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VALIDATION AND EXPANSION OF THE FLOW ANGULARITY TECHNIQUE FOR PREDICTING STORE SEPARATION TRAJECTORIES

AIRCRAFT COMPATIBILITY AND WEAPONS FLIGHT DYNAMICS BRANCH
PRODUCT ASSURANCE DIVISION

TECHNICAL REPORT AFATL-TR-72-184

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AIR FORCE ARMAMENT LABORATORY

AIR FORCE SYSTEMS COMMAND • UNITED STATES AIR FORCE

EGLIN AIR FORCE BASE, FLORIDA

Validation and Expansion of the Flow Angularity Technique for Predicting Store Separation Trajectories

Stephen C. Korn, Captain, USAF

FOREWORD

This report is based on a study performed at the Air Force Armament Laboratory from April through August 1972 as part of Project 2567, Task 02, Work Unit 014.

This technical report has been reviewed and is approved.

RANDALL L. FETTY, Colonel, USAF
Chief, Product Assurance Division

ABSTRACT

This report documents the external flow fields caused by various weapon configurations on the wing of an F-4 aircraft, verifies assumptions made in the flow angularity technique, and presents the documentation for the "Flow Angularity Computer Program" with example trajectories. The flow angularity program is presently capable of calculating the trajectories of stores off the inboard and outboard wing stations in either single, triple ejector rack, or multiple ejector rack configurations. The assumptions made in the flow angularity technique have been analyzed and generally validated as good approximations.

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LIST OF SYMBOLS AND ABBREVIATIONS

c.g.	Center of gravity
FS; BL, WL	Fuselage station, butt line, and water line of F-4C aircraft (feet)
MFS, MGL, MWL	Model fuselage station, butt line, and water line of F-4C 5% model aircraft (inches)
υ	Upwash angle (degrees)
α_p	Angle of attack of aircraft (degrees)

SECTION I

INTRODUCTION

The flow angularity technique for predicting store separation trajectories was originally documented in Reference (1), and this report is a follow-on to substantiate some of the assumptions made in that original report and to present the text of the "Flow Angularity Computer Program" (See Appendixes I to IV). The original "Flow Angularity Computer Program" was designed around the flow field of three M-117 bombs on a triple ejector rack (TER). In order to simulate the launches of stores from the different positions on the TER, certain scaling parameters were used to adjust the flow field. Since the publication of the original report, an additional wind tunnel test was conducted in which the flow field was surveyed for single ejector rack, TER, and a multiple ejector rack (MER) configurations. These additional flow fields enabled the evaluation of many of the scale factors used in the original program. The flow angularity program has been revised so it would accept data from these new flow fields.

The flow angularity program is presently being utilized at the Air Force Armament Laboratory for predicting trajectories of stores that have had new modifications, and stores that are new in design. The flow angularity program is also being used by the 6511 Test Group (TGEA) at El Centro, California, to determine safe launch conditions for their test vehicles.

SECTION II

DISCUSSION OF FLOW FIELD SURVEY TEST

A second flow field survey test (similar to that described in Reference 2) was conducted at Arnold Engineering and Development Center in March 1972. The test was conducted in order to measure the velocity vector components in the flow field beneath the wing of the F-4C aircraft at Mach number 0.85 and is documented in Reference 3. A conical-tip pressure probe was used to measure the velocity vectors beneath the wing with configuration combinations of pylons, ejector racks, (TER and MER) and stores (M-117, MK-81, and MK-84 bombs). The F-4 model and area surveyed are displayed in Figures 1 and 2.

As discussed in Reference (1), the flow angularity semi-empirical approach would only be cost effective if a flow field taken under one set of conditions could be used to predict trajectories of stores under many other launch conditions. Reference (1) built a rationale for using the flow field of three M-117 bombs for predicting trajectories for one, two, or three stores of any type on the TER at time of launch.

To test this theory, trajectories were calculated for M-117 bombs, SUU-51 bombs, and a tactical fighter attack flare. These trajectories were then compared with wind tunnel trajectories under the same conditions. It was found that all the trajectories had good trends and that the flow angularity method would be a useful tool in predicting store separation trajectories.

This second flow field test conducted in March 1972 had as objectives: to validate some assumptions made in the first report, to collect flow field data on the MER configurations on the outboard wing station, and to collect flow field data on large diameter stores on the inboard and outboard pylon stations. By validating the assumptions, very little additional flow field data would be needed for the F-4, F-15, and A-7 aircraft.

The first approximation that needed investigation was the use of the three bomb (TER) configuration flow field to predict the trajectories of stores from the shoulder stations of the TER. To investigate this approximation, the MK-81 and M-117 bombs were tested in configurations T3, T2, and T1 (See Figure 3). The velocity components measured during the test are given in Figures 4 to 24. The flow fields produced at the nose and tail of these bombs (for the TER configurations) are displayed in Figures 7(a), 7(b), 10(a), 10(b), 11(a), 11(b), 12(a), 12(b), 13(a), 13(b), 14(a), and 14(b). As can be seen, the flow pictures are similar for the three configurations, but some differences are present.

In order to investigate the effect that the differences in the flow field have on the trajectories, launches of the MK-81 from the T2 and T1

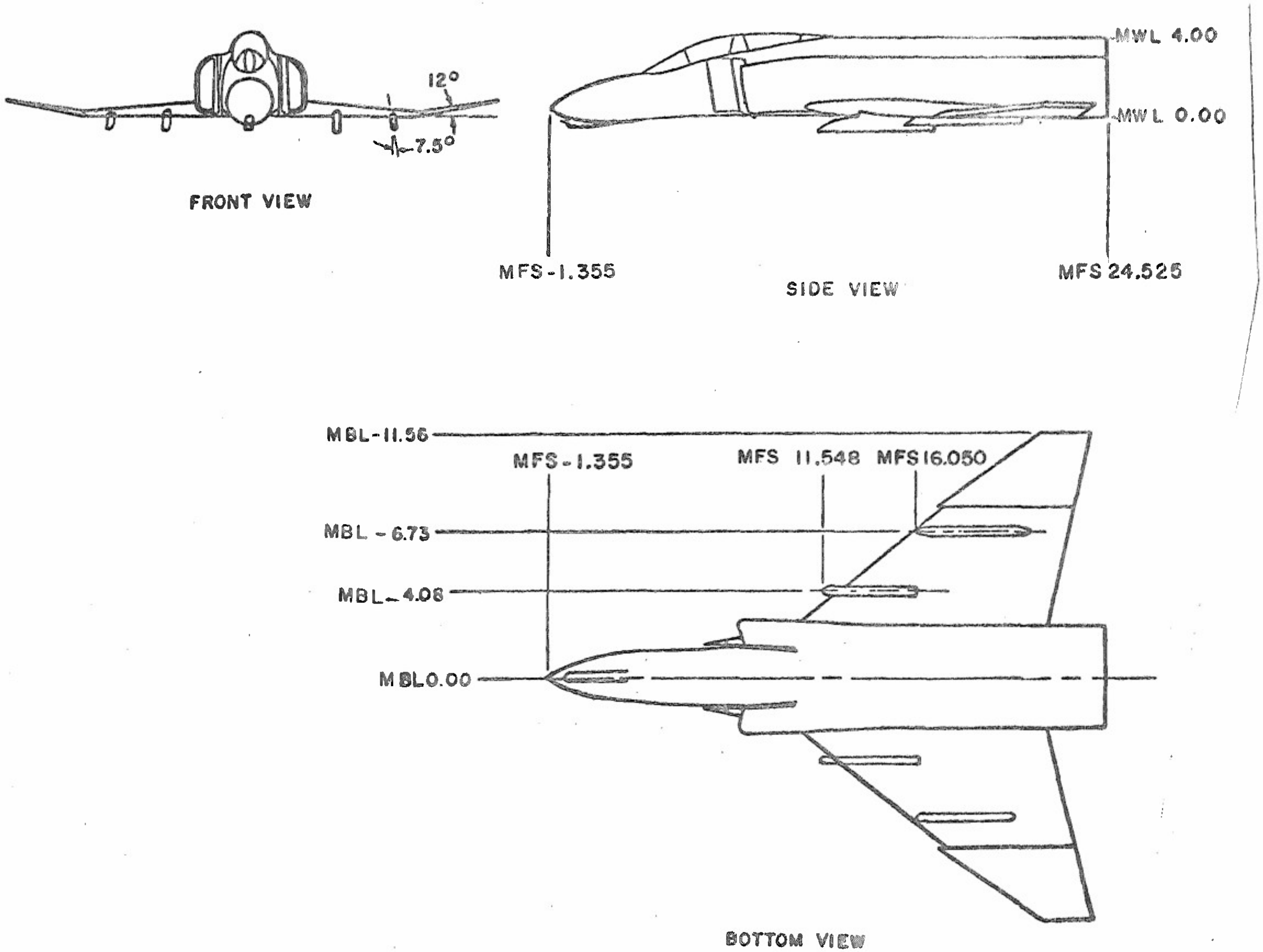
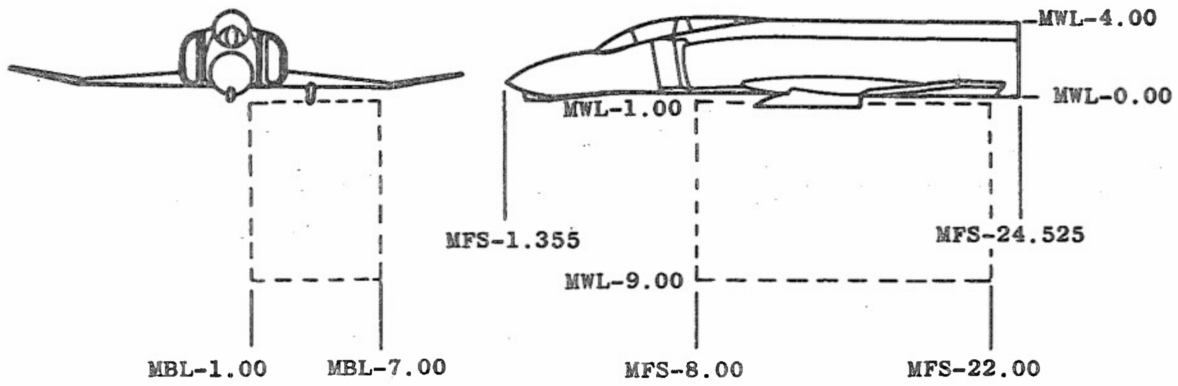
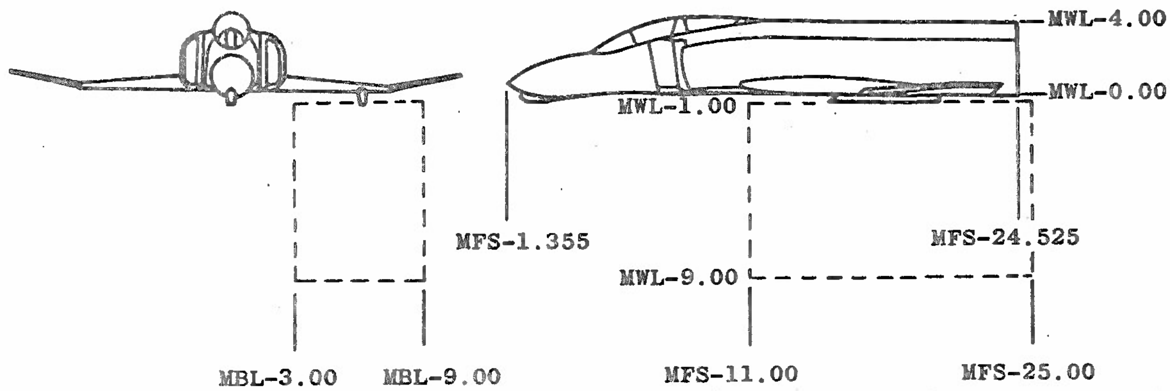


Figure 1. Sketch of the F-4C Parent-Aircraft Model Showing Pylon Locations



a. Region of Inboard Survey



b. Region of Outboard Survey

Figure 2. F-4C Parent Aircraft Showing Regions Surveyed

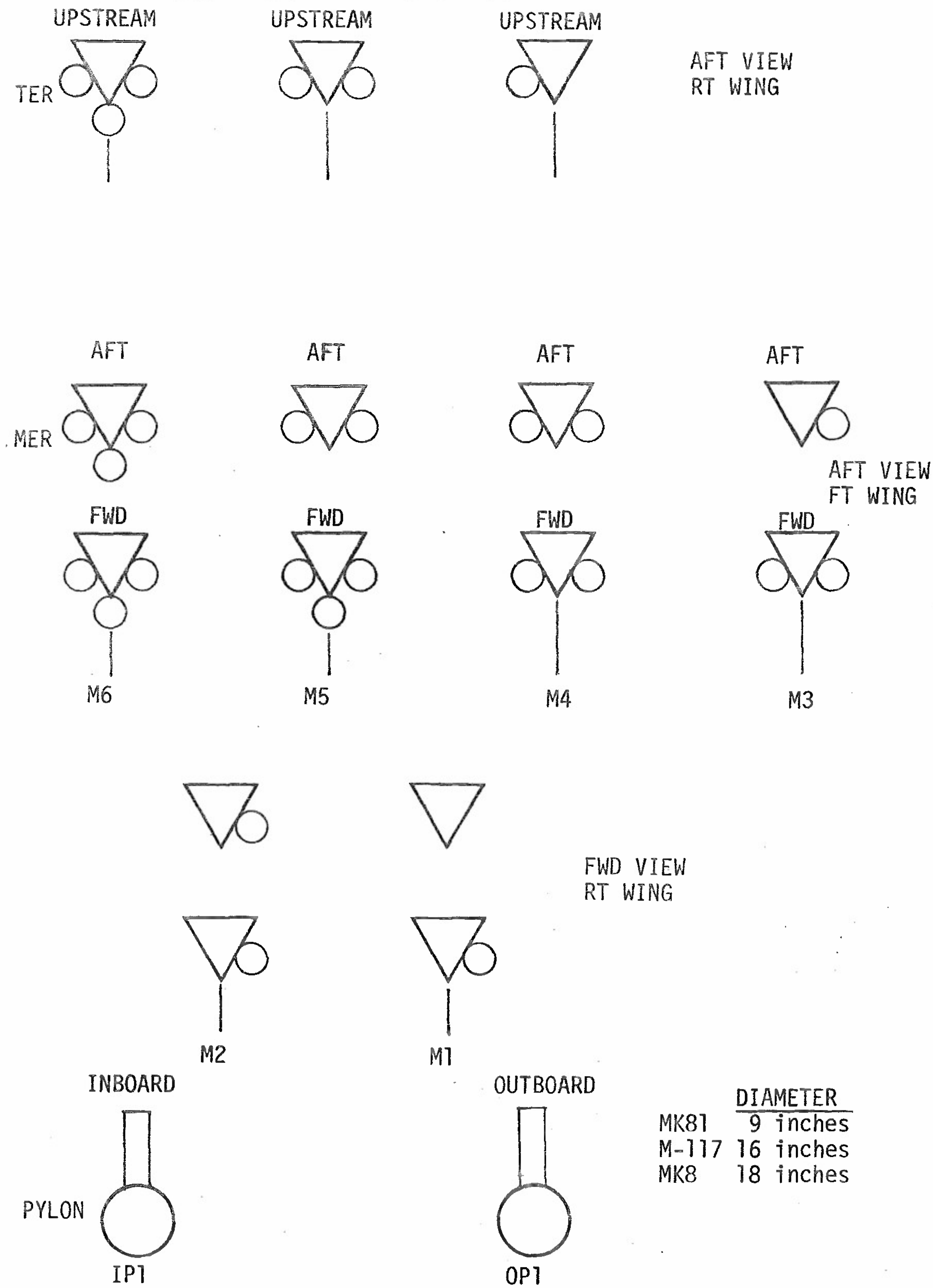
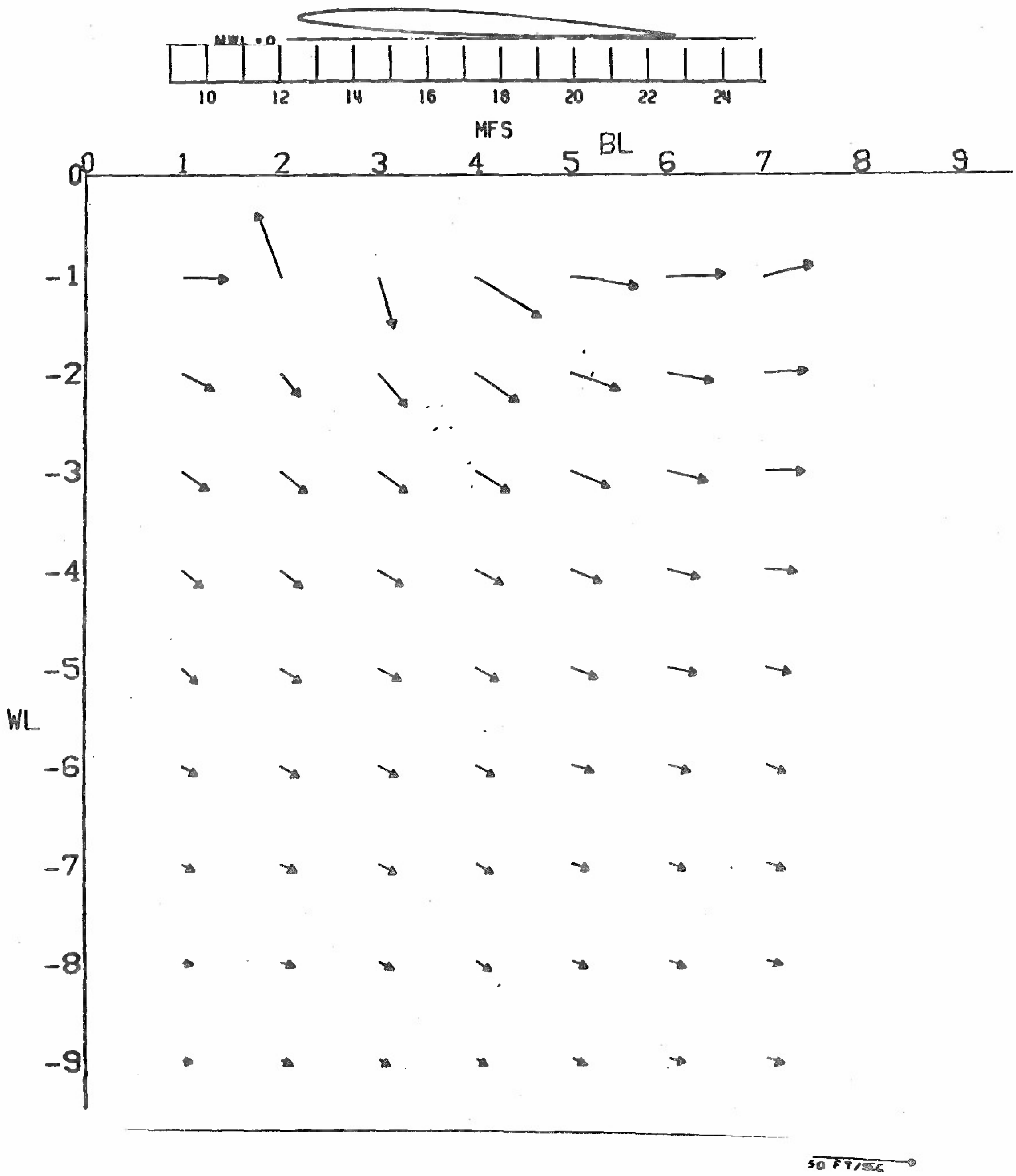
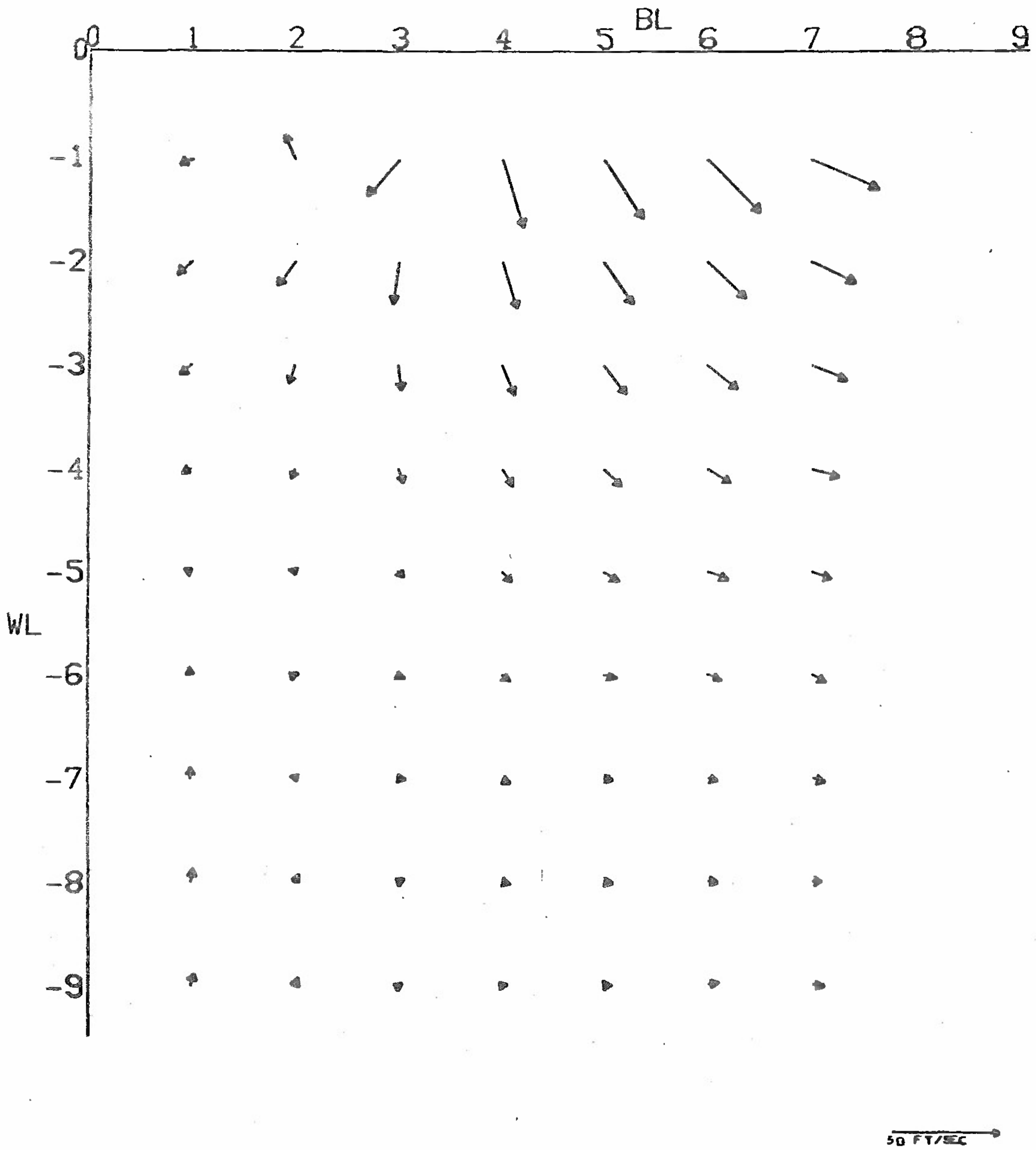


Figure 3. Configurations



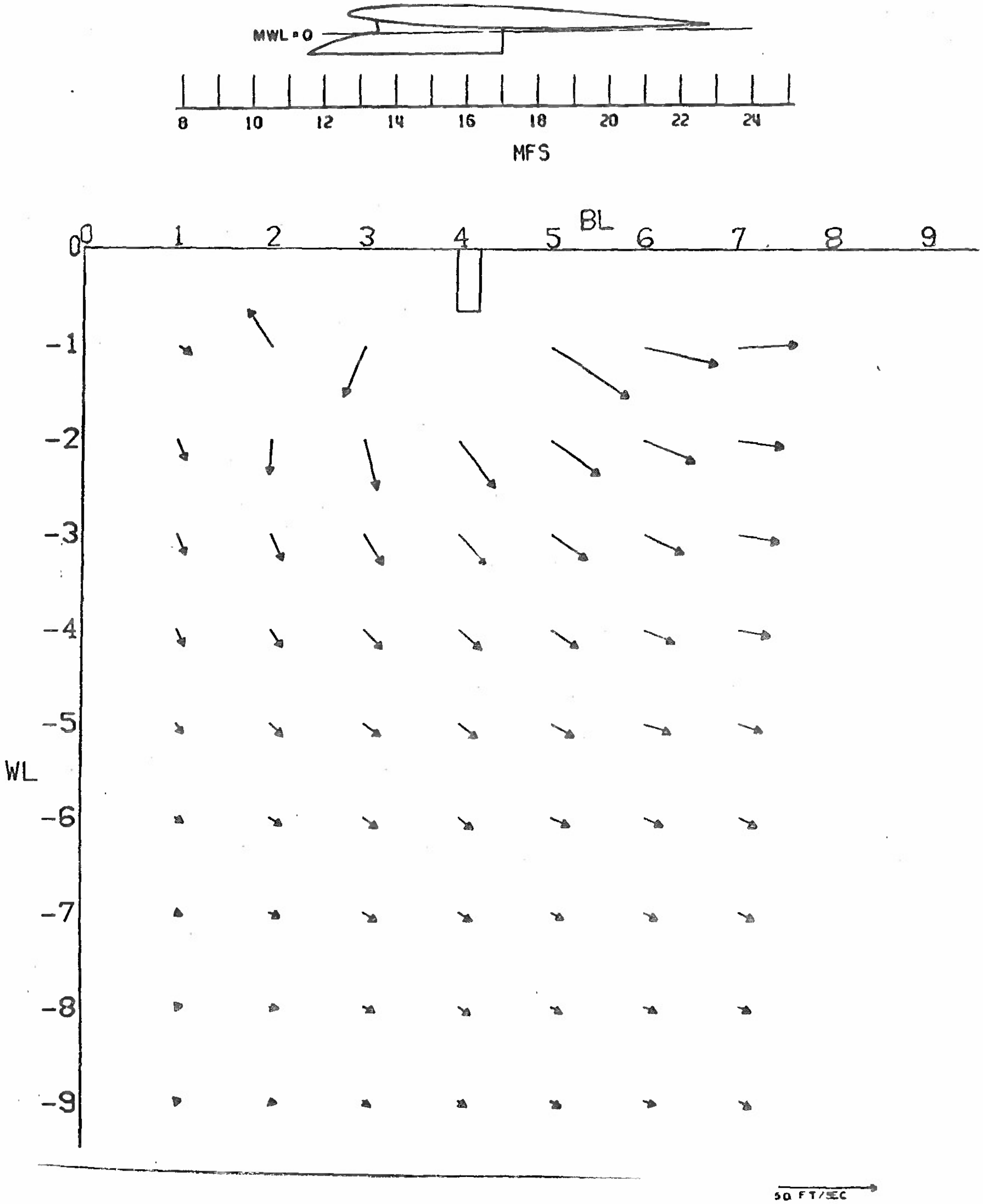
(a) MFS = 12

Figure 4. Effect of the Clean Wing on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



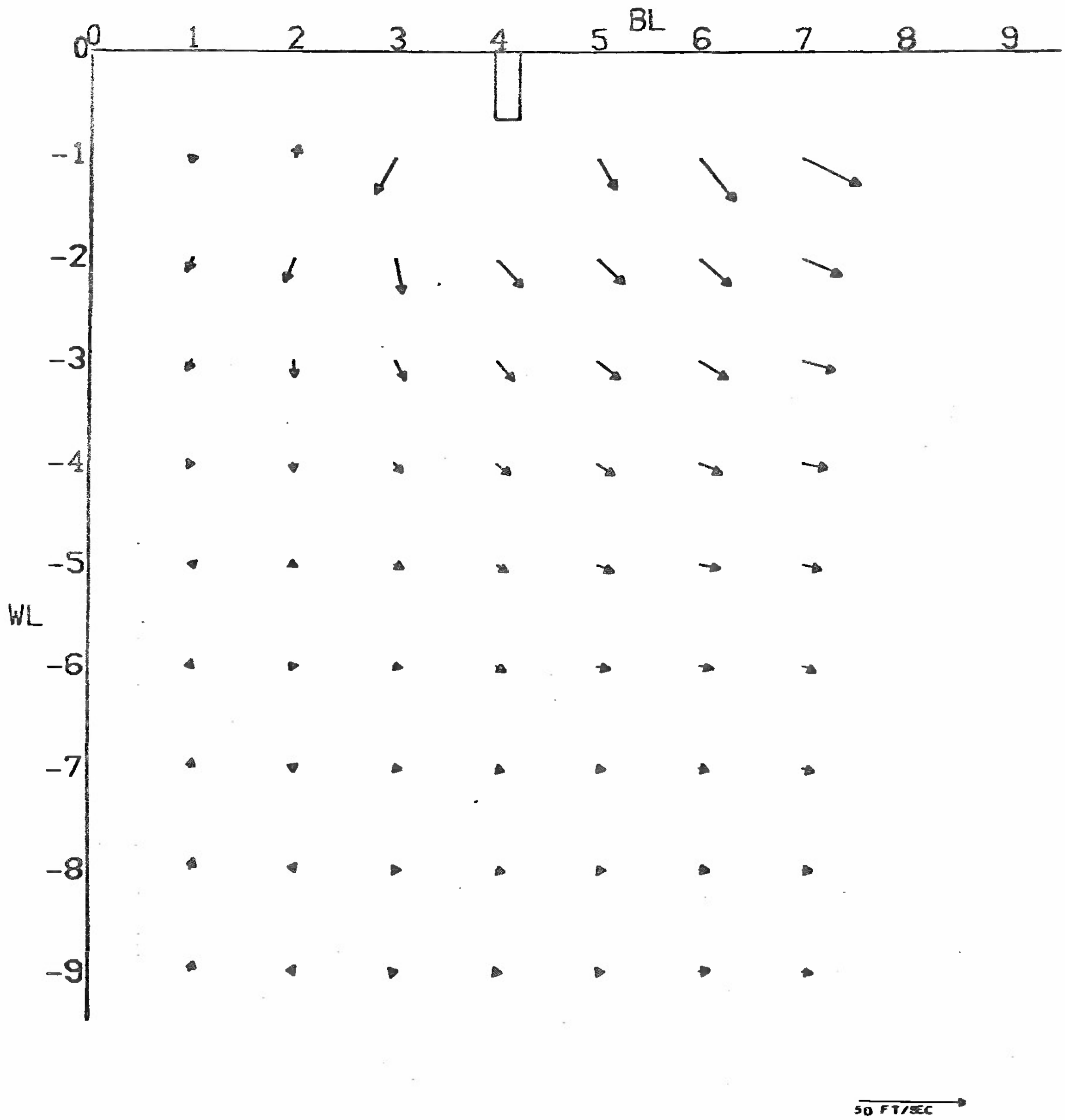
(b) MFS = 16

Figure 4. Concluded



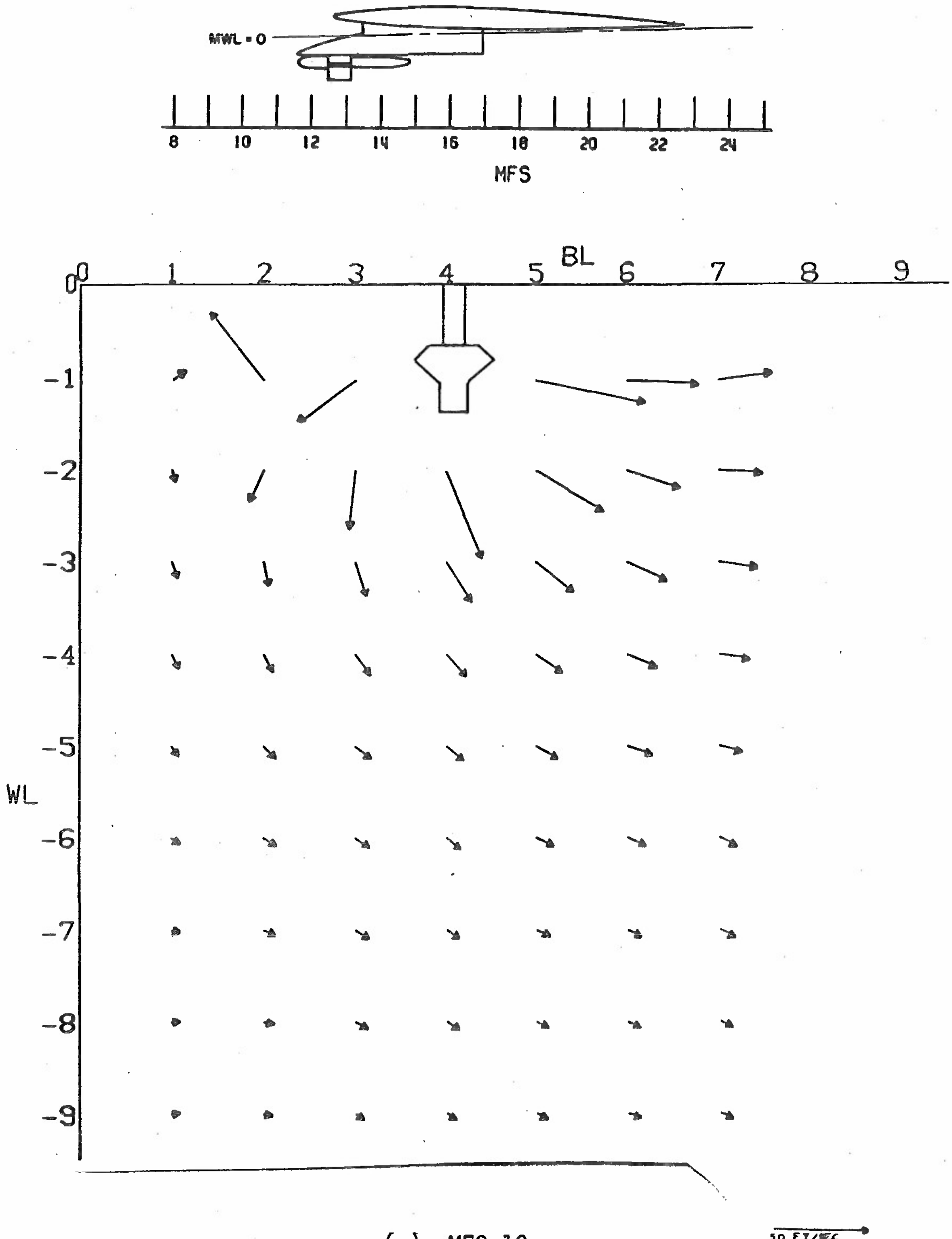
(a) MFS = 13

Figure 5. Effect of an Inboard Pylon on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



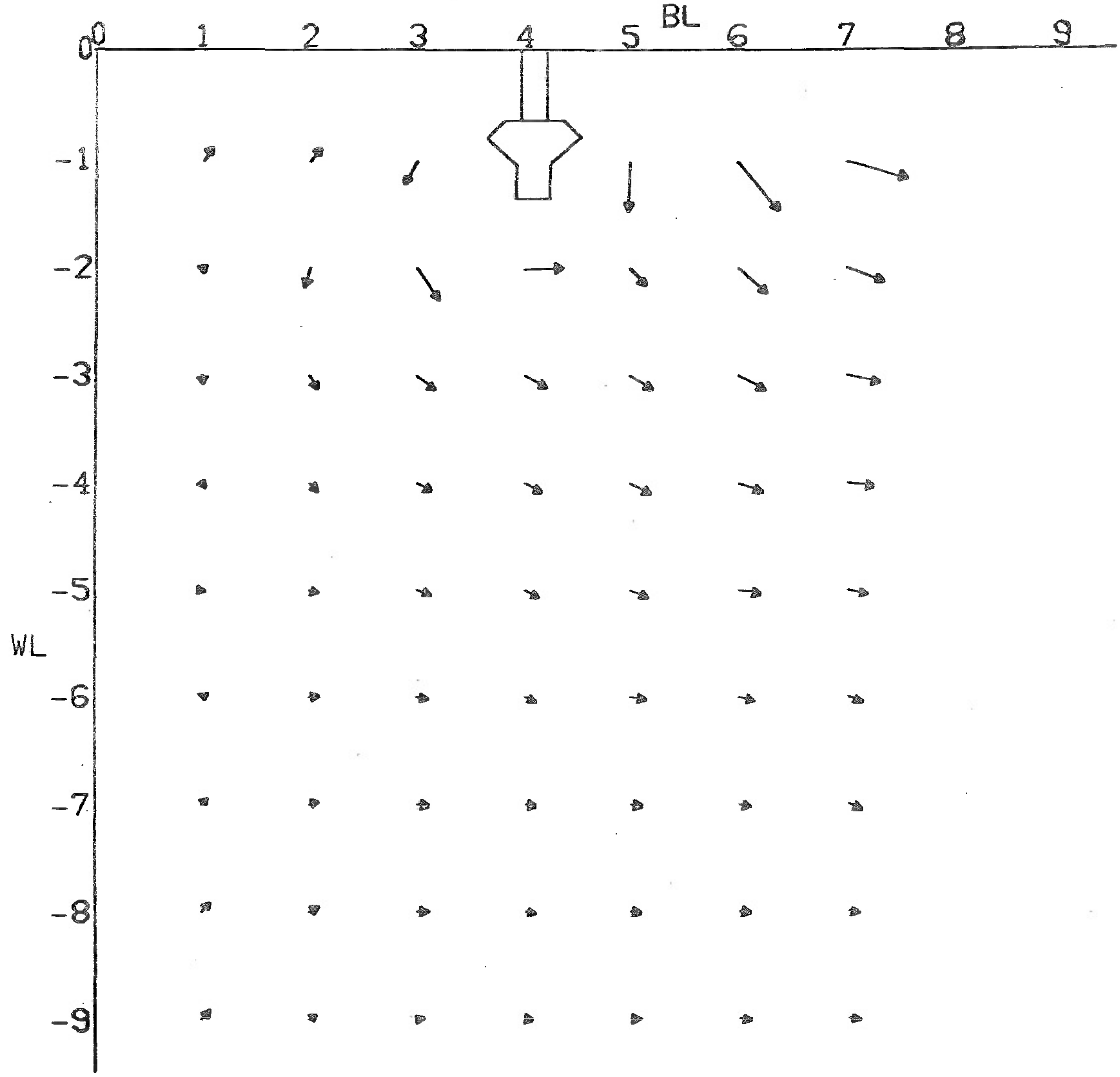
(b) MPS = 16

Figure 5. Concluded

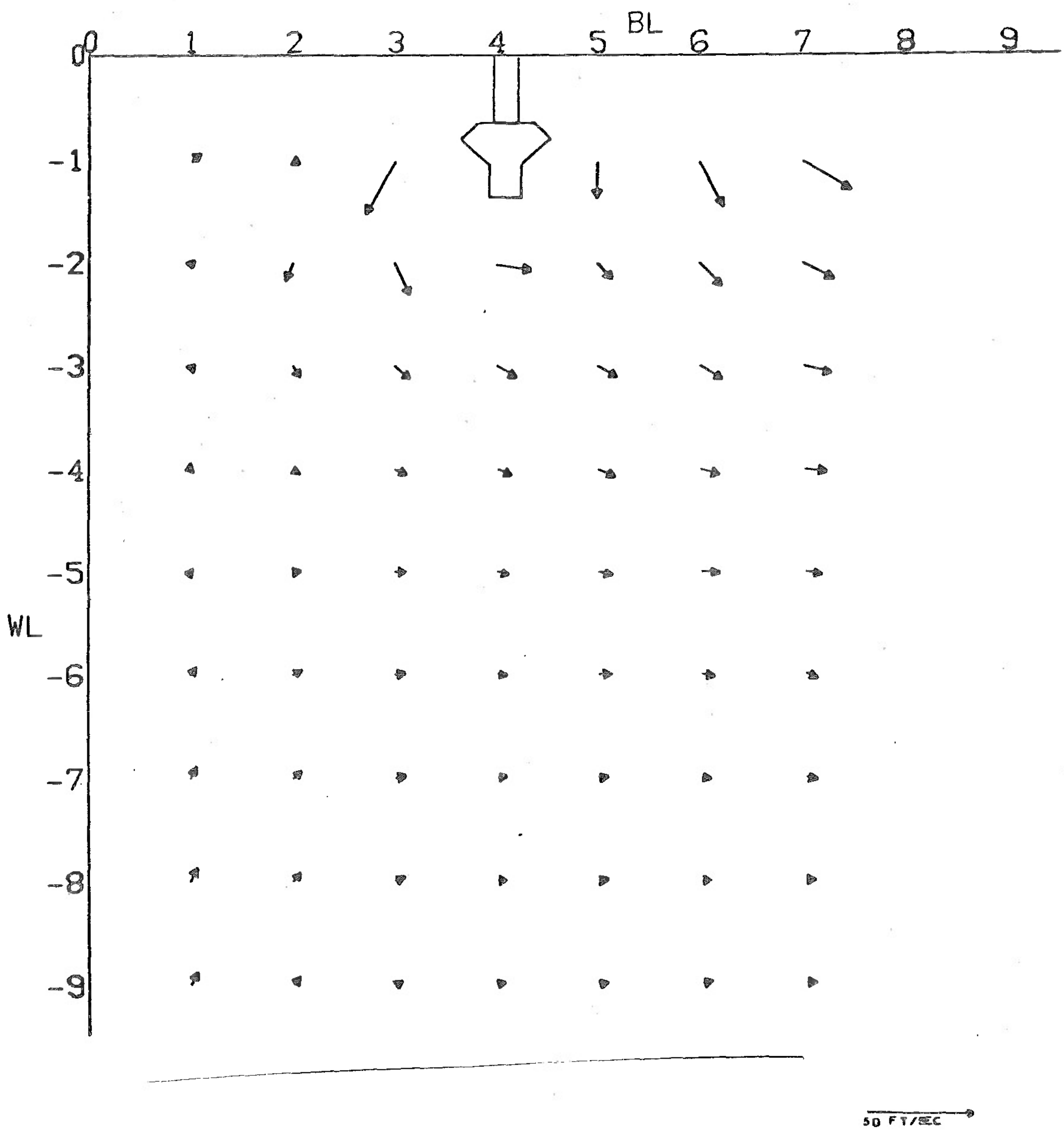


(a) MFS 12

Figure 6. Effect of TER Rack on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$

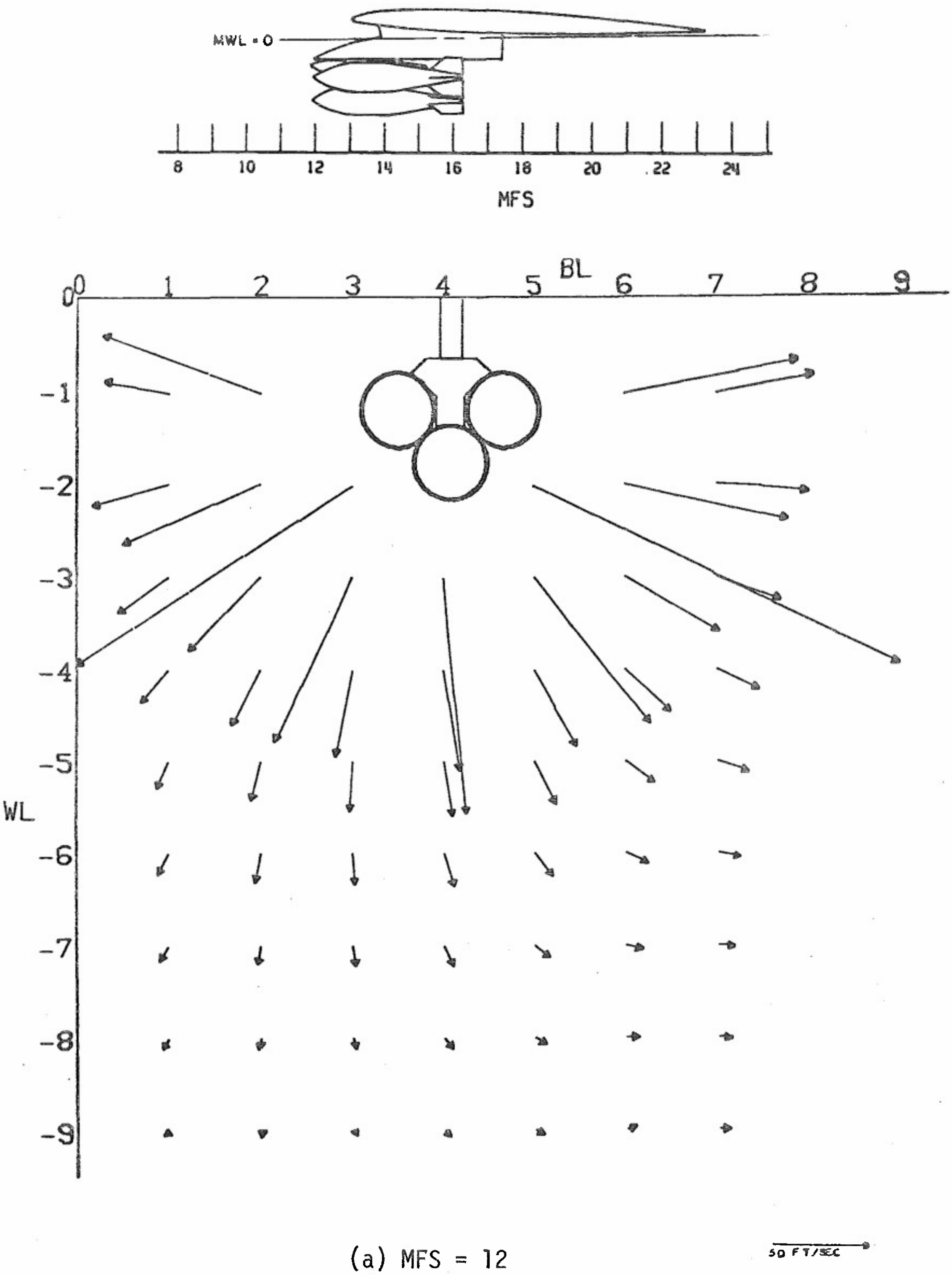


(b) MFS = 15
Figure 6. Continued



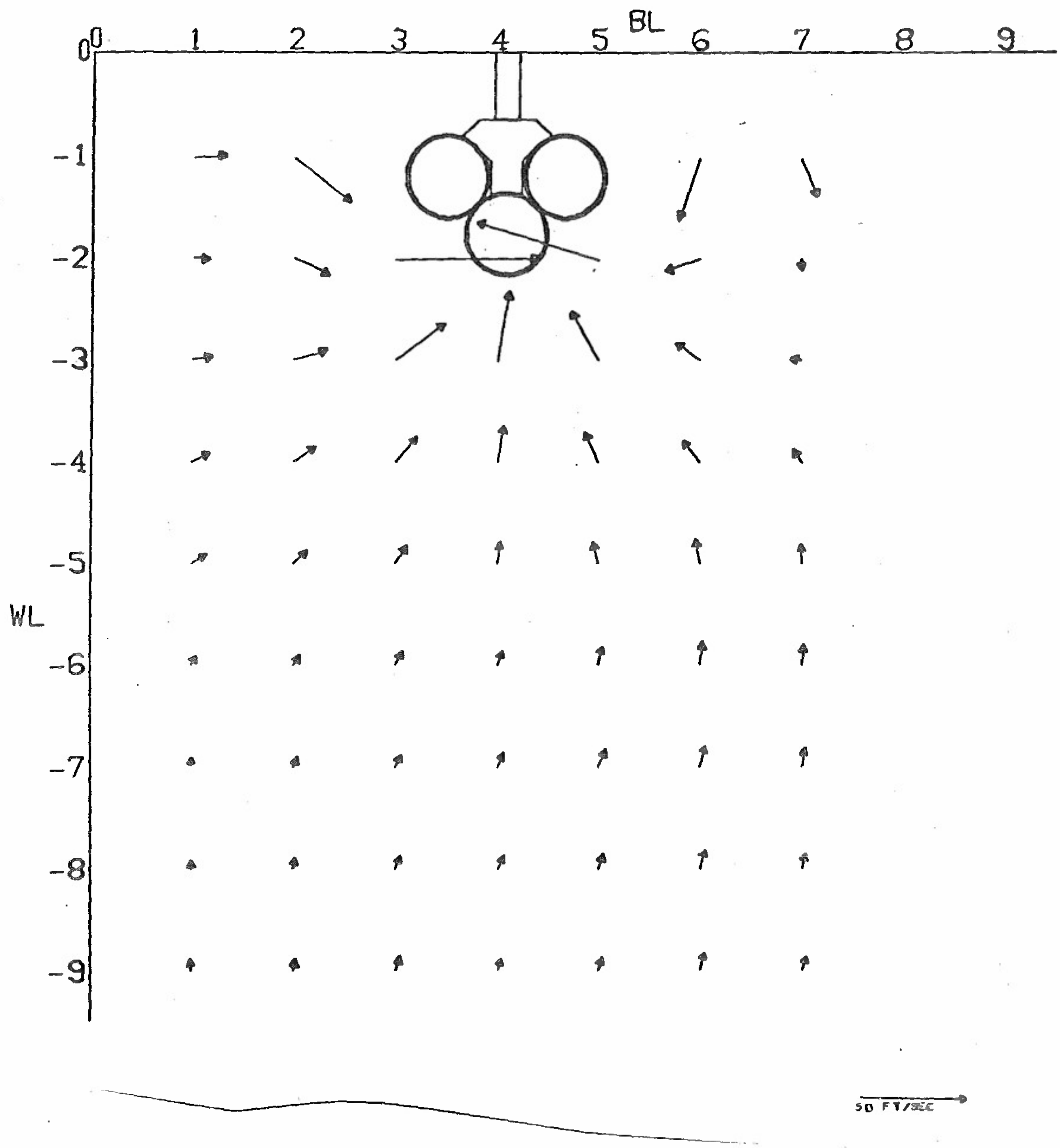
(c) MPS = 16

Figure 6. Concluded



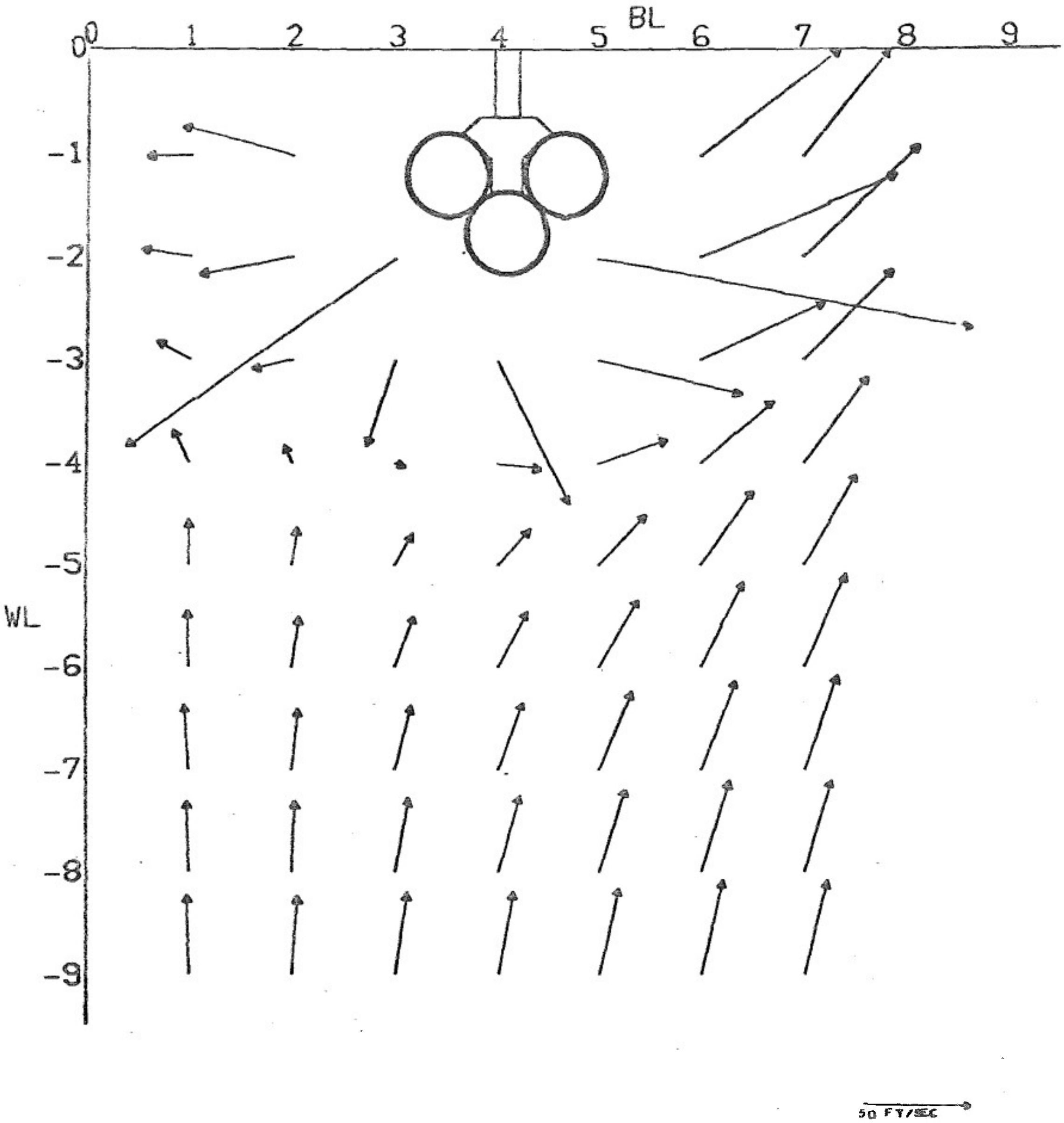
(a) MFS = 12

Figure 7. Effect of Three M-117 Bombs and TER on the Transverse Velocity Components of the Flow at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



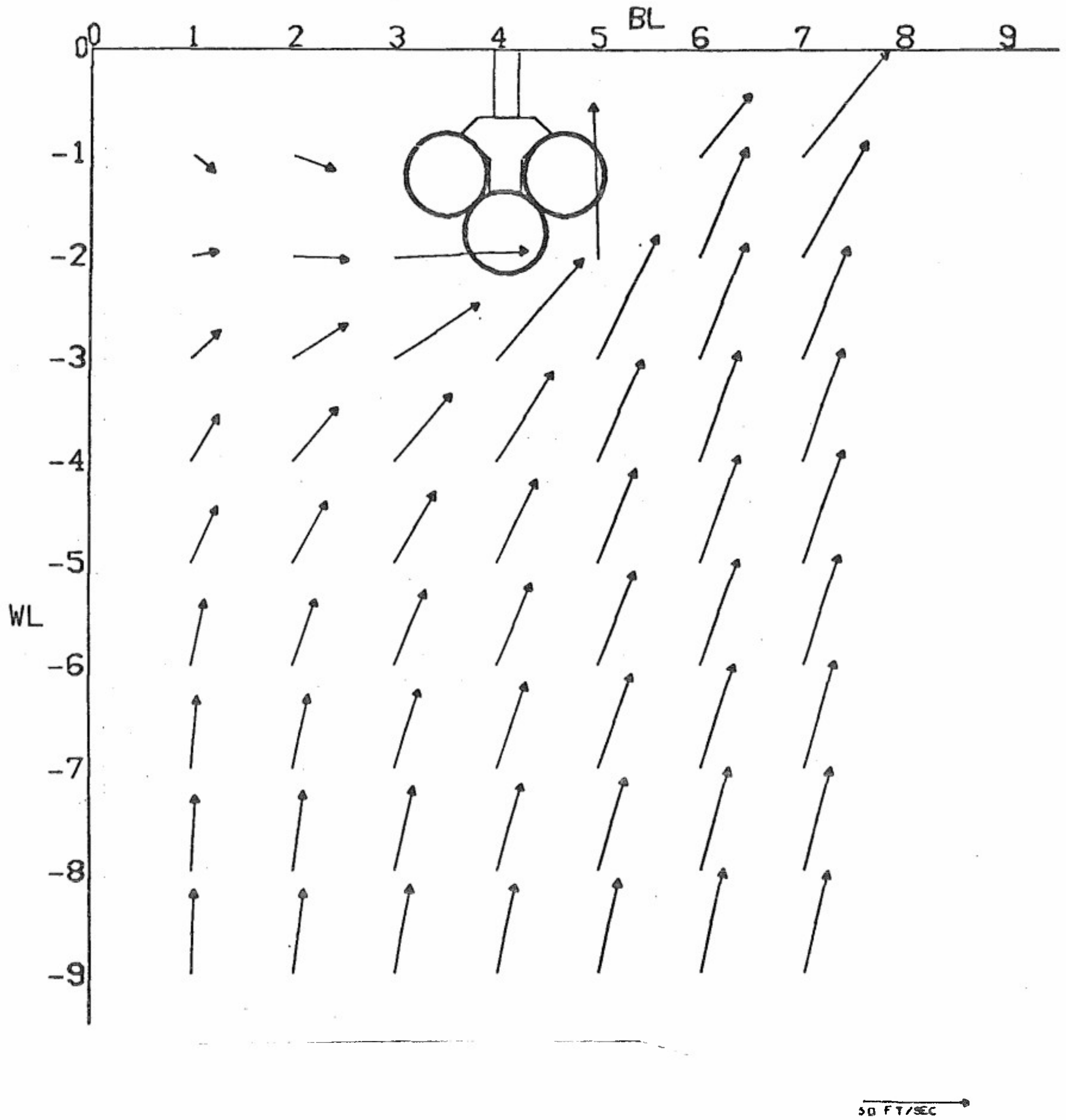
(b) α_p = 0.3, MPS = 16

Figure 7. Continued



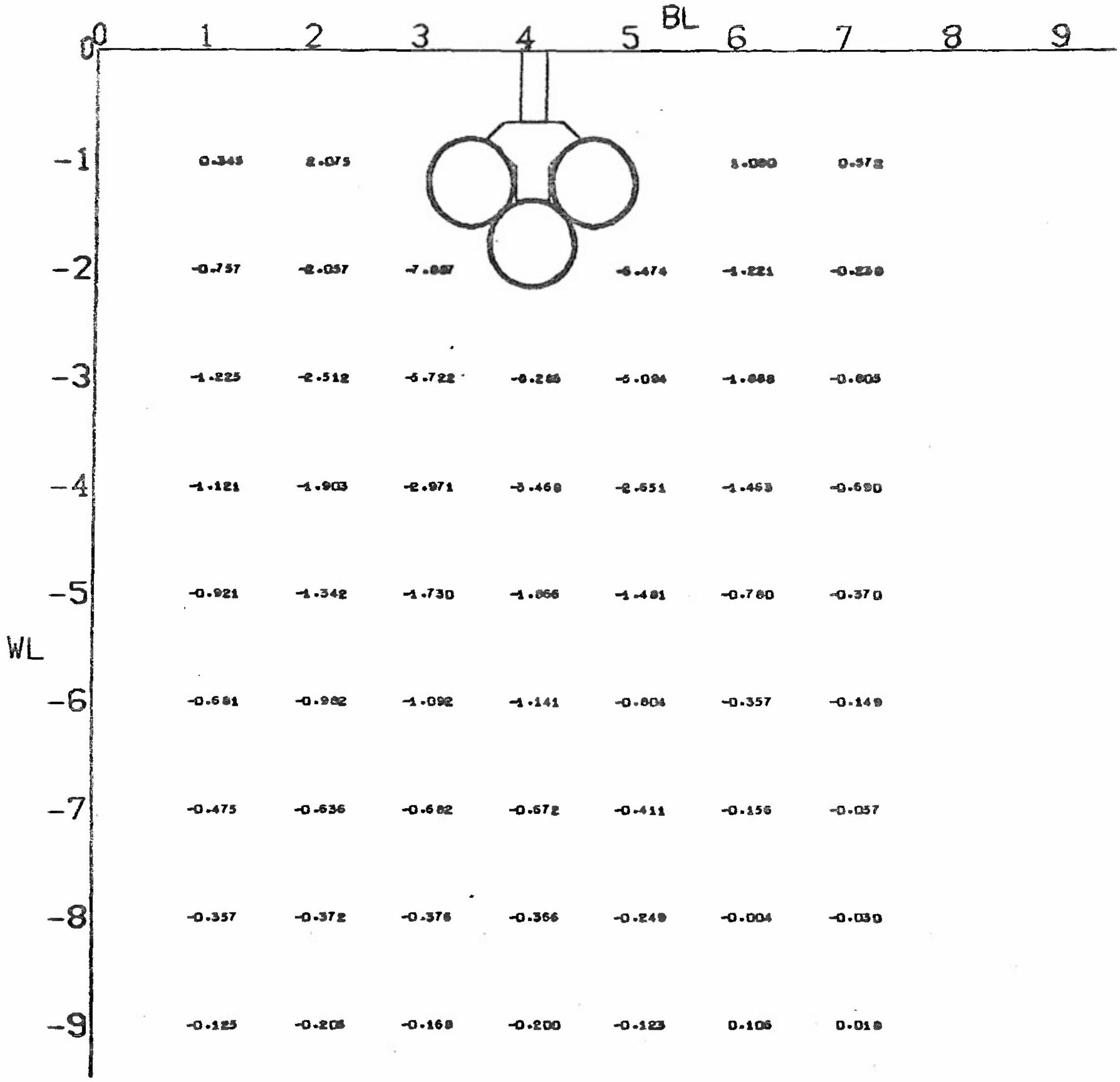
(c) α_p = 3,3, MFS = 12

Figure 7, Continued



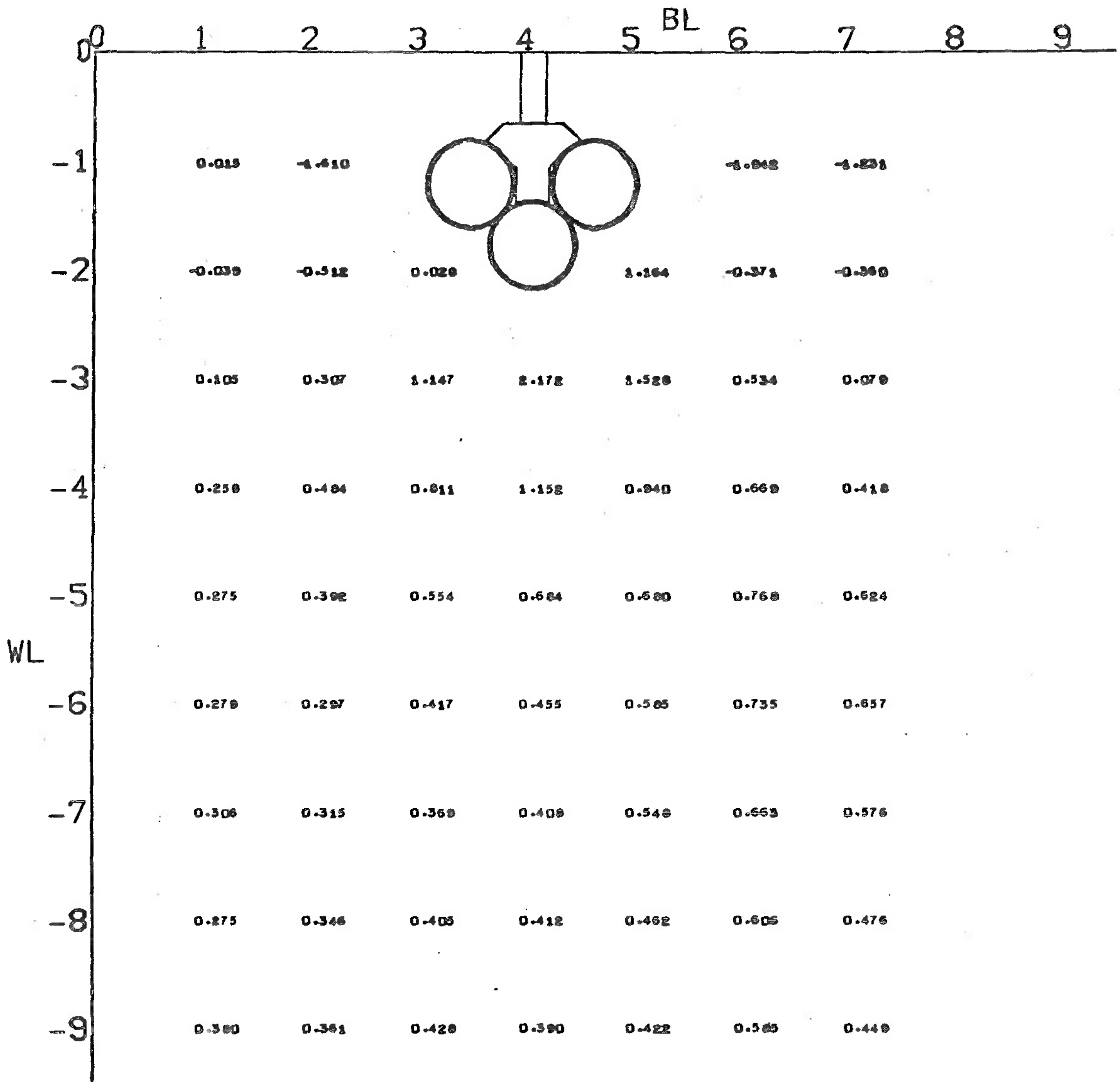
(d) α_p = 3,3, MFS = 16

Figure 7. Concluded



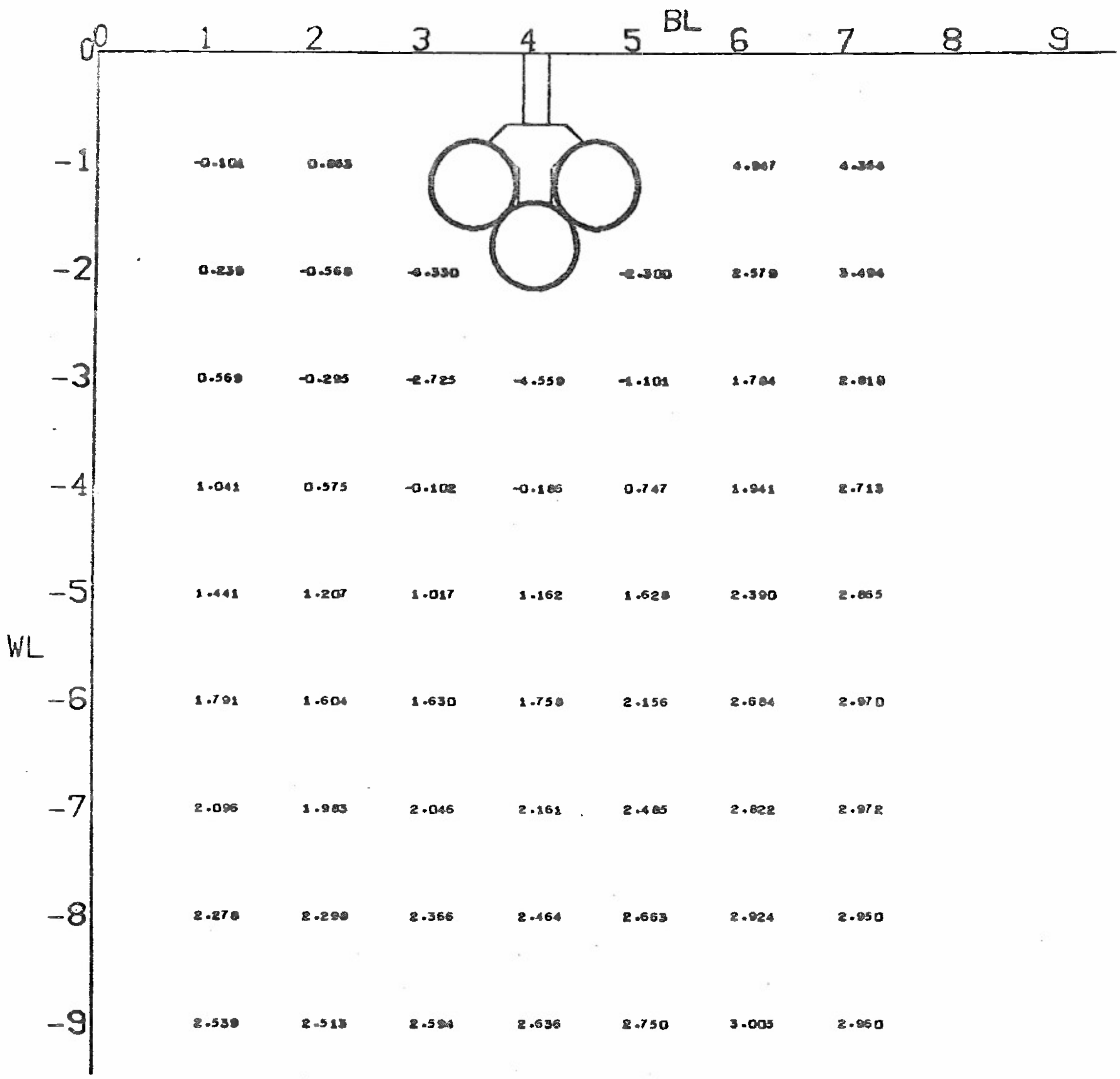
(a) MFS = 12

Figure 8. Effect of Three M-117 Bombs and TER on the Flow Angle Formed by the z Component of Velocity and the Total Velocity Vector at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



(b) MFS = 16

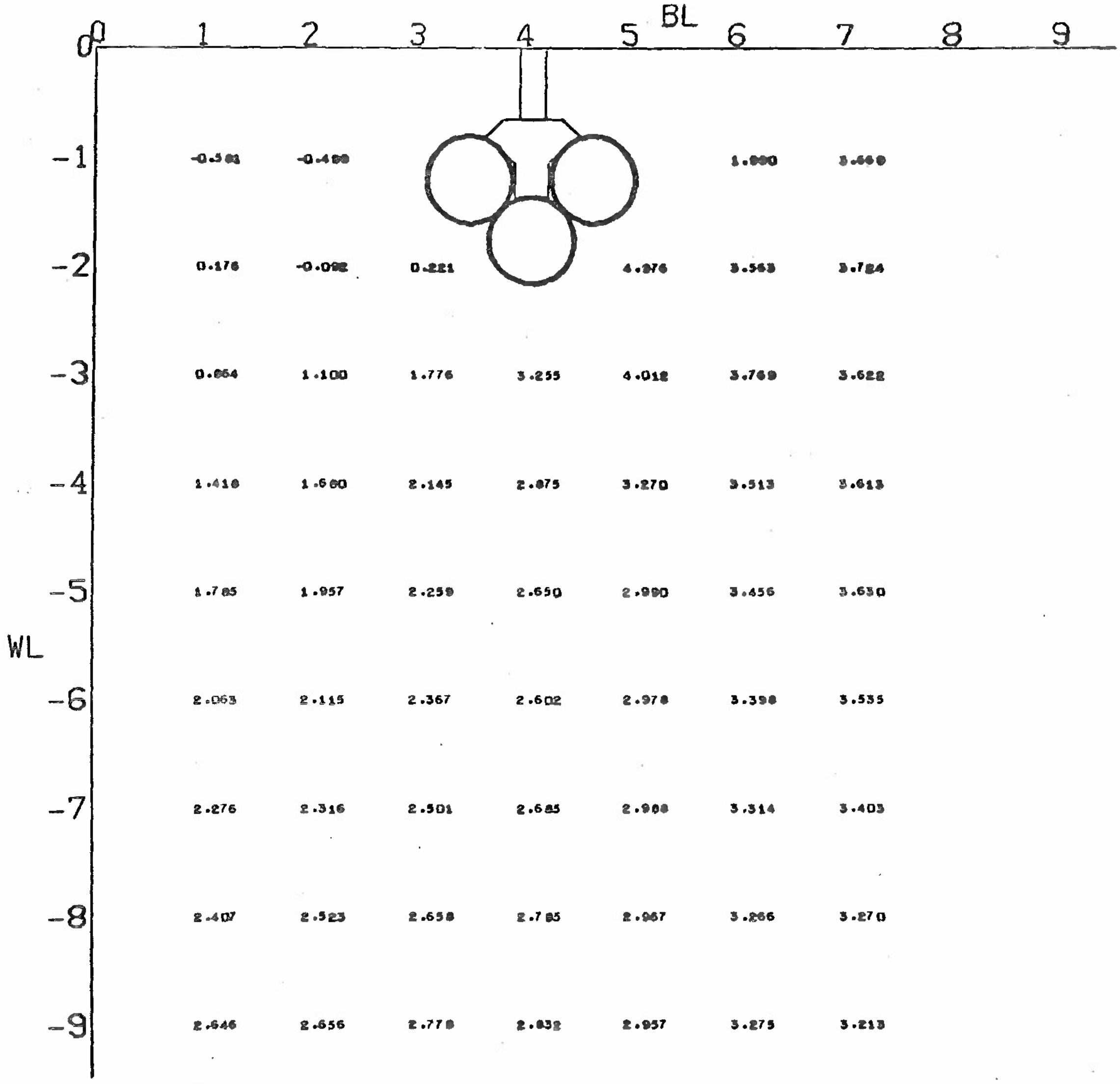
Figure 8. Concluded



WL \ BL	1	2	3	4	5	6	7
-1	-0.104	0.863				4.947	4.364
-2	0.239	-0.568	-4.330		-2.300	2.579	3.494
-3	0.569	-0.295	-2.725	-4.559	-1.101	1.704	2.818
-4	1.041	0.575	-0.102	-0.186	0.747	1.941	2.713
-5	1.441	1.207	1.017	1.162	1.628	2.390	2.865
-6	1.791	1.604	1.630	1.758	2.156	2.684	2.970
-7	2.096	1.983	2.046	2.161	2.485	2.822	2.972
-8	2.278	2.298	2.366	2.464	2.663	2.924	2.950
-9	2.539	2.513	2.594	2.636	2.750	3.005	2.960

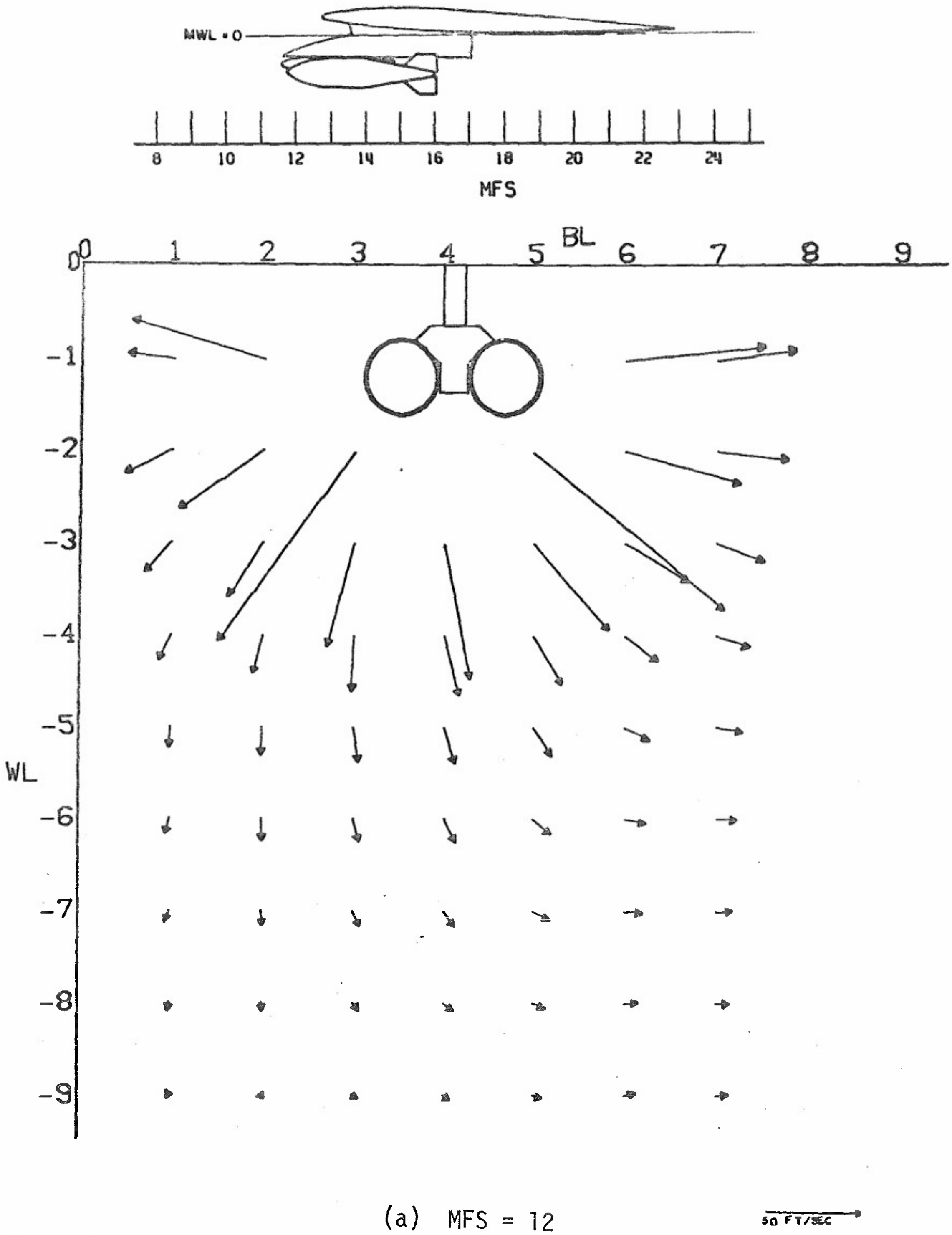
(a) MFS = 12

Figure 9. Effect of Three M-117 Bombs and TER on the Flow Angle Formed by the z Component of Velocity and Total Velocity Vector at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 3.3$



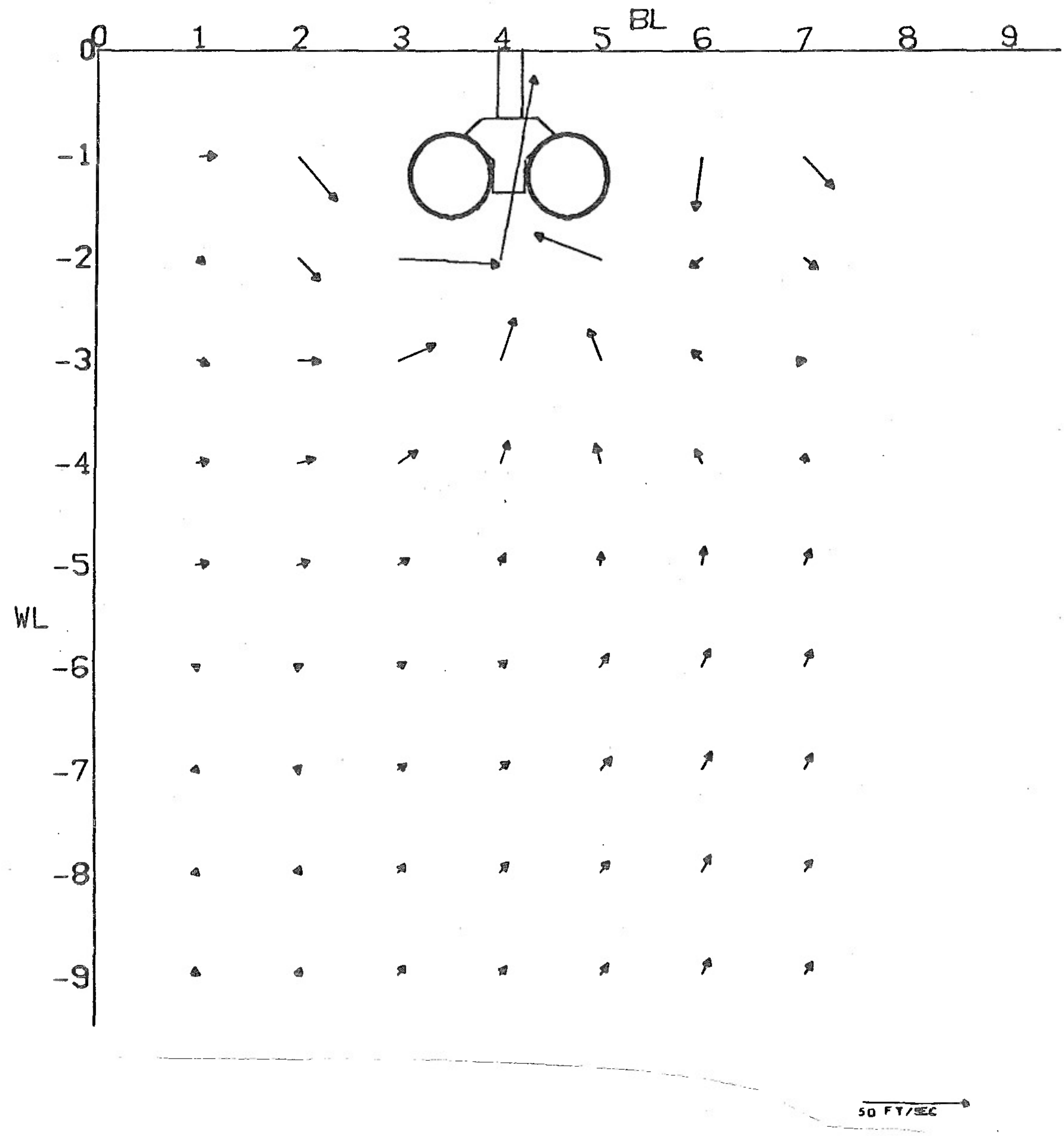
(b) MFS = 16

Figure 9. Concluded



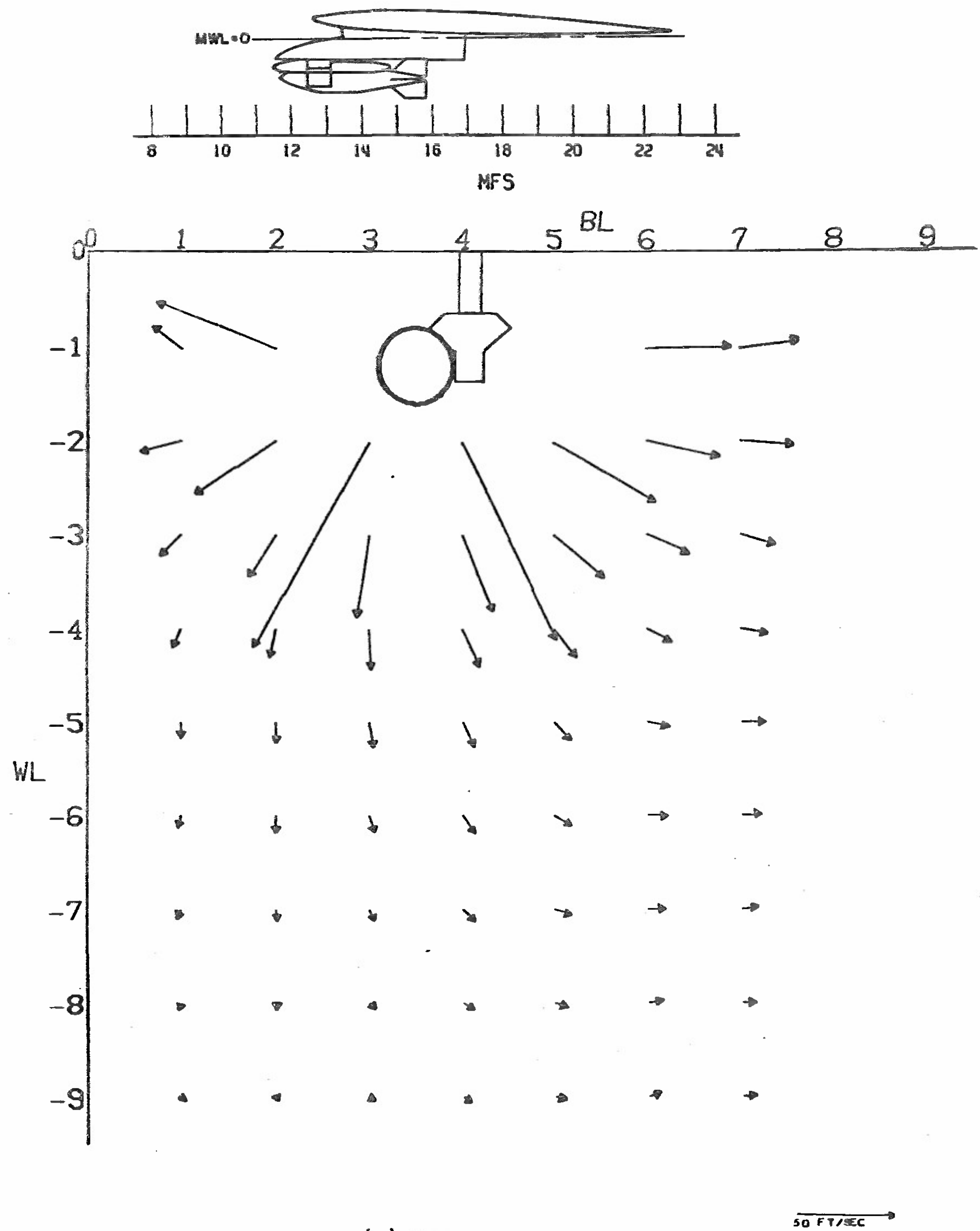
(a) MFS = 12

Figure 10. Effect of Two M-117 Bombs and TER on the Transverse Velocity Components of the Flow Field at $M_{\infty} = 0.85$, $V_{\infty} = 935$, $\alpha_p = 0.3$



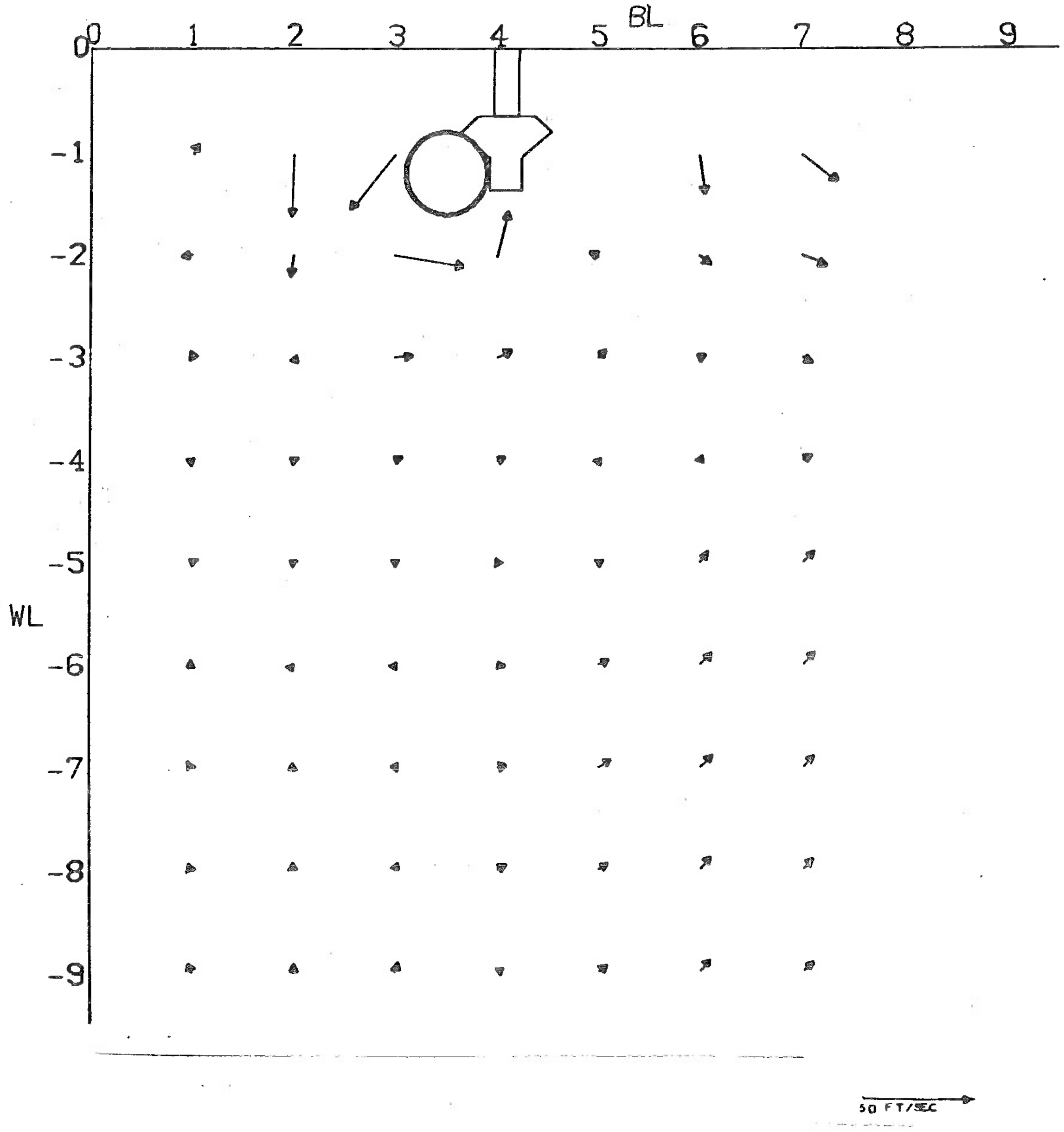
(b) MFS = 16

Figure 10. Concluded



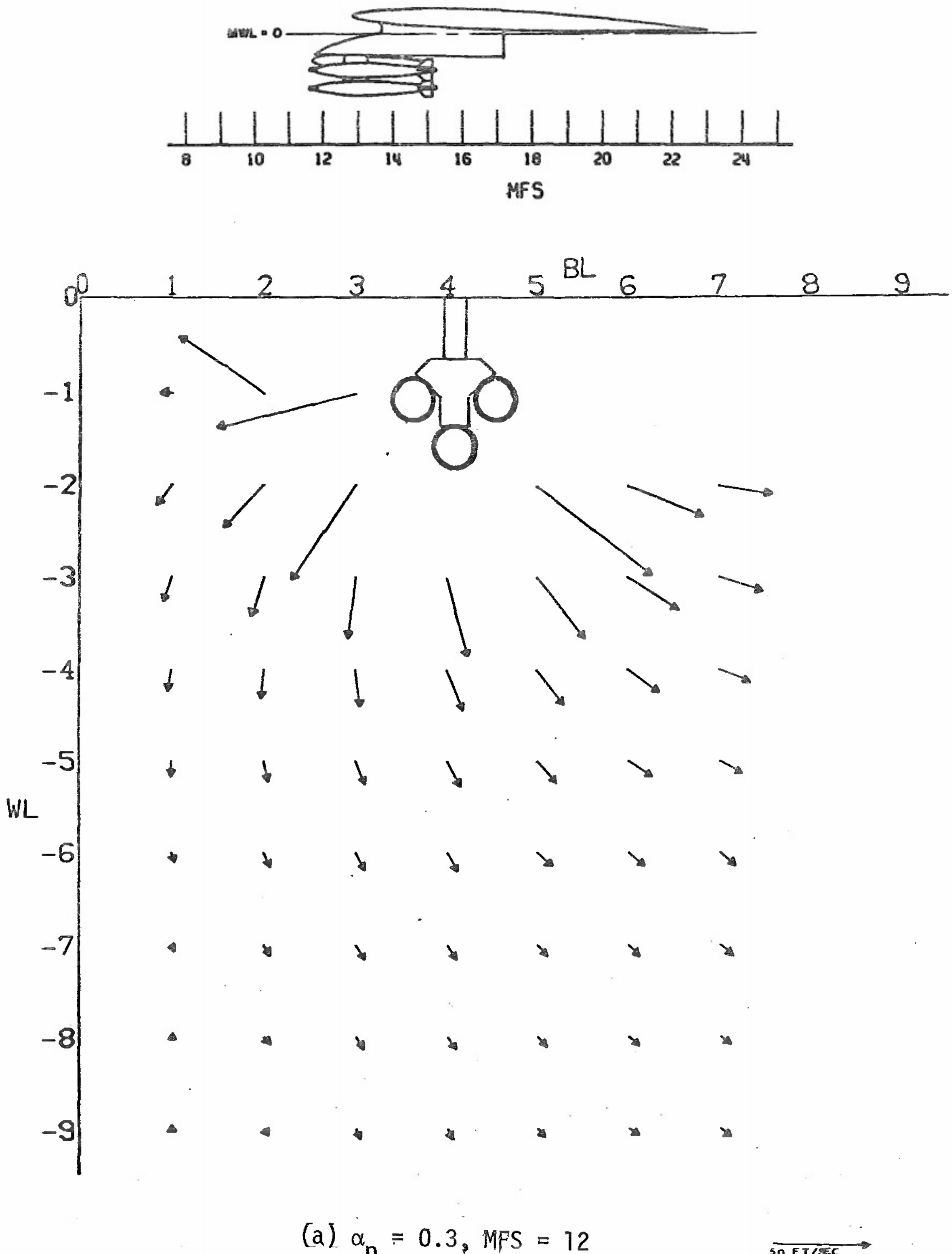
(a) MFS = 12

Figure 11. Effect of one M-117 Bomb and TER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



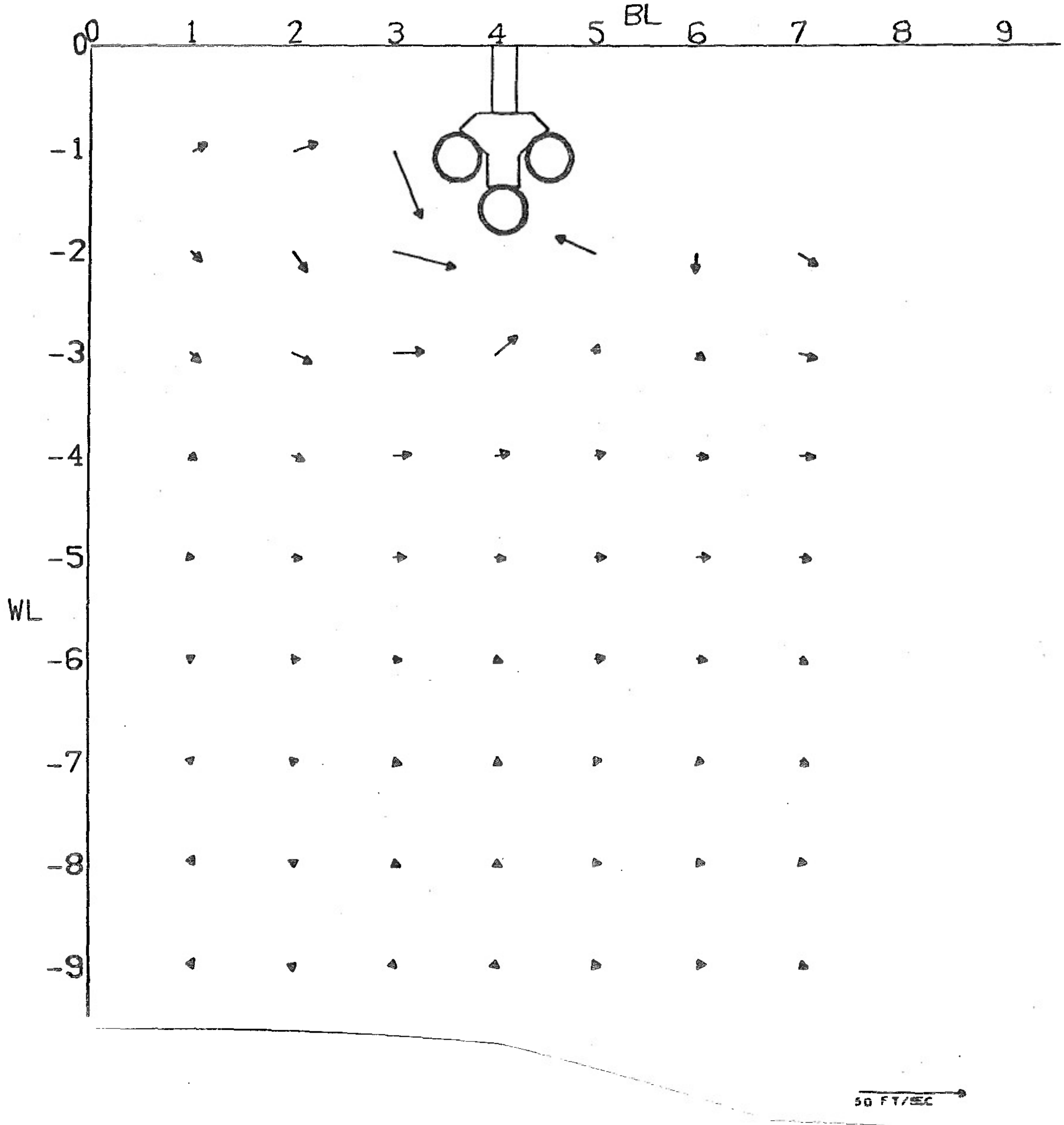
(b) MFS = 16

Figure 11. Concluded



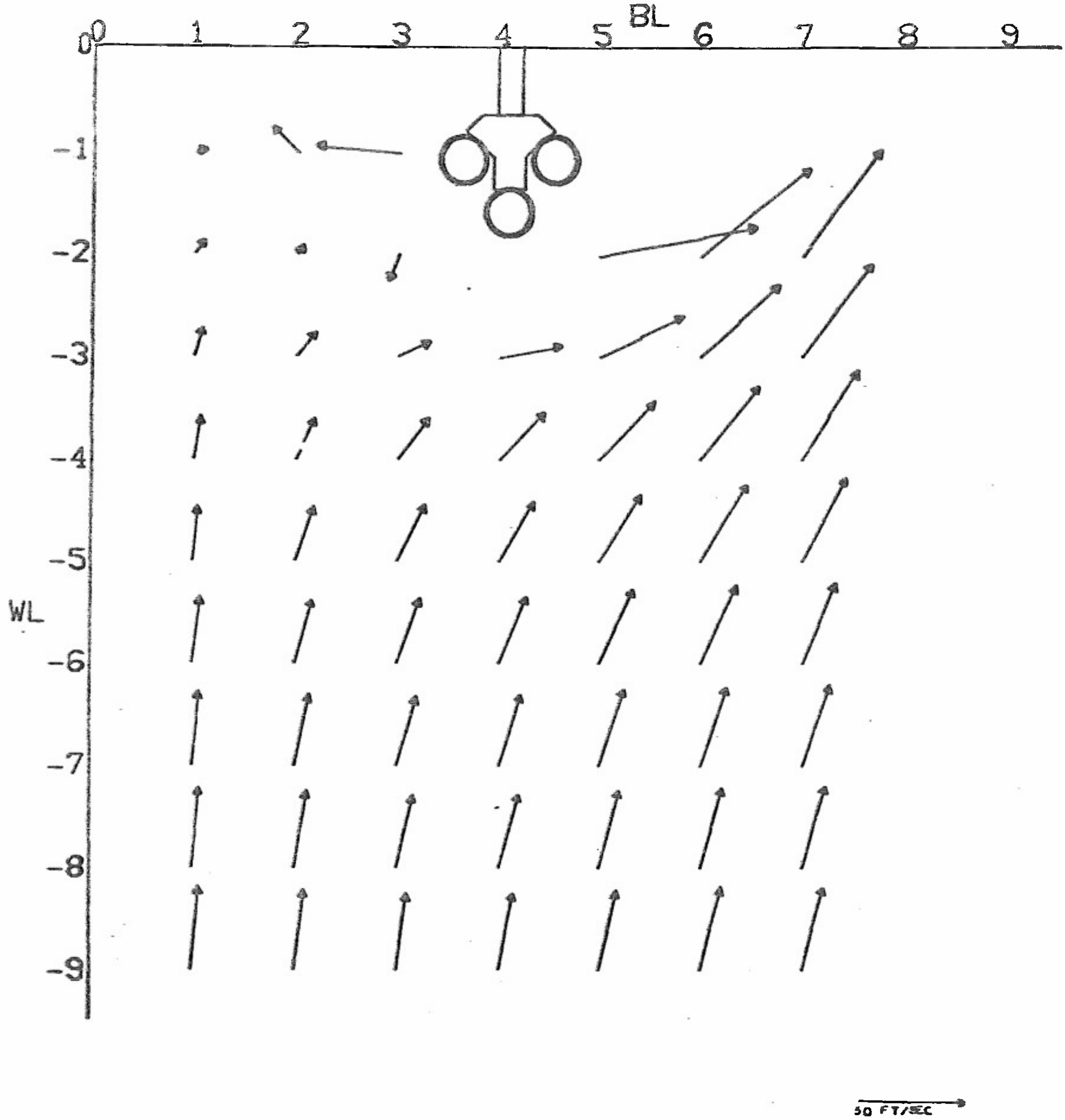
(a) α_p = 0.3, MFS = 12

Figure 12. Effect of Three MK-81 Bombs and TER on the Transverse Velocity Components of the Flow Field M_∞ = 0.85, V_∞ = 935, α_p = 0.3



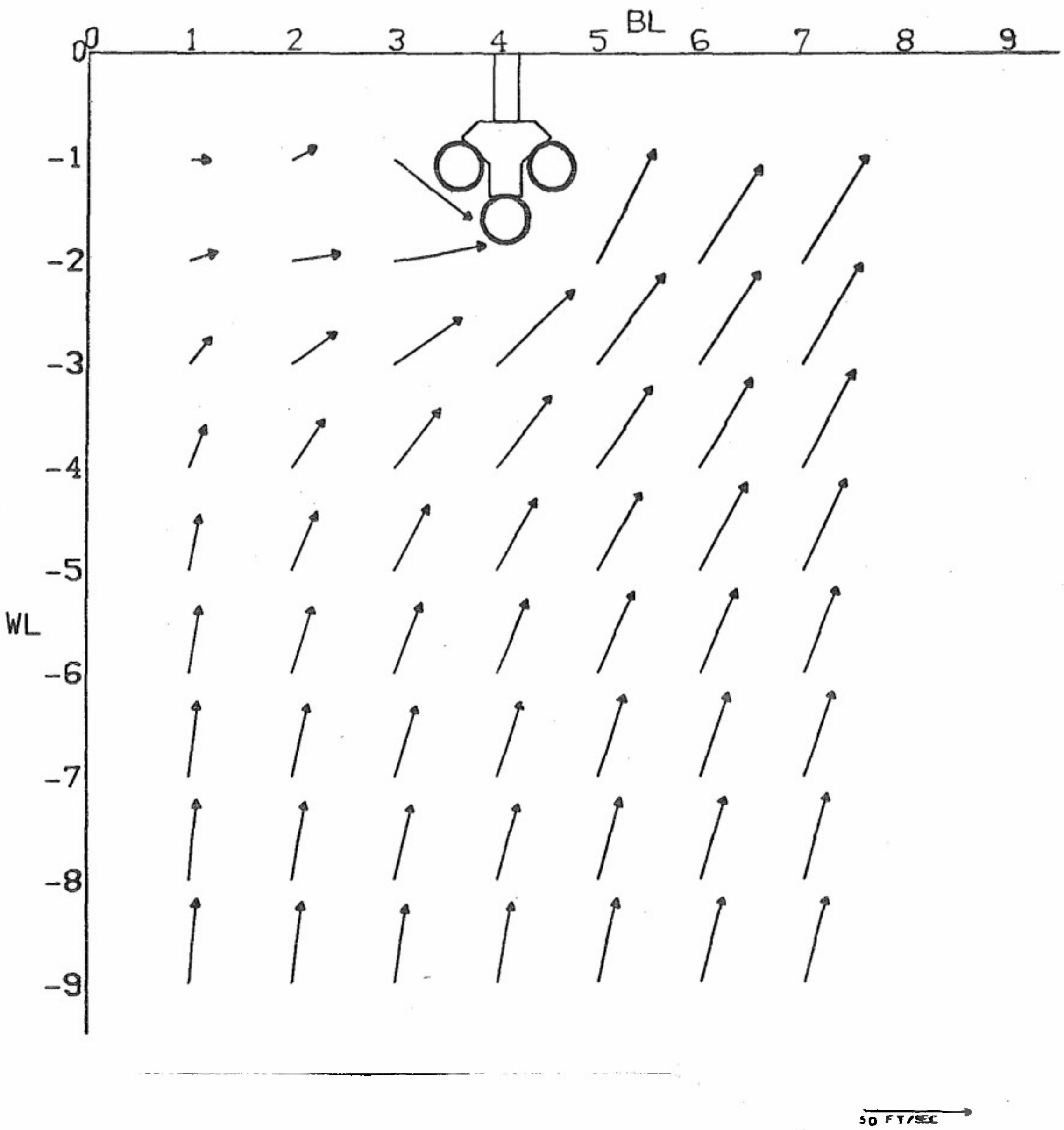
(b) α_p = 0.3, MFS = 15

Figure 12. Continued



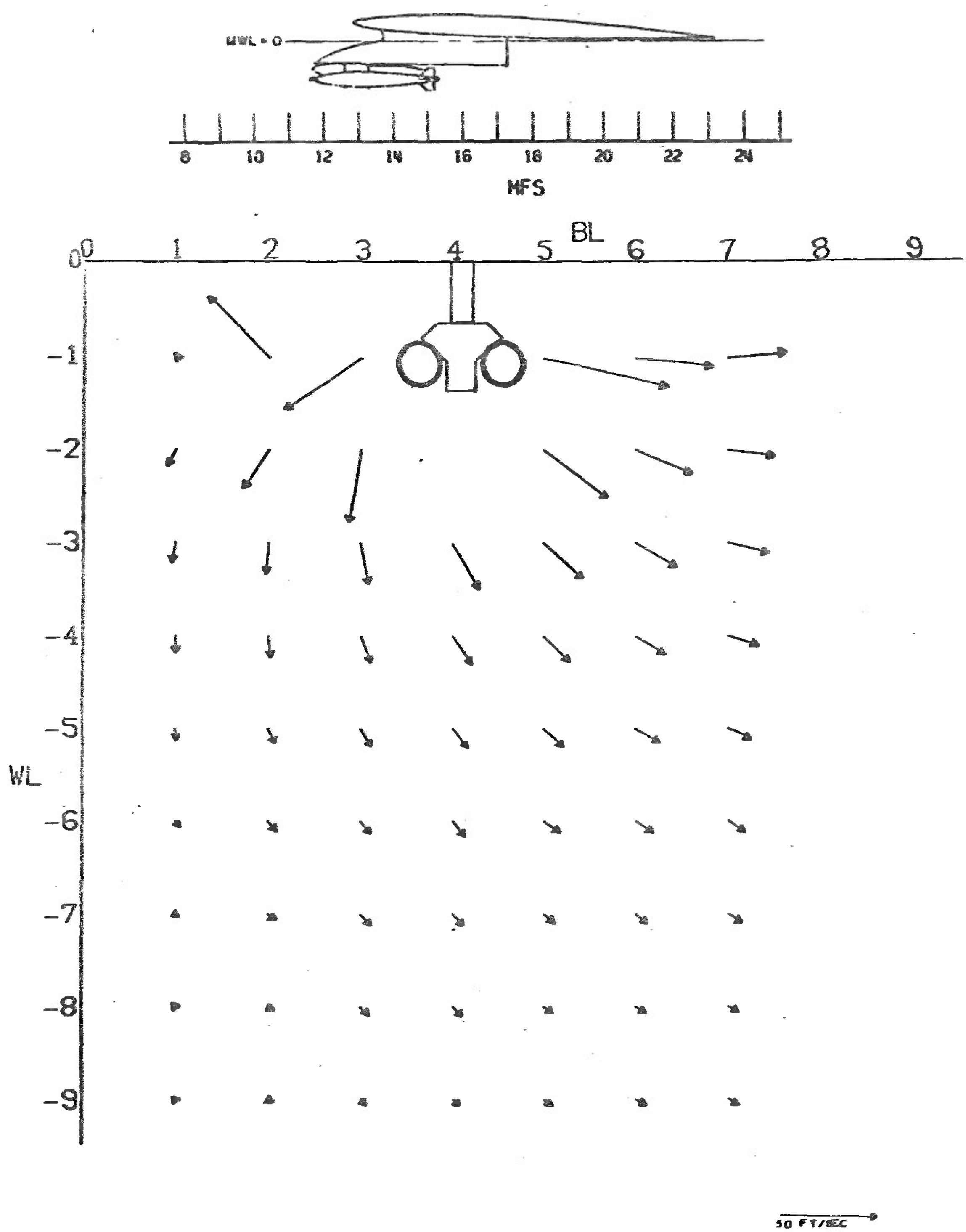
(c) α_p = 3.3, MPS = 12

Figure 12. Continued



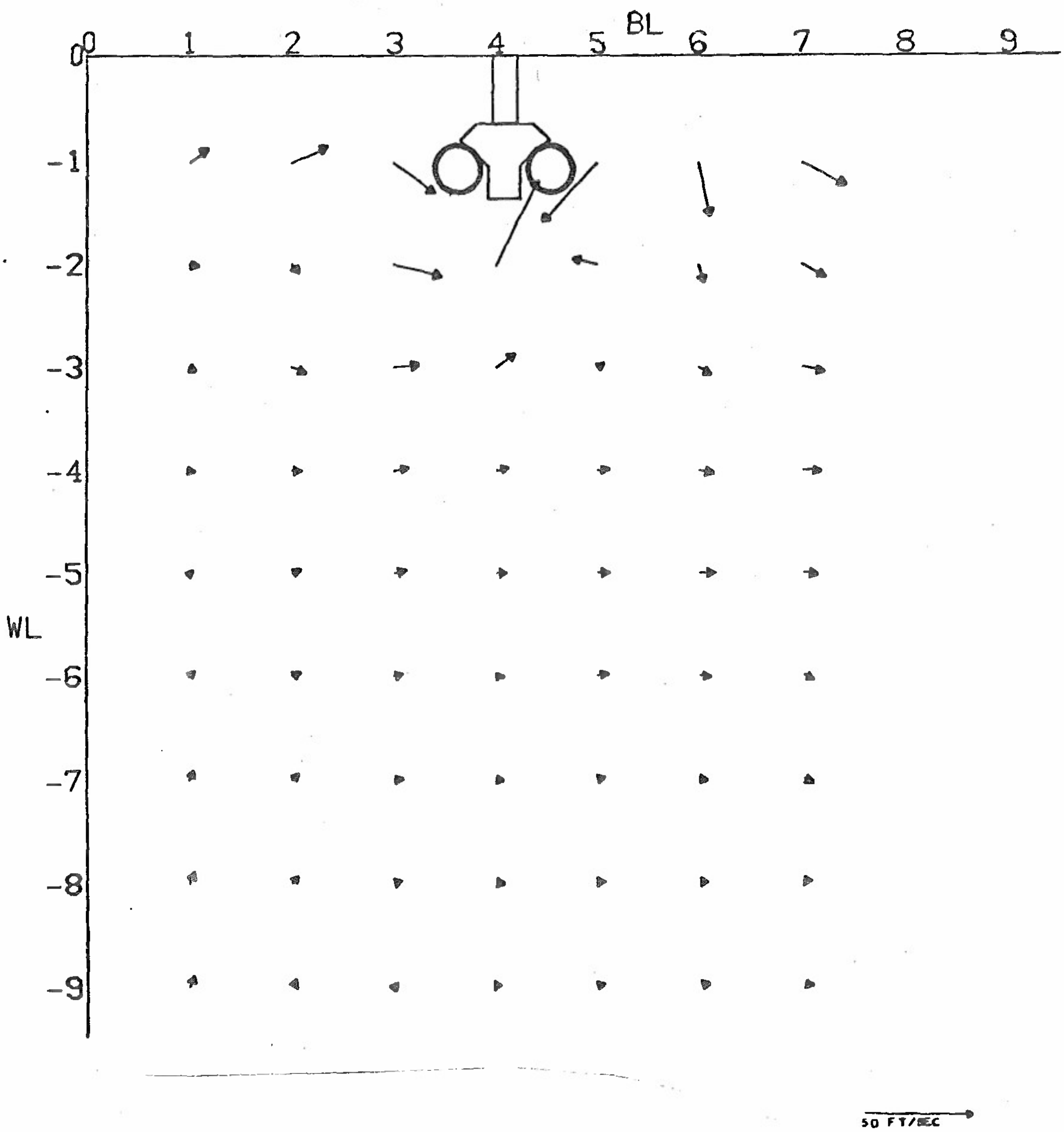
(d) α_p = 3.3, MPS = 15

Figure 12. Concluded



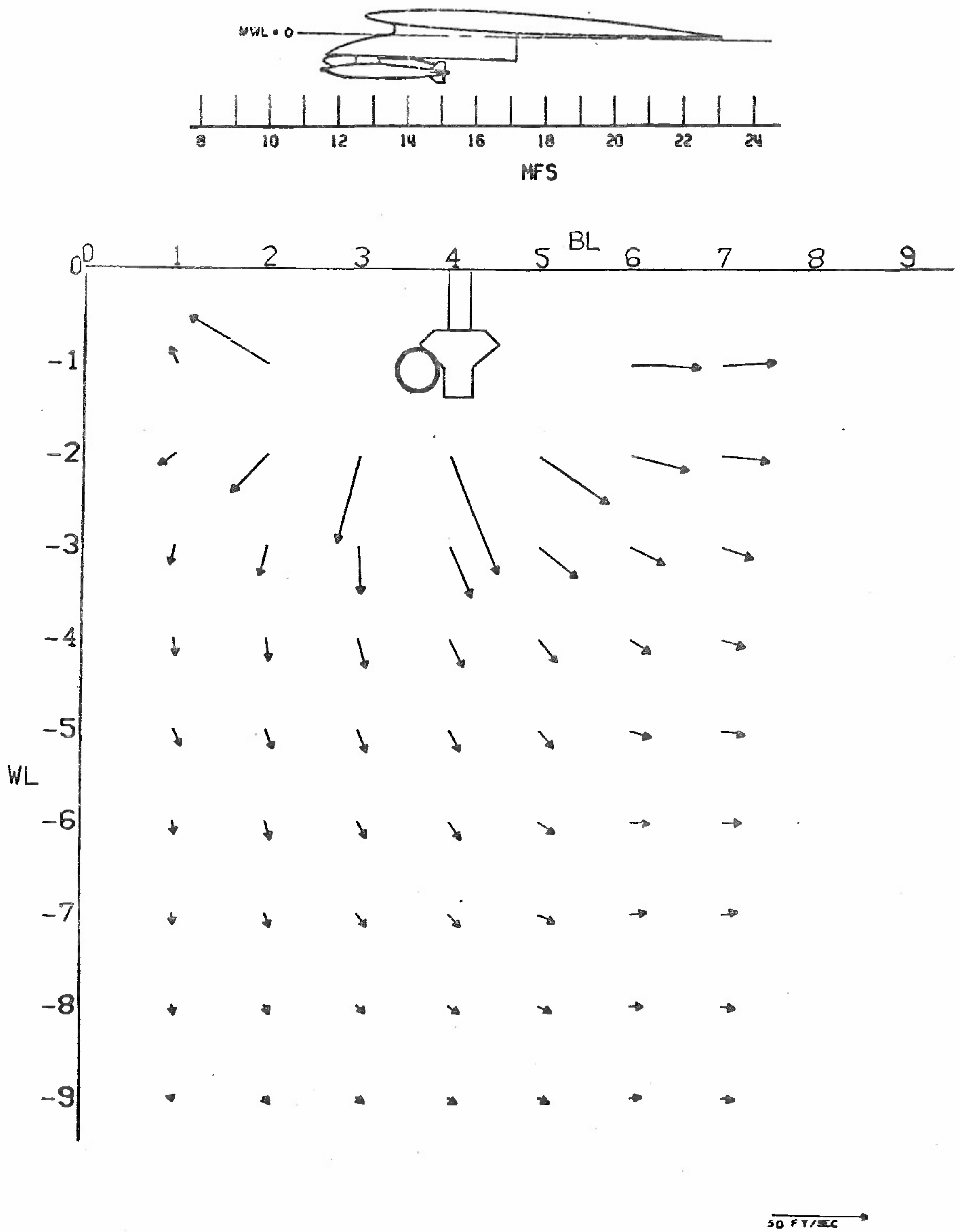
(a) MFS = 12

Figure 13. Effect of Two MK-81 Bombs and TER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



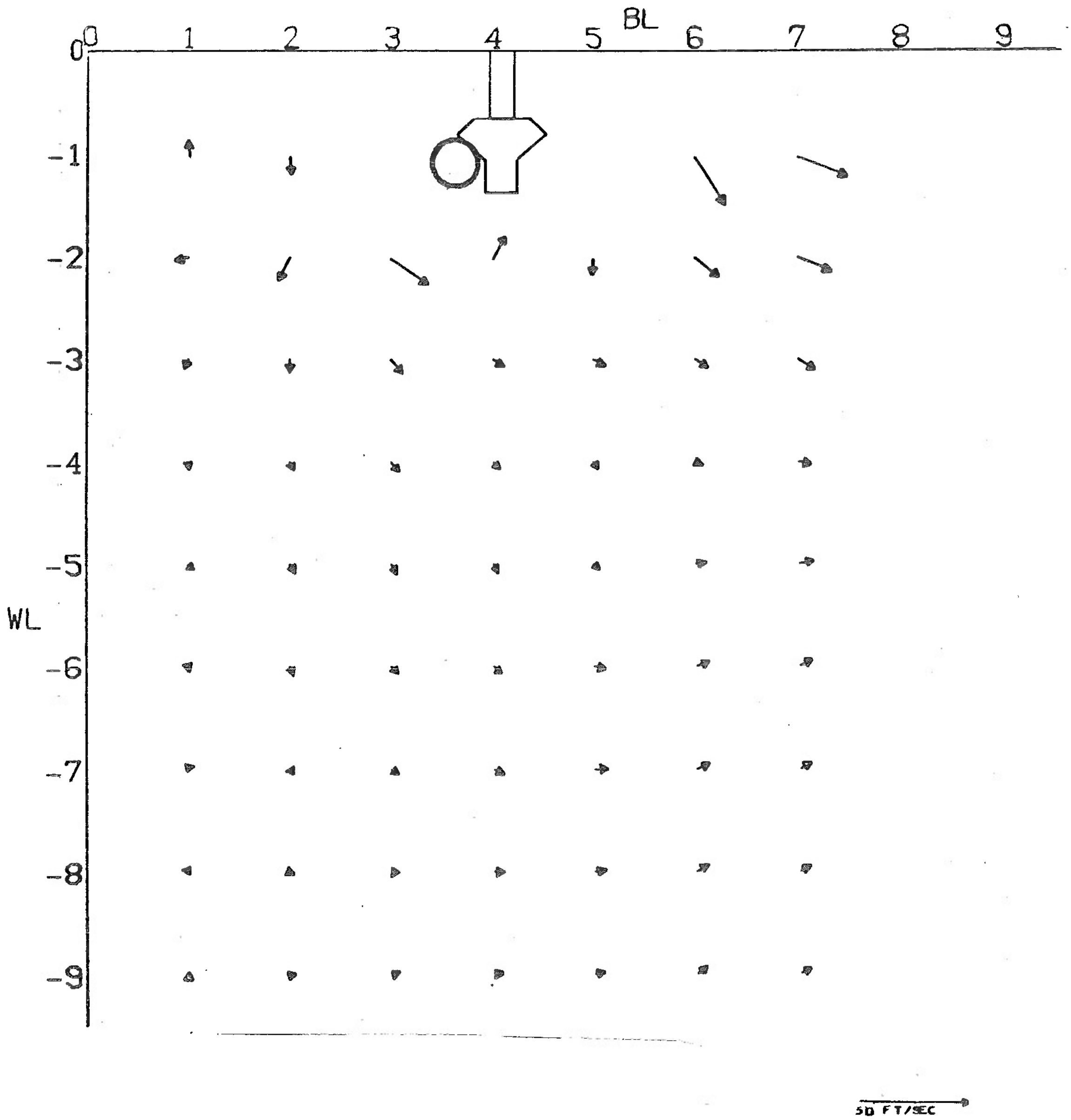
(b) MFS = 15

Figure 13. Concluded



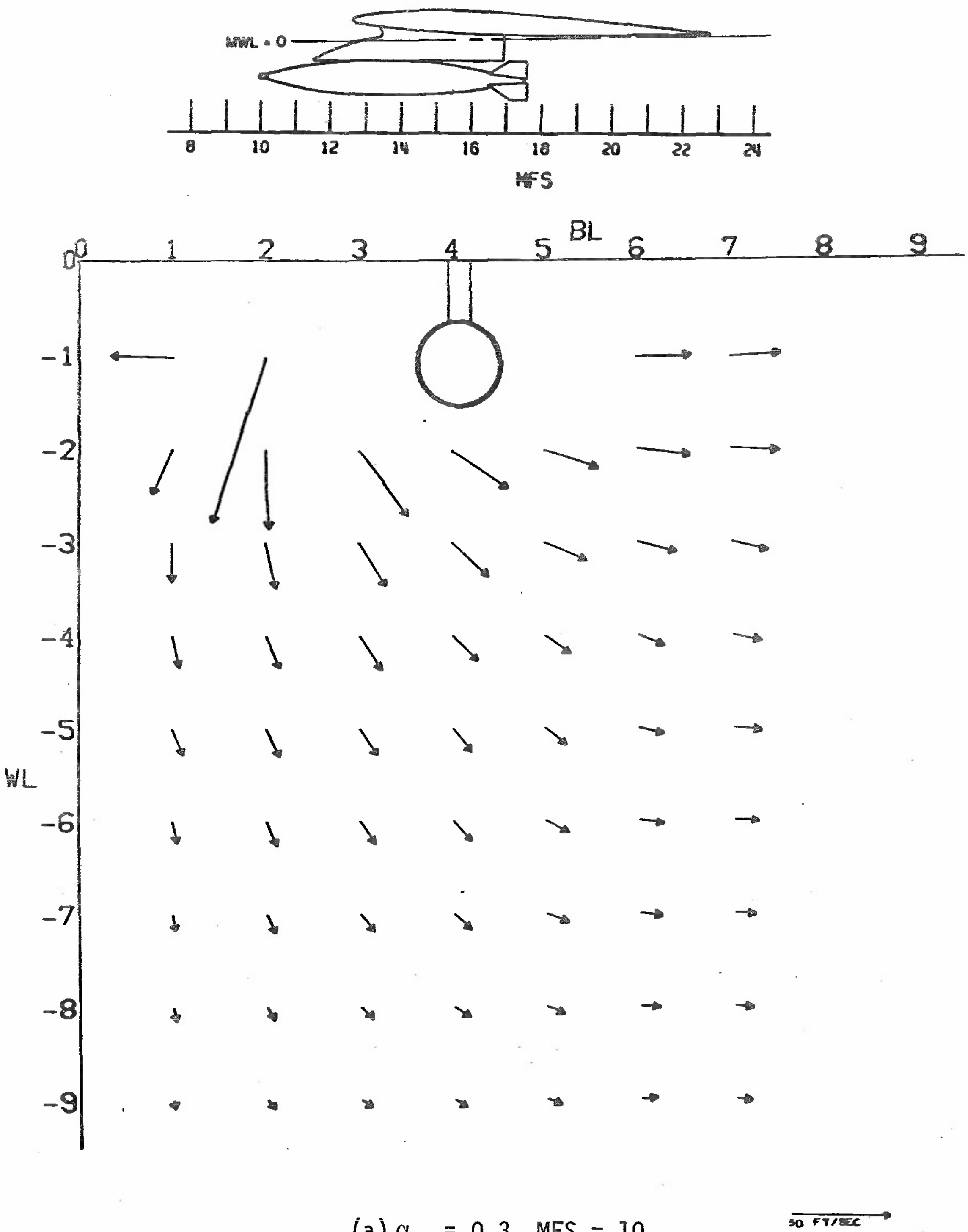
(a) MFS = 12

Figure 14. Effect of One MK-81 Bomb and TER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



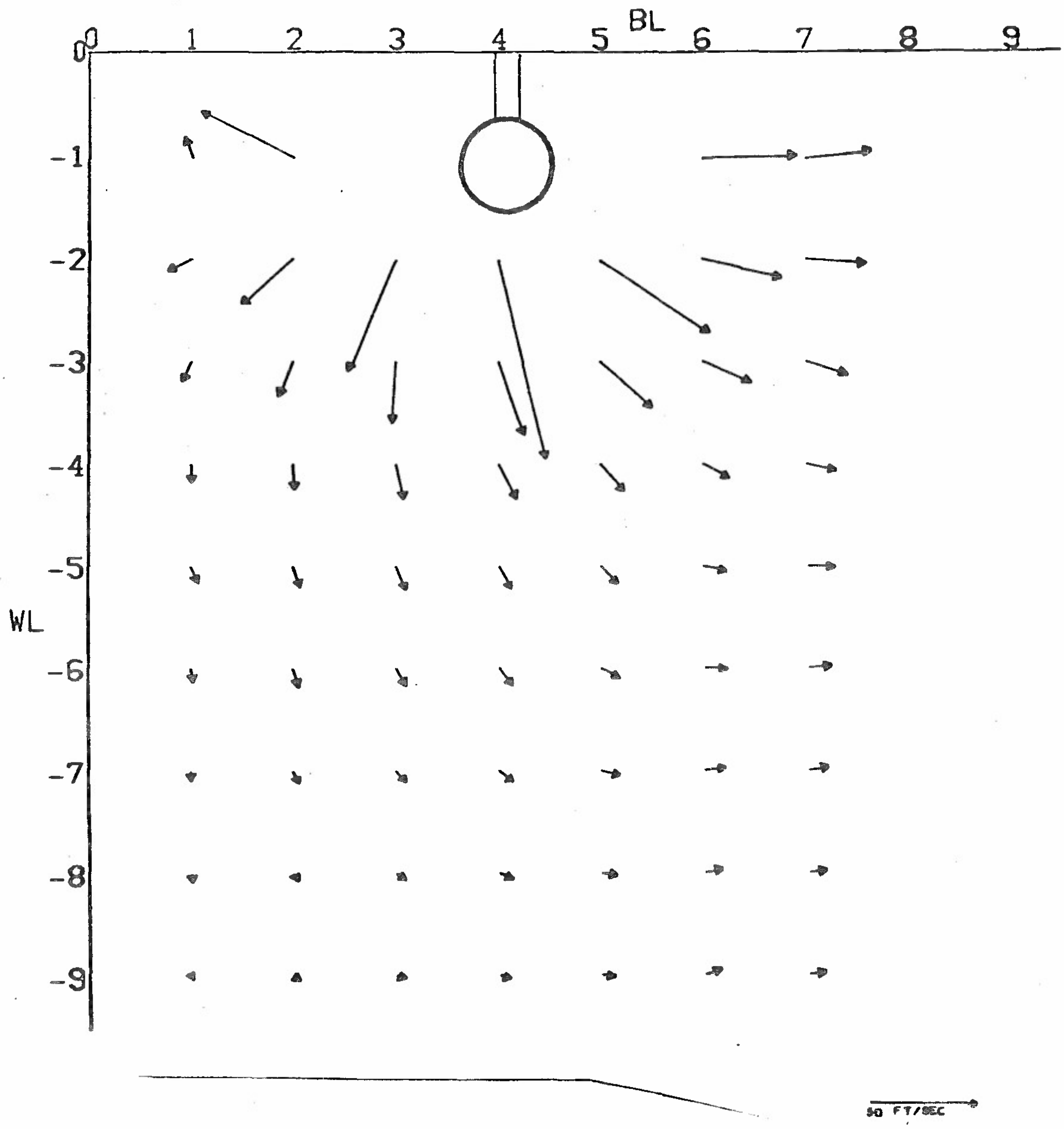
(b) MFS = 15

Figure 14. Concluded



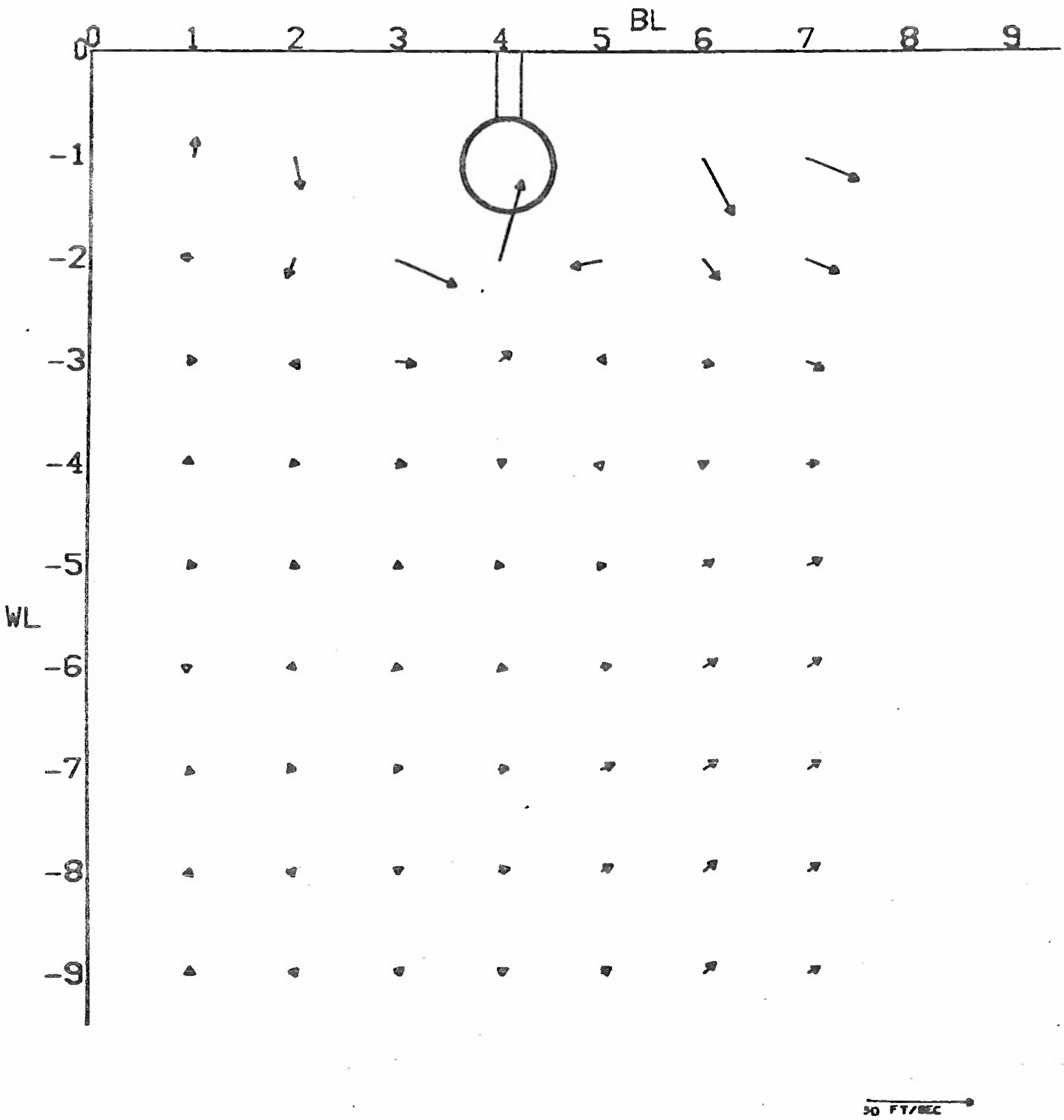
(a) α_p = 0.3, MFS = 10

Figure 15. Effect of one MK-84 Bomb and Inboard Pylon on the Transverse Velocity Components of the Flow Field at M_∞ = 0.85, V_∞ = 935, α_p = 0.3



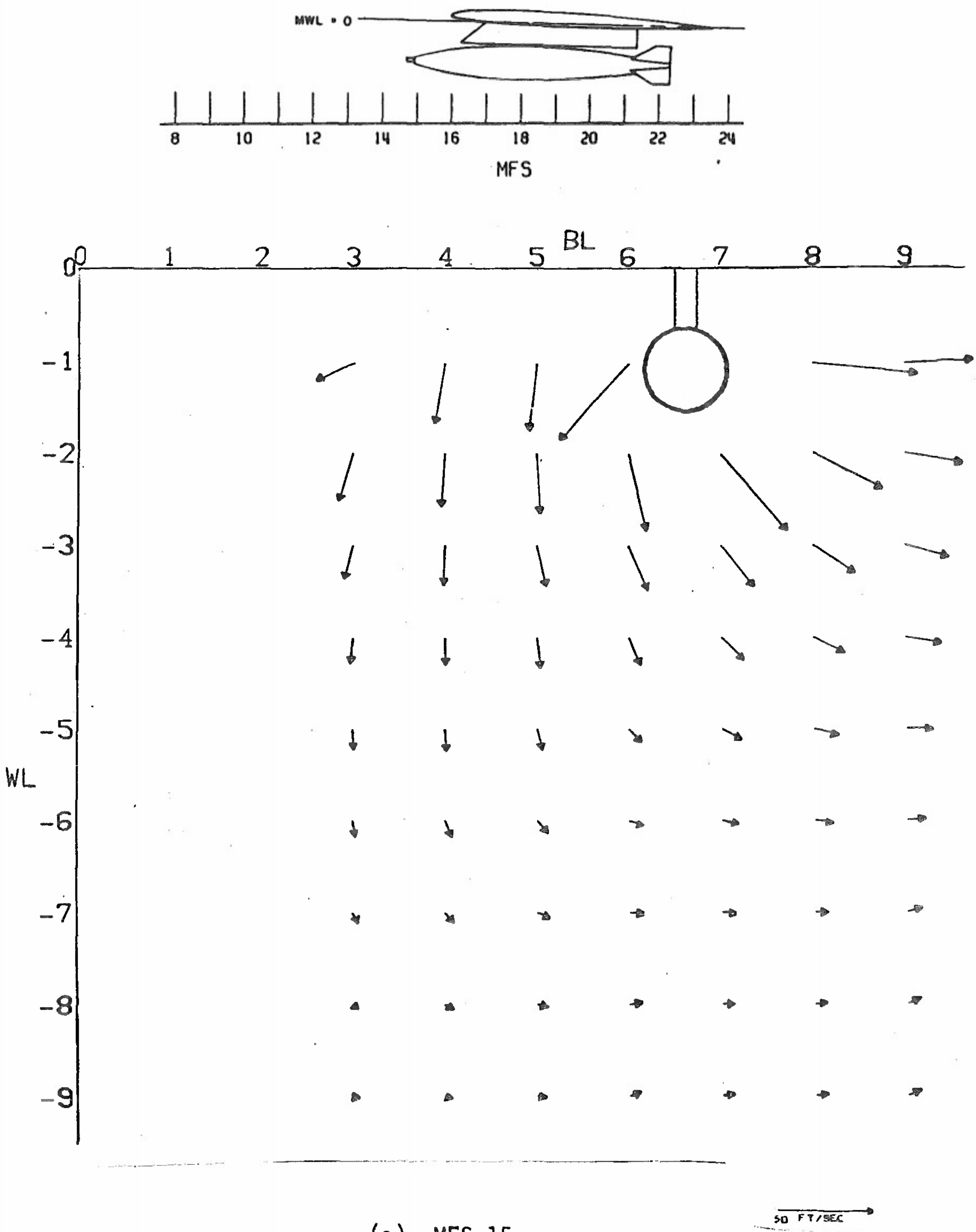
(b) MFS = 12

Figure 15. Continued



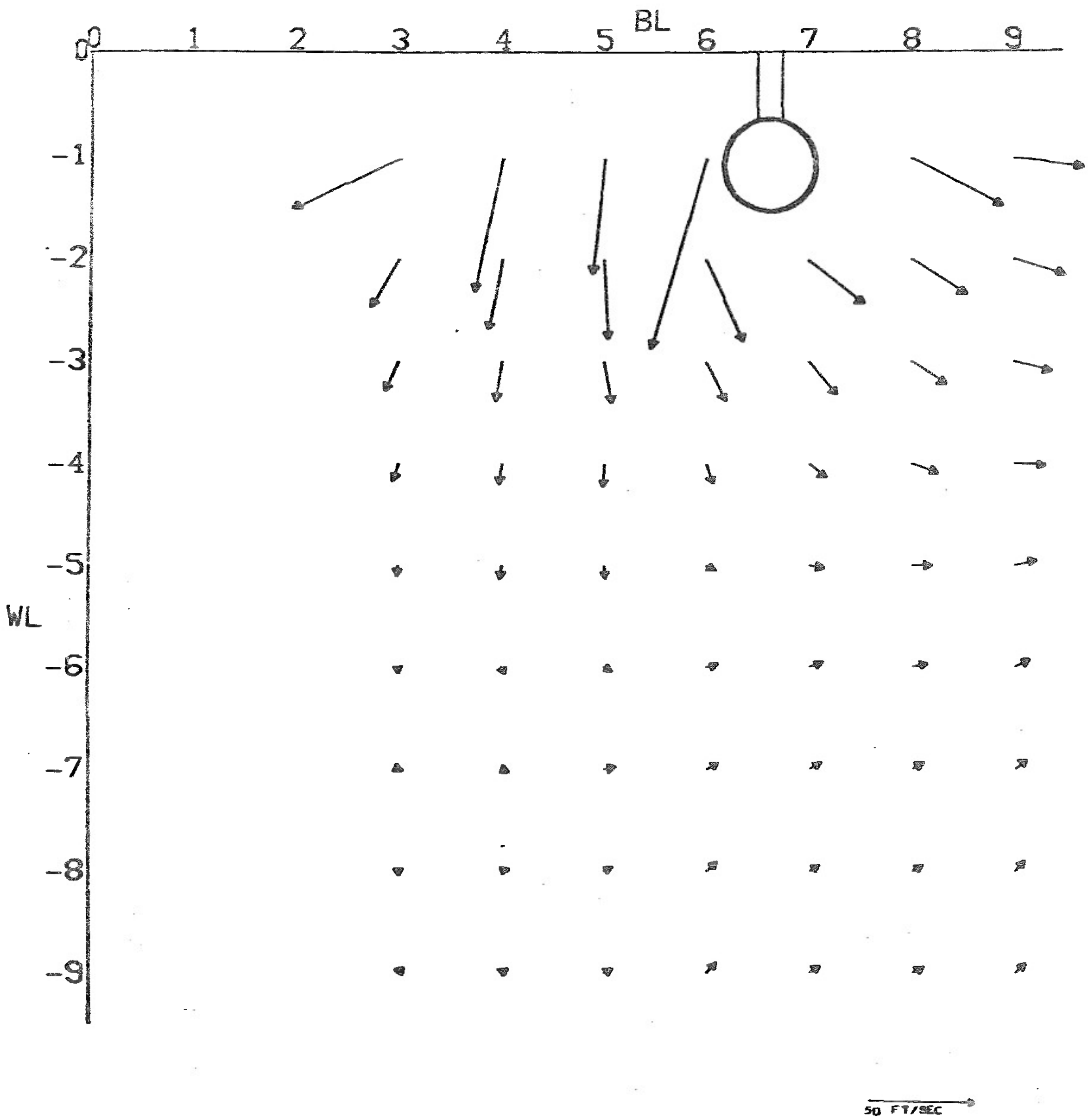
(c) MFS = 17

Figure 15. Concluded



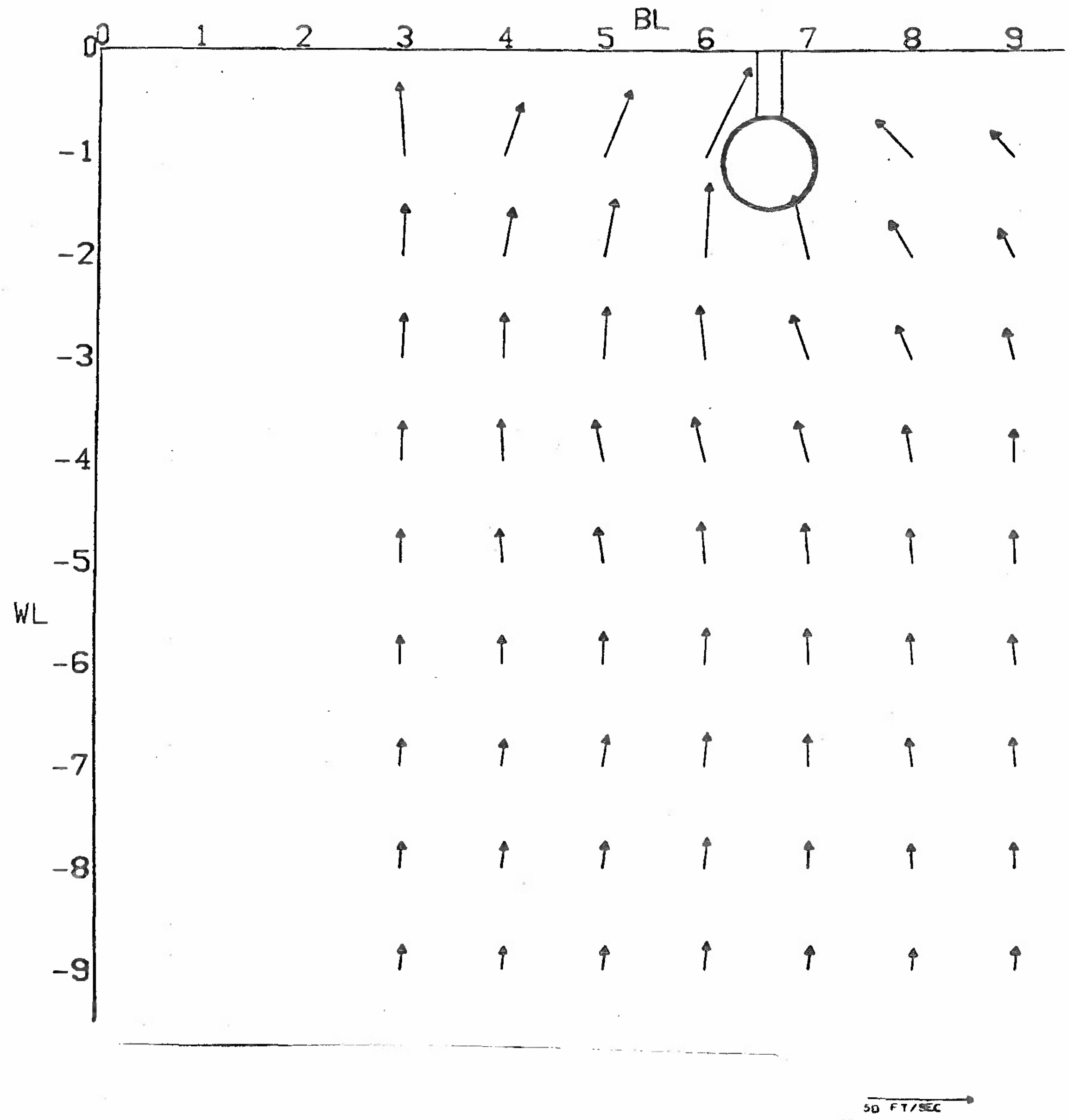
(a) MFS 15

Figure 16. Effect of One MK-84 Bomb and Outboard Pylon on the Transverse Velocity Components of the Flow Field at $M_{\infty} = 0.85$, $V_{\infty} = 935$, $\alpha_p = 0.3$



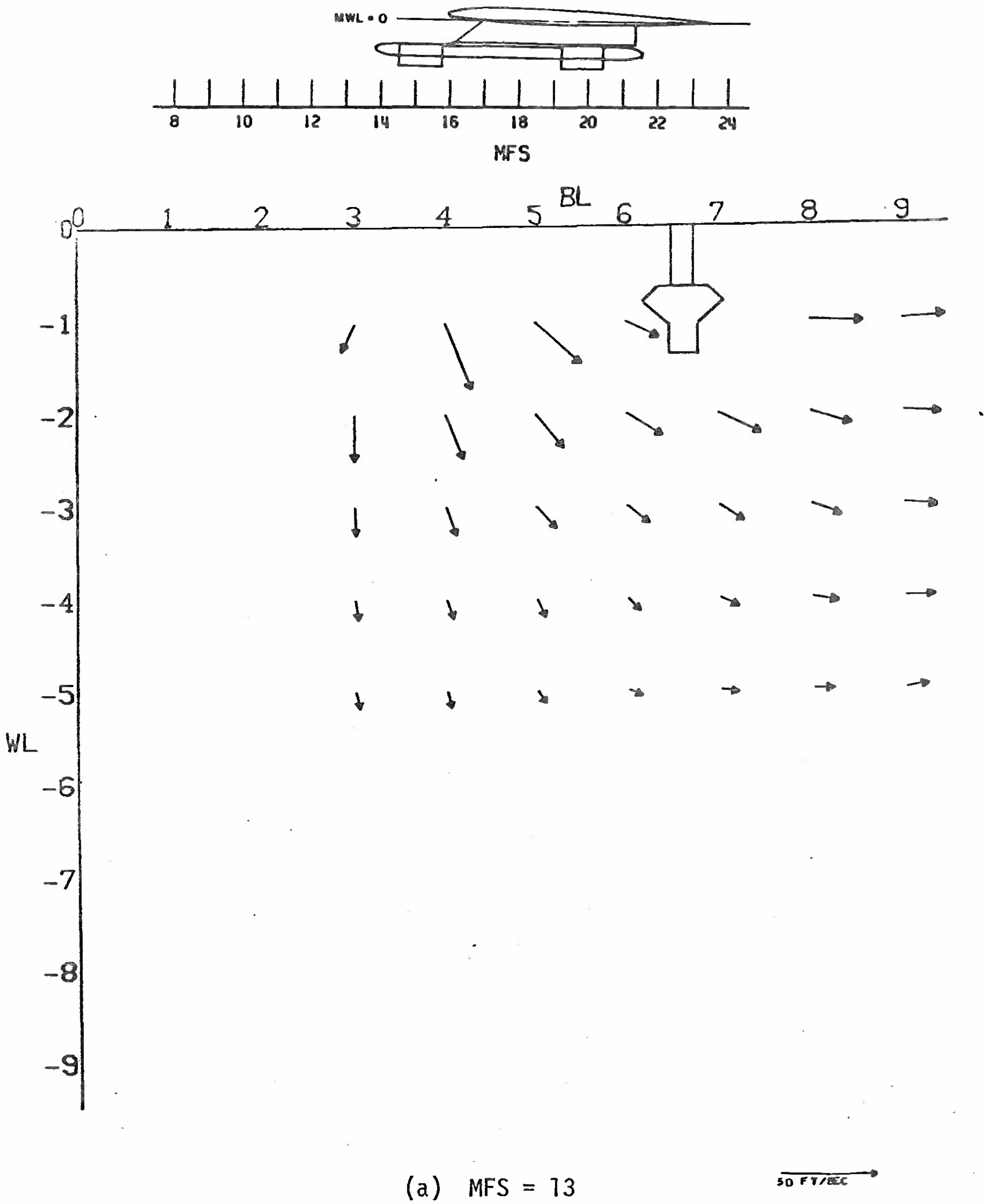
(b) MFS 17

Figure 16. Continued



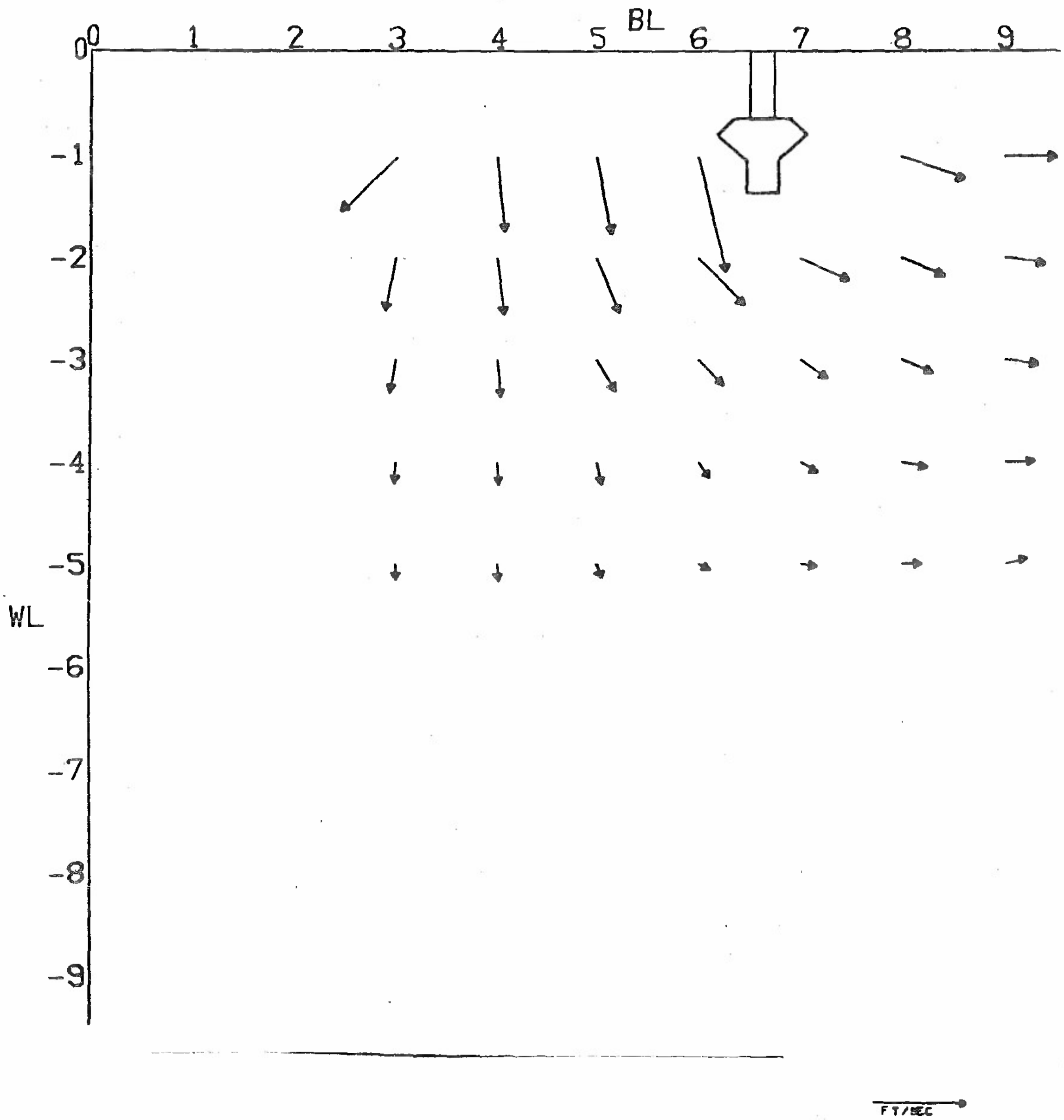
(c) MFS = 22

Figure 16. Concluded



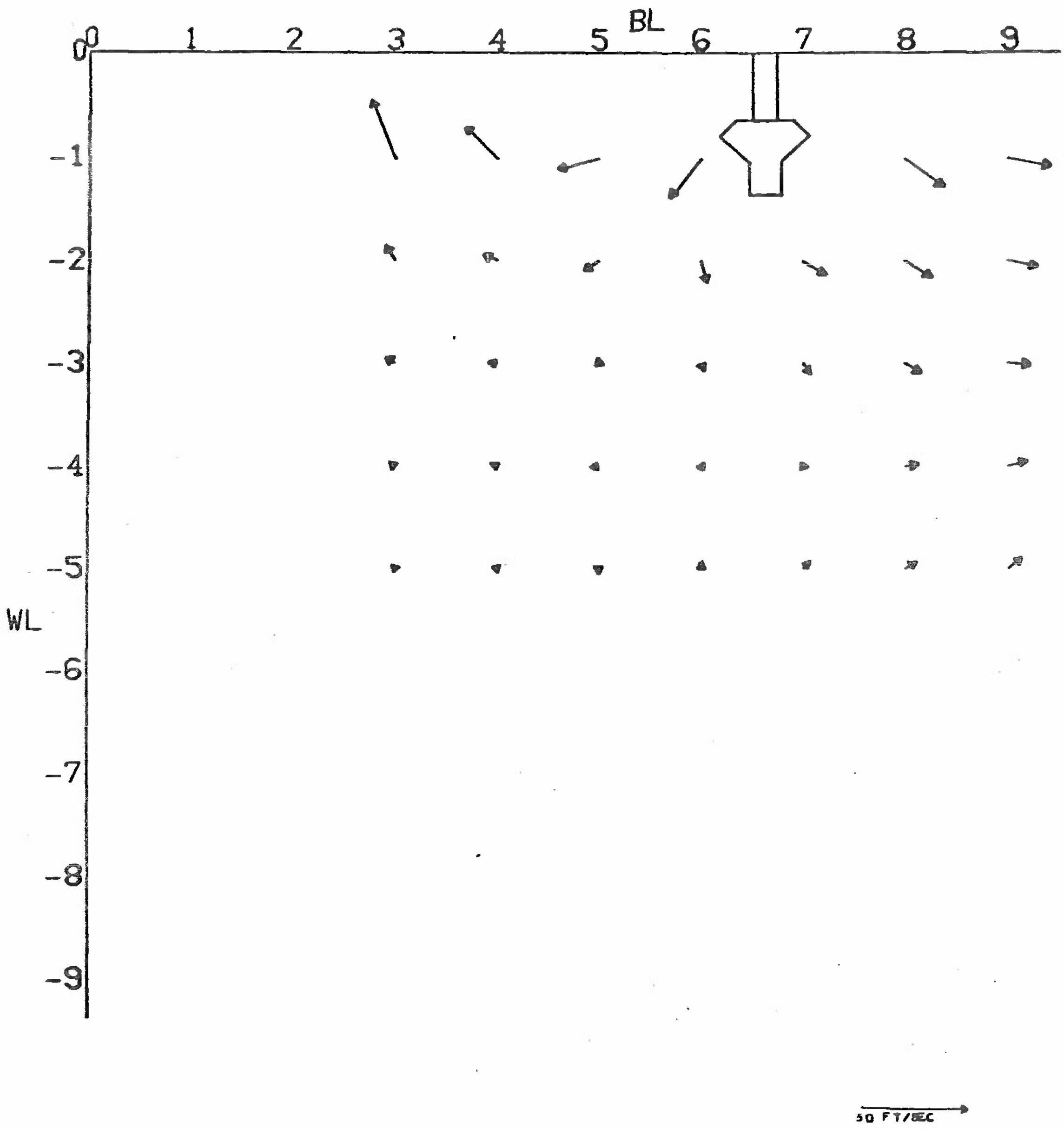
(a) MFS = 13

Figure 17. Effect of an Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



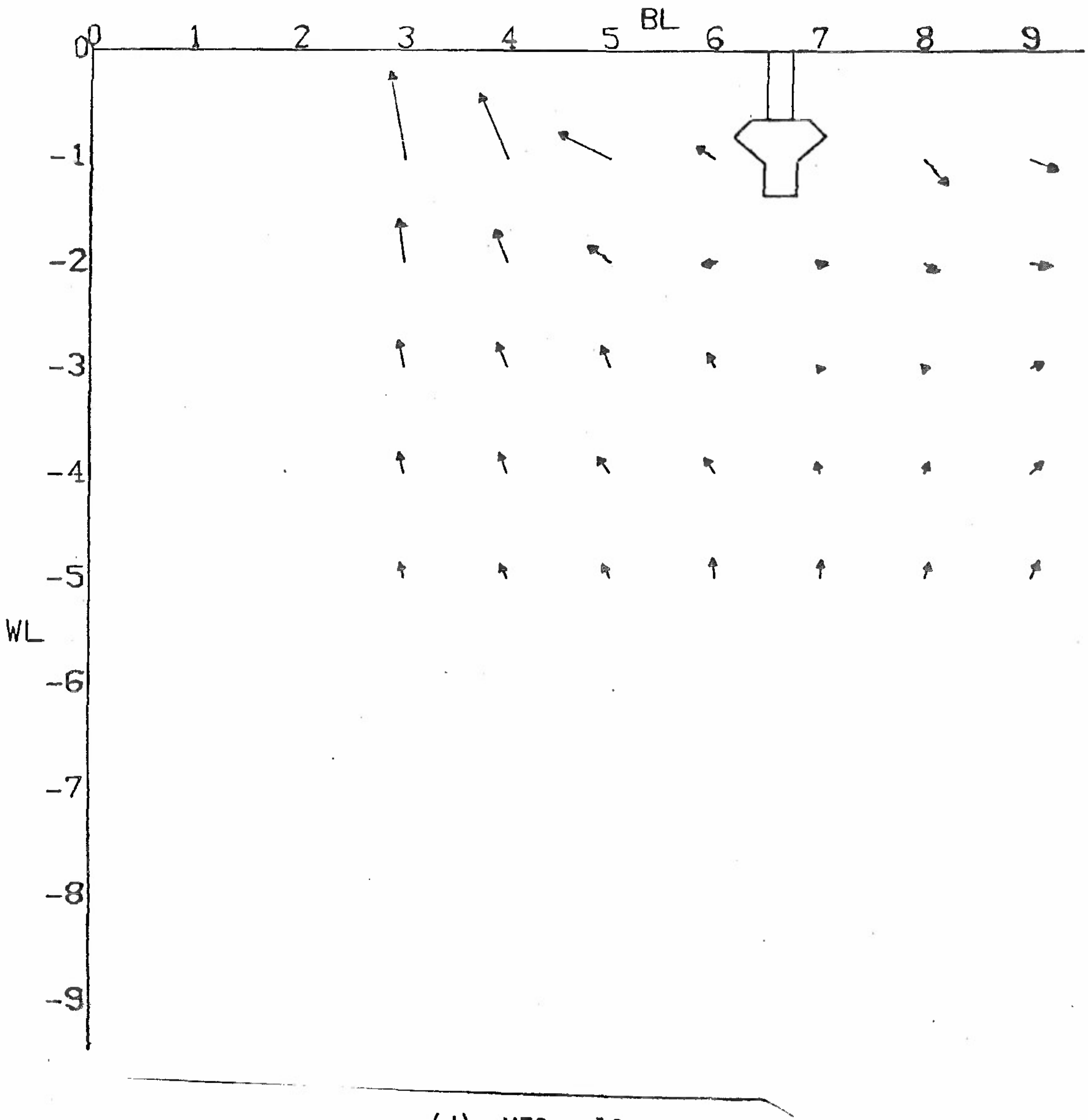
(b) MFS = 16

Figure 17. Continued



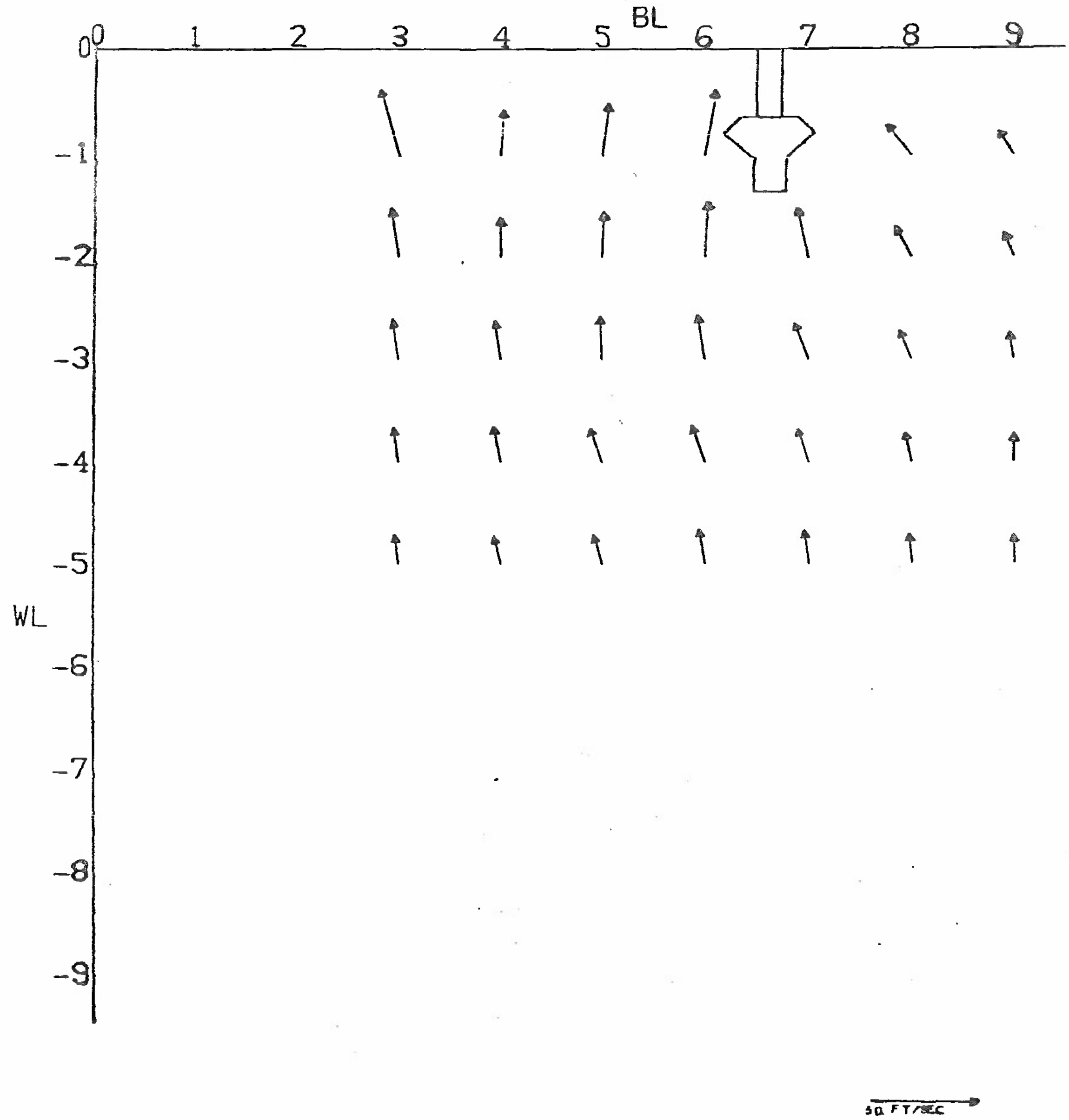
(c) MFS = 18

Figure 17. Continued



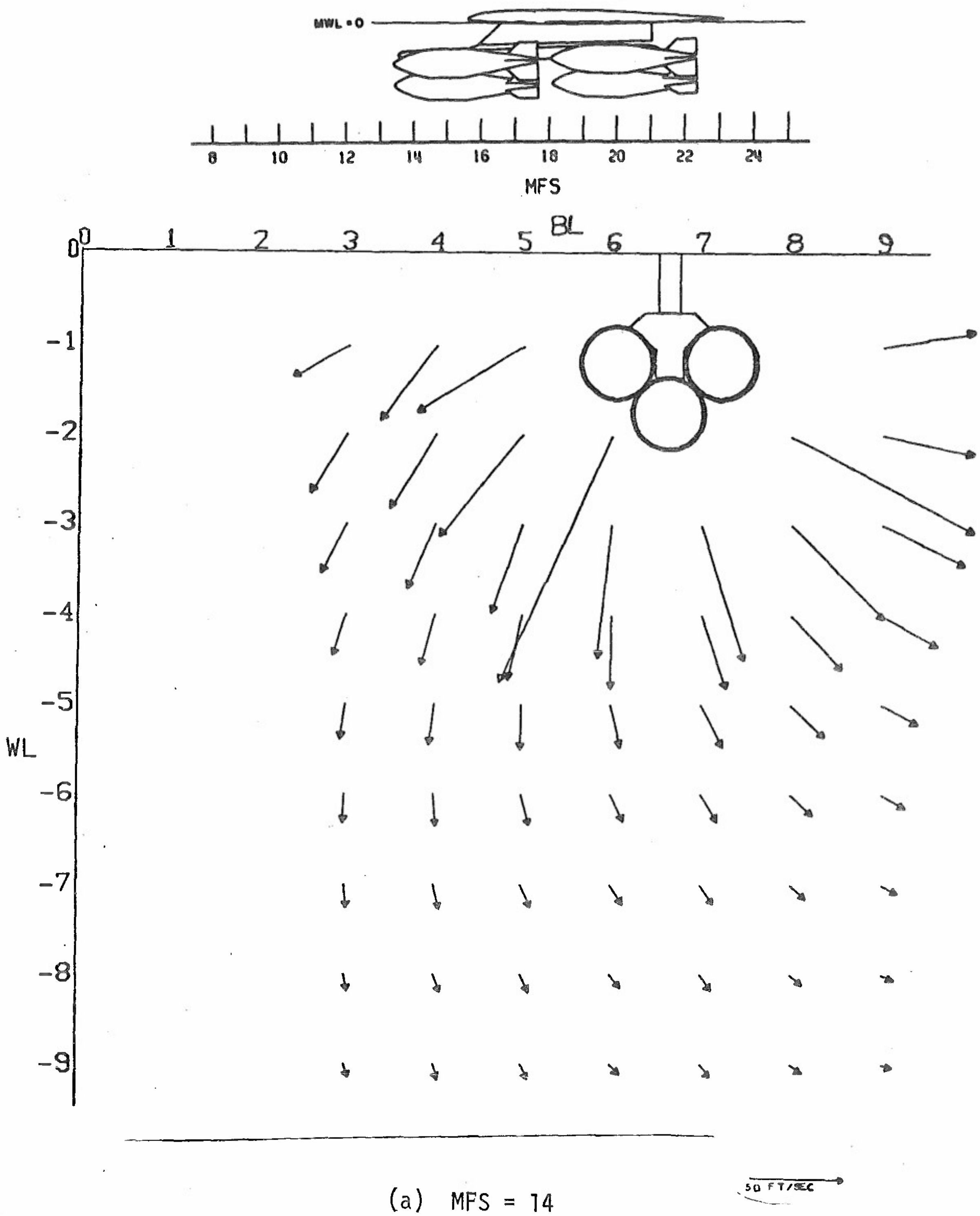
(d) MFS = 19

Figure 17. Continued



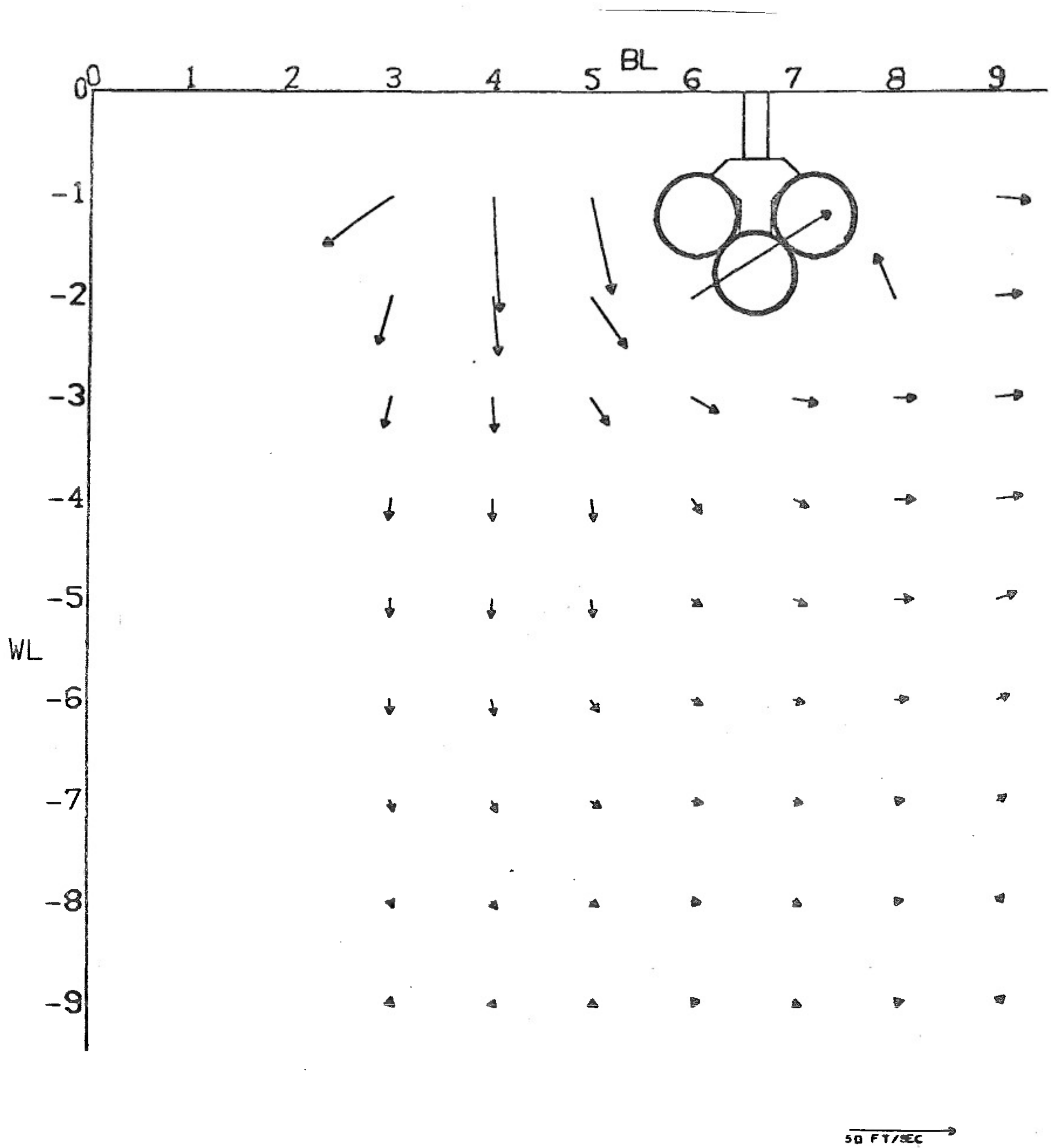
(e) MFS = 22

Figure 17. Concluded



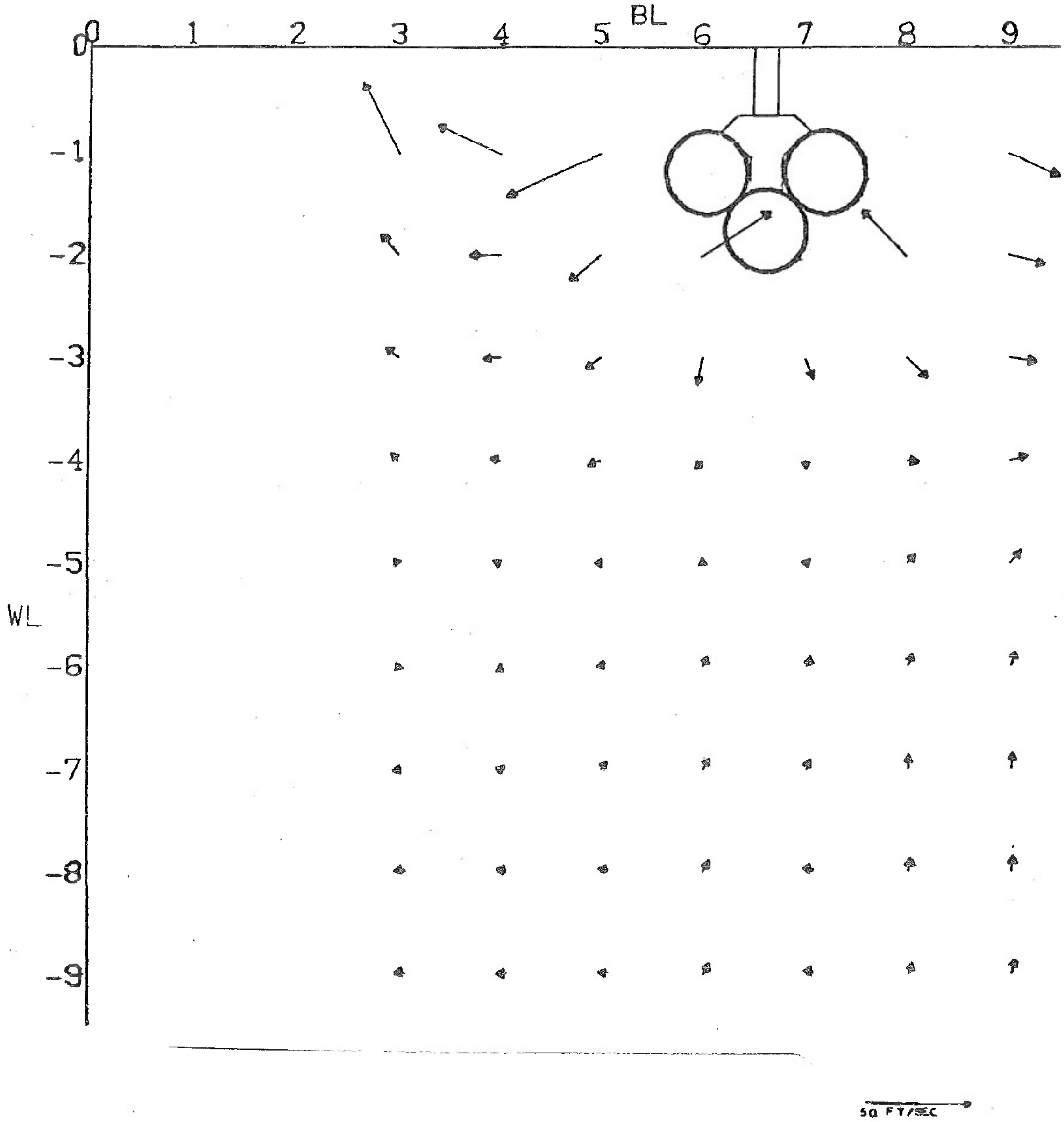
(a) MFS = 14

Figure 18. Effect of Six M-117 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



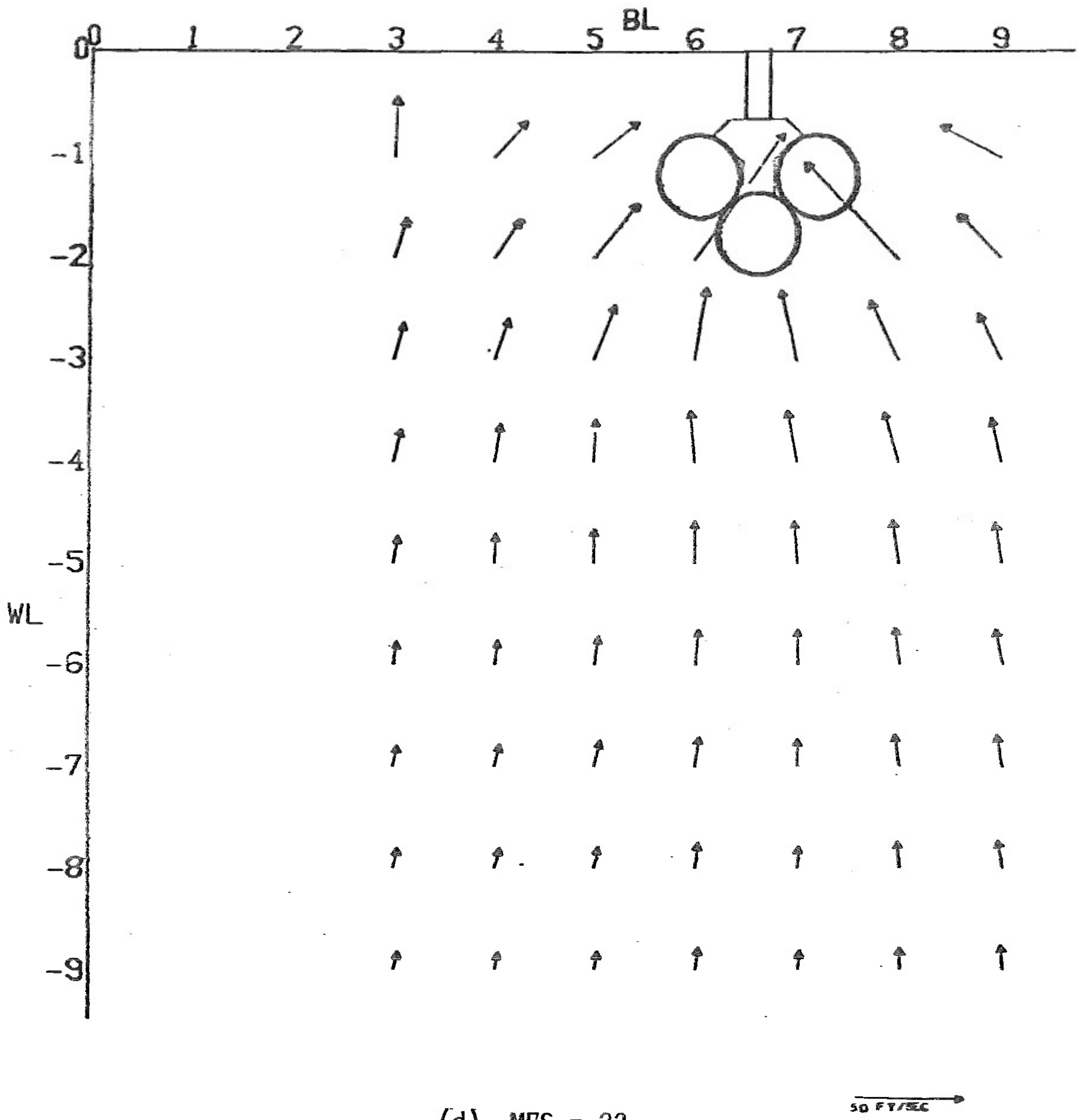
(b) MFS = 17

Figure 18. Continued



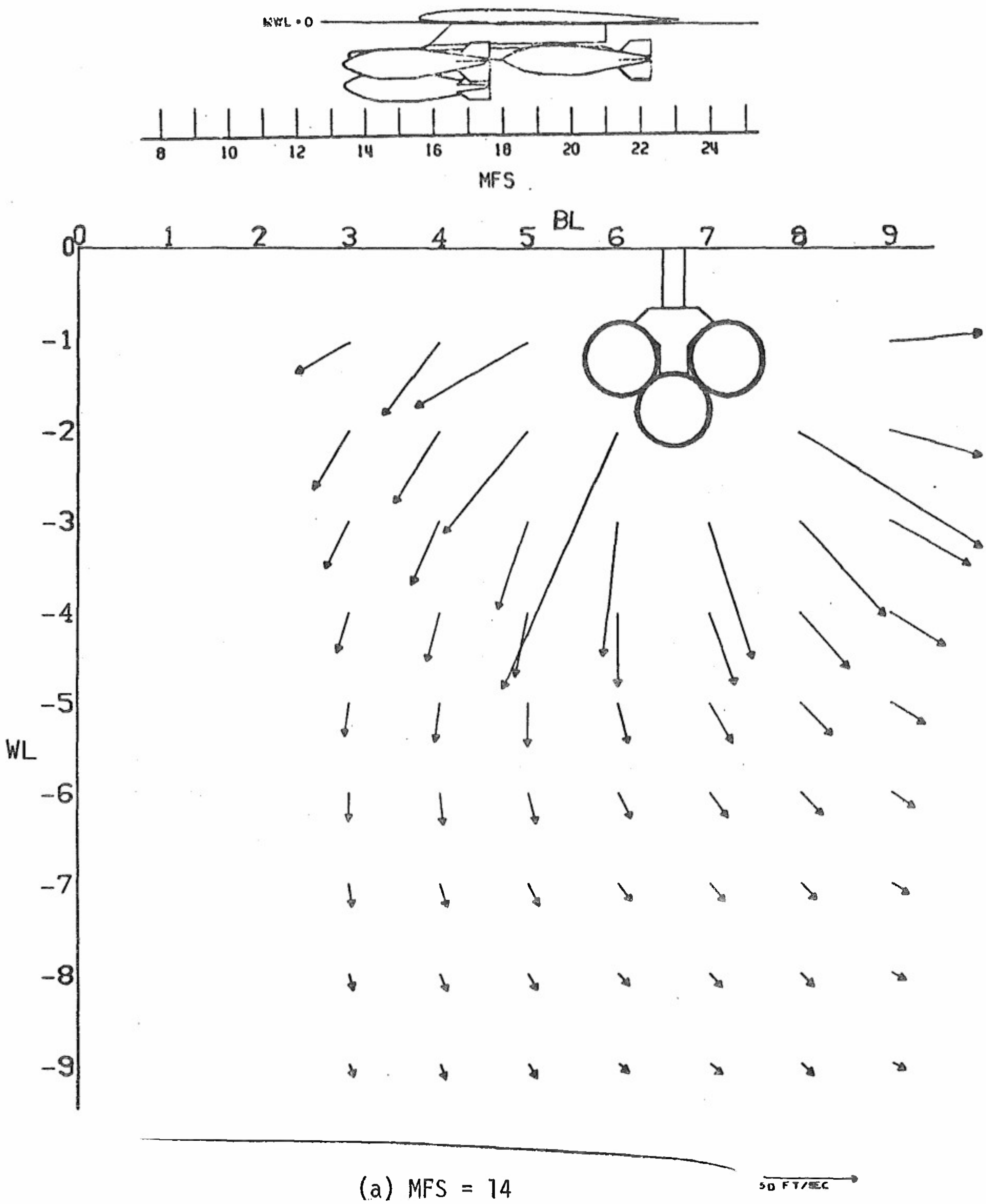
(c) MFS = 19

Figure 18. Continued



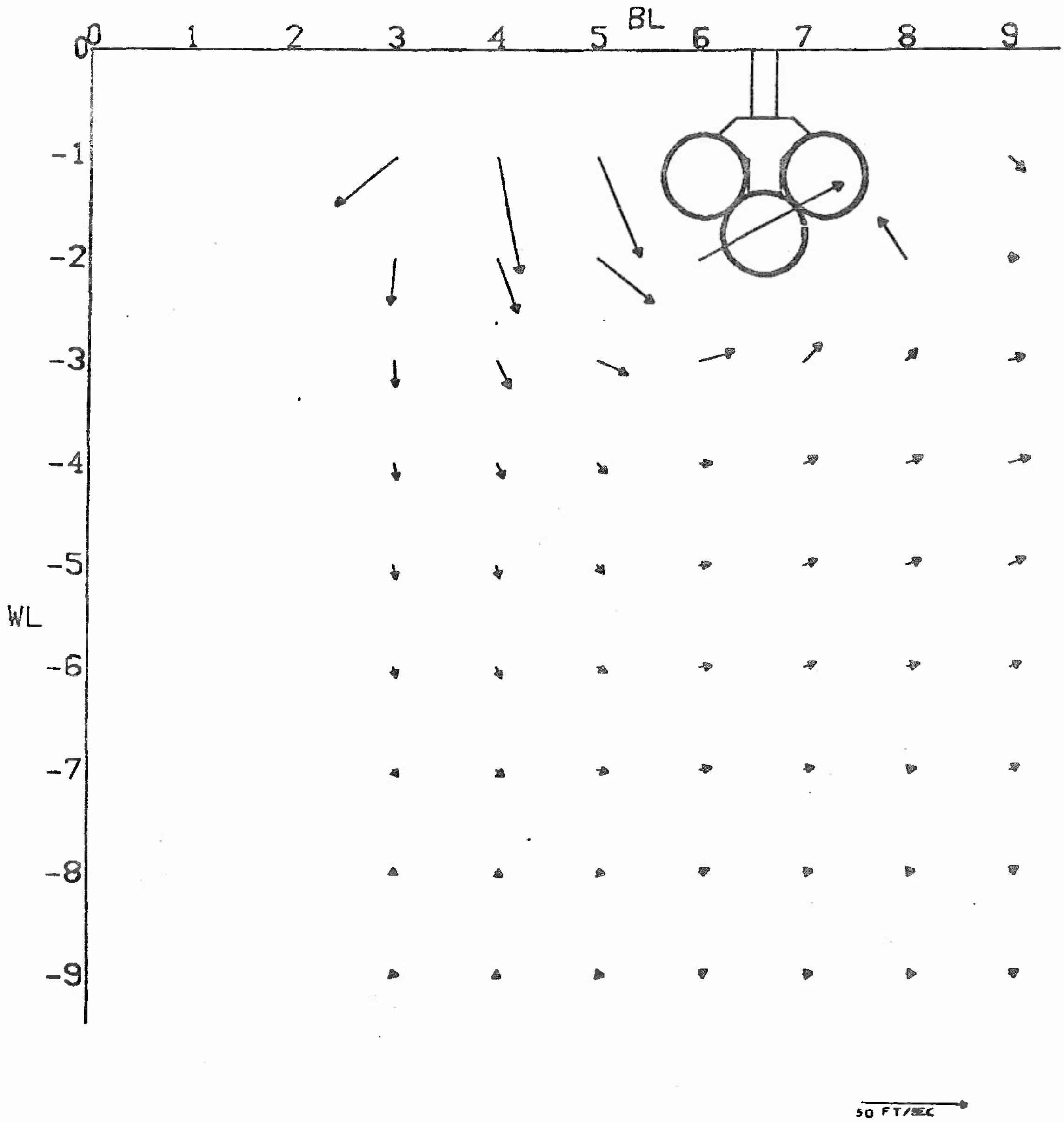
(d) MFS = 22

Figure 18. Concluded



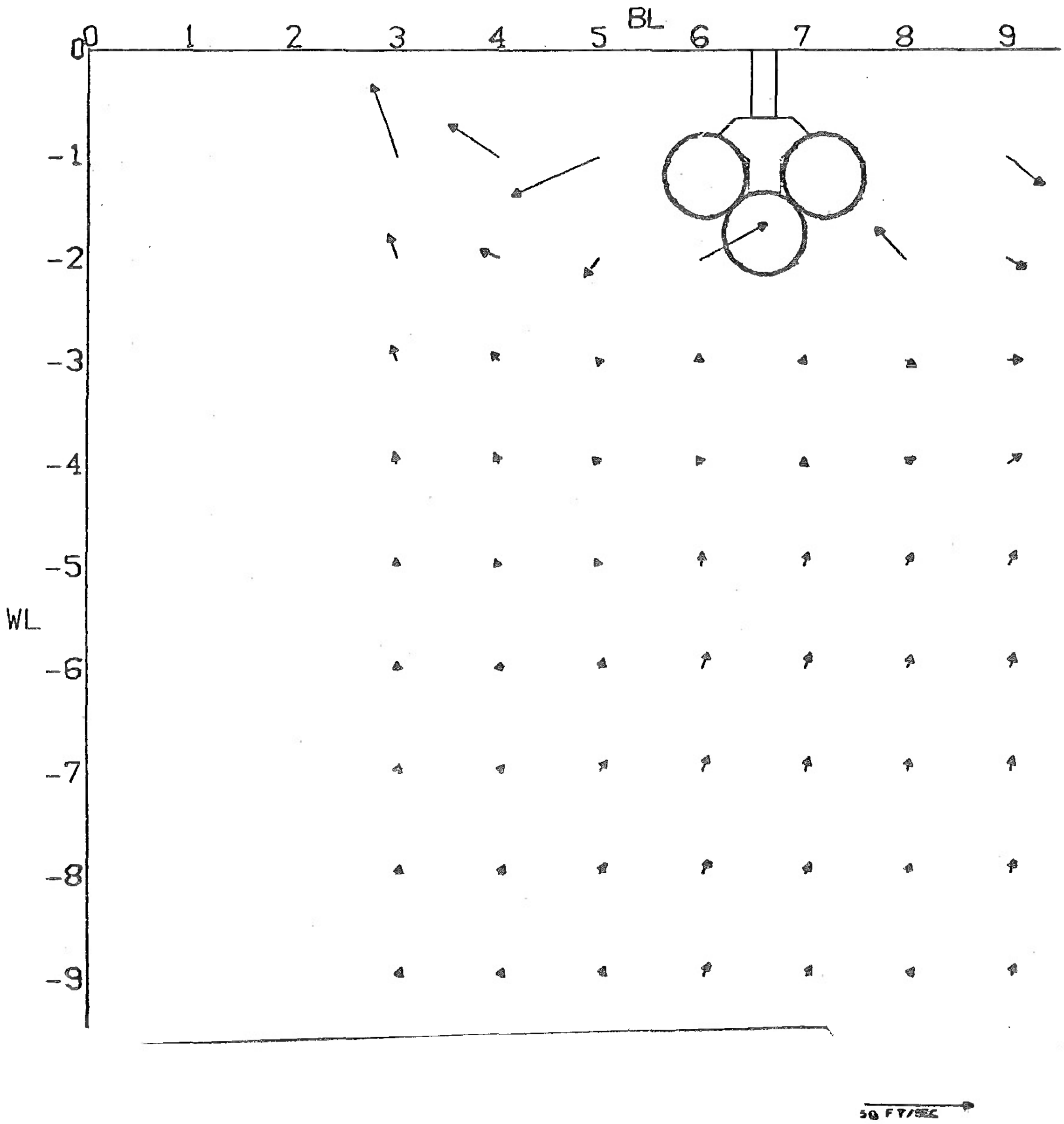
(a) MFS = 14

Figure 19. Effect of Five M-117 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



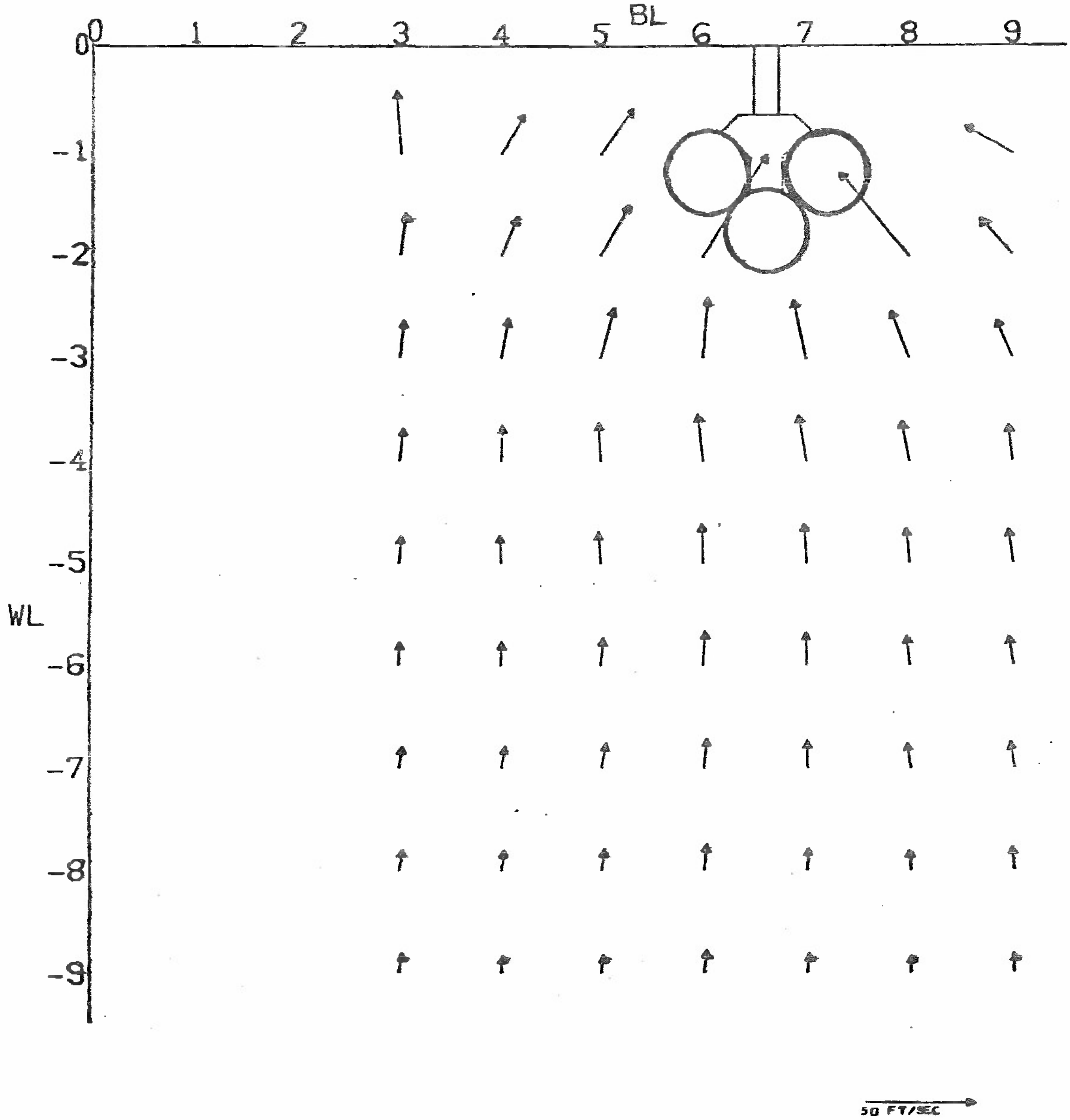
(b) MFS = 17

Figure 19. Continued



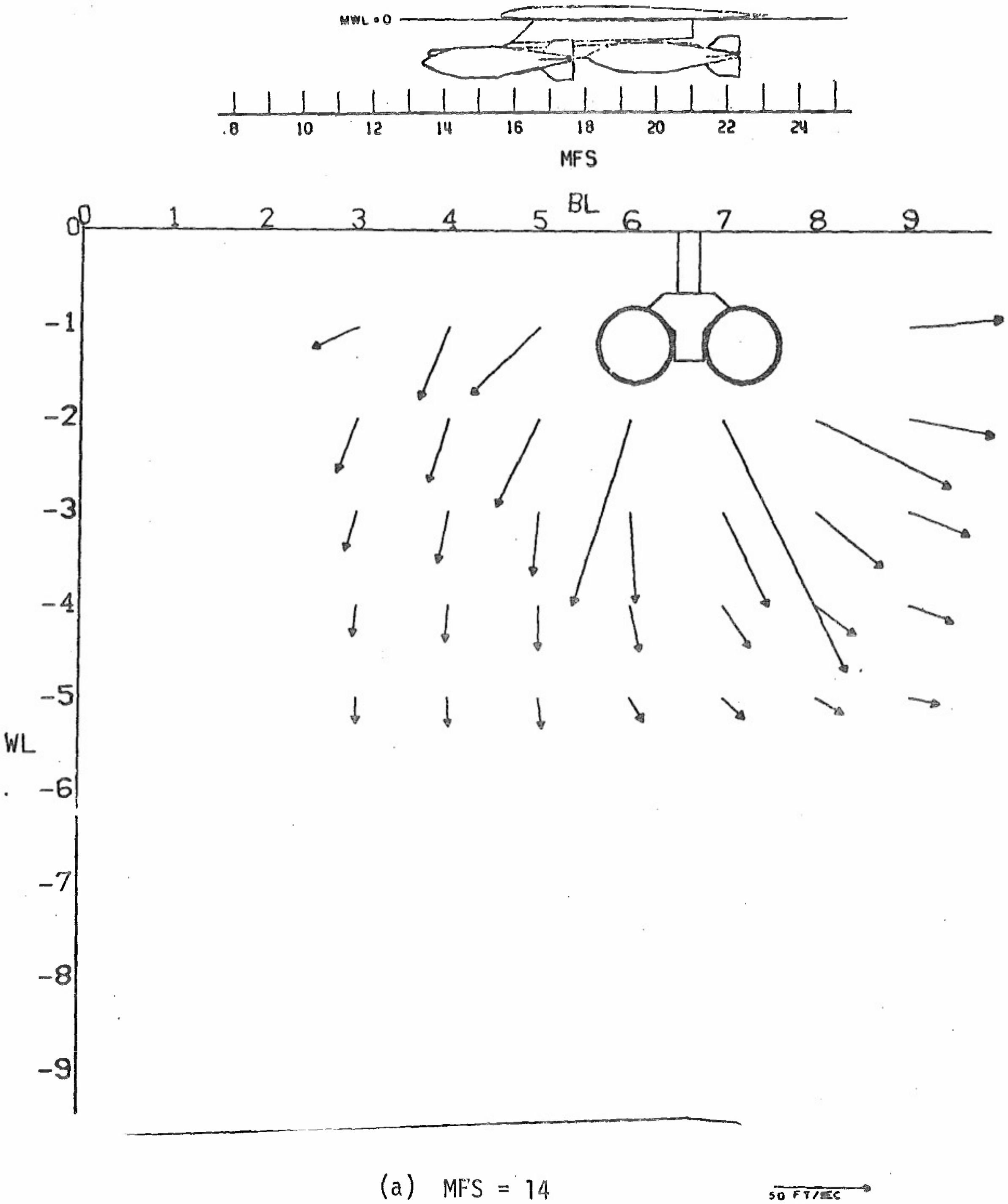
(c) MFS = 19

Figure 19. Continued



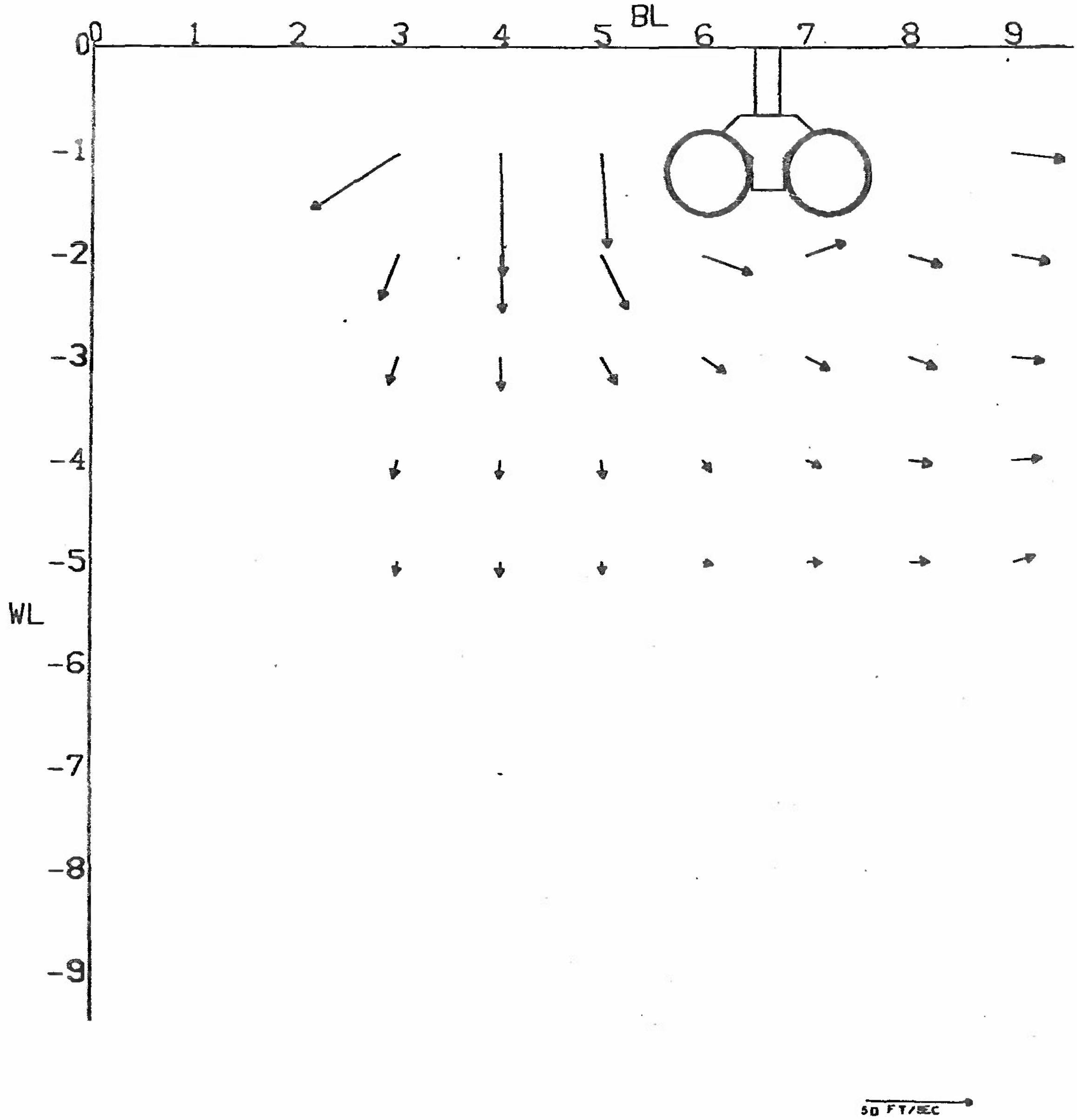
(d) MFS = 22

Figure 19. Concluded



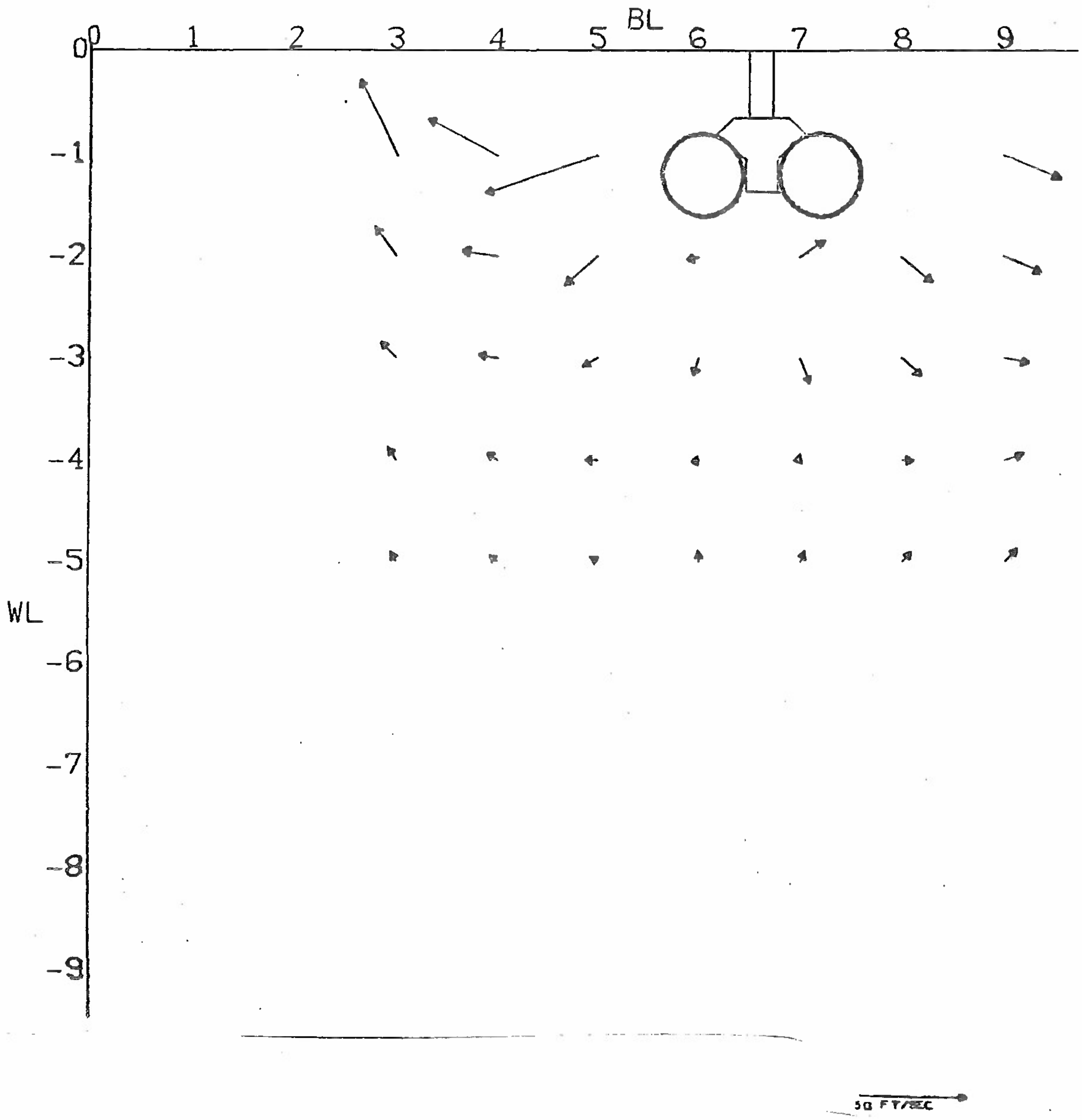
(a) MFS = 14

Figure 20. Effect of Four M-117 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



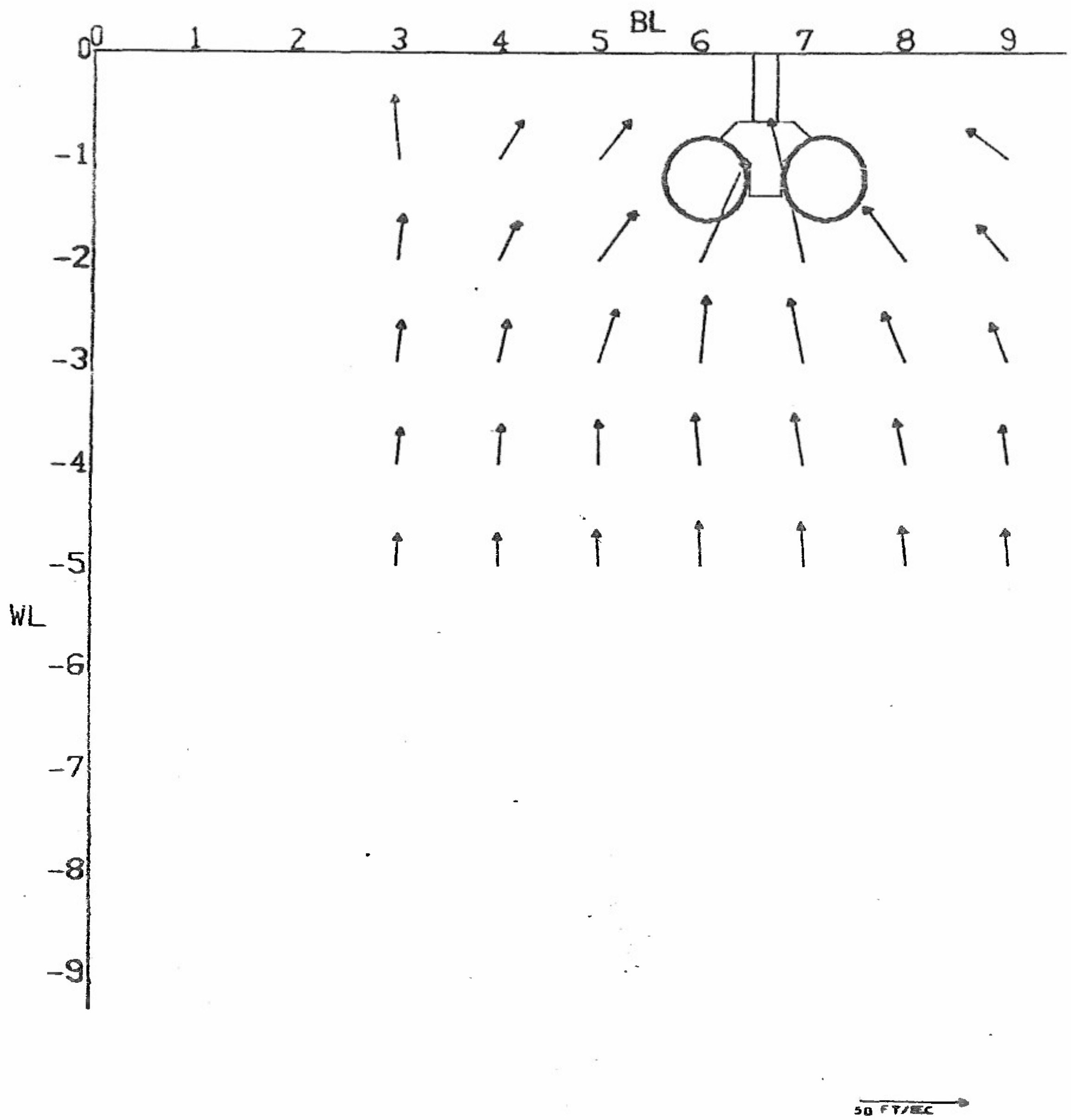
(a) MFS = 17

Figure 20. Continued



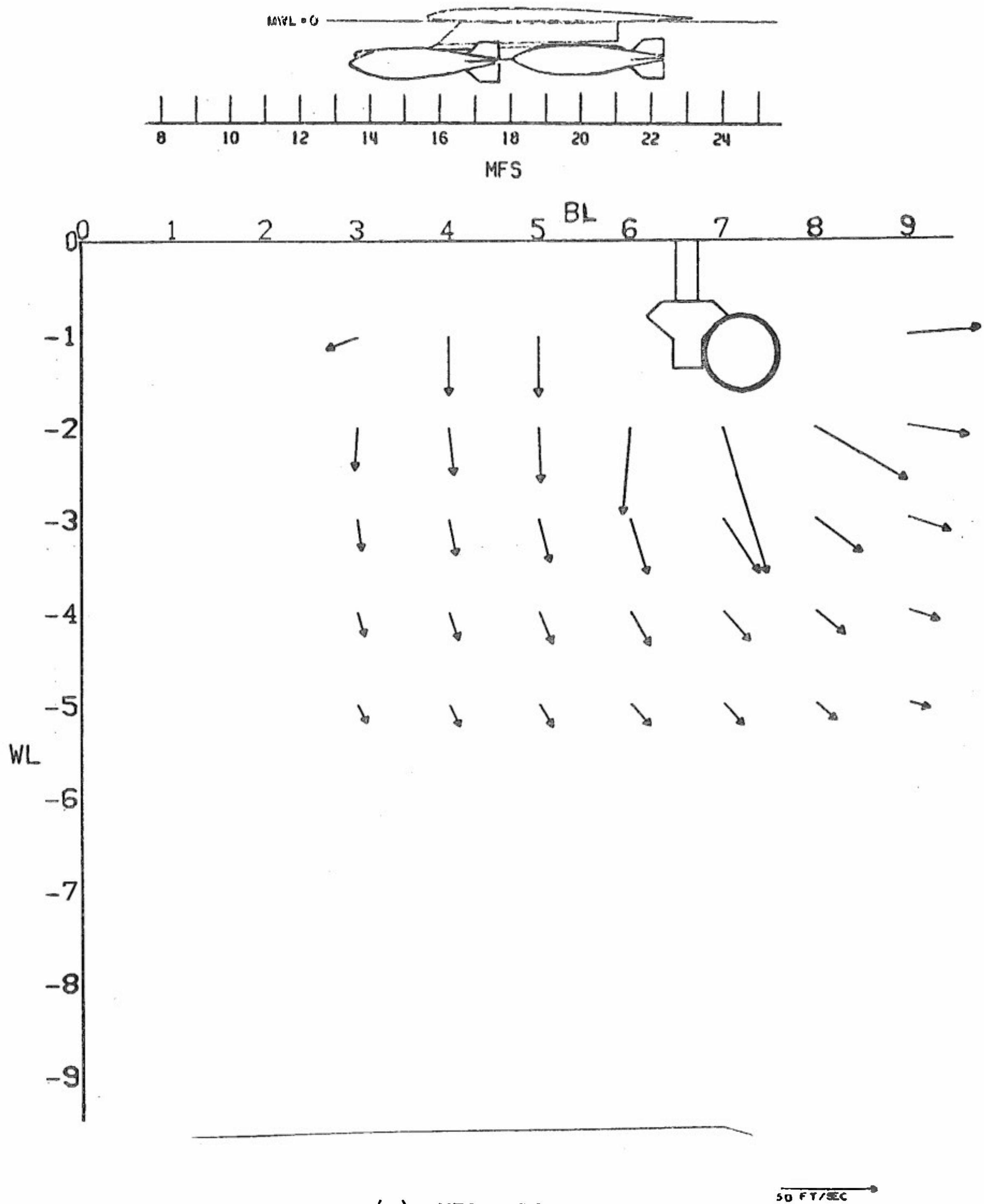
(c) MFS = 19

Figure 20. Continued



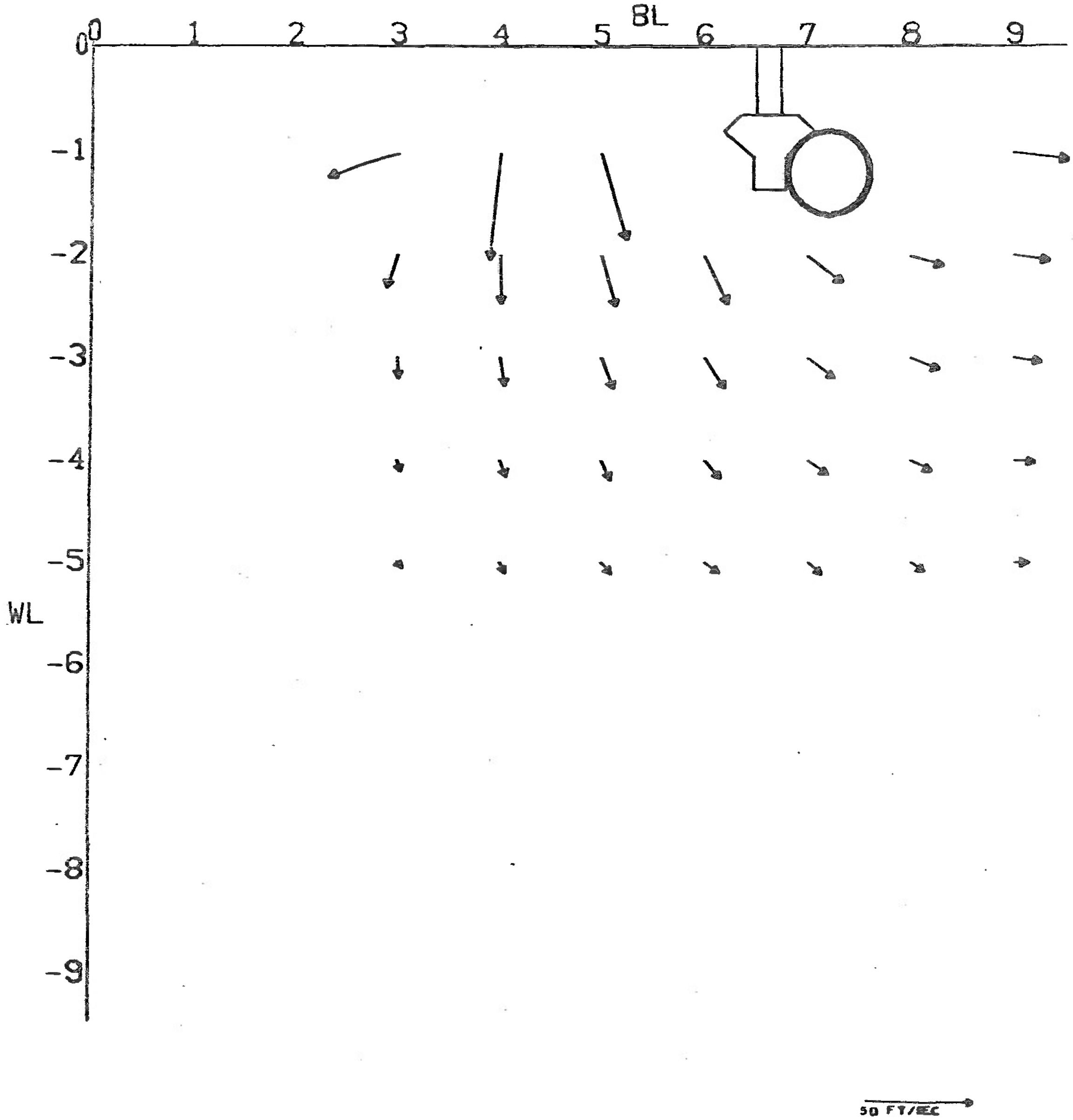
(d) MFS = 22

Figure 20. Concluded



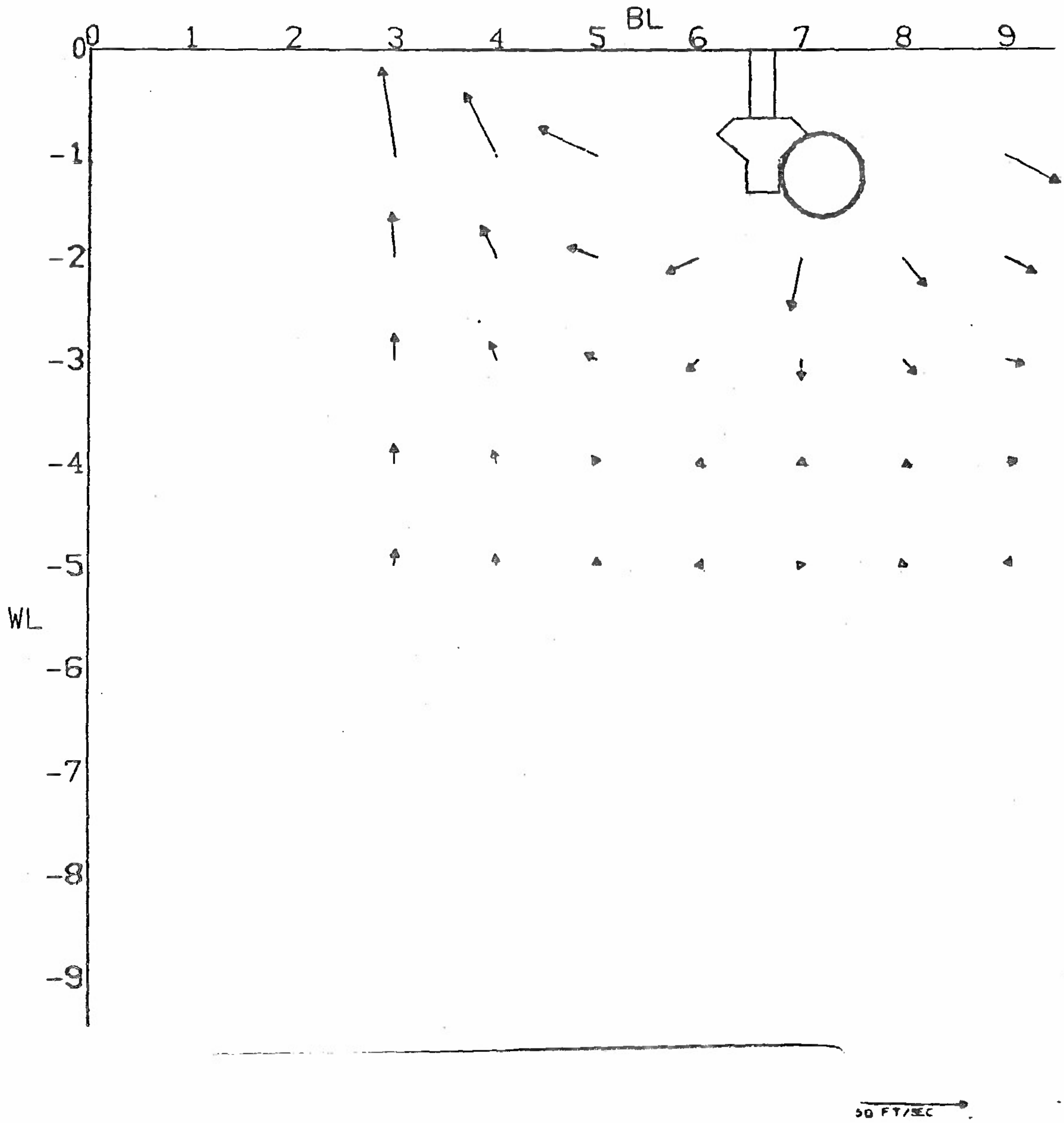
(a) MFS = 14

Figure 21. Effect of Two M-117 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



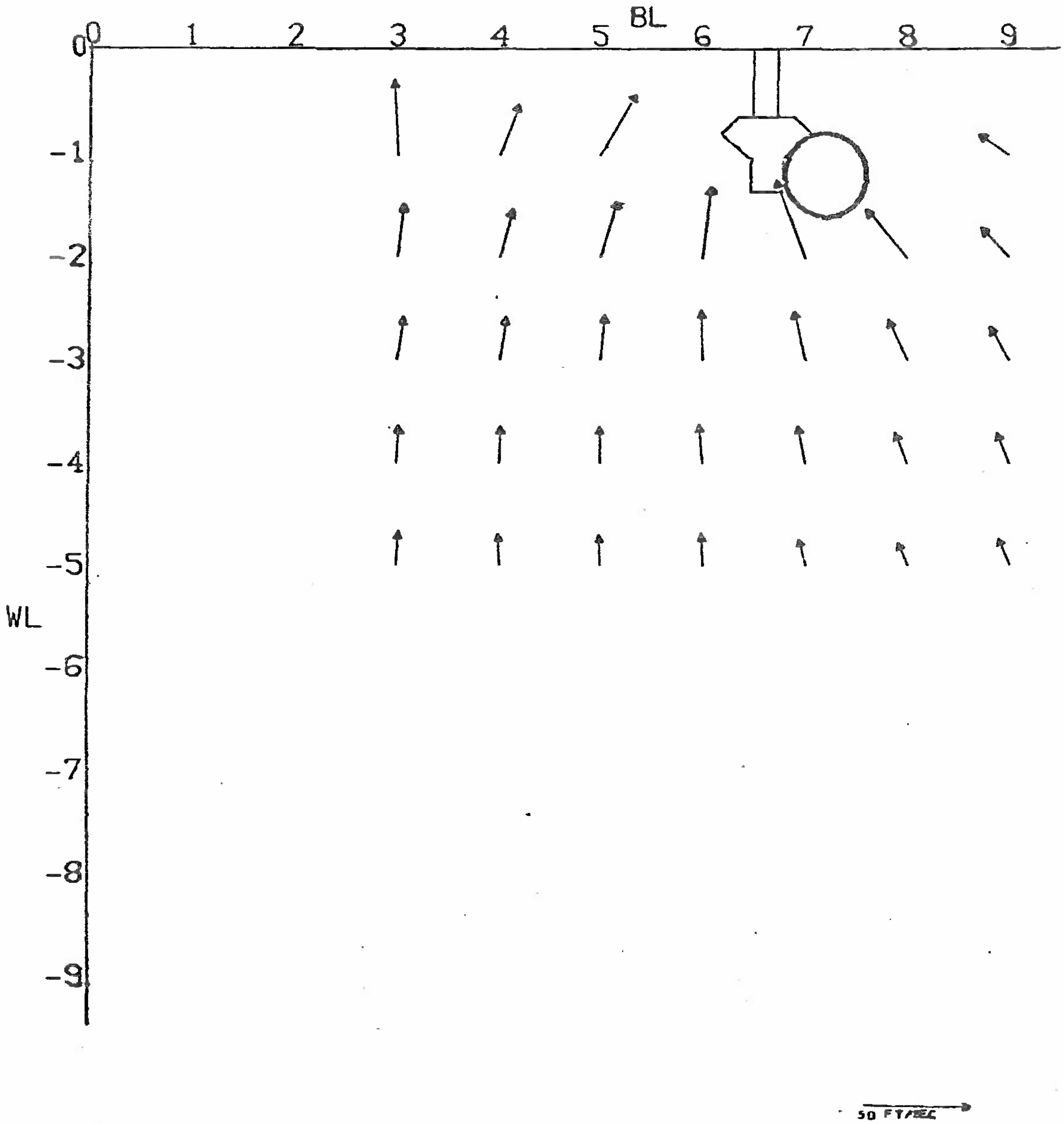
(b) MFS = 17

Figure 21. Continued



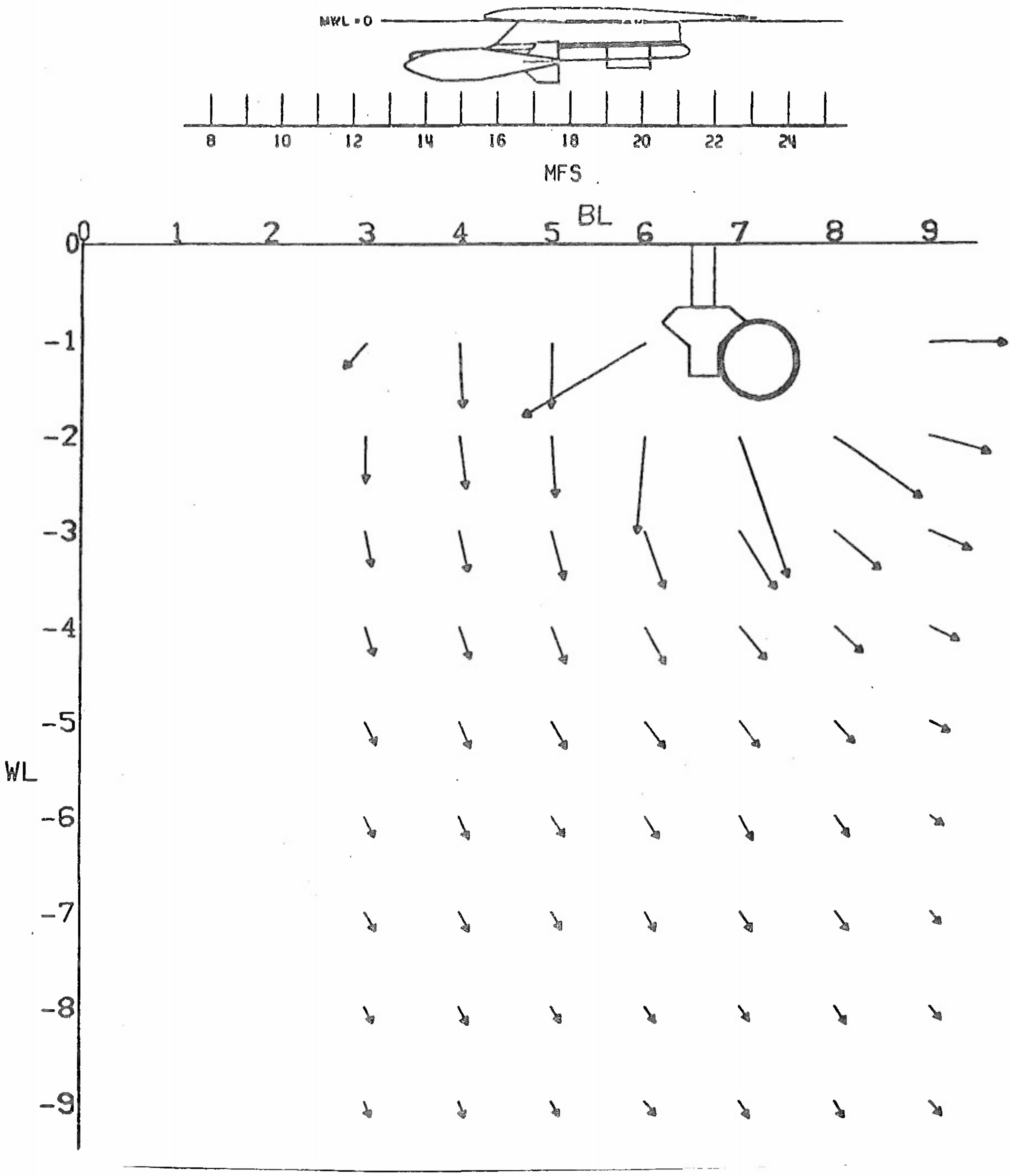
(c) MFS = 19

Figure 21. Continued



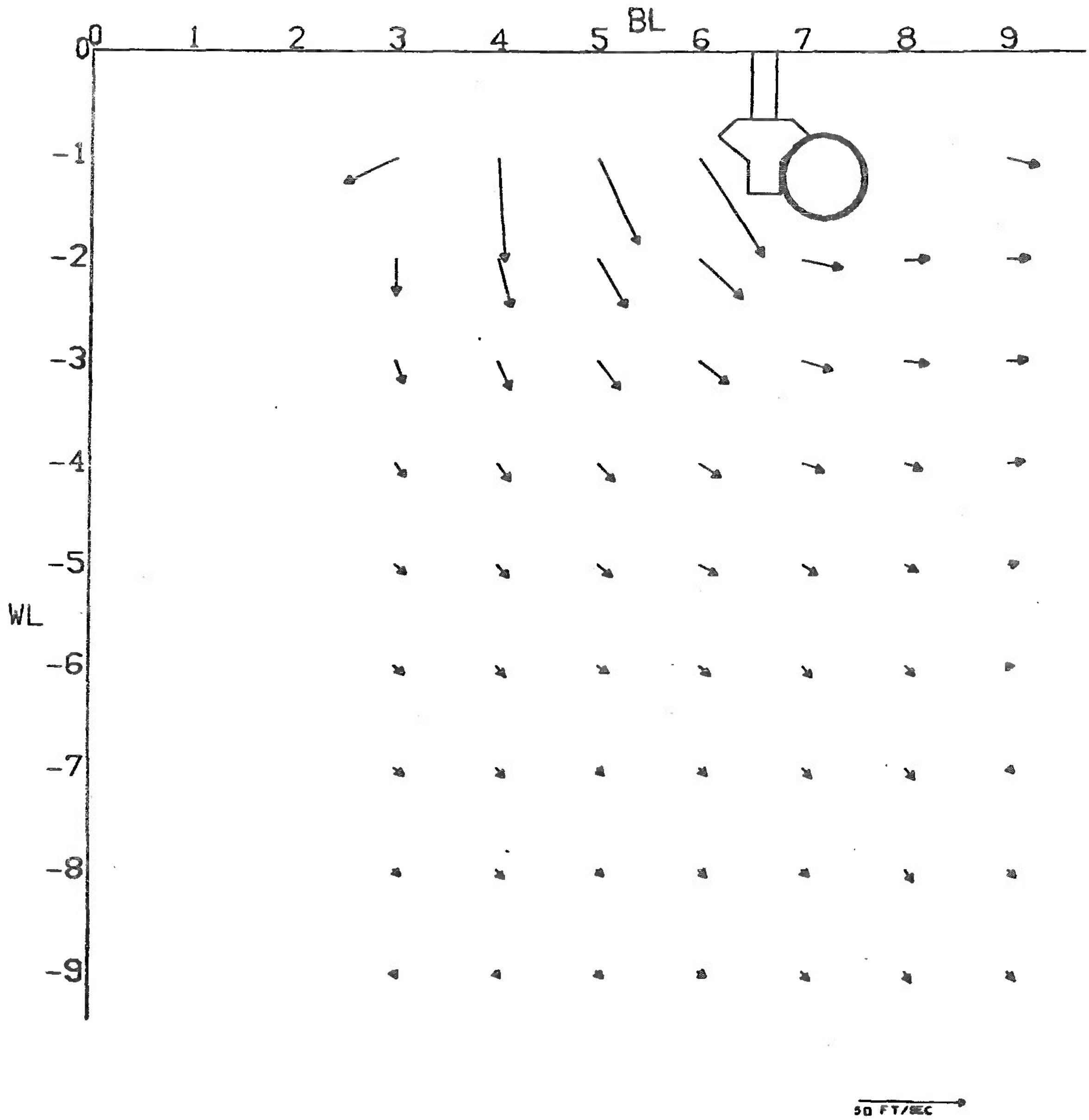
(d) MFS = 22

Figure 21. Concluded



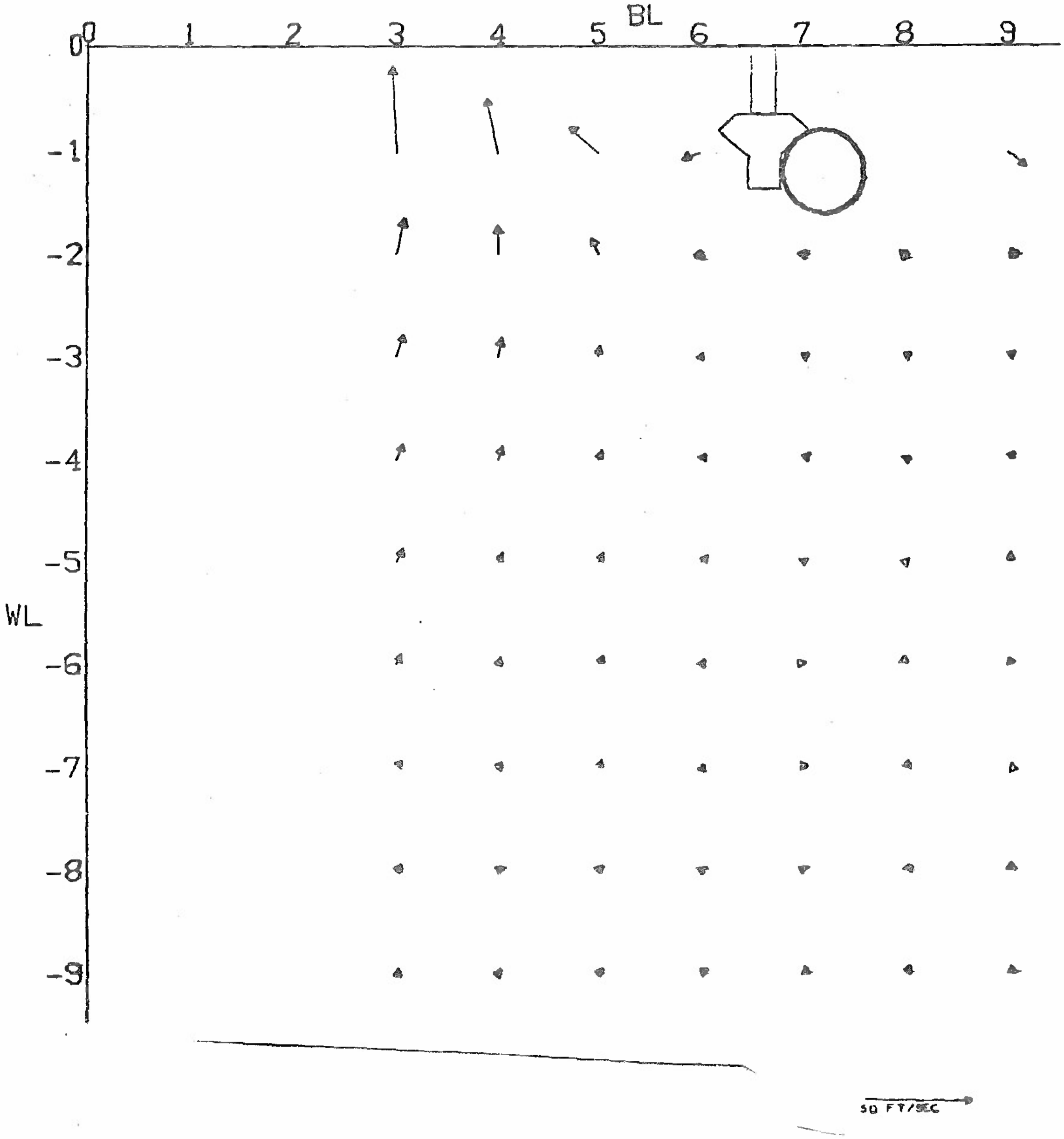
(a) MFS = 14

Figure 22. Effect of One M-117 Bomb and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



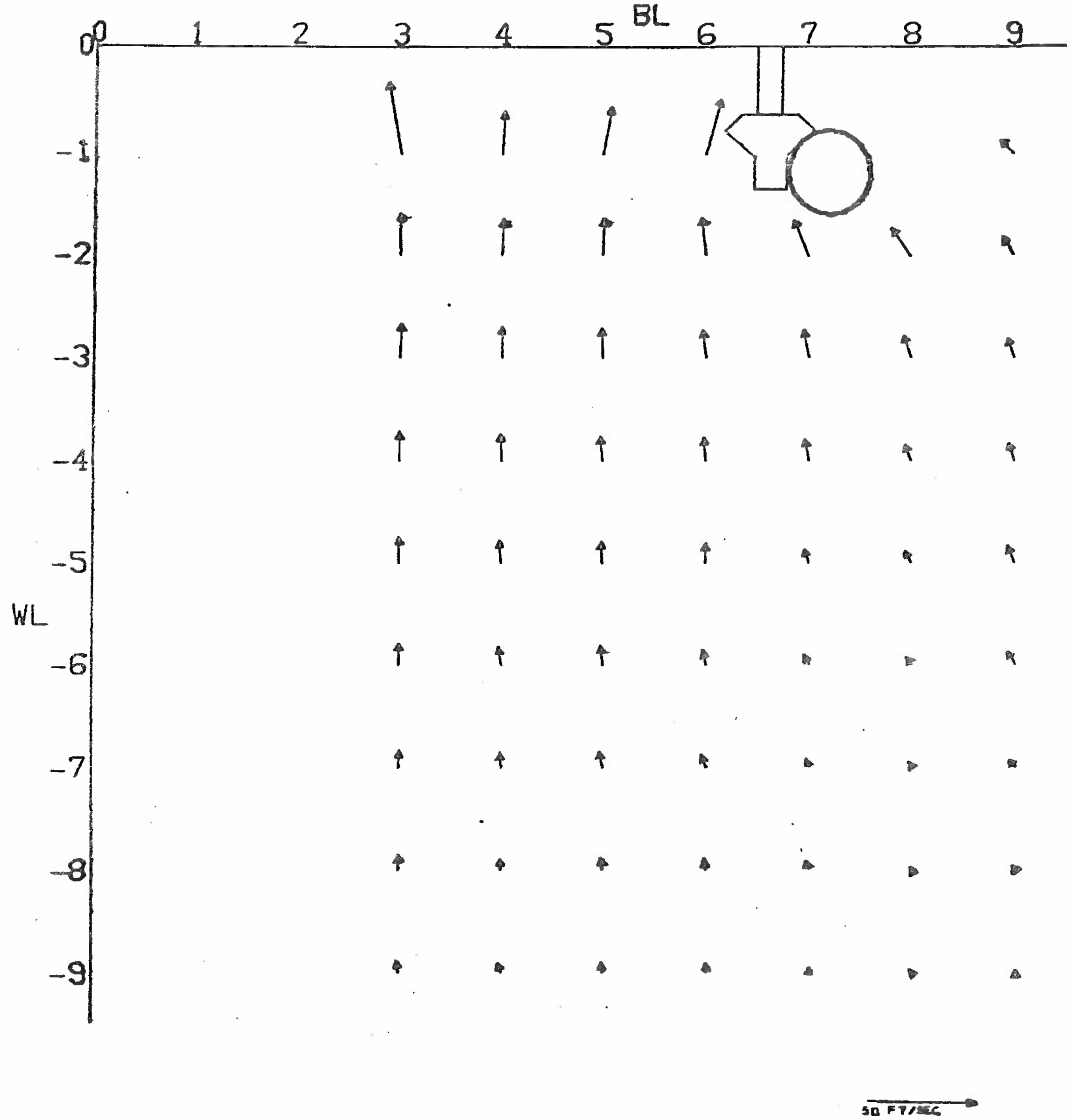
(b) MFS = 17

Figure 22. Continued



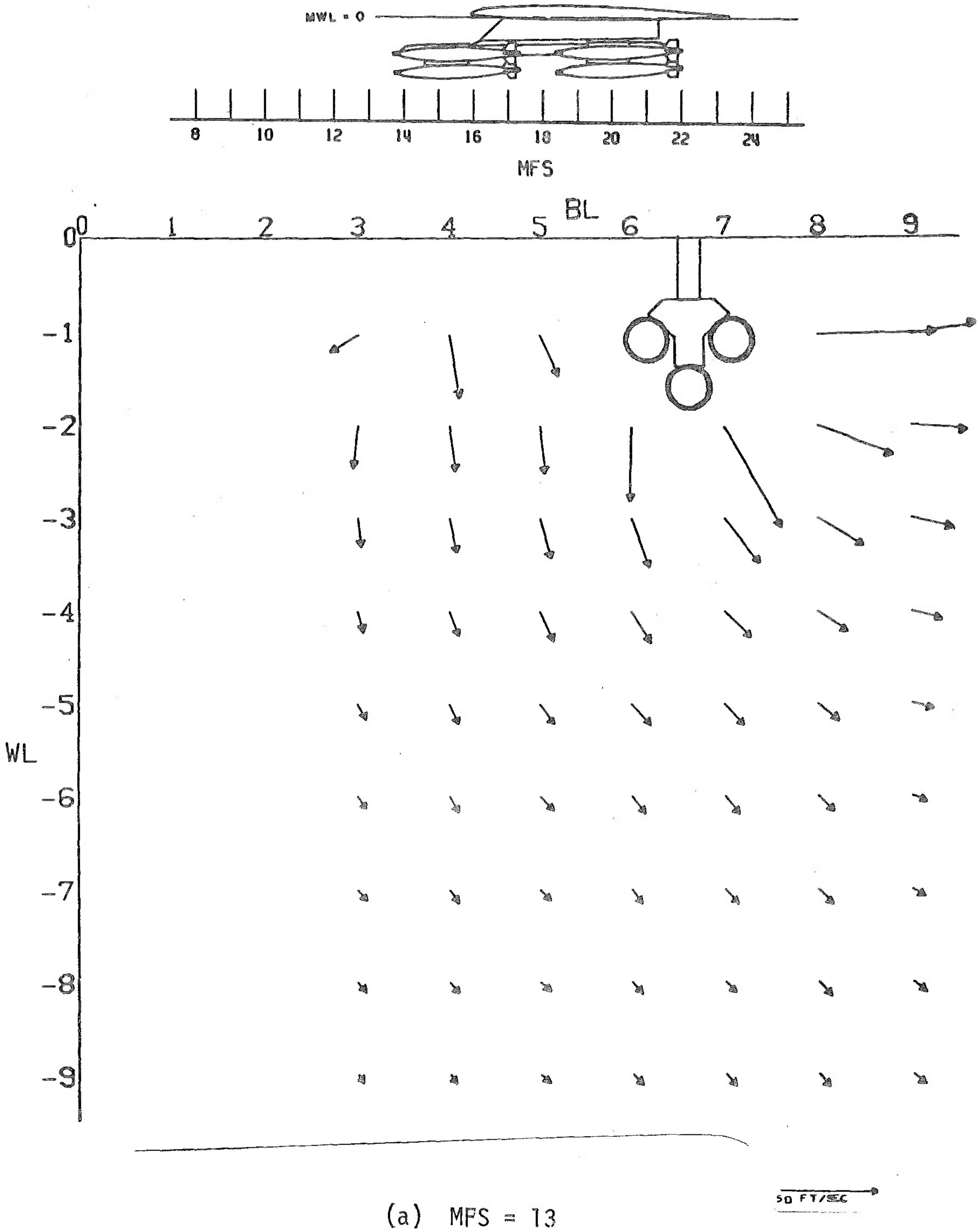
(c) MFS = 19

Figure 22. Continued



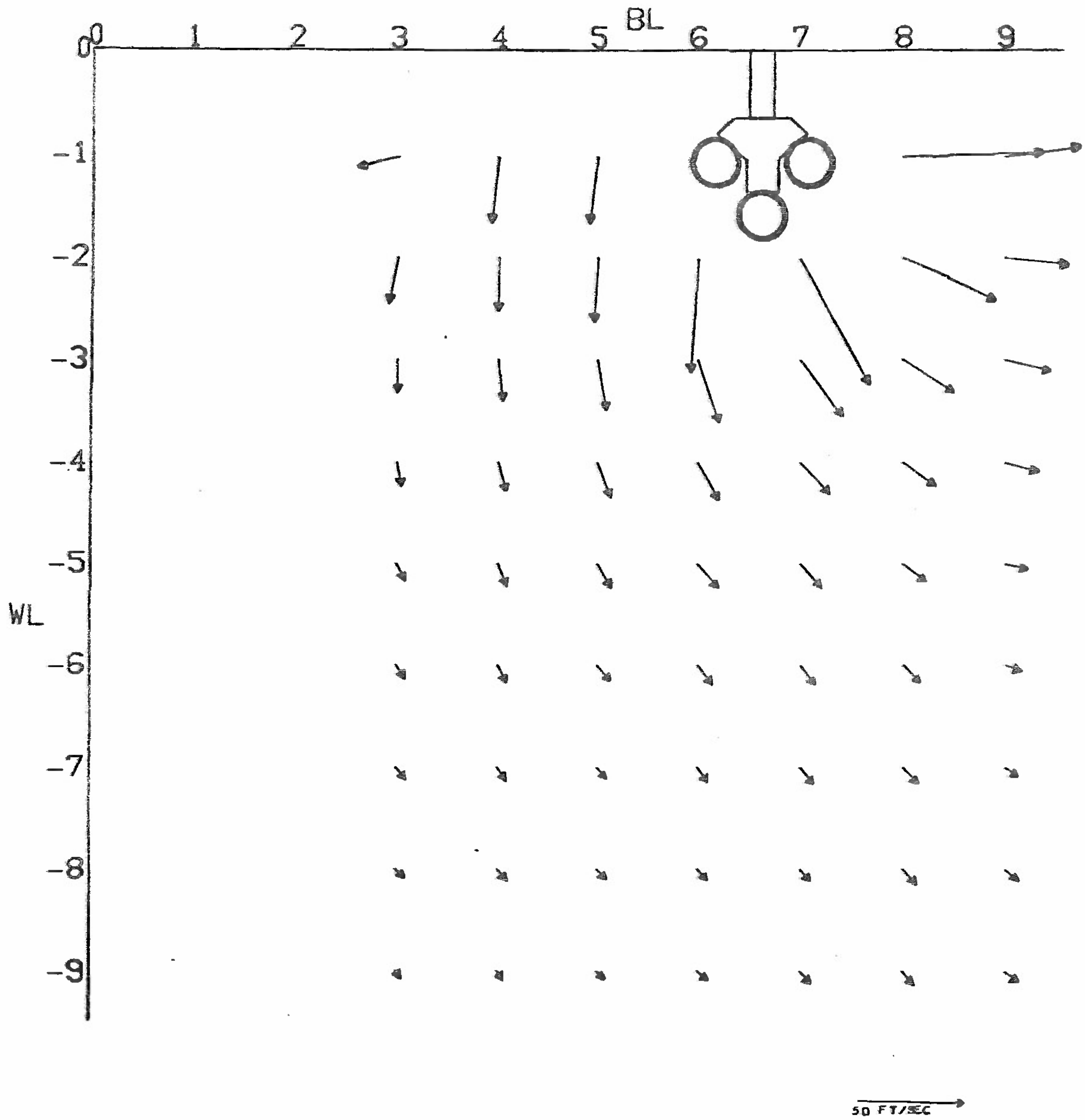
(d) MFS = 22

Figure 22. Concluded



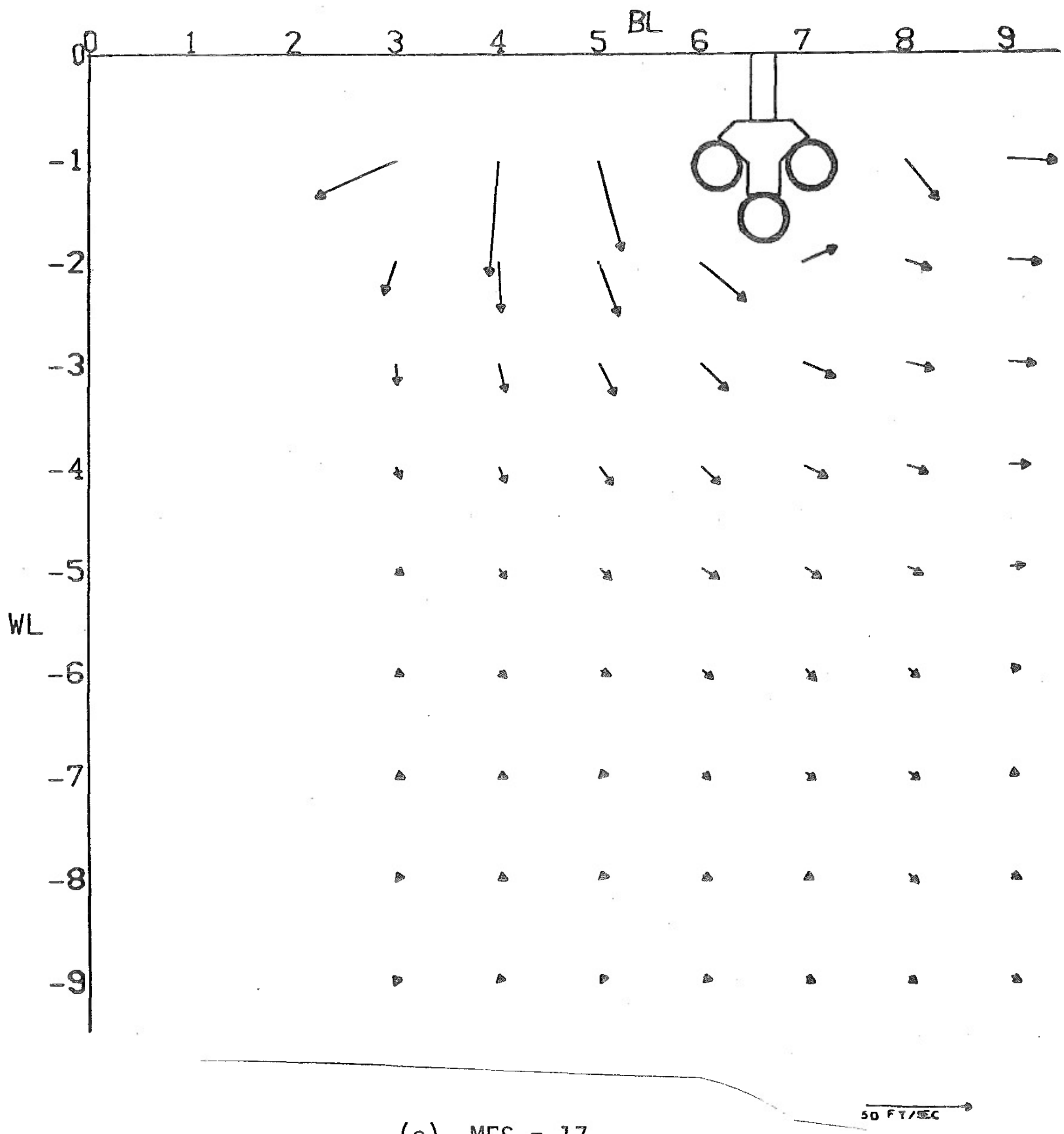
(a) MFS = 13

Figure 23. Effect of Six MK-81 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at M_∞ = 0.85, V_∞ = 935, α_p = 0.3



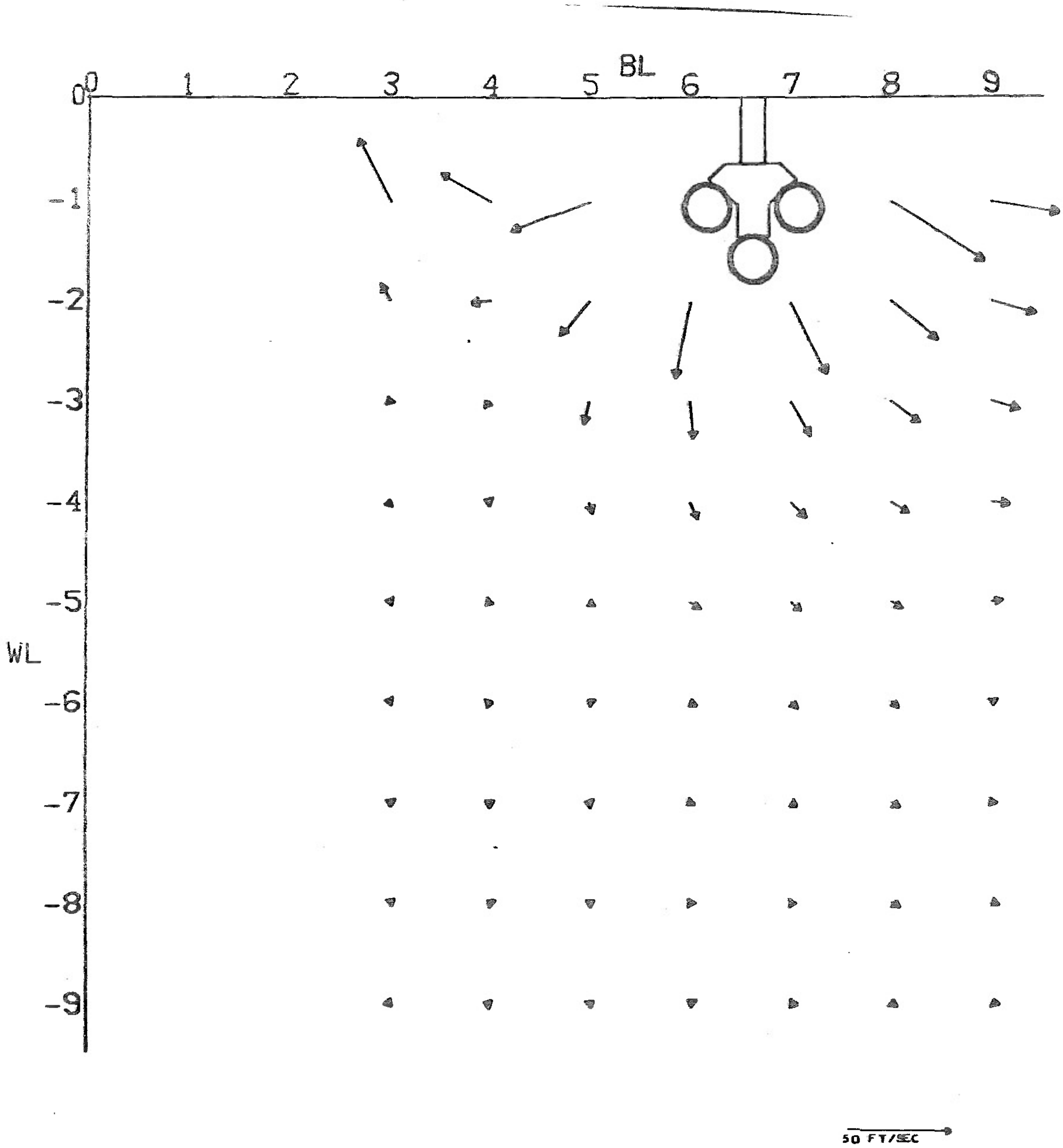
(b) MFS = 14

Figure 23. Continued



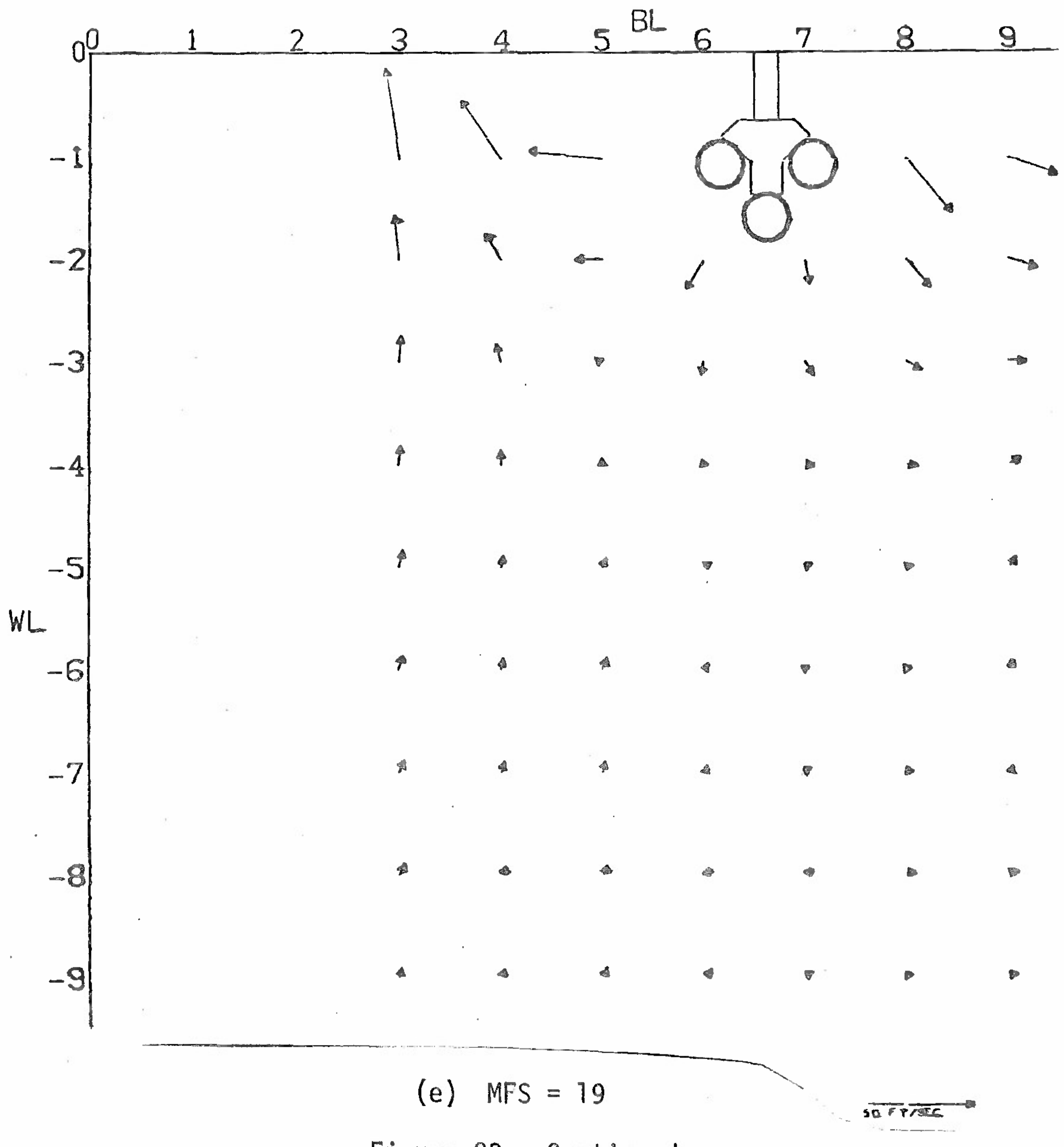
(c) MFS = 17

Figure 23. Continued



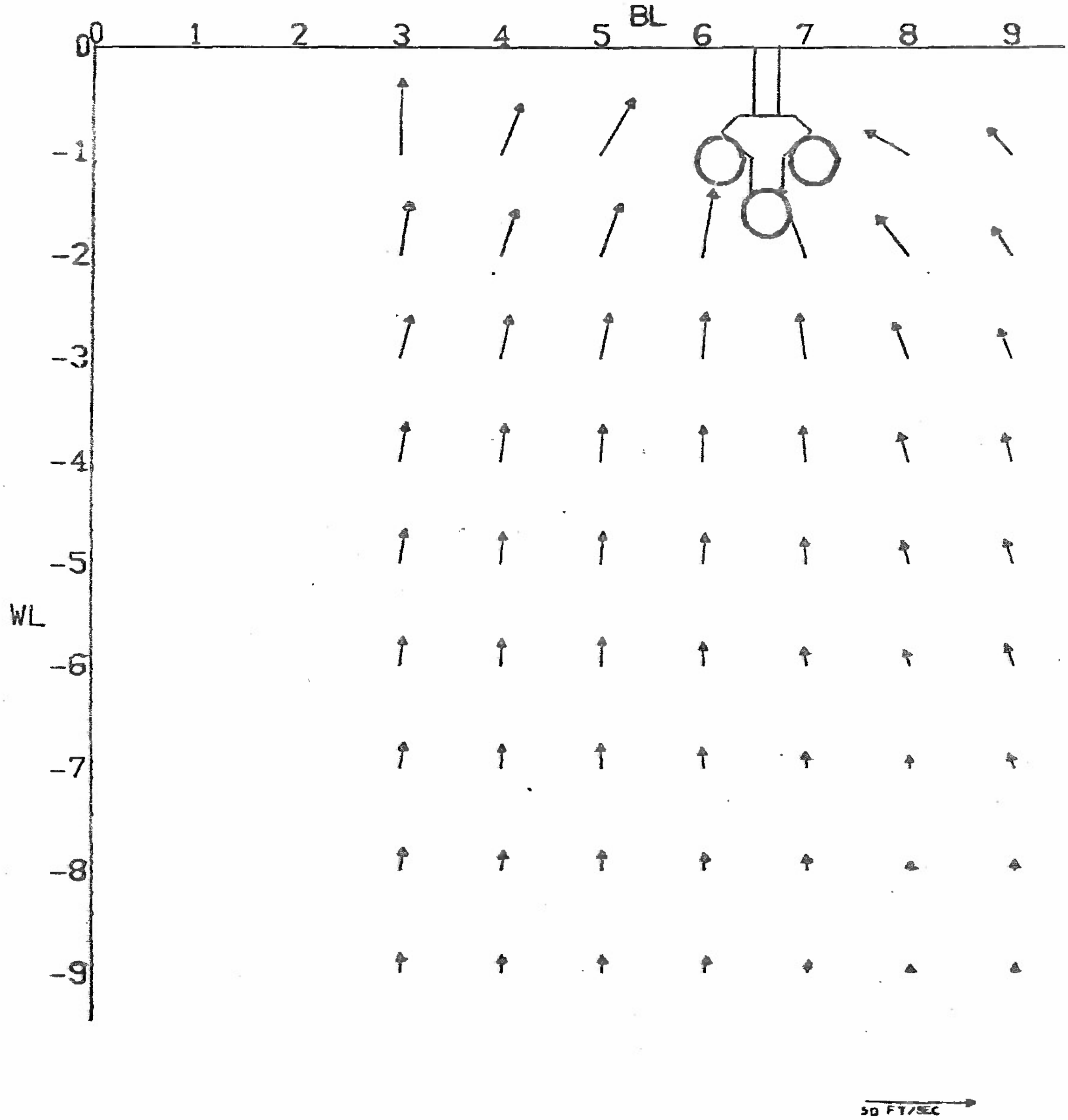
(d) MFS = 18

Figure 23. Continued



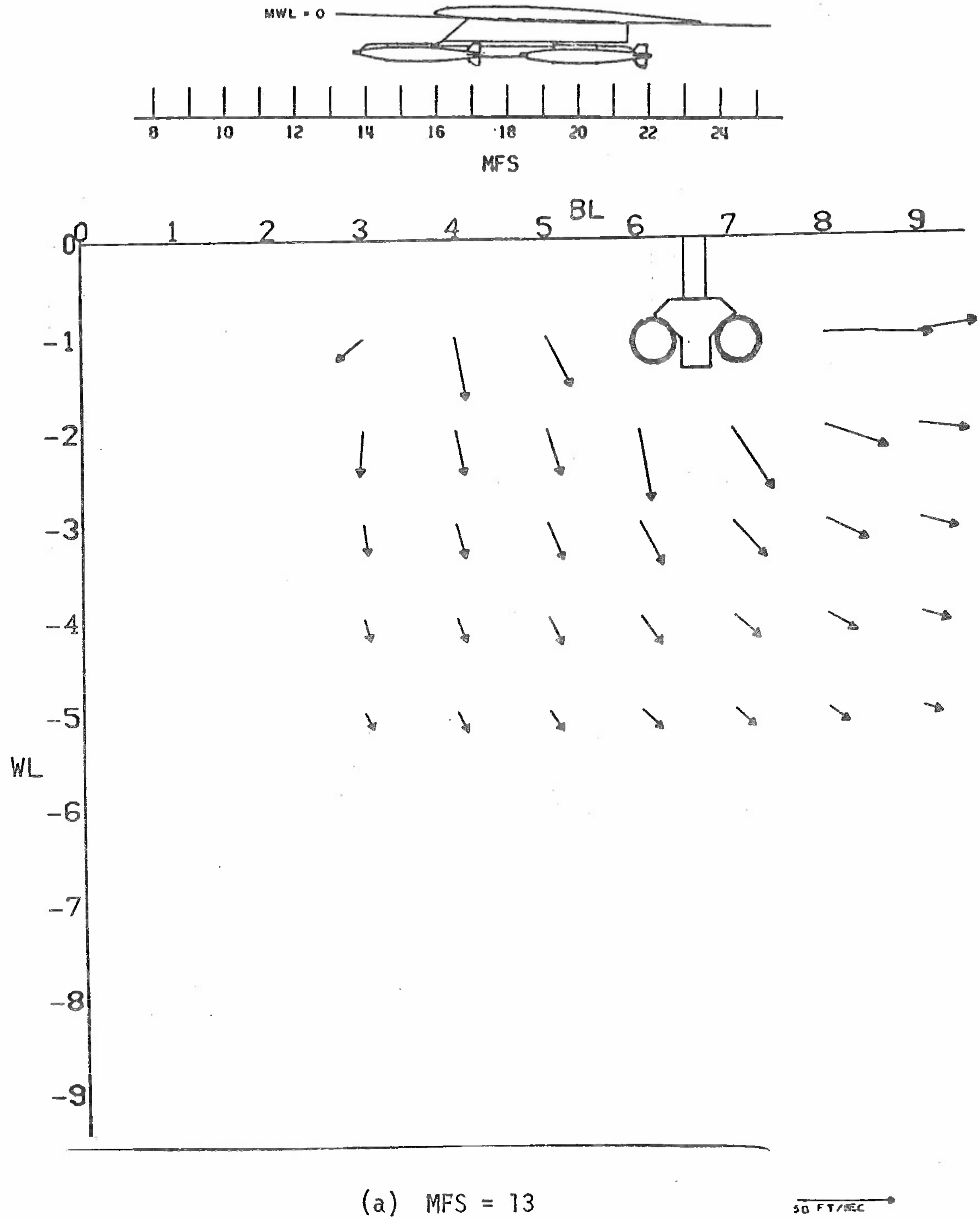
(e) MFS = 19

Figure 23. Continued



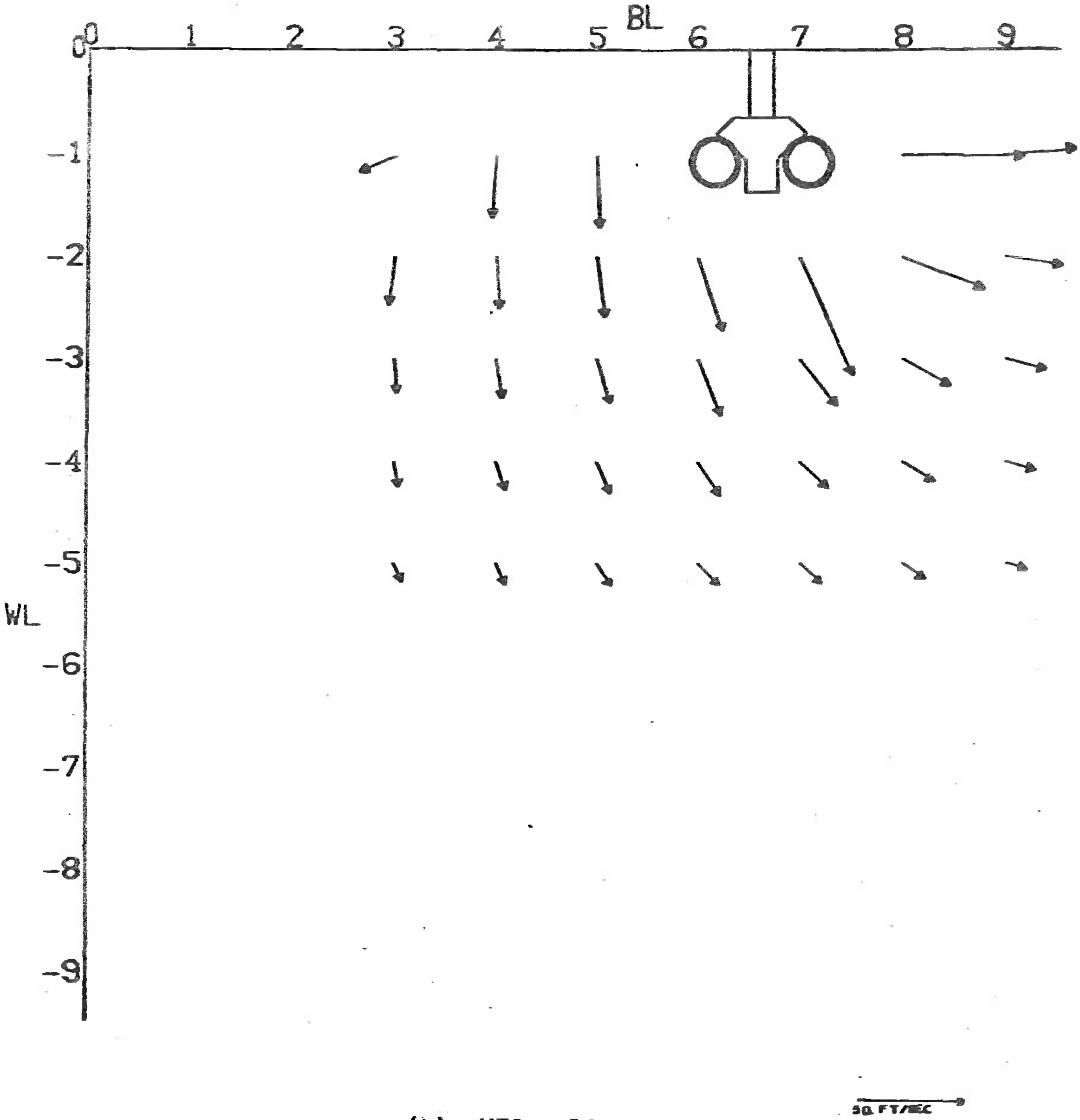
(f) MFS = 22

Figure 23. Concluded



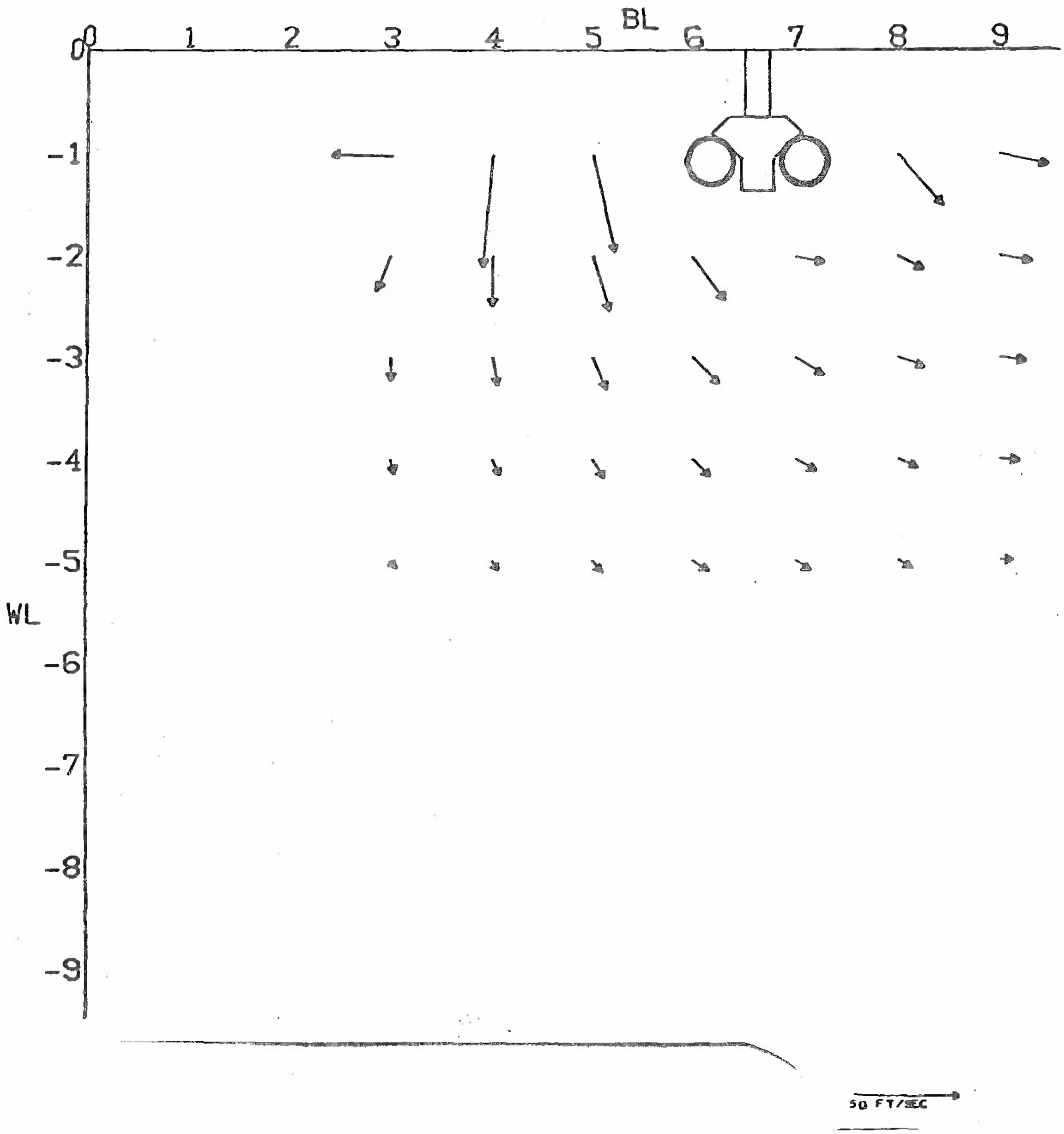
(a) MFS = 13

Figure 24. Effect of Four MK-81 Bombs and Outboard MER on the Transverse Velocity Components of the Flow Field at $M_\infty = 0.85$, $V_\infty = 935$, $\alpha_p = 0.3$



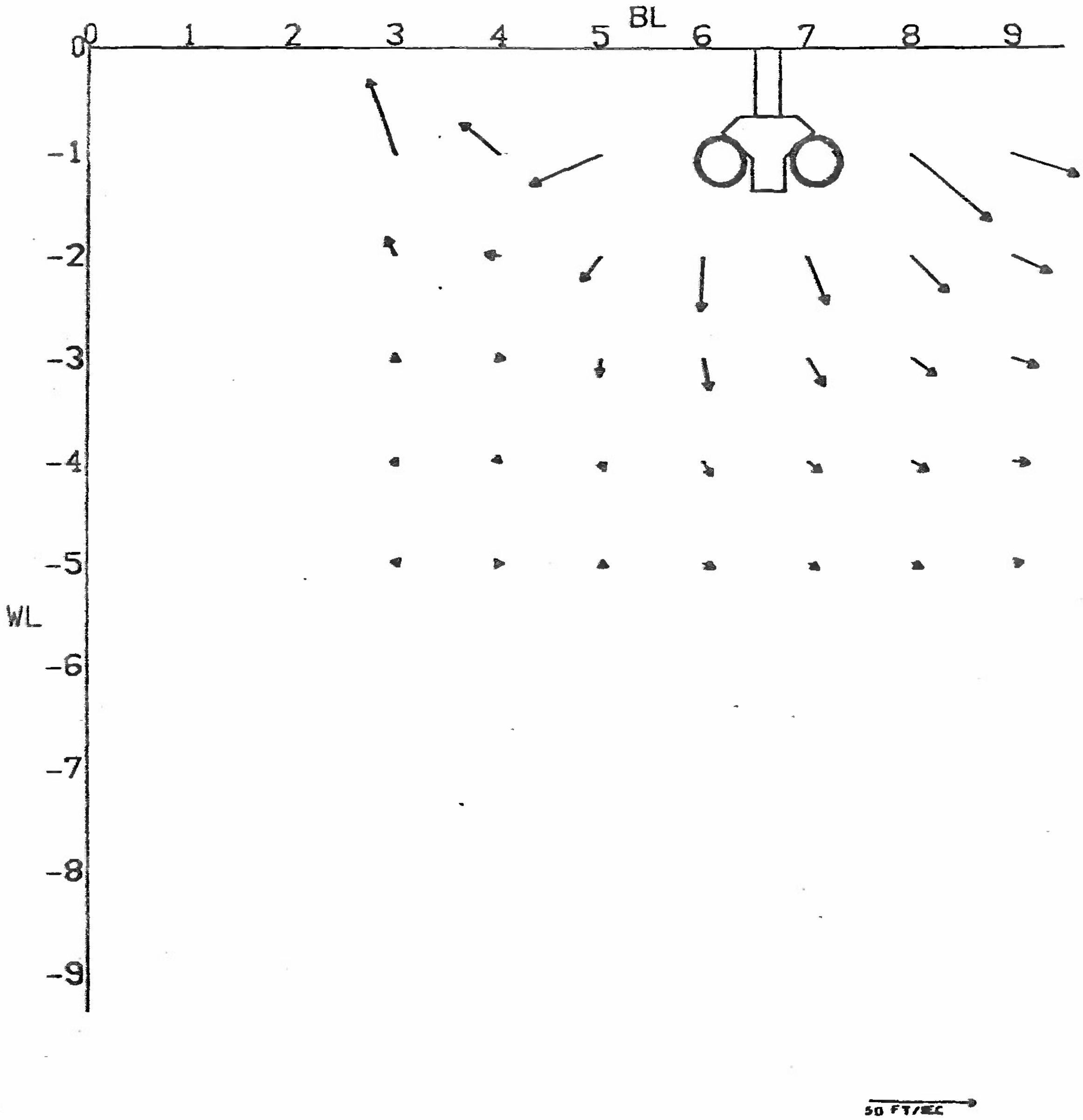
(b) MFS = 14

Figure 24. Continued



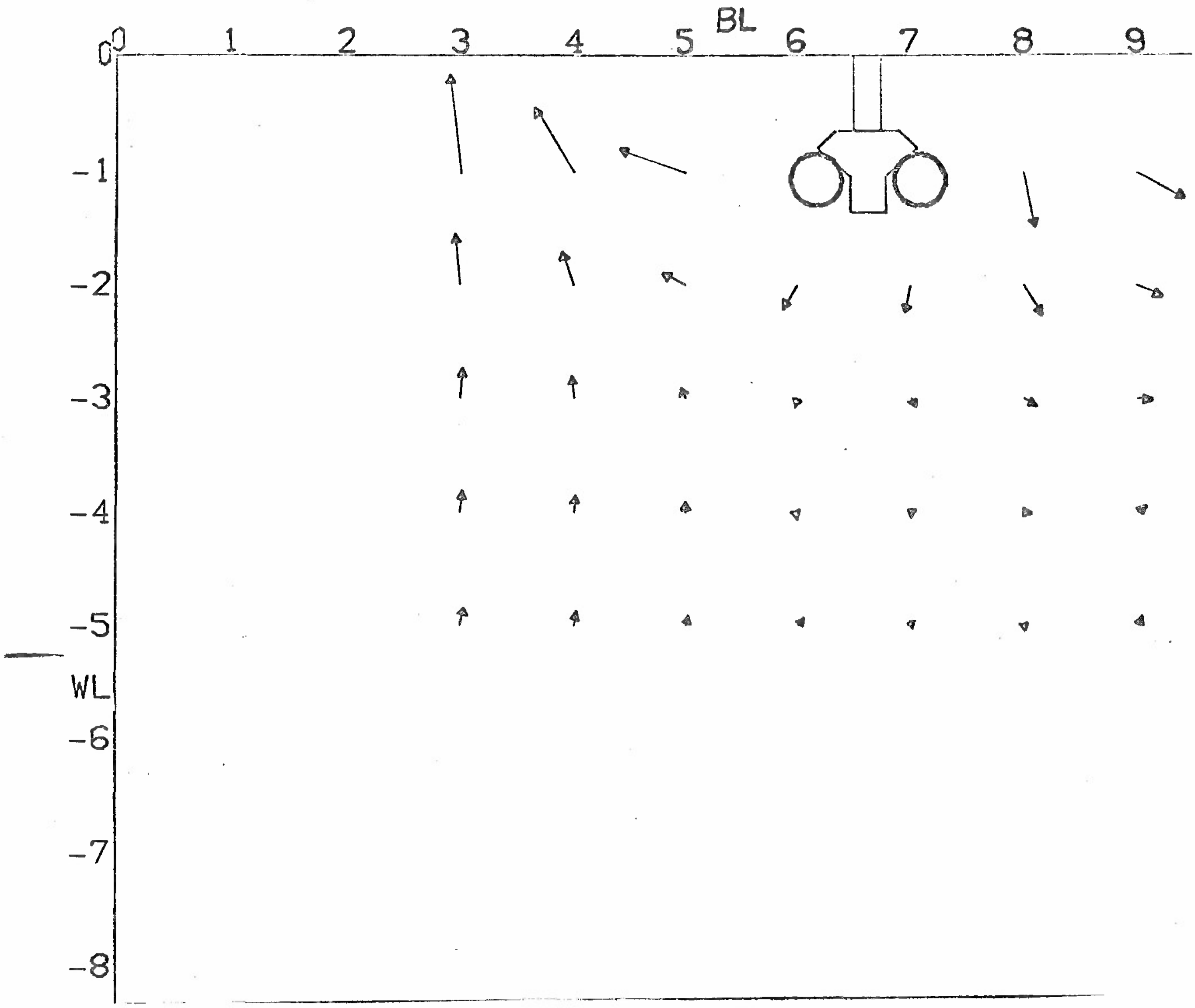
(c) MFS = 17

Figure 24. Continued



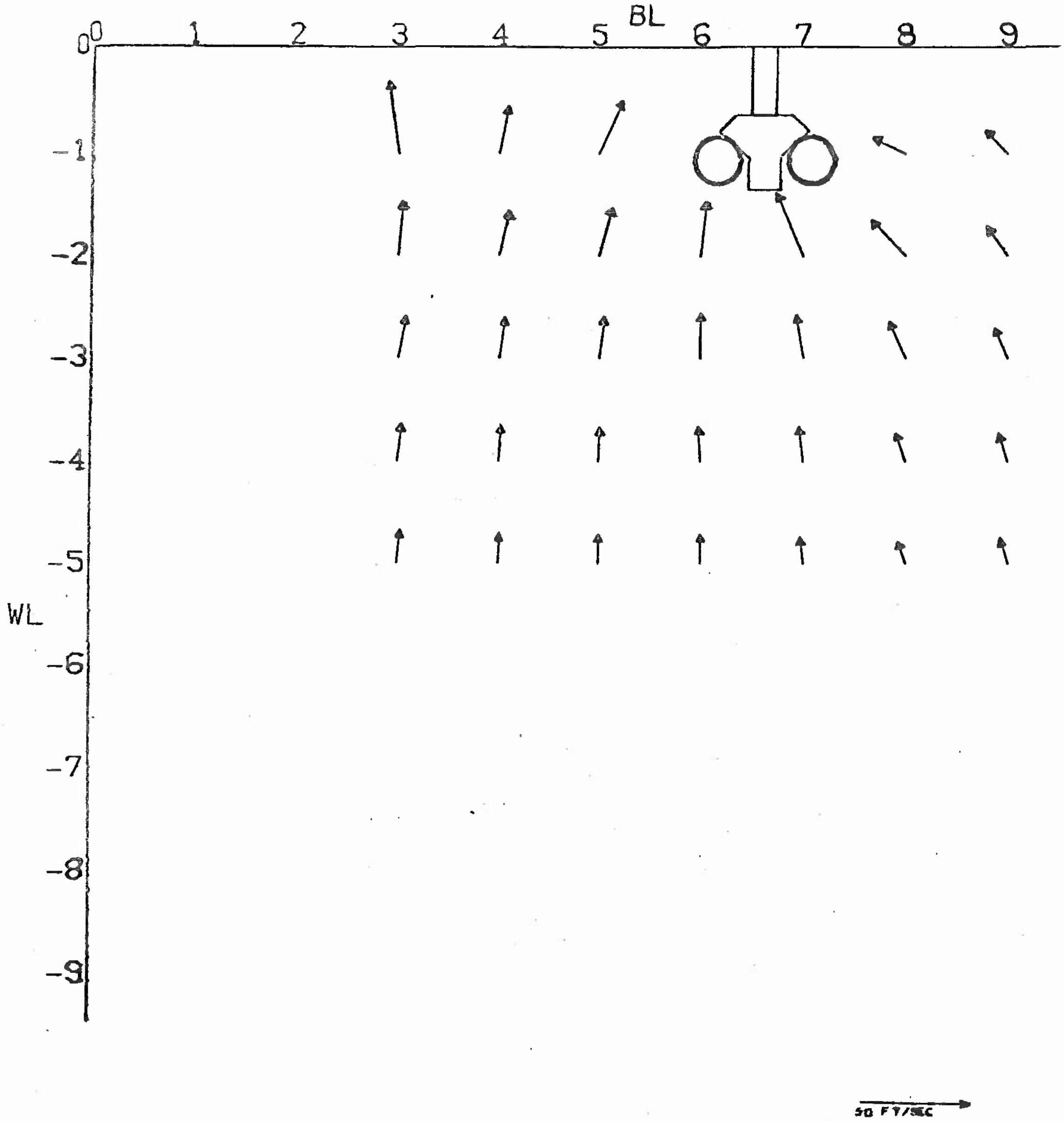
(d) MFS = 18

Figure 24. Continued



(e) MFS = 19

Figure 24. Continued



(f) MFS = 22

Figure 24. Concluded

configurations with the MK-81 T2 and T1 flow fields, respectively, were simulated. Then they were compared to trajectories of the MK-81 in the T2 and T1 configurations, but this time calculated using the T3 MK-81 flow field with a scale factor of 1/3 and 1/5 placed on all the flow angularities for the T2 and T1 configurations, respectively. The comparison plot for the T2 configuration (Figure 25) shows that the curves appear nearly on top of each other. As shown on the comparison plot for the T1 configuration (Figure 26) the yaw prediction is somewhat different. Since the scale factor of 1/5 for the T1 configuration in the T3 flow field produces good results in all parameters except yaw, it can be concluded that the flow field cannot be scaled by a single parameter. However, the results are adequate for showing trends if that is all that is desired. If good accuracy is desired, a T1 flow field should be used with a T1 configuration. The same results were found with the M-117 bomb in Reference 1. The T2 configuration can be used with the T3 flow field with good results.

The second major approximation was that the flow angularities could be scaled in a direct relation to the diameter of the bomb being launched to the diameter of the bomb that was used in collecting the flow field data. In order to investigate this approximation, the M-117 and MK-81 bombs were tested in both the TER and the MER configurations, and their flow patterns are displayed in Figures 7(a), 7(b), 10(a), 10(b), 11(a), 11(b), 12(a), 12(b), 13(a), 13(b), 14(a), 14(b), 18(a) to 18(d), 19 (a) to 19(d), 20 (a) to 20(d), 21(a) to 21(d), 23(a) to 23(f), and 24(a) to 24(f).

Similar flow pictures exist for both the M-117 and MK-81 bombs in the same configurations. In order to find the effect of the differences that do exist, the MK-81 was launched from the T3, T2, and T1 configuration using the MK-81 T3, T2, and T1 flow fields, respectively. These trajectories were then compared to the MK-81 bomb launched in the T3, T2, and T1 configuration using the M-117 T3, T2, and T1 flow fields, respectively, and a flow field scale factor based on the ratio of the weapon diameters,

$$\frac{\text{MK-81 DIA}}{\text{M-117 DIA}} = \frac{9}{16}$$

The resulting comparisons are displayed in Figures 27, 28, and 29. For the bottom station launch shown in Figure 27, the M-117 flow field produces more pitch than the MK-81 flow field; however, the comparison is still very good considering the large difference in bomb diameter. The shoulder station comparisons (Figures 28 and 29) show nearly identical trajectories. The diameter ratio scaling is a simple, accurate means of adjusting the flow fields for various diameter bombs.

A third approximation was that the angle of attack of the aircraft could be added to the flow angularities in the flow field. To investigate

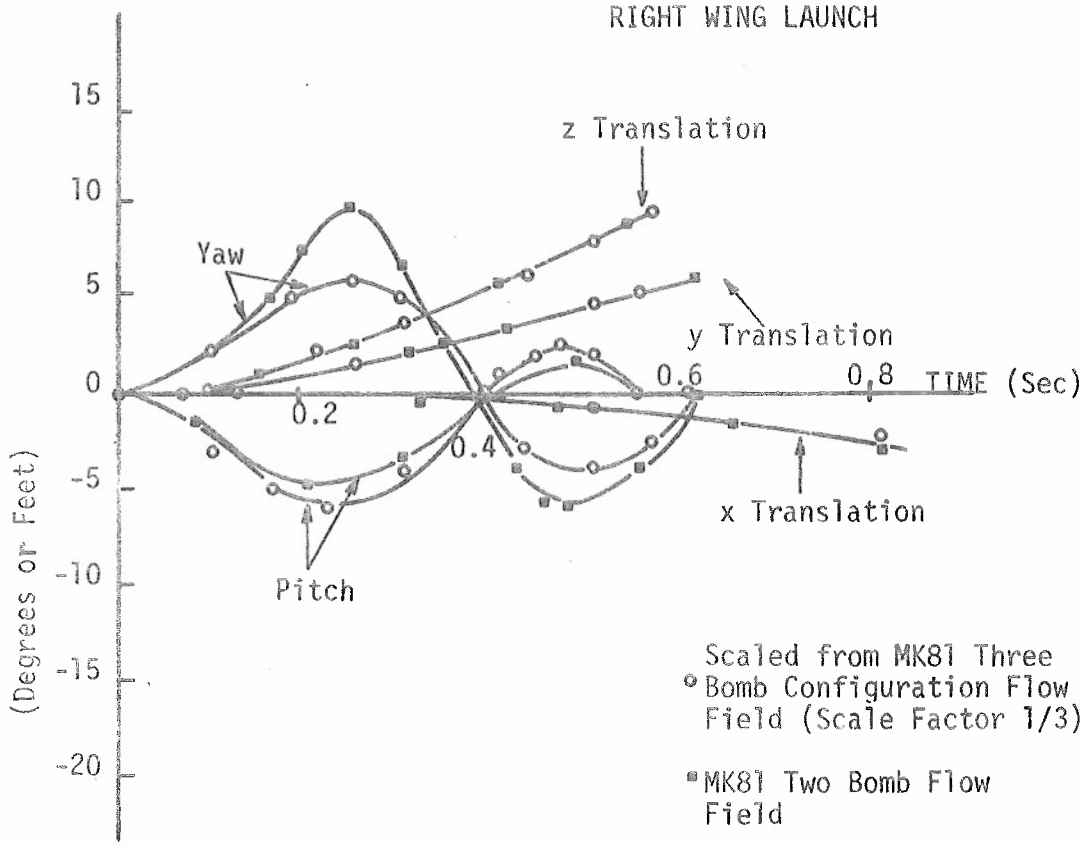


Figure 25. Pitch, Yaw, x, y, and z Time Histories of a MK-81 Launched from the Outboard Shoulder Station of the TER at M = 0.85 Using Scaled and Unscaled MK-81 Flow Field Data

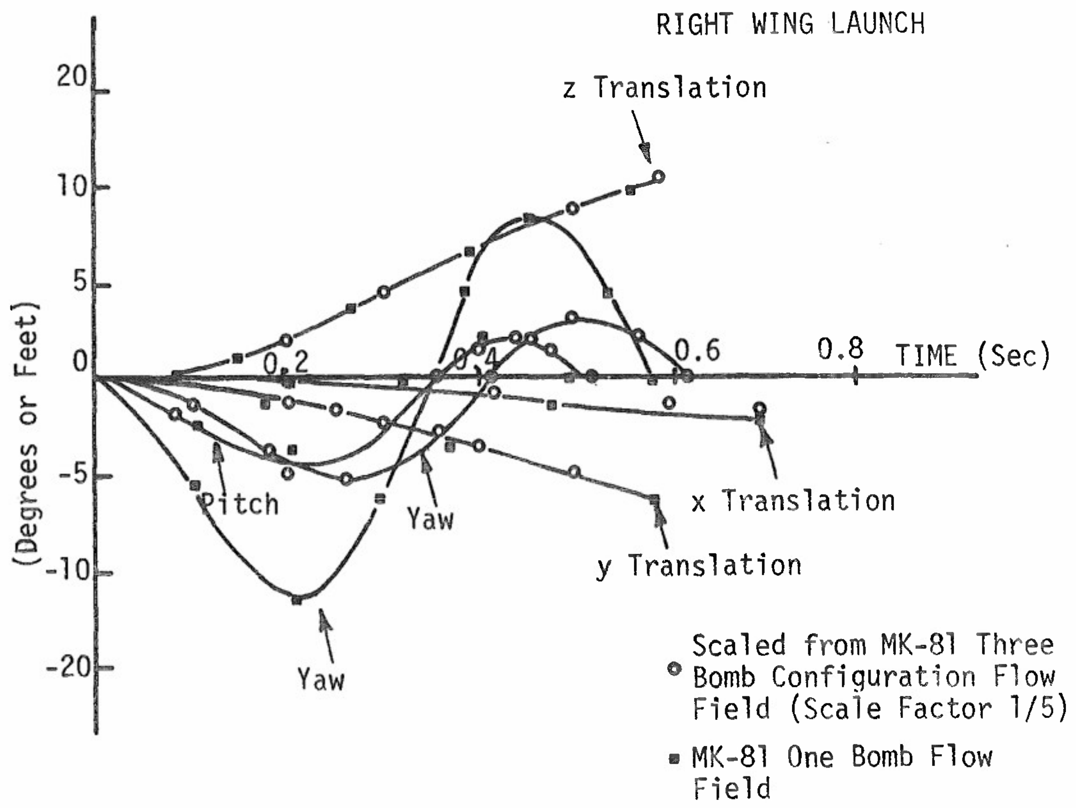


Figure 26. Pitch, Yaw, x, y, and z Time Histories of a MK-81 Launched from the Inboard Shoulder Station of the TER at M = 0.85 Using Scaled and Unscaled MK-81 Flow Field Data

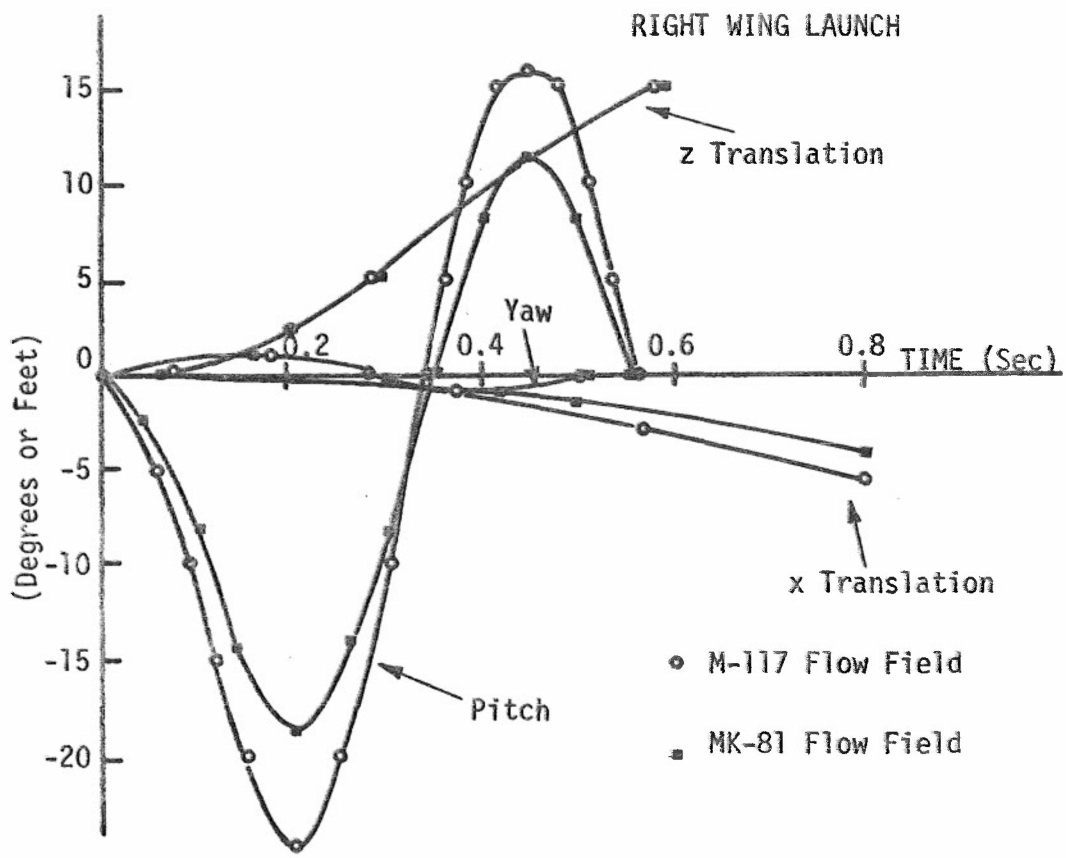


Figure 27. Pitch, Yaw, x, and z Time Histories of a MK-81 Launched from the Bottom TER Station at M = 0.85 Using M-117 and MK-81 Flow Field Data

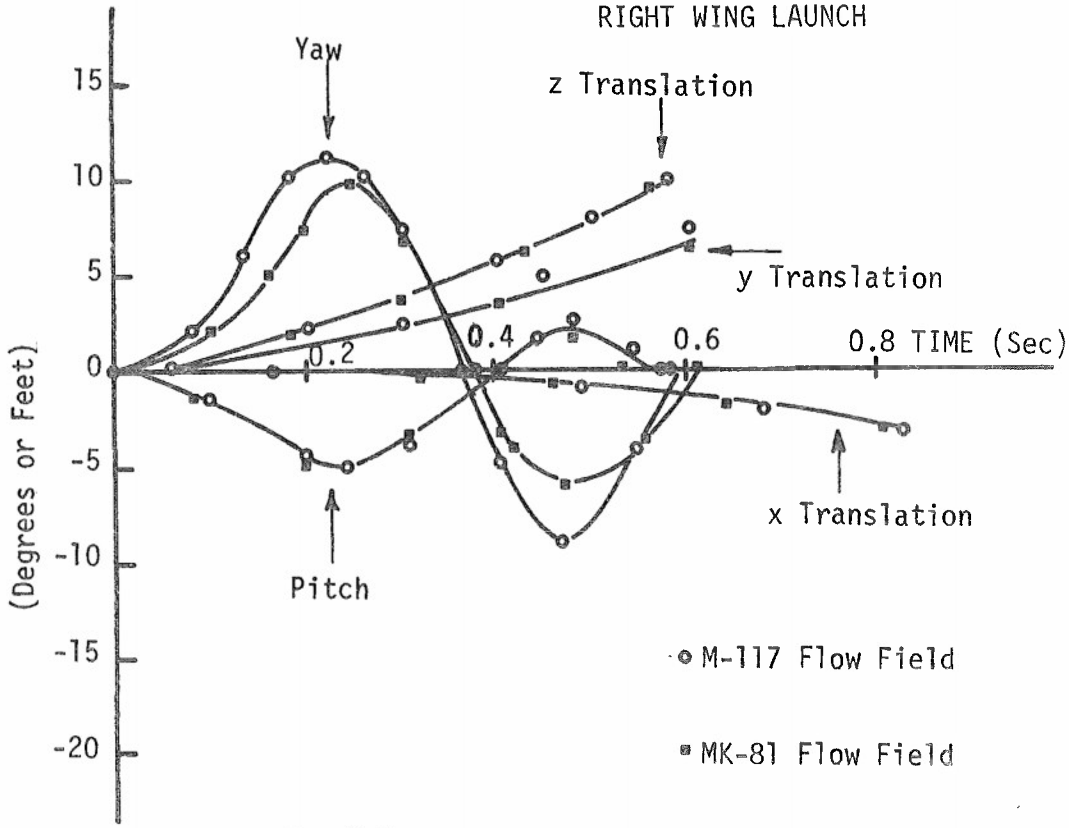


Figure 28. Pitch, Yaw, x, y, and z Time Histories of a MK-81 Launched from the Outboard Shoulder Station of the TER at M = 0.85 Using M-117 and MK-81 Flow Field Data

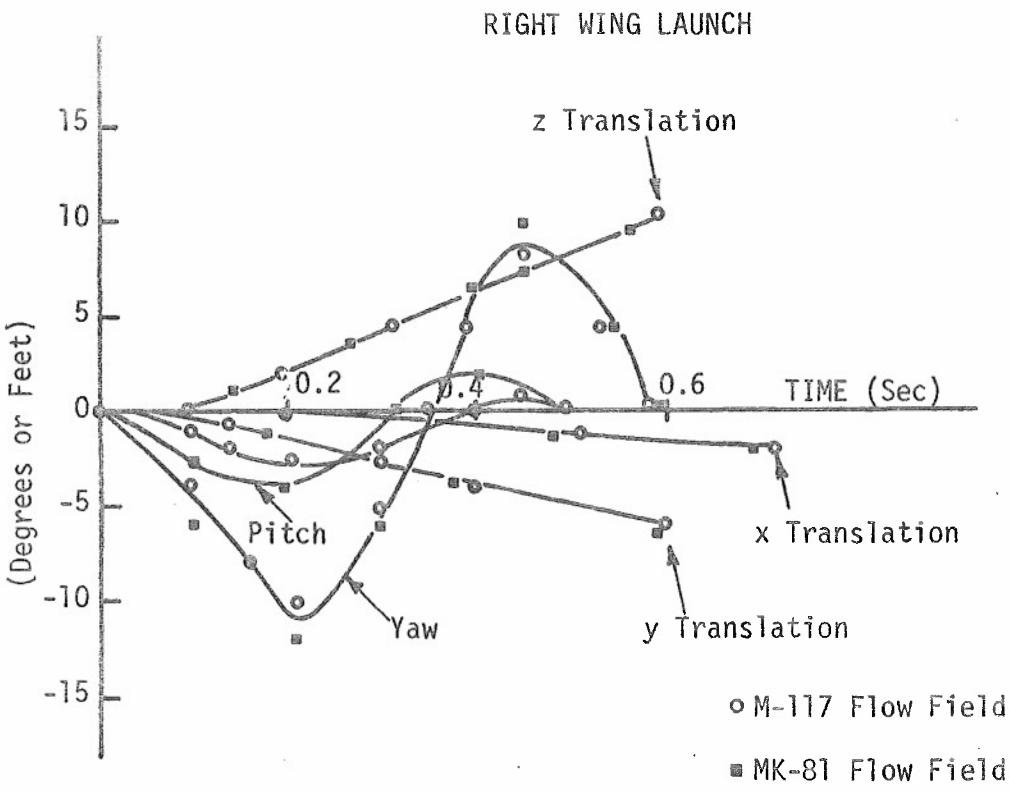


Figure 29. Pitch, Yaw, x, y, and z Time Histories of a MK-81 Launched from the Inboard Shoulder Station of a TER at M = 0.85 Using M-117 and MK-81 Flow Field Data

the validity of this approximation, the M-117 and MK-81 bombs were tested in the T3 configuration at aircraft angles of attack (α_p) of 0.3 and 3.3 degrees. The flow pictures for the 3.3 degree conditions are displayed in Figures 7(c), 7(d), 12(c), and 12(d). The actual upwash angles are presented for the M-117 bomb at α_p = 0.3 in Figures 8(a) and 8(b) and for α_p = 3.3 in Figures 9(a) and 9(b). These figures tend to show that the angle of attack can be added to the flow field angles and is the only practical way to handle the angle of attack variations.

The effect of Mach number on flow angularity was discussed in Reference (1), and an attempt was made to collect data at a Mach number of 1.3 during the test described in Reference (3). The method for collecting data gave very poor and inconsistent results at this Mach number and could not be analyzed. In Reference (1), it was assumed that Mach number had an insignificant effect on the flow angularity in the subsonic region; however, this assumption produced trajectories with larger pitch and yaw excursions at low Mach numbers (0.5 and 0.6) than experimental data obtained by the captive trajectory system. To investigate this problem, a theoretical solution developed by Auburn University (Reference 1) was used to calculate the flow angularities beneath two unfinned M-117 shaped bodies installed on the TER. The resultant flow angle (upwash angle ϑ) was calculated at a position that would correspond to the centerline location of the bottom bomb if it were attached. These angles were displayed in Figure 30 for various Mach numbers. The analysis shows there is a Mach number effect at the nose and tail in a region of the flow field that would be used in the flow angularity program to calculate the trajectory. To account for this Mach number effect, a second order correction factor is used to fit the flow angularities at M = .85 to values at higher or lower Mach numbers.

An objective of the test was to collect flow field data on single carriage of large diameter bombs and multiple ejector rack configurations. Figures 15(a) to 15(c) and 16(a) to 16(c) show the flow patterns around the MK-84 bomb on the inboard and outboard wing stations (configurations IP1 and OP1). As in the TER configurations, a downwash exists on the nose and an upwash exists at the tail of the bomb. Figures 31 and 32 display example trajectories of the MK-84 calculated with the flow field program. Trajectories of MER Configurations M6, M5, M4, M2, and M1 are presented in Figures 33, 34, 35, 36, and 37, respectively.

Some additional build-up configurations have their flow fields displayed: clean wing in Figures 4(a) and 4(b), wing/pylon in Figures 5(a) and 5(b), wing/pylon/TER in Figures 6(a) and 6(b), and wing/pylon/MER in Figures 17(a) to 17(e).

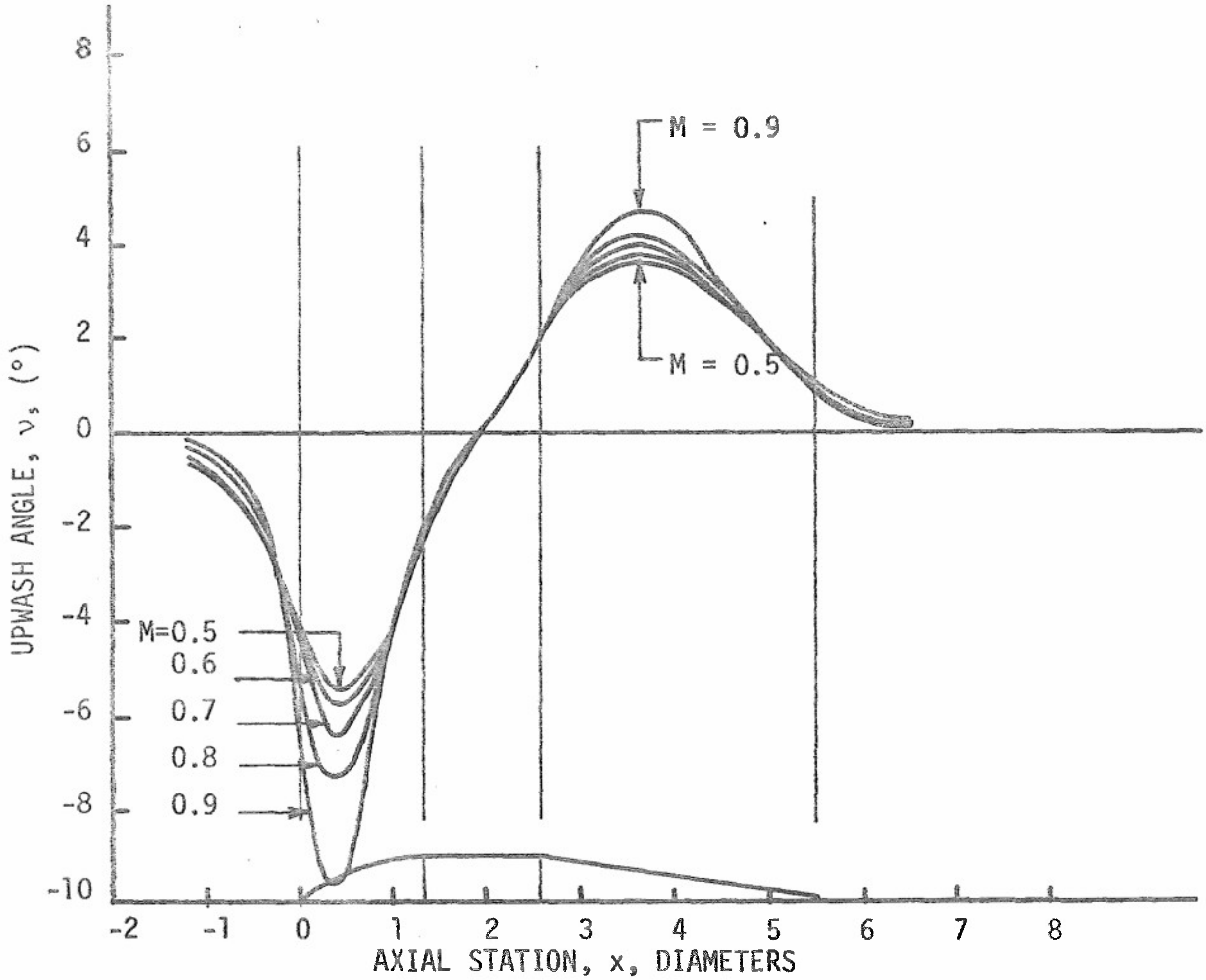


Figure 30. Mach Number Effect on Upwash Angle for Triple Ejector Rack and M-117 Bombs

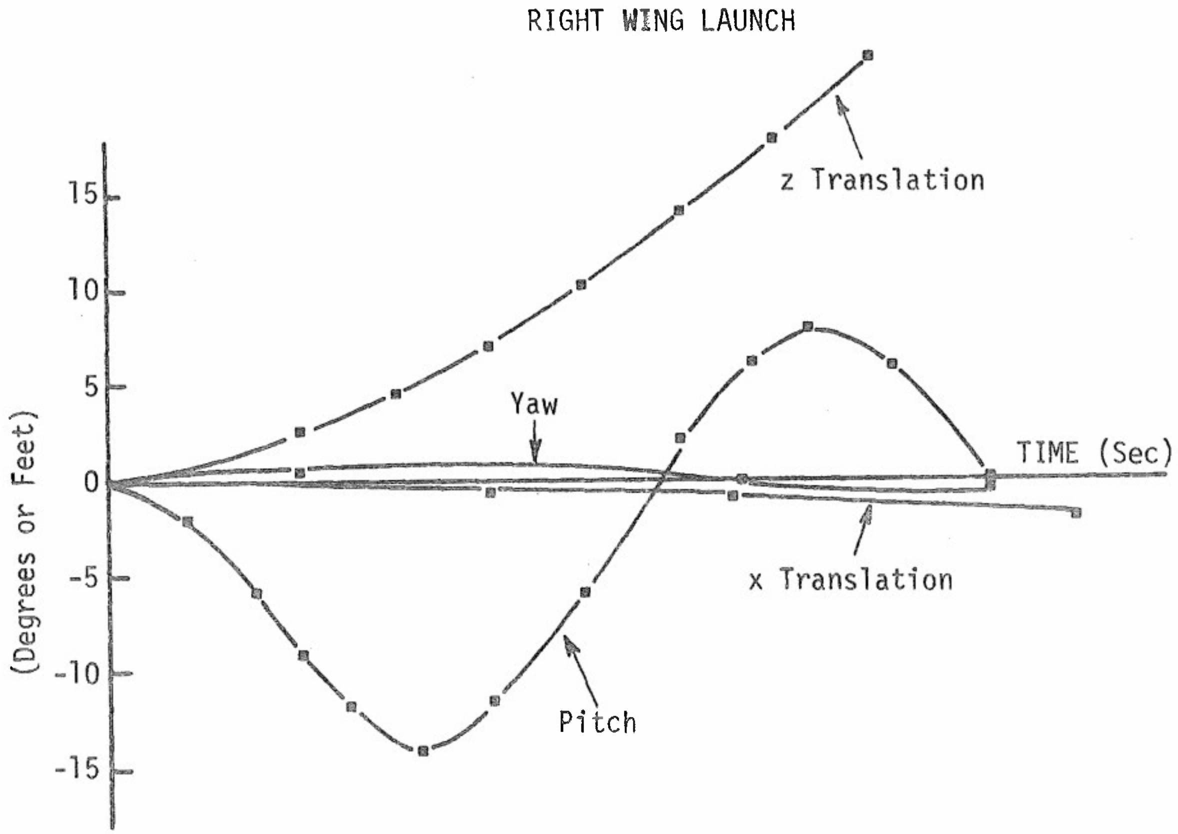


Figure 31. Pitch, Yaw, x, and z Time Histories of a MK-84 Bomb Launch from the Inboard Pylon at M = 0.85 Using the MK-84 Flow Field at that Station

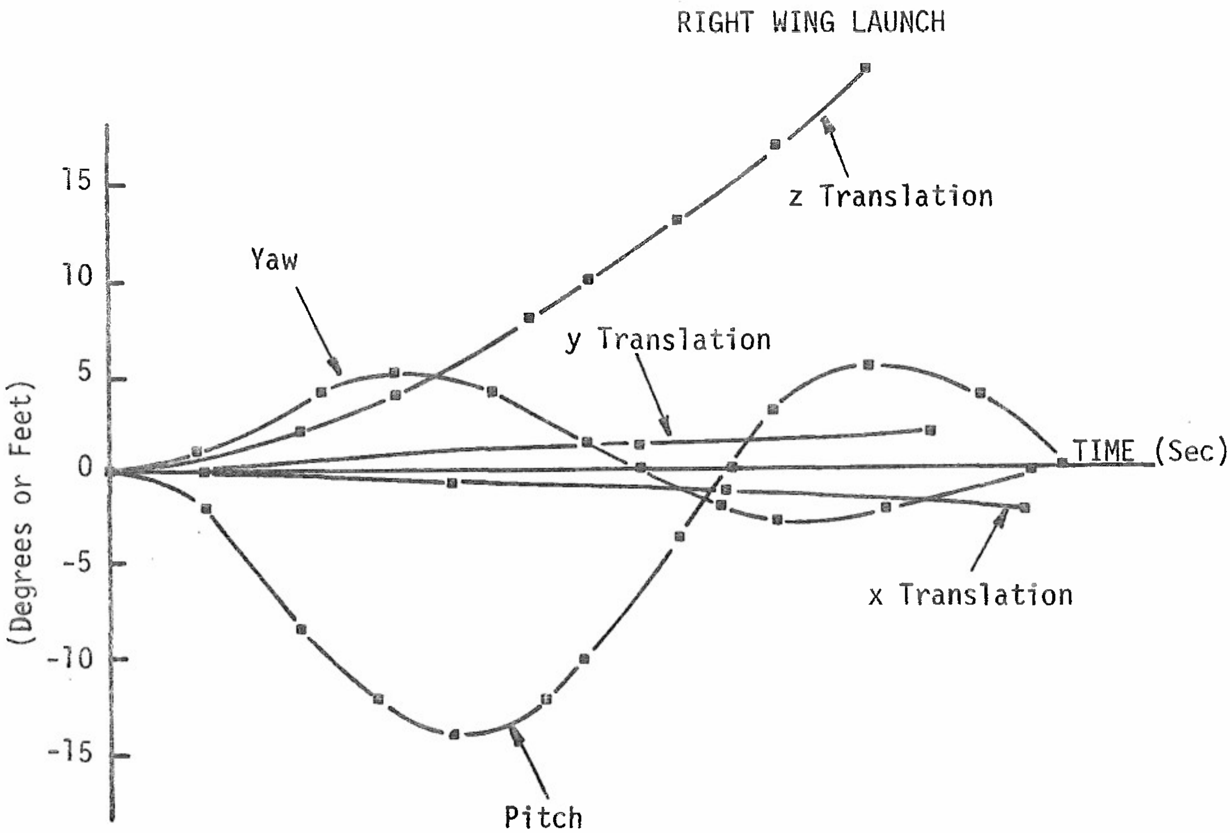


Figure 32. Pitch, Yaw, x, y, z Time Histories of a MK-84 Bomb Launch from the Outboard Pylon at M = 0.85 using the MK-84 Flow Field at that Station

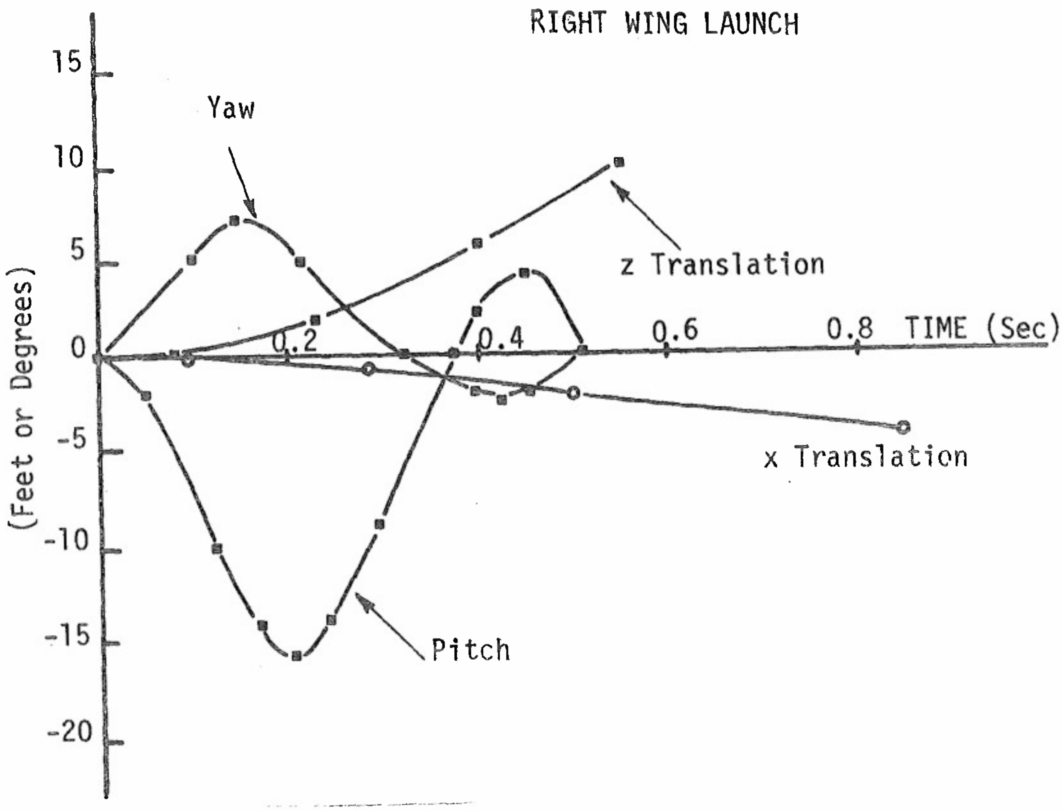


Figure 33. Pitch, Yaw, x, and z Time Histories of an M-117 Bomb Launched from the Bottom Back Station of the MER at M = 0.85 Using the Six Bomb Flow Field

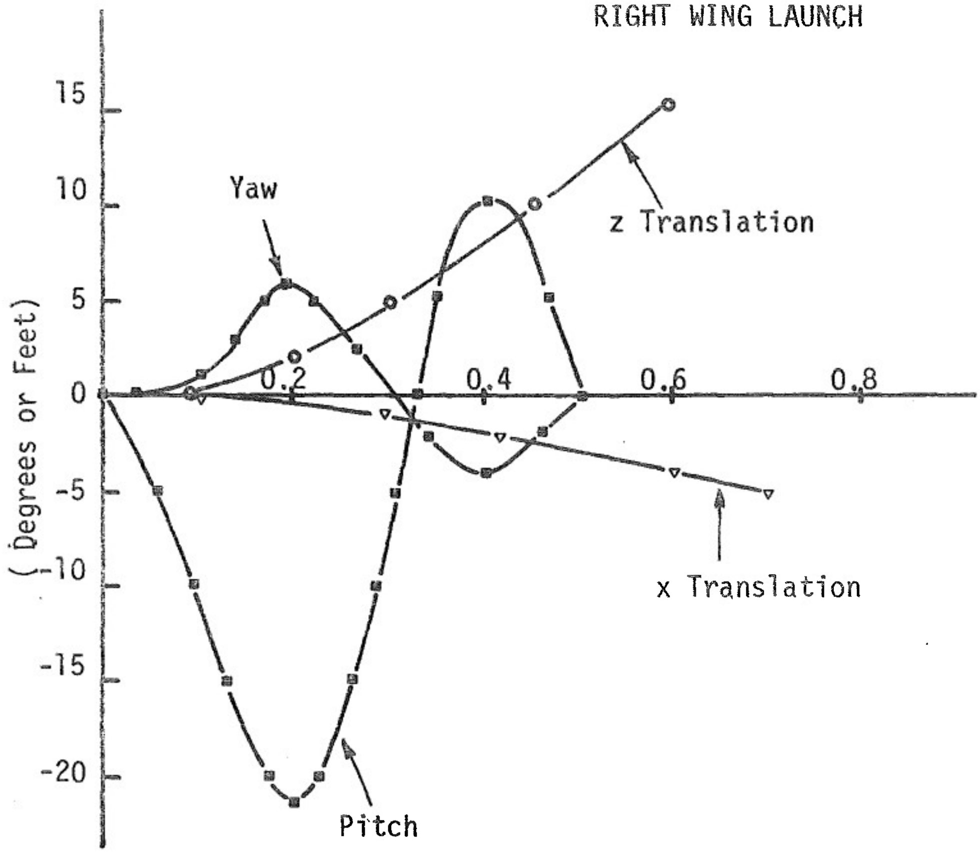


Figure 34. Pitch, Yaw, x, and z Time Histories of an M-117 Bomb Launched from the Bottom Forward MER Station at M = 0.85 Using the Five Bomb Flow Field

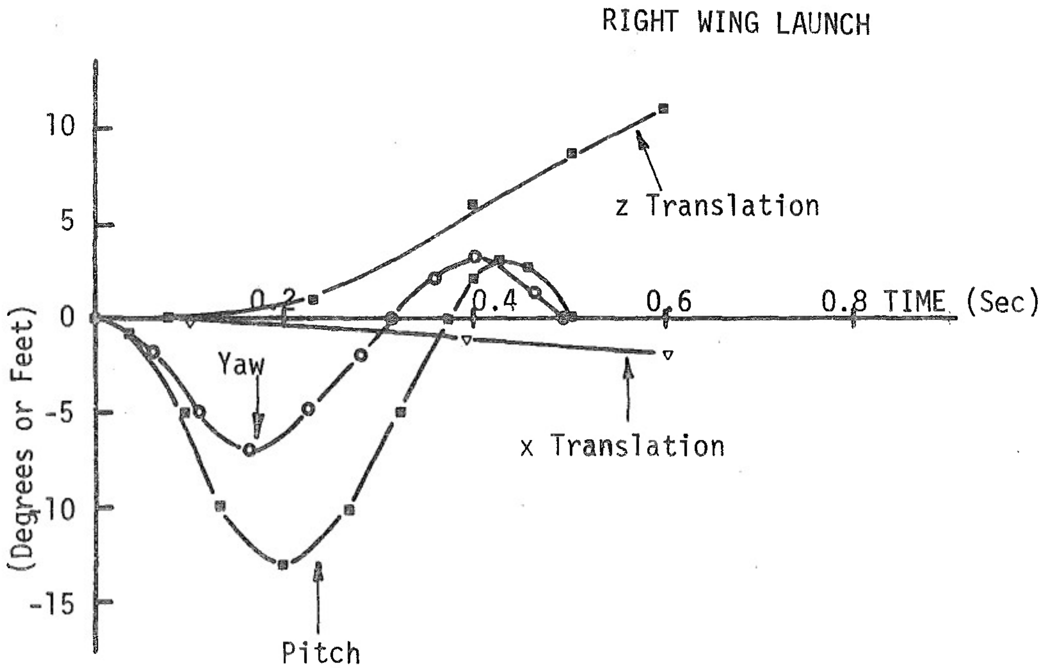


Figure 35. Pitch, Yaw, x, and z Translation of an M-117 Bomb from the Aft Inboard Shoulder Station of MER at M = 0.85 Using the Four Bomb Flow Field

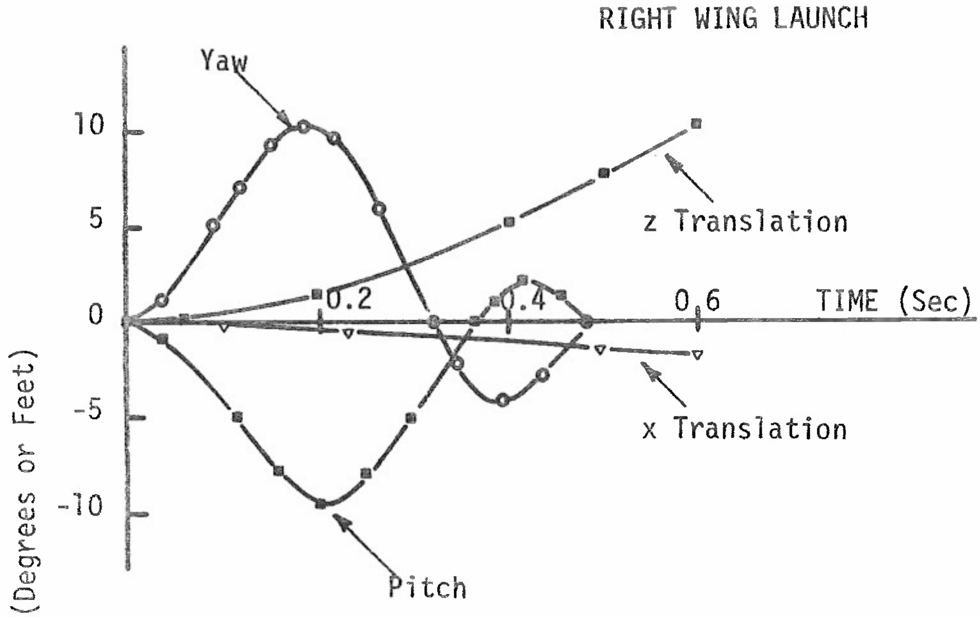


Figure 36. Pitch, Yaw, x, and z Time Histories of an M-117 Bomb Launched from the Aft Outboard Shoulder Station at M = 0.85 Using the Two Bomb Flow Field

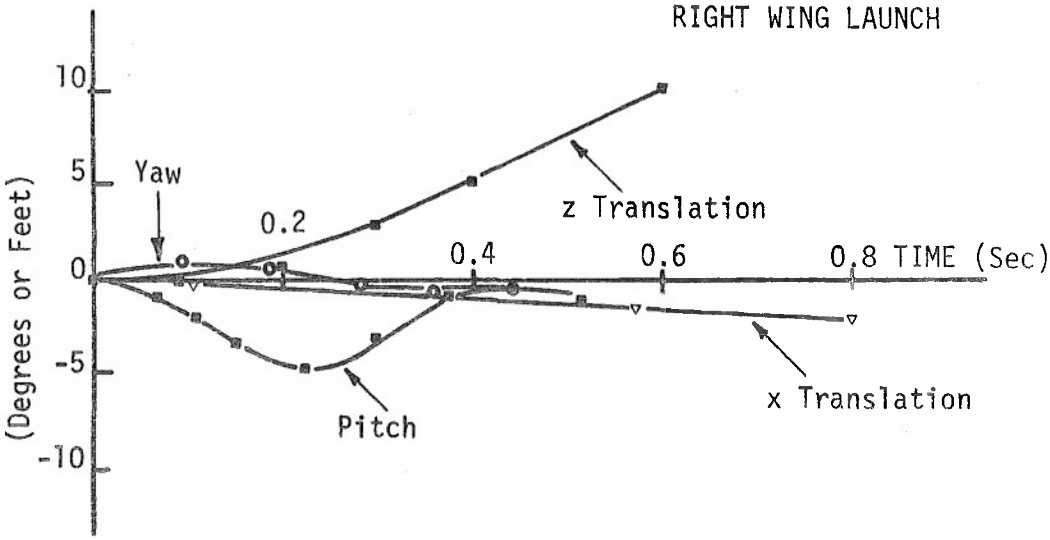


Figure 37. Pitch, Yaw, x, and z Time Histories of an M-117 Bomb Launched from the Forward Outboard Shoulder Station of a MER at M = 0.85 Using the One Bomb Flow Field

SECTION III

RESULTS

As a result of the second flow field test, the effects of the approximations made in the flow angularity technique (Reference 1) are more clearly defined. The use of the scaled flow field for T3 configuration on a TER for calculating trajectories from T2 and T1 configurations gives good results; however, more accurate results can be obtained by using the actual flow field. The diameter scaling parameter for the flow field produces good results, and the best results will be obtained by using a flow field that was produced by a store close to the diameter of the one being simulated. The new Mach number correction which comes from theoretical calculations will improve the programs accuracy at low Mach numbers.

With the additional flow field data, good trajectories can now be calculated for stores of large diameter launched from a pylon and all the MER configurations.

APPENDIXES

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APPENDIX I

PROGRAM INTRODUCTION

The flow angularity technique for predicting store separation trajectories is based on a general six-degree-of-freedom digital computer program that has been modified to accept flow field data and build the interference aerodynamic coefficients as explained in Reference 1. Table I-1 presents a list of modules used in the simulation. Differential equations are formulated in state variable form, where derivatives of state variables are computed in the appropriate module. Integration is accomplished by executive routines after each pass through the modules. An Adams-Moulton (fourth-order) integration algorithm with Runga-Kutta start, is employed with a fixed integration step size as long as the bomb remains in the interference flow field. After the bomb is free of the interference flow field, the integration step size can be changed for the rest of the flight to the ground. Executive routines monitor input/output which permit many trajectories to be simulated with each run. A table look-up routine with linear interpolation between data points is used to extract flow field data or any other data that needs to be entered in the program but is a function of one, two, or three variables. A plot routine that is designed for the 4020 Stromberg/Carlson plotter will permit trajectory plots.

A module interconnection diagram is presented in Figure I-1 to show how the different modules fit together. Figures I-2 and I-3 explain the axis systems used in the program.

The program text, definitions, and input data are presented in Appendixes II, III, and IV, respectively. Two example runs are displayed in Appendixes V and VI. Example 1 consists of an M-117 launched from the bottom TER station at M = .85 and M = .5. Example 2 is a MK-84 bomb dropped from the outboard pylon at M = .85, and a MK-81 launched from the outboard pylon at M = .5.

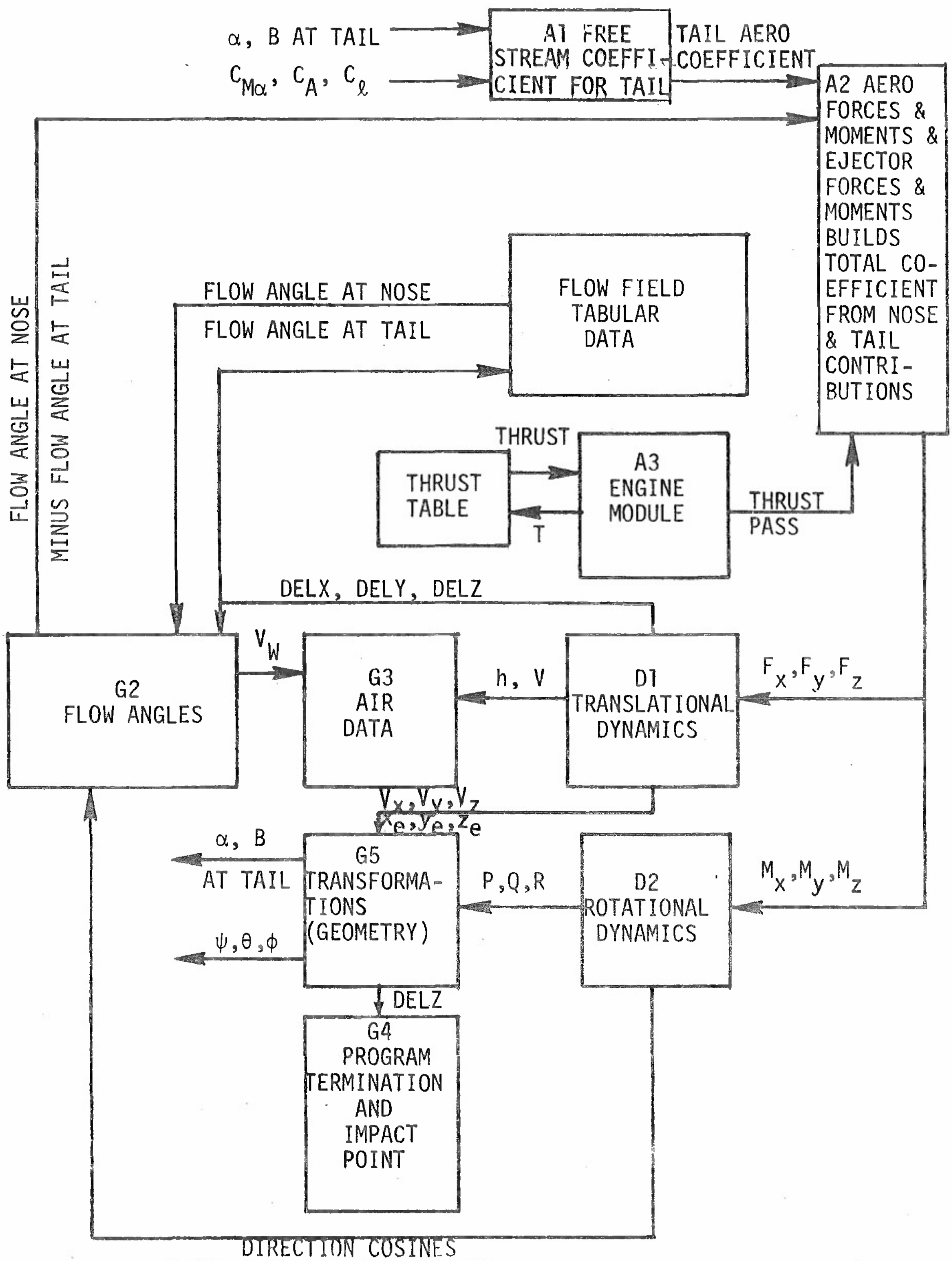


Figure I-1. Module Interconnection Diagram

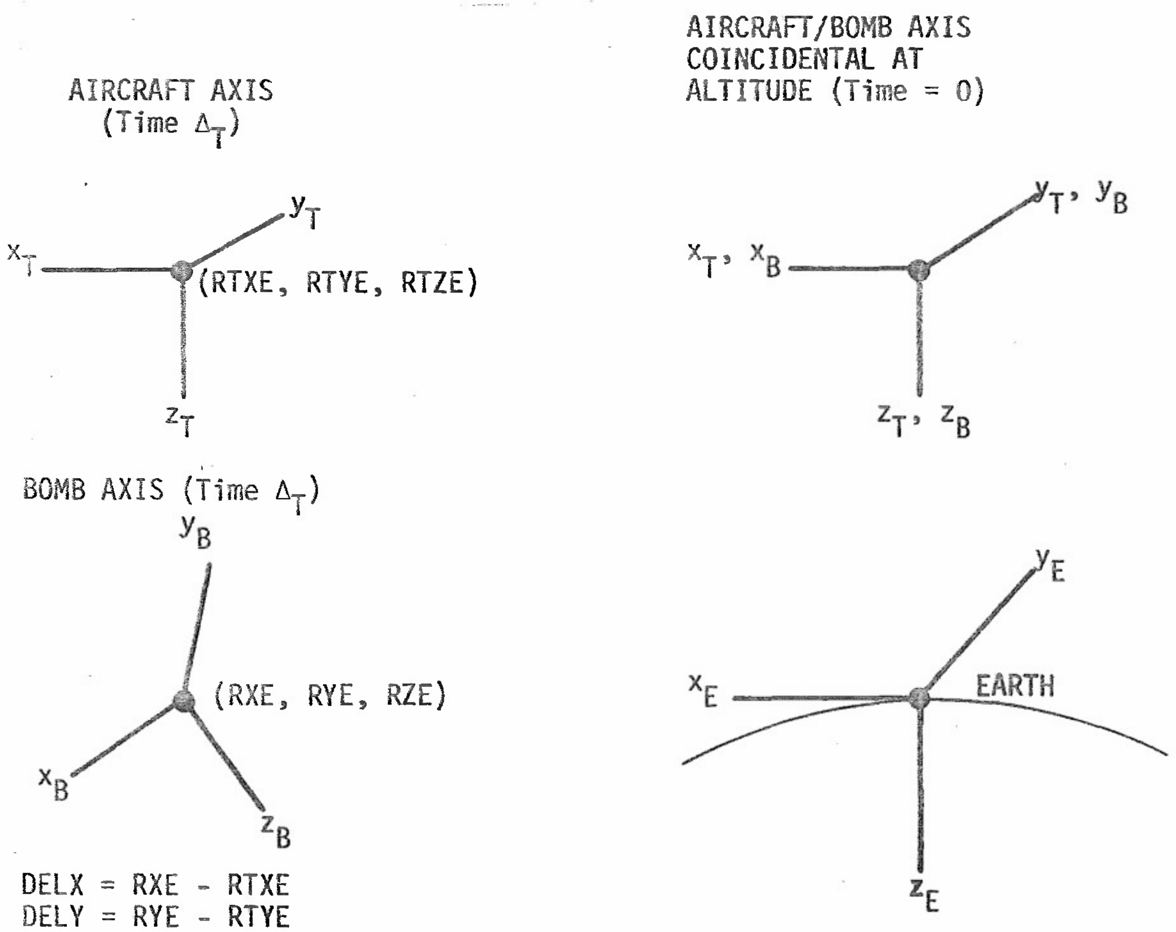
x_e, y_e, z_e - Earth Axis System

x_B, y_B, z_B - Bomb Body Axis System

x_T, y_T, z_T - Aircraft Body Axis System

RTXE, RTYE, RTZE - Origin Coordinates of the Aircraft Body Axis System with respect to the Earth Axis System

RXE, RYE, RZE - Origin Coordinates of the Bomb Body Axis System with respect to the Earth Axis System (Origin at bomb C_g)



DELX = RXE - RTXE
DELY = RYE - RTYE
DELZ = RZE - RTZE
All Angles measures in Euler order (Yaw, Pitch, Roll) with respect to the Earth Axis System

Figure I-2. Axes Systems Definition

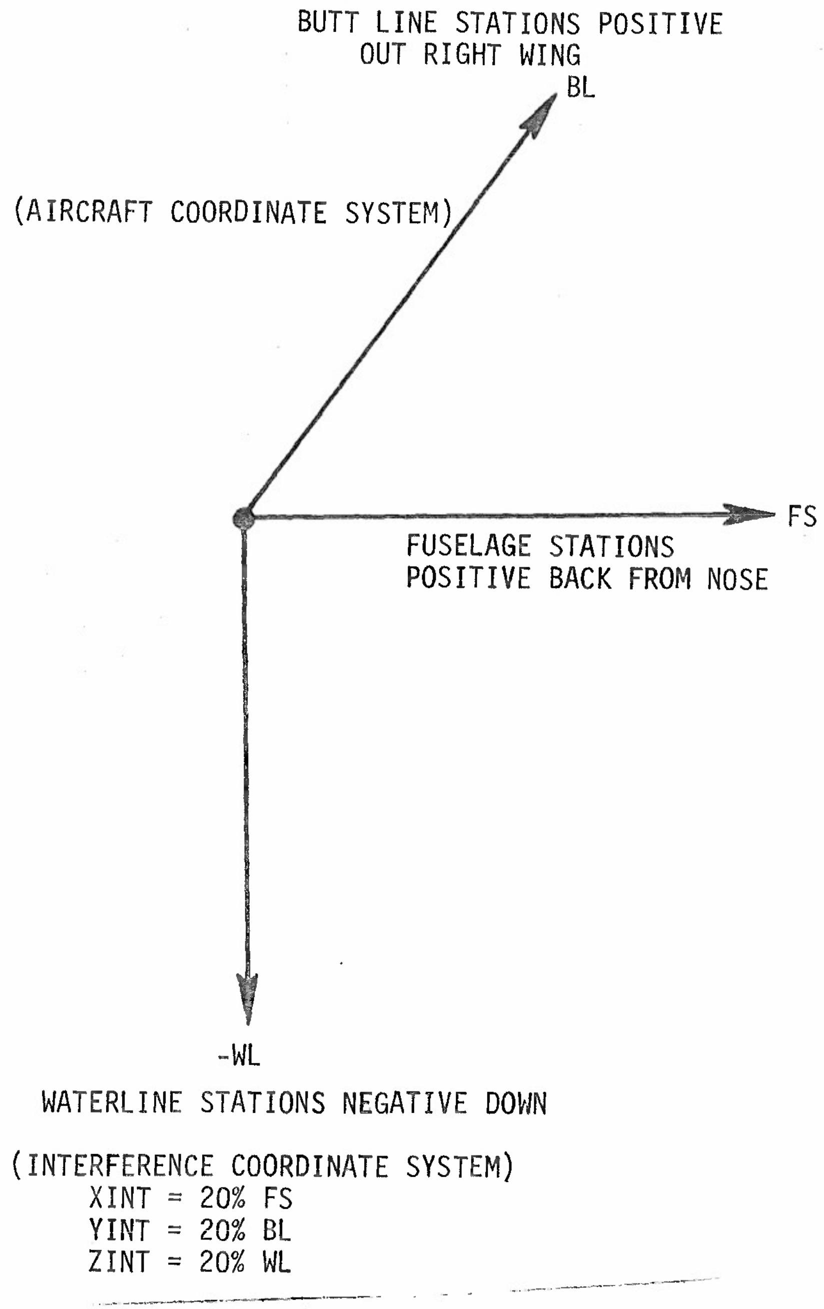


Figure I-3. Conversion from Aircraft Coordinate System to Interference Coordinate System

TABLE I-1. PROGRAM MODULES

I. GEOPHYSICAL AND EXTERNAL ENVIRONMENT

G2 - Flow field table look-up to determine the flow angularities at the nose and tail of the bomb.

G3 - Air data, including dynamic pressure, density, speed of sound.

G4 - Terminal Geometry, computes impact point.

G5 - Transformation of position and velocity between various coordinate systems.

II. AIRFRAME

A1 - Free stream aerodynamic coefficients.

A2 - Aerodynamic forces and movements, in bomb body axes.

A3 - Engine, computes thrust as well as c.g. shifts and mass changes - including table look-up for thrust.

III. DYNAMICS

D1 - Translational dynamics of bomb-accelerations in body axes are transformed into earth coordinates and integrated into velocities and positions.

D2 - Rotational dynamics of bomb, computes rotational accelerations and velocities referred to bomb body axes.

APPENDIX II

PROGRAM TEXT

1. MAIN

MAIN is the central executive routine of the entire program. MAIN calls subroutine ZERO initially then sets the value of the integration parameter NPT. MAIN then decides by REPPLT whether it will use the old and/or new type 4 and 7 cards for multiple runs. OINPT1 is called, and all the input parameters are read into the C array. LSTEP is set equal to STEP, and this parameter will determine whether another set of data exists behind the present set. Next, AUXI is called, and from AUXI, all the initialization routines are called. SUBL2 is called to set the printing and graphing parameters. The VAR and DER arrays are filled from the C array according to the number of state variables found in the initialization routines. AUXSUB is called next to find the derivatives of all the state variables before entering the integration loop. AMRK is called and this routine integrates all the derivatives of the state variables, and then, MAIN places the new values of the state variables back into the C array. SUBL3 is called next and, in turn, calls STAG3 and OUPT3. STAG3 sets KSTEP=2 if it is time to terminate the trajectory, and OUPT3 prints the variable listed on the type 4 cards at certain time intervals. If it is not time to terminate, AMRK is called again; the program starts looping between AMRK, MAIN, and SUBL3. If KSTEP equals 2, the program leaves the integration loop, zeros the VAR array, and calls RESET. RESET zeros all C array elements that need zeroing. If LSTEP equals 2, the control is transferred back to where OINPT1 is called and the process starts over. If LSTEP equals 11, the program will exit. If OPTIN10 is greater than zero, DUMPO will be called before the exit.

2. SUBROUTINE ZERO

ZERO makes sure that the counters which count the numbers of the various types of input cards and the number of points to be plotted are set equal to zero.

3. OINPT1

OINPT1 reads all the input cards. When a type 6 input card is read, the subroutine returns. It also prints out the values of the input cards as it reads them.

4. AUXI

AUXI has the capability of calling the initialization routine of any regular subroutine. The type 2 cards determine which subroutines will be used in the program, and the DUMMY subroutine has entry statements for any subroutine that does not need an initialization routine.

5. A3I

A3I identifies the thrust as the derivative of the total impulse and stores the C storage location of thrust in the IPL array.

6. D1I

D1I identifies the derivative of the state variables that define the position of the bomb and aircraft and stores the value of their C storage location in the IPL array. The initial velocity of the store is set by the read-in Mach number (VMACH) and RZE displacement. The initial locations of store and aircraft are defined.

7. D2I

D2I is the rotational dynamics initialization module. The derivatives of the elements of the position matrix, the pitch, yaw, and roll accelerations are defined and stored in the IPL array. Also, the angular rate derivatives are reset to zero.

8. SUBL2

SUBL2 calls staging and output routines according to the values placed on the type 1 cards.

9. STAG2

STAG2 sets KCONV=0, LCONV=0, KSTEP=1.

10. OUPT2

OUPT2 updates DOC by 1, and if that value is less than 7, DUMPO is called. OUPT2 initializes the counters needed to space the printing on the page. It also stores the first values of the variables to be plotted in the graph array and initializes OPOINT equal to 1.

DTCNT decides how many lines of data will be printed each time OUPT3 is called.

11. AUXSUB

AUXSUB calls the regular subroutines according to the value on the type 2 cards in columns 20 through 25.

NOMOD = number of type 2 cards.

XMODNO or MODNO array stores the value on columns 20 to 25 read in E.15 format from the type 2 cards.

12. G2

G2 calculates the nose and tail positions of the bomb in the interference flow field after scaling the unit length of the flow field by the ratio of DIASC. The values of the flow angularity are found in the tabular data.

The angularity at the tail is then converted into a cross-flow velocity when the freestream velocity is multiplied by the angularity. These cross-flow velocities VWXE, VWYE, and VWZE are inputs in subroutine G3. The angularity at the nose minus the angularity at the tail is then passed on to A2 for calculations of the nose moment and force contribution.

13. G3

G3 calculates the store velocity at the tail with respect to the air mass in earth axis system. It also sets the speed of sound, Mach number, and density for the calculated altitude.

14. G5

G5 calculates pitch, yaw, and roll angles in degrees and their associated derivatives. It then calculates a total velocity of the store with respect to earth axis system (VTOTE) and the distance the store has moved from its initial position (RANGO). The velocity of the store with respect to the air mass in body axes are calculated, and from these velocities, the angles of attack and side slip are calculated.

15. A1

A1 calculates the moment and force coefficients CX, CY, CZ, CM, and CL from input parameters CAA, CNAA, and CMAA which are Ca, CN_α, and CM_α, respectively. The wind tunnel angle of attack and roll angle are used to position the store with respect to the free stream velocity rather than the angle of attack and side slip angles. These coefficients, however, do not include the nose correction yet.

16. A2

A2 makes the corrections to the moment and force correction due to the flow field at the nose having a different angularity than the tail. These aerodyanmic coefficients are then transferred to body forces and moments. Ejector forces and moments are then combined with the aerodynamic forces and moments to give the resultant values. The ejector forces and moments last over either an ejector force time (EFT) or an ejector stroke distance (EJD). When the time is greater than EFT or the distance traveled is greater than EJD, the ejector force and moment become zero.

This routine has an option for a rail launched missile. Until the missile leaves the rail, it is restricted to move only in the X direction. The lug loads are calculated during that time. If no rail launch is desired, make OPTN4 = 2 and RAIL = RLUG = 0. Any forces and moments found due to a thrusting motor are also added to the total forces and moments.

17. A3

A3 calculates the thrust and thrust misalignment effects. It also calculates any c.g. and IXX, IYY, and IZZ changes due to burning the propellant. If no thrust exists, the thrust values in the table look-up must be zero. If no thrust exists, the specific impulse (ISP) must be read in as 1.

18. D1

D1 is the translational dynamics module that transfers the forces calculated in A2 into body accelerations in body axis and then transfers then into earth axis. The gravity term is added to the verticle acceleration, and the velocity is defined as the integral of the acceleration and the derivative of the position. Also, the aircraft velocity is integrated to find its position.

19. D2

D2 is the rotational dynamics module that calculates the body angular rates and the derivatives of elements of the position matrix.

20. AMRK

AMRK is the integration subroutine. This routine under usual operation does three Runge-Kutta integrations and then uses the Adams-Moulton predictor corrector until completion. The variable NPT is set equal to 2 at the beginning of the program unless RKUTTA is set equal to 1. On coming into AMRK with NPT equal to 2, KOUNT is set equal to 0, and NPT is set equal to ZERO. Each time through AMRK, COUNTE is updated by 1 until COUNTE equals 3, at which time AMRK switches from Runga-Kutta to Adams-Moulton.

The Runge-Kutta integration calls AUXSUB four times, and the Adams-Moulton predictor corrector calls AUXSUB twice.

If RKUTTA is set equal to 1, NPT is set equal to one and Runge-Kutta integration is used all the time.

21. STAG3

STAG3 calls G4 which determines whether ground impact has occurred. If impact has occurred, LCONV will be equal to 2. STAG3 also determines whether TF, which is the maximum trajectory time that is read as an input, has been exceeded by T. If either condition has been met, one more integration is performed with DER(1)=0. Then OUPT3 is called to write the results of the last integration, and the KSTEP is equal to 2. KSTEP equal to 2 eventually terminates the integration in MAIN.

22. G4

G4 calculates the distance the impact point is from the origin of the earth axis system by determining when RZE becomes positive and then interpolating between that position and the position of the store at its previously calculated position. The miss distances X, Y, Z, and T are printed from this subroutine.

23. OUPT3

OUPT3 checks to see if the computer ITCNT is less than 7 and, if so, DUMPO is called. The main purpose of OUPT3 is printing the value of the variables listed on the type 4 cards and their alphanumeric names. PCNT is updated by CPP which is the time interval between printing. OUPT3 also stores the values of the variables to be plotted in the GRAPH array (these are variables input by type 7 cards). PPNT is updated by PPP which is the time interval between saving points to be plotted. If a DUMPO has occurred, PGCNT will equal 1, and the printing format is adjusted by printing the variable names at the top of the next page. PGCNT counts the number of lines that have been printed, and when PGCNT equals or is greater than 112, the new heading is printed and PGCNT is reinitialized by the number of lines that were used for the heading print out. OPOINT counts the number of times that data is stored in the graph array.

24. DUMPO

DUMPO prints all values stored in the C array 9 to a line with a counter in the first 5 columns.

25. DUMMY

This subroutine contains entry statements that are used if a subroutine is called and is not present in the program. If the subroutine is present in the program, the appropriate entry statement in DUMMY should be removed or preferably a C placed in Column 1 of that card turning that entry into a comment card.

APPENDIX III

NOMENCLATURE DEFINITION

1. EXECUTIVE ROUTINES

Variable Name	Reset To Zero	C Storage Location	Variable's Dimension	Input	Definition
RKUTTA	YES	1972	1	YES	If RUNGE-KUTTA integration desired exclusively; RKUTTA=1; otherwise, RKUTTA=0.
NJ	YES	1974	1	NO	NJ=N-1.
NPT	YES	1975	1	NO	Controls integration.
PLOTN4	NO	1982	1	YES	Number of variables plotted by type 4 graph routine.
PLOTN2	NO	1983	1	YES	Number of variables plotted by type 2 graph routine.
OUTPLOT	NO	1985	15	NO	Array containing C storage location of variables to be plotted.
T	NO	2000	1	YES	Time (initially zero)

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
TF	NO	2001	1	YES	Maximum allowable trajectory time before the program shuts itself off.
PCNT	YES	2003	1	NO	The value of time at which the next print out will occur.
PPNT	YES	2004	1	NO	The updated plotting time.
PPP	NO	2005	1	YES	Plotting time is updated by adding PPP to the last plotting time.
REPPLT	NO	2006	1	YES	0. Use new type 4 and 7 cards, and discard old. 1. Use old plus those added type 4 and 7 cards. -1. Use new type 7 cards and discard old.
PTLESS	YES	2007	1	YES	Number of last plotting points deleted.
PLOTNO	NO	2008	1	YES	Total number of variables to be plotted.
NOPLOT	NO	2009	1	YES	Integer value of PLOTNO.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
STEP	NO	2010	1	YES	STEP=2, another set of data behind this set. STEP=11, last set of data.
KSTEP	YES	2011	1	NO	Flag set to take the program out of the integration loop after G4 decides the bomb has contacted the ground. KSTEP=2 at this time.
LSTEP	NO	2012	1	NO	Integer value of STEP.
DOC	NO	2013	1	YES	Counter for DUMPO. DOC $\geq$ 6, C array not printed. DOC $<$ 6, C array printed.
ITCNT	YES	2014	1	NO	Counter that counts iteration so DUMPO can be called. (If ITCNT $>$ 6, DUMPO will not be called)
CPP	NO	2015	1	YES	Value that updates PCNT after each print out.
PGCNT	YES	2016	1	NO	A counter that automatically counts the lines of data printed on an output page. When PGCNT is greater than or equal to

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
					112, a flag is set so that headings will be printed at the top of the next page.
DTCNT	YES	2017	1	NO	A counter that is automatically set during operation subroutine OUPT2 to the required number of lines of numerical data per print out. DTCNT is used in operational subroutine OUTP3 to determine when headings should be printed on each output page.
OPOINT	NO	2023	1	NO	Number of points to be plotted for each variable. It is a counter.
TIME	NO	2025	300	NO	Storage array containing the times during trajectory that variable values will be saved for plotting.
VLABLE	NO	2325	(2,15)	NO	Array containing alphanumeric names of variables to be plotted.
IR(I)	YES	2355	2	YES	Value on columns 1 and 2 of input cards. Determines card type.
VR(1) VR(2)	YES	2357	2	YES	Value on columns 31-45 on type 3 cards. Value on columns 46-61 on type 3 cards.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
NOMOD	NO	2361	99	NO	The number of modules to be processed.
NOSUB	NO	2461	1	NO	Number of type 1 cards.
SUBNO	NO	2462	99	NO	Storage values on type 1 cards (columns 21-25)
N	NO	2561	1	NO	Number of state variables as counted in the initialization subroutines.
IPL	YES	2562	101	NO	Storage array for the C locations of all the derivatives of the state variables.
DER	YES	2664	101	NO	Storage array for the derivative of the state variables.
VAR	YES	2965	101	NO	Storage array for values of all state variables.
NOLIST	NO	3066	1	NO	Number of type 3 cards to be reset. If VR(2) equal 1 the variable is reset.
LISTNO	NO	3067	50	NO	Storage array of the C storage locations of variables on type 3 cards that need to be reset.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
VALUE	NO	3117	50	NO	Storage array of the values of the variables that will be reset.
OUTNO	NO	3168	50	NO	Storage array for the locations of variables on type 4 cards.

2. G2

Variable Name	Reset to Zero	Cstorage Location	Variable's Dimension	Input	Definition
COUNTE	YES	42	1	YES	COUNTE=2. No flow angularity calculated. COUNTE=0. Flow angularity calculated.
ZLUN	YES	44	1	NO	ZINT coordinate of the store for table look up in the flow angularity table. (inch)
XLUN	YES	45	1	NO	XINT coordinate of the nose of the store for table look up in the flow angularity table.(inch)
PWY3	YES	46	1	NO	Flow angularity in the XINT, YINT plane at the store nose after all scaling. (rad)
OPTNW	NO	50	1	YES	0=No interference flow field. 1=Interference flow field.
XPOS	NO	54	1	YES	FS position of the c.g.for the store be-ing launched (FT)

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
YPOS	NO	55	1	YES	BL position of the c.g.for the store being launched (FT)
ZPOS	NO	56	1	YES	WL position of the c.g.for the store being launched (FT)
XTAIL	NO	57	1	YES	Length from store c.g.to tail of store being launched (FT; usually negative)
TNOSOS	NO	58	1	YES	Scale factor used to adjust the flow field if the three store flow field is used for other configurations. 1. store on TER TNOSOS=5 2. Stores on TER TNOSOS=3 3. Stores on TER TNOSOS=1 All other configurations TNOSOS=1.
XNOSE	NO	59	1	YES	Length from store c.g.to nose of the store used to generate the flow field.
AAN	YES	60	1	NO	Flow angularity at the nose minus flow angularity at the tail after all scaling in the XINT, YINT plane (rad)
ASN	YES	61	1	NO	Flow angularity at nose minus flow angularity at the tail after all scaling in the XINT, YINT plane (rad)

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
PWZ1	YES	62	1	NO	Flow angularity at the nose in the XINT, ZINT plane before scaling.
PWY1	YES	63	1	NO	Flow angularity at the nose in the XINT, YINT plane before scaling.
XLUN	YES	67	1	NO	XINTcoordinate of the nose of the store for table lookup in the flow angularity table.
DIASC	YES	69	1	YES	Ratio of the diameter of the store used to generate the flow field and the diameter of the store being launched.
DELX	YES	70	1	NO	Store RXE position minus aircraft RTXE position.
DELY	YES	71	1	NO	Store XYE position minus aircraft RTYE position,
DELZ	YES	72	1	NO	Store RZE position minus aircraft RTZE position.
XNOSE1	NO	73	1	YES	Distance from store c.g.to the estimated center of pressure of the nose body. (FT)

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
XNPOS	YES	90	1	NO	Positions of the nose of the store calculated during the trajectory.
YNPOS	YES	91	1	NO	
ZNPOS	YES	92	1	NO	
XTPOS	YES	93	1	NO	Positions of the tail of the store calculated during the trajectory.
YTPOS	YES	94	1	NO	
ZTPOS	YES	95	1	NO	
VWXE	YES	100	1	NO	Cross wind components at tail due to the interference flow field.
VWYE	YES	101	1	NO	
VWZE	YES	102	1	NO	
PPP1	NO	120	1	YES	Value of PPP desired after store leaves the interference flow field.
CPP1	NO	121	1	YES	Value of CPP desired after store leaves the interference flow field.
DER1	NO	122	1	YES	Integration step size desired after the store leaves the interference flow field.
XTL	NO	123	1	YES	The upper limits of the values of XINT, YINT and ZINT that define the interference flow field control volume (model inch).
YTL	NO	125	1	YES	
ZTL	NO	127	1	YES	

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
XLL	NO	124	1	YES	The lower limits of the values of XINT,
YLL	NO	126	1	YES	YINT, and ZINT that defines the inter-
ZLL	NO	128	1	YES	ference flow field control volume(model inch).

3. G3

Variable Name	Reset to Zero	C Storage Location	Variable's Dimension	Input	Definition
VMWXE VMWYE VMWZE	YES YES YES	200 201 202	1 1 1	NO NO NO	Store velocity WRT the air mass in earth axis system with a tail interference velocity correction included.
PDYNMC	YES	203	1	NO	Dynamic pressure.
VMACH	YES	204	1	YES	Initial and updated Mach number.
DRHO	YES	205	1	NO	Standard atmosphere density at the calculated altitude.
VSOUND	YES	206	1	NO	Velocity of sound at the calculated altitude.
VAIRSP	YES	207	1	NO	Calculated airspeed of store WRT the air mass including the interference flow field velocity.
RW	YES	209	1	NO	Calculated altitude.

4. G4

Variable	Reset to Zero	C Storage Location	Variable's Dimension	Input	Definition
RMISS	YES	N/A	N/A	NO	Distance of impact point from the origin of the earth axis system.
TZERO	YES	N/A	N/A	NO	Time of impact.
RDX RDY RDZ	YES YES YES	N/A N/A N/A	N/A N/A N/A	NO NO NO	Xe, Ye, Ze components of distance that locate the impact point from the origin of the earth axis system.

5. G5

Variable	Reset to Zero	C Storage Location	Variable's Dimension	Input	Definition
BTHT BPSI BPHI	YES YES YES	350 351 352	1 1 1	NO NO NO	Euler pitch, yaw and roll angles of store WRT earth axis system.
BTHTD BPSID BPHID	YES YES YES	353 354 355	1 1 1	NO NO NO	Derivatives of Euler pitch, yaw, and roll angles.
VTOTE	YES	356	1	NO	Total velocity of store with respect to the earth axis system.
VMWU VMWV VMWW	YES YES YES	360 361 362	1 1 1	NO NO NO	Velocity components of store with respect to air in body axis system.
BALPHA	YES	367	1	NO	Angle of attack of store.
BALPAY	YES	368	1	NO	Angle of side slip of store.
BALPHP	YES	369	1	NO	Angle of attack of store in wind tunnel axis system.
BPHIP	YES	370	1	NO	Roll angle in wind tunnel axis system.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
RANGO	YES	380	1	NO	Distance of the store from launch point in the earth axis system.
ALPHAO	YES	381	1	YES	Initial angle attack of aircraft.

6. A1

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINTION
CMAA	YES	1272	1	YES	CM_{α}
CNA	YES	1273	1	YES	CN_{α}
CAA	YES	1274	1	YES	CA
CL2	YES	1240	1	NO	Cl
CX	YES	1203	1	NO	(body axis) axial force coefficient
CY	YES	1204	1	NO	(body axis) side force coefficient.
CZ	YES	1205	1	NO	(body axis) normal force coefficient.
CM	YES	1210	1	NO	(body axis) pitching moment coefficient
CN	YES	1211	1	NO	(body axis) yawing moment coefficient
CMQ	NO	1207	1	YES	Pitch damping coefficient.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
CNR	NO	1208	1	YES	Yaw damping coefficient.
CLP	NO	1206	1	YES	Roll damping coefficient,
CL	YES	1209	1	NO	Rolling moment coefficient in body axis

7. A2

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
RFAREA	NO	1306	1	YES	Cross sectional area of store (max)
RFLGTH	NO	1307	1	YES	Diameter at maximum cross section of store.
RLUG	NO	1316	1	YES	For rail launch only; distance between lugs
RAIL	NO	1317	1	YES	Rail length between front lug and end of rail
OPTN4	NO	3504	1	YES	If OPTN4=0, no rail launch. If OPTN4>0, can be rail launch if RAIL or RLUG>0.
FXBA FYBA FZBA	YES YES YES	1300 1301 1302	1 1 1	NO NO NO	Combination of aerodynamic and ejector forces on the store.
FMXBA FMYBA FMZBA	YES YES YES	1303 1304 1305	1 1 1	NO NO NO	Combination of aerodynamic and ejector moments on store.

Variable Name	Reset to Zero	C storage Location	Variable's Dimension	Input	Definition
FMXTH	YES	1320	1	NO	Moments caused by thrust misalignments.
FMYTH	YES	1321	1	NO	
FMZTH	YES	1322	1	NO	
FMXLUG	YES	1323	1	NO	Moments for store transferred to the lugs.
FMYLUG	YES	1324	1	NO	
FMZLUG	YES	1325	1	NO	
EFT	NO	1332	1	YES	Ejector force action time.
EJD	YES	1333	1	YES	Ejector stroke length.
EFORCX	NO	1326	1	YES	Ejector forces in earth axis system.
EFORCY	NO	1327	1	YES	
EFORCZ	NO	1328	1	YES	
EMOMX	NO	1329	1	YES	Ejector moments in earth axis.
EMOMY	NO	1330	1	YES	
EMOMZ	NO	1331	1	YES	

8. A3

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
BALPHT	NO	1401	1	YES	Angle between the thrust vector and X body axis.
BPHIT	NO	1402	1	YES	Angle between the thrust vector projected into the Y_B,Z_B plane and the Z_B axis
QNALGN	NO	1403	1	YES	QNALGN > 0 include thrust misalignment angles
PCFTH	NO	1404	1	YES	Fractional increase in total impulse
CISP	NO	1414	1	YES	Specific impulse (sec) must be greater than zero
DWT	NO	1415	1	YES	Total store and propellant weight.
DWP	NO	1416	1	YES	Total propellant weight.
RDCGO	NO	1417	1	YES	Launch value of c.g.

VARIABLE NAME	RESET TO ZERO	C storage Location	VARIABLE'S DIMENSION	INPUT	DEFINITION
RDCGF	NO	1418	1	YES	Final c.g.positon.
FMIXO FMIYO	NO NO	1419 1420	1 1 1	YES YES	Initial moments of inertia.
RLCGO	NO	1421	1	YES	Launch value of c.g.
RDELCG	YES	1308	1	NO	C.g.shift at each time.
DWP	YES	1409	1	NO	Weight of propellant used.
FTHRST	YES	1410	1	NO	Thrust value read in table.
FTHX FTHY FTHZ	YES YES YES	1411 1412 1413	1 1 1	NO NO NO	Thrust in body axis system because of thrust alignment.
RLCG	YES	1422	1	NO	C.g.location at each time.
DMASS	YES	1628	1	NO	Mass of store and propellant.

9. D11

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
VTARG	YES	1643	1	NO	Aircraft total velocity.
RXO RYO RZO	YES YES YES	1668 1669 1670	1 1 1	NO NO NO	Initial position of store WRT earth axis system.

10. D1

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
AGRAV	NO	1627	1	YES	Gravity
VXED VXE VYED VYE VZED VZE	YES YES YES YES YES YES	1600 1603 1604 1607 1608 1611	1 1 1 1 1 1	NO NO NO NO NO NO	Three components of velocity and accelerations of the store with respect to the earth axis system.
RXED RXE RYED RYE RZED RZE	YES NO YES NO YES NO	1612 1615 1616 1619 1620 1623	1 1 1 1 1 1	NO YES NO YES NO YES	Three components of position and velocity of the store WRT the earth axis system.

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
RTXED	NO	1648	1	NO	Three components of position and velocity of the aircraft WRT earth axis system.
RTXE	NO	1651	1	YES	
RTYED	NO	1652	1	NO	
RTYE	NO	1655	1	YES	
RTZED	NO	1656	1	NO	
RTZE	NO	1659	1	YES	
VTXE	NO	1660	1	NO	Three components of velocity of aircraft WRT earth axis system.
VTYE	NO	1661	1	NO	
VTZE	NO	1662	1	NO	
AXBA	NO	1624	1	NO	Three components of acceleration of the store WRT the body axis system.
AYBA	NO	1625	1	NO	
AZBA	NO	1626	1	NO	
VDELX	NO	1632	1	NO	The separation velocity of the store from the aircraft WRT earth axis system
VDELY	NO	1633	1	NO	
VDELZ	NO	1634	1	NO	
RDELX	NO	1635	1	NO	The separation distance of the store from the aircraft WRT earth axis system.
RDELY	NO	1636	1	NO	
RDELZ	NO	1677	1	NO	
DELX	NO	70	1	NO	Separation distance of the aircraft from the store WRT earth axis system.
DELY	NO	71	1	NO	
DELZ	NO	72	1	NO	

11. D2I

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
BPHIO	NO	1752	1	YES	Euler angles that located the body axis at time T=0 from the earth axis system.
BTHTO	YES	1753	1	YES	
BPSIO	YES	1754	1	YES	

12. D2

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
CRAD	NO	1751	1	YES	57.3
OPTN3	NO	3504	1	YES	OPTN3>0 roll acceleration is locked to zero.
CFA11D	YES	1700	1	NO	Elements and their derivative of the matrix that orients the body axis WRT the earth axis system.
CFA11	YES	1703	1	NO	
CFA12D	YES	1704	1	NO	
CFA12	YES	1707	1	NO	
CFA13D	YES	1708	1	NO	
CFA13	YES	1711	1	NO	
CFA21D	YES	1712	1	NO	
CFA21	YES	1715	1	NO	
CFA22D	YES	1716	1	NO	
CFA22	YES	1719	1	NO	
CFA23D	YES	1720	1	NO	
CFA23	YES	1723	1	NO	
CFA31D	YES	1724	1	NO	
CFA31	YES	1727	1	NO	

VARIABLE NAME	RESET TO ZERO	C STORAGE LOCATION	VARIABLE'S DIMENSION	INPUT	DEFINITION
CFA32D	YES	1728	1	NO	Elements and their derivatives of the e matrix that orients the body axis WRT the earth axis system
CFA32	YES	1731	1	NO	
CFA33D	YES	1732	1	NO	
CFA33	YES	1735	1	NO	
WPD	YES	1736	1	NO	Roll, pitch and yaw Euler angle velocities and accelerations.
WP	NO	1739	1	YES	
WQD	YES	1740	1	NO	
WQ	NO	1743	1	YES	
WRD	YES	1744	1	NO	
WR	NO	1747	1	YES	

APPENDIX IV

INPUT DATA

1. TYPE I CARDS (See Figure IV-1)

Type 1 cards determine which output and staging subroutines will be called. The value located in columns 20 to 25 (I5 Format) is the determining factor. Under normal operation there should be the following type 1 cards:

Column 2	Columns 9 to 15	Column 25
1	OUPT 2,3	3
1	STAG 2,3	4

These two cards will allow SUBL2 to call STAG2 and OUPT2 and SUBL3 to call STAG3 and OUPT3.

2. TYPE 2 CARDS (See Figure IV-1)

Type 2 cards determine which regular or functional subroutines are called and the order of calling. The value located in columns 20 to 25 (I5 Format) is the determining factor. Under normal operation, there should be the following type 2 cards.

Column 2	Columns 9 to 15	(Right-Hand Justified) Columns 20 to 25
2	G2	23
2	G3	24
2	G5	26
2	A1	2
2	A3	4
2	A2	3
2	D1	17
2	D2	18

These type 2 cards will allow subroutines AUXI and AUXSUB to call subroutines G2, G3, G5, A1, A3, A2, D1, D2 in consecutive order.

3. TYPE 3 CARDS (See Figure IV-1)

Type 3 cards can initialize any variable found in the C array. To keep the input list short and simple, the core of the computer should be cleared to zero by a control card; or a loop that zeros the entire C array

DESCRIPTION	TYPE	VARIABLE NAME			C LOCATION		VARIABLE'S VALUE	RESET FLAG
COLUMN NO.	2	3	9	20	21 25		31 45	46 60
FORMAT	I2	A6	A6	A6	I5	5X	E15.9	E15.9
	1	XX	XX	XX	XXXXX		BLANK	BLANK
	2	XX	XX	XX	XXXXX		BLANK	BLANK
	3	XX	XX	XX	XXXXX		XXXXX	OPTIONAL
	4	--	XX	XX	XXXX		BLANK	BLANK
	7	--	XX	XX	XXXX		BLANK	BLANK
	6	BLANK			BLANK		BLANK	BLANK

Figure IV-1. Format for Input Cards

should be inserted at the beginning of the program. This will initialize all variables to zero and only non-zero variables will have to be read in by type 3 cards. An exception to this occurs for multiple runs. Any input variable that is initially zero, but has its value calculated during the trajectory and is not set to zero in RESET SUBROUTINE, must be either read in initially as zero and have the reset parameter 1. punched in columns 46 through 61 or be read in as zero for each run after the first. The reset parameter allows the initial value of the variable to be stored in the VALUE array, and at the end of each run, the parameters are reinitialized to the initial value.

For normal operation, the following type 3 cards should be included: (See Figure IV-1)

Column 2	Columns 9 to 15	Columns 20 to 25	Columns 31 to 45	Columns 46 to 61
3	TF	2001	--	--
3	T	2000	0.	1.
3	REPPLT	2006	1.	0.
3	PPP	2005	--	0.
3	CPP	2015	.1	--
3	DOC	2013	6.	1.
3	DER (1)	2664	.002	0.
3	OPTN4	3502	0.	0.
3	AGRAV	1627	32.174	0.
3	CRAD	1751	57.29577	0.
3	WP	1739	0.	1.
3	WQ	1743	0.	1.
3	WR	1747	0.	1.
3	RXE	1615	0.	1.
3	RYE	1619	0.	1.
3	RZE	1623	--	1.
3	RTXE	1651	0.	1.
3	RTYE	1655	0.	1.
3	RTZE	1659	--	--
3	EFORCX	1326	--	0.
3	EFORCY	1327	--	0.
3	EFORCZ	1328	--	0.
3	EMOMX	1329	--	0.
3	EMOMY	1330	--	0.
3	EMOMZ	1331	--	0.
3	EFT	1332	--	0.
3	EJD	1333	--	--
3	VMACH	204	--	--
3	CAA	1274	--	--
3	CNAA	1273	--	--
3	CMAA	1272	--	--

Column 2	Columns 9 to 15	Columns 20 to 25	Columns 31 to 45	Columns 46 to 61
3	CMQ	1207	--	0
3	CNR	1208	--	0
3	CLP	1206	--	0
3	ALPHAO	381	--	--
3	DIASC	69	--	--
3	TNOSOS	58	--	--
3	OPTNW	50	1.	1.
3	FMIYO	1419	--	0
3	FMIYO	1420	--	0
3	XTAIL	57	-4.	0.
3	XNOSE	59	2.17	0
3	XNOSE1	73	--	1.
3	RFLGTH	1307	--	0
3	RFAREA	1306	--	0.
3	DWT	1415	--	0
3	DWP	1416	1.	0
3	CISP	1414	1.	0
3	XINTER	1252	-1.0	1.
3	STEP	2010	--	--
3	XPOS	54	--	--
3	YPOS	55	--	--
3	ZPOS	56	--	--

OTHER POSSIBLE INPUTS

OPTN10	2022
PTLESS	2007
RKUTTA	1972
COUNTE	42
RLUG	1316
RAIL	1317
BALPHT	1401
BPHIT	1402
QNALGN	1403
PCFTH	1404
RDCGO	1417
RDCGF	1418
BPHIO	1752
BPHTO	1753
BPSIO	1754
OPTN3	3504
PLOTN2	1983
PLOTN4	1982
PLOTNO	2008

dimensional variables

length = ft

area = ft^2

weight = lb

moment of inertia = slug - ft^2

angles = degrees

4. TYPE 4 CARDS (See Figure IV-1)

Type 4 cards control the variables which have values that are printed out at regular periods of time (CPP). The variables are printed five per line in the order in which these cards appear in the deck. The label appearing in columns 9 to 20 is used as a header regardless of the "Program Name" of the variable. The C storage location of the variable appears in columns 21 to 25. A maximum of 50 such cards are allowed.

5. TYPE 7 CARDS (See Figure IV-1)

Type 7 cards control the variables to be plotted using the SC4020 microfilm plotter (hard copy). Labels and identification are the same as type 4 cards. If four variables are to be plotted such as (RXE, RZE, RTXE, RTZE), then they are set up on type 7 cards and PLOTN4 is set to 4. The variables on the first and third type 7 cards lie on the abscissa and the second and fourth on the ordinate. PLOTN4 can be set to 0; in which case, the program will expect the first type 7 card to be a PLOTN2 variety.

PLOTN2 is another full page plot option available for plotting one or more variables (ordinates) versus a single variable (abscissa). The program variable "PLOTN2" is set to the number of variables involved and the type 7 cards are placed directly after the seven cards that defined the PLOTN4 variables. The remaining variables are plotted three to a frame, versus time, where the variable PLOTNO must equal the total number of type 7 cards or plotted variables (15 maximum). The plotting interval in seconds is controlled by the input data parameter PPP. The total number of plotting points for each variable must be less than 300.

6. CARD ORDER FOR MULTIPLE RUNS

RUN 1	TYPE 1 TYPE 2 TYPE 3 TYPE 4 TYPE 7 TYPE 6
RUN 2	TYPE 3 TYPE 6
RUN 3	TYPE 3 TYPE 6
	ETC.

APPENDIX V

EXAMPLE 1

The first example is a multiple run that simulates the trajectory of an M-117 bomb from the bottom station of the triple ejector rack (T3). The flow field data used in simulating the trajectories were collected in the presence of M-117 bombs in configuration T3 at M=.85 and angle of attack = 0.3. The first trajectory occurs at M=.85 and angle = 0.3 degree. All the scale factors are 1.. The second launch occurs at M=.5. The ejector force is 1200 pounds and acts until the bomb is 0.255 foot down from its initial position. The trajectory is allowed to run for only 1 second.

EXAMPLE I. PROGRAM TEXT


```
      PROGRAM SIXD(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,FILMPL)
C
C*****DIMODS TO BE USED WITH FORTRAN AMRK INTEGRATION ROUTINE
C
      COMMON     C(3510)           ,GRAPH              ,TEMPS(1000)
      EQUIVALENCE (C(2662),HMIN   ), (C(2663),HMAX   ), (C(2664),DER    ),
     C            (C(2561),N      ), (C(2562),IPL    ), (C(2965),VAR    ),
     C            (C(2000),T      ), (C(2011),KSTEP  ), (C(2010),STEP   ),
     C            (C(2012),LSTEP  ), (C(2008),PLOTNO ), (C(2009),NOPLOT ),
     C            (C(2023),OPOINT ), (C(2025),TIME   ), (C(2325),VLABLE ),
     C            (C(3167),NOOUT  ), (C(2022),OPTN10 ), (C(2006),REPPLT ),
     C            (C(2865),EU     ), (C(2765),EL     ), (C(2007),PTLESS)
      EQUIVALENCE                    (C(1971),RITE   ), (C(1972),RKUTTA)
      EQUIVALENCE (C(1973),KASE   ), (C(1974),NJ     ), (C(1975),NPT    )
      DIMENSION   GRAPH(300,15)    , TIME(300)
      DIMENSION   VLABLE(2,15)     , IPL(100)          , DER(101)
      DIMENSION   VAR(101)         , EL(100)           , EU(100)
      EQUIVALENCE (C(1980),RN     )
      EQUIVALENCE (C(1981),RNT    )
      EQUIVALENCE (C(1982),PLOTN4)
      EQUIVALENCE (C(1983),PLOTN2)
      EQUIVALENCE (C(1984),NPLOT )
      INTEGER OPOINT
C     INTEGER OPT
      EXTERNAL AUXSUB
      NPT=2
      CALL COUNTV
 1000 CALL ZERO
 1001 NPT=2
      IF(PLOTNO.LE.0.) GO TO 7
      IF(REPPLT.GT.0.)GOTO7
C
C                             REPPLT = 0.   USE NEW NO.4,7 (DISCARD OLD)
C                                      1.   USE OLD PLUS THOSE ADDED
C                                     -1.   USE NEW NO. 7 (DISCARD OLD)
      IF (REPPLT.GT.-1.0) NOOUT = 0
      NPLOT=0
    7 CALL OINPT1
      KASE=0
      IF(RKUTTA.GT.0.0) NPT=1
      LSTEP = STEP
      NPLOT4=PLOTN4
      NPLOT2=PLOTN2
      NOPLOT=PLOTNO
 1002 CONTINUE
 1003 CALL  AUXI
 1004 CALL  SUBL2
 1005 DO 60 I = 2,N
      J = IPL(I-1)
      EL(I-1)=C(J+1)
      EU(I-1)=C(J+2)
      VAR(I) = C(J+3)
   60 DER(I) = C(J)
      VAR(1) = T
 1006 CALL   AUXSUB
```

```
 1007 NJ=N-1
      CALL AMRK(AUXSUB)
 1008 DO 50 I = 2, N
      J = IPL(I-1)
   50 C(J+3) = VAR(I)
      T = VAR(1)
 1009 CALL  SUBL3
      IF ( KSTEP .EQ. 1 ) GO TO 1007
      DO 155 JV=2,N
  155 VAR(JV)=0.
      CALL RESET
      IF(LSTEP.EQ.5.OR.LSTEP.EQ.7.OR.NOPLOT.EQ.0)GOTO5
      CALL TIMEV(DELT)
      WRITE(6,96)DELT
   96 FORMAT(1H ,17HSTART PLOTTING ATF14.7)
      LESSPT=PTLESS
      OPOINT=OPOINT-LESSPT
      CALL PLOT4(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL PLOT2(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL PLOTN(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL TIMEV(DELT)
      WRITE(6,97)DELT
   97 FORMAT(1H ,18HPLOTTING ENDED AT F14.7)
      IF((RNT.GT.0.1 .AND. RN.EQ.RNT).AND. LSTEP.EQ.2)GO TO 70
    5 GO TO (1000,1001,1002,1003,1004,1005,1006,1007,1008,1009,1010),
     1 LSTEP
 1010  IF(OPTN10.GT.0.) CALL DUMPO
   70 CALL S8
      CALL EXIT
      END
```

```
      BLOCK DATA CCL2
      COMMON/NCL2/NCL2(4)
     *     /CL2ARG/ALP(7),AM(5)
     *      /CL2FUN/CL2(35)
      DATA NCL2/7,5,0,0/
      DATA ALP/0., 4., 8., 12., 16., 20.,50./
      DATA AM/0., .6, .9, 1.1, 1.4/
      DATA CL2/
     * 0., .05, .05, .05, .05, .05, .05,
     * 0., .05, .05, .05, .05, .05, .05,
     * 0., .05, .05, .05, -.1, -.05, -.05,
     * 0., .05, .10, 0., -.15, -.4, -.6,
     * 0., .05, .1, -.05, -.2 , -.55, -.8/
      END
```

```
      BLOCK DATA CXOO
      COMMON /NCXO/NCXO(2)
     *       /CXOARG/AM(8)
     *       /CXOFUN/CXO(8)
      DATA NCXO/8,0/
      DATA AM/0., .75, .85, .95, 1., 1.1, 1.2, 1.4/
      DATA CXO/
     * .06, .074, .074,  .14, .14, .14, .14, .14/
      END
```

```
      BLOCK DATA THST
      COMMON/NTH/NTH(2)
     *      /THARG/THA(13)
     *      /THFUN/THF(13)
      DATA NTH/13,0/
      DATA THA/
     *0.0, .08,.16, .4, .56, .72, .8, 1.6, 2.4, 4., 4.8, 5.6, 100./
      DATA THF/
     *0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0./
      END
```

```
      BLOCK DATA VZC
      COMMON/NVZ/NVZ(3)
     *     /VZARG/YLOP(7),ZLOP(9),XLOP(10)
     *     /VZFUN/VZ1(63),VZ2(63),VZ3(63),VZ4(63),VZ5(63),VZ6(63),VZ7(63)
     *  ,VZ8(63),VZ9(63),VZ10(63)
      DATA NVZ/7,9,10/
      DATA YLOP/1.,2.,3.,4.,5.,6.,7./
      DATA ZLOP/1.,2.,3.,4.,5.,6.,7.,8.,9./
      DATA XLOP/9.,10.,11.,12.,13.,14.,15.,16.,17.,20./
        DATA VZ1/
     C     -.010, -.085, -.159,  .025,  .001,  .002,  .003,
     C     -.028, -.045, -.039, -.025, -.012, -.003, -.001,
     C     -.025, -.029, -.028, -.022, -.012, -.007, -.005,
     C     -.020, -.022, -.023, -.018, -.014, -.008, -.004,
     C     -.017, -.019, -.019, -.017, -.012, -.005, -.002,
     C     -.014, -.017, -.016, -.015, -.009, -.003, -.001,
     C     -.011, -.012, -.012, -.011, -.006, -.002, -.001,
     C     -.009, -.008, -.008, -.007, -.005, -.001, -.002,
     C     -.005, -.006, -.005, -.005, -.004,  .000, -.001/
        DATA VZ2/
     C      .026,  .035,  .045,  .026,  .011,  .009,  .007,
     C     -.002, -.013, -.019, -.026, -.010, -.002, -.000,
     C     -.012, -.018, -.024, -.025, -.017, -.010, -.007,
     C     -.015, -.019, -.024, -.023, -.019, -.011, -.006,
     C     -.015, -.018, -.021, -.020, -.016, -.008, -.004,
     C     -.013, -.016, -.017, -.016, -.011, -.005, -.002,
     C     -.010, -.012, -.013, -.012, -.007, -.003, -.002,
     C     -.008, -.008, -.008, -.008, -.006, -.001, -.002,
     C     -.004, -.006, -.005, -.005, -.004,  .000, -.001/
        DATA VZ3/
     C      .024,  .068,  .111, -.130,  .024,  .017,  .010,
     C     -.004, -.021, -.063, -.130, -.051, -.012, -.003,
     C     -.016, -.031, -.061, -.083, -.054, -.025, -.012,
     C     -.017, -.028, -.041, -.046, -.038, -.022, -.011,
     C     -.016, -.022, -.028, -.030, -.024, -.014, -.007,
     C     -.013, -.018, -.020, -.020, -.015, -.007, -.004,
     C     -.010, -.013, -.013, -.013, -.009, -.004, -.002,
     C     -.008, -.008, -.008, -.008, -.006, -.002, -.002,
     C     -.004, -.005, -.004, -.005, -.004,  .000, -.001/
        DATA VZ4/
     C      .006,  .036,  .066, -.254,  .028,  .019,  .010,
     C     -.013, -.036, -.138, -.254, -.113, -.021, -.004,
     C     -.021, -.044, -.100, -.145, -.089, -.033, -.014,
     C     -.020, -.033, -.052, -.061, -.046, -.026, -.012,
     C     -.016, -.023, -.030, -.033, -.026, -.014, -.006,
     C     -.012, -.017, -.019, -.020, -.014, -.006, -.003,
     C     -.008, -.011, -.012, -.012, -.007, -.003, -.001,
     C     -.006, -.006, -.007, -.006, -.004, -.000, -.001,
     C     -.002, -.004, -.003, -.003, -.002,  .002,  .000/
        DATA VZ5/
     C     -.002, -.011, -.021, -.022, -.022, -.010,  .002,
     C     -.014, -.032, -.019, -.022,  .012, -.011, -.003,
     C     -.015, -.024, -.031, -.020, -.017, -.009, -.005,
     C     -.013, -.017, -.021, -.018, -.015, -.007, -.003,
     C     -.010, -.013, -.015, -.013, -.010, -.003,  .000,
```

```
      C     -.007, -.010, -.010, -.009, -.005,  .000,  .002,
      C     -.005, -.006, -.006, -.006, -.002,  .002,  .002,
      C     -.003, -.003, -.003, -.002, -.001,  .003,  .002,
      C      .000, -.001, -.000, -.000,  .000,  .004,  .002/
       DATA VZ6/
      C      .001, -.031, -.063,  .089, -.060, -.034, -.007,
      C     -.006, -.018,  .016,  .089,  .045, -.005, -.002,
      C     -.004, -.000,  .020,  .048,  .029,  .010,  .001,
      C     -.002,  .002,  .010,  .017,  .014,  .008,  .005,
      C     -.002, -.000,  .003,  .006,  .006,  .008,  .007,
      C     -.001, -.002,  .000,  .001,  .004,  .008,  .007,
      C     -.000, -.001,  .000,  .001,  .004,  .007,  .006,
      C      .000,  .001,  .002,  .002,  .003,  .006,  .005,
      C      .002,  .002,  .003,  .002,  .003,  .006,  .004/
       DATA VZ7/
      C      .005, -.027, -.059,  .075, -.063, -.039, -.014,
      C     -.001, -.012,  .000,  .075,  .029, -.007, -.004,
      C      .001,  .005,  .025,  .045,  .032,  .011,  .002,
      C      .003,  .008,  .016,  .022,  .018,  .012,  .008,
      C      .003,  .006,  .009,  .011,  .011,  .012,  .010,
      C      .003,  .003,  .005,  .006,  .009,  .011,  .010,
      C      .003,  .003,  .005,  .005,  .008,  .010,  .008,
      C      .003,  .004,  .005,  .005,  .006,  .009,  .007,
      C      .005,  .004,  .006,  .005,  .006,  .009,  .006/
       DATA VZ8/
      C      .000, -.028, -.056,  .061, -.046, -.034, -.021,
      C     -.001, -.009,  .000,  .061,  .020, -.006, -.006,
      C      .002,  .005,  .020,  .038,  .027,  .009,  .001,
      C      .005,  .008,  .014,  .020,  .016,  .012,  .007,
      C      .005,  .007,  .010,  .012,  .012,  .013,  .011,
      C      .005,  .005,  .007,  .008,  .010,  .013,  .011,
      C      .005,  .006,  .006,  .007,  .010,  .012,  .010,
      C      .005,  .006,  .007,  .007,  .008,  .011,  .008,
      C      .007,  .006,  .007,  .007,  .007,  .010,  .008/
       DATA VZ9/
      C     -.003, -.020, -.038,  .042, -.030, -.026, -.022,
      C      .001, -.004, -.000,  .042,  .016, -.005, -.006,
      C      .004,  .006,  .015,  .028,  .021,  .008,  .001,
      C      .006,  .009,  .013,  .017,  .014,  .012,  .008,
      C      .007,  .008,  .010,  .011,  .011,  .014,  .012,
      C      .007,  .007,  .008,  .009,  .011,  .014,  .012,
      C      .007,  .007,  .008,  .008,  .011,  .013,  .011,
      C      .007,  .008,  .008,  .009,  .009,  .012,  .010,
      C      .008,  .008,  .009,  .008,  .009,  .011,  .009/
       DATA VZ10/
      C      .004,  .003,  .002,  .039, -.014, -.014, -.014,
      C      .007,  .006,  .009,  .039,  .019,  .000, -.002,
      C      .008,  .010,  .016,  .027,  .021,  .011,  .004,
      C      .010,  .012,  .014,  .018,  .015,  .013,  .010,
      C      .010,  .010,  .011,  .012,  .012,  .015,  .013,
      C      .009,  .009,  .010,  .010,  .012,  .015,  .014,
      C      .009,  .009,  .009,  .009,  .012,  .014,  .012,
      C      .008,  .009,  .010,  .010,  .010,  .013,  .011,
      C      .010,  .009,  .010,  .009,  .010,  .013,  .010/
       END
```

```
      BLOCK DATA VYC
      COMMON/NVY/NVY(3)
     *     /VYARG/YLOP(7),ZLOP(9),XLOP(10)
     *     /VYFUN/VY1(63),VY2(63),VY3(63),VY4(63),VY5(63),VY6(63),VY7(63)
     *  ,VY8(63),VY9(63),VY10(63)
      DATA NVY/7,9,10/
      DATA YLOP/1.,2.,3.,4.,5.,6.,7./
      DATA ZLOP/1.,2.,3.,4.,5.,6.,7.,8.,9./
      DATA XLOP/9.,10.,11.,12.,13.,14.,15.,16.,17.,20./
       DATA VY1/
     C    -.043, -.023,  .016,  .027,  .039,  .035,  .032,
     C    -.018, -.004,  .024,  .028,  .032,  .033,  .030,
     C    -.007, -.000,  .011,  .019,  .025,  .023,  .022,
     C    -.003,  .002,  .007,  .012,  .013,  .015,  .018,
     C     .000,  .002,  .005,  .008,  .011,  .014,  .017,
     C    -.003,  .000,  .004,  .008,  .011,  .013,  .014,
     C    -.004,  .000,  .004,  .007,  .010,  .011,  .011,
     C    -.003, -.001,  .003,  .006,  .008,  .008,  .009,
     C    -.003,  .000,  .002,  .004,  .006,  .006,  .008/
       DATA VY2/
     C    -.017, -.043, -.096, -.026,  .044,  .039,  .037,
     C    -.022, -.019,  .000,  .017,  .034,  .039,  .035,
     C    -.014, -.011, -.001,  .013,  .026,  .028,  .026,
     C    -.008, -.005,  .001,  .009,  .014,  .018,  .020,
     C    -.003, -.002,  .002,  .006,  .011,  .015,  .018,
     C    -.005, -.002,  .002,  .007,  .011,  .013,  .014,
     C    -.005, -.001,  .003,  .007,  .010,  .011,  .011,
     C    -.003, -.001,  .002,  .006,  .007,  .008,  .009,
     C    -.003, -.000,  .002,  .003,  .005,  .006,  .008/
       DATA VY3/
     C    -.029, -.085, -.196, -.036,  .125,  .076,  .051,
     C    -.038, -.058, -.072,  .015,  .103,  .073,  .050,
     C    -.026, -.032, -.026,  .014,  .051,  .047,  .036,
     C    -.015, -.014, -.007,  .009,  .022,  .026,  .025,
     C    -.006, -.005, -.001,  .006,  .013,  .018,  .020,
     C    -.007, -.003,  .001,  .006,  .012,  .014,  .015,
     C    -.006, -.002,  .002,  .006,  .010,  .011,  .011,
     C    -.004, -.002,  .002,  .005,  .007,  .008,  .009,
     C    -.003, -.000,  .001,  .003,  .005,  .006,  .007/
       DATA VY4/
     C    -.040, -.102, -.227, -.014,  .200,  .105,  .058,
     C    -.046, -.084, -.211,  .008,  .227,  .099,  .055,
     C    -.030, -.043, -.048,  .014,  .071,  .057,  .038,
     C    -.016, -.017, -.011,  .009,  .025,  .027,  .025,
     C    -.007, -.006, -.002,  .005,  .013,  .017,  .019,
     C    -.006, -.003,  .001,  .006,  .011,  .013,  .013,
     C    -.005, -.002,  .001,  .005,  .009,  .010,  .010,
     C    -.004, -.002,  .001,  .005,  .006,  .007,  .008,
     C    -.003, -.000,  .001,  .003,  .005,  .005,  .007/
       DATA VY5/
     C    -.022, -.041, -.079, -.004,  .071,  .047,  .035,
     C    -.024, -.027,  .049,  .011, -.027,  .030,  .029,
     C    -.013, -.011, -.000,  .015,  .021,  .021,  .019,
     C    -.006, -.004,  .002,  .007,  .010,  .011,  .013,
     C    -.001, -.001,  .002,  .004,  .007,  .009,  .012,
```

```
      C     -.003, -.001,  .001,  .004,  .007,  .009,  .010,
      C     -.003, -.001,  .002,  .004,  .007,  .008,  .008,
      C     -.003, -.001,  .001,  .004,  .005,  .006,  .006,
      C     -.003,  .000,  .001,  .003,  .004,  .005,  .006/
        DATA VY6/
      C      .006,  .028,  .071,  .026, -.019,  .004,  .016,
      C      .002,  .021,  .119,  .012, -.096, -.016,  .007,
      C      .006,  .016,  .031,  .011, -.013, -.008,  .001,
      C      .005,  .009,  .012,  .006, -.003, -.004,  .002,
      C      .005,  .006,  .005,  .003,  .001,  .002,  .005,
      C      .001,  .002,  .003,  .004,  .005,  .005,  .005,
      C     -.001,  .001,  .003,  .005,  .006,  .006,  .005,
      C     -.001, -.000,  .002,  .005,  .005,  .005,  .004,
      C     -.002,  .001,  .002,  .003,  .003,  .004,  .004/
        DATA VY7/
      C      .017,  .039,  .082,  .017, -.047, -.008,  .012,
      C      .010,  .023,  .103,  .007, -.088, -.021,  .001,
      C      .012,  .020,  .032,  .007, -.016, -.014, -.005,
      C      .009,  .013,  .013,  .005, -.007, -.009, -.003,
      C      .008,  .008,  .007,  .002, -.002, -.002,  .001,
      C      .003,  .003,  .004,  .004,  .003,  .003,  .003,
      C      .001,  .002,  .004,  .005,  .005,  .004,  .003,
      C      .000,  .001,  .003,  .004,  .004,  .004,  .003,
      C     -.001,  .002,  .003,  .003,  .003,  .003,  .004/
       DATA VY8/
      C      .018,  .034,  .068,  .007, -.054, -.012,  .009,
      C      .009,  .018,  .078,  .005, -.067, -.019,  .000,
      C      .011,  .017,  .026,  .007, -.014, -.014, -.006,
      C      .009,  .012,  .011,  .003, -.007, -.009, -.004,
      C      .008,  .007,  .005,  .001, -.003, -.003, -.000,
      C      .003,  .003,  .004,  .003,  .002,  .001,  .001,
      C      .001,  .002,  .003,  .004,  .004,  .003,  .002,
      C      .000,  .001,  .003,  .004,  .003,  .003,  .002,
      C     -.001,  .001,  .002,  .002,  .002,  .002,  .003/
        DATA VY9/
      C      .017,  .033,  .065,  .016, -.032, -.008,  .003,
      C      .006,  .012,  .057,  .004, -.049, -.015, -.001,
      C      .008,  .012,  .018,  .005, -.010, -.012, -.006,
      C      .007,  .009,  .008,  .002, -.007, -.009, -.005,
      C      .008,  .006,  .004,  .000, -.003, -.004, -.001,
      C      .003,  .002,  .003,  .002,  .001,  .001,  .001,
      C      .000,  .002,  .003,  .003,  .004,  .002,  .001,
      C     -.000,  .001,  .002,  .003,  .003,  .002,  .001,
      C     -.000,  .001,  .002,  .002,  .002,  .002,  .002/
       DATA VY10/
      C      .018,  .034,  .066,  .019, -.028, -.011, -.002,
      C      .005,  .008,  .041,  .001, -.040, -.013, -.002,
      C      .005,  .008,  .013,  .003, -.010, -.011, -.007,
      C      .005,  .006,  .005,  .000, -.008, -.010, -.005,
      C      .006,  .004,  .002, -.001, -.004, -.004, -.002,
      C      .002,  .002,  .002,  .001,  .001, -.000, -.000,
      C     -.000,  .001,  .002,  .003,  .003,  .001,  .000,
      C      .000,  .000,  .002,  .003,  .002,  .001,  .001,
      C     -.001,  .001,  .001,  .002,  .001,  .001,  .001/
       END
```

```
      SUBROUTINE G2
C**WINO AND GUSTS MOOULE
      COMMON C(3510)
      COMMON/NVZ/NVZ/VZARG/VZA/VZFUN/VZF
     */NVY/NVY/VYARG/VYA/VYFUN/VYF
C**INPUT OATA
      EQUIVALENCE (C(  50),OPTNW )
      EQUIVALENCE (C(204),VMACH)
      EQUIVALENCE (C(120),PPP1)
      EQUIVALENCE (C(121),CPP1)
      EQUIVALENCE (C(122),OER1)
      EQUIVALENCE (C(123),XTL)
      EQUIVALENCE (C(124),XLL)
      EQUIVALENCE (C(125),YTL)
      EQUIVALENCE (C(126),YLL)
      EQUIVALENCE (C(127),ZTL)
      EQUIVALENCE (C(128),ZLL)
C**OUTPUT OATA
      EQUIVALENCE (C( 100),VWXE   )
      EQUIVALENCE (C( 101),VWYE   )
      EQUIVALENCE (C( 102),VWZE   )
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE(C(1635),ROELX)
      EQUIVALENCE(C(1636),ROELY)
      EQUIVALENCE(C(1637),ROELZ)
      EQUIVALENCE(C(54),XPOS)
      EQUIVALENCE(C(55),YPOS)
      EQUIVALENCE(C(56),ZPOS)
      EQUIVALENCE(C(57),XTAIL      )
      EQUIVALENCE(C(1648),RTXEO)
      EQUIVALENCE(C(47),PWY2)
      EQUIVALENCE(C(46),PWY3)
      EQUIVALENCE(C(45),YLUN)
      EQUIVALENCE(C(44),ZLUN)
      EQUIVALENCE(C(58),TNOSOS)
      EQUIVALENCE(C(59),XNOSE)
      EQUIVALENCE(C(60),AAN)
      EQUIVALENCE(C(61),ASN)
      EQUIVALENCE (C(62),PWZ1)
      EQUIVALENCE (C(63),PWY1)
      EQUIVALENCE(C(43),CLMT)
      EQUIVALENCE (C(48),CROFLO)
      EQUIVALENCE(C(42),COUNTE)
      EQUIVALENCE(C(41),OBSTAL)
      EQUIVALENCE (C(67),XLUN)
      EQUIVALENCE (C(69),DIASC)
      EQUIVALENCE (C(90), XNPOS)
      EQUIVALENCE (C(91), YNPOS)
      EQUIVALENCE (C(92), ZNPOS)
      EQUIVALENCE (C(93), XTPOS)
      EQUIVALENCE (C(94), YTPOS)
      EQUIVALENCE (C(95), ZTPOS)
      EQUIVALENCE (C(1703),CFA11)
      EQUIVALENCE (C(1707),CFA12)
      EQUIVALENCE (C(1711),CFA13)
```

```
      XT=CFA11*XTAIL
      YT=CFA12*XTAIL
      ZT=CFA13*XTAIL
      XN=CFA11*XNOSE
      YN=CFA12*XNOSE
      ZN=CFA13*XNOSE
      XNPOS=RDELX -XN
      YNPOS=-RDELY +YN
      ZNPOS= -RDELZ + ZN
      XTPOS=RDELX -XT
      YTPOS=-RDELY +YT
      ZTPOS= -RDELZ + ZT
      IF(COUNTE .EQ.1.) RETURN
      IF(COUNTE.EQ.2.) GO TO 10
      IF(OPTNW.LE.0.) GO TO 10
      XLUN=(+RDELX-XN+XPOS) *.6
      YLUN=((-RDELY+YN)*DIASC  +YPOS)*.6
      ZLUN=((-RDELZ+ZN)*DIASC-ZPOS)*.6
      XLUP=(+RDELX-XT+XPOS) *.6
      YLUP=((-RDELY+YT)*DIASC +YPOS)*.6
      ZLUP=((-RDELZ+ZT)*DIASC-ZPOS)*.6
      PWZ1=0.0
      PWY1=0.0
      VWZE=0.
      VWYE=0.
      AAN=0.
      ASN=0.
      IF(XLUP.GT.XTL.OR.XLUP.LT.XLL) GO TO 10
      IF(YLUP.GT.YTL. OR.YLUP.LT.YLL) GO TO 10
      IF(ZLUP.GT.ZTL. OR.ZLUP.LT.ZLL) GO TO 10
      IF(XLUN.GT.XTL.OR.XLUN.LT.YLL) GO TO 112
      IF(YLUN.GT.YTL. OR.YLUN.LT.YLL) GO TO 112
      IF(ZLUN.GT.ZTL. OR.ZLUN.LT.ZLL) GO TO 112
      CALL TABL3 (YLUN,ZLUN,XLUN,VZA,VZF,NVZ,XINTER,4HPWZ1,PWZ1)
      CALL TABL3(YLUN,ZLUN,XLUN,VYA,VYF,NVY,XINTER,4HPWY1,PWY1)
      FFMC=2.3832*VMACH**2 - 2.0232*VMACH + .9966
      PWZ1=PWZ1*FFMC
      PWY1=PWY1*FFMC
      PWZ1=-PWZ1
      PWZ1=PWZ1/(TNOSOS*DIASC)
      PWY1=PWY1/(TNOSOS*DIASC)
      PWY2=PWY1
  112 CALL TABL3 (YLUP,ZLUP,XLUP,VZA,VZF,NVZ,XINTER,4HPWZE,PWZE)
      CALL TABL3  (YLUP,ZLUP,XLUP,VYA,VYF,NVY,XINTER,4HPWYE,PWYE)
      PWZE=-PWZE
      PWZE=PWZE*FFMC /(TNOSOS*DIASC)
      PWYE=PWYE*FFMC /(TNOSOS*DIASC)
      VWZE=(RTXED*PWZE)
      VWYE=(RTXED*PWYE)
      PWY3=PWY2-PWYE
      PWZ1=PWZ1-PWZE
      AAN=ASIN(PWZ1)
      ASN=ASIN(PWY3)
      RETURN
   10 VWXE = 0.
```

```
      VWYE = 0.
      VWZE = 0.
      AAN=0.
      ASN=0.
      COUNTE=1.
      C(2005)=PPP1
      C(2015)=CPP1
      C(2664)=DER1
      RETURN
      END
```

```
      C**AIR DATA MODULE G3
            SUBROUTINE G3
            COMMON C(3510)
      C**INPUT DATA
            EQUIVALENCE (C(0208),RHZRO )
      C**INPUTS FROM OTHER MODULES
            EQUIVALENCE (C(0100),VWXE   )
            EQUIVALENCE (C(0101),VWYE   )
            EQUIVALENCE (C(0102),VWZE   )
            EQUIVALENCE (C(1603),VXE    )
            EQUIVALENCE (C(1607),VYE    )
            EQUIVALENCE (C(1611),VZE    )
            EQUIVALENCE (C(1623),RZE   )
      C**INPUTS FROM MAIN PROGRAM
      C**STATE VARIABLE OUTPUTS
      C**NONE
      C**OTHER OUTPUTS
            EQUIVALENCE (C(0200),VMWXE )
            EQUIVALENCE (C(0201),VMWYE )
            EQUIVALENCE (C(0202),VMWZE )
            EQUIVALENCE (C(0203),PDYNMC)
            EQUIVALENCE (C(0204),VMACH )
            EQUIVALENCE (C(0205),DRHO  )
            EQUIVALENCE (C(0206),VSOUND)
            EQUIVALENCE (C(0207),VAIRSP)
            EQUIVALENCE (C(0209),RH    )
      C**CALCULATE PRESENT ALTITUDE
            RH= -RZE+RHZRO
      C**CALCULATE MISSILE VELOCITY WRT AIR MASS IN EARTH AXES
            VMWXE = VXE-VWXE
            VMWYE = VYE-VWYE
            VMWZE = VZE-VWZE
            VAIRSP = SQRT(VMWXE*VMWXE+VMWYE*VMWYE+VMWZE*VMWZE)
      C**AIR DENSITY, SPEED OF SOUND, DYNAMIC PRESSURE, AND MACH
            DRHO=(.076475)/(1.+.3325E-04*RH+RH*RH*RH*.02315E-12)
            VSOUND = -.00392*RH+1117.3
            PDYNMC = (DRHO*VAIRSP*VAIRSP)/64.344
            VMACH = VAIRSP/VSOUND
            RETURN
            END
```

```
      SUBROUTINE G4
C** ENO-OF-RUN CALCULATIONS SUBROUTINE G4
C** THIS IS A SUBROUTINE, NOT A MODULE.
C** IT IS CALLEO BY STAGE 3 TO COMPUTE MISS OISTANCE ANO STOP THE
C** PROGRAM IF RANGE IS ZERO.
C***********************************************************************
      COMMON C(3510)
C**INPUT OATA
C**NONE
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(1615),RXE    )
      EQUIVALENCE (C(1619),RYE    )
      EQUIVALENCE (C(1623),RZE    )
      EQUIVALENCE (C(2000),T      )
C**STATE VARIABLE OUTPUTS
C**NONE
C**OTHER OUTPUTS
      EQUIVALENCE (C(2020),LCONV )
C** MISS OISTANCE PARAMETERS ARE OUTPUT OIRECTLY ANO ARE NOT IN COMMON
C** TEST FOR INCREASING RANGE ANO SOLVE FOR TIME AT WHICH RANGE IS ZERO
    5 FORMAT (1H0, 16H MISS DISTANCE= 1PE17.8/1H0,13H TIME FINAL=
     C       1PE17.8)
    6 FORMAT (1H0,10X,10HXM  EARTH=1PE17.8,3X,10HYM  EARTH=1PE17.8,3X,
     C     10HZM  EARTH=1PE17.8)
    7 FORMAT (1H0,40X,10HY FLTPATH=1PE17.8,3X,10HZ FLTPATH=1PE17.8)
C** TEST FOR INCREASING RANGE ANO SOLVE FOR TIME AT WHICH RANGE IS ZERO
      IF(RZE.LT.0.0)    GO TO 10
      UXYZ=RZE/(RZE-UZE)
      RDY=RYE-(RYE-UYE)*UXYZ
      ROX=RXE-(RXE-UXE)*UXYZ
      RDZ=0.0
      TZERO=T-(T-UT)*UXYZ
      RMISS=SQRT(ROX**2 + ROY**2 + ROZ**2)
      WRITE (6,5) RMISS,TZERO
      WRITE (6,6) RDX,  RDY,  RDZ
      LCONV=2
      RETURN
   10 UT = T
      UXE = RXE
      UYE = RYE
      UZE = RZE
      IF (RZE .GT. 100.) LCONV = 2
      RETURN
      END
```

```
C**COORDINATE CONVERSION MODULE
      SUBROUTINE G5
      COMMON  C(3510)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(0200),VMWXE )
      EQUIVALENCE (C(0201),VMWYE )
      EQUIVALENCE (C(0202),VMWZE )
      EQUIVALENCE (C(1603),VXE   )
      EQUIVALENCE (C(1607),VYE   )
      EQUIVALENCE (C(1611),VZE   )
      EQUIVALENCE (C(1668),RXO   )
      EQUIVALENCE (C(1669),RYO   )
      EQUIVALENCE (C(1670),RZO   )
      EQUIVALENCE (C(1703),CFA11 )
      EQUIVALENCE (C(1707),CFA12 )
      EQUIVALENCE (C(1711),CFA13 )
      EQUIVALENCE (C(1715),CFA21 )
      EQUIVALENCE (C(1719),CFA22 )
      EQUIVALENCE (C(1723),CFA23 )
      EQUIVALENCE (C(1727),CFA31 )
      EQUIVALENCE (C(1731),CFA32 )
      EQUIVALENCE (C(1735),CFA33 )
      EQUIVALENCE (C(1739),WP    )
      EQUIVALENCE (C(1743),WQ    )
      EQUIVALENCE (C(1747),WR    )
      EQUIVALENCE (C(1751),CRAD  )
      EQUIVALENCE(C(3504),OPTN4)
C
C**OTHER OUTPUTS
      EQUIVALENCE (C(0350),BTHT  )
      EQUIVALENCE (C(0351),BPSI  )
      EQUIVALENCE (C(0352),BPHI  )
      EQUIVALENCE (C(0353),BTHTD )
      EQUIVALENCE (C(0354),BPSID )
      EQUIVALENCE (C(0355),BPHID )
      EQUIVALENCE (C(0356),VTOTE )
      EQUIVALENCE (C(0360),VMWU  )
      EQUIVALENCE (C(0361),VMWV  )
      EQUIVALENCE (C(0362),VMWW  )
      EQUIVALENCE (C(0367),BALPHA)
      EQUIVALENCE (C(0368),BALPHY)
      EQUIVALENCE (C(0369),BALPHP)
      EQUIVALENCE (C(0370),BPHIP )
      EQUIVALENCE (C( 380),RANGO )
      EQUIVALENCE(C(381),ALPHAO)
C
C**CALCULATION OF HEADING, PITCH, ROLL EULER ANGLES IN DEGREES
      BPHI = ATAND(CFA23,CFA33)
      BTHT = ATAND(-CFA13,SQRT(CFA11*CFA11+CFA12*CFA12))
      BPSI = ATAND(CFA12,CFA11)
C
      IF(COSD(BTHT).EQ.0.0) GO TO 5
      BPSID = (WQ*SIND(BPHI)+WR*COSD(BPHI))/COSD(BTHT)
5      CONTINUE
```

```
      BPHID = WP+BPSID*SIND(BTHT)
      BTHTD = WQ*COSD(BPHI)-WR*SIND(BPHI)
C
C**CALCULATION OF TOTAL VELOCITY
      VTOTE = SQRT(VXE*VXE+VYE*VYE+VZE*VZE)
C
      RANGD = SQRT( (RXE-RXD)**2 + (RYE-RYD)**2 + (RZE-RZD)**2)
C
      IF ((OPTN4 .GT. 0.).AND.(T .LT. DER)) GO TO 30
C**VELOCITY WRT AIR IN BODY AXES
      VMWU = CFA11*VMWXE+CFA12*VMWYE+CFA13*VMWZE
      VMWV = CFA21*VMWXE+CFA22*VMWYE+CFA23*VMWZE
      VMWW = CFA31*VMWXE+CFA32*VMWYE+CFA33*VMWZE
C
C**VERTICAL AND HORIZONTAL ANGLES OF ATTACK
      BALPHA = ATAND(VMWW,VMWU)
      BALPHA=BALPHA+ALPHAO
      BALPHY = ATAND(VMWV,VMWU)
C**ALPHA PRIME AND PHI PRIME (WIND TUNNEL AXES)
      IF ((BALPHA-BALPHY).EQ.0.) GO TO 30
      BPHIP = ATAND(BALPHY,BALPHA)
   30 BALPHP=SQRT(BALPHA**2+BALPHY**2)
      RETURN
      END
```

```
      SUBROUTINE A1
C
      COMMON C(3510)
C
C**TABLE LOOKUP FOR BOOY FORCE COEFFICIENTS
      COMMON /NCXO /NCXO /CXOARG/ CXOA /CXOFUN/ CXOF
     1        /NCXCP / NCX /CXARG /CXA /CXFUN /CXF
     2        /NCZ /NCN /CZARG /CNA /CZFUN /CNF
     3        /NOCZ/NCDCN /DCZARG/COCNA /OCZFUN/COCNF
     5        /NCY2 /NCY2 /CY2ARG/ CY2A /CY2FUN/ CY2F
C
C**TABLE LOOKUP FOR BODY MOMENT COEFFICIENTS
     1        /NCL2/NCL2   /CL2ARG/ CL2A    /CL2FUN/ CL2F
     2        /NCL3/ NCL3   /CL3ARG/ CL3A    /CL3FUN/ CL3F
     5        /NCM/ NCM    /CMARG / CMA     /CMFUN / CMF
     6        /NOCM/ NCOCM  /OCMARG/ COCMA   /OCMFUN/ COCMF
     8        /NCN2/ NCN2   /CN2ARG/ CN2A    /CN2FUN/ CN2F
     */NCLP/ NCLP   /CLPARG/ CLPA      /CLPFUN/ CLPF
     */NCMQ/ NCMQ   /CMQARG/ CMQA      /CMQFUN/ CMQF
C
C**TABLE LOOKUP FOR SURFACE COEFFICIENTS
      COMMON   /NCZD/ NCZD   /CZOARG/ CZDA   /CZOFUN/ CZDF
     2         /NCLD/ NCLD   /CLOARG/ CLOA   /CLDFUN/ CLOF
     3         /NCMD/ NCMO   /CMOARG/ CMOA   /CMDFUN/ CMOF
C
C** INPUT DATA
      EQUIVALENCE (C(1252),XINTER)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(0204),VMACH )
      EQUIVALENCE (C(0367),BALPHA)
      EQUIVALENCE (C(0368),BALPHY)
      EQUIVALENCE (C(0369),BALPHP)
      EQUIVALENCE (C(0370),BPHIP )
C
C**INPUTS FROM MAIN PROGRAM
      EQUIVALENCE (C(2000),T      )
      EQUIVALENCE (C(2664),OER    )
C
C**OUTPUTS - COEFFICIENTS FOR BOOY FORCES
      EQUIVALENCE (C(1203),CX     )
C**OUTPUTS - COEFFICIENTS FOR BODY MOMENTS
      EQUIVALENCE (C(1206),CLP    )
      EQUIVALENCE (C(1207),CMQ    )
      EQUIVALENCE (C(1208),CNR    )
      EQUIVALENCE (C(1209),CL     )
      EQUIVALENCE (C(1210),CM     )
      EQUIVALENCE (C(1211),CN     )
      EQUIVALENCE (C(1240),CL2    )
      EQUIVALENCE (C(1247),CMP    )
      EQUIVALENCE (C(1248),CNP    )
      EQUIVALENCE (C(1249),CLR    )
C
C**OUTPUTS - COEFFICIENTS FOR SURFACE EFFECTS, AND TOTAL EFFECTS
      EQUIVALENCE (C(1204),CY     )
```

```
            EQUIVALENCE (C(1205),CZ     )
            EQUIVALENCE (C(1209),CL     )
            EQUIVALENCE (C(1210),CM     )
            EQUIVALENCE (C(1211),CN     )
            EQUIVALENCE(C(1272),CMAA)
            EQUIVALENCE(C(1273),CNAA)
            EQUIVALENCE(C(1274),CAA)
            EQUIVALENCE(C(1250),P)
      C
      C  INPUT VARIABLE XINTER IS THE INTERPOLATION CONTROL
      C    LESS THAN ZERO - STRAIGHT LINE INTERPOLATION
      C    POSITIVE - PARABOLIC INTERPOLATION , WITH END INTERVAL
      C               INTERPOLATION   (0. TO 1.)
      C               0.0 - STRAIGHT LINE
      C               1.0 - FULL PARABOLIC
      C
      C
            IF(P.EQ.0..AND.T.LE.DER) UTIME=-1.
            IF (T-UTIME .LE. 0.) RETURN
            P=1.
            UTIME= T
      C
      C  MULTIPLE ANGLE FORMULAE AND ABSOLUTE VALUES OF ANGLE OF ATTACK
            USPHI = SIND(BPHIP)
            UCPHI = COSD(BPHIP)
            CX=CAA
            CNP=CNAA*BALPHP
            CMP=CMAA*BALPHP
            CL2=.05
            US4PHI=SIND(4.*BPHIP)
            CLR=CL2*US4PHI
            CY=-CNP*USPHI
            CZ=-CNP*UCPHI
            CM=CMP*UCPHI
            CN=-CMP*USPHI
            CL=CLR
            RETURN
            END
```

```
C**AERO FORCE AND MOMENT MODULE   BODY AXES
      SUBROUTINE A2
      COMMON C(3510)
C
C**INPUT DATA
      EQUIVALENCE (C(1306),RFAREA)
      EQUIVALENCE (C(1307),RFLGTH)
      EQUIVALENCE (C(1308),RDELCG)
      EQUIVALENCE (C(1313),RFXCG )
      EQUIVALENCE (C(1314),RFYCG )
      EQUIVALENCE (C(1315),RFZCG )
      EQUIVALENCE (C(1316),RLUG  )
      EQUIVALENCE (C(1317),RAIL  )
      EQUIVALENCE (C(1627),AGRAV )
      EQUIVALENCE (C(3504),OPTN4 )
      EQUIVALENCE (C(1360),EMA)
      EQUIVALENCE (C(1361),SFORCZ)
      EQUIVALENCE (C(1362),SFORCY)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(0203),PDYNMC)
      EQUIVALENCE (C(0207),VAIRSP)
      EQUIVALENCE (C( 350),BTHT  )
      EQUIVALENCE (C( 380),RANGO )
      EQUIVALENCE (C(1203),CX    )
      EQUIVALENCE (C(1204),CY    )
      EQUIVALENCE (C(1205),CZ    )
      EQUIVALENCE (C(1206),CLP   )
      EQUIVALENCE (C(1207),CMQ   )
      EQUIVALENCE (C(1208),CNR   )
      EQUIVALENCE (C(1209),CL    )
      EQUIVALENCE (C(1210),CM    )
      EQUIVALENCE (C(1211),CN    )
      EQUIVALENCE (C(1236),CH1   )
      EQUIVALENCE (C(1237),CH2   )
      EQUIVALENCE (C(1238),CH3   )
      EQUIVALENCE (C(1239),CH4   )
      EQUIVALENCE (C(1411),FTHX  )
      EQUIVALENCE (C(1412),FTHY  )
      EQUIVALENCE (C(1413),FTHZ  )
      EQUIVALENCE (C(1422),RLCG  )
      EQUIVALENCE (C(1628),DMASS )
      EQUIVALENCE (C(1723),CFA23 )
      EQUIVALENCE (C(1735),CFA33 )
      EQUIVALENCE (C(1739),WP    )
      EQUIVALENCE (C(1743),WQ    )
      EQUIVALENCE (C(1747),WR    )
      EQUIVALENCE (C(1749),FMIY  )
      EQUIVALENCE (C(1750),FMIZ  )
      EQUIVALENCE(C(1703),CFA11)
      EQUIVALENCE(C(1707),CFA12)
      EQUIVALENCE(C(1711),CFA13)
      EQUIVALENCE(C(1715),CFA21)
      EQUIVALENCE(C(1719),CFA22)
      EQUIVALENCE(C(1723),CFA23)
```

```
      EQUIVALENCE(C(1727),CFA31)
      EQUIVALENCE(C(1731),CFA32)
      EQUIVALENCE(C(1735),CFA33)
C
C**OTHER OUTPUTS
      EQUIVALENCE (C(1300),FXBA   )
      EQUIVALENCE (C(1301),FYBA   )
      EQUIVALENCE (C(1302),FZBA   )
      EQUIVALENCE (C(1303),FMXBA  )
      EQUIVALENCE (C(1304),FMYBA  )
      EQUIVALENCE (C(1305),FMZBA  )
      EQUIVALENCE (C(1309),FMH1   )
      EQUIVALENCE (C(1310),FMH2   )
      EQUIVALENCE (C(1311),FMH3   )
      EQUIVALENCE (C(1312),FMH4   )
      EQUIVALENCE (C(1320),FMXTH  )
      EQUIVALENCE (C(1321),FMYTH  )
      EQUIVALENCE (C(1322),FMZTH  )
      EQUIVALENCE (C(1323),FMXLUG)
      EQUIVALENCE (C(1324),FMYLUG)
      EQUIVALENCE (C(1325),FMZLUG)
      EQUIVALENCE(C(2000),T)
      EQUIVALENCE(C(1332),EFT)
      EQUIVALENCE(C(1333),EJD)
      EQUIVALENCE(C(1326),EFORCX)
      EQUIVALENCE(C(1327),EFORCY)
      EQUIVALENCE(C(1328),EFORCZ)
      EQUIVALENCE(C(1329),EMOMX)
      EQUIVALENCE(C(1330),EMOMY)
      EQUIVALENCE(C(1331),EMOMZ)
      EQUIVALENCE(C(61),ASN)
      EQUIVALENCE(C(60),AAN)
      EQUIVALENCE (C(73),XNOSE1)
      EQUIVALENCE (C(72),DELZ)
C
C**FORCE VECTOR COMPONENTS
      UQS = PDYNMC*RFAREA
      UQSL = UQS*RFLGTH
      CY=CY+.04*ASN*57.3
      CN=CN+.04*ASN*57.3*XNOSE1/RFLGTH
      CM=CM-.04*AAN*57.3*XNOSE1/RFLGTH
      CZ=CZ+.04*AAN*57.3
C
      FXBA=UQS*(-CX)+FTHX
      FYBA=UQS*CY+FTHY
      FZBA=UQS*CZ+FTHZ
      IF(VAIRSP.LE.0.0) GO TO 72
C
C**AERO MOMENTS
      VAIRSP=VAIRSP*2.
      FMXBA = (CL+(CLP/VAIRSP)*RFLGTH*WP)*UQSL
      FMYBA = (CM+(CMQ/VAIRSP)*RFLGTH*WQ)*UQSL+FZBA*RDELCG
      FMZBA = (CN+(CNR/VAIRSP)*RFLGTH*WR)*UQSL-FYBA*RDELCG
      EFBAX=0.
      EFBAY=0.
```

```
      EFBAZ=0.
      EMBAX=0.
      EMBAY=0.
      EMBAZ=0.
      IF(T.GT.EFT) GO TO 37
      IF(DELZ.GT.EJD) GO TO 37
      EFBAX=EFORCX*CFA11 +EFORCY*CFA12 +EFORCZ*CFA13
      EFBAY=EFORCX*CFA21 +EFORCY*CFA22 +EFORCZ*CFA23
      EFBAZ=EFORCX*CFA31 +EFORCY*CFA32 +EFORCZ*CFA33
      EMBAX=EMOMX*CFA11 +EMOMY*CFA12 +EMOMZ*CFA13
      EMBAY=EMOMX*CFA21 +EMOMY*CFA22 +EMOMZ*CFA23
      EMBAZ=EMOMX*CFA31 +EMOMY*CFA32 +EMOMZ*CFA33
      FXBA=FXBA+EFBAX
      FYBA=FYBA+EFBAY
      FZBA=FZBA+EFBAZ
      FMXBA=FMXBA + EMBAX
      FMYBA=FMYBA  +EMBAY
      FMZBA=FMZBA+EMBAZ
 37   CONTINUE
      VAIRSP=VAIRSP/2.
C
C**MOMENTS CAUSED BY THRUST MISALIGNMENTS
      FMXTH = -FTHY*RFZCG + FTHZ*RFYCG
      FMYTH =  FTHX*RFZCG + FTHZ*RFXCG
      FMZTH = -FTHX*RFYCG - FTHY*RFXCG
C
C**MOMENTS AND FORCES DUE TO LUGS
      IF ( (OPTN4 .GT. 0.).AND.(RANGO .LE. RAIL+RLUG) ) GO TO 70
      FYLUG = 0.
      FZLUG = 0.
      FMXLUG = 0.
      FMYLUG = 0.
      FMZLUG = 0.
      GO TO 74
   70 IF (RANGO .LE. RAIL) GO TO 72
      FYLUG = -(FYBA + DMASS*AGRAV*CFA23 + (FMZBA + FMZTH)*
     *          RLCG*DMASS/FMIZ)/(1. + DMASS*RLCG*RLCG/FMIZ)
      FZLUG = -(FZBA + DMASS*AGRAV*CFA33 + (FMYBA + FMYTH)*
     *          RLCG*DMASS/FMIY)/(1. + DMASS*RLCG*RLCG/FMIY)
      FMXLUG = -(FMXBA + FMXTH)
      FMYLUG = FZLUG*RLCG
      FMZLUG = FYLUG*RLCG
      GO TO 74
   72 CONTINUE
      FYLUG = -(FYBA + DMASS*AGRAV*CFA23)
      FZLUG = -(FZBA + DMASS*AGRAV*CFA33)
      FMXLUG = -(FMXBA + FMXTH)
      FMYLUG = -(FMYBA + FMYTH)
      FMZLUG = -(FMZBA + FMZTH)
   74 CONTINUE
C
C**TOTAL FORCE AND MOMENTS
      FYBA = FYBA + FYLUG
      FZBA = FZBA + FZLUG
      FMXBA = FMXBA + FMXTH + FMXLUG
```

```
      FMYBA = FMYBA + FMYTH + FMYLUG
      FMZBA = FMZBA + FMZTH + FMZLUG
C
C** CALCULATE HINGE MOMENTS
      FMH1 = CH1*UQSL
      FMH2 = CH2*UQSL
      FMH3 = CH3*UQSL
      FMH4 = CH4*UQSL
      RETURN
      END
```

```
C**INITIALIZATION FOR ENGINE MODULE
      SUBROUTINE A3I
      COMMON C(3510)
      DIMENSION IPL(101)
      EQUIVALENCE (C(2561),N      )
      EQUIVALENCE (C(2562),IPL    )
      C(1499) = 0.
      IPL(N  ) = 1496
      N = N+1
      RETURN
      END
```

```
C**ENGINE MODULE
      SUBROUTINE A3
      COMMON C(3510)
C
C**LOOK UP TABLE FOR THRUST
      COMMON  /NTH/NTH   /THARG/THA   /THFUN/THF
C
C** INPUT DATA
      EQUIVALENCE (C(1401),BALPHT)
      EQUIVALENCE (C(1402),BPHIT )
      EQUIVALENCE (C(1403),QNALGN)
      EQUIVALENCE (C(1404),PCFTH )
      EQUIVALENCE (C(1405),QBURN )
      EQUIVALENCE (C(1414),CISP  )
      EQUIVALENCE (C(1415),DWT   )
      EQUIVALENCE (C(1416),DWP   )
      EQUIVALENCE (C(1417),RDCGO )
      EQUIVALENCE (C(1418),RDCGF )
      EQUIVALENCE (C(1419),FMIXO )
      EQUIVALENCE (C(1420),FMIYO )
      EQUIVALENCE (C(1421),RLCGO )
      EQUIVALENCE (C(1627),AGRAV )
C
C** INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(1252),XINTER)
      EQUIVALENCE (C(2000),T     )
C
C** OUTPUTS
      EQUIVALENCE (C(1308),RDELCG)
      EQUIVALENCE (C(1409),UDWP  )
      EQUIVALENCE (C(1410),FTHRST)
      EQUIVALENCE (C(1411),FTHX  )
      EQUIVALENCE (C(1412),FTHY  )
      EQUIVALENCE (C(1413),FTHZ  )
      EQUIVALENCE (C(1422),RLCG  )
      EQUIVALENCE (C(1628),DMASS )
      EQUIVALENCE (C(1748),FMIX  )
      EQUIVALENCE (C(1749),FMIY  )
      EQUIVALENCE (C(1750),FMIZ  )
C
C**STATE VARIABLES AND THEIR DERIVATIVES
      EQUIVALENCE (C(1496),UIMPD )
      EQUIVALENCE (C(1499),UIMP  )
C
      IF (QBURN.GT.0.) RETURN
      CALL TABLE (T,THA,THF,NTH,XINTER,6HFTHRST,FTHRST)
      FTHRST = FTHRST*(1. + PCFTH)
C
      IF (QNALGN) 20,20,10
   10 USINA=SIND(BALPHT)
      FTHX=FTHRST*COSD(BALPHT)
      FTHY=-FTHRST*USINA*SIND(BPHIT)
      FTHZ=FTHRST*USINA*COSD(BPHIT)
      GO TO 30
   20 FTHX=FTHRST
```

```
      FTHY=0.
      FTHZ=0.
   30 CONTINUE
C
      UIMPD = FTHRST
      UDWP = UIMP/CISP
C
      DMASS = (DWT - UDWP)/AGRAV
      RDELCG = RDCGD - (RDCGD - RDCGF)*UDWP/DWP
C
      FMIX = FMIXD*(DWT - UDWP)/DWT
      FMIY = FMIYD*(DWT - UDWP)/DWT
      FMIZ = FMIY
      RLCG = RLCGO + RDELCG
      IF (FTHRST .GT. 0.) RETURN
C
      WRITE (6,100) T
  100 FORMAT (//14H BURNOUT TIME=,F8.4,5H SEC.)
      QBURN=1.0
      FTHRST=0.
      FTHX=0.
      FTHY=0.
      FTHZ=0.
      RETURN
      END
```

```
C**    TRANSLATIONAL DYNAMICS INITIALIZATION MODULE FOR D1
       SUBROUTINE D1I
       COMMON C(3510)
       EQUIVALENCE (C(2561),N      )
       EQUIVALENCE (C(2562),IPL    )
       DIMENSION  IPL (100)
C
C** INPUT DATA
       EQUIVALENCE (C( 100),VWXE  )
       EQUIVALENCE (C( 101),VWYE  )
       EQUIVALENCE (C( 102),VWZE  )
       EQUIVALENCE (C( 204),VMACH )
       EQUIVALENCE (C( 367),BALPHA)
       EQUIVALENCE (C( 368),BALPHY)
       EQUIVALENCE (C(1615),RXE   )
       EQUIVALENCE (C(1619),RYE   )
       EQUIVALENCE (C(1623),RZE   )
       EQUIVALENCE (C(1603),VXE   )
       EQUIVALENCE (C(1607),VYE   )
       EQUIVALENCE (C(1611),VZE   )
       EQUIVALENCE (C(1635),RDELX )
       EQUIVALENCE (C(1636),RDELY )
       EQUIVALENCE (C(1637),RDELZ )
       EQUIVALENCE (C(1643),VTARG )
       EQUIVALENCE (C(1651),RTXE  )
       EQUIVALENCE (C(1655),RTYE  )
       EQUIVALENCE (C(1659),RTZE  )
       EQUIVALENCE (C(1668),RXO   )
       EQUIVALENCE (C(1669),RYO   )
       EQUIVALENCE (C(1670),RZO   )
       EQUIVALENCE (C(1753),BTHTO )
       EQUIVALENCE (C(1754),BPSIO )
        EQUIVALENCE (C(0209), RH )
       EQUIVALENCE(C(1660),VTXE)
       EQUIVALENCE(C(1661),VTYE)
       EQUIVALENCE(C(1662),VTZE)
C
       IPL(N) = 1600
       IPL(N+1) = 1604
       IPL(N+2) = 1608
       IPL(N+3) = 1612
       IPL(N+4) = 1616
       IPL(N+5) = 1620
       IPL(N+6) = 1640
       IPL(N+7) = 1644
       IPL(N+8) = 1648
       IPL(N+9) = 1652
       IPL(N+10) = 1656
       N = N+11
C
       RH=-RZE
    24 VSOUND = 1117.3 - .00392*RH
       VMWTE = VMACH*VSOUND
       VTARG=VMWTE
       VMWXY = VMWTE*COSD(BALPHA - BTHTO)
```

```
C
      VXE = VWXE + VMWXY*COSD(BALPHY + BPSIO)
      VYE = VWYE + VMWXY*SIND(BALPHY + BPSIO)
      VZE = VWZE + VMWTE*SIND(BALPHA - BTHTO)
C
      VTXE=VXE
      VTYE=VYE
      VTZE=VZE
   30 RDELX = RTXE-RXE
      RDELY = RTYE-RYE
      RDELZ = RTZE-RZE
      RXO = RXE
      RYO = RYE
      RZO = RZE
      RETURN
      END
```

```
C**TRANSLATIONAL DYNAMICS MODULE
      SUBROUTINE D1
      COMMON C(3510)
C
C**INPUT DATA
      EQUIVALENCE (C(1627),AGRAV )
      EQUIVALENCE (C(1628),DMASS )
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(1300),FXBA  )
      EQUIVALENCE (C(1301),FYBA  )
      EQUIVALENCE (C(1302),FZBA  )
      EQUIVALENCE (C(1667),RZ    )
      EQUIVALENCE (C(1703),CFA11 )
      EQUIVALENCE (C(1707),CFA12 )
      EQUIVALENCE (C(1711),CFA13 )
      EQUIVALENCE (C(1715),CFA21 )
      EQUIVALENCE (C(1719),CFA22 )
      EQUIVALENCE (C(1723),CFA23 )
      EQUIVALENCE (C(1727),CFA31 )
      EQUIVALENCE (C(1731),CFA32 )
      EQUIVALENCE (C(1735),CFA33 )
      EQUIVALENCE (C(2000),T     )
C
C**STATE VARIABLE OUTPUTS
      EQUIVALENCE (C(1600),VXED  )
      EQUIVALENCE (C(1603),VXE   )
      EQUIVALENCE (C(1604),VYED  )
      EQUIVALENCE (C(1607),VYE   )
      EQUIVALENCE (C(1608),VZED  )
      EQUIVALENCE (C(1611),VZE   )
      EQUIVALENCE (C(1612),RXED  )
      EQUIVALENCE (C(1615),RXE   )
      EQUIVALENCE (C(1616),RYED  )
      EQUIVALENCE (C(1619),RYE   )
      EQUIVALENCE (C(1620),RZED  )
      EQUIVALENCE (C(1623),RZE   )
      EQUIVALENCE (C(1648),RTXED )
      EQUIVALENCE (C(1651),RTXE  )
      EQUIVALENCE (C(1652),RTYED )
      EQUIVALENCE (C(1655),RTYE  )
      EQUIVALENCE (C(1656),RTZED )
      EQUIVALENCE (C(1659),RTZE  )
C
C**OTHER OUTPUTS
      EQUIVALENCE (C(1624),AXBA  )
      EQUIVALENCE (C(1625),AYBA  )
      EQUIVALENCE (C(1626),AZBA  )
      EQUIVALENCE (C(1632),VDELX )
      EQUIVALENCE (C(1633),VDELY )
      EQUIVALENCE (C(1634),VDELZ )
      EQUIVALENCE (C(1635),RDELX )
      EQUIVALENCE (C(1636),RDELY )
      EQUIVALENCE (C(1637),RDELZ )
      EQUIVALENCE (C(1660),VTXE  )
```

```
      EQUIVALENCE (C(1661),VTYE   )
      EQUIVALENCE (C(1662),VTZE   )
      EQUIVALENCE(C(72),DELZ)
      EQUIVALENCE(C(71),DELY)
      EQUIVALENCE(C(70),DELX)
C
C**ADD AERO AND THRUST FORCES TO GET TOTAL ACCELERATION IN BODY AXES
      AXBA = FXBA/DMASS
      AYBA = FYBA/DMASS
      AZBA = FZBA/DMASS
C
C**RESOLVE FROM BODY TO EARTH AXES
      AXE = CFA11*AXBA+CFA21*AYBA+CFA31*AZBA
      AYE = CFA12*AXBA+CFA22*AYBA+CFA32*AZBA
      AZE = CFA13*AXBA+CFA23*AYBA+CFA33*AZBA
C
C**INTEGRATE ACCELERATIONS
      VXED = AXE
      VYED = AYE
      VZED = AZE + AGRAV
C
C
C**INTEGRATE VELOCITIES TO EARTH AXES  POSITION
   10 RXED = VXE
      RYED = VYE
      RZED = VZE
C
C
      RTXED = VTXE
      RTYED = VTYE
      RTZED = VTZE
C
      VDELX = VTXE-VXE
      VDELY = VTYE-VYE
      VDELZ = VTZE-VZE
C
      RDELX = RTXE-RXE
      RDELY = RTYE-RYE
      RDELZ = RTZE-RZE
      DELX=-RDELX
      DELY=-RDELY
      DELZ=-RDELZ
      RETURN
      END
```

```
C**ROTATIONAL DYNAMICS INITIALIZATION MODULE D2IEUL
      SUBROUTINE D2I
      COMMON C(3510)
      DIMENSION  IPL (100)
C**INPUT DATA
      EQUIVALENCE (C(1752),BPHIO )
      EQUIVALENCE (C(1753),BTHTO )
      EQUIVALENCE (C(1754),BPSIO )
C**INPUTS FROM OTHER MODULES
C**NONE
C**INPUTS FROM MAIN PROGRAM
      EQUIVALENCE (C(2561),N      )
      EQUIVALENCE (C(2562),IPL    )
C**STATE VARIABLE OUTPUTS
      EQUIVALENCE (C(1703),CFA11 )
      EQUIVALENCE (C(1707),CFA12 )
      EQUIVALENCE (C(1711),CFA13 )
      EQUIVALENCE (C(1715),CFA21 )
      EQUIVALENCE (C(1719),CFA22 )
      EQUIVALENCE (C(1723),CFA23 )
      EQUTVALENCE (C(1727),CFA31 )
      EQUIVALENCE (C(1731),CFA32 )
      EQUIVALENCE (C(1735),CFA33 )
C**OTHER OUTPUTS
C**NONE
C**INITIAL CALCULATION OF EULER ANGLE MATRIX OF DIRECTION COSINES (CFA)
      USPHI = SIND(BPHIO)
      UCPHI = COSD(BPHIO)
      USTHT = SIND(BTHTO)
      UCTHT = COSD(BTHTO)
      USPSI = SIND(BPSIO)
      UCPSI = COSD(BPSIO)
      CFA11 = UCPSI*UCTHT
      CFA12 = USPSI*UCTHT
      CFA13 = -USTHT
      CFA21 = -USPSI*UCPHI+UCPSI*USTHT*USPHI
      CFA22 = UCPSI*UCPHI+USPSI*USTHT*USPHI
      CFA23 = UCTHT*USPHI
      CFA31 = UCPSI*USTHT*UCPHI+USPSI*USPHI
      CFA32 = USPSI*USTHT*UCPHI-UCPSI*USPHI
      CFA33 = UCTHT*UCPHI
C
C**TNTEGRATED PARAMATER LIST (IPL) FOR WPD,WQD,WRD,AND CFAD
      IPL(N) = 1700
      IPL(N+1) = 1704
      IPL(N+2) = 1708
      IPL(N+3) = 1712
      IPL(N+4) = 1716
      IPL(N+5) = 1720
      IPL(N+6) = 1724
      IPL(N+7) = 1728
      IPL(N+8) = 1732
      IPL(N+9) = 1736
      IPL(N+10) = 1740
      IPL(N+11) = 1744
```

```
      N = N+12
C** RESET ANGULAR RATE DERIVATIVES TO ZERO.
      C(1700) = 0.
      C(1704) = 0.
      C(1708) = 0.
      C(1712) = 0.
      C(1716) = 0.
      C(1720) = 0.
      C(1724) = 0.
      C(1728) = 0.
      C(1732) = 0.
      C(1736) = 0.
      C(1740) = 0.
      C(1744) = 0.
      RETURN
      END
```

```
C**    ROTATIONAL DYNAMICS MODULE
       SUBROUTINE D2
       COMMON C(3510)
C
C**DATA INPUTS
       EQUIVALENCE (C(1421),RAIL   )
       EQUIVALENCE (C(1748),FMIX   )
       EQUIVALENCE (C(1749),FMIY   )
       EQUIVALENCE (C(1750),FMIZ )
       EQUIVALENCE (C(1751),CRAD   )
       EQUIVALENCE (C(3503),OPTN3)
       EQUIVALENCE (C(3504),OPTN4 )
C
C**INPUTS FROM OTHER MODULES
       EQUIVALENCE (C( 380),RANGO )
       EQUIVALENCE (C(1303),FMXBA )
       EQUIVALENCE (C(1304),FMYBA )
       EQUIVALENCE (C(1305),FMZBA )
       EQUIVALENCE (C(1308),RDELCG)
C
C**INPUTS FROM MAIN PROGRAM
C**STATE VARIABLE OUTPUTS
       EQUIVALENCE (C(1700),CFA11D)
       EQUIVALENCE (C(1703),CFA11 )
       EQUIVALENCE (C(1704),CFA12D)
       EQUIVALENCE (C(1707),CFA12 )
       EQUIVALENCE (C(1708),CFA13D)
       EQUIVALENCE (C(1711),CFA13 )
       EQUIVALENCE (C(1712),CFA21D)
       EQUIVALENCE (C(1715),CFA21 )
       EQUIVALENCE (C(1716),CFA22D)
       EQUIVALENCE (C(1719),CFA22 )
       EQUIVALENCE (C(1720),CFA23D)
       EQUIVALENCE (C(1723),CFA23 )
       EQUIVALENCE (C(1724),CFA31D)
       EQUIVALENCE (C(1727),CFA31 )
       EQUIVALENCE (C(1728),CFA32D)
       EQUIVALENCE (C(1731),CFA32 )
       EQUIVALENCE (C(1732),CFA33D)
       EQUIVALENCE (C(1735),CFA33 )
       EQUIVALENCE (C(1736),WPD    )
       EQUIVALENCE (C(1739),WP     )
       EQUIVALENCE (C(1740),WQD    )
       EQUIVALENCE (C(1743),WQ     )
       EQUIVALENCE (C(1744),WRD    )
       EQUIVALENCE (C(1747),WR     )
C
C**INTEGRATE BODY ANGULAR RATES
       IF (OPTN3.GT.0.) GO TO 55
       WPD = CRAD*FMXBA/FMIX
   55  WQD = (CRAD*FMYBA+(FMIZ-FMIX)*WP*WR/CRAD)/FMIY
   65  WRD = (CRAD*FMZBA+(FMIX-FMIY)*WP*WQ/CRAD)/FMIZ
C
C**INTEGRATE ATTITUDE DIRECTION COSINES
   49  CFA11D=(CFA21*WR-CFA31*WQ)/CRAD
```

```
      CFA12D=(CFA22*WR-CFA32*WQ)/CRAD
      CFA13D=(CFA23*WR-CFA33*WQ)/CRAD
      CFA21D = (CFA31*WP-CFA11*WR)/CRAD
      CFA22D = (CFA32*WP-CFA12*WR)/CRAD
      CFA23D = (CFA33*WP-CFA13*WR)/CRAD
      CFA31D = (CFA11*WQ-CFA21*WP)/CRAD
      CFA32D = (CFA12*WQ-CFA22*WP)/CRAD
      CFA33D = (CFA13*WQ-CFA23*WP)/CRAD
      RETURN
      END
```

```
C     BASIC INPUT SUBROUTINE OINPT1
      SUBROUTINE OINPT1
      COMMON C(3510)
      EQUIVALENCE (C(3218),ONAME1), (C(3268),ONAME2), (C(3318),ONAME3),
     C            (C(3328),ONAME4), (C(2361),NOMOD ), (C(2362),MODNO ),
     C            (C(3440),NORNDM), (C(3441),RNDMNO), (C(3167),NOOUT ),
     C            (C(3168),OUTNO ), (C(2461),NOSUB ), (C(2462),SUBNO ),
     C            (C(2355),IR    ), (C(2357),VR    ), (C(3339),NOSTAT),
     C            (C(3338),LOSTAT), (C(3340),STATNO), (C(3066),NOLIST),
     C            (C(3067),LISTNO), (C(3117),VALUE ), (C(2008),PLOTNO),
     *(C(2009),NOPLOT),(C(2325),VLABLE)
      EQUIVALENCE (C(1984),NPLOT )
      EQUIVALENCE (C(1985),OUTPLT)
      DIMENSION ONAME3(10),ONAME4(10)
      DIMENSION LISTNO(50), VALUE(50)
      DIMENSION SUBNO(99),IR(2),VR(2)
      DIMENSION RNDMNO(50)
      DIMENSION ALPHA(3),ONAME1(50),ONAME2(50),OUTNO(50) ,MODNO(99)
      DIMENSION STATNO (100)
      DIMENSION VLABLE(2,15)
      DIMENSION OUTPLT(15)
      REAL MODNO
      INTEGER OUTNO
      INTEGER RNDMNO
      INTEGER STATNO
      INTEGER OUTPLT
      JAR = 0
      WRITE(6,31)
   31 FORMAT(11H1INPUT DATA/)
    1 READ(5,2) IR(1),ALPHA(1),ALPHA(2),ALPHA(3),IR(2),VR(1),VR(2)
      WRITE(6,30)IR(1),ALPHA(1),ALPHA(2),ALPHA(3),IR(2),VR(1),VR(2)
   30 FORMAT(I2,3A6,I5,5X,1P2E15.7)
    2 FORMAT(I2,3A6,I5,5X,2E15.9)
    7 IF( IR(1) .NE. 1 )  GO TO 3
      NOSUB = NOSUB + 1
      SUBNO(NOSUB) = IR(2)
      GO TO 1
    3 IF( IR(1) .NE. 2 )  GO TO 4
      NOMOD = NOMOD + 1
      MODNO(NOMOD) = IR(2)
      GO TO 1
    4 IF(IR(1) .NE. 3) GO TO 5
      L = IR(2)
      C(L) = VR(1)
      IF (VR(2) .EQ. 0.) GO TO 1
      NOLIST = NOLIST + 1
      LISTNO(NOLIST) = L
      VALUE(NOLIST) = VR(1)
      GO TO 1
    5 IF(IR(1) .NE. 4)GO TO 6
      NOOUT = NOOUT + 1
      IF (NOOUT.GT.50) GO TO 1
      ONAME1(NOOUT)=ALPHA(2)
      ONAME2(NOOUT) = ALPHA(3)
      OUTNO(NOOUT) = IR(2)
```

```
      GO TO 1
    6 IF (IR(1) .NE. 5) GO TO 16
      IF (VR(1) .EQ. 0.) GO TO 17
      LOSTAT = LOSTAT + 1
   17 NOSTAT = NOSTAT + 1
      STATNO(NOSTAT) = IR(2)
      ONAME3(NOSTAT)=ALPHA(2)
      ONAME4(NOSTAT)=ALPHA(3)
      GO TO 1
   16 IF (IR(1).NE.7) GO TO 19
      NPLOT=NPLOT+1
      IF (NPLOT.GT.15) GO TO 1
      DO 20 I=1,2
   20 VLABLE (I,NPLOT)=ALPHA(I+1)
      OUTPLT(NPLOT)=IR(2)
      GO TO 1
   19 IF (IR(2) .EQ. 0) RETURN
      RETURN
      END
```

```
C     OUTPUT INITIALIZITION SUBROUTINE OUPT2
      SUBROUTINE OUPT2
      COMMON      C(3510)          , GRAPH
      EQUIVALENCE (C(2017),DTCNT ), (C(3167),NOOUT ), (C(2016),PGCNT ),
     C            (C(2014),ITCNT ), (C(2003),PCNT  ), (C(2015),CPP   ),
     C            (C(2018),TAPE  ), (C(2019),TAPEND), (C(2013),DOC   ),
     C            (C(2000),T     ), (C(2021),KCONV ), (C(2025),TIME  ),
     C            (C(2008),PLOTNO), (C(2009),NOPLOT), (C(3168),OUTNO ),
     C            (C(2004),PPNT  ), (C(2023),OPOINT)
      DIMENSION   GRAPH(300,15)    , TIME(300)        , OUTNO(50)
      INTEGER     PGCNT , DTCNT , OUTNO , OPOINT
      EQUIVALENCE (C(1985),OUTPLT)
      INTEGER OUTPLT
      DIMENSION OUTPLT(15)
      KCONV=0
      ITCNT = DOC + 1.0
      PCNT = T-0.000001
      PPNT=PCNT
      PGCNT = 1
      DTCNT = (NOOUT + 4)/5
      IF ( ITCNT .GE. 7) GO TO 2
      CALL DUMPO
C
    2 TIME(1)=T
      OPOINT =1
      DO 10 J=1,NOPLOT
      K=OUTPLT(J)
   10 GRAPH(1,J)=C(K)
      RETURN
      END
```

```
C     OUTPUT SUBROUTINE OUPT3
      SUBROUTINE OUPT3
      COMMON      C(3510)          , GRAPH
      EQUIVALENCE (C(3168),OUTNO ), (C(3218),ONAME1), (C(3268),ONAME2),
     C            (C(2017),DTCNT ), (C(3167),NOOUT ), (C(2016),PGCNT ),
     C            (C(2014),ITCNT ), (C(2003),PCNT  ), (C(2015),CPP   ),
     C            (C(2000),T     ), (C(2664),DER   ), (C(2018),TAPE  ),
     C            (C(2019),TAPEND), (C(2008),PLOTNO), (C(2009),NOPLOT),
     C            (C(2005),PPP   ), (C(2004),PPNT  ), (C(2025),TIME  ),
     C            (C(2023),OPOINT)
      EQUIVALENCE (C(1985),OUTPLT)
      DIMENSION B(50),OUTNO(50),ONAME1(50),ONAME2(50)
      DIMENSION TIME(300),GRAPH(300,15)
      DIMENSION OUTPLT(15)
      INTEGER DTCNT,PGCNT,OUTNO
      INTEGER OPOINT
      INTEGER OUTPLT
      IF (ITCNT. GT. 6) GO TO 7
      ITCNT = ITCNT + 1
C
      CALL DUMPO
      PGCNT = 1
    7 IF (DER. EQ. DER1) GO TO 8
      DER1 = DER
      WRITE(6,20)T,DER
   20 FORMAT(1H ,5HTIME=F14.7,2X,10HSTEP SIZE=1PE19.7)
    8 IF (T .LT. PCNT)GOTO15
    9 PCNT = PCNT + CPP
      IF (PGCNT. NE. 1) GO TO 3
    1 WRITE(6,2) (ONAME1(I),ONAME2(I), I=1,NOOUT)
    2 FORMAT (1H1,3X,4HTIME,5X,5(7X,2A6)//(20X,2A6,7X,2A6,7X,2A6,7X,
     12A6,7X,2A6)/)
      PGCNT = 2*DTCNT + 4
    3 IF(PGCNT.GE.112) GO TO 1
      DO 4 I = 1,NOOUT
      J = OUTNO(I)
    4 B(I) = C(J)
      WRITE (6,5) T,(B(I), I = 1,NOOUT)
    5 FORMAT (///,F14.7,1P5E19.7/(14X,1P5E19.7))
      PGCNT = PGCNT + DTCNT + 4
   15 IF(T.LT.PPNT.OR.NOPLOT.EQ.0)RETURN
      PPNT=PPNT+PPP
      KPOINT =OPOINT +1
      IF (KPOINT-300) 16,13,18
   13 WRITE (6,14)
   14 FORMAT (//71H ****  WARNING-PLOTTING ARRAY FILLED-ONLY FIRST 300 P
     COINTS PLOTTED ****,//)
   16 OPOINT=KPOINT
      TIME (OPOINT)=T
      DO 10 J=1,NOPLOT
      K=OUTPLT(J)
   10 GRAPH(OPOINT   ,J)=C(K)
   18 RETURN
      END
```

```
      SUBROUTINE DUMPD
C   PRINT OUT A DUMP OF COMMON
      COMMON NN(3510)
      DIMENSION A(9),MM(9)
      EQUIVALENCE (A(1),MM(1))
      WRITE (6,100)
      DO 30 I=1,3510,9
      N=I-1
      DO 20 J=1,9
      K=J+N
      IF(AND(IABS(NN(K)),37770000000000000000B)) 5,5,10
  5   A(J)=NN(K)
      GO TO 20
 10   MM(J)=NN(K)
 20   CONTINUE
      WRITE(6,200)I,A
 30   CONTINUE
      RETURN
100   FORMAT(1H1)
200   FORMAT(I5,1P9E14.7)
      END
```

```
      SUBROUTINE ZERO
      COMMON C(3510)
      EQUIVALENCE (C(1984),NPLOT )
      EQUIVALENCE (C(2023),OPOINT)
      EQUIVALENCE (C(2361),NOMOD )
      EQUIVALENCE (C(2461),NOSUB )
      EQUIVALENCE (C(3066),NOLIST)
      EQUIVALENCE (C(3167),NOOUT )
      EQUIVALENCE (C(3338),LOSTAT)
      EQUIVALENCE (C(3339),NOSTAT)
      EQUIVALENCE (C(3440),NORNDM)
       EQUIVALENCE (C(2008),PLOTNO)
      INTEGER OPOINT
      LOSTAT = 0
      NOSTAT = 0
      NOSUB = 0
      NOMOD = 0
      NOOUT = 0
      NORNDM = 0
      NOLIST = 0
      OPOINT=0
      NPLOT=0
      RETURN
      END
```

```
      SUBROUTINE   SUBL1
      COMMON       C(3510)
      EQUIVALENCE (C(2461),NOSUB ), (C(2462),SUBNO )
      DIMENSION    SUBNO(99)
      DO 1 I = 1, NOSUB
      J = SUBNO(I)
      GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J
    2 CALL INPT1
      GO TO 1
    3 CALL OUPT1
      GO TO 1
    4 CALL STGE1
      GO TO 1
    5 CALL CNTR1
      GO TO 1
    6 CALL RNDM1
      GO TO 1
    7 CALL AUXA1
      GO TO 1
    8 CALL AUXB1
      GO TO 1
    9 CALL AUXC1
    1 CONTINUE
      RETURN
       END
```

```
      SUBROUTINE   SUBL2
      COMMON       C(3510)
      EQUIVALENCE (C(2461),NOSUB ), (C(2462),SUBNO )
      DIMENSION    SUBNO(99)
      DO 1 I = 1, NOSUB
      J = SUBNO(I)
      GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J
    2 CALL INPT2
      GO TO 1
    3 CALL OUPT2
      GO TO 1
    4 CALL STGE2
      GO TO 1
    5 CALL CNTR2
      GO TO 1
    6 CALL RNDM2
      GO TO 1
    7 CALL AUXA2
      GO TO 1
    8 CALL AUXB2
      GO TO 1
    9 CALL AUXC2
    1 CONTINUE
      RETURN
       END
```

```
      SUBROUTINE   SUBL3
      COMMON       C(3510)
      EQUIVALENCE (C(2461),NOSUB ), (C(2462),SUBNO )
      DIMENSION   SUBNO(99)
      DO 1 I = 1, NOSUB
      J = SUBNO(I)
      GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J
    2 CALL INPT3
      GO TO 1
    3 CALL OUPT3
      GO TO 1
    4 CALL STGE3
      GO TO 1
    5 CALL CNTR3
      GO TO 1
    6 CALL RNDM3
      GO TO 1
    7 CALL AUXA3
      GO TO 1
    8 CALL AUXB3
      GO TO 1
    9 CALL AUXC3
    1 CONTINUE
      RETURN
       END
```

```
      SUBROUTINE STGE2
      COMMON      C(3510)
      EQUIVALENCE (C(2011),KSTEP ), (C(2020),LCONV ), (C(2021),KCONV )
      KCONV = 0
      LCONV = 0
      KSTEP = 1
      RETURN
      END
```

```
      SUBROUTINE STGE3
      COMMON C(3510),GRAPH,TEMPS(1000)
      EQUIVALENCE (C(2000),T     ), (C(2001),TF    ), (C(2003),PCNT  )
      EQUIVALENCE (C(2010),STEP  ), (C(2011),KSTEP ), (C(2020),LCONV )
      EQUIVALENCE (C(2021),KCONV ), (C(2561),N     ), (C(2662),HMIN  )
      EQUIVALENCE (C(2663),HMAX  ), (C(2664),DER   ), (C(2765),EL    )
      EQUIVALENCE (C(2865),EU    ), (C(2965),VAR   )
      EQUIVALENCE (C(1973),KASE  ), (C(1974),NJ    ), (C(1975),NPT   )
      DIMENSION   DER(101)        , VAR(101)        , EL(100)
      DIMENSION   EU(100)         , GRAPH(300,15)
      EXTERNAL AUXSUB
      CALL G4
      IF (ABS( T-TF) .LE. 0.01 ) GO TO 20
      IF ( (TF-T) .LT. 0.) GO TO 10
      IF (LCONV .EQ. 2) GO TO 20
      IF (LCONV .EQ. 1) GO TO 10
      IF ( DER. LT. 0.) DER = -DER*0.5
      RETURN
   10 IF (DER. GT. 0.) DER = -DER*0.5
      KCONV = KCONV + 1
      IF(KCONV .GE. 10) GO TO 20
      RETURN
   20 PCNT = 1.0
C     DUMM = RECRM(LOC(X3),LOC(X4))
C     WRITE (6,30)  X3, X4
C  30 FORMAT (38H0 RESTART INITIALIZERS, X3 AND X4, ARE 2F11.0)
      IF(STEP .EQ.11.)GOTO 40
      PREDER = DER(1)
      DER(1) = 0.
      NJ=N-1
      NPT=0
      CALL AMRK(AUXSUB)
      DER(1) = PREDER
   40 CALL OUPT3
      KSTEP = 2
      RETURN
      END
```

ARD NO.	SEVERITY		DIAGNOSTIC
17	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED
17	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED
17	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED
19	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED
19	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED
19	I	DER	ARRAY NAME OPERAND NOT SUBSCRIPTED, FIRST ELEMENT WILL BE USED

```
      SUBROUTINE AMRK(AUXSUB)
C*SINGLE PRECISION VERSION* INDEPENOENT VARIABLE IN OOUBLE PRECISION
      COMMON      C(3510)          , GRAPH             , T(1000)
C     OOUBLE PRECISION DELT,TME
C     DOUBLE PRECISION NEWC(200),NEWP(200),OLO(200)
      DIMENSION OLD(200)
      REAL NEWC(200), NEWP(200)
      OIMENSION O(101)            ,EL(100)            ,EU(100)
      DIMENSION   V(101)          , GRAPH(300,15)
      EQUIVALENCE (C(2662),HMIN  ), (C(2663),HMAX  ), (C(2664),O      )
      EQUIVALENCE (C(2765),EL    ), (C(2865),EU    ), (C(2965),V      )
      EQUIVALENCE (C(1971),RITE  ), (J1,N1)
      EQUIVALENCE (C(1973),KASE  ), (C(1974),NJ    ), (C(1975),NPT    )
      DATA KOUNT/0/
      OATA P1,P2,P3,P4/2.29166667,2.45833333,1.5416667,0.375/
      OATA C2,C3,C4/0.7916667,0.2083333,0.0416667/
      IF(KASE.GT.0)GO TO 20
      N1=NJ
      J2=J1+N1
      J3=J2+N1
      J4=J3+N1
      J5=J4+N1
      J6=J5+N1
      J7=J6+N1
      J8=J7+N1
      J9=J8+N1
      KASE=KASE+1
C*NPT.EQ.0  AOAMS-MOULTON INTEGRATION MOOE
C*NPT.EQ.1  RUNGE-KUTTA INTEGRATION MODE
C*NPT.EQ.2  BEGINNING AOAMS-MOULTON WITH RUNGE-KUTTA START
   20 IF(NPT.EQ.1)GO TO 40
      IF(NPT.EQ.2)GO TO 30
      IF(DELT.NE.(.5*O(1))) GO TO 30
      IF(KOUNT.LT.3)GO TO 40
      GO TO 200
   30 KOUNT=0
      NPT=0
C*START RUNGE-KUTTA INTEGRATION
C*COMPUTE K1
   40 DO 50 I=1,N1
      NEWP(I)=V(I+1)
   50 CONTINUE
      TME=V(1)
      KOUNT=KOUNT+1
      DO 60 I=1,N1
   60 OLO(I)=D(1)*D(I+1)
C COMPUTE K2
      OELT=0.5*O(1)
      TME=TME+DELT
      V(1)=TME
      DO 70 I=1,N1
      IF(KOUNT.NE.2)GO TO 65
      K1=J9+I
      T(K1)=NEWP(I)
   65 T(I)=D(I+1)
```

```
          NEWP(I)=NEWP(I)+0.5*OLD(I)
       70 V(I+1)=NEWP(I)
          CALL AUXSUB
          DO 80 I=1,N1
       80 NEWC(I)=D(1)*D(I+1)
.C COMPUTE K3
          DO 90 I=1,N1
          NEWP(I)=NEWP(I)+0.5*(NEWC(I)-OLD(I))
       90 V(I+1)=NEWP(I)
          CALL AUXSUB
          DO 100 I=1,N1
          K2=J7+I
      100 T(K2)=D(1)*D(I+1)
C COMPUTE K4
          TME=TME+DELT
          V(1)=TME
          DO 110 I=1,N1
          K2=J7+I
          NEWP(I)=NEWP(I)+T(K2)-0.5*NEWC(I)
      110 V(I+1)=NEWP(I)
          CALL AUXSUB
          DO 120 I=1,N1
          K3=J8+I
      120 T(K3)=D(1)*D(I+1)
C COMPUTE VALUE OF FUNCTION
          DO 130 I=1,N1
          K2=J7+I
          K3=J8+I
          NEWP(I)=NEWP(I)-T(K2)+0.16666667*
         X(OLD(I)+NEWC(I)+NEWC(I)+T(K2)+T(K2)+T(K3))
      130 V(I+1)=NEWP(I)
      140 CALL AUXSUB
          DO 150 I=1,N1
          K5=J1+I
          K0=J2+I
          K1=J3+I
          K2=J4+I
          K3=J5+I
          K4=J6+I
          T(K4)=T(K3)
          T(K3)=T(K2)
          T(K2)=T(K1)
          T(K1)=T(K0)
          T(K0)=T(K5)
          T(K5)=T(I)
      150 T(I)=D(I+1)
          RETURN
C ADAMS-MOULTON INTEGRATION
      200 KOUNT=KOUNT+1
          DELT=0.5*D(1)
          DO 210 I=1,N1
          K1=J2+I
          K2=J3+I
          K4=J1+I
C COMPUTE Y-PREDICTED
```

```
      OLD(I)=NEWP(I)
      NEWP(I)=OLD(I)+D(1)*(P1*T(I)-P2*T(K4)+P3*T(K1)-P4*T(K2))
  210 V(I+1)=NEWP(I)
      TME=TME+D(1)
      V(1)=TME
      CALL AUXSUB
      K5=0
      DO 250 I=1,N1
      K2=J2+I
      K4=J1+I
C COMPUTE Y-CORRECTED
      NEWC(I)=OLD(I)+D(1)*(P4*D(I+1)+C2*T(I)-C3*T(K4)+C4*T(K2))
  250 CONTINUE
C INTEGRATION IS FINISHED. SET UP DERIVATIVES AND EXIT.
  290 DO 300 I=1,N1
      NEWP(I)=NEWC(I)
  300 V(I+1)=NEWC(I)
      GO TO 140
      END
```

```
      SUBROUTINE AUXI
      COMMON      C(3510)
      EQUIVALENCE (C(2361),NOMOO ), (C(2362),XMODNO), (C(2561),N      )
      DIMENSION  XMODNO(99)
      N = 1
      DO 1 I=1,NOMOD
      L =XMODNO(I)
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
     1      ,24,25,26,27,28,29,30,31,32,33,34,35,36,37),L
    2 CALL A1I
      GO TO 1
    3 CALL A2I
      GO TO 1
    4 CALL A3I
      GO TO 1
    5 CALL A4I
      GO TO 1
    6 CALL A5I
      GO TO 1
    7 CALL C1I
      GO TO 1
    8 CALL C2I
      GO TO 1
    9 CALL C3I
      GO TO 1
   10 CALL C4I
      GO TO 1
   11 CALL C5I
      GO TO 1
   12 CALL C6I
      GO TO 1
   13 CALL C7I
      GO TO 1
   14 CALL C8I
      GO TO 1
   15 CALL C9I
      GO TO 1
   16 CALL C10I
      GO TO 1
   17 CALL D1I
      GO TO 1
   18 CALL D2I
      GO TO 1
   19 CALL D3I
      GO TO 1
   20 CALL D4I
      GO TO 1
   21 CALL D5I
      GO TO 1
   22 CALL G1I
      GO TO 1
   23 CALL G2I
      GO TO 1
   24 CALL G3I
      GO TO 1
```

```
   25 CALL G4I
      GO TO 1
   26 CALL G5I
      GO TO 1
   27 CALL G6I
      GO TO 1
   28 CALL S1I
      GO TO 1
   29 CALL S2I
      GO TO 1
   30 CALL S3I
      GO TO 1
   31 CALL S4I
      GO TO 1
   32 CALL S5I
      GO TO 1
   33 CALL S6I
      GO TO 1
   34 CALL S7I
      GO TO 1
   35 CALL S8I
      GO TO 1
   36 CALL S9I
      GO TO 1
   37 CALL S10I
    1 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE AUXSUB
      COMMON      C(3510)
      EQUIVALENCE (C(2000),T      ), (C(2361),NOMOD ), (C(2362),XMODNO)
      EQUIVALENCE (C(2561),N      ), (C(2562),IPL   ), (C(2664),DER   )
      EQUIVALENCE (C(2965),VAR    )
      EQUIVALENCE (C(2020),LCONV)
      DIMENSION   DER(101)          , VAR(101)          , IPL(100)
      DIMENSION   XMODNO(99)
      DO 50 I = 2, N
      J = IPL(I-1)
   50 C(J+3) = VAR(I)
      T = VAR(1)
      DO 1 I=1,NOMOD
      IF(LCONV.EQ.2)RETURN
      L =XMODNO(I)
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,
     123,24,25,26,27,28,29,30,31,32,33,34,35,36,37),L
    2 CALL A1
      GO TO 1
    3 CALL A2
      GO TO 1
    4 CALL A3
      GO TO 1
    5 CALL A4
      GO TO 1
    6 CALL A5
      GO TO 1
    7 CALL C1
      GO TO 1
    8 CALL C2
      GO TO 1
    9 CALL C3
      GO TO 1
   10 CALL C4
      GO TO 1
   11 CALL C5
      GO TO 1
   12 CALL C6
      GO TO 1
   13 CALL C7
      GO TO 1
   14 CALL C8
      GO TO 1
   15 CALL C9
      GO TO 1
   16 CALL C10
      GO TO 1
   17 CALL D1
      GO TO 1
   18 CALL D2
      GO TO 1
   19 CALL D3
      GO TO 1
   20 CALL D4
      GO TO 1
```

```
21 CALL D5
   GO TO 1
22 CALL G1
   GO TO 1
23 CALL G2
   GO TO 1
24 CALL G3
   GO TO 1
25 CALL G4
   GO TO 1
26 CALL G5
   GO TO 1
27 CALL G6
   GO TO 1
28 CALL S1
   GO TO 1
29 CALL S2
   GO TO 1
30 CALL S3
   GO TO 1
31 CALL S4
   GO TO 1
32 CALL S5
   GO TO 1
33 CALL S6
   GO TO 1
34 CALL S7
   GO TO 1
35 CALL S8
   GO TO 1
36 CALL S9
   GO TO 1
37 CALL S10
 1 CONTINUE
   DO 60 I = 2, N
   J = IPL(I-1)
60 DER(I) = C(J)
   RETURN
   END
```

```
      SUBROUTINE RESET
      COMMON       C(3510)
      EQUIVALENCE (C(3066),NOLIST), (C(3067),LISTNO), (C(3117),VALUE )
      DIMENSION   LISTNO(50)      , VALUE(50)
      DO 10 I=1,3510
      IF(I.GE.1982.AND.I.LE.2000) GO TO 10
      IF(I.GE.2025.AND.I.LE.2354) GO TO 10
      IF(I.GE.3167.AND.I.LE.3338) GO TO 10
      IF(I.GE.2361.AND.I.LE.2561) GO TO 10
      IF(I.GE.3066.AND.I.LE.3167) GO TO 10
      IF(I.EQ.3    ) GO TO 10
      IF(I.EQ.4    ) GO TO 10
      IF(I.EQ.23   ) GO TO 10
      IF(I.EQ.24   ) GO TO 10
      IF(I.EQ.26   ) GO TO 10
      IF(I.EQ.28   ) GO TO 10
      IF(I.EQ.7    ) GO TO 10
      IF(I.EQ.10   ) GO TO 10
      IF(I.EQ.2    ) GO TO 10
      IF(I.EQ.17   ) GO TO 10
      IF(I.EQ.18   ) GO TO 10
      IF(I.EQ.2000 ) GO TO 10
      IF(I.EQ.2001 ) GO TO 10
      IF(I.EQ.2015 ) GO TO 10
      IF(I.EQ.2013 ) GO TO 10
      IF(I.EQ.2662 ) GO TO 10
      IF(I.EQ.2663 ) GO TO 10
      IF(I.EQ.2664 ) GO TO 10
      IF(I.GE.50.AND.I.LE.53) GO TO 10
      IF(I.EQ.3502 ) GO TO 10
      IF(I.EQ.3504 ) GO TO 10
      IF(I.EQ.50   ) GO TO 10
      IF(I.GE.120. AND. I. LE. 128) GO TO 10
      IF(I.EQ.427  ) GO TO 10
      IF(I.EQ.431  ) GO TO 10
      IF(I.EQ.441  ) GO TO 10
      IF(I.EQ.442  ) GO TO 10
      IF(I.EQ.443  ) GO TO 10
      IF(I.EQ.444  ) GO TO 10
      IF(I.EQ.446  ) GO TO 10
      IF(I.EQ.447  ) GO TO 10
      IF(I.EQ.449  ) GO TO 10
      IF(I.EQ.448  ) GO TO 10
      IF(I.EQ.450  ) GO TO 10
      IF(I.EQ.453  ) GO TO 10
      IF(I.EQ.456  ) GO TO 10
      IF(I.EQ.457  ) GO TO 10
      IF(I.EQ.458  ) GO TO 10
      IF(I.EQ.464  ) GO TO 10
      IF(I.EQ.465  ) GO TO 10
      IF(I.EQ.850  ) GO TO 10
      IF(I.EQ.851  ) GO TO 10
      IF(I.EQ.852  ) GO TO 10
      IF(I.EQ.853  ) GO TO 10
      IF(I.EQ.855  ) GO TO 10
```

```
      IF(I.EQ.856  ) GO TO 10
      IF(I.EQ.864  ) GO TO 10
      IF(I.EQ.863  ) GO TO 10
      IF(I.EQ.865  ) GO TO 10
      IF(I.EQ.866  ) GO TO 10
      IF(I.EQ.877  ) GO TO 10
      IF(I.EQ.1103 ) GO TO 10
      IF(I.EQ.1107 ) GO TO 10
      IF(I.EQ.1111 ) GO TO 10
      IF(I.EQ.1115 ) GO TO 10
      IF(I.EQ.1140 ) GO TO 10
      IF(I.EQ.1141 ) GO TO 10
      IF(I.EQ.1142 ) GO TO 10
      IF(I.EQ.1260 ) GO TO 10
      IF(I.EQ.1261 ) GO TO 10
      IF(I.EQ.1262 ) GO TO 10
      IF(I.EQ.1263 ) GO TO 10
      IF(I.EQ.1264 ) GO TO 10
      IF(I.EQ.1265 ) GO TO 10
      IF(I.EQ.1306 ) GO TO 10
      IF(I.EQ.1307 ) GO TO 10
      IF(I.EQ.1313 ) GO TO 10
      IF(I.EQ.1314 ) GO TO 10
      IF(I.EQ.1315 ) GO TO 10
      IF(I.EQ.1316 ) GO TO 10
      IF(I.EQ.1317 ) GO TO 10
      IF(I.EQ.1403 ) GO TO 10
      IF(I.EQ.1401 ) GO TO 10
      IF(I.EQ.1402 ) GO TO 10
      IF(I.EQ.1404 ) GO TO 10
      IF(I.EQ.1414 ) GO TO 10
      IF(I.EQ.1415 ) GO TO 10
      IF(I.EQ.1416 ) GO TO 10
      IF(I.EQ.1417 ) GO TO 10
      IF(I.EQ.1418 ) GO TO 10
      IF(I.EQ.1419 ) GO TO 10
      IF(I.EQ.1420 ) GO TO 10
      IF(I.EQ.1421 ) GO TO 10
      IF(I.EQ.1627 ) GO TO 10
      IF(I.EQ.1615 ) GO TO 10
      IF(I.EQ.1619 ) GO TO 10
      IF(I.EQ.1623 ) GO TO 10
      IF(I.EQ.1739 ) GO TO 10
      IF(I.EQ.1743 ) GO TO 10
      IF(I.EQ.1747 ) GO TO 10
      IF(I.EQ.1751 ) GO TO 10
      IF(I.EQ.1752 ) GO TO 10
      IF(I.EQ.2008 ) GO TO 10
      IF(I.EQ.2009 ) GO TO 10
      IF(I.EQ.2010 ) GO TO 10
      IF(I.EQ.2012 ) GO TO 10
      IF(I.EQ.2005) GO TO 10
      IF(I.EQ.2006) GO TO 10
      IF(I.EQ.2023) GO TO 10
      IF(I.EQ.1326) GO TO 10
```

```
      IF(I.EQ.1327) GO TO 10
      IF(I.EQ.1328) GO TO 10
      IF(I.EQ.1329) GO TO 10
      IF(I.EQ.1330) GO TO 10
      IF(I.EQ.1331) GO TO 10
      IF(I.EQ.1332) GO TO 10
      IF(I.EQ.54  ) GO TO 10
      IF(I.EQ.55  ) GO TO 10
      IF(I.EQ.56  ) GO TO 10
      IF(I.EQ.58  ) GO TO 10
      IF(I.EQ.57  ) GO TO 10
      IF(I.EQ.73  ) GO TO 10
      IF(I.EQ.59  ) GO TO 10
      IF(I.EQ.1206) GO TO 10
      IF(I.EQ.1207) GO TO 10
      IF(I.EQ.1208) GO TO 10
      IF(I.EQ.1252) GO TO 10
      C(I)=0.0
   10 CONTINUE
      IF (NOLIST .EQ. 0) RETURN
      DO 1 I = 1, NOLIST
      J = LISTNO(I)
    1 C(J) = VALUE(I)
      RETURN
      END
MORE MEMORY WOULD HAVE RESULTED IN BETTER OPTIMIZATION
```

```
C   DUMMY SUBROUTINE
      SUBROUTINE DUMMY
C     ENTRY A1
      ENTRY A1I
C     ENTRY A2
      ENTRY A2I
C     ENTRY A3
C     ENTRY A3I
      ENTRY A4
      ENTRY A4I
      ENTRY A5
      ENTRY A5I
      ENTRY C1
      ENTRY C1I
      ENTRY C2
      ENTRY C2I
      ENTRY C3
      ENTRY C3I
      ENTRY C4
      ENTRY C4I
      ENTRY C5
      ENTRY C5I
      ENTRY C6
      ENTRY C6I
      ENTRY C7
      ENTRY C7I
      ENTRY C8
      ENTRY C8I
      ENTRY C9
      ENTRY C9I
      ENTRY C10
      ENTRY C10I
C     ENTRY D1
C     ENTRY D1I
C     ENTRY D2
C     ENTRY D2I
      ENTRY D3
      ENTRY D3I
      ENTRY D4
      ENTRY D4I
      ENTRY D5
      ENTRY D5I
      ENTRY G1
      ENTRY G1I
C     ENTRY G2
      ENTRY G2I
C     ENTRY G3
      ENTRY G3I
C     ENTRY G4
      ENTRY G4I
C     ENTRY G5
      ENTRY G5I
      ENTRY G6
      ENTRY G6I
      ENTRY S1
```

```
              ENTRY S1I
              ENTRY S2
              ENTRY S2I
              ENTRY S3
              ENTRY S3I
              ENTRY S4
              ENTRY S4I
              ENTRY S5
              ENTRY S5I
              ENTRY S6
              ENTRY S6I
              ENTRY S7
              ENTRY S7I
              ENTRY S8
              ENTRY S8I
              ENTRY S9
              ENTRY S9I
              ENTRY S10
              ENTRY S10I
              ENTRY AUXA1
              ENTRY AUXA2
              ENTRY AUXA3
              ENTRY AUXB1
              ENTRY AUXB2
              ENTRY AUXB3
              ENTRY AUXC1
              ENTRY AUXC2
              ENTRY AUXC3
              ENTRY CNTR1
              ENTRY CNTR2
              ENTRY CNTR3
              ENTRY INPT1
              ENTRY INPT2
              ENTRY INPT3
              ENTRY OUPT1
C             ENTRY OUPT2
C             ENTRY OUPT3
              ENTRY PROCES
C             ENTRY RESET
              ENTRY RNDM1
              ENTRY RNDM2
              ENTRY RNDM3
              ENTRY STGE1
C             ENTRY STGE2
C             ENTRY STGE3
C             ENTRY SUBL1
C             ENTRY SUBL2
              ENTRY KIKSET
              ENTRY COUNTV
              RETURN
              END
```

```
C**   FOR USE WITH CODIM2, FCN2, FCN3
C
      SUBROUTINE TERROR (XLABEL)
      COMMON C(3510)
      EQUIVALENCE (C(2020),LCONV)
      WRITE (6,10) XLABEL
 10   FORMAT  ( 43H0         NO AERO POINTS SPECIFIED FOR ARG , 5X,
     C   7HTABLE  ,A6 )
      CALL EXIT
C
      ENTRY AERROR
      WRITE (6,20) XLABEL
   20 FORMAT  ( 43H0         OUT OF AERO TABLE ARGUMENT ARRAY , 5X,
     C   7HTABLE  ,A6 )
      DO 40 I=1202,1251,7
  40  WRITE(6,30) C(I),C(I+1),C(I+2),C(I+3),C(I+4),C(I+5),C(I+6)
   30 FORMAT(1H ,7E15.7)
      WRITE (6,30) C(2000),C(367),C(368),C(204),C(369),C(370),C(1117),
     C C(1118),C(1119),C(1120)
      LCONV=2
      RETURN
      END
```

```
      FUNCTION SIND (X)
      SIND= SIN (X/57.29578)
      RETURN
      END
```

```
      FUNCTION COSD (X)
      COSD= COS (X/57.29578)
      RETURN
      END
```

```
      FUNCTION ATAND (Y,X)
      IF(X.EQ.0.0.AND.Y.EQ.0.0) GO TO 1
      ATAND= 57.29578*ATAN2 (Y,X)
    1 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE TABLE (X,XI,YI,NX,XK,XLABEL,Y)
      DIMENSION XLABEL (2)
      Y  =   CODIM2 (X,XI,YI,NX,XK,XLABEL)
      RETURN
      END
```

```
      SUBROUTINE TABL2(X,Y,XYI,ZI,NXY,XINTER,XLABEL,Z)
      DIMENSION XYI(2),NXY(2)
      Z  =   FCOON2 (X,Y,XYI,XYI(NXY+1),ZI,NXY,NXY(2),NXY,XINTER,XLABEL)
      RETURN
      END
```

```
      SUBROUTINE TABL3(X,Y,Z,XYZI,WI,NXYZ,XINTER,XLABEL,W)
      DIMENSION XYZI(1),NXYZ(1)
      NZI= NXYZ(1) + NXYZ(2) + 1
      W  =   FCODN3 (X,Y,Z,XYZI,XYZI(NXYZ+1),XYZI(NZI), WI,NXYZ(3),
     C    NXYZ(2),NXYZ,XINTER,XLABEL)
      RETURN
      END
```

```
      SUBROUTINE TIMEV(DELT)
      RETURN
      END
```

```
      SUBROUTINE WRITE(IA,F,N)
      RETURN
      END
```

```
      SUBROUTINE PLOT4 (GRAPH,NP,YL,T,NPLOT4,NPLOT2,NOPLOT)
C**PLOT SUBROUTINE
      DIMENSION GRAPH(300,15),YL(2,15),T(300)
      IF (NPLOT4.EQ.0) RETURN
      KK = 1
      XM1 = GRAPH(1,1)
      YM1 = GRAPH(1,2)
      XT1 = GRAPH(1,3)
      YT1 = GRAPH(1,4)
      XM2 = XM1
      YM2 = YM1
      XT2 = XT1
      YT2 = YT1
      DO 1 I=1,NP
      XM1 = AMIN1(GRAPH(I,1),XM1)
      YM1 = AMIN1(GRAPH(I,2),YM1)
      XT1 = AMIN1(GRAPH(I,3),XT1)
      YT1 = AMIN1(GRAPH(I,4),YT1)
      XM2 = AMAX1(GRAPH(I,1),XM2)
      YM2 = AMAX1(GRAPH(I,2),YM2)
      XT2 = AMAX1(GRAPH(I,3),XT2)
    1 YT2 = AMAX1(GRAPH(I,4),YT2)
      XMIN = AMIN1(XM1,XT1)
      YMIN = AMIN1(YM1,YT1)
      XMAX = AMAX1(XM2,XT2)
      YMAX = AMAX1(YM2,YT2)
      DELX = ABS(XMAX-XMIN)
      DELY = ABS(YMAX-YMIN)
      DEL = AMAX1(DELX,DELY)
      X1 = XMIN
      Y1 = YMIN-(DEL-DELY)/2.
      X2 = X1+DEL
      Y2 = Y1+DEL
      CALL CAMRAV (9)
      CALL SETMIV (24,0,24,24)
      CALL DXDYV(1,X1,X2,DX,N,I,NX,25.,IERR)
      CALL DXDYV(2,Y2,Y1,DY,M,J,NY,25.,IERR)
      CALL GRID1V(KK,X1,X2,Y2,Y1,DX,DY,N,M,I,J,NX,NY)
      DO 2 J=1,3,2
      K = J+1
      UTIME = 0.
      IX1 = NXV(GRAPH(1,J) )
      IY1 = NYV(GRAPH(1,K) )
      DO 2 IJ=2,NP
      IX2 = NXV(GRAPH(IJ,J))
      IY2 = NYV(GRAPH(IJ,K))
      IF(T(IJ)-(.5+UTIME)) 7,3,3
    3 UTIME = T(IJ)
      CALL POINTV(IX2,IY2,-17,2)
    7 IF(J-2) 4,5,5
    5 CALL POINTV(IX2,IY2,0,2)
      GO TO 6
    4 CALL LINEV(IX1,IY1,IX2,IY2)
    6 IX1 = IX2
    2 IY1 = IY2
```

```
      LAB1=(YL(1,1 ).AND.77777777777700000000B).OR.(SHIFT(YL(2,1 ),-36)
     *.AND.777777777B)
      LAB2=(YL(1,2 ).AND.77777777777700000000B).OR.(SHIFT(YL(2,2 ),-36)
     *.AND.777777777B)
60     CALL PRINTV(10,LAB1        ,524,12)
      CALL APRNTV(0,-14,10,LAB2        ,12,524)
      RETURN
      END
```

```
C
C
      SUBROUTINE PLOT2 (GRAPH,NP,YL,T,NPLOT4,NPLOT2,NOPLOT)
      DIMENSION GRAPH(300,15),YL(2,15),T(300)
      DIMENSION IXP(4),IYP(4),MRKPT(4)
      DATA (MRKPT(I),I=1,4)/42,16,38,63/
      DATA(IXP(I),I=1,4)/4,28,4,28/
      DATA(IYP(I),I=1,4)/776,776,411,411/
      IF (NPLOT2.EQ.0) RETURN
      JX= NPLOT4+1
      JY1= JX+1
      JYN= NPLOT4+NPLOT2
      X1= GRAPH(1,JX)
      X2= X1
      DO 110 I=2,NP
      X1= AMIN1 (GRAPH(I,JX),X1)
  110 X2= AMAX1 (GRAPH(I,JX),X2)
      Y1= GRAPH(1,JY1)
      Y2= Y1
      DO 120 JY=JY1,JYN
      DO 120 I=1,NP
      Y1= AMIN1 (GRAPH(I,JY),Y1)
  120 Y2= AMAX1 (GRAPH(I,JY),Y2)
      CALL CAMRAV (9)
      CALL SETMIV (36,24,24,24)
      CALL DXDYV (1,X1,X2,DX,N,I,NX,14.0,IERR)
      CALL DXDYV (2,Y1,Y2,DY,M,J,NY,14.0,IERR)
      CALL GRID1V (1,X1,X2,Y1,Y2,DX,DY,N,M,I,J,-3,-3)
      IMARK= 1
      DO 140 JY=JY1,JYN
      IX1= NXV (GRAPH(1,JX))
      IY1= NYV (GRAPH(1,JY))
C
      DO 130 IJ=2,NP
      IX2= NXV (GRAPH(IJ,JX))
      IY2= NYV (GRAPH(IJ,JY))
      CALL LINEV (IX1,IY1,IX2,IY2)
      CALL LINEV (IX1,IY1,IX2,IY2)
      IX1= IX2
  130 IY1= IY2
      IF (IMARK.GT.4) GO TO 140
      CALL APLOTV (NP,GRAPH(1,JX),GRAPH(1,JY),20,20,1,MRKPT(IMARK),IRR)
  140 IMARK= IMARK + 1
      LAB1=(YL(1,JX).AND.77777777777700000000B).OR.(SHIFT(YL(2,JX),-36)
     *.AND.77777777B)
      CALL PRINTV (10, LAB1         ,468,8)
      I=1
      DO 150 JY=JY1,JYN
      IF (I.GT.4) GO TO 150
      IYQ= IYP(I) + 28
      CALL PLOTV (IXP(I),IYQ,MRKPT(I))
      LAB2=(YL(1,JY).AND.77777777777700000000B).OR.(SHIFT(YL(2,JY),-36)
     *.AND.77777777B)
      CALL APRNTV (0,-14,10,LAB2          ,IXP(I),IYP(I))
  150 I= I+1
```

```
      RETURN
      END
```

```
C
C
      SUBROUTINE PLOTN (GRAPH,NP,YL,T,NPLOT4,NPLOT2,NOPLOT)
      DIMENSION GRAPH(300,15),YL(2,15),T(300)
      NPLOT3=NOPLOT-NPLOT2-NPLOT4
      IF (NPLOT3.LE.0) RETURN
      DO 100 NM=1,NPLOT3
      JY=NPLOT4+NPLOT2+NM
      IX=MOD(NM,3)
      IF(IX  .EQ.  0)IX=3
      II=712-344*(IX-1)
      JJ=28+344*(IX-1)
      KK=1
      IF(IX  .GT.  1)KK=2
      X1=T(1)
      X2=T(NP)
      Y1=GRAPH(1,JY)
      Y2=Y1
      DO 50 I=1,NP
      Y1=AMIN1(GRAPH(I,JY),Y1)
   50 Y2=AMAX1(GRAPH(I,JY),Y2)
      CALL CAMRAV(9)
      CALL SETMIV(24,0,II,JJ)
      CALL OXDYV(1,X1,X2,DX,N,I,NX,14.,IERR)
      CALL DXDYV(2,Y1,Y2,DY,M,J,NY,10.,IERR)
      CALLGRID1V(KK,X1,X2,Y1,Y2,DX,DY,N,M,I,J,NX,-3)
      IX1=NXV(X1)
      IY1=NYV(GRAPH(1,JY))
      DO 55 IJ=2,NP
      IX2=NXV(T(IJ))
      IY2=NYV(GRAPH(IJ,JY))
      CALL LTNEV(IX1,IY1,IX2,IY2)
      IY1=IY2
   55 IX1=IX2
      CALL PRINTV (-11,10HTIME (SEC),468,696-344*(IX-1))
      LAB2=(YL(1,JY).AND.77777777777700000000B).OR.(SHIFT(YL(2,JY),-36)
     *.AND.77777777B)
  100 CALL APRNTV (0,-14,10,LAB2        ,4,890-344*(IX-1))
      RETURN
      END
```

```
C . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
C
C     SUBROUTINE CODIM2
C
C        PURPOSE
C           TO FIT A SET OF POINTS WITH A CONTINUOUS FUNCTION THAT
C           SIMULATES A FRENCH CURVE TYPE CURVE FIT.
C
C        USAGE
C           Y  =  CODIM2 ( X , XI , YI , N , F , XLABEL )
C              OR
C           Y  =  CODIM1 ( X , XI , YI , N , F , XLABEL )
C
C        DESCRIPTION OF PARAMETERS
C           X        ARGUMENT - INDEPENDENT VARIABLE
C           XI       ARRAY OF INDEPENDENT VARIABLE , X
C           YI       ARRAY OF DEPENDENT VARIABLE , Y
C           N        NUMBER OF POINTS REPRESENTED BY XI AND YI ARRAYS
C           F        INTERPOLATION CONTROL
C                       LESS THAN ZERO - STRAIGHT LINE INTERPOLATION
C                       POSITIVE - END INTERVAL INTERPOLATION
C                          0.0   STRAIGHT LINE
C                          1.0   FULL PARABOLIC
C           XLABEL  HOLLERITH FIELD OF UP TO 6 CHARACTERS
C
C        REMARKS
C           EXTRAPOLATICN IS DONE BY PASSING A STRAIGHT LINE THRU THE
C           TWO POINTS AT THE END INTERVAL.
C           THE ARRAY OF THE INDEPENDENT VARIABLE , XI , MAY BE IN
C           EITHER INCREASING OR DECREASING ORDER.
C
C . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

      FUNCTION CODIM2 ( X , XI , YI , N , F , XLABEL )


      DIMENSION  XI(N) , YI(N) , P(2) , E(2) , IS(4,2) , XLABEL(2)
      LOGICAL  OUT
      ENTRY CODIM1
      DATA  IS / -1, 0, -2, -1,  0, 1, -1, 0 /

  100 OUT  =  .FALSE.
      N1  =  N
      XX  =  X
      J  =  1
      IF ( N1 - 2 )  150 , 1200 , 300
  150 CALL TERROR (XLABEL)
  200 CODIM2  =  YI(J)
      RETURN

  300 KPL  =  1
      KPU  =  2
      IF ( XI(1) - XI(2) )  400 , 150 , 600
  400 DO   500   J = 1 , N1
      IF ( XX - XI(J) )  900 , 200 , 500
```

```
       500    CONTINUE
              GO TO   800
       600    DO    700    J = 1  , N1
              IF ( XI(J)  - XX )   900  , 200  , 700
       700    CONTINUE

       800    J   =  N1
              CALL AERROR (XLABEL)
              GO TO   1300

       900    OUT   =   F .LT. 0.0
              IF ( J - 2 )   1200  , 1000  , 1100
      1000    KPL   =   2
              GO TO   1500
      1100    IF ( J - N1 )   1500  , 1400  , 1300
      1200    J   =   2
      1300    OUT   =   .TRUE.
      1400    KPU   =   1
      1500    AL   =   ( XX - XI(J-1) ) / ( XI(J) - XI(J-1) )
              CODIM2   =   AL * YI(J) + ( 1.0 - AL ) * YI(J-1 )
              IF ( OUT )   RETURN

              DO   1800    KP = KPL  , KPU
              P(KP)   =   0.0
              DO   1600    K = 1  , 3
              J0   =   J + KP  + K - 4
              X0   =   XI(J0)
              Y0   =   YI(J0)
              J1   =   J + IS(K,KP)
              J2   =   J + IS(K+1,KP)
      1600    P(KP)   =   P(KP) + Y0 * ( XX - XI(J1) ) / ( X0 - XI(J1) )
             *            * ( XX - XI(J2) ) / ( X0 - XI(J2) )
              IF ( KPL .NE. KPU )   GO TO  1700
              J1   =   3 - KPL
              P(J1)   =   CODIM2 + F * ( P(KP) - CODIM2 )
              E(J1)   =   ABS  ( P(J1) - CODIM2 )
      1700    E(KP)   =   ABS  ( P(KP) - CODIM2 )
      1800    CONTINUE

              IF ( E(1) + E(2)  .EQ. 0.0 )    RETURN
              CODIM2   =    ( ( E(1) * AL ) * P(2) + ( E(2) * ( 1.0 - AL ) )
             *                 * P(1) ) / ( ( E(1) * AL ) + ( E(2) * ( 1.0 - AL ) ) )

              RETURN
              END
```

```
      C     2-DIMENSIONAL INTERPOLATION SUBPROGRAM....FCODN2
      C
      C     CALLING SEQUENCE -
      C     Z = FCODN2(X,Y,XI,YI,ZI,NXD,NY,NX,XK,XLABEL)
      C
      C         X = ARGUMENT - 1ST VARIABLE
      C         Y = ARGUMENT - 2ND VARIABLE
      C        XI = ARRAY OF 1ST VARIABLE
      C        YI = ARRAY OF 2ND VARIABLE
      C        ZI = ARRAY OF DEPENDENT VARIABLE
      C       NXD = DIMENSIONED SIZE OF XI ARRAY
      C        NY = NUMBER OF VALUES IN ARRAY YI
      C        NX = NUMBER OF VALUES IN ARRAY XI
      C        XK = END INTERVAL INTERPOLATION CONTROL CONSTANT
      C    XLABEL = HOLLERITH FIELD OF UP TO 6 CHARACTERS
      C
      C        THIS ROUTINE DIFFERS FROM FCOOM2 IN THAT THE ZI ARRAY DOES NOT
      C           HAVE TO BE PACKED - I.E., IT DOES NOT HAVE TO OCCUPY CON-
      C           SECUTIVE LOCATIONS IN CORE, AND IN THAT EITHER OR BOTH THE
      C           XI AND YI ARRAYS MAY BE IN ASCENDING OR DESCENDING ORDER.
      C
            FUNCTION FCODN2(X,Y,XI,YI,ZI,NXD,NY,NX,XK,XLABEL)
      C
            DIMENSION XI(1), YI(1), ZI(NXD,1), T(4) , XLABEL(2)
      C
            IF (NY.GT.4) GO TO 120
            N3=1
      C        N3 IS THE INDEX NUMBER OF THE FIRST Y CURVE TO BE USED
            N4=NY
      C        N4 IS THE COUNT OF THE NUMBER OF Y CURVES TO BE USED
            GO TO 200
      C
        120 N4=4
            IF (YI(1)-YI(2)) 130,150,133
        130    DO 132 K=1,NY
               IF (Y-YI(K)) 150,150,132
        132    CONTINUE
            GO TO 140
      C
      C
        133    DO 134 K=1,NY
               IF (YI(K)-Y) 150,150,134
        134    CONTINUE
        140 N3=NY-3
            GO TO 200
      C
        150 IF (K-3) 155,155,160
        155 N3=1
            GO TO 200
      C
        160 IF (K-NY) 165,140,140
        165 N3=K-2
      C
        200 L=N3
               DO 300 I=1,N4
```

```
              T(I)=CODIM2(X,XI,ZI(1,L),NX,XK,XLABEL)
  300         L=L+1
C
        FCODN2=CODIM2(Y,YI(N3),T,N4,XK,XLABEL)
        RETURN
        END
```

```
C      3-DIMENSIONAL INTERPOLATION SUBPROGRAM....FCOON3
C
C      CALLING SEQUENCE -
C
C      W = FCOON3(X,Y,Z,XI,YI,ZI,WI,NZ,NY,NX,XK,XLABEL)
C         X = ARGUMENT - 1ST VARIABLE
C         Y = ARGUMENT - 2ND VARIABLE
C         Z = ARGUMENT - 3RD VARIABLE
C        XI = ARRAY OF 1ST VARIABLE
C        YI = ARRAY OF 2ND VARIABLE
C        ZI = ARRAY OF 3RD VARIABLE
C        WI = ARRAY OF DEPENDENT VARIABLE
C        NZ = NUMBER OF POINTS IN ZI ARRAY
C        NY = NUMBER OF POINTS IN YI ARRAY
C        NX = NUMBER OF POINTS IN XI ARRAY
C        XK = END INTERVAL INTERPOLATION CONTROL CONSTANT (0.0 TO 1.0)
C    XLABEL = HOLLERITH FIELD OF UP TO 6 CHARACTERS
C
C        FCOON3 DIFFERS FROM FCOOM3 IN THAT THE WI ARRAY DOES NOT NEED
C          TO BE PACKED, I.E., WI NEED NOT OCCUPY CONSECUTIVE LOCATIONS
C          IN CORE, AND ANY OR ALL ARRAYS MAY BE IN EITHER ASCENDING OR
C          DESCENDING ORDER.
C
       FUNCTION FCOON3(X,Y,Z,XI,YI,ZI,WI,NZ,NY,NX,XK,XLABEL)
C
       DIMENSION XI(1),YI(1),ZI(1), WI(NX,NY,1),T(4),XLABEL(2)
C
       IF (NZ.GT.4) GO TO 120
       N4=1
       N5=NZ
       GO TO 200
C
 120   N5=4
       IF (ZI(1)-ZI(2)) 130,150,133
 130      DO 132 K=1,NZ
          IF (Z-ZI(K)) 150,150,132
 132      CONTINUE
       GO TO 140
C
 133      DO 134 K=1,NZ
          IF (ZI(K)-Z) 150,150,134
 134      CONTINUE
 140   N4=NZ-3
       GO TO 200
C
 150   IF (K.GT.3) GO TO 160
       N4=1
       GO TO 200
C
 160   IF (K.GE.NZ) GO TO 140
       N4=K-2
C
 200   L=N4
          DO 300 I=1,N5
       T(I)= FCOON2 (X,Y,XI,YI,WI(1,1,L),NX,NY,NX,XK,XLABEL)
```

```
  300   L=L+1
C
        FCODN3=CODIM2(Z,ZI(N4),T,NZ,XK,XLABEL)
        RETURN
        END
```

EXAMPLE I. PROGRAM

INPUT DATA

1	OUPT 2,3	3	-0.	-0.
1	STAG2,3	4	-0.	-0.
2	G2-T	23	-0.	-0.
2	G3	24	-0.	-0.
2	G5	26	-0.	-0.
2	A1	2	-0.	-0.
2	A3-T	4	-0.	-0.
2	A2	3	-0.	-0.
2	D1	17	-0.	-0.
2	D2	18	-0.	-0.
3	TF	2001	1.0000000E+00	-0.
3	T	2000	-0.	1.0000000E+00
3	PPP	2005	1.0000000E-02	1.0000000E+00
3	REPPLT	2006	1.0000000E+00	-0.
3	CPP	2015	5.0000000E-02	1.0000000E+00
3	DOC	2013	6.0000000E+00	1.0000000E+00
3	DER%1<	2664	2.0000000E-03	1.0000000E+00
3	PPP1	120	6.0000000E-03	-0.
3	CPP1	121	1.0000000E-01	-0.
3	DER1	122	2.0000000E-03	-0.
3	XTL	123	2.0000000E+01	-0.
3	XLL	124	9.0000000E+00	-0.
3	YLT	125	7.0000000E+00	-0.
3	YLL	126	1.0000000E+00	-0.
3	ZTL	127	9.0000000E+00	-0.
3	ZLL	128	1.0000000E+00	-0.
3	OPTN4	3502	-0.	-0.
3	AGRAV	1627	3.2174000E+01	-0.
3	CRAD	1751	5.7295770E+01	-0.
3	WP	1739	-0.	1.0000000E+00
3	WQ	1743	-0.	1.0000000E+00
3	WR	1747	-0.	1.0000000E+00
3	RXE	1615	0.	1.0000000E+00
3	RYE	1619	-0.	1.0000000E+00
3	RZE	1623	-5.0000000E+03	1.0000000E+00
3	RTXE	1651	0.	1.0000000E+00
3	RTYE	1655	-0.	1.0000000E+00
3	RTZE	1659	-5.0000000E+03	1.0000000E+00
3	EFORCX	1326	-0.	-0.
3	EFT	1332	1.0000000E+01	-0.
3	EJD	1333	2.5540000E-01	1.0000000E+00
3	CIASC	69	1.0000000E+00	1.0000000E+00
3	FMIXO	1419	4.0000000E+00	-0.
3	FMIYO	1420	5.0000000E+01	-0.

3	OPTNW	50	1.0000000E+00	1.0000000E+00
3	XTAIL	57	-3.0000000E+00	-0.
3	XNOSE	59	2.5600000E+00	-0.
3	XNOSE1	73	2.0000000E+00	-0.
3	RFLGTH	1307	1.3333300E+00	-0.
3	RFAREA	1306	1.3960000E+00	-0.
3	OWT	1415	8.2300000E+02	-0.
3	OWP	1416	1.0000000E+00	-0.
3	CISP	1414	1.0000000E+00	-0.
3	XINTER	1252	-1.0000000E+00	1.0000000E+00
3	PLOTN0	2008	1.2000000E+01	-0.
3	PLOTN2	1983	-0.	-0.
3	PLOTN4	1982	-0.	-0.
3	CMQ	1207	-1.2200000E+00	-0.
3	CNR	1208	-1.2200000E+00	-0.
3	CLP	1206	-3.3000000E-01	-0.
3	TNOSOS	58	1.0000000E+00	-0.
3	YPOS	55	6.8000000E+00	-0.
3	XPOS	54	2.1966000E+01	-0.
3	ZPOS	56	-3.0000000E+00	-0.
3	EFORCZ	1328	1.2000000E+03	-0.
3	EFORCY	1327	-0.	-0.
3	EMOMZ	1331	-0.	-0.
3	CNAA	1273	9.6000000E-02	1.0000000E+00
3	CAA	1274	1.2000000E-01	1.0000000E+00
3	CMAA	1272	-1.3330000E-01	1.0000000E+00
3	VMACH	204	8.5000000E-01	1.0000000E+00
3	ALPHAD	381	-0.	-0.
3	STEP	2010	2.0000000E+00	-0.
4	P	1739	-0.	-0.
4	PHI MSL	352	-0.	-0.
4	CX	1203	-0.	-0.
4	CL	1209	-0.	-0.
4	XNOSE1	73	-0.	-0.
4	Q	1743	-0.	-0.
4	THETA MSL	350	-0.	-0.
4	CY	1204	-0.	-0.
4	CM	1210	-0.	-0.
4	AAN	60	-0.	-0.
4	R	1747	-0.	-0.
4	PSI	351	-0.	-0.
4	CZ	1205	-0.	-0.
4	CN	1211	-0.	-0.
4	ASN	61	-0.	-0.
4	FMXBA	1303	-0.	-0.
4	FXBA	1300	-0.	-0.
4	XNPOS	90	-0.	-0.
4	VXED	1600	-0.	-0.
4	XTPOS	93	-0.	-0.

4	FMYBA	1304	-0.	-0.
4	FYBA	1301	-0.	-0.
4	YNPOS	91	-0.	-0.
4	VYED	1604	-0.	-0.
4	YTPOS	94	-0.	-0.
4	FMZBA	1305	-0.	-0.
4	FZBA	1302	-0.	-0.
4	ZNPOS	92	-0.	-0.
4	VZED	1608	-0.	-0.
4	ZTPOS	95	-0.	-0.
4	RXED	1612	-0.	-0.
4	RXE	1615	-0.	-0.
4	RTXED	1648	-0.	-0.
4	RTXE	1651	-0.	-0.
4	DELX	70	-0.	-0.
4	RYED	1616	-0.	-0.
4	RYE	1619	-0.	-0.
4	RTYED	1652	-0.	-0.
4	RTYE	1655	-0.	-0.
4	DELY	71	-0.	-0.
4	RZED	1620	-0.	-0.
4	RZE	1623	-0.	-0.
4	RTZED	1656	-0.	-0.
4	RTZE	1659	-0.	-0.
4	DELZ	72	-0.	-0.
4	XLUN	67	-0.	-0.
4	YLUN	45	-0.	-0.
4	ZLUN	44	-0.	-0.
4	DIASC	69	-0.	-0.
4	TNOSOS	58	-0.	-0.
7	PITCH	350	-0.	-0.
7	YAW	351	-0.	-0.
7	ROLL	352	-0.	-0.
7	X FT	70	-0.	-0.
7	Y FT	71	-0.	-0.
7	Z FT	72	-0.	-0.
7	XNPOS	90	-0.	-0.
7	YNPOS	91	-0.	-0.
7	ZNPOS	92	-0.	-0.
7	XTPOS	93	-0.	-0.
7	YTPOS	94	-0.	-0.
7	ZTPOS	95	-0.	-0.
6		-0	-0.	-0.

BURNOUT TIME= -0.0000 SEC.
TIME= .0020000 STEP SIZE= 2.0000000E-03

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.0020000	-2.0695088E-01	-1.6590527E-04	1.2000000E-01	-5.2506054E-03	2.0000000E+00
	-6.6894790E+00	-6.3328780E-03	8.6983434E-02	-2.5173116E+00	2.8436694E-01
	2.4153754E-01	2.5074949E-04	8.9878075E-01	9.9718304E-02	1.6654031E-02
	-8.6156060E+00	-1.4892836E+02	-2.5599883E+00	-5.8321674E+00	3.0000116E+00
	-4.1596130E+03	1.0804517E+02	1.5921883E-05	4.2241069E+00	-8.4109238E-06
	1.6480858E+02	2.3164429E+03	4.6501905E-04	1.2273134E+02	-1.4952537E-04
	9.3303335E+02	1.8660784E+00	9.3304500E+02	1.8660900E+00	-1.1634401E-05
	5.7822214E-03	5.6034417E-06	0.	0.	5.6034417E-06
	2.0964013E-01	-4.9999998E+03	0.	-5.0000000E+03	2.1608488E-04
	1.1643607E+01	4.0800096E+00	1.8002790E+00	1.0000000E+00	1.0000000E+00
.0500000	-1.5307826E+01	-2.7851998E-01	1.2000000E-01	-4.4526276E-02	2.0000000E+00
	-1.7634668E+02	-4.6675290E+00	1.3721488E-01	-1.9510910E+00	2.8547267E-01
	6.5107912E+00	1.8112928E-01	1.3185769E+00	1.1077417E-01	2.2843481E-02
	-6.7799353E+01	-5.1445180E+01	-2.5435254E+00	-1.1040183E+01	2.9980072E+00
	-2.9782226E+03	1.6466820E+02	1.2873953E-02	6.9411358E+00	-4.6445650E-03
	1.7413204E+02	2.8342673E+03	3.4992475E-01	1.4241198E+02	-1.0251282E-01
	9.3269389E+02	4.6644281E+01	9.3304500E+02	4.6652254E+01	-7.9730889E-03
	2.1317294E-01	4.8094006E-03	0.	0.	4.8094006E-03
	5.8394288E+00	-4.9998584E+03	0.	-5.0000000E+03	1.4162601E-01
	1.1653485E+01	4.0877244E+00	2.0099548E+00	1.0000000E+00	1.0000000E+00

.1000000	1.2481862E+01	-3.3489561E-01	1.2000000E-01	1.6262692E-02	2.0000000E+00
	-2.3443091E+02	-1.5648242E+01	1.7834545E-01	-2.2747261E-01	2.3939556E-01
	1.0145149E+01	7.0416169E-01	2.1257385E+00	2.1714599E-02	2.0427898E-02
	2.2058515E+01	-1.4896990E+02	-2.4201874E+00	-3.3531790E+01	2.9333284E+00
	-3.9076237E+01	2.2140086E+02	5.4236256E-02	8.8467670E+00	-1.1561444E-02
	2.1339426E+01	2.6389254E+03	1.2784501E+00	1.2989395E+02	-2.2125170E-01
	9.3175417E+02	9.3259764E+01	9.3304500E+02	9.3304509E+01	-4.4744764E-02
	5.6744150E-01	2.3942227E-02	0.	0.	2.3942227E-02
	1.1770231E+01	-4.9994120E+03	0.	-5.0000000E+03	5.8795434E-01
	1.1727488E+01	4.1125418E+00	2.5670701E+00	1.0000000E+00	1.0000000E+00
.1500000	2.5087339E+01	4.4964340E-01	1.2000000E-01	1.4734960E-02	2.0000000E+00
	-1.3169227E+02	-2.5400050E+01	2.2460230E-01	1.3933599E+00	1.8404975E-01
	6.9161447E+00	1.2069791E+00	2.7663162E+00	-7.8392862E-02	1.7729043E-02
	1.4552031E+01	-1.4843709E+02	-2.1513902E+00	-6.2849506E+01	2.8700333E+00
	2.4872850E+03	2.7782759E+02	1.1128396E-01	8.4891201E+00	5.4882125E-03
	-1.3923050E+02	3.4218660E+03	2.4375570E+00	1.5059985E+02	5.2675324E-02
	9.2945912E+02	1.3979613E+02	9.3304500E+02	1.3995676E+02	-1.6063705E-01
	9.7604790E-01	6.2573161E-02	0.	0.	6.2573161E-02
	1.8476279E+01	-4.9986605E+03	0.	-5.0000000E+03	1.3394924E+00
	1.1888766E+01	4.1467704E+00	3.2625342E+00	1.0000000E+00	1.0000000E+00
.2000000	3.4828569E+01	1.9034253E+00	1.2000000E-01	1.7852128E-02	2.0000000E+00
	6.2402220E+01	-2.7336164E+01	2.5569580E-01	2.1411766E+00	1.1810473E-01
	-4.9055058E+00	1.3003987E+00	2.6825679E+00	-1.8073689E-01	1.2901211E-02
	1.5723295E+01	-1.4723394E+02	-1.8538687E+00	-6.4519466E+01	3.0839560E+00
	3.4135125E+03	3.1372583E+02	1.7205432E-01	6.5215112E+00	5.9965026E-02
	-2.8865271E+02	3.2913753E+03	3.6201006E+00	1.4413205E+02	1.0668934E+00
	9.2625060E+02	1.8618935E+02	9.3304500E+02	1.8660902E+02	-4.1966547E-01
	1.3234410E+00	1.2044534E-01	0.	0.	1.2044534E-01
	2.5683007E+01	-4.9975555E+03	0.	-5.0000000E+03	2.4445297E+00
	1.2067279E+01	4.1832326E+00	3.9720603E+00	1.0000000E+00	1.0000000E+00

.2500000	4.9267442E+01	4.1791138E+00	1.2000000E-01	2.5434184E-02	2.0000000E+00
	2.4512975E+02	-1.9303937E+01	2.1963031E-01	1.6131181E+00	6.3715292E-02
	-3.3010444E+01	8.0567268E-01	1.7783999E+00	-2.4507415E-01	4.4769438E-03
	2.2260265E+01	-1.4596019E+02	-1.5885771E+00	-3.3574277E+01	3.6583069E+00
	2.2668410E+03	2.6714402E+02	2.2772116E-01	3.7815060E+00	1.5393650E-01
	-3.5042015E+02	2.1631299E+03	4.7399806E+00	1.1060379E+02	2.9019615E+00
	9.2378996E+02	2.3243402E+02	9.3304500E+02	2.3326127E+02	-8.2725569E-01
	1.5889025E+00	1.9374835E-01	0.	0.	1.9374835E-01
	3.2017062E+01	-4.9961063E+03	0.	-5.0000000E+03	3.8937021E+00
	1.2226454E+01	4.2166327E+00	4.6439883E+00	1.0000000E+00	1.0000000E+00
.3000000	6.1887828E+01	7.1942630E+00	1.2000000E-01	8.6293250E-03	2.0000000E+00
	3.0665284E+02	-4.6854461E+00	3.2908013E-02	1.5062857E-02	3.1605503E-02
	-5.4864818E+01	-5.3665278E-02	3.1641187E-01	2.8114386E-02	5.5684871E-03
	-9.8652366E+00	-1.4545494E+02	-1.2340190E+00	-6.8987157E+00	4.3073940E+00
	-4.1184692E+02	3.9888609E+01	2.7377114E-01	-3.2413346E-01	2.7896143E-01
	1.2347854E+02	3.8353057E+02	5.8153886E+00	4.6729958E+01	5.3612184E+00
	9.2291556E+02	2.7859610E+02	9.3304500E+02	2.7991353E+02	-1.3174231E+00
	1.6719512E+00	2.7616101E-01	0.	0.	2.7616101E-01
	3.5954780E+01	-4.9943937E+03	0.	-5.0000000E+03	5.6062762E+00
	1.2439189E+01	4.2442627E+00	5.2892331E+00	1.0000000E+00	1.0000000E+00

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS

.3500000	8.0993364E+01	1.0597466E+01	1.2000000E-01	4.0751693E-02	2.0000000E+00
	2.0464844E+02	8.9719353E+00	-2.5801017E-01	-1.6488411E+00	1.8380887E-02
	-4.7382734E+01	-6.9063947E-01	-1.0104128E+00	3.8133609E-01	1.7017328E-03
	3.4643107E+01	-1.4529636E+02	-6.9627620E-01	-1.3330133E+01	4.7952937E+00
	-2.9528354E+03	-3.1239949E+02	3.2761147E-01	-3.0481878E+00	3.9380969E-01
	6.8299249E+02	-1.2234108E+03	7.0334205E+00	-1.5595216E+01	7.9005055E+00
	9.2252195E+02	3.2473357E+02	9.3304500E+02	3.2656578E+02	-1.8322162E+00
	1.5839770E+00	3.5809112E-01	0.	0.	3.5809112E-01
	3.6578322E+01	-4.9925673E+03	0.	-5.0000000E+03	7.4326550E+00
	1.2761834E+01	4.2765669E+00	6.0200523E+00	1.0000000E+00	1.0000000E+00
.4000000	1.0655872E+02	1.5237661E+01	1.2000000E-01	4.7872897E-02	2.0000000E+00
	4.1677145E+00	1.4517597E+01	-5.1480148E-01	-2.2657894E+00	1.1866880E-02
	-2.8979652E-01	-9.0668394E-01	-1.5175955E+00	7.3058492E-01	1.2129331E-03
	3.6174295E+01	-1.4495632E+02	-9.6466952E-02	-2.4491278E+01	5.2853286E+00
	-3.6552481E+03	-6.2186442E+02	3.9362533E-01	-4.2335111E+00	4.7879731E-01
	1.1771075E+03	-1.8332089E+03	8.5848860E+00	-3.9530189E+01	9.9786511E+00
	9.2149982E+02	3.7083655E+02	9.3304500E+02	3.7321804E+02	-2.3814819E+00
	1.3960351E+00	4.3284108E-01	0.	0.	4.3284108E-01
	3.4982099E+01	-4.9907734E+03	0.	-5.0000000E+03	9.2266202E+00
	1.3121720E+01	4.3161752E+00	6.9509316E+00	1.0000000E+00	1.0000000E+00

.4500000	1.3077747E+02	2.1248241E+01	1.2000000E-01	4.9666165E-02	2.0000000E+00
	-1.6844746E+02	9.6834713E+00	-4.7337060E-01	-1.5481799E+00	7.7975361E-03
	7.4966108E+01	-6.3494706E-01	-1.0401487E+00	6.8405756E-01	2.0259851E-03
	2.9627901E+01	-1.4461126E+02	4.6385190E-01	-1.4647096E+01	5.9442930E+00
	-2.2486693E+03	-5.7045597E+02	4.6981581E-01	-2.8638524E+00	5.3055208E-01
	9.9280279E+02	-1.2534767E+03	1.0499156E+01	-1.9862914E+01	1.1434375E+01
	9.2044719E+02	4.1688307E+02	9.3304500E+02	4.1987029E+02	-2.9872204E+00
	1.2130895E+00	4.9778065E-01	0.	0.	4.9778065E-01
	3.3309425E+01	-4.9890702E+03	0.	-5.0000000E+03	1.0929761E+01
	1.3457911E+01	4.3618895E+00	8.0994935E+00	1.0000000E+00	1.0000000E+00
.5000000	1.3909359E+02	2.8223725E+01	1.2000000E-01	-4.8168293E-02	2.0000000E+00
	-2.1353033E+02	-1.7961888E+00	-3.0530927E-02	-2.1034299E-02	0.
	1.2635232E+02	-1.3609085E-01	-1.5148483E-02	4.2393464E-02	0.
	-1.3060443E+02	-1.4439060E+02	1.0711924E+00	-5.6031864E+00	6.6284411E+00
	2.6890332E+02	-3.6736490E+01	5.4961975E-01	-9.1511639E-01	5.6281954E-01
	-1.1107340E+02	-1.8227487E+01	1.2669512E+01	3.0690673E+01	1.2495238E+01
	9.2001402E+02	4.6289262E+02	9.3304500E+02	4.6652255E+02	-3.6299256E+00
	1.1184306E+00	5.5569735E-01	0.	0.	5.5569735E-01
	3.3504076E+01	-4.9874107E+03	0.	-5.0000000E+03	1.2589271E+01
	1.3638901E+01	4.3868444E+00	8.7648465E+00	1.0000000E+00	1.0000000E+00
.6000000	1.2173766E+02	4.1653545E+01	1.2000000E-01	4.9338204E-03	2.0000000E+00
	3.1322580E+00	-1.6787231E+01	9.5354182E-01	1.3911362E+00	0.
	-1.3070199E+00	5.4406267E-01	1.0018685E+00	-1.3240325E+00	0.
	-3.8719074E+01	-1.4401379E+02	2.5406833E+00	-2.4140777E+01	7.8634941E+00
	2.2215915E+03	1.1443598E+03	6.9297212E-01	1.9570865E+00	6.4242687E-01
	-2.1167995E+03	1.2023574E+03	1.6983856E+01	9.2638112E+01	1.5378027E+01
	9.1847171E+02	5.5483558E+02	9.3304500E+02	5.5982706E+02	-4.9914739E+00
	1.2114720E+00	6.6969949E-01	0.	0.	6.6969949E-01
	4.0664299E+01	-4.9837555E+03	0.	-5.0000000E+03	1.6244482E+01
	1.3638901E+01	4.3868444E+00	8.7648465E+00	1.0000000E+00	1.0000000E+00

.7000000	4.0727795E+01	5.0246788E+01	1.2000000E-01	-4.2555211E-02	2.0000000E+00
	1.2441459E+02	-3.2695294E+00	2.9957077E-02	1.0821932E-02	0.
	-1.5827821E+02	2.2230605E-01	7.7937397E-03	-4.1596649E-02	0.
	-8.3507348E+01	-1.4366608E+02	3.9866379E+00	-5.6844030E+00	9.5375424E+00
	-1.5864381E+02	3.5865132E+01	8.0935649E-01	5.9412358E-01	7.8781902E-01
	1.5740078E+02	9.3308004E+00	2.0860308E+01	3.3162750E+01	2.0543205E+01
	9.1695953E+02	6.4658911E+02	9.3304500E+02	6.5313156E+02	-6.5424501E+00
	1.3601571E+00	7.9943996E-01	0.	0.	7.9943996E-01
	4.7697954E+01	-4.9792857E+03	0.	-5.0000000E+03	2.0714304E+01
	1.3638901E+01	4.3868444E+00	8.7648465E+00	1.0000000E+00	1.0000000E+00
.8000000	-1.5813697E+01	5.1598589E+01	1.2000000E-01	-2.6412870E-02	2.0000000E+00
	-4.0995794E+00	8.8630268E+00	-9.1334354E-01	-9.5664285E-01	0.
	2.1344493E+00	-2.2261391E-01	-6.8895509E-01	1.2682156E+00	0.
	-3.6038754E+01	-1.4339050E+02	5.6598699E+00	-1.3775310E+01	1.1153436E+01
	-1.5183546E+03	-1.0913732E+03	9.2482359E-01	-1.2273654E+00	9.4616809E-01
	2.0175359E+03	-8.2324680E+02	2.5128524E+01	-1.9751911E+01	2.5985168E+01
	9.1601836E+02	7.3824679E+02	9.3304500E+02	7.4643607E+02	-8.1892814E+00
	1.3131468E+00	9.3465127E-01	0.	0.	9.3465127E-01
	4.7561104E+01	-4.9744771E+03	0.	-5.0000000E+03	2.5522950E+01
	1.3638901E+01	4.3868444E+00	8.7648465E+00	1.0000000E+00	1.0000000E+00

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS

.9000000	-5.4264678E+01	4.7970782E+01	1.2000000E-01	-4.7271993E-02	2.0000000E+00
	-1.1025387E+02	-2.5231301E+00	-3.9301187E-02	-2.8110257E-02	0.
	1.2953526E+02	-4.2528660E-02	-2.0244446E-02	5.4571335E-02	0.
	-5.4454761E+01	-1.4311985E+02	7.3892829E+00	-5.5022838E+00	1.2943887E+01
	1.1091997E+02	-4.6873167E+01	1.0577761E+00	-5.2161274E-01	1.0618991E+00
	-9.6056467E+01	-2.4144851E+01	3.0342922E+01	2.9936526E+01	3.0098156E+01
	9.1509230E+02	8.2979378E+02	9.3304500E+02	8.3974058E+02	-9.9467986E+00
	1.1991863E+00	1.0596744E+00	0.	0.	1.0596744E+00
	4.7451945E+01	-4.9697698E+03	0.	-5.0000000E+03	3.0230224E+01
	1.3638901E+01	4.3868444E+00	8.7648465E+00	1.0000000E+00	1.0000000E+00

START PLOTTING AT 0.0000000
PLOTTING ENDED AT 0.0000000

INPUT DATA

3	ALPHAD	381	3.0000000E+00	-0.
3	VMACH	204	5.0000000E-01	-0.
3	STEP	2010	1.1000000E+01	-0.
6		-0	-0.	-0.

BURNOUT TIME= -0.0000 SEC.

TIME					
TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.0020000	-3.2073293E-02	-2.5698578E-05	1.2000000E-01	-2.3537737E-03	2.0000000E+00
	-1.8557438E+00	-1.7847485E-03	5.0351855E-02	-1.8489119E+00	1.6315556E-01
	4.8398780E-02	5.0274907E-05	2.2429544E-01	5.7720532E-02	9.6399894E-03
	-1.3367621E+00	-5.1356266E+01	-2.5599960E+00	-2.0092783E+00	3.0000040E+00
	-1.0542320E+03	2.1564173E+01	3.1924396E-06	8.4304127E-01	-1.6862528E-06
	3.2919761E+01	1.2960613E+03	2.3292630E-04	8.2841589E+01	5.9733766E-05
	5.4884598E+02	1.0976960E+00	5.4885000E+02	1.0977000E+00	-4.0158936E-06
	1.1580278E-03	1.1233423E-06	0.	0.	1.1233423E-06
	1.5866311E-01	-4.9999998E+03	0.	-5.0000000E+03	1.5997665E-04
	1.1643602E+01	4.0800019E+00	1.8001398E+00	1.0000000E+00	1.0000000E+00
.0500000	-1.0762983E+00	-2.5105408E-02	1.2000000E-01	-4.0748188E-03	2.0000000E+00
	-5.0882399E+01	-1.2923616E+00	6.1485124E-02	-1.7330752E+00	1.6347184E-01
	1.4767432E+00	3.6660078E-02	3.1064166E-01	6.6379419E-02	1.1521688E-02
	-2.0814224E+00	-2.4344532E+01	-2.5568281E+00	-2.1272559E+00	3.0017564E+00
	-9.4693217E+02	2.5815268E+01	2.5334741E-03	1.0306798E+00	-1.0231259E-03
	3.6668163E+01	1.3327771E+03	1.5835362E-01	8.4241836E+01	3.2953094E-02
	5.4874876E+02	2.7439982E+01	5.4885000E+02	2.7442502E+01	-2.5202649E-03
	3.7344829E-02	8.9615316E-04	0.	0.	8.9615316E-04
	4.0377621E+00	-4.9998994E+03	0.	-5.0000000E+03	1.0061878E-01
	1.1645503E+01	4.0815201E+00	1.8950122E+00	1.0000000E+00	1.0000000E+00

.1000000	-4.8056322E+00	-1.4988066E-01	1.2000000E-01	-2.6561198E-02	2.0000000E+00
	-9.0716405E+01	-4.9089776E+00	8.0992584E-02	-1.2553673E+00	1.5718757E-01
	3.0454235E+00	1.5636738E-01	5.9692865E-01	7.0757141E-02	1.3859340E-02
	-1.4076343E+01	-5.1421223E+01	-2.5402682E+00	-2.8620300E+00	2.9993163E+00
	-6.4053198E+02	3.4706148E+01	1.0963140E-02	1.3751349E+00	-4.1551194E-03
	3.7851339E+01	2.5579001E+02	6.1612973E-01	4.1961469E+01	1.4034366E-01
	5.4863412E+02	5.4874673E+01	5.4885000E+02	5.4885005E+01	-1.0332178E-02
	8.9280559E-02	4.0025224E-03	0.	0.	4.0025224E-03
	7.2914013E+00	-4.9996029E+03	0.	-5.0000000E+03	3.9706615E-01
	1.1655439E+01	4.0865779E+00	2.1696778E+00	1.0000000E+00	1.0000000E+00
.1500000	2.1806744E-01	-3.9755051E-01	1.2000000E-01	1.7281687E-02	2.0000000E+00
	-1.0822235E+02	-9.9939447E+00	9.0855537E-02	-4.6850893E-01	1.3668971E-01
	3.9354416E+00	3.6106142E-01	9.6904741E-01	4.9146536E-02	1.3263701E-02
	9.8225863E+00	-5.1414202E+01	-2.4960363E+00	-4.8046072E+00	2.9794877E+00
	-1.7612881E+02	3.8927208E+01	2.5918383E-02	1.6041419E+00	-8.5872412E-03
	2.4747926E+01	4.1518999E+02	1.2581131E+00	4.7799361E+01	2.9320799E-01
	5.4846189E+02	8.2302439E+01	5.4885000E+02	8.2327508E+01	-2.5068789E-02
	1.5350916E-01	1.0031205E-02	0.	0.	1.0031205E-02
	9.4280626E+00	-4.9991862E+03	0.	-5.0000000E+03	8.1384315E-01
	1.1681978E+01	4.0955510E+00	2.5548679E+00	1.0000000E+00	1.0000000E+00
.2000000	5.3409906E+00	-3.0400347E-01	1.2000000E-01	1.2479968E-02	2.0000000E+00
	-9.9269798E+01	-1.5293540E+01	1.0539161E-01	3.7694904E-01	1.1281756E-01
	4.4555859E+00	6.1581413E-01	1.3515377E+00	6.2578591E-03	1.1483599E-02
	5.9031811E+00	-5.1378351E+01	-2.4179723E+00	-7.9215670E+00	2.9448220E+00
	2.9910460E+02	4.5123728E+01	4.6101929E-02	1.7990157E+00	-1.1539518E-02
	-1.9403498E-01	5.7866483E+02	2.0204863E+00	5.3455832E+01	5.5395695E-01
	5.4816689E+02	1.0971878E+02	5.4885000E+02	1.0977001E+02	-5.1228624E-02
	2.2936937E-01	1.9562236E-02	0.	0.	1.9562236E-02
	1.1876152E+01	-4.9986547E+03	0.	-5.0000000E+03	1.3452521E+00
	1.1728817E+01	4.1076612E+00	3.0122918E+00	1.0000000E+00	1.0000000E+00

.2500000	9.4313397E+00	-3.1937586E-03	1.2000000E-01	1.3849486E-02	2.0000000E+00
	-6.6091914E+01	-1.9519109E+01	1.2368865E-01	1.1112222E+00	8.7565854E-02
	3.4302772E+00	8.4589252E-01	1.6400671E+00	-6.5460726E-02	7.9485990E-03
	5.7385853E+00	-5.1294758E+01	-2.3164641E+00	-1.1076542E+01	2.9234315E+00
	6.8915508E+02	5.2871495E+01	6.8776521E-02	1.9051460E+00	-8.5888730E-03
	-4.0206103E+01	7.0105702E+02	2.8613575E+00	5.7335625E+01	1.0036437E+00
	5.4771027E+02	1.3711636E+02	5.4885000E+02	1.3721251E+02	-9.6150352E-02
	3.1554818E-01	3.3155207E-02	0.	0.	3.3155207E-02
	1.4587689E+01	-4.9979940E+03	0.	-5.0000000E+03	2.0060090E+00
	1.1789722E+01	4.1212659E+00	3.5168145E+00	1.0000000E+00	1.0000000E+00
.3000000	1.3715628E+01	5.4026916E-01	1.2000000E-01	1.6494928E-02	2.0000000E+00
	-1.6083294E+01	-2.1625265E+01	1.4031092E-01	1.5812363E+00	6.2420531E-02
	3.5718491E-02	9.4224448E-01	1.7381921E+00	-1.4240638E-01	3.8895649E-03
	6.2488071E+00	-5.1172660E+01	-2.2121191E+00	-1.2578819E+01	2.9558356E+00
	9.1263395E+02	5.9834025E+01	9.0346566E-02	1.8591813E+00	5.3505025E-03
	-8.1000082E+01	7.4123263E+02	3.7499817E+00	5.8393861E+01	1.7009302E+00
	5.4712805E+02	1.6448764E+02	5.4885000E+02	1.6465502E+02	-1.6737135E-01
	4.0678426E-01	5.1211751E-02	0.	0.	5.1211751E-02
	1.7443554E+01	-4.9971935E+03	0.	-5.0000000E+03	2.8065348E+00
	1.1852329E+01	4.1342079E+00	4.0499890E+00	1.0000000E+00	1.0000000E+00

TIME					
	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.3500000	1.8294174E+01	1.3859450E+00	1.2000000E-01	1.8655258E-02	2.0000000E+00
	3.9214588E+01	-2.1040663E+01	1.4353487E-01	1.6537619E+00	4.4294656E-02
	-5.4687477E+00	8.1688457E-01	1.6165973E+00	-1.7576194E-01	1.7535446E-03
	6.4102130E+00	-5.1040329E+01	-2.1203846E+00	-1.1554747E+01	3.0683791E+00
	9.0482914E+02	6.1050559E+01	1.0781869E-01	1.5712504E+00	3.3835782E-02
	-9.5069096E+01	6.8759716E+02	4.6694965E+00	5.6592523E+01	2.6732876E+00
	5.4652745E+02	1.9182883E+02	5.4885000E+02	1.9209752E+02	-2.6868681E-01
	4.9277845E-01	7.3754625E-02	0.	0.	7.3754625E-02
	2.0296269E+01	-4.9962496E+03	0.	-5.0000000E+03	3.7503796E+00
	1.1907369E+01	4.1446912E+00	4.6016979E+00	1.0000000E+00	1.0000000E+00
.4000000	2.2813502E+01	2.5259850E+00	1.2000000E-01	2.0090508E-02	2.0000000E+00
	8.7386036E+01	-1.7811107E+01	1.2418194E-01	1.3613921E+00	2.8609463E-02
	-1.1646966E+01	4.8226561E-01	1.2555604E+00	-1.5034537E-01	1.6904024E-03
	6.1746249E+00	-5.0927415E+01	-2.0393732E+00	-8.2982241E+00	3.2539484E+00
	6.9680640E+02	5.2702210E+01	1.2067215E-01	1.0704259E+00	7.6116556E-02
	-7.5271468E+01	5.3285372E+02	5.6165732E+00	5.1464906E+01	3.9158814E+00
	5.4603323E+02	2.1914218E+02	5.4885000E+02	2.1954002E+02	-3.9783982E-01
	5.5911605E-01	1.0015735E-01	0.	0.	1.0015735E-01
	2.2987590E+01	-4.9951665E+03	0.	-5.0000000E+03	4.8335215E+00
	1.1955976E+01	4.1524033E+00	5.1699439E+00	1.0000000E+00	1.0000000E+00

.4500000	2.6923349E+01	3.8883952E+00	1.2000000E-01	1.9910353E-02	2.0000000E+00
	1.1759872E+02	-1.2561064E+01	7.9089082E-02	7.3124760E-01	1.9328533E-02
	-1.6750131E+01	4.2997335E-02	7.1254398E-01	-6.6322297E-02	3.2846084E-03
	5.1274651E+00	-5.0868724E+01	-1.9514169E+00	-4.5229013E+00	3.4755011E+00
	3.1438322E+02	3.3526339E+01	1.3107970E-01	5.0349540E-01	1.2700710E-01
	-2.3395773E+01	3.0205169E+02	6.6004478E+00	4.3327373E+01	5.3912592E+00
	5.4571939E+02	2.4643522E+02	5.4885000E+02	2.4698252E+02	-5.4730805E-01
	5.9778142E-01	1.2920459E-01	0.	0.	1.2920459E-01
	2.5352024E+01	-4.9939563E+03	0.	-5.0000000E+03	6.0436995E+00
	1.2008750E+01	4.1586478E+00	5.7602687E+00	1.0000000E+00	1.0000000E+00
.5000000	2.9358355E+01	5.3893609E+00	1.2000000E-01	-1.7478629E-02	2.0000000E+00
	1.2310593E+02	-6.3807331E+00	5.1434990E-03	-5.1806182E-02	1.3035952E-02
	-1.9686977E+01	-3.8565827E-01	8.8098263E-02	1.4907176E-02	1.6343244E-03
	-1.6553804E+01	-5.0847900E+01	-1.8358535E+00	-2.1381732E+00	3.6895784E+00
	-1.3280543E+02	2.1794677E+00	1.4234336E-01	-3.7851155E-02	1.7953564E-01
	2.4979594E+01	3.7330097E+01	7.6456319E+00	3.3404951E+01	7.0277228E+00
	5.4556344E+02	2.7371680E+02	5.4885000E+02	2.7442503E+02	-7.0823031E-01
	6.0842134E-01	1.5946787E-01	0.	0.	1.5946787E-01
	2.7262430E+01	-4.9926389E+03	0.	-5.0000000E+03	7.3611273E+00
	1.2078088E+01	4.1654060E+00	6.3873792E+00	1.0000000E+00	1.0000000E+00
.5500000	3.7217824E+01	7.0869795E+00	1.2000000E-01	3.2329594E-02	2.0000000E+00
	1.0316145E+02	-5.5045723E-01	-9.2831264E-02	-8.1118311E-01	9.6969700E-03
	-1.9517686E+01	-7.5632890E-01	-4.9103004E-01	1.3564520E-01	5.0379382E-04
	9.7977879E+00	-5.0845462E+01	-1.6847467E+00	-1.9150018E+00	3.8745117E+00
	-5.4503839E+02	-3.9333738E+01	1.5584412E-01	-4.9721888E-01	2.2923298E-01
	9.3047488E+01	-2.0805541E+02	8.7862797E+00	2.3894085E+01	8.7328640E+00
	5.4547088E+02	3.0099262E+02	5.4885000E+02	3.0186753E+02	-8.7491184E-01
	5.9454731E-01	1.8963466E-01	0.	0.	1.8963466E-01
	2.8680476E+01	-4.9912383E+03	0.	-5.0000000E+03	8.7616856E+00
	1.2168752E+01	4.1735065E+00	7.0717678E+00	1.0000000E+00	1.0000000E+00

.6000000	4.4579392E+01	9.1207597E+00	1.2000000E-01	3.7110198E-02	2.0000000E+00
	6.3007386E+01	3.7509521E+00	-1.9715839E-01	-1.3586429E+00	6.8211476E-03
	-1.4669625E+01	-1.0381174E+00	-9.1293131E-01	2.8312373E-01	7.1706238E-04
	1.0820272E+01	-5.0834620E+01	-1.5074392E+00	-3.0079764E+00	4.0397391E+00
	-8.2038584E+02	-8.3520600E+01	1.7233423E-01	-7.7287130E-01	2.7285214E-01
	1.7225269E+02	-3.8673763E+02	1.0054694E+01	1.6891731E+01	1.0418427E+01
	5.4534989E+02	3.2826338E+02	5.4885000E+02	3.2931003E+02	-1.0466572E+00
	5.6237709E-01	2.1861585E-01	0.	0.	2.1861585E-01
	2.9680458E+01	-4.9897778E+03	0.	-5.0000000E+03	1.0222168E+01
	1.2275136E+01	4.1834005E+00	7.8328161E+00	1.0000000E+00	1.0000000E+00
.6500000	5.2716835E+01	1.1536775E+01	1.2000000E-01	4.2179051E-02	2.0000000E+00
	1.2288804E+01	5.7120989E+00	-2.8615592E-01	-1.5793508E+00	0.
	-4.3801377E+00	-1.1977354E+00	-1.1120213E+00	4.0334748E-01	0.
	1.1816552E+01	-5.0790612E+01	-1.3208512E+00	-3.8835456E+00	4.2103316E+00
	-9.0161897E+02	-1.2111695E+02	1.9246110E-01	-8.7828067E-01	3.0810415E-01
	2.3130661E+02	-4.7066870E+02	1.1470638E+01	1.3490515E+01	1.2024024E+01
	5.4517389E+02	3.5552665E+02	5.4885000E+02	3.5675254E+02	-1.2258804E+00
	5.2027146E-01	2.4570682E-01	0.	0.	2.4570682E-01
	3.0423508E+01	-4.9882746E+03	0.	-5.0000000E+03	1.1725434E+01
	1.2387089E+01	4.1954767E+00	8.6823826E+00	1.0000000E+00	1.0000000E+00

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS

.7500000	7.0141513E+01	1.7688915E+01	1.2000000E-01	4.8966159E-02	2.0000000E+00
	-7.3101475E+01	2.1551086E+00	-2.6956795E-01	-1.0522145E+00	0.
	2.5687449E+01	-1.1364409E+00	-7.5778390E-01	3.7430633E-01	0.
	1.1667332E+01	-5.0747479E+01	-9.4573514E-01	-2.4904845E+00	4.6092387E+00
	-5.3187419E+02	-1.1399911E+02	2.4271755E-01	-3.8996963E-01	3.5291288E-01
	1.8947109E+02	-3.2046352E+02	1.4742590E+01	1.8968127E+01	1.4951673E+01
	5.4482969E+02	4.1002559E+02	5.4885000E+02	4.1163754E+02	-1.6119507E+00
	4.4485747E-01	2.9345497E-01	0.	0.	2.9345497E-01
	3.1935646E+01	-4.9851611E+03	0.	-5.0000000E+03	1.4838858E+01
	1.2387089E+01	4.1954767E+00	8.6823826E+00	1.0000000E+00	1.0000000E+00

.8500000	7.5550727E+01	2.5370167E+01	1.2000000E-01	1.6367944E-02	2.0000000E+00
	-9.0885265E+01	-7.4784122E+00	7.3031551E-02	1.1990231E-01	0.
	4.4008955E+01	-9.3801506E-01	8.6351254E-02	-1.0140735E-01	0.
	-7.9438280E+00	-5.0746057E+01	-5.1391544E-01	-2.1940396E+00	4.9980517E+00
	1.4397946E+02	3.0883861E+01	2.9599837E-01	5.1524760E-01	3.8624533E-01
	-9.4159787E+01	3.6516547E+01	1.8483384E+01	3.3707622E+01	1.7759736E+01
	5.4463598E+02	4.6449858E+02	5.4885000E+02	4.6652255E+02	-2.0239687E+00
	4.5241112E-01	3.3755092E-01	0.	0.	3.3755092E-01
	3.4540776E+01	-4.9818498E+03	0.	-5.0000000E+03	1.8150193E+01
	1.2387089E+01	4.1954767E+00	8.6823826E+00	1.0000000E+00	1.0000000E+00
.9500000	7.6937310E+01	3.3041585E+01	1.2000000E-01	2.8185662E-02	2.0000000E+00
	-4.0974863E+01	-1.5363595E+01	5.0512412E-01	9.5058084E-01	0.
	2.2098390E+01	-1.0833852E+00	6.8458935E-01	-7.0138588E-01	0.
	-1.5988350E+00	-5.0730249E+01	-6.4421056E-03	-5.6144573E+00	5.3539064E+00
	5.7024080E+02	2.1354227E+02	3.3968278E-01	9.3534808E-01	4.4105175E-01
	-4.1391678E+02	2.8941157E+02	2.2473846E+01	4.5183107E+01	2.1000760E+01
	5.4425100E+02	5.1894592E+02	5.4885000E+02	5.2140755E+02	-2.4616320E+00
	5.3084559E-01	3.8635626E-01	0.	0.	3.8635626E-01
	3.8560707E+01	-4.9782044E+03	0.	-5.0000000E+03	2.1795591E+01
	1.2387089E+01	4.1954767E+00	8.6823826E+00	1.0000000E+00	1.0000000E+00

START PLOTTING AT 0.0000000
PLOTTING ENDED AT 0.0000000

APPENDIX VI

EXAMPLE 2

The second example is also a multiple run that simulates the trajectory of a MK-84 and a MK-81 bomb for the outboard pylon. The flow field data used in simulating the trajectories was collected in the presence of a MK-84 on the outboard pylon at M=.85 and angle of attack = .3. The first trajectory is that of the MK-84 at M=.85 with all the scale factors being 1. The second trajectory simulates the MK-81 and has the scale factor (DIASC) equal to 2 since the MK-81 diameter is 1/2 that of the MK-84. This launch occurs at M=.5 and an angle of attack = 3.3 degrees. The ejector force for both runs was 10,000 pounds and acted until the bomb was 0.333 foot down from the aircraft. The trajectory was calculated until ground impact.

EXAMPLE II PROGRAM

INPUT DATA

1	OUPT 2,3	3	-0.	-0.
1	STAG2,3	4	-0.	-0.
2	G2-T	23	-0.	-0.
2	G3	24	-0.	-0.
2	G5	26	-0.	-0.
2	A1	2	-0.	-0.
2	A3-T	4	-0.	-0.
2	A2	3	-0.	-0.
2	D1	17	-0.	-0.
2	D2	18	-0.	-0.
3	TF	2001	1.0000000E+02	1.0000000E+00
3	T	2000	-0.	1.0000000E+00
3	PPP	2005	1.0000000E-02	1.0000000E+00
3	REPPLT	2006	1.0000000E+00	-0.
3	CPP	2015	5.0000000E-02	1.0000000E+00
3	DOC	2013	6.0000000E+00	1.0000000E+00
3	DER(1)	2664	2.0000000E-03	1.0000000E+00
3	PPP1	120	1.0000000E-01	-0.
3	CPP1	121	1.0000000E+00	-0.
3	DER1	122	1.0000000E-02	-0.
3	XTL	123	2.4000000E+01	-0.
3	XLL	124	1.2000000E+01	-0.
3	YLT	125	9.0000000E+00	-0.
3	YLL	126	3.0000000E+00	-0.
3	ZTL	127	9.0000000E+00	-0.
3	ZLL	128	1.0000000E+00	-0.
3	OPTN4	3502	-0.	-0.
3	AGRAV	1627	3.2174000E+01	-0.
3	CRAD	1751	5.7295770E+01	-0.
3	WP	1739	-0.	1.0000000E+00
3	WQ	1743	-0.	1.0000000E+00
3	WR	1747	-0.	1.0000000E+00
3	RXE	1615	0.	1.0000000E+00
3	RYE	1619	-0.	1.0000000E+00
3	RZE	1623	-1.0000000E+03	1.0000000E+00
3	RTXE	1651	0.	1.0000000E+00
3	RTYE	1655	-0.	1.0000000E+00
3	RTZE	1659	-1.0000000E+03	1.0000000E+00
3	EFORCX	1326	-0.	-0.
3	EFT	1332	1.0000000E+01	-0.
3	EJD	1333	3.3300000E-01	1.0000000E+00
3	DIASC	69	1.0000000E+00	1.0000000E+00
3	FMIYO	1420	3.6000000E+02	-0.
3	FMIXO	1419	1.8300000E+01	-0.
3	OPTNW	50	1.0000000E+00	1.0000000E+00
3	XTAIL	57	-6.8260000E+00	-0.

3	XNOSE	59	5.1660000E+00	-0.
3	XNOSE1	73	3.3330000E+00	-0.
3	RFLGTH	1307	1.5000000E+00	-0.
3	RFAREA	1306	1.7670000E+00	-0.
3	OWT	1415	2.0540000E+03	-0.
3	DWP	1416	1.0000000E+00	-0.
3	CISP	1414	1.0000000E+00	-0.
3	XINTER	1252	-1.0000000E+00	1.0000000E+00
3	PLOTN0	2008	1.2000000E+01	-0.
3	PLOTN2	1983	-0.	-0.
3	PLOTN4	1982	-0.	-0.
3	CMQ	1207	-1.3000000E+00	-0.
3	CNR	1208	-1.3000000E+00	-0.
3	CLP	1206	-3.3000000E-01	-0.
3	TNOSOS	58	1.0000000E+00	-0.
3	XPOS	54	2.9590000E+01	-0.
3	YPOS	55	1.1040000E+01	-0.
3	ZPOS	56	-1.8500000E+00	-0.
3	EFORCZ	1328	1.0000000E+04	-0.
3	EFORCY	1327	-0.	-0.
3	EMOMZ	1331	-0.	-0.
3	CNAA	1273	8.0000000E-02	1.0000000E+00
3	CMAA	1272	-1.5000000E-01	1.0000000E+00
3	CAA	1274	1.0000000E-01	1.0000000E+00
3	VMACH	204	8.5000000E-01	1.0000000E+00
3	ALPHAD	381	-0.	-0.
3	STEP	2010	2.0000000E+00	-0.
4	P	1739	-0.	-0.
4	PHI MSL	352	-0.	-0.
4	CX	1203	-0.	-0.
4	CL	1209	-0.	-0.
4	XNOSE1	73	-0.	-0.
4	Q	1743	-0.	-0.
4	THETA MSL	350	-0.	-0.
4	CY	1204	-0.	-0.
4	CM	1210	-0.	-0.
4	AAN	60	-0.	-0.
4	R	1747	-0.	-0.
4	PSI	351	-0.	-0.
4	CZ	1205	-0.	-0.
4	CN	1211	-0.	-0.
4	ASN	61	-0.	-0.
4	FMXBA	1303	-0.	-0.
4	FXBA	1300	-0.	-0.
4	XNPOS	90	-0.	-0.
4	VXED	1600	-0.	-0.
4	XTPOS	93	-0.	-0.
4	FMYBA	1304	-0.	-0.

4	FYBA	1301	-0.	-0.
4	YNPOS	91	-0.	-0.
4	VYED	1604	-0.	-0.
4	YTPOS	94	-0.	-0.
4	FMZBA	1305	-0.	-0.
4	FZBA	1302	-0.	-0.
4	ZNPOS	92	-0.	-0.
4	VZED	1608	-0.	-0.
4	ZTPOS	95	-0.	-0.
4	RXED	1612	-0.	-0.
4	RXE	1615	-0.	-0.
4	RTXED	1648	-0.	-0.
4	RTXE	1651	-0.	-0.
4	DELX	70	-0.	-0.
4	RYED	1616	-0.	-0.
4	RYE	1619	-0.	-0.
4	RTYED	1652	-0.	-0.
4	RTYE	1655	-0.	-0.
4	DELY	71	-0.	-0.
4	RZED	1620	-0.	-0.
4	RZE	1623	-0.	-0.
4	RTZED	1656	-0.	-0.
4	RTZE	1659	-0.	-0.
4	DELZ	72	-0.	-0.
4	XLUN	67	-0.	-0.
4	YLUN	45	-0.	-0.
4	ZLUN	44	-0.	-0.
4	DIASC	69	-0.	-0.
4	TNOSOS	58	-0.	-0.
7	PITCH	350	-0.	-0.
7	YAW	351	-0.	-0.
7	ROLL	352	-0.	-0.
7	X FT	70	-0.	-0.
7	Y FT	71	-0.	-0.
7	Z FT	72	-0.	-0.
7	XNPOS	90	-0.	-0.
7	YNPOS	91	-0.	-0.
7	ZNPOS	92	-0.	-0.
7	XTPOS	93	-0.	-0.
7	YTPOS	94	-0.	-0.
7	ZTPOS	95	-0.	-0.
6		-0	-0.	-0.

BURNOUT TIME= -0.0000 SEC.
TIME= .0020000 STEP SIZE= 2.0000000E-03

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.0020000	6.5593515E-01	5.2526909E-04	1.0000000E-01	4.5917042E-02	3.3330000E+00
	-8.7759535E-01	-8.1119923E-04	2.3737263E-01	-1.4014257E+00	9.2861488E-02
	4.9842943E-01	4.7842150E-04	1.8270567E-01	8.2554670E-01	6.7654397E-02
	1.2529240E+02	-1.8245079E+02	-5.1659943E+00	-2.8602703E+00	6.8260057E+00
	-3.8358720E+03	4.3351598E+02	4.7832537E-05	6.7891170E+00	-5.2301027E-05
	2.2596736E+03	1.0333607E+04	4.4910011E-04	1.9404036E+02	2.7931621E-04
	9.4636728E+02	1.8927403E+00	9.4637300E+02	1.8927460E+00	-5.7144067E-06
	8.3425806E-03	9.0279773E-06	0.	0.	9.0279773E-06
	3.8230466E-01	-9.9999962E+02	0.	-1.0000000E+03	3.8460963E-04
	1.4654403E+01	6.6240287E+00	1.1102695E+00	1.0000000E+00	1.0000000E+00
.0500000	1.6238170E+01	4.3769054E-01	1.0000000E-01	2.8453518E-02	3.3330000E+00
	-2.6082335E+01	-6.5541730E-01	2.5614395E-01	-1.3691484E+00	9.2173492E-02
	1.4225971E+01	3.6017447E-01	1.9359349E-01	7.1235616E-01	6.3317395E-02
	6.6360363E+01	-6.8311646E+01	-5.1619706E+00	-2.9714242E+00	6.8290079E+00
	-3.6786653E+03	5.4436334E+02	3.8871849E-02	7.2693624E+00	-3.6507197E-02
	1.9121305E+03	1.0352751E+04	2.9850846E-01	1.9437777E+02	1.6133269E-01
	9.4622884E+02	4.7315065E+01	9.4637300E+02	4.7318654E+01	-3.5894179E-03
	2.6266123E-01	6.4018314E-03	0.	0.	6.4018314E-03
	9.5796755E+00	-9.9976058E+02	0.	-1.0000000E+03	2.3941831E-01
	1.4656818E+01	6.6473231E+00	1.2891051E+00	1.0000000E+00	1.0000000E+00

.1000000	9.2886794E+00	1.2027597E+00	1.0000000E-01	-2.0913859E-02	3.3330000E+00
	-4.8240171E+01	-2.5611275E+00	2.9165066E-01	-1.0704549E+00	9.0032375E-02
	2.4123518E+01	1.3200784E+00	3.3202758E-01	3.8038122E-01	4.9085603E-02
	-6.3938761E+01	-1.8263694E+02	-5.1448851E+00	-3.4768769E+00	6.8319566E+00
	-2.7966372E+03	5.3266184E+02	1.4612201E-01	8.0644705E+00	-1.2986984E-01
	9.7409934E+02	6.0640501E+02	1.0638780E+00	4.1708318E+01	5.2801282E-01
	9.4607405E+02	9.4622724E+01	9.4637300E+02	9.4637309E+01	-1.4585067E-02
	5.7840160E-01	2.7229992E-02	0.	0.	2.7229992E-02
	1.2967385E+01	-9.9916696E+02	0.	-1.0000000E+03	8.3303750E-01
	1.4667069E+01	6.7116732E+00	1.7483268E+00	1.0000000E+00	1.0000000E+00
.1500000	2.8076346E+00	1.5776642E+00	1.0000000E-01	-2.4903792E-02	3.3330000E+00
	-6.1547241E+01	-5.3839492E+00	3.2980058E-01	-5.7489103E-01	8.2351442E-02
	2.6004390E+01	2.5429266E+00	5.2130198E-01	-2.6666196E-02	3.1351855E-02
	-7.0200650E+01	-1.8255005E+02	-5.1040434E+00	-4.6652050E+00	6.8232941E+00
	-1.4008064E+03	6.0205112E+02	2.9343842E-01	8.8182888E+00	-2.3627380E-01
	-1.4627768E+02	9.5163702E+02	2.0178573E+00	4.6999313E+01	8.9265500E-01
	9.4588247E+02	1.4192186E+02	9.4637300E+02	1.4195596E+02	-3.4101151E-02
	9.5046192E-01	6.5246241E-02	0.	0.	6.5246241E-02
	1.5079686E+01	-9.9846686E+02	0.	-1.0000000E+03	1.5331376E+00
	1.4691574E+01	6.8000631E+00	2.3207144E+00	1.0000000E+00	1.0000000E+00
.2000000	6.0729816E+00	1.5721438E+00	1.0000000E-01	2.9872421E-02	3.3330000E+00
	-6.2599219E+01	-8.5768945E+00	3.8549496E-01	6.1631395E-02	6.6697289E-02
	2.0589421E+01	3.6535622E+00	7.0406397E-01	-3.1739796E-01	2.1487105E-02
	7.7407402E+01	-1.8244057E+02	-5.0329720E+00	-6.5250869E+00	6.8008162E+00
	3.4496345E+02	7.0329922E+02	4.4912252E-01	1.0065018E+01	-3.0650342E-01
	-9.2658139E+02	1.2844984E+03	3.1160513E+00	5.1934636E+01	1.3276053E+00
	9.4561796E+02	1.8920975E+02	9.4637300E+02	1.8927462E+02	-6.4872775E-02
	1.3956708E+00	1.2360925E-01	0.	0.	1.2360925E-01
	1.7461078E+01	-9.9765439E+02	0.	-1.0000000E+03	2.3456141E+00
	1.4734217E+01	6.8934735E+00	2.9796308E+00	1.0000000E+00	1.0000000E+00

.2500000	2.1215018E+01	2.1108270E+00	1.0000000E-01	4.4734485E-02	3.3330000E+00
	-5.0837325E+01	-1.1487513E+01	4.3302522E-01	6.4211870E-01	5.3523921E-02
	1.1067058E+01	4.3783488E+00	8.8150172E-01	-4.8736703E-01	1.7274719E-02
	1.0713841E+02	-1.8225787E+02	-4.9363835E+00	-8.7462362E+00	6.7810982E+00
	1.8985749E+03	7.8922252E+02	5.9230733E-01	1.0790904E+01	-3.0484980E-01
	-1.3635509E+03	1.6066062E+03	4.3126628E+00	5.6696788E+01	1.9244039E+00
	9.4525053E+02	2.3648192E+02	9.4637300E+02	2.3659327E+02	-1.1135794E-01
	1.8994277E+00	2.0582406E-01	0.	0.	2.0582406E-01
	2.0108248E+01	-9.9671617E+02	0.	-1.0000000E+03	3.2838334E+00
	1.4792170E+01	6.9793844E+00	3.6975977E+00	1.0000000E+00	1.0000000E+00
.3000000	3.8079037E+01	3.5554624E+00	1.0000000E-01	4.8776137E-02	3.3330000E+00
	-2.8750401E+01	-1.3523736E+01	4.6797161E-01	1.0904270E+00	4.0577078E-02
	-1.9768148E-01	4.5632961E+00	9.9087520E-01	-5.4285827E-01	1.7855957E-02
	1.0598010E+02	-1.8201958E+02	-4.8279671E+00	-1.0449266E+01	6.7945716E+00
	3.0580670E+03	8.5179997E+02	7.1354305E-01	1.0767748E+01	-2.1409094E-01
	-1.4816064E+03	1.8035869E+03	5.5682184E+00	5.9727073E+01	2.7639114E+00
	9.4478072E+02	2.8373305E+02	9.4637300E+02	2.8391193E+02	-1.7887412E-01
	2.4240965E+00	3.1393074E-01	0.	0.	3.1393074E-01
	2.2971043E+01	-9.9563984E+02	0.	-1.0000000E+03	4.3601604E+00
	1.4857220E+01	7.0521258E+00	4.4509311E+00	1.0000000E+00	1.0000000E+00

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.3500000	5.3984227E+01	5.9536715E+00	1.0000000E-01	4.9560421E-02	3.3330000E+00
	-5.7780997E-01	-1.4241631E+01	4.7282741E-01	1.3063735E+00	3.0049460E-02
	-1.2167731E+01	4.1918874E+00	9.9912264E-01	-5.4909154E-01	1.7939722E-02
	9.6609645E+01	-1.8177993E+02	-4.7222742E+00	-1.0800725E+01	6.8700787E+00
	3.5637116E+03	8.5950533E+02	8.1385138E-01	9.6762477E+00	-3.5787580E-02
	-1.4629988E+03	1.8162044E+03	6.8536885E+00	6.0253145E+01	3.9035161E+00
	9.4425469E+02	3.3095902E+02	9.4637300E+02	3.3123058E+02	-2.7156327E-01
	2.9226349E+00	4.4783832E-01	0.	0.	4.4783832E-01
	2.5939366E+01	-9.9441721E+02	0.	-1.0000000E+03	5.5827931E+00
	1.4920635E+01	7.1123108E+00	5.2222131E+00	1.0000000E+00	1.0000000E+00
.4000000	6.8248488E+01	9.2203196E+00	1.0000000E-01	4.9215849E-02	3.3330000E+00
	2.7097720E+01	-1.3446653E+01	4.3232168E-01	1.2118350E+00	2.4969960E-02
	-2.4949092E+01	3.3468623E+00	8.9703186E-01	-5.3665188E-01	1.4487053E-02
	8.5381797E+01	-1.8160233E+02	-4.6254457E+00	-9.5364832E+00	7.0179224E+00
	3.2249334E+03	7.8510624E+02	8.9819460E-01	7.5064588E+00	2.1728699E-01
	-1.3917490E+03	1.6290307E+03	8.1548595E+00	5.7926094E+01	5.3662411E+00
	9.4374959E+02	3.7815887E+02	9.4637300E+02	3.7854924E+02	-3.9036836E-01
	3.3408848E+00	6.0486869E-01	0.	0.	6.0486869E-01
	2.8871797E+01	-9.9304644E+02	0.	-1.0000000E+03	6.9535594E+00
	1.4978733E+01	7.1629168E+00	6.0029157E+00	1.0000000E+00	1.0000000E+00

.4500000	8.0682333E+01	1.3208562E+01	1.0000000E-01	4.8290354E-02	3.3330000E+00
	4.8308566E+01	-1.1254859E+01	3.3904900E-01	8.9564157E-01	2.2188412E-02
	-3.8106072E+01	2.1491705E+00	7.0056502E-01	-4.5632161E-01	9.4648154E-03
	7.3912341E+01	-1.8146537E+02	-4.5307228E+00	-7.1776688E+00	7.2223821E+00
	2.3022150E+03	6.1525652E+02	9.6991125E-01	4.5663461E+00	5.2884421E-01
	-1.1350545E+03	1.2712829E+03	9.4752151E+00	5.2792807E+01	7.1346948E+00
	9.4333616E+02	4.2533553E+02	9.4637300E+02	4.2586789E+02	-5.3236443E-01
	3.6369913E+00	7.7990536E-01	0.	0.	7.7990536E-01
	3.1620663E+01	-9.9153305E+02	0.	-1.0000000E+03	8.4669498E+00
	1.5035566E+01	7.2059467E+00	6.7951291E+00	1.0000000E+00	1.0000000E+00
.5000000	9.1797873E+01	1.7758550E+01	1.0000000E-01	4.9833584E-02	3.3330000E+00
	5.9852367E+01	-8.0204442E+00	1.9231269E-01	4.8819189E-01	1.8527665E-02
	-4.9085581E+01	7.4820986E-01	4.4655014E-01	-2.2158744E-01	7.3943148E-03
	7.0122306E+01	-1.8135488E+02	-4.4230343E+00	-4.7480829E+00	7.4506511E+00
	1.1599547E+03	3.4876846E+02	1.0328249E+00	1.2717950E+00	8.7776093E-01
	-4.6494109E+02	8.0984048E+02	1.0831212E+01	4.5390402E+01	9.1580109E+00
	9.4304464E+02	4.7249455E+02	9.4637300E+02	4.7318655E+02	-6.9199741E-01
	3.7807671E+00	9.6602540E-01	0.	0.	9.6602540E-01
	3.4056198E+01	-9.8988958E+02	0.	-1.0000000E+03	1.0110419E+01
	1.5100179E+01	7.2436950E+00	7.6087271E+00	1.0000000E+00	1.0000000E+00
.5500000	9.5148889E+01	2.2709194E+01	1.0000000E-01	-3.8343341E-02	3.3330000E+00
	6.0987967E+01	-4.2436309E+00	3.0911554E-03	7.1185474E-02	1.4172481E-02
	-5.4307647E+01	-6.5315152E-01	1.8067033E-01	1.1180793E-01	6.2360659E-03
	-1.7206768E+02	-1.8126232E+02	-4.2879831E+00	-3.2056381E+00	7.6703623E+00
	2.2313355E+01	5.6031001E+00	1.0965359E+00	-1.8629892E+00	1.2328627E+00
	4.5647750E+02	3.2748724E+02	1.2248164E+01	3.6716817E+01	1.1360784E+01
	9.4285315E+02	5.1964168E+02	9.4637300E+02	5.2050520E+02	-8.6351897E-01
	3.7628364E+00	1.1552638E+00	0.	0.	1.1552638E+00
	3.6090469E+01	-9.8813411E+02	0.	-1.0000000E+03	1.1865892E+01
	1.5181210E+01	7.2819215E+00	8.4588981E+00	1.0000000E+00	1.0000000E+00

TIME= .5900000 STEP SIZE= 1.0000000E-02

.6000000	7.8789043E+01	2.7162553E+01	1.0000000E-01	-4.1184108E-02	3.3330000E+00
	5.4302577E+01	-4.8705654E-01	-2.1353361E-01	-9.8814344E-02	0.
	-5.1429262E+01	-1.8569783E+00	-5.2700983E-02	4.0037552E-01	0.
	-1.6792991E+02	-1.8099923E+02	-4.1198414E+00	-2.9512577E+00	7.8654272E+00
	-4.2063846E+02	-3.8649419E+02	1.1725109E+00	-4.6110718E+00	1.5610941E+00
	1.2313118E+03	-9.5388374E+01	1.3756133E+01	2.8056878E+01	1.3654194E+01
	9.4270515E+02	5.6678060E+02	9.4637300E+02	5.6782386E+02	-1.0432582E+00
	3.6003692E+00	1.3399138E+00	0.	0.	1.3399138E+00
	3.7692448E+01	-9.8628778E+02	0.	-1.0000000E+03	1.3712221E+01
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00
1.6000000	-1.9816087E+01	2.4210702E+01	1.0000000E-01	2.3662054E-02	3.3330000E+00
	-1.5944406E+01	2.4637372E+00	-3.3037497E-01	-7.9461242E-01	0.
	2.4098990E+01	-1.4445120E+00	-4.2379329E-01	6.1945307E-01	0.
	7.8086532E+01	-1.8028631E+02	1.7222315E+00	-3.5447796E+00	1.3699338E+01
	-2.1041816E+03	-5.9562085E+02	4.0612123E+00	-3.5129885E+00	4.3632370E+00
	1.6076456E+03	-7.6404131E+02	6.4813999E+01	1.7567569E+01	6.5329500E+01
	9.3847526E+02	1.5073151E+03	9.4637300E+02	1.5141969E+03	-6.8818156E+00
	2.3435560E+00	4.1913206E+00	0.	0.	4.1913206E+00
	6.6419842E+01	-9.3496393E+02	0.	-1.0000000E+03	6.5036070E+01
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
2.6000000	2.4606693E+00	3.0327874E+01	1.0000000E-01	-4.2203827E-02	3.3330000E+00
	-2.8502125E+01	-8.8203590E+00	2.2487604E-01	2.4942546E-01	0.
	2.4569330E+01	1.7527682E+00	1.3302691E-01	-4.2164258E-01	0.
	-1.1601265E+02	-1.8048724E+02	1.1517466E+01	-3.8917383E+00	2.3362103E+01
	7.5530106E+02	4.0587257E+02	7.0762731E+00	3.4711214E+00	6.7138139E+00
	-1.2105033E+03	2.4009660E+02	1.4852082E+02	3.8120629E+01	1.4668201E+02
	9.3499949E+02	2.4439501E+03	9.4637300E+02	2.4605700E+03	-1.6619984E+01
	2.5812359E+00	6.9201304E+00	0.	0.	6.9201304E+00
	9.7682031E+01	-8.5227132E+02	0.	-1.0000000E+03	1.4772868E+02
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00
3.6000000	1.7156682E+00	2.6614068E+01	1.0000000E-01	3.3087425E-02	3.3330000E+00
	1.3846890E+01	-1.0836011E+01	1.2898760E-01	3.5003927E-01	0.
	-1.8451074E+01	5.9409150E-01	1.8668761E-01	-2.4185174E-01	0.
	8.8795157E+01	-1.8138479E+02	2.4730643E+01	-3.9998619E+00	3.6508183E+01
	9.1332800E+02	2.3396388E+02	9.8353278E+00	8.5891957E-01	9.7132038E+00
	-6.0599036E+02	3.3862293E+02	2.6347367E+02	3.7910016E+01	2.6121919E+02
	9.3144953E+02	3.3771389E+03	9.4637300E+02	3.4069431E+03	-2.9804256E+01
	3.1657700E+00	9.7827184E+00	0.	0.	9.7827184E+00
	1.3137286E+02	-7.3749753E+02	0.	-1.0000000E+03	2.6250247E+02
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00

4.6000000	-1.2948997E+01	2.9586904E+01	1.0000000E-01	-1.9570632E-02	3.3330000E+00
	9.0632219E+00	-7.4666318E+00	-1.6476749E-01	-2.5231844E-01	0.
	-5.5815500E+00	-7.9928390E-01	-1.3456983E-01	3.0893905E-01	0.
	-4.4388934E+01	-1.8300248E+02	4.1053711E+01	-2.1338121E+00	5.2942869E+01
	-7.1835738E+02	-3.0152860E+02	1.2578378E+01	-2.1731316E+00	1.2744244E+01
	8.6389729E+02	-2.4626613E+02	4.0984662E+02	2.6163107E+01	4.0828827E+02
	9.2843983E+02	4.3071408E+03	9.4637300E+02	4.3533162E+03	-4.6175408E+01
	2.8421326E+00	1.2649831E+01	0.	0.	1.2649831E+01
	1.6277788E+02	-5.9082470E+02	0.	-1.0000000E+03	4.0917530E+02
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00
5.6000000	2.1611782E+01	2.8279001E+01	1.0000000E-01	4.6115495E-02	3.3330000E+00
	-1.3987031E+01	-1.1113815E+01	-1.6137200E-02	-1.0011242E-01	0.
	1.3951818E+01	3.0306179E-01	-5.3393290E-02	3.0257251E-02	0.
	1.1242938E+02	-1.8525622E+02	6.0452213E+01	-2.5433301E+00	7.2219153E+01
	-2.3812191E+02	-2.9895168E+01	1.5449360E+01	3.0821617E-01	1.5387120E+01
	4.4106237E+01	-9.8914392E+01	5.8823053E+02	3.0058040E+01	5.8591897E+02
	9.2565584E+02	5.2341681E+03	9.4637300E+02	5.2996893E+03	-6.5521260E+01
	2.6090811E+00	1.5422548E+01	0.	0.	1.5422548E+01
	1.9333044E+02	-4.1276526E+02	0.	-1.0000000E+03	5.8723474E+02
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00
6.6000000	-1.5373756E+01	2.8861416E+01	1.0000000E-01	1.4171967E-03	3.3330000E+00
	-2.3838574E+00	-1.5328980E+01	9.3501710E-02	1.7781839E-01	0.
	-1.1843001E+00	6.4229040E-01	9.4836472E-02	-1.7531571E-01	0.
	1.5307812E+01	-1.8816548E+02	8.2816087E+01	-3.8531063E+00	9.4380733E+01
	5.0879652E+02	1.7593794E+02	1.8264587E+01	1.0212307E+00	1.8134941E+01
	-4.9139391E+02	1.7844950E+02	7.9815879E+02	3.5038738E+01	7.9498858E+02
	9.2261897E+02	6.1582644E+03	9.4637300E+02	6.2460624E+03	-8.7797988E+01
	2.8621790E+00	1.8208737E+01	0.	0.	1.8208737E+01
	2.2535936E+02	-2.0320689E+02	0.	-1.0000000E+03	7.9679311E+02
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00

MISS DISTANCE= 6.94246672E+03

TIME FINAL= 7.45109003E+00

XM EARTH= 6.94243618E+03 YM EARTH= 2.05946911E+01 ZM EARTH= 0.

7.4600000	7.7301141E-01	2.8305247E+01	1.0000000E-01	3.2929430E-02	3.3330000E+00
	3.5354392E+00	-1.6197034E+01	3.8699510E-02	1.0478473E-01	0.
	-5.5114328E+00	2.7835293E-01	5.5885190E-02	-7.2561582E-02	0.
	9.3861532E+01	-1.9118988E+02	1.0434848E+02	-3.4413303E+00	1.1586436E+02
	2.9014546E+02	7.3989548E+01	2.0644562E+01	2.1009417E-01	2.0588615E+01
	-1.9194335E+02	1.0684683E+02	1.0036902E+03	3.3281443E+01	1.0003451E+03
	9.2004515E+02	6.9506339E+03	9.4637300E+02	7.0599433E+03	-1.0930937E+02
	2.8933681E+00	2.0620460E+01	0.	0.	2.0620460E+01
	2.5260314E+02	2.2492019E+00	0.	-1.0000000E+03	1.0022492E+03
	1.5260398E+01	7.3175216E+00	9.1775738E+00	1.0000000E+00	1.0000000E+00

START PLOTTING AT 0.0000000
PLOTTING ENDED AT 0.0000000

245

INPUT DATA

3	ALPHAD	381	3.0000000E+00	-0.	
3	VMACH	204	5.0000000E-01	-0.	
3	DIASC	69	2.0000000E+00	1.0000000E+00	
3	DWT	1415	2.6000000E+02	-0.	
3	RFAREA	1306	4.4170000E-01	-0.	
3	RFLGTH	1307	7.5000000E-01	-0.	
3	FMIXO	1419	7.0000000E-01	-0.	
3	FMIYO	1420	1.4600000E+01	-0.	
3	XNOSE1	73	2.1000000E+00	-0.	
3	STEP	2010	1.1000000E+01	-0.	
6		-0	-0.	-0.	

BURNOUT TIME= -0.0000 SEC.
TIME= .0020000 STEP SIZE= 2.0000000E-03

TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
.0020000	2.0786934E-01	1.6744957E-04	1.0000000E-01	1.2595407E-02	2.1000000E+00
	-8.7096109E-01	-8.4476829E-04	8.9756698E-02	-1.1613504E+00	4.2156125E-02
	2.2254234E-01	2.1648418E-04	-1.3750026E-01	3.4989712E-01	2.4169675E-02
	1.4825236E+00	-1.5604137E+01	-5.1659961E+00	-1.9491642E+00	6.8260039E+00
	-1.3710816E+02	1.4167321E+01	2.0859498E-05	1.7495354E+00	-2.4450616E-05
	4.1312717E+01	9.9783415E+03	2.6067162E-03	1.2669554E+03	2.4299063E-03
	5.5668610E+02	1.1133761E+00	5.5669000E+02	1.1133800E+00	-3.8976657E-06
	2.1984114E-03	2.3355734E-06	0.	0.	2.3355734E-06
	2.5322603E+00	-9.9999747E+02	0.	-1.0000000E+03	2.5328506E-03
	1.4654402E+01	6.6240250E+00	1.1131281E+00	2.0000000E+00	1.0000000E+00
.0500000	2.1111077E+00	8.3356835E-02	1.0000000E-01	-1.5451526E-03	2.1000000E+00
	-2.9354653E+01	-7.1723779E-01	4.5990067E-02	-1.2797987E+00	2.8839360E-02
	4.5631309E+00	1.3633878E-01	-3.4728262E-01	1.1136919E-01	9.1385582E-03
	-2.3871114E-01	-1.5807113E+01	-5.1631565E+00	-1.8730568E+00	6.8278699E+00
	-1.4868277E+02	7.2697020E+00	1.3746825E-02	9.0502516E-01	-1.4786604E-02
	1.2730371E+01	-5.4895357E+01	1.2179583E+00	2.5358273E+01	1.0678444E+00
	5.5659373E+02	2.7832078E+01	5.5669000E+02	2.7834503E+01	-2.4240940E-03
	5.2551161E-02	1.4552178E-03	0.	0.	1.4552178E-03
	3.0673706E+01	-9.9884671E+02	0.	-1.0000000E+03	1.1532919E+00
	1.4656106E+01	6.6404962E+00	2.5715499E+00	2.0000000E+00	1.0000000E+00

.1000000	-1.1677982E+00	1.2353651E-01	1.0000000E-01	-1.4604479E-02	2.1000000E+00
	-5.1305294E+01	-2.7802270E+00	5.2507236E-02	-7.9939905E-01	1.6422489E-02
	5.7502587E+00	3.9729497E-01	-2.3708498E-01	3.8391476E-02	6.3434309E-03
	-1.7000965E+00	-1.5801621E+01	-5.1502966E+00	-1.7354768E+00	6.8273000E+00
	-8.9423183E+01	8.2969945E+00	4.0816654E-02	1.0247051E+00	-4.2238594E-02
	3.9541191E+00	-3.7463270E+01	2.9693588E+00	2.7450897E+01	2.3876859E+00
	5.5650457E+02	5.5659507E+01	5.5669000E+02	5.5669005E+01	-9.4986237E-03
	9.1967936E-02	5.0376761E-03	0.	0.	5.0376761E-03
	3.1964900E+01	-9.9728122E+02	0.	-1.0000000E+03	2.7187820E+00
	1.4663822E+01	6.6729800E+00	4.6732305E+00	2.0000000E+00	1.0000000E+00
.1500000	-1.6580038E+01	-2.6539878E-01	1.0000000E-01	-4.4112924E-02	2.1000000E+00
	-6.2629236E+01	-5.6737675E+00	6.3835156E-02	-3.3688967E-01	1.3029697E-02
	4.7542040E+00	6.7377900E-01	-3.0094724E-02	-5.9743321E-02	2.7250500E-03
	-4.7918062E+00	-1.5801423E+01	-5.1193951E+00	-1.9015526E+00	6.8130302E+00
	-3.3436386E+01	1.0086863E+01	7.1361212E-02	1.2231948E+00	-6.8966544E-02
	-7.5727754E+00	-4.7553947E+00	4.8632812E+00	3.1389358E+01	3.6777022E+00
	5.5641649E+02	8.3482567E+01	5.5669000E+02	8.3503508E+01	-2.0940894E-02
	1.4492907E-01	1.0909882E-02	0.	0.	1.0909882E-02
	3.3418900E+01	-9.9564745E+02	0.	-1.0000000E+03	4.3525492E+00
	1.4682363E+01	6.7096335E+00	6.9459374E+00	2.0000000E+00	1.0000000E+00
.2000000	-9.9385633E+00	-1.0826778E+00	1.0000000E-01	4.9940801E-02	2.1000000E+00
	-6.2794967E+01	-8.8555991E+00	6.8806130E-02	1.5621938E-01	1.0609292E-02
	1.7533341E+00	8.7880115E-01	2.0532785E-01	-9.9819894E-02	1.3501390E-03
	6.1794779E+00	-1.5800310E+01	-5.0666297E+00	-2.5674211E+00	6.7810253E+00
	2.5018117E+01	1.0871582E+01	9.7995394E-02	1.3817183E+00	-8.3737875E-02
	-1.2010540E+01	3.2442437E+01	6.8596043E+00	3.5813948E+01	5.0134992E+00
	5.5630815E+02	1.1130082E+02	5.5669000E+02	1.1133801E+02	-3.7188381E-02
	2.0842372E-01	1.9707066E-02	0.	0.	1.9707066E-02
	3.5089082E+01	-9.9393567E+02	0.	-1.0000000E+03	6.0643261E+00
	1.4714022E+01	6.7415945E+00	9.3415252E+00	2.0000000E+00	1.0000000E+00

.2500000	9.5847114E+00	-1.0576083E+00	1.0000000E-01	3.1855950E-02	2.1000000E+00
	-5.2047752E+01	-1.1767964E+01	7.0002679E-02	6.0210478E-01	8.4165965E-03
	-7.6865190E-01	9.6039021E-01	4.1777670E-01	-1.1305434E-01	8.3576556E-04
	3.5223120E+00	-1.5797651E+01	-4.9968456E+00	-3.5990041E+00	6.7414521E+00
	7.6730825E+01	1.1058779E+01	1.1664372E-01	1.4588757E+00	-8.0131718E-02
	-1.3315317E+01	6.5998905E+01	8.9186751E+00	3.9744662E+01	6.4729222E+00
	5.5615627E+02	1.3911265E+02	5.5669000E+02	1.3917251E+02	-5.9862746E-02
	2.7901006E-01	3.1875405E-02	0.	0.	3.1875405E-02
	3.6973858E+01	-9.9213492E+02	0.	-1.0000000E+03	7.8650763E+00
	1.4755893E+01	6.7639725E+00	1.1812410E+01	2.0000000E+00	1.0000000E+00

TIME= .2540000 STEP SIZE= 1.0000000E-02

.3040000	2.1135408E+01	-1.8492974E-01	1.0000000E-01	2.2654320E-02	2.1000000E+00
	-2.8599797E+01	-1.3984017E+01	6.5703413E-02	1.0431264E+00	0.
	-3.1933975E+00	8.7905642E-01	5.5633406E-01	-1.2319390E-01	0.
	2.1264945E+00	-1.5785769E+01	-4.9179337E+00	-4.5403819E+00	6.7172915E+00
	1.2646099E+02	1.0371789E+01	1.2579724E-01	1.2490280E+00	-5.2729382E-02
	-1.4254613E+01	8.7821608E+01	1.1169124E+01	4.2243382E+01	8.2712429E+00
	5.5593651E+02	1.6913940E+02	5.5669000E+02	1.6923378E+02	-9.4372249E-02
	3.4999294E-01	4.8890281E-02	0.	0.	4.8890281E-02
	3.9187366E+01	-9.9007925E+02	0.	-1.0000000E+03	9.9207544E+00
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00

TIME					
TIME	P	PHI MSL	CX	CL	XNOSE1
	Q	THETA MSL	CY	CM	AAN
	R	PSI	CZ	CN	ASN
	FMXBA	FXBA	XNPOS	VXED	XTPOS
	FMYBA	FYBA	YNPOS	VYED	YTPOS
	FMZBA	FZBA	ZNPOS	VZED	ZTPOS
	RXED	RXE	RTXED	RTXE	DELX
	RYED	RYE	RTYED	RTYE	DELY
	RZED	RZE	RTZED	RTZE	DELZ
	XLUN	YLUN	ZLUN	DIASC	TNOSOS
1.3040000	2.1785685E+01	5.9064598E+01	1.0000000E-01	2.4179205E-02	2.1000000E+00
	2.4150817E+01	-7.9750741E+00	-1.0693661E-01	2.5436261E-02	0.
	-3.6868219E+01	-3.4003130E+00	1.3566006E-02	2.0050615E-01	0.
	2.2995929E+00	-1.5848107E+01	-2.8398480E+00	-1.7860410E+00	9.0152651E+00
	5.1507482E-01	-1.6947429E+01	1.5444858E-01	-1.2024884E+00	8.5883705E-01
	2.7661449E+01	2.1499552E+00	6.6514553E+01	3.0255896E+01	6.4850755E+01
	5.5316604E+02	7.2365665E+02	5.5669000E+02	7.2592383E+02	-2.2671829E+00
	3.3434889E-01	4.5789028E-01	0.	0.	4.5789028E-01
	7.2615526E+01	-9.3420219E+02	0.	-1.0000000E+03	6.5797810E+01
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00
2.3040000	3.0161247E+01	4.3322908E+01	1.0000000E-01	2.6177788E-02	2.1000000E+00
	-1.7407736E+01	-9.3118179E+00	-1.6725857E-01	-4.1455774E-01	0.
	1.7893194E+01	-1.6683965E+00	-2.2109746E-01	3.1360983E-01	0.
	2.3495128E+00	-1.6048409E+01	1.7158061E+00	-1.0563103E+00	1.3544764E+01
	-4.8075511E+01	-2.6842341E+01	6.7824231E-01	6.2713593E-01	1.0227873E+00
	3.5874302E+01	-3.5482625E+01	1.5412313E+02	2.6451396E+01	1.5218273E+02
	5.5111912E+02	1.2758023E+03	5.5669000E+02	1.2826139E+03	-6.8115697E+00
	4.1883712E-01	8.2666786E-01	0.	0.	8.2666786E-01
	1.0284271E+02	-8.4671277E+02	0.	-1.0000000E+03	1.5328723E+02
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00

3.3040000	-2.5971374E+01	4.6203784E+01	1.0000000E-01	-2.2808408E-03	2.1000000E+00
	-9.8724288E+00	-1.8965623E+01	1.7716070E-01	3.2468244E-01	0.
	5.8454639E+00	-2.1972940E+00	1.7316397E-01	-3.3217632E-01	0.
	4.1823321E-01	-1.6376858E+01	8.6212686E+00	-3.5473934E+00	1.9953933E+01
	4.0925391E+01	2.9013356E+01	1.1378046E+00	8.7867825E-02	1.5726256E+00
	-4.1419253E+01	2.8358817E+01	2.7392206E+02	3.6263171E+01	2.7002465E+02
	5.4896537E+02	1.8258007E+03	5.5669000E+02	1.8393039E+03	-1.3503235E+01
	5.9679866E-01	1.3251199E+00	0.	0.	1.3251199E+00
	1.3469581E+02	-7.2775689E+02	0.	-1.0000000E+03	2.7224311E+02
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00
4.3040000	1.0428571E+01	5.2906360E+01	1.0000000E-01	-4.1927267E-02	2.1000000E+00
	1.1176274E+01	-1.7918157E+01	-6.0308699E-02	-6.7283622E-02	0.
	-1.0392022E+01	-2.5441237E+00	-3.5884598E-02	1.1307881E-01	0.
	-5.5769830E+00	-1.6829174E+01	1.7433088E+01	-1.5402988E+00	2.8832196E+01
	-9.6955703E+00	-1.0149456E+01	1.6880957E+00	-9.3120149E-02	2.1945870E+00
	1.5391361E+01	-6.0390815E+00	4.2456518E+02	3.0151173E+01	4.2087574E+02
	5.4672413E+02	2.3736503E+03	5.5669000E+02	2.3959940E+03	-2.2343677E+01
	5.6354841E-01	1.9062850E+00	0.	0.	1.9062850E+00
	1.6677868E+02	-5.7702418E+02	0.	-1.0000000E+03	4.2297582E+02
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00
5.3040000	1.7504527E+01	5.4915584E+01	1.0000000E-01	1.3872574E-02	2.1000000E+00
	-1.0797343E+01	-2.1025969E+01	-3.4702304E-02	-7.4922197E-02	0.
	1.1347567E+01	-2.3628496E+00	-3.9958505E-02	6.5066820E-02	0.
	1.3233212E+00	-1.7408658E+01	2.8379206E+01	-1.6011070E+00	3.9563243E+01
	-8.5965201E+00	-6.0412053E+00	2.3605311E+00	3.4101859E-01	2.8220169E+00
	7.2493315E+00	-6.9562393E+00	6.0693117E+02	3.0368192E+01	6.0262854E+02
	5.4492381E+02	2.9194869E+03	5.5669000E+02	2.9526841E+03	-3.3197146E+01
	7.4669604E-01	2.5593333E+00	0.	0.	2.5593333E+00
	1.9753856E+02	-3.9492235E+02	0.	-1.0000000E+03	6.0507765E+02
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00

6.3040000	-2.1253299E+00	5.5407000E+01	1.0000000E-01	-2.3701851E-03	2.1000000E+00
	2.2848330E+00	-2.5610868E+01	5.7474747E-02	1.0523978E-01	0.
	-1.2508873E+00	-2.7827688E+00	5.6127883E-02	-1.0776515E-01	0.
	-2.6131968E-01	-1.8111781E+01	4.1410807E+01	-2.7996478E+00	5.2211861E+01
	1.4038776E+01	1.0409700E+01	3.0897243E+00	-1.6851493E-01	3.6147279E+00
	-1.4498037E+01	1.0165759E+01	8.2071435E+02	3.2805529E+01	8.1553072E+02
	5.4274295E+02	3.4633103E+03	5.5669000E+02	3.5093741E+03	-4.6063763E+01
	7.7343307E-01	3.3158892E+00	0.	0.	3.3158892E+00
	2.2916013E+02	-1.8151869E+02	0.	-1.0000000E+03	8.1848131E+02
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00

MISS DISTANCE= 3.87184325E+03

TIME FINAL= 7.05773162E+00

XM EARTH= 3.87184124E+03 YM EARTH= 3.93932850E+00 ZM EARTH= 0.

7.0640000	9.3486511E+00	5.4119488E+01	1.0000000E-01	2.9273585E-03	2.1000000E+00
	3.7971207E+00	-2.7223304E+01	2.2108618E-02	4.2685987E-02	0.
	-3.0986879E+00	-2.6692897E+00	2.2765859E-02	-4.1453659E-02	0.
	1.3916510E-01	-1.8732027E+01	5.2636291E+01	-2.3960274E+00	6.3288388E+01
	5.5615878E+00	4.1413923E+00	3.7306685E+00	-1.5650043E-02	4.2272866E+00
	-5.4685397E+00	4.2645069E+00	1.0039474E+03	3.1757898E+01	9.9846156E+02
	5.4115314E+02	3.8752335E+03	5.5669000E+02	3.9324586E+03	-5.7225078E+01
	8.4167886E-01	3.9446052E+00	0.	0.	3.9446052E+00
	2.5288557E+02	1.5841874E+00	0.	-1.0000000E+03	1.0015842E+03
	1.4759480E+01	6.7652809E+00	1.2012049E+01	2.0000000E+00	1.0000000E+00

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13. ABSTRACT

This report documents the external flow fields caused by various weapon configurations on the wing of an F-4 aircraft, verifies assumptions made in the flow angularity technique, and presents the documentation for the "Flow Angularity Computer Program" with example trajectories. The flow angularity program is presently capable of calculating the trajectories of stores off the inboard and outboard wing stations in either single, triple ejector rack, or multiple ejector rack configurations. The assumptions made in the flow angularity technique have been analyzed and generally validated as good approximations.

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2 Stores Trajectory						
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Wind Tunnel Test						
3. Stores -- Separation						
4 " -- Flow Angularity						