. Analyses for thermal protection system.
AMaRV-43	Bicone with Double Slice	S,A	FYS F	--	--	-25°	--	AMaRV aero analysis. Aero analysis for FTV-3. Increased control ablation assumed for FTV-3. No explicit data.
AMaRV-48 Vol. I	Bicone with Double Slice	S	FYS F	FLIGHT	Var.	35°	F&M p, q	AMaRV post-flight report. Introduction & aero. comparisons to predictions.
AMaRV-48 Vol. II	Bicone with Double Slice	S	FYS F	FLIGHT	Var.	35°	F&M p, q	AMaRV-1 Post-Flight report. Thermo and loads data.

REFERENCE	CONFIGURATION			FACILITY	TEST CONDITIONS		DATA TYPE	COMMENTS & KEY WORDS
	BODY	NOSE	CONTROL		M _∞	α		
MK500-2	Bicone	S,A	FBN	AEDC-A AEDC-B	5,8	14°	Dynamic Stability	Forced oscillation tests for pitch and yaw damping. Most tests at αT. Various nosetips, δN, cone angles. Plots of results.
MK500-11	Bicone	S,A	FBN	AEDC-A AEDC-B AEDC-C	5,8, 10	24° 810°	F&M P	Mostly laminar, some trips. Ablated nosetips. Variations in δN. Plots of data.

SECTION 6
DETAILED DATA SUMMARY, REVIEW,
AND CRITIQUE

DETAILED DATA SUMMARY, REVIEW, AND CRITIQUE

This section contains the detailed data summary review and critique of those sources that contain information that are useful for detailed computer code validation. The objective of this review is to provide the user with sufficient information as to data type and content so that a judgement can be made whether the report contains the information desired for the specified use. The information contained includes the basic test objective, a description of the geometry, a detailed description of the data obtained, and some comments on the data utility and limitations relative to the MAT program objectives. It should be noted that the data itself are not contained, the reader is referred to the original sources for these details.

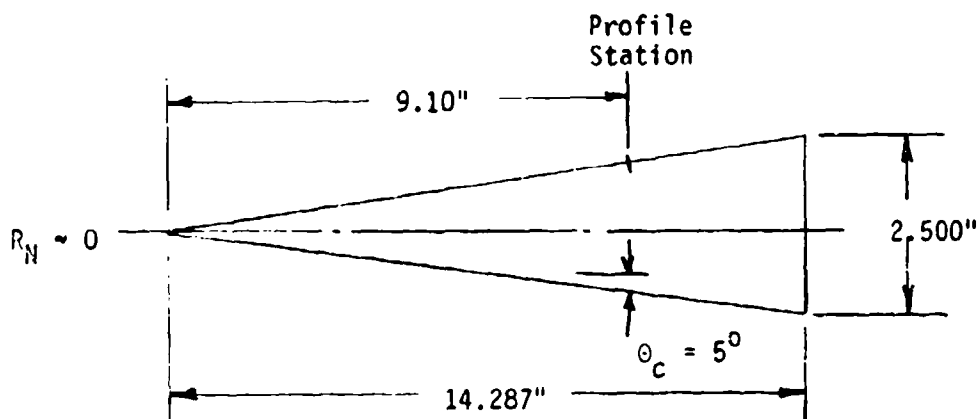
GROUND TEST DATA

DATA REVIEW

REFERENCE: 69-18 (NOLTR 69-187)

TEST OBJECTIVE: Probe the leeside flow field of a yawed sharp cone at large angle-of-attack

CONFIGURATION:



FACILITY: NSWC - TUNNEL 2 - $M_\infty = 5.07$

ANGLE OF ATTACK: 24°

DATA:

- SURFACE PRESSURE
- FLOW FIELD SURVEY (Leaside only)
 - FIVE HOLE CONE PROBE ----> M
 - PITOT PRESSURE, P_t ----> P, P_o
 - EQUIL. TOTAL TEMP. ----> T, T_o
- SCHLIEREN PHOTOS

TEST SUMMARY:

<u>Type of Measurement</u>	<u>Re_∞/FT</u>	<u>Azimuth Angle, ϕ</u>
<u>SURFACE PRESSURE</u>	2.2 x 10 ⁶ 4.4 x 10 ⁶	0° and 180° 0° through 180°
<u>FLOW-FIELD SURVEY</u>		
<u>Pitot Tube</u>	2.2 x 10 ⁶ 4.4 x 10 ⁶	180° (leeside) 135°, 150°, 160°, 165°, 180°
<u>Five-Hole Cone Probe</u>	2.2 x 10 ⁶ 4.4 x 10 ⁶	180° 130°, 140°, 150°, 160°, 165°, 170°, 180°
<u>Temperature Probe</u>	2.2 x 10 ⁶ 4.4 x 10 ⁶	180° 180°
<u>SCHLIEREN PHOTOGRAPHS</u>	4.4 x 10 ⁶	--

DATA UTILITY:

Data could be utilized to evaluate PNS code prediction capability on a sharp circular cone -- specifically on the leeside flow field where extensive cross flow separation has occurred.

LIMITATIONS:

Only leeside shock layer data were obtained at a fixed axial station for a laminar boundary layer flow. Therefore if PNS code agreement with data is poor, there are not enough other diagnostic measurements to establish cause.

DATA REVIEW

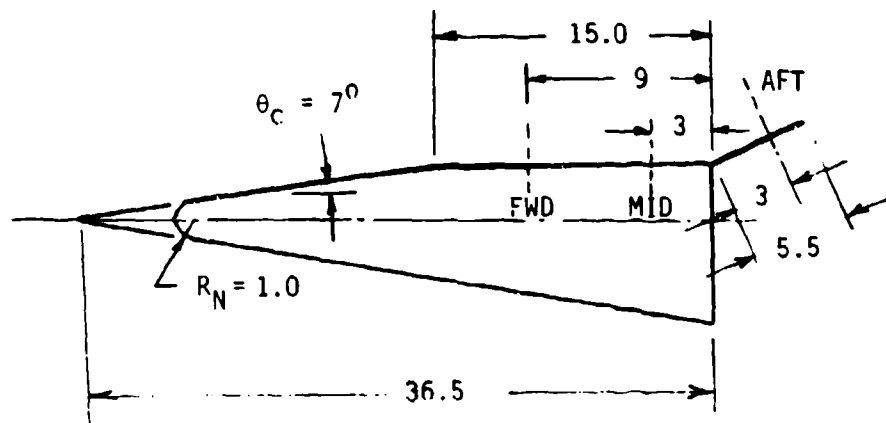
REFERENCE:

74-6 (AFFDL-TR-74-79)

TEST OBJECTIVE:

Determine the heating and pressure distributions, and shock layer surveys in the vicinity of the control element for a sharp and blunt nosed slender reentry body.

CONFIGURATION:



----- + survey stations

- 3 models were fabricated
 - one of stainless steel for pressure and survey measurements
 - two of RTV rubber for heat transfer
- spherical trips were used to promote turbulence

FACILITY:

AEDC VKF Tunnel B Mach 8

DATA:

Surface pressure (115 orifices)
Heat transfer via phase change paint data
Shock layer surveys
Pitot pressure
Shielded total temperature probe
Oil Flow - (surface streamlines)
Vapor Screen - (shock shape)
Schlieren and shadowgraphs

TEST SUMMARY: $M_\infty = 8$ $Re_\infty/ft = 3.7 \times 10^6$

Phase Change Paint Data (heat transfer)

- Angle of Attack - $0^\circ, 3^\circ, 6^\circ, 10^\circ, 20^\circ$
- Flap deflections - $0 \rightarrow 40^\circ$ in 5° increments.
(including some split flap data)
- Sharp and blunt configuration

Static Pressure

- Angle of Attack - $0^\circ, 3^\circ, 6^\circ, 10^\circ, 20^\circ$
- Flap deflections - $0 \rightarrow 40^\circ$ in 5° increments.
(including some split flap data)
- Sharp and blunt configuration

Shock Layer Survey

Sharp Nose

δ_F	Angle of Attack and Stations							
	$\alpha = 0 \text{ deg}$			$\alpha = 10 \text{ deg}$			$\alpha = 20 \text{ deg}$	
	Fwd	Mid	Aft	Fwd	Mid	Aft	Fwd	Mid
0	X	X	X	X	X	X	X	X
10			X		X	X		
20		X	X					

Blunt Nose ($R_n = 1 \text{ in.}$)

0	X	X	X	X	X	X	X	X
10			X		X	X		
20		X	X					
40	X	X						

DATA UTILITY:

The data contained in this report are useful for evaluating flap effectiveness on conical bodies with and without vortical flow (i.e., nose bluntness) effects. In addition, data of sufficient detail were obtained, over a large range of angle of attack and flap deflection angle, which makes this a useful source for detailed code validation. This is especially true for flow field codes such as the parabolized Navier Stokes and inviscid solutions of the Euler equations.

DATA LIMITATIONS:

Data were obtained with boundary layer trips, which at angle of attack could compromise the data reliability. That is, not enough effort was devoted to insure that the trips did not produce disturbances outside of the boundary layer. The data are further limited to one Mach number and Reynolds number.

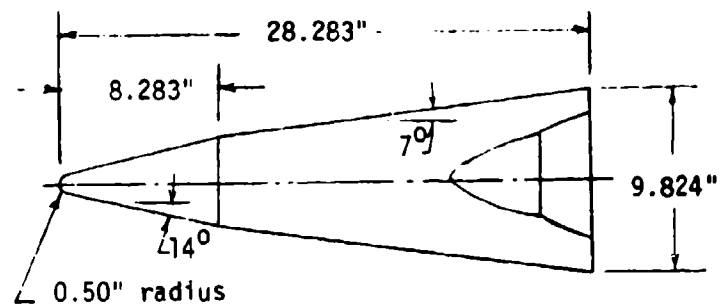
DATA REVIEW

REFERENCE: 79-9 (AEDC-TSR-79-V36)

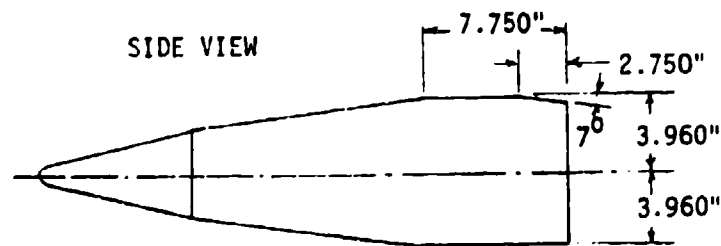
TEST OBJECTIVE: Provide a laminar flow data base for developing and validating analytical codes for predicting hypersonic aerodynamic characteristics of biconic bodies with single and multiple flat surfaces (slices)

CONFIGURATION:

TOP VIEW



SIDE VIEW



FACILITY: AEDC TUNNEL C - $M_{\infty}=10$

DATA:

- SURFACE HEAT TRANSFER
- SURFACE PRESSURE
- SURFACE TEMPERATURE
- FLOW FIELD SURVEY
- MACH/FLOW ANGULARITY PROBE
- PITOT PROBE
- SHIELDED TOTAL TEMPERATURE PROBE

TEST SUMMARY:

HEAT TRANSFER

Re_{∞}/FT	Angle of Attack, α	Azimuth Angle, ϕ
1.0×10^6	$0 \rightarrow 14^\circ$ in 1° increments	$0^\circ \rightarrow 40^\circ$ 5° increments $40^\circ \rightarrow 150^\circ$ 10° increments $150^\circ \rightarrow 180^\circ$ 5° increments
0.55×10^6	$0, 2^\circ, 5^\circ, 7^\circ, 10^\circ, 14^\circ$	$0, 180^\circ$

SURFACE PRESSURE - $Re_{\infty} = 1.0 \times 10^6 \text{ ft}^{-1}$
 $\alpha = 2^\circ, 10^\circ$
 $\phi = 0, 180^\circ$

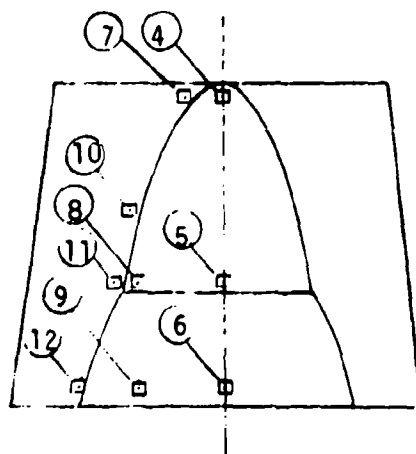
FLOW FIELD SURVEY - $Re_{\infty} = 1.0 \times 10^6 \text{ ft}^{-1}$

FORECONE - 1 AXIAL STATION
AFTCONE - 1 AXIAL STATION

} $\alpha = \pm 2^\circ, \pm 10^\circ$

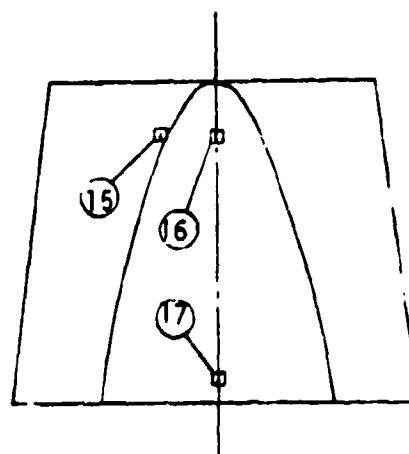
WINDWARD SLICE

$\alpha = -2^\circ, -10^\circ$



LEEWARD SLICE

$\alpha = 2^\circ, 10^\circ$



DATA UTILITY:

Data could be used to evaluate flow field code prediction capability, for laminar flow, on a blunted bicone with localized departure from a circular cross section (i.e. windward slice/cut and leeward slice). For the 10° case, leeside flow is separated - good data for PNS code validation.

LIMITATIONS:

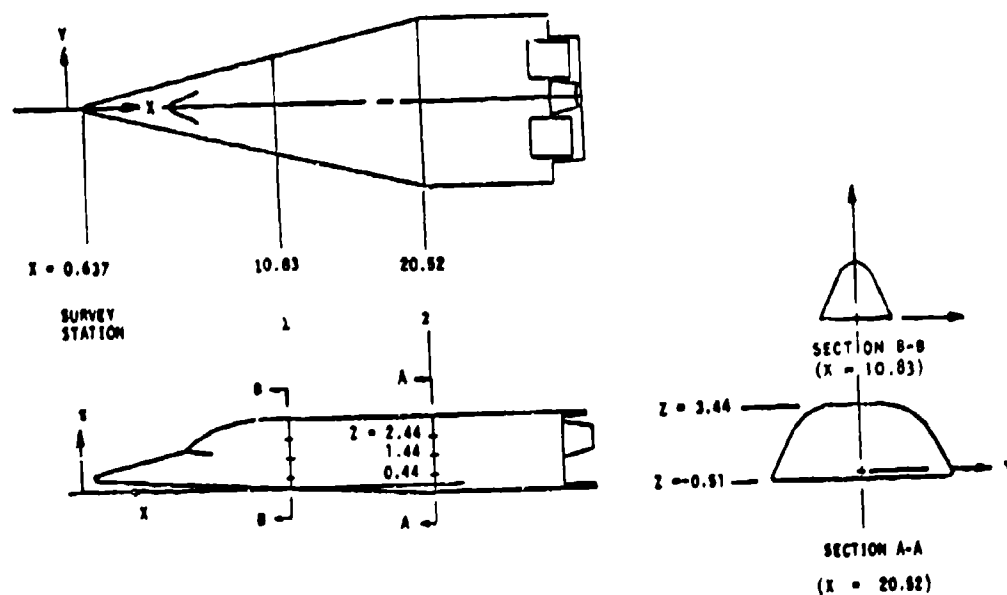
Laminar data taken with $\alpha_{\max} = 10^\circ$. It would be desirable to have data with $\alpha \rightarrow 20^\circ$. Data not useful for testing real gas capability of codes.

DATA REVIEW

REFERENCES: 79-11 (AEDC-TSR-79-V47)
80-8 (AEDC-TSR-80-V22)

TEST OBJECTIVE: Define the local Mach number and flow angle within the bow shock of the X-24C configuration to provide a data base for use in validating flow field codes.

CONFIGURATION: X-24C (FOREBODY)



FACILITY: AEDC VKF TUNNEL B

DATA: MACH/FLOW ANGULARITY SURVEY
Shadowgraphs

TEST SUMMARY:

$M_{\infty} = 6$

$R_{e\infty}/ft = 3.08 \times 10^6$

Mach/Flow AngularitySurvey Sta. (X) α Azimuth Angle, ϕ

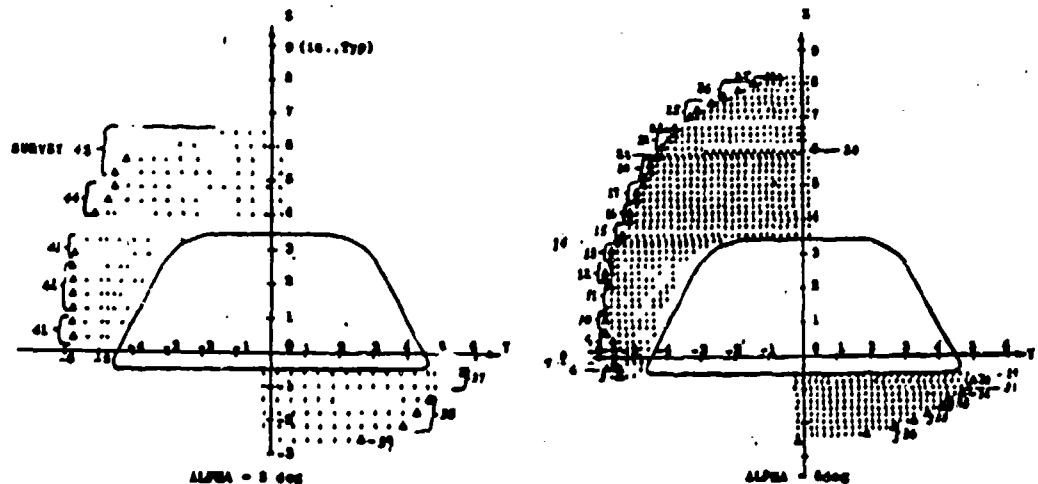
20.52

 $2^{\circ}, 6^{\circ}, 12^{\circ}, 20^{\circ}$ $0^{\circ} \rightarrow 180^{\circ}$

10.83

 $6^{\circ}, 20^{\circ}$ $0^{\circ} \rightarrow 180^{\circ}$

For illustrative purposes only, the sketch below defines the data density at the survey station $X = 20.52$

DATA UTILITY:

The data obtained are extremely useful for evaluating flow field code prediction capability for a non-circular cross-section lifting body.

LIMITATIONS:

In these reports, only Mach/Flow angularity data were obtained. Although these data are a useful diagnostic tool for technique validation it is not sufficient for a total technique evaluation. It would be desirable to have total temperature, Pitot pressure and surface Preston tube data as well. It should also be recognized that these data are for one specific non-circular cross section configuration and consequently is therefore limited in its utility.

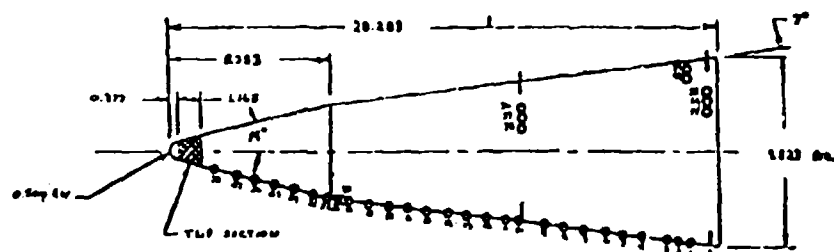
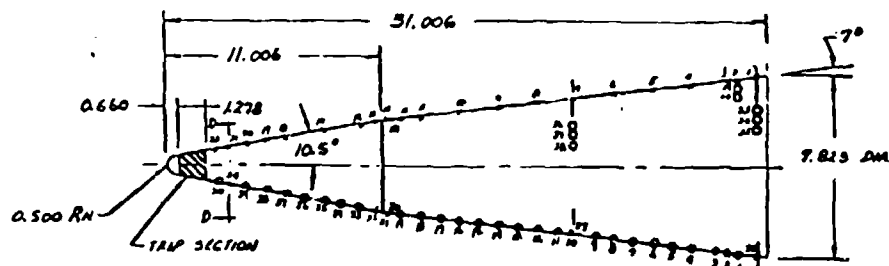
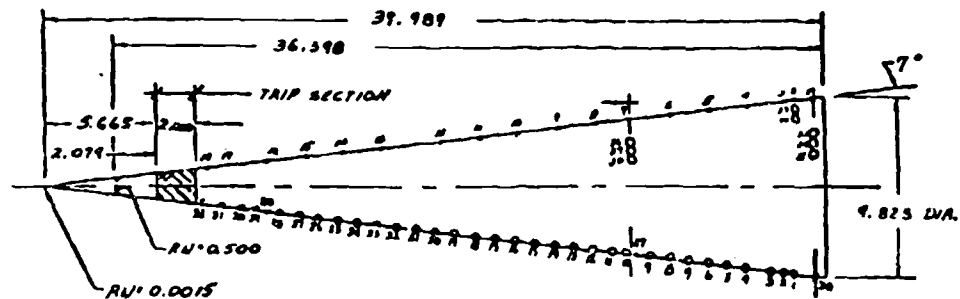
DATA REVIEW

REFERENCE: 80-7 (AEDC-TSR-80-V14)

TEST OBJECTIVE: Provide a turbulent flow data base for sharp cones and blunt cones and bicones which could be used to validate analytic codes.

CONFIGURATION: (B. L. TRIP 0.060" height machined V GROOVE)

x PRESSURE ORIFICES o HEAT TRANSFER GAGES



FACILITY: AEDC VKF TUNNEL B - $M_\infty = 8$

DATA: SURFACE HEAT TRANSFER
SURFACE PRESSURE
FLOW FIELD SURVEY
MACH/FLOW ANGULARITY PROBE
PITOT PROBE
SHIELDED TOTAL TEMPERATURE PROBE
PRESTON TUBE

TEST SUMMARY:

(NOTE - All Tests w/trips unless otherwise noted)

HEAT TRANSFER

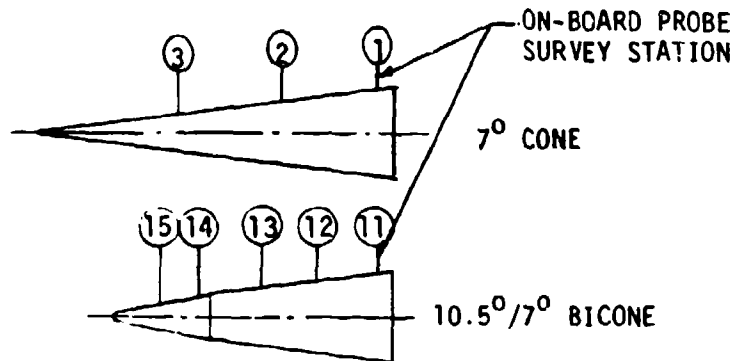
Geometry	$Re_{\infty}/ft \times 10^{-6}$	α	Azimuth Angle, ϕ
7° Sharp Cone	0.6, 1.0 1.0, 2.5, 3.7	0, 7°, 10° 0, 2°, 4°, 7°, 10°	180° (w/o trips) 0→180° in 45° increments
0.5" Blunt Cone	1.0 1.0, 1.5, 2.5, 3.7	0 0, 4°, 7°, 10°	180° (w/o trips) 0→180° in 45° increments
0.5" Blunt 10.5°/7° Bicone	3.7	0, 4°, 7°, 10°	0→180° in 45° increments
0.5" Blunt 14°/7° Bicone	3.7	0, 4°, 7°, 10°	0→180° in 45° increments

SURFACE PRESSURE AND PRESTON TUBE

Geometry	$Re_{\infty}/ft \times 10^{-6}$	α	Azimuth Angle, ϕ
7° Sharp Cone	3.7	0, 4°	0, 40°, 80°, 130°, 180°
0.5" Blunt Cone	3.7	0, 4°, 10°	0, 20, 40, 60, 80, 105, 130, 180°
0.5 Blunt 10.5°/7° Bicone	3.7	0, 4°, 10°	0, 40°, 80°, 130°, 180°

FLOW FIELD SURVEY - $Re_{\infty} = 3.7 \times 10^6 \text{ ft}^{-1}$

SURVEY STATIONS
(OVERHEAD PROBE)



Geometry	α	Azimuth Angle, ϕ	
		Overhead Probe	Onboard Probe
7° Sharp Cone	$0, \pm 4^\circ, \pm 10^\circ$	180°	--
	$0, 4^\circ$	--	$10^\circ \rightarrow 120^\circ$
0.5" Blunt Cone	$0, \pm 4^\circ, \pm 10^\circ$	180°	--
	$4^\circ, 10^\circ$	--	$10^\circ \rightarrow 120^\circ$
0.5 Blunt	$0, \pm 4^\circ, \pm 20^\circ$	180°	--
10.5°/7° Bicone	$4^\circ, 10^\circ$	--	$30^\circ \rightarrow 120^\circ$

DATA UTILITY:

Data would be useful for evaluating flow field code prediction capability, for turbulent flow, on a sharp circular cone and blunted circular cone and bicones. At $\alpha = 10^\circ$ leeside separation should be present -- good data for PNS code validation.

LIMITATIONS:

The maximum angle of attack for which data were taken was 10° -- it would have been useful to provide data for $\alpha/\theta_c \approx 3$. For the blunted cases, turbulent flow conditions were achieved by 60 mil machined roughness grooves. The effect these have on the surface and profile data quality, especially at angle of attack, is not known. Relative to these tests,

the diagnostic information for boundary layer trip effects on the data quality were performed over an angle of attack range using surface heat transfer, and at zero angle of attack only using the shock layer probe data. This information may be found in AEDC-TSR-78-V24 and V25 (August 1978 and April 1978, respectively).

DATA REVIEW
ELLIPTIC CROSS-SECTION CONES

The documents that contain experimental aerodynamic and aerothermodynamic ground test results for elliptic cross-section cone configurations are collectively reviewed and summarized in the table below.

REF.	A/B	NOSE SHAPE		r_n	α	DATA TYPE			R_e /FT $\times 10^{-4}$	LA (in.)	REMARKS
		SHARP	BLUNT			F&T	P	q			
58-1	1.5 3.0 6.0	X	-	1.97 2.94	16°	X	X	-	9.7	9.9	EXCELLENT BASIC REPORT ON LOW M RESULTS
59-1	1.39 1.78	X	-	3.09 6.0	20°	-	X	-	0.30 0.03	4.5	LIMITED DATA BASE
59-2 61-4	2.0	X	-	5.8	14° #10°	-	X	-	0.02	4.2	LIMITED DATA BASE
59-3	1.39 1.78 3.68	X	-	3.09 5.94	15°	-	X	-	0.30 0.03	4.5	LIMITED DATA BASE
64-4	1.43 2.0	X	- X	10	60°	-	-	X	0.34 1.10 2.38	16.0	TUNNEL CONDENSATION EFFECTS COMPROMISE DATA
64-28	1.46	-	X	0.6 to 1.4 2.3, 4, 5, 8, 10	30° #10°	X	-	-	1.65 TO 3.54	8.0 13.5	LARGE DATA BASE FOR BLUNTED CONES
65-7	1.22	-	X	8	90°	X	X	-	1.81	18.0	BLUNTED HALF-CONE DATA OVER WIDE M RANGE
65-14	1.43 1.50 2.0	X	X	10 14	60°	-	X	X	0.06 TO 2.3	11.1 14.3 16.0	LARGE q DATA BASE LIMITED PRESSURE DATA
69-9	1.85	X	-	3.0 TO 6.0	16°	X	-	-	1.12 2.99 4.67	25.7	LIMITED DATA BASE FOR UPSTAGE CONFIGURATION
73-2	2.25	X	X	8	60°	-	-	X	2.0 TO 3.7	30.0	PAINT DATA EVALUATION OF BOUNDARY LAYER TRANSITION

DATA UTILITY:

These references collectively provide a variety of force and moment, pressure and heat transfer data for bodies with elliptic cross section that could be used to assess the validity of flow field prediction codes.

LIMITATIONS:

A complete data set (force and moment, pressure, heat transfer) does not exist for any combination of configuration and test condition. Also, no diagnostic shock layer data are available.

DATA REVIEW

ADVANCED CONTROL EXPERIMENT (ACE) PROGRAM

The documents that define the experimental aerodynamic and thermodynamic test results for the BMO ACE program are collectively reviewed and summarized below. Reports in this series are, in general, classified SECRET and can be obtained through DTIC with BMO approval. ARV (Pre-ACE) testing is not included because thermal deformations of the models, as a result of the pitch-pause run mode, were later determined to substantially influence the measured aerodynamic forces and moments. In addition, the data taken in the AEDC Tunnel F facility should be viewed with caution since a conical nozzle was employed. This nozzle provided a source flow and consequently affected the measured forces and moments. Analytic studies performed circa 1973 indicated that at Mach 16, for an $8^\circ/6^\circ$ biconic with $R_n/R_b = 0.1$, the error in x_{cp} between source flow and uniform flow results were 1/2 to 1% of L_A .

AEROTHERMODYNAMIC WIND TUNNEL TEST SUMMARY

OVERALL TEST OBJECTIVE:

To provide aerothermodynamic data on the ACE configuration for use in design and to support preflight predictions.

CONFIGURATION:

The configuration is classified SECRET. A description of the geometry and the tests may be found in the ACE Program Final Report Volume I (Ref. ACE-22). Volume III (Ref. ACE-22) presents a summary of the data analysis and comparison with flight data. More thorough discussions of the data analysis are available in miscellaneous other ACE references. These are summarized below:

ACE PROGRAM AERODYNAMIC TESTS

1. TEST OBJECTIVES:

To provide control effectiveness data to verify FTV-3 predictions.

MODEL DESCRIPTION:

ACE configuration with 2 cuts and deflectable controls and with 2 interchangeable forecones (different angles).

$$D_{\text{BASE}} = 6.3 \text{ IN.}$$

$$L = 24 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

FACILITY

M_{∞}

Re_{∞}/FT

AEDC F

12

5.5×10^6

Note: Conical nozzle was used.

INSTRUMENTATION:

Surface pressure and heat transfer rate measurements.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

ACE Reentry Vehicle High Mach Number Flap Effectiveness Wind Tunnel Test, (Ref. ACE-19).

FACILITY REPORTS:

Pressure and Heat Transfer Tests on the SAMS0/McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Number 12, (Ref. ACE-12).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

2. TEST OBJECTIVES.

To evaluate viscous interaction effects on pitch and yaw stability and drag at high angles of attack.

MODEL DESCRIPTION:

ACE configuration with 2 cuts and deflectable controls.

$$D_{\text{BASE}} = 4 \text{ IN.}$$

$$L = 16 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC F	16	$0.2 - 0.7 \times 10^6$
	19	$0.1 - 0.6 \times 10^6$

Note: Conical nozzle was used.

INSTRUMENTATION:

6-component balance = 2 base pressures (+ 1 control surface pressure and 2 surface heat transfer rate measurements for selected runs).

DOCUMENTATION:

TEST RESULTS AND ANALYSIS: Examination of Viscous Effects in ACE High-Angle-of-Attack Directional-Stability Wind Tunnel Data, (Ref. ACE-18).

FACILITY REPORTS:

Lateral Static Stability Tests of the Advanced Control Experiment (ACE) Vehicle at High Angle of Attack and Mach Numbers 16 and 19, (Ref. ACE-16).

Lateral Static Stability Tests of the Advanced Control Experiment (ACE) Vehicle at High Angle of Attack and Mach Numbers 15 and 20, (Ref. ACE-17).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

3. TEST OBJECTIVES:

To obtain basic stability and control effectiveness data for various biconic configurations.

MODEL DESCRIPTION:

Biconic with various noses (8 spherical and 8 ablated), 4 different forcone angles, 3 different biconic juncture stations, 6 different cut configurations, 6 different control geometries, and flared and skirted configurations for yaw stability enhancement.

$$D_{\text{BASE}} = 8 \text{ IN.} \quad L = 32 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC A	3 & 5	4.2×10^6
		6.5×10^6
AEDC B	8	3.5×10^6
AEDC C	10	2.2×10^6

INSTRUMENTATION:

6-Component Balance

DOCUMENTATION:

TEST RESULTS:

ACE Biconic Configuration Refinement
Aerodynamics Testing at Low Hypersonic
Mach Numbers (Ref. ACE-24).

DATA ANALYSIS:

ACE Biconic Aerodynamics and Requirements
Study, Final Report, Volume 1 (Ref. ACE-25).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

4. TEST OBJECTIVES:

To provide parametric data on biconic configurations and to provide parallel flow data to evaluate the source flow corrections made to the AEDC Tunnel F data.

MODEL DESCRIPTION:

Bicone with 2 different forecones and 5 different nose tips (1 spherical and 4 ablated shapes) capable of being tested with or without a single cut/control geometry.

$$D_{\text{BASE}} = 3 \text{ IN.}$$

$$L = 12 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
ARL 20" TUNNEL	14.2	0.6×10^6

INSTRUMENTATION:

3-component balance (for first 2 entries),
5-component balance (for second 2 entries).

DOCUMENTATION:

TEST RESULTS:

ACE Biconic Configuration Refinement Aerodynamic Testing in the ARL 20 Inch Hypersonic Wind Tunnel, (Ref. ACE-23).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

5. TEST OBJECTIVES:

To provide an independent source of data for establishing uncertainties in hypersonic tunnel data and to develop methods for applying ballistic range to MRV testing.

MODEL DESCRIPTIONS:

Blunt bicones with windward cuts and with fixed controls set to trim at $\alpha \approx 0$.

$$D_{\text{BASE}} = 1.0 \text{ IN.} \quad L = 4 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC RANGE G	12-14	$3.6 - 30 \times 10^6$

INSTRUMENTATION:

Position - attitude - time measurements from shadowgraph photos.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

ACE Biconic Aerodynamics and Requirements Study, Final Report, Volume III, (Ref. ACE-25).

FACILITY REPORTS:

Free Flight Investigation of the Aerodynamic Characteristics of the Small Evader Vehicle, (Ref. 73-16).

Free Flight Range Tests of an ACE Biconic Configuration at Mach Numbers of 11.9 to 14.3, (Ref. ACE-31).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

6. TEST OBJECTIVES:

To verify accuracy of predictions, to determine viscous effects on stability, and to evaluate accuracy and credibility of data from various facilities.

MODEL DESCRIPTION:

Blunt bicone tested with a single nose bluntness, with and without a single windward and leeward cut geometry, and two separate control configurations (one with trapezoidal edges).

$$D_{\text{BASE}} = 8 \text{ IN.} \quad L = 32 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC A	3	4×10^6
AEDC A	5	$1-6.5 \times 10^6$
AEDC B	8	$1-4 \times 10^6$

INSTRUMENTATION:

6-component balance = 4 base pressures + cut surface pressures ($M_{\infty} = 5$ only).

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

ACE Biconic Aerodynamics and Requirements Study, Final Report, Volume III, (Ref. ACE-25).

FACILITY REPORTS:

Static - Stability Characteristics of the Advanced Control Experiment (ACE) Biconic - Phase II Vehicle at Mach Number from 3 to 10, (Ref. ACE-13).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

7. TEST OBJECTIVES:

To verify accuracy of predictions, to determine viscous effects on stability, and to evaluate accuracy and credibility of data from various facilities.

MODEL DESCRIPTION:

Blunt bicone with a single nose bluntness capable of being tested with or without a single cut configuration and control geometry.
(Same model was tested in NSWC tunnel 8a and in ARL 20" tunnel.)

$$D_{\text{BASE}} = 3 \text{ IN.} \quad L = 12 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC B	8	$0.6-3.5 \times 10^6$
ARL 20"	14	0.6×10^6
NSWC 8a	18	0.6×10^6

INSTRUMENTATION:

6-component balance + 4 base pressures (AEDC B and ARL 20"), 4-component balance + 2 base pressures (NSWC 8a), + 2 cut surface pressures and 6 surface heat transfer rate measurements (AEDC B only).

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

ACE Biconic Aerodynamics and Requirements Study, Final Report, Volume III, (Ref. ACE-25).

ACE PROGRAM AERODYNAMIC TESTS (CONT'D)

8. TEST OBJECTIVES:

To verify accuracy of predictions, to determine viscous effects on stability, and to evaluate accuracy and credibility of data from various facilities.

MODEL DESCRIPTION:

Blunt bicone with single nose bluntness capable of being tested with and without a single cut configuration and control geometry. $M_\infty = 12$ testing was initially begun with balsa wood core model covered with a thin magnesium skin (Designed for $M_\infty = 16$ load conditions) but this model deformed excessively during higher load conditions and was replaced with the solid magnesium model.

$$D_{\text{BASE}} = 4 \text{ IN.} \quad L = 16 \text{ IN.}$$

(Also, a 70° sharp cone was tested for diagnostic purposes)

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞/FT</u>
AEDC F	8	$10-40 \times 10^6$
	12	5.8×10^6

INSTRUMENTATION:

6-component balance + 4 base pressure, stagnation pressure, and 3 surface heat transfer rate measurements.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

ACE Biconic Aerodynamics and Requirements Study, Final Report, Volume III, (Ref. ACE-25).

ACE PROGRAM THERMODYNAMIC TESTS

1. TEST OBJECTIVE:

To provide thermal mapping of all exposed surfaces and assist placement of discrete sensors in subsequent tests.

MODEL DESCRIPTION:

30% scale model with changeable flap deflection angles of 4° , 8° , 12° , 16°

$D_{\text{BASE}} = 6.28 \text{ IN.}$ $L = 23.9 \text{ IN.}$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
KMS	7.6	---

INSTRUMENTATION:

Paint

DOCUMENTATION:

TEST RESULTS:

"Wind Tunnel Measurements of Aeroheating and Pressure for a 30% Model of the ACE Vehicle at Mach Numbers of 8, 11, and 14, Volume I," Part 1, (Ref. ACE-8).

ACE PROGRAM THERMODYNAMIC TESTS (CONT'D)

2. TEST OBJECTIVE:

To obtain control surface pressure and heating data prior to start of the principal thermodynamic test program.

MODEL DESCRIPTION:

Modified 37.5% aerodynamic model with changeable flap angles of 5° , 7.5° , 10° , 15°

$D_{\text{BASE}} = 7.85 \text{ IN.}$ $L = 29.9 \text{ IN.}$

FACILITY DESCRIPTION:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC B	8	3.6×10^6

INSTRUMENTATION:

Pressure and heat sensors on the flaps only.
Heat sensors were 0.25 inch Gardon gages.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

"Wind Tunnel Measurements of Aeroheating and Pressure for a 30% Model of the ACE Vehicle at Mach Number 8, 11, and 14, Volume I," Part 2, (Ref. ACE-8).

ACE PROGRAM THERMODYNAMIC TESTS (CONT'D)

3. TEST OBJECTIVES:

To provide detailed pressure and heating data over the entire model, with particular emphasis on the submerged surfaces of the flap assembly.

TEST BACKGROUND:

This test program evolved into five series of tests. Each new series was conducted to provide an expanded investigation of some problem detected in an earlier series. Most of these problems involved some portion of the flap assembly.

MODEL DESCRIPTION:

30% scale model with three sets of flaps representing different stages of ablated surface geometry, and changeable flap angles of 4° , 8° , 10° , 12° , 16° , 20° .

$$D_{\text{BASE}} = 6.28 \text{ IN.}$$

$$L = 23.9 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

	<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
1)	AEDC F	11	10×10^6
		14	3×10^6
2)	AEDC F	11	10×10^6
		8	30×10^6
		11	10×10^6
3)	AEDC F	14	3×10^6
		11	10×10^6
		14	3×10^6
4)	AEDC F	8	30×10^6
		11	10×10^6

Note: conical nozzle used

INSTRUMENTATION:

Pressure, heating rate, and temperature sensitive phosphor paint. Heat sensors were sizes of RT and coax gages.

ACE PROGRAM THERMODYNAMIC TESTS (CONT'D)

DOCUMENTATION:

TEST RESULTS AND
ANALYSIS:

"Wind Tunnel Measurements of Aeroheating and Pressure for a 30% Model of the ACE Vehicle at Mach Numbers of 8, 11, and 14, Volume I, " (Ref. ACE-8).

TABULATED DATA
AND PHOTOS:

"Wind Tunnel Measurements of Aeroheating and Pressure for a 30% Model of the ACE Vehicle at Mach Numbers of 8, 11, and 14, Volume II," (Ref. ACE-8).

ACE PROGRAM THERMODYNAMIC TESTS (CONT'D)

4. TEST OBJECTIVES:

To determine bluntness and biconic configuration effects on frustum and control surface thermal environment.

MODEL DESCRIPTION:

Biconic with alternate 15% and 20% blunt nose tips and changeable flap angles of 5° , 7.5° , 10° , 15° .

$$D_{\text{BASE}} = 8 \text{ IN.}$$

$$L = 32.2 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞/FT</u>
AEDC B	8	3.5×10^6

INSTRUMENTATION:

Pressure and heating rate (Gardon gages)

DOCUMENTATION:

TESTS RESULTS AND ANALYSIS:

"Ace Biconic Aerodynamics and Requirements Study, Final Report - Volume II," (Ref. ACE-25).

FACILITY REPORT:

"SAMSO - MDAC/SEV Tunnel B Heat Transfer and Pressure Data," (Ref. 72-15).

ACE PROGRAM THERMODYNAMIC TESTS (CONT'D)

5. TEST OBJECTIVES:

To support thermal prediction methodology development for the ACE biconic configuration, with particular emphasis on the control surfaces.

MODEL DESCRIPTION:

Biconic with changeable flap angles of -15° , 10° , 15° , 20° and one alternate trapezoidal planform configuration.

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC F	8	50×10^6
	12	10×10^6
	14	8×10^6

Note: Conical nozzle used.

INSTRUMENTATION:

Pressure, heating rate, and temperature sensitive phosphor paint. Heat sensors were RT and coax gages.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

"Biconic Reentry Vehicle Flap Effectiveness Tests at Mach Number of 8, 12 and 14," (Ref. ACE-26).

FACILITY REPORT

"Pressure and Heat Transfer Rate Test Results on the SAMSO/McDonnell Douglas Advanced Control Experiment (ACE) Vehicle at Mach Numbers 8, 12 and 14," (Ref. ACE-10).

DATA ANALYSES:

"Ace Biconic Aerodynamics and Requirements Study, Final Report - Volume II," (Ref. ACE-25).

ACE TEST PROGRAM SUMMARY

DATA UTILITY:

The data obtained under the auspices of the BMO/ACE program provides a formidable data set for blunted cones and bicones with slices - cuts - and flaps. These data were obtained over a wide range of Mach numbers from 3 to 19 for laminar and turbulent boundary layer flows. Surface pressure, heat transfer, and force and moment data were obtained. Effects of nose tip bluntness on the local flow properties and aerodynamic coefficients are available for spherical, non-spherical axisymmetric, and asymmetric nosetip geometries. These data were useful not only in providing assistance in the design of the ACE vehicles but also provide a useful library of information with which to evaluate the accuracy of predictive aerothermodynamic tools.

LIMITATIONS:

Although the data were obtained over a wide range of Mach numbers, the data obtained in Tunnel F were obtained in the conical nozzles ($M = 8 \rightarrow 19$). These data suffer from the axial pressure gradients associated with the source flow present in these nozzles.

For this entire test series, only surface properties were measured, consequently if predictive techniques disagree with the measurements, there is insufficient diagnostic flow properties available to ascertain the error source. This is especially true for the flow in the slice-flap regions of the body. Furthermore, real gas effects which are present in flight for $M \gtrsim 10$ are not simulated in the tunnels, therefore these data cannot be directly scaled (e.g. by Reynolds number) to the flight case.

ADVANCED MANEUVERING REENTRY VEHICLE (AMaRV) PROGRAM

Similar to the summary for the ACE program, the documents that define the experimental aerodynamic and thermodynamic test results for the BMO/AMaRV program will be collectively reviewed and summarized. All reports in this series are classified SECRET and can be obtained through DTIC with BMO approval. Contrary to the ACE program tests, the AMaRV program utilized the AEDC Tunnel F when contoured nozzles were available and consequently the acquired data do not suffer the deficiencies discussed for the conical nozzle (source flow) cases.

OVERALL TEST OBJECTIVE:

To provide aerothermodynamic data on the AMaRV configuration for use in design and to validate a pretest (ground and flight) prediction capabilities.

CONFIGURATION:

The configuration is classified SECRET. A description of the geometry and the overall aerodynamic test summaries may be found in References (AMaRV-24, 36, and 41). More thorough discussions of the data analysis are available in the several other AMaRV references, highlights of which are summarized below:

AMaRV AEROTHERMODYNAMIC TESTS

1. TEST OBJECTIVE:

To provide data on stability and control effectiveness in a high Mach number laminar separated flow environment.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable nooses (3), and a single set of cut, flap, and stabilizer geometries.

$$D_{\text{BASE}} = 4 \text{ IN.}$$

$$L = 14 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
NSWC 8a	18	0.6×10^6

INSTRUMENTATION:

4-component balance

DOCUMENTATION:

TEST RESULTS:

AMaRV Aerodynamics Testing Report, Parametric Test Phase, (Ref. - AMaRV-15).

FACILITY TEST REPORT:

Parametric Tests of the AMaRV Configuration at Mach 18 in NSWC/WOL Tunnel 8a, (Ref. AMaRV-8).

DATA ANALYSIS:

AMaRV Aerodynamic Analyses,

(Book I AMaRV-24)

(Book II AMaRV-36)

(Book III AMaRV-43)

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

2. TEST OBJECTIVE:

To provide data on body stability and control, and stabilizer effectiveness for environments best simulating the critical design conditions.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses (5), 2 different cut geometries, and a single control and stabilizer geometry.

$D_{\text{BASE}} = 15 \text{ IN.}$ $L = 53 \text{ IN.}$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
NSWC 9	14	$0.9 - 4.0 \times 10^6$

INSTRUMENTATION:

4-component balance + 92 pressure and heat transfer rate transducers concentrated in control and stabilizer regions.

DOCUMENTATION:

TEST RESULTS:

AMaRV Aerodynamics Testing Report, Parametric Test Phase, (Ref. AMaRV-15).

FACILITY TEST REPORT:

Parametric Tests of the AMaRV at $M_{\infty} = 14$ in the NSWC/WOL Hypervelocity Tunnel 9, (Ref. AMaRV-13).

DATA ANALYSIS:

AMaRV Aerodynamic Analyses, (same as for #1 Test Objective).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

3. TEST OBJECTIVE:

To provide parametric configuration data to support the AMaRV configuration design task.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses (10), 3 different control/cut geometries, 2 ablated forecone geometries, and 6 pairs of yaw stabilizers.

$D_{BASE} = 8 \text{ IN.}$

$L = 28 \text{ IN.}$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC B	8	3.5×10^6

INSTRUMENTATION:

6-component balance + 2 base pressures.

DOCUMENTATION:

TESTS RESULTS:

AMaRV Aerodynamics Testing Report, Parametric Test Phase, (Ref. AMaRV-15).

FACILITY TEST REPORT:

Static-Stability Characteristics of the AMaRV Prototype at Mach Number 8, (AMaRV-10).

DATA ANALYSIS:

AMaRV Aerodynamic Analyses, (same as for #1 Test Objective).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

4. TEST OBJECTIVE:

To provide design verification data necessary to support final definition of the AMaRV baseline configuration.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses, capable of being tested with and without cut, with and without controls set at various deflections, and with and without yaw stabilizers.

$$D_{\text{BASE}} = 15 \text{ IN.}$$

$$L = 53 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	M_{∞}	Re_{∞}/FT
NSWC 9	14	4.0×10^6

INSTRUMENTATION:

4-component balance + stagnation pressure measurement.

DOCUMENTATION:

FACILITY TEST REPORT:

Documentation Tests of the AMaRV at $M_{\infty} = 14$ in the NSWC/WOL Hypervelocity Tunnel 9, (Ref. AMaRV-32)

DATA ANALYSIS:

AMaRV Aerodynamic Analysis, (Ref. AMaRV-24). Supplement (Ref. AMaRV-36).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

5. TEST OBJECTIVE:

To provide design verification data necessary to support final definition of the AMaRV baseline configuration.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses, capable of being tested with and without cut, with and without controls set at various deflections, and with and without yaw stabilizers.

$$D_{\text{BASE}} = 8 \text{ IN.}$$

$$L = 28 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC A	3.5	4.1×10^6
AEDC A	5	5.6×10^6
AEDC B	8	3.5×10^6

INSTRUMENTATION:

6-component balance + 2 base pressure measurements.

DOCUMENTATION:

TEST RESULTS:

AMaRV Aerodynamics Testing, Report, Documentation Test Phase (Ref. AMaRV-32).

FACILITY TEST REPORT:

Documentation Test Results for the AMaRV Prototype at Mach numbers 3, 5, 5.0 and 8.0, (Ref. AMaRV-20).

DATA ANALYSIS:

AMaRV Aerodynamic Analysis,

(Book I - Ref. AMaRV-24)

(Book II - Ref. AMaRV-36)

(Book III - Ref. AMaRV-43)

AMaRV Aerodynamic Characteristics, Aerospace Corporation Report (Ref. AMaRV-41).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

A Summary of the AMaRV Pitch Plane Wind Tunnel Data and Comparison with Theory, (Ref. AMaRV-37).

An Analysis of AMaRV Control Surface Characteristics in Turbulent flow, (Ref. AMaRV-40).

Longitudinal Stability of AMaRV Under Tunnel and Flight Conditions in Turbulent Flow, (Ref. AMaRV-46).

Test Plan for AMaRV Parametric and Configuration Refinement Wind Tunnel Test Series, (Ref. AMaRV-4).

Note: Data analysis reports from AEDC and SAMSO document independent analyses that were performed to check MDAC's aerodynamic estimates (i.e., independent interpretation of wind tunnel test results).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

6. TEST OBJECTIVE:

To provide design verification data necessary to support final definition of the AMaRV baseline configuration.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses, capable of being tested with and without cut, with and without controls set at various deflections, and with and without yaw stabilizers.

$$D_{\text{BASE}} = 12 \text{ IN.}$$

$$L = 43 \text{ IN.}$$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_{∞}</u>	<u>Re_{∞}/FT</u>
AEDC F	12.5	4.0×10^6

INSTRUMENTATION:

6-component balance + 4 model surface pressure, nose stagnation pressure, 2 base pressure and 2 surface heat transfer measurements.

DOCUMENTATION:

TEST RESULTS:

AMaRV Aerodynamics Testing Report, Documentation Test Phase, (AMaRV-32).

FACILITY TEST REPORT:

Test Results on the AMaRV at Mach 12.8, (Ref. AMaRV-31).

DATA ANALYSIS:

AMaRV Aerodynamic Analysis,

- (Book I - Ref. AMaRV-24)
- (Book II - Ref. AMaRV-36)
- (Book III - Ref. AMaRV-43)

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

7. TEST OBJECTIVE:

To provide pressure data for correlation with control and yaw stabilizer analytic predictions and to verify NSWC Tunnel 9 results for conditions near the critical flight environments.

MODEL DESCRIPTION:

Bicone AMaRV configuration with interchangeable noses (3), a single cut configuration, 3 different control geometries including 2 ablated shapes, and 4 separate stabilizer geometries.

$D_{BASE} = 15 \text{ IN.}$

$L = 53 \text{ IN.}$

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞/FT</u>
AEDC F	12.5	4.0×10^6

INSTRUMENTATION:

92 surface pressure and 8 heat transfer rate transducers with pressure measurements concentrated on control and stabilizer surfaces.

DOCUMENTATION:

TEST RESULTS:

AMaRV Aerodynamics Testing Report, Parametric Test Phase, (Ref. AMaRV-15).

FACILITY TEST REPORT:

Pressure Test Results on the Advanced Maneuvering Reentry Vehicle (AMaRV) at Mach 13, (Ref. AMaRV-12).

DATA ANALYSIS:

AMaRV Aerodynamic Analyses, (Ref. AMaRV-14).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

8. TEST OBJECTIVE:

To obtain substantiation of ablated flap contours and heating distributions for subsequent aerodynamic force tests.

MODEL DESCRIPTION:

Modified aero force model with both planar and contoured flaps and three alternate yaw stabilizers with angles of 10° , 15° , and 20° . All control surfaces were made of RTV-60, silicon rubber, to comply with IR heat survey requirements.

$D_{\text{BASE}} = 8.0 \text{ IN.}$

$L = 27.9 \text{ IN.}$

FACILITY AND TEST
CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞/FT</u>
AEDC B	8	3.5×10^6

INSTRUMENTATION:

Heating rate determined from surface IR radiation scans, (RTV-60 surface coating used on flaps).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

9. TEST OBJECTIVE:

To survey heating rate distribution over all exposed surfaces of the AMaRV vehicle.

MODEL DESCRIPTION:

48% scale model of the AMaRV vehicle with interchangeable nose tips and flaps representing nominal and ablated surface contours. Flap angles were changeable at 0° , 4° , 8° , 12° , 16° , 20° , 24° , and yaw stabilizer angles were 10° , 15° , and 20° .

$D_{BASE} = 11.0$ IN.

$L = 38.4$ IN.

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞/FT</u>
AEDC B	8	3.5×10^6

INSTRUMENTATION:

Heating rate determined from surface IR radiation scans (RTV-60 surface coating).

DOUCMENTATION:

TEST RESULTS AND ANALYSIS:

"Post Test Report - AEDC/VKF Tunnel B, AMaRV Thermodynamic Survey Wind Tunnel Tests 1B1 and Piggyback," (Ref. AMaRV-17).

AMaRV AEROTHERMODYNAMIC TESTS (CONT'D)

10. TEST OBJECTIVES:

To obtain pressure and heating data on all external surfaces in order to substantiate or develop appropriate design methodology. Particular emphasis was given to the controls region.

MODEL DESCRIPTION:

52% model of the AMaRV FTV with alternate nose tips, flaps, flap box walls, and yaw stabilizers to permit evaluation of nominal and ablated surface contours. Flap deflection angles were changeable at 0° , 4° , 8° , 12° , 16° , and 20° .

$D_{BASE} = 12$ IN.

$L = 42.7$ IN.

FACILITY AND TEST CONDITIONS:

<u>FACILITY</u>	<u>M_∞</u>	<u>Re_∞ / FT</u>
AEDC F	9	15×10^6
	13	4×10^6

INSTRUMENTATION:

Pressure and heating rate sensors, using both RT and coax gages. Also used temperature sensitive phosphor paint on control surfaces.

DOCUMENTATION:

TEST RESULTS AND ANALYSIS:

"Wind Tunnel Measurements of Aeroheating and Pressure for a 52% Model of the AMaRV Vehicle at Mach Numbers of 9 and 13," (Ref. AMaRV-1).

FACILITY REPORT:

"Heat Transfer and Pressure Test Results on the AMaRV Configuration at Mach 9 and 13," (Ref. AMaRV-38).

AMaRV TEST PROGRAM SUMMARY

DATA UTILITY:

The configuration and data obtained for the BMO/AMaRV program are similar to those of the ACE program, consequently there is some overlap in results from an analysis, or code validation, point of view. Programatically these data were obtained specifically to assist in the design and validation of the vehicle system and also to provide confidence in the computer code predictions of vehicle aerodynamics. Where these data clearly augment those for the ACE program are in the areas of; flap effectiveness as affected by ablation of the flap surface, ablated nosetip effects on vehicle aerodynamics, and stability data as affected by FYS.

LIMITATIONS:

It should be noted that, contrary to the ACE program, the Tunnel F tests at AEDC were conducted in contoured nozzles therefore the deficiencies noted before are not present here. Again, only surface characteristics were measured (i.e., pressure, heat transfer, and configuration force and moment) - no inflow measurements were made.

In general, turbulent boundary layer flow properties on the scaled (blunted) configurations were obtained by providing boundary layer trips. Consequently, the surface properties which depend on the boundary layer state (e.g., the heat transfer) are viewed by viscous flow analysts with some trepidation. This is especially true for the case where the symmetric trips were sized to provide turbulent flow at zero angle of attack and are directly used for the large angle of attack cases (i.e. $\alpha > 10^\circ$).

FLIGHT TEST DATA

DATA REVIEW
MBRV FLIGHT TEST

REFERENCE: MBRV-60 (SAMSO-TR-68-60)

TEST OBJECTIVE: Flight tests of the MBRV system

CONFIGURATION: Cone with flap control

DATA: Flight measurements and derived quantities include:

- Force and Moment Coefficients (C_D , C_m , C_N)
- Control Effectiveness (hinge moment, $C_{m\delta}$)
- Surface Pressure (frustum and base)
- Surface Heat Transfer (frustum)
- Recession and In-Depth Temperature (frustum and flap)
- Boundary Layer Transition

DATA UTILITY:

These tests provide data over a wide range of Mach number and angle of attack, and include the effects of real gas chemistry, high Reynolds number, mass addition, and ablation shape change. They provide data on a configuration with a multi flap control. However, data appear to be of only minimal use for flow field code comparisons and validation.

LIMITATIONS:

Large data tolerances preclude use of hinge moment data for prediction comparisons. Only limited force and moment as heat transfer data is presented.

DATA REVIEW

MARCAS III FLIGHT TEST

REFERENCE: 69-14 (SAMS0-TR-69-308)

TEST OBJECTIVE: Flight test of MARCAS III vehicles

CONFIGURATION: Cone with JI control

DATA:

- JI Control Effectiveness (moment amplification factor)
- Static Margin
- Surface Pressure (JI region)
- Recession and In-Depth Temperature (frustum and J^{*} egion)
- Boundary Layer Transition (acoustic sensors)

DATA UTILITY:

Provides data for JI performance in high M, high Re flight environment. Provides bases for comparisons with prediction techniques and ground test data.

LIMITATIONS:

Minimal pressure and temperature data in vicinity of JI control.

DATA REVIEW

UPSTAGE FLIGHT TEST

REFERENCES: 72-13 (MDC G3263)
72-9 (MDC G3232)

TEST OBJECTIVE: Flight Test of Upstage Vehicles

CONFIGURATIONS: Elliptic Cone with EB Control
Elliptic Cone with JI Control

DATA:

- JI Control Effectiveness (moment amplification factor)
- EB Control Effectiveness (specific impulse)
- g and Stability (C_A , X_{cp})
- base Pressure

DATA UTILITY:

Provides data for JI and EB performance in flight environment. Also includes a summary of ground test JI and EB data. Provides basis for comparisons with prediction technique and ground test data.

LIMITATIONS:

Absence of diagnostic surface pressure and temperature data for modeling detailed control interaction effects.

DATA REVIEW
ACE FLIGHT TEST

REFERENCE: ACE-22 (SAMS0-TR-75-23)

TEST OBJECTIVE: Flight Tests of ACE FTV-1, FTV-2, and FTV-3

CONFIGURATION: Cone with Flap Control

DATA: Flight measurements and derived quantities include:

- Force and Moment Coefficients (C_x , C_N , C_m , x_{cp})
- Control Effectiveness (hinge moment, x_{cpF} , ΔC_{mF})
- Surface Pressure (flap, frustum, base)
- Surface Temperature (flap, frustum)
- Recession and In-Depth Temperature (flap, frustum)
- Boundary Layer Transition

DATA UTILITY:

Provides data over wide range of Mach number and angle of attack at high Reynolds number real gas flow conditions not attainable in ground test facilities. These data could be used to check the validity of flow field codes for predicting total vehicle and flap aerodynamic characteristics.

LIMITATIONS:

Data scatter precludes use for detailed assessments of prediction code accuracy. Also, the effects of flap and frustum heatshield recession and mass addition are implicit in the data.

DATA REVIEW

AMaRV FLIGHT TEST

REFERENCE: AMaRV-48 (BMO-TR-80-14)

TEST OBJECTIVE: Flight test of AMaRV FTV-1

CONFIGURATION: Bicone with flap control

DATA: Flight measurements and derived quantities include

- Force and Moment Coefficients (C_x , C_N , C_D , C_L , L/D , C_L , C_m , C_y , C_n , X_{cp})
- Stability Derivatives (X_{cp} , $C_{Y\beta}$, $C_{n\beta}$)
- Control Effectiveness (flap load, hinge moment, flap deflection, C_{N_F} , X_{cp_F} , $C_{m\delta}$)
- Nosetip Force and Moment Coefficients (C_x , C_N , C_m , C_y , C_n)
- Nosetip Recession and Shape
- Surface Temperature (frustum, flap, base)
- Surface Pressure (frustum, flap, base)
- Recession and In-Depth Temperature (frustum, flap)
- Acoustic Pressure (frustum)
- Vibration (frustum and flap)
- Boundary Layer Transition (from temperature response)

DATA UTILITY:

This flight provides benchmark MaRV aerodynamic and aerothermodynamic performance data over a wide range of Mach numbers and angle of attack, and includes the effects of real gas chemistry, high Reynolds number, boundary layer mass addition, and ablation shape change. These data could be used to validate flow field codes at conditions of interest not achievable in ground test facilities. The particular trajectory flown by this vehicle resulted in minimal shape change thus providing useful aerodynamic coefficient data over a wide range in Mach number and angle of attack. The additional acquisition of nosetip and flap control component force and moment measurements further enhances the appropriateness of this data for code validation.

LIMITATIONS:

It is frequently not possible to isolate the effect of any one factor (e.g., shape change, real gas flow, mass addition, etc.) from the flight data since all can contribute to the measured vehicle performance. However this vehicle does not suffer significantly from these problems. Furthermore, data measurement accuracies (especially for derived parameters such as aero coefficients and stability derivatives) are lower, in some parts of the flight spectrum, than desired for use in code assessment and validation.

DATA REVIEW

MK 500 FLIGHT TEST

REFERENCE: (None Available)

TEST OBJECTIVE: Flight test of MK 500 vehicles

CONFIGURATION: Bicone with nose control

DATA: Flight measurements and derived quantities include

- Force and Moment Coefficients (C_A , C_N , L/D , C_Y , C_n)
- Stability Derivatives (C_{m_α} , C_{N_α} , C_{n_β} , C_{Y_β} , X_{cp})
- Surface Pressure (frustum, base)
- Nosetip recession
- Frustum Recession and In-Depth Temperature
- Boundary Layer Transition (from temperature response)

DATA UTILITY:

MK 500 flight results provide aerodynamic and aerothermodynamic performance data over a wide range of Mach number and angle of attack, and include the effects of real gas chemistry, high Reynolds number, boundary layer mass addition and ablation shape change. These data could be used to check the validity of flow field codes for a nose controlled vehicle for predicting vehicle aerodynamic and aerothermodynamic performance.

LIMITATIONS:

Data measurement accuracy limits the extent to which these data can be used for code validation but can be used as a benchmark for prediction accuracy. Also the effects of parameters such as mass addition and recession can not be isolated from the flight data.

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