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National Aeronautics
and Space Administration

A Computer Code for Estimating Installed Performance of Aircraft Gas Turbine Engines

Vol. III - Library of Inlet/Nozzle Configurations and Performance Maps

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A computerized method has been developed which utilizes the engine performance data generated by the NAVY NASA Engine Program (NNEP) to estimate the installed performance of aircraft gas turbine engines. This installation includes:

- o engine weight and dimensions
- o inlet and nozzle internal performance and drag
- o inlet and nacelle weight
- o nacelle drag

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FOREWORD

This report documents the work accomplished during NASA LeRC Contract No. NAS3-21238. It was the purpose of this contract to develop a supervisory computer program which would tie together the routines (either presently existing or to be developed) to access the installation of a propulsion system. The contract was divided into seven tasks:

- o Task A - Data Base
- o Task B - Supervisory Program
- o Task C - Nacelle Weight and Drag
- o Task D - Nozzle Boattail Drag
- o Task E - Pitot Inlets
- o Task F - Two-Dimensional Inlets
- o Task G - Axisymmetric Inlets

In TASK A, standardized formats for:

- o Inlet performance and drag
- o Nozzle internal performance and afterbody drag

were compiled for the data base described in this contract. In TASK B, a supervisory computer program was developed which evaluates the installation penalties associated with the inlets and nozzles of TASK A. The NASA NAVY Engine Program (NNEP), modified through the contract NAS3-21205 to predict bare engine weight, was used as this computer program's driver routine. The supervisory computer program also has the capability to determine the changes in inlet performance due to perturbations in engine cycle characteristics and/or inlet design parameters. In TASK C, computer procedures were developed for estimating nacelle weight and drag. In TASK D, a computer procedure was developed for estimating boattail drag for the nozzle data base of TASK A. In TASKS E, F, and G, a theoretically-based computer procedure was supplied to estimate conceptual design, performance and weight for pitot inlets, mixed and external compression axisymmetric and two-dimensional inlets.

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Mr. L. J. Winslow was Program Manager for the Boeing Company. E. J. Kowalski was principal investigator. The following individuals contributed to the work accomplished during this contract: G. W. Klees, general consulting; R. A. Atkins, Jr., computer programming; S. G. Kyle and R. J. Pera, inlet performance; R. W. Rankin, inlet and nacelle weight; A. Hagen, A. Killinger, J. Welti, document preparation.

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SYMBOLS AND NOMENCLATURE

A	Area, ft^2 (m^2)
A_C	Inlet capture area, $ft^2(m^2)$
ALT	Altitude, ft(m)
A_o	$A_{o_I}-A_{o_{BLD}}$
$A_{o_{BLD}}$	Freestream tube area of bleed air entering the inlet, $ft^2(m^2)$
$A_{o_{BYP}}$	Free stream tube area of bypass air entering the inlet, $ft^2(m^2)$
A_{o_E}	Free stream tube area of engine demanded air entering the inlet, $ft^2(m^2)$
A_{o_I}	Free stream tube of air entering inlet, $ft^2(m^2)$
$A_{o_{SPL}}$	Free stream tube of air entering inlet, $ft^2(m^2)$
AR	Aspect ratio

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SYMBOLS AND NOMENCLATURE (Continued)

A_w	Wetted area, $ft^2(m^2)$
A_{10}	Maximum cross sectional area, $ft^2(m^2)$
C_D	Drag coefficient
C_{F_G}	Nozzle gross thrust coefficient
C_P	Pressure coefficient
C_0	Angularity loss coefficient
$C_{D_{PAP}}$	Incremental drag coefficient due to tail fore-and-aft location
C_{D_R}	Incremental drag coefficient due to radial tail orientation
D	Drag, lb_f(Nt)
	Diameter, ft(m)
g_0	Acceleration of gravity, 32.174 ft/sec^2 (9.806 m/sec^2)

h	Height, ft(m)
IMS_T	Integral mean slope parameter, truncated $IMS_T = -\frac{1}{(1 - A_9/A_{10})} \int_{A_9/A_{10}}^{1.0} \frac{d(A/A_{10})}{d(L/D_{eq})}\, d(A/A_{10})$
L	Length, ft(m)
M	Mach number
M_s	Started Mach number
P	Pressure, $lb_f/ft^2 (Nt/m^2)$
PS	Power setting
q	Dynamic pressure, $lb_f/ft^2 (Nt/m^2)$
r/D	Ratio of inlet lip radius to inlet highlite diameter
R_e	Reynolds number
T	Temperature, $^oR(^oK)$

SYMBOLS AND NOMENCLATURE (continued)

V	Velocity, ft/sec(m/sec)
W	Air flow, lb_m/sec(kg/sec)
	Weight, lb_m(kg)
	Width, ft(m)
W_{COR}	Corrected airflow - $\frac{w\sqrt{\theta}}{\delta}$, lb_m/sec(kg/sec)
α	Nozzle convergence angle
δ	Pressure ratio - P/2116.2
ϵ	Subsonic duct loss coefficient
γ	Ratio of specific heats
Θ	Temperature ratio - T/518.688
Θ_{DIV}	Divergence half angle
Θ_N	Wedge half angle (2D nozzle)

Θ_P	Plug half angle (round nozzle)
Θ_R	Radial tail orientation

<u>Subscripts</u>

AB	Aftbody
AC	Capture area
ADD	Additive
AMB	Ambient
BASE, B	Base flow region
BD	Bypass door
BLC	Bleed
BYP	Bypass
CD	Convergent-Divergent

SYMBOLS AND NOMENCLATURE (continued)

CON	Convergent
D	Design
E	Exit
EFF	Effective
ENG	Engine
f	Flap
GEO	Geometric
HI	Hilite
lip	Inlet lip
MAX	Maximum
MIN	Minimum
MOM	Momentum
PRI	Primary

SYMBOLS AND NOMENCLATURE (continued)

REF	Reference
SEC	Secondary
SPILL	Spill
T	Throat
	Total
0	Local conditions for inlet, ambient conditions for nozzle
1	Inlet entrance
2	Compressor face
8	Nozzle throat
9	Nozzle exit

1.0 INTRODUCTION

An essential element of this computer code is the use of two data base files to represent the engine and the inlet/nozzle/aftbody performance characteristics. This volume of the contract document contains the existing library of performance characteristics for inlets and nozzle/aftbodies and an example of the 1000 series of engine data tables.

2.0 NNEP ENGINE PERFORMANCE MAPS

The user has the option of utilizing tabular data to define input variables for engine components. They need only insert the desired table number in the respective DATINP variable location and the tabular values will be used during the program execution. The Engine Performance Maps are in card image format and coupled to the program load module with the following DD statement:

```
//FTIZFOOT  DD  DSN = (data set name of engine map), DISPOLD
```

2.1 ENGINE PERFORMANCE MAP FORMAT

Consider the TABLE DATA as three dimensional, composed of a series of planes with each plane assigned a value called Z. Then, on each Z plane, the Dependent Variable (ordinate axis), F(X,Y,Z=Constant) is a two dimensional Function of X, (absicca axis or column position) and Y (row position).

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Each TABLE representing a single Table Look-up has the following INPUT DATA CARD Setup.

Card 1	TABLE Reference Number (Integer, col 2-5) TABLE Identification Label, col 6-75)
Card 2	Z-Identifier (4 Character Symbol, col 1-4) NZ-Number of Z values (Integer, col 6 & 7) Z-Variable values,7F10., Beginning in Column 11. If needed, extra cards follow 10X,7F10. Format. Z values MUST be in ascending order.
Card 3	Y-Identifier (4 Character Symbol, col 1-4) NY-Number of Y values (Integer, col 6 & 7) Y-Variable values,7F10., Beginning in Column 11. If needed, extra cards follow 10X,7F10. Format. Y values MUST be in ascending order.
Card 4	X-Identifier (4 Character Symbol, col 1-4) NX-Number of X values (Integer, col 6 & 7) X-Variable values,7F10., Beginning in Column 11. If needed, extra cards follow 10X,7F10. Format. X values MUST be in ascending order.
Card 5	F9X,Y,Z)-Identifier (4 Character Symbol, col 1-4) NX-Number of X values (Integer, col 6 & 7) F(X,Y,Z)-Variable values,7F10., Beginning in Column 11. If needed, extra cards follow 10X,7F10. Format. These Values correspond to the values on the X Identifier Card.

Last Card 3 Character Symbol EOT in col 1-3

The remaining cards follow the same basic format as the cards before. The first X and F(X,Y,Z) cards are for the first Y value in the first Z plane. This series of Card 4 & 5 types is repeated for each Y value until the Y values in the first plane are exhausted. Following this last F(X,Y,Z) identifier is the Y identifier card (type 3) with the next Y values for the second Z plane. This series is repeated for the remaining Z planes. In each plane where X variable values are not changing, once defined, they need not be repeated. See example for a sample listing.

LIMITATIONS

1) NZ, NY, and NX may not be blank or zero
2) 30 TABLES Maximum
3) NZ, NY, and NX are limited to 100 or less
4) A zero or blank table reference number will halt the read
5) A storage overflow message will result if TABLE storage exceeds limits set in TREAD Subroutine.

SAMPLE MAP

BETA	2	40.	60.			
RPM	3	100.	110.	140.		
PR	4	1.1	1.3	1.4	2.0	
EFF	4	0.8	0.82	0.82	0.81	
PR	3	1.1	1.8	1.9		
EFF	3	0.8	0.83	0.82		
EFF	3	0.79	0.82	0.83		
RPM	3	100.	110.	140.		
PR	5	1.1	1.3	1.4	2.0	2.2
EFF	5	0.8	0.81	0.815	0.82	0.81
EFF	5	0.81	0.81	0.82	0.84	0.83
EFF	5	0.83	0.84	0.85	0.84	0.83
EOT						

2.2 ENGINE TABLES USED BY NNEP

The following is a list of the dependent and independent variables for each table which may be included in the Engine Performance Map data base.

COMPONENT TYPE	VARIABLE DEFINITIONS
Inlet	F(X,Y,Z)=Inlet recovery X=Corrected airflow Y=Mach number Z=0
Inlet	F(X,Y,Z)=Inlet drag X=Mach number Y=corrected airflow Z=0
Compressor	F(X,Y,Z)=corrected airflow X="R" value Y=corrected RPM Z=flow angle
Compressor	F(X,Y,Z)=pressure ratio X="R" value Y=corrected RPM Z=flow angle
Compressor	F(X,Y,Z)=efficiency X="R" value Y=fuel to air ratio Z=flow angle
Burner	F(X,Y,Z)=pressure drop X=corrected air flow Y=0 Z=0
Burner	F(X,Y,Z)=efficiency X=corrected air flow Y=fuel to air ratio Z=0
Burner	F(X,Y,Z)=fuel heating value X=pressure Y=temperature Z=0

Heat Exchanger	F(X,Y,Z)=pressure drop (main flow) X=corrected air flow Y=0 Z=0
Heat Exchanger	F(X,Y,Z)=effectiveness X=primary corrected air flow Y=primary/secondary air flow rates Z=0
Heat Exchanger	F(X,Y,Z)=pressure drop (secondary flow) X=corrected air flow Y=0 Z=0
Nozzle	F(X,Y,Z)=gross thrust coefficient X=pressure ratio at throat Y=area ratio (exit area/throat area) Z=0
Nozzle	F(X,Y,Z)=flow coefficient X=pressure ratio (total/exit) Y=0 Z=0
Nozzle	F(X,Y,Z)=nozzle exit area ratio X=area ratio (effective throat area/actual throat area) Y=0 Z=0
Turbine	F(X,Y,Z)=corrected air flow X=pressure ratio at design point Y=corrected RPM Z=flow angle
Turbine	F(X,Y,Z)=efficiency X=pressure ratio at design point Y=corrected RPM Z=flow angle

The use of this table format provides a flexible way of making changes in the source code to include tubular variable definition. The user simply adds the new table to the data base and includes in the source code a call to the TLOOK routine to use the table.

3.0 INLET AND NOZZLE/AFTBODY PERFORMANCE MAPS

In order to run the installation portion of the NNEP program the user may elect to specify the use of configuration maps which define the inlet and nozzle/aftbody of an existing engine configuration. At present, there are 19 inlet, 9 nozzle/aftbody, 5 CFG and 1 delta CD nozzle/aftbody maps available in the data base. These maps are in card image format and are coupled to the program load module with the following DD statement:

//FT51F001 DD DSN=(dataset name of inlet and nozzle/aftbody performance maps), DFSP=OLD

3.1 INLET AND NOZZLE/AFTBODY MAP FORMATS

There are five groupings or sets of maps recognized by the installation portion of the NNEP program. These are:

1. Inlet maps (long form)
2. Inlet maps (short form)
3. Nozzle/aftbody maps
4. Delta CD maps
5. Gross thrust coefficient (CFG) maps

Each of these groupings of maps is structured as follows:

title card
derivative parameter cards
non-changeable parameters
map tables

In the next sections each of the maps as well as the map structures will be covered in detail.

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3.2 TITLE CARD

Each of the five map sets is headed by a single card which includes information regarding the type and name of the map set. The structure of the title card is as follows:

COLS	DESCRIPTION	FORMAT
1-7	7 character descriptor naming the map set. This descriptor is the name which is used in the namelist input to access the desired mapset.	A7
8	Type of map set code (ITYPE) 1=inlet mapset (long form) 2=nozzle/aftbody mapset 3=CFG mapset 4=inlet mapset (short form) 5=delta CD mapset	I1
9-10	blank	
11-80	70 character title describing the mapset	7A10

3.3 DERIVATIVE PARAMETERS

The derivative parameters, to the maximum extent possible, are defined in terms of geometric variables that can be easily related to an airplane configuration. The following list shows the derivative parameters and their definitions for each inlet and aftbody configuration in the library of maps.

INLET DERIVATIVE PARAMETERS

1. Aspect Ratio (AR)	- Applicable to two-dimensional inlets only - Defined as inlet width divided by inlet lip height (relative to tip position).
2. Sideplate Cutback (SPC)	- Applicable to two-dimensional inlets only - Defined as the percent of a full sideplate area that is removed to define a partial sideplate. The upper edge of a full sideplate extends from the ramp tip to the cowl lip.
3. First Ramp or Cone Angle	- Applicable to two-dimensional and axisymmetric inlets - Defined as surface ramp angle, in degrees, relative to horizontal reference line for two-dimensional inlets - Defined as cone surface angle, in degrees, relative to inlet centerline for axisymmetric inlets (cone half-angle)
4. Design Mach Number (M_0 Design)	- Applicable to all inlets - Defined as the maximum Mach number at which the inlet is designed to operate
5. Cowl Lip Bluntness	- Applicable to all inlets - Defined as the inlet lip surface radius divided by the lip height.
6. Takeoff Door Area	- Applicable to all inlets - Defined as the total door area for the takeoff auxiliary air system divided by the inlet capture area
7. External Cowl Angle	- Applicable to all inlets - Defined as external cowl surface angle, in degrees, relative to inlet horizontal reference line

8. Exit Nozzle Type for Bleed
   - Applicable to two-dimensional and axisymmetric inlets
   - Defines whether bleed exit nozzle is convergent or convergent-divergent

9. Exit Nozzle Angle for Bleed
   - Applicable to two-dimensional and axisymmetric inlets
   - Defined as bleed exit nozzle angle, in degrees, relative to inlet horizontal reference line

10. Exit Flap Aspect Ratio for Bleed (AR_F)
   - Applicable to two-dimensional and axisymmetric inlets
   - Defined as flap width divided by flap length

11. Exit Flap Area for Bleed (A_F/A_C)
   - Applicable to two-dimensional and axisymmetric inlets
   - Defined as flap area divided by inlet capture area

12. Exit Nozzle Type for Bypass
   - Applicable to all inlets
   - Defines whether bypass exit nozzle is convergent or convergent-divergent

13. Exit Nozzle Angle for Bypass
   - Applicable to all inlets
   - Defined as bypass exit nozzle angle, in degrees, relative to inlet horizontal reference line

14. Exit Flap Aspect Ratio for Bypass (AR_F)
   - Applicable to all inlets
   - Defined as flap width divided by flap length

15. Exit Flap Area for Bypass (A_F/A_C)
   - Applicable to all inlets
   - Defined as flap area divided by inlet capture area

16. Subsonic Diffuser Area Ratio (A_2/A_1)
   - Applicable to all inlets
   - Defined as exit area (compressor face) divided by entrance area (throat)

17. Subsonic Diffuser Total Wall Angle
   - Applicable to all inlets
   - Defined as the total equivalent wall divergence angle, from entrance to exit

18. Subsonic Diffuser Loss Coefficient (ϵ)

- Applicable to all inlets
- Defined by the equation $P_{T_2}/P_{T_1} = 1.0 - \epsilon \left[1 - \frac{1}{(1 + 0.2 M^2)^{3.5}} \right]$

19. Throat to Capture Area Ratio (A_T/A_C)

- Applicable to Pitot inlets <u>only</u>
- Defined as the fixed throat area divided by the inlet capture area

Note: If this parameter is altered and the subsonic diffuser area ratio is not, the compressor face area is scaled with throat area at a fixed capture (lip) area.

<u>Nozzle Aftbody Derivative Parameters</u>

20. Nozzle/Aftbody Area Distribution - Applicable to all nozzle/aftbodies. Defined by the cross-sectional area distribution as a function of station from A_{10} (ref. area) to A_9 (nozzle exit area). Characterized by the parameter IMS_T

21. Radial Tail Orientation Position - Applicable to all nozzle/aftbodies with tails. Defined by the angular orientation of the tail relative to the vertical position.

22. Fore-and-aft Tail Location - Applicable to all nozzle/aftbodies with tails. Defined by the location of the aft point of the tail/aftbody junction relative to the aftbody length ($X_{A_{10}} - X_{A_9}$)

23. Base Area - Applicable to all nozzle/aftbodies with base area. Defined by the ratio of the base area, A_{BASE} to the aftbody reference area, A_{10}

<u>Nozzle CFG Derivative Parameters</u>

24. Plug Half Angle - Applicable to round plug nozzles. Defined as the half-angle of the plug centerbody measured relative to the plug axial centerline.

25. Ramp Half Angle - Applicable to two-dimensional wedge nozzles. Defined by the wedge half-angle relative to the wedge centerline.

26. Aspect Ratio (W_9/H_9) - Applicable to two-dimensional nozzles, both C-D and wedge types. Defined by the ratio of nozzle width to height at the nozzle exit station.

27. Divergence Half-Angle (Θ_{DIV}) - Applicable to convergent-divergent round and 2-D nozzles. Defined as the angle of the diverging section nozzle wall relative to the axial centerline of the nozzle.

3.3.1 INLET DERIVATIVE PARAMETER CARDS

The inlet derivative parameters provide the basic information describing the configuration in terms of its important parameters. These data are used by the derivative program as a starting point from which a new configuration performance is derived.

Card 1	Parameter Definition	Format
Cols.		
1-7	Aspect Ratio (2D only)	F7.0
8-14	Sideplate Cutback (2D only)	F7.0
15-21	First Ramp (cone) angle (deg)	F7.0
22-28	Mach Number	F7.0
29-35	Cowl Lip Bluntness	F7.0
36-42	Takeoff Door Area	F7.0
43-49	External Cowl Angle (deg)	F7.0
50-56	Exit Nozzle Type for Bleed	F7.0
57-63	Exit Nozzle Angle for Bleed (deg)	F7.0
64-70	Exit Flap Aspect Ratio for Bleed	F7.0

Card 2	Parameter Definition	Format
Cols.		
1-7	Exit Flap Area for Bleed	F7.0
8-14	Exit Nozzle Type for Bypass	F7.0
15-21	Exit Nozzle Angle for Bypass (deg)	F7.0
22-28	Exit Flap Aspect Ratio for Bypass	F7.0

29-35	Exit Flap Area for Bypass	F7.0
36-42	Subsonic Diffuser Area Ratio	F7.0
43-49	Subsonic Diffuser Total Wall Angle (deg)	F7.0
50-56	Subsonic Diffuser Loss Coefficient	F7.0
57-63	Throat to Capture Area Ratio (PITOT)	F7.0

3.3.2 AFTBODY DERIVATIVE PARAMETER CARD

The aftbody derivative parameters provide the basic information describing the configuration in terms of its important parameters. These data are used by the derivative program as a starting point from which a new configuration performance is derived.

Card 1	Parameter Definition	Format
Cols. 1-7	Nozzle Static Pressure Ratio	F7.0
8-14	Tail Fin Configurations (0-Fins, 1-No Fins)	F7.0
15-21	Tail Fin Angle (deg)	F7.0
22-28	Tail Fin Fore-and-Aft Location Ratio	F7.0
29-35	Base Area Ratio	F7.0

Aftbody Station Versus Area Curves Derivative Parameter Cards

The area curves are used to calculate the IMS_T parameter which is the basic aftbody drag correlation parameter.

Card 1	Parameter Definition	Format
Cols. 1-7	Number of Curves	F7.0

Card 2	Parameter Definition	Format
Cols.		
1-7	No. Points for Curve 1	F7.0
8-14	No. Points for Curve 2	F7.0
.	.	.
.	.	.
.	.	.
64-70	No. Points for Curve 10	F7.0

Card 3	Parameter Definition	Format
Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	. Curve 1 Station Values (in.)	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

Card 4	Parameter Definition	Format
Cols.		
1-7	A_1	F7.0
8-14	A_2	F7.0
.	.	.
.	Curve 1 Area Values (sq. ft.)	.
.	.	.
64-70	A_{10}	F7.0

Etc. for the rest of the Area Ratios in C Table

3.3.3 CFG DERIVATIVE PARAMETERS

The nozzle/aftbody derivative parameters provide the basic information describing the configuration in terms of its important parameters. These data are used by the derivative program as a starting point from which a new configuration performance is derived.

Card 1	Parameter Definition	Format
Cols.		
1-7	Plug Half Angle (deg)	F7.0
8-14	Wedge Half Angle (deg)	F7.0
15-21	Aspect Ratio	F7.0
22-28	Divergence Half Angle (deg)	F7.0

3.3.4 DELTA CD AND INLET (SHORT FORM) DERIVATIVE PARAMETERS CARD

No derivative parameters are required for these maps.

3.4 NON-CHANGEABLE PARAMETERS

The non-changeable parameters provide information about the basic design ground rules of the mapset configuration.

3.4.1 INLET (LONG FORM) NON-CHANGEABLE PARAMETERS CARD

Card 1	Parameter Definition	Format
Cols. 1-7	Geometry Type 0. = axisymmetric inlet 1. = 2-D inlet 2. = PITOT inlet	F7.0
8-14	Nominal Normal Shock Mach Number	F7.0
15-21	Starting Mach Number	F7.0
22-28	Nominal Throat Mach Number	F7.0

3.4.2 NOZZLE/AFTBODY NON-CHANGEABLE PARAMETERS CARD

Card 1	Parameter Definition	Format
Cols. 1-7	Geometry Type 0. = axisymmetric 1. = 2-D	F7.0
8-14	Afterbody Type 1. = CD Axisymmetric Single Nozzle 2. = CD Axisymmetric Dual Nozzle 3. = CD 2-D Single Nozzle 4. = CD 2-D Dual Nozzle 5. = Plug Axisymmetric Single Nozzle 6. = Plug Axisymmetric Dual Nozzle 7. = Wedge 2-D Single Nozzle 8. = Wedge 2-D Dual Nozzle	F7.0

3.4.3 CFG NON-CHANGEABLE PARAMETERS CARD

Card 1	Parameter Definition	Format
Cols. 1-7	Table Format Type Flag = 0 Table is CFG (PT8/P0,A9/A8) =-1 Table is CFG (PT8/P0,PS) =+1 Table is CFG (PT8/P0,A8)	
8-14	Nozzle Type 1 = Round Convergent-Divergent 2 = 2-D Wedge 3 = Round Plug 4 = 2-D Convergent-Divergent	F7.0

3.4.4 DELTA CD AND INLET (SHORT FORM) NON-CHANGEABLE PARAMETERS

No non-changeable parameters are defined for these maps.

3.5 MAP TABLE FORMAT

The values in the tables are in a 10F7.0 card format. The meanings of the quantities placed in a card image differ depending on the type of table. There are four table types:

a) One dimensional = Type 1

b) Two dimensional (symmetric) = Type 2

c) Two dimensional (non-symmetric) = Type 3

d) Three-dimensional = Type 4

One Dimensional Table Definition - Type 1

Card 1	Table Definition Card	Format
Cols		
1-7	Table Name	A7
8-14	Number of X Values	F7.0

Card 2	X Values	
Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

Card 3	Table Values	
Cols.		
1-7	$f(x_1)$	F7.0
8-14	$f(x_2)$	F7.0
.	.	.
.	.	.
64-70	$f(x_{10})$	F7.0

Two-Dimensional Table Definition (Symmetric) - Type 2

Card 1	Table Definition Card	Format
Cols.		
1-7	Table Title	A7
8-14	Number of X Values	F7.0
15-21	Number of Y Values	F7.0

<u>Card 2</u> Y Values

Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0

<u>Card 3</u> X Values

Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

<u>Card 4</u> Table Values for Y_1, and all X Values

Cols.		
1-7	$f(x_1,y_1)$	F7.0
8-14	$f(x_2,y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(x_{10},y_1)$	F7.0

<u>Card 5</u> Table Values for Y_2, and all X Values

Cols.		
1-7	$f(x_1,y_2)$	F7.0
8-14	$f(x_2,y_2)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(x_{10},y_2)$	F7.0

Etc. for additional Y values

Two-Dimensional Table (Non-Symmetric) - Type 3

Card 1	Table Definition Card	Format
Cols.		
1-7	Table Name	A7
8-14	Number of Y values	F7.0

Card 2	Number of X Values for A Particular Y Value	
Cols.		
1-7	NX (Y_1)	F7.0
8-14	NX (Y_1)	F7.0
.	.	.
.	.	.
.	.	.
.	.	.
64-70	NX (Y_{10})	F7.0
Card 3	Y Values	
Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0
Card 4	X Values for Y_1	
Cols.		
1-7	$X_1(y_1)$	F7.0
8-14	$X_2(y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$X_{10}(y_1)$	F7.0

Card 5	Table Values for $(X_1\text{-}X_{10}, Y_1)$	
Cols.		
1-7	$f(X_1,Y_1)$	F7.0
8-14	$f(X_2,Y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10},Y_1)$	F7.0

<u>Card 6</u> X Values for Y_2
(See Card 4)

<u>Card 7</u> Table Values for $(X_1\text{-}X_{10},Y_2)$
(See Card 5)

Etc. for all Y values

<u>Three-Dimensional Table Definition - Type 4</u>

<u>Card 1</u>	Table Definition Card	<u>Format</u>
Cols.		
1-7	table name	A7
8-14	NX = number of X values	F7.0
15-21	NY = number of Y values	F7.0
22-28	NZ = number of Z values	F7.0

<u>Card 2</u>	Z Values	
Cols.		
1-7	Z_1	F7.0
8-14	Z_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Z_{10}	F7.0

Card 3	Y Values	
Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0

Card 4	X Values	
Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

Card 5	Table Values for Y_1, Z_1,	
Cols.	and all X Values	
1-7	$f(X_1,Y_1,Z_1)$	F7.0
8-14	$f(X_2,Y_1,Z_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10},Y_1,Z_1)$	F7.0

Card 6	Table Values for Y_2,Z_1	
Cols.	and all X Values	
1-7	$f(X_1,Y_2,Z_1)$	F7.0
8-14	$f(X_2,Y_2,Z_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10},Y_2,Z_1)$	F7.0

Etc. until Y Values have been gone through

Card 6 + NX	Table Values for Y_1, Z_2 and all X Values	
Cols.		
1-7	$f(X_1, Y_1, Z_2)$	F7.0
8-14	$f(X_2, Y_1, Z_2)$	F7.0
.	.	.
.	.	.
.	.	.

Etc. until all Y and Z Values have been gone through

Table Examples

Examples of tables in each of the 4 formats are shown below:

Table 2E6.

.55	.7	.8	1.2	1.6	2.0
1.055	.935	.89	.846	.89	.935

Table Type 1

Tables 7. 8.

0.	.8489	.85	1.0	1.2	1.4	1.7	2.20
0.	.04	.08	.12	.16	.20	.24	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	.062	.125	.198	.28	.38	.50	
0.	.05	.10	.156	.217	.29	.375	
0.	.036	.075	.117	.162	.22	.29	
0.	.03	.062	.097	.135	.185	.241	
0.	.025	.052	.081	.116	.16	.216	
0.	.02	.045	.074	.11	.153	.21	

Table Type 2

Table 2A6

7.	6.	7.	7.	8.	9.			
.55	.70	.85	1.20	1.60	2.0			
.7	.8	.9	1.0	1.055	1.075	1.1		
.9915	.991	.985	.969	.95	.933	.875		
.6	.7	.8	.9	.95	.97			
.99	.99	.985	.974	.945	.90			
.5	.6	.7	.8	.85	.875	.905		
.99	.99	.989	.983	.975	.962	.90		
.5	.6	.7	.8	.85	.875	.902		
.98	.979	.977	.973	.967	.955	.90		
.500	.600	.700	.800	.850	.875	.885	.890	
.976	.970	.965	.958	.955	.940	.925	.900	
.5	.6	.7	.8	.9	.93	.935	.943	.95
.958	.953	.949	.944	.935	.925	.92	.900	.85

Table Type 3

Table AD

	5.	4.		
2.180	3.930	5.680	7.430	
.400	.875	1.350	1.825	2.300
.500	1.000	1.500	2.000	3.000
.105	0.000	-.105	-.210	-.420
.114	0.000	-.114	-.227	-.455
.068	0.000	-.068	-.137	0.274
.015	0.000	-.015	-.030	-.061
.002	0.000	-.002	-.004	0.009
.036	0.000	-.036	-.071	-.143
.039	0.000	-.039	-.077	-.155
.023	0.000	-.023	-.047	-.093
.005	-.000	-.005	-.010	-.021
.001	0.000	-.001	-.001	-.003
.020	0.000	-.070	-.041	-.081
.022	0.000	-.022	-.044	-.088
.013	-.000	-.013	-.027	-.053
.003	-.000	-.003	-.006	-.012
.000	0.000	-.000	-.001	-.002
.014	0.000	-.014	-.027	-.055
.015	0.000	-.015	-.030	-.059
.009	0.000	-.009	-.018	-.036
.002	0.000	-.002	-.004	-.008
.000	0.000	-.000	-.001	-.001

Table Type 4

3.5.1 INLET MAPS (LONG FORM)

This inlet map file consists of up to 15 tables. The tables are input in sequential order and are listed below.

Table 1

A Type 1 table of Local Mach Number versus Freestream Mach Number. This table is used to account for the fact that the local flow field ahead of the inlet may be different from free-stream.

Table 1 Local Mach Number

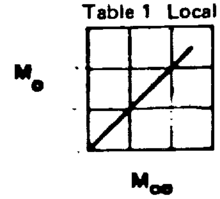


Table 2

A Type 3 table of Recovery versus Mass Flow and Local Mach Number. This table is used to obtain the inlet total pressure recovery as a function of "engine plus bypass" mass flow ratio for each free-stream Mach number.

Table 2 Recovery vs Mass Flow

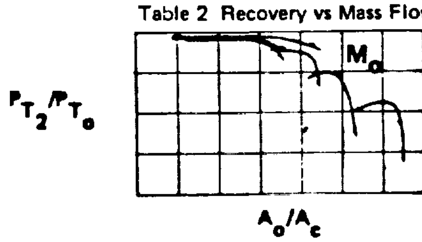


Table 2B

A Type 1 table of Matched Inlet Recovery versus Local Mach Number. This table is used to obtain the "matched" inlet total pressure recovery for sizing purposes and for mixed compression mode inlet operation at free-stream Mach numbers greater than M_{start}.

Table 2B Matched Inlet Recovery

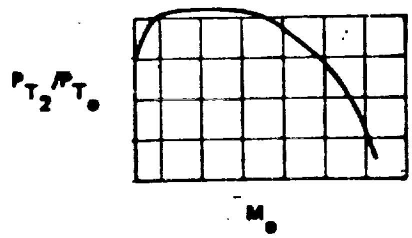


Table 2C

A Type 1 table of Matched Mass Flow versus Local Mach Number. The data in this table are used to obtain the "matched" engine-plus-bypass mass flow ratio for sizing purposes. The data from this table are also used for mixed-compression inlet operation above starting Mach number, M_{start}.

Table 2C Matched Mass Flow

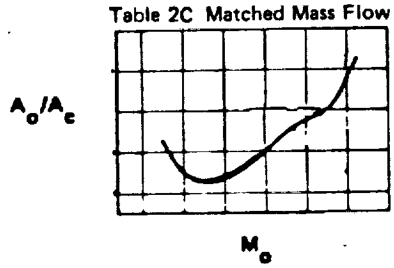


Table 2D

A Type 1 table of Buzz Limit versus Local Mach Number. This table provides a first-order estimate of the minimum inlet mass flow ratio at which buzz is likely to occur.

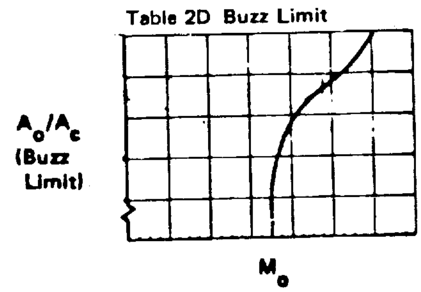


Table 2E

A Type 1 table of Distortion Limit versus Local Mach Number. This table provides a first-order estimate of the maximum inlet mass flow ratio that can be reached before engine distortion limits are likely to be exceeded.

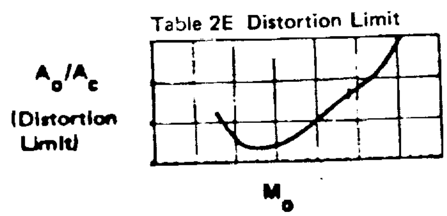


Table 3

A Type 3 table of Spillage Drag versus Inlet Supply ratio and Local Mach Number. This table provides the inlet spillage drag coefficient variation as a function of inlet mass flow ratio and Mach number. The drag coefficient data are "zeroed-out" at a reference mass flow ratio which is presented in Table 3B.

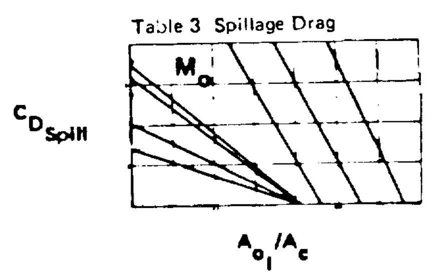


Table 3A

A Type 1 table of Reference Spillage Drag versus Local Mach Number. This table presents the reference spillage drag coefficient as a function of Mach number. This drag coefficient corresponds to the spillage drag of the excess airflow between the reference mass flow ratio and a mass flow ratio of 1.0.

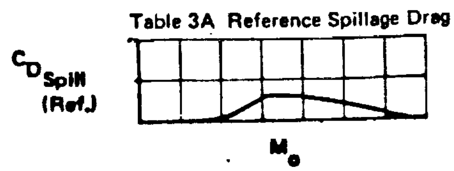


Table 3B

A Type 1 table of Reference Mass Flow versus Local Mach Number. This table specifies the reference mass flow used as a basis for spillage drag calculation. The spillage drag at the reference mass flow ratio is normally included in the aerodynamic drag polar, since it is not throttle-dependent.

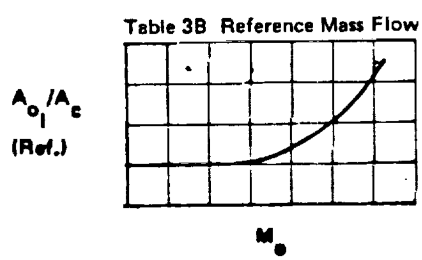


Table 4

A Type 2 table of Boundary Layer Bleed Drag versus Bleed Supply Ratio and Local Mach Number. This table is used to obtain the boundary layer bleed drag coefficient as a function of boundary layer bleed mass flow ratio and Mach number. This table is used during operation in the external-compression mode.

Table 4 Boundary Layer Bleed Drag

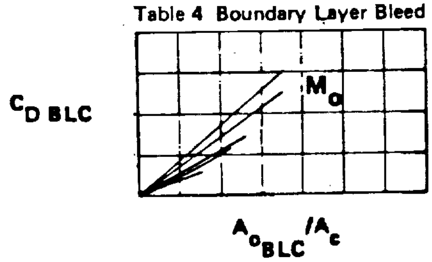


Table 5

A Type 2 table of Bypass Drag versus Bypass Supply Ratio and Local Mach Number. This table is used to obtain the bypass drag coefficient after the amount of bypass mass flow is determined at a given local Mach number.

Table 5 Bypass Drag

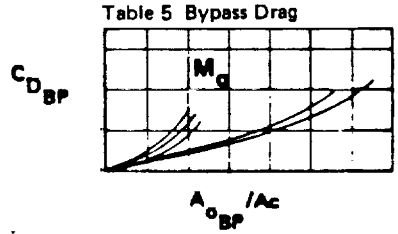
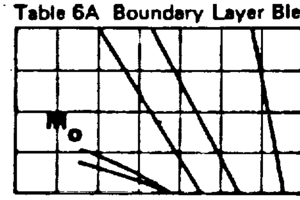


Table 6A

A Type 3 table of Bleed Supply ratio versus A_0/A_C and Local Mach Number. This table supplies the data required to obtain the boundary layer bleed mass flow ratio as a function of "engine-plus-bypass" mass flow ratio for a given local Mach number. It is used in the external-compression operating mode.

Table 6A Boundary Layer Bleed

$A_{O_{BLC}}/A_c$



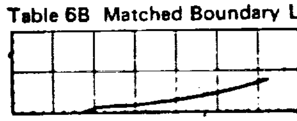
A_o/A_c

Table 6B

A Type 1 table of Matched Boundary Layer Bleed ratio versus Local Mach Number. This table provides the boundary layer bleed mass flow ratio for mixed-compression mode operation. For mixed-compression operation it is assumed that the bypass will be scheduled to keep the inlet operating at the design shock position.

Table 6B Matched Boundary Layer Bleed

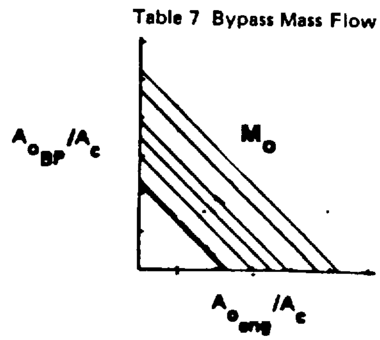
$A_{o_{BLC}}/A_c$



M_o

Table 7

A Type 3 table of Bypass Ratio versus Engine Supply ratio and Local Mach Number. This table is used to schedule the amount of bypass mass flow as a function of engine mass flow ratio and local Mach number for external-compression mode operation.

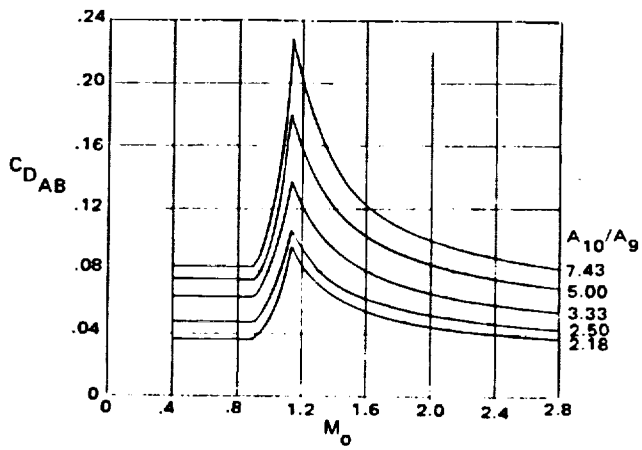


3.5.2 NOZZLE/AFTBODY MAPS

This nozzle/aftbody mapset consists of one table. The input is required is listed below.

Table AB

The aftbody drag table is a type 2 (non-symmetric) table of aftbody drag versus A10/A9 and local Mach number.



The same table format is used for both round and two-dimensional nozzles; however, the aftbody drag coefficient in the input table for the two-dimensional nozzle is defined differently from that for the round nozzle input. These coefficients are defined as follows:

For Round Nozzle:

$$C_{D\,AB} = \frac{D_{AB}}{q_o A_{10}}$$

For Two-Dimensional Nozzle:

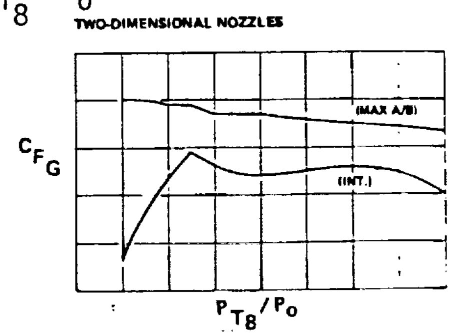
$$C_{D\,AB} = \frac{D_{AB}}{q_o\,(A_{10} - A_9)}$$

The definitions for the two nozzle/aftbody drag coefficients are different because the experimental data for the two-dimensional nozzle as obtained were nearly all based on the projected aftbody area, $(A_{10}-A_9)$, rather than the cross-sectional reference area, A_{10}, as was the case for the round nozzle. Therefore, for two-dimensional nozzles, the input drag coefficient was defined as shown above to make the most direct use of the available experimental data.

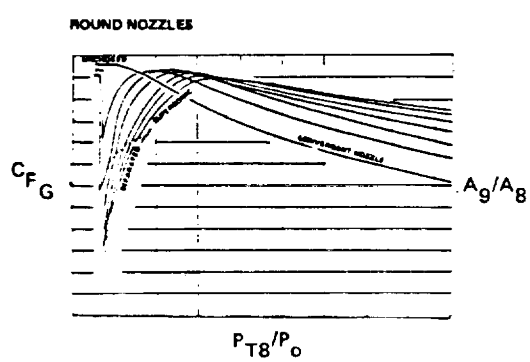
3.5.3 NOZZLE CFG MAP

The Gross Thrust Coefficient (CFG) mapset consists of a single table which can have different formats depending on whether the nozzle is axisymmetric or two-dimensional. These two possible formats are shown below.

For a two-dimensional nozzle the table is a Type 2 table of nozzle thrust coefficient versus P_{T_8}/P_0 and PS.

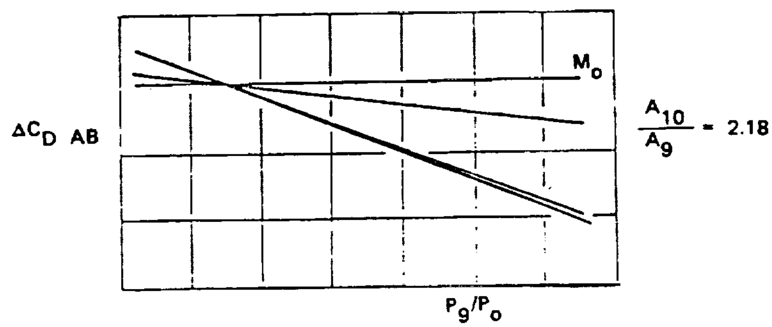


For a Round Nozzle the table is a Type 2 table of nozzle thrust coefficient versus P_{T_8}/P_0 and A_9/A_8.



3.5.4 DELTA CD MAP

A type 4 table of aftbody drag correction versus pressure ratio, local Mach number and A10/A9 ratio. This table is optional and will be defaulted to zero if it is not present as program input.



3.5.5 INLET MAP FILE (SHORT)

This inlet mapset consists of only two tables. This input data format can be used if the inlet input data are available in the form of two comprehensive maps which include all the individual effects. The two-map format does not provide good visibility of the individual contributors to drag and recovery, but is sometimes preferred by users wishing to know only the total result. This format is not used very often because the two-maps are normally obtained by starting with the 14 maps and converting them to two maps. Therefore, if the 14 maps are already available, there is little reason to convert to the two-map format.

Table RF

A Type 2 table of Recovery versus $\frac{W\sqrt{\theta}}{\delta A_c}$ and Local Mach Number

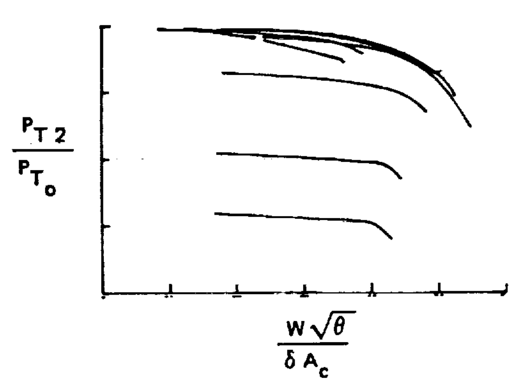
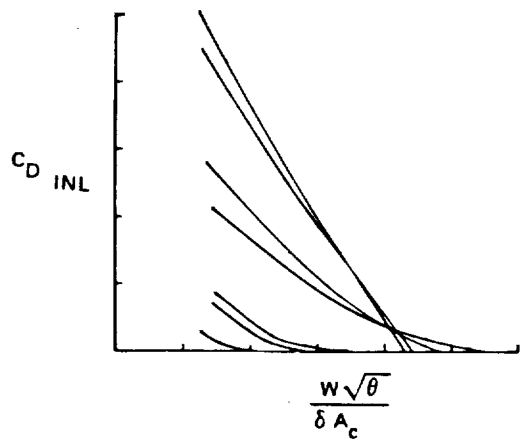


Table CD

A Type 2 table of Inlet Drag versus $\frac{W\sqrt{\theta}}{\delta A_c}$ and Local Mach Number



4.0 DATA BASE DESCRIPTIONS AND LISTINGS

In the following sections the data bases used by the computer code are exemplified. The NNEP engine performance data base is comprised of component performance maps from the NASA LeRC 1000 series. The inlet and nozle/aftbody data bases are comprised of performance maps for 19 inlets, 9 aftbodies, and 5 CFG configurations.

4.1 NNEP ENGINE PERFORMANCE DATA BASE

This section contains a listing of the NASA LeRC 1000 series component performance maps.

Preceding page blank

1001	HIGH PRESSURE FAN WITH VARIABLE STATORS						
ANGL 3	-5.00	0.00	10.00				
SPED 13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
	0.850	0.900	0.950	1.000	1.050	1.100	
R 7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
FLOW 7	0.0560	0.0720	0.1040	0.1370	0.1540	0.1720	0.1900
FLOW 7	0.1320	0.1460	0.1800	0.2140	0.2330	0.2540	0.2890
FLOW 7	0.2200	0.2410	0.2760	0.3100	0.3300	0.3590	0.3940
FLOW 7	0.2770	0.3050	0.3430	0.3750	0.3970	0.4280	0.4570
FLOW 7	0.3330	0.3600	0.4050	0.4340	0.4560	0.4900	0.5160
FLOW 7	0.4040	0.4260	0.4690	0.4940	0.5150	0.5470	0.5700
FLOW 7	0.4670	0.4860	0.5220	0.5430	0.5660	0.5910	0.6100
FLOW 7	0.5610	0.5700	0.5930	0.6080	0.6250	0.6460	0.6650
FLOW 7	0.6410	0.6480	0.6610	0.6750	0.6870	0.7030	0.7160
FLOW 7	0.7070	0.7100	0.7200	0.7340	0.7440	0.7560	0.7660
FLOW 7	0.7650	0.7660	0.7750	0.7850	0.7920	0.8010	0.8050
FLOW 7	0.8030	0.8060	0.8152	0.8224	0.8296	0.8338	0.8369
FLOW 7	0.8350	0.8380	0.8450	0.8490	0.8520	0.8550	0.8570
SPED 13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
	0.850	0.900	0.950	1.000	1.050	1.100	
R 7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
FLOW 7	0.2560	0.2720	0.3040	0.3370	0.3540	0.3720	0.3900
FLOW 7	0.3320	0.3460	0.3800	0.4140	0.4330	0.4540	0.4890
FLOW 7	0.4200	0.4410	0.4760	0.5100	0.5300	0.5590	0.5940
FLOW 7	0.4770	0.5050	0.5430	0.5750	0.5970	0.6280	0.6570
FLOW 7	0.5330	0.5600	0.6050	0.6340	0.6560	0.6900	0.7160
FLOW 7	0.6040	0.6260	0.6690	0.6940	0.7150	0.7470	0.7700
FLOW 7	0.6670	0.6860	0.7220	0.7430	0.7660	0.7910	0.8100
FLOW 7	0.7610	0.7700	0.7930	0.8080	0.8250	0.8460	0.8650
FLOW 7	0.8410	0.8480	0.8610	0.8750	0.8870	0.9030	0.9160
FLOW 7	0.9070	0.9100	0.9200	0.9340	0.9440	0.9560	0.9660
FLOW 7	0.9650	0.9660	0.9750	0.9850	0.9920	1.0010	1.0050
FLOW 7	1.0030	1.0060	1.0152	1.0224	1.0296	1.0338	1.0369
FLOW 7	1.0350	1.0380	1.0450	1.0490	1.0520	1.0550	1.0570
SPED 13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
	0.850	0.900	0.950	1.000	1.050	1.100	
R 7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
FLOW 7	0.6560	0.6720	0.7040	0.7370	0.7540	0.7720	0.7900
FLOW 7	0.7320	0.7460	0.7800	0.8140	0.8330	0.8540	0.8890
FLOW 7	0.8200	0.8410	0.8760	0.9100	0.9300	0.9590	0.9940
FLOW 7	0.8770	0.9050	0.9430	0.9750	0.9970	1.0280	1.0570
FLOW 7	0.9330	0.9600	1.0050	1.0340	1.0560	1.0900	1.1160
FLOW 7	1.0040	1.0260	1.0690	1.0940	1.1150	1.1470	1.1700
FLOW 7	1.0670	1.0860	1.1220	1.1430	1.1660	1.1910	1.2100
FLOW 7	1.1610	1.1700	1.1930	1.2080	1.2250	1.2460	1.2650
FLOW 7	1.2410	1.2480	1.2610	1.2750	1.2870	1.3030	1.3160
FLOW 7	1.3070	1.3100	1.3200	1.3340	1.3440	1.3560	1.3660
FLOW 7	1.3650	1.3660	1.3750	1.3850	1.3920	1.4010	1.4050
FLOW 7	1.4030	1.4060	1.4152	1.4224	1.4296	1.4338	1.4369
FLOW 7	1.4350	1.4380	1.4450	1.4490	1.4520	1.4550	1.4570
EOT							
1002	HIGH PRESSURE FAN WITH VARIABLE STATORS						
ANGL 3	-5.00	0.00	10.00				
SPED 13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
	0.850	0.900	0.950	1.000	1.050	1.100	
R 7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
EFF 7	0.5826	0.6484	0.7800	0.8200	0.8214	0.8190	0.8049
EFF 7	0.6289	0.6819	0.7800	0.8239	0.8264	0.8258	0.8146
EFF 7	0.6854	0.7439	0.8073	0.8287	0.8336	0.8341	0.8190
EFF 7	0.6947	0.7595	0.8205	0.8362	0.8400	0.8361	0.8190

Series 1000 Engine Component Performance Maps.

EFF	7	0.7000	0.7761	0.8273	0.8424	0.8492	0.8385	0.8190
EFF	7	0.7420	0.7941	0.8361	0.8482	0.8492	0.8385	0.8190
EFF	7	0.7839	0.8102	0.8385	0.8482	0.8482	0.8385	0.8190
EFF	7	0.8117	0.8190	0.8385	0.8482	0.8482	0.8385	0.8190
EFF	7	0.8190	0.8219	0.8385	0.8482	0.8482	0.8385	0.8190
EFF	7	0.8326	0.8346	0.8424	0.8463	0.8443	0.8385	0.8190
EFF	7	0.8424	0.8429	0.8434	0.8433	0.8418	0.8336	0.8180
EFF	7	0.8346	0.8351	0.8356	0.8346	0.8326	0.8287	0.8092
EFF	7	0.8190	0.8209	0.8219	0.8205	0.8166	0.8078	0.7985
SPED	13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
		0.850	0.900	0.950	1.000	1.050	1.100	
R	7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
EFF	7	0.5975	0.6650	0.8000	0.8410	0.8425	0.8400	0.8255
EFF	7	0.6450	0.6994	0.8000	0.8450	0.8476	0.8470	0.8355
EFF	7	0.7030	0.7630	0.8280	0.8500	0.8550	0.8555	0.8400
EFF	7	0.7125	0.7790	0.8415	0.8576	0.8615	0.8575	0.8400
EFF	7	0.7180	0.7960	0.8485	0.8640	0.8710	0.8600	0.8400
EFF	7	0.7610	0.8145	0.8575	0.8700	0.8710	0.8600	0.8400
EFF	7	0.8040	0.8310	0.8600	0.8700	0.8700	0.8600	0.8400
EFF	7	0.8325	0.8400	0.8600	0.8700	0.8700	0.8600	0.8400
EFF	7	0.8400	0.8430	0.8600	0.8699	0.8700	0.8600	0.8400
EFF	7	0.8540	0.8560	0.8640	0.8680	0.8660	0.8600	0.8400
EFF	7	0.8640	0.8645	0.8650	0.8649	0.8634	0.8550	0.8390
EFF	7	0.8560	0.8565	0.8570	0.8560	0.8540	0.8500	0.8300
EFF	7	0.8400	0.8420	0.8430	0.8415	0.8375	0.8285	0.8190
SPED	13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
		0.850	0.900	0.950	1.000	1.050	1.100	
R	7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
EFF	7	0.6274	0.6982	0.8400	0.8830	0.8846	0.8820	0.8668
EFF	7	0.6772	0.7344	0.8400	0.8872	0.8900	0.8893	0.8773
EFF	7	0.7381	0.8011	0.8694	0.8925	0.8977	0.8983	0.8820
EFF	7	0.7481	0.8179	0.8836	0.9005	0.9046	0.9004	0.8820
EFF	7	0.7539	0.8358	0.8909	0.9072	0.9145	0.9030	0.8820
EFF	7	0.7990	0.8552	0.9004	0.9135	0.9145	0.9030	0.8820
EFF	7	0.8442	0.8725	0.9030	0.9135	0.9135	0.9030	0.8820
EFF	7	0.8741	0.8820	0.9030	0.9135	0.9135	0.9030	0.8820
EFF	7	0.8820	0.8851	0.9030	0.9134	0.9135	0.9030	0.8820
EFF	7	0.8967	0.8988	0.9072	0.9114	0.9093	0.9030	0.8820
EFF	7	0.9072	0.9077	0.9082	0.9081	0.9066	0.8977	0.8809
EFF	7	0.8988	0.8993	0.8998	0.8988	0.8967	0.8925	0.8715
EFF	7	0.8820	0.8841	0.8851	0.8836	0.8794	0.8699	0.8599
EOT								
1003		HIGH PRESSURE FAN WITH VARIABLE STATORS						
ANGL	3	-5.00	0.00	10.00				
SPED	13	0.400	0.500	0.600	0.650	0.700	0.750	0.800
		0.850	0.900	0.950	1.000	1.050	1.100	
R	7	1.000	1.100	1.300	1.500	1.700	1.900	2.100
PR	7	1.1396	1.1396	1.1396	1.1323	1.1263	1.1150	1.0924
PR	7	1.2141	1.2135	1.2121	1.2002	1.1928	1.1829	1.1470
PR	7	1.3192	1.3185	1.3172	1.3052	1.2926	1.2693	1.2294
PR	7	1.3990	1.3983	1.3957	1.3904	1.3724	1.3451	1.2959
PR	7	1.4795	1.4788	1.4781	1.4655	1.4522	1.4223	1.3824
PR	7	1.5872	1.5859	1.5752	1.5659	1.5486	1.5114	1.4755
PR	7	1.6916	1.6896	1.6750	1.6630	1.6397	1.5985	1.5553
PR	7	1.8572	1.8512	1.8312	1.8080	1.7767	1.7282	1.6803
PR	7	2.0314	2.0241	2.0095	1.9809	1.9456	1.8878	1.8146
PR	7	2.2003	2.1970	2.1804	2.1504	2.1152	2.0507	1.9576
PR	7	2.3865	2.3832	2.3579	2.3220	2.2801	2.2036	2.0972
PR	7	2.5481	2.5415	2.5062	2.4663	2.4198	2.3366	2.2236
PR	7	2.6924	2.6824	2.6392	2.5827	2.5195	2.4297	2.3433

Series 1000 Engine Component Performance Maps. (cont.)

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SPED 13      0.400     0.500     0.600     0.650     0.700     0.750     0.800
             0.850     0.900     0.950     1.000     1.050     1.100
R      7     1.000     1.100     1.300     1.500     1.700     1.900     2.100
PR     7    1.2100    1.2100    1.2100    1.1990    1.1900    1.1730    1.1390
PR     7    1.3220    1.3210    1.3190    1.3010    1.2900    1.2750    1.2210
PR     7    1.4800    1.4790    1.4770    1.4590    1.4400    1.4050    1.3450
PR     7    1.6000    1.5990    1.5950    1.5870    1.5600    1.5190    1.4450
PR     7    1.7210    1.7200    1.7190    1.7000    1.6800    1.6350    1.5750
PR     7    1.8830    1.8810    1.8650    1.8510    1.8250    1.7690    1.7150
PR     7    2.0400    2.0370    2.0150    1.9970    1.9620    1.9000    1.8350
PR     7    2.2890    2.2800    2.2500    2.2150    2.1680    2.0950    2.0230
PR     7    2.5510    2.5400    2.5180    2.4750    2.4220    2.3350    2.2250
PR     7    2.8050    2.8000    2.7750    2.7300    2.6770    2.5800    2.4400
PR     7    3.0850    3.0800    3.0420    2.9880    2.9250    2.8100    2.6500
PR     7    3.3280    3.3180    3.2650    3.2050    3.1350    3.0100    2.8400
PR     7    3.5450    3.5300    3.4650    3.3800    3.2850    3.1500    3.0200
SPED 13      0.400     0.500     0.600     0.650     0.700     0.750     0.800
             0.850     0.900     0.950     1.000     1.050     1.100
R      7     1.000     1.100     1.300     1.500     1.700     1.900     2.100
PR     7    1.3507    1.3507    1.3507    1.3323    1.3173    1.2889    1.2321
PR     7    1.5377    1.5361    1.5327    1.5027    1.4843    1.4592    1.3691
PR     7    1.8016    1.7999    1.7966    1.7665    1.7348    1.6763    1.5761
PR     7    2.0020    2.0003    1.9936    1.9803    1.9352    1.8667    1.7431
PR     7    2.2041    2.2024    2.2007    2.1690    2.1356    2.0604    1.9602
PR     7    2.4746    2.4713    2.4445    2.4212    2.3777    2.2842    2.1940
PR     7    2.7368    2.7318    2.6950    2.6650    2.6065    2.5030    2.3944
PR     7    3.1526    3.1376    3.0875    3.0290    2.9506    2.8286    2.7084
PR     7    3.5902    3.5718    3.5351    3.4632    3.3747    3.2294    3.0457
PR     7    4.0143    4.0060    3.9642    3.8891    3.8006    3.6386    3.4048
PR     7    4.4819    4.4736    4.4101    4.3200    4.2147    4.0227    3.7555
PR     7    4.8878    4.8711    4.7825    4.6823    4.5654    4.3567    4.0728
PR     7    5.2501    5.2251    5.1165    4.9746    4.8159    4.5905    4.3734
EOT
 1004     HIGH PRESSURE COMPRESSOR WITH VARIABLE STATORS
ANGL  3      -5.00      0.00     10.00
SPED 15      0.600     0.700     0.750     0.800     0.810     0.820     0.830
             0.840     0.850     0.860     0.870     0.900     0.935     0.985
             1.035
R      7     1.000     1.050     1.150     1.300     1.450     1.600     1.750
FLOW   7    0.1520    0.1580    0.1640    0.1730    0.1820    0.1840    0.1840
FLOW   7    0.1910    0.1960    0.2060    0.2140    0.2210    0.2250    0.2260
FLOW   7    0.2330    0.2440    0.2500    0.2550    0.2580    0.2600    0.2610
FLOW   7    0.2690    0.2840    0.2930    0.3000    0.3040    0.3050    0.3060
FLOW   7    0.3080    0.3230    0.3350    0.3480    0.3530    0.3550    0.3560
FLOW   7    0.3690    0.3820    0.3930    0.4080    0.4170    0.4210    0.4240
FLOW   7    0.4240    0.4380    0.4540    0.4700    0.4770    0.4800    0.4810
FLOW   7    0.4580    0.4720    0.4860    0.5020    0.5100    0.5140    0.5160
FLOW   7    0.4880    0.5030    0.5160    0.5300    0.5370    0.5410    0.5440
FLOW   7    0.5240    0.5350    0.5510    0.5660    0.5750    0.5780    0.5800
FLOW   7    0.5580    0.5710    0.5850    0.6020    0.6090    0.6110    0.6150
FLOW   7    0.6430    0.6550    0.6680    0.6800    0.6850    0.6890    0.6910
FLOW   7    0.7120    0.7250    0.7350    0.7480    0.7510    0.7530    0.7540
FLOW   7    0.7860    0.7950    0.8040    0.8090    0.8100    0.8100    0.8100
FLOW   7    0.8600    0.8600    0.8600    0.8600    0.8600    0.8600    0.8600
SPED 15      0.600     0.700     0.750     0.800     0.810     0.820     0.830
             0.840     0.850     0.860     0.870     0.900     0.935     0.985
             1.035
R      7     1.000     1.050     1.150     1.300     1.450     1.600     1.750
FLOW   7    0.3520    0.3580    0.3640    0.3730    0.3820    0.3840    0.3840
FLOW   7    0.3910    0.3960    0.4060    0.4140    0.4210    0.4250    0.4260
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Series 1000 Engine Component Performance Maps. (cont.)

FLOW 7	0.4330	0.4440	0.4500	0.4550	0.4580	0.4600	0.4610
FLOW 7	0.4690	0.4840	0.4930	0.5000	0.5040	0.5050	0.5060
FLOW 7	0.5080	0.5230	0.5350	0.5480	0.5530	0.5550	0.5560
FLOW 7	0.5690	0.5820	0.5930	0.6080	0.6170	0.6210	0.6240
FLOW 7	0.6240	0.6380	0.6540	0.6700	0.6770	0.6800	0.6810
FLOW 7	0.6580	0.6720	0.6860	0.7020	0.7100	0.7140	0.7160
FLOW 7	0.6880	0.7030	0.7160	0.7300	0.7370	0.7410	0.7440
FLOW 7	0.7240	0.7350	0.7510	0.7660	0.7750	0.7780	0.7800
FLOW 7	0.7580	0.7710	0.7850	0.8020	0.8090	0.8110	0.8150
FLOW 7	0.8430	0.8550	0.8680	0.8800	0.8850	0.8890	0.8910
FLOW 7	0.9120	0.9250	0.9350	0.9480	0.9510	0.9530	0.9540
FLOW 7	0.9860	0.9950	1.0040	1.0090	1.0100	1.0100	1.0100
FLOW 7	1.0600	1.0600	1.0600	1.0600	1.0600	1.0600	1.0600
SPED 15	0.600	0.700	0.750	0.800	0.810	0.820	0.830
	0.840	0.850	0.860	0.870	0.900	0.935	0.985
	1.035						
R 7	1.000	1.050	1.150	1.300	1.450	1.600	1.750
FLOW 7	0.7520	0.7580	0.7640	0.7730	0.7820	0.7840	0.7840
FLOW 7	0.7910	0.7960	0.8060	0.8140	0.8210	0.8250	0.8260
FLOW 7	0.8330	0.8440	0.8500	0.8550	0.8580	0.8600	0.8610
FLOW 7	0.8690	0.8840	0.8930	0.9000	0.9040	0.9050	0.9060
FLOW 7	0.9080	0.9230	0.9350	0.9480	0.9530	0.9550	0.9560
FLOW 7	0.9690	0.9820	0.9930	1.0080	1.0170	1.0210	1.0240
FLOW 7	1.0240	1.0380	1.0540	1.0700	1.0770	1.0800	1.0810
FLOW 7	1.0580	1.0720	1.0860	1.1020	1.1100	1.1140	1.1160
FLOW 7	1.0880	1.1030	1.1160	1.1300	1.1370	1.1410	1.1440
FLOW 7	1.1240	1.1350	1.1510	1.1660	1.1750	1.1780	1.1800
FLOW 7	1.1580	1.1710	1.1850	1.2020	1.2090	1.2110	1.2150
FLOW 7	1.2430	1.2550	1.2680	1.2800	1.2850	1.2890	1.2910
FLOW 7	1.3120	1.3250	1.3350	1.3480	1.3510	1.3530	1.3540
FLOW 7	1.3860	1.3950	1.4040	1.4090	1.4100	1.4100	1.4100
FLOW 7	1.4600	1.4600	1.4600	1.4600	1.4600	1.4600	1.4600
EOT							
1005	HIGH PRESSURE COMPRESSOR WITH VARIABLE STATORS						
ANGL 3	-5.00	0.00	10.00				
SPED 15	0.600	0.700	0.750	0.800	0.810	0.820	0.830
	0.840	0.850	0.860	0.870	0.900	0.935	0.985
	1.035						
R 7	1.000	1.050	1.150	1.300	1.450	1.600	1.750
EFF 7	0.8775	0.8287	0.6981	0.5314	0.3315	0.1950	0.1950
EFF 7	0.9165	0.8853	0.8141	0.6435	0.4339	0.3071	0.2730
EFF 7	0.9301	0.9165	0.8609	0.7459	0.5216	0.2779	0.1755
EFF 7	0.9399	0.9301	0.8931	0.7917	0.6289	0.3900	0.2340
EFF 7	0.9487	0.9418	0.9194	0.8434	0.7264	0.5479	0.3120
EFF 7	0.9613	0.9545	0.9409	0.8824	0.7975	0.6776	0.5333
EFF 7	0.9711	0.9672	0.9574	0.9145	0.8463	0.7468	0.6191
EFF 7	0.9779	0.9730	0.9652	0.9262	0.8677	0.7693	0.6493
EFF 7	0.9818	0.9789	0.9721	0.9379	0.8804	0.7868	0.6640
EFF 7	0.9857	0.9838	0.9779	0.9467	0.8950	0.8092	0.6864
EFF 7	0.9886	0.9867	0.9828	0.9584	0.9077	0.8151	0.6922
EFF 7	0.9925	0.9896	0.9896	0.9701	0.9184	0.8336	0.7069
EFF 7	0.9896	0.9886	0.9857	0.9574	0.9067	0.8219	0.6825
EFF 7	0.9818	0.9760	0.9682	0.9331	0.8833	0.7956	0.6513
EFF 7	0.8950	0.8950	0.8863	0.8677	0.8317	0.7546	0.5918
SPED 15	0.600	0.700	0.750	0.800	0.810	0.820	0.830
	0.840	0.850	0.860	0.870	0.900	0.935	0.985
	1.035						
R 7	1.000	1.050	1.150	1.300	1.450	1.600	1.750
EFF 7	0.9000	0.8500	0.7160	0.5450	0.3400	0.2000	0.2000
EFF 7	0.9400	0.9080	0.8350	0.6600	0.4450	0.3150	0.2800

Series 1000 Engine Component Performance Maps.(cont.)

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EFF    7        0.9540     0.9400     0.8830     0.7650     0.5350     0.2850     0.1800
EFF    7        0.9640     0.9540     0.9160     0.8120     0.6450     0.4000     0.2400
EFF    7        0.9730     0.9660     0.9430     0.8650     0.7450     0.5620     0.3200
EFF    7        0.9860     0.9790     0.9650     0.9050     0.8180     0.6950     0.5470
EFF    7        0.9960     0.9920     0.9820     0.9380     0.8680     0.7660     0.6350
EFF    7        1.0030     0.9980     0.9900     0.9500     0.8900     0.7890     0.6660
EFF    7        1.0070     1.0040     0.9970     0.9620     0.9030     0.8070     0.6810
EFF    7        1.0110     1.0090     1.0030     0.9710     0.9180     0.8300     0.7040
EFF    7        1.0140     1.0120     1.0080     0.9830     0.9310     0.8360     0.7100
EFF    7        1.0180     1.0150     1.0150     0.9950     0.9420     0.8550     0.7250
EFF    7        1.0150     1.0140     1.0110     0.9820     0.9300     0.8430     0.7000
EFF    7        1.0070     1.0010     0.9930     0.9570     0.9060     0.8160     0.6680
EFF    7        0.9180     0.9180     0.9090     0.8900     0.8530     0.7740     0.6070
SPED  15         0.600      0.700      0.750      0.800      0.810      0.820      0.830
                 0.840      0.850      0.860      0.870      0.900      0.935      0.985
                 1.035
R      7         1.000      1.050      1.150      1.300      1.450      1.600      1.750
EFF    7        0.8550     0.8075     0.6802     0.5177     0.3230     0.1900     0.1900
EFF    7        0.8930     0.8626     0.7932     0.6270     0.4227     0.2993     0.2660
EFF    7        0.9063     0.8930     0.8388     0.7268     0.5082     0.2707     0.1710
EFF    7        0.9158     0.9063     0.8702     0.7714     0.6127     0.3800     0.2280
EFF    7        0.9244     0.9177     0.8959     0.8217     0.7077     0.5339     0.3040
EFF    7        0.9367     0.9301     0.9168     0.8597     0.7771     0.6603     0.5196
EFF    7        0.9462     0.9424     0.9329     0.8911     0.8246     0.7277     0.6032
EFF    7        0.9528     0.9481     0.9405     0.9025     0.8455     0.7495     0.6327
EFF    7        0.9567     0.9538     0.9471     0.9139     0.8579     0.7666     0.6470
EFF    7        0.9604     0.9585     0.9528     0.9224     0.8721     0.7885     0.6688
EFF    7        0.9633     0.9614     0.9576     0.9338     0.8845     0.7942     0.6745
EFF    7        0.9671     0.9642     0.9642     0.9452     0.8949     0.8122     0.6887
EFF    7        0.9642     0.9633     0.9604     0.9329     0.8835     0.8009     0.6650
EFF    7        0.9567     0.9509     0.9434     0.9092     0.8607     0.7752     0.6346
EFF    7        0.8721     0.8721     0.8636     0.8455     0.8104     0.7353     0.5766
EOT
 1006     HIGH PRESSURE COMPRESSOR WITH VARIABLE STATORS
ANGL   3         -5.00       0.00      10.00
SPED  15         0.600      0.700      0.750      0.800      0.810      0.820      0.830
                 0.840      0.850      0.860      0.870      0.900      0.935      0.985
                 1.035
R      7         1.000      1.050      1.150      1.300      1.450      1.600      1.750
PR     7        1.7135     1.6730     1.4894     1.3059     1.1017     1.0000     1.0000
PR     7        2.0600     1.9583     1.7900     1.5506     1.3159     1.1889     1.1529
PR     7        2.4371     2.2948     2.0806     1.8153     1.5300     1.3564     1.2806
PR     7        2.7330     2.5900     2.3759     2.0700     1.7747     1.5606     1.4436
PR     7        3.0489     2.8753     2.6818     2.3759     2.0600     1.7900     1.6271
PR     7        3.4871     3.2989     3.0894     2.7430     2.4018     2.0959     1.8665
PR     7        3.8748     3.7065     3.4871     3.1253     2.7330     2.3759     2.0853
PR     7        4.1089     3.9459     3.7012     3.3189     2.9212     2.5288     2.2130
PR     7        4.3283     4.1701     3.9154     3.4971     3.0642     2.6565     2.3047
PR     7        4.5930     4.4148     4.1494     3.7112     3.2630     2.8347     2.4424
PR     7        4.8583     4.6595     4.3895     3.9307     3.4565     2.9724     2.5701
PR     7        5.5360     5.2713     4.9601     4.4148     3.8794     3.3341     2.8447
PR     7        6.0866     5.7754     5.4289     4.8224     4.2259     3.6400     3.0642
PR     7        6.5654     6.2701     5.8931     5.2201     4.5577     3.8947     3.2836
PR     7        6.8613     6.7542     6.2954     5.5306     4.8377     4.1295     3.4618
SPED  15         0.600      0.700      0.750      0.800      0.810      0.820      0.830
                 0.840      0.850      0.860      0.870      0.900      0.935      0.985
                 1.035
R      7         1.000      1.050      1.150      1.300      1.450      1.600      1.750
PR     7        2.0730     2.0120     1.7360     1.4600     1.1530     1.0000     1.0000
PR     7        2.5940     2.4410     2.1880     1.8280     1.4750     1.2840     1.2300
```

Series 1000 Engine Component Performance Maps.(cont.)

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PR     7      3.1610    2.9470    2.6250    2.2260    1.7970    1.5360    1.4220
PR     7      3.6060    3.3910    3.0690    2.6090    2.1650    1.8430    1.6670
PR     7      4.0810    3.8200    3.5290    3.0690    2.5940    2.1880    1.9430
PR     7      4.7400    4.4570    4.1420    3.6210    3.1080    2.6480    2.3030
PR     7      5.3230    5.0700    4.7400    4.1960    3.6060    3.0690    2.6320
PR     7      5.6750    5.4300    5.0620    4.4870    3.8890    3.2990    2.8240
PR     7      6.0050    5.7670    5.3840    4.7550    4.1040    3.4910    2.9620
PR     7      6.4030    6.1350    5.7360    5.0770    4.4030    3.7590    3.1690
PR     7      6.8020    6.5030    6.0970    5.4070    4.6940    3.9660    3.3610
PR     7      7.8210    7.4230    6.9550    6.1350    5.3300    4.5100    3.7740
PR     7      8.6490    8.1810    7.6600    6.7480    5.8510    4.9700    4.1040
PR     7      9.3690    8.9250    8.3580    7.3460    6.3500    5.3530    4.4340
PR     7      9.8140    9.6530    8.9630    7.8130    6.7710    5.7060    4.7020
SPED 15       0.600     0.700     0.750     0.800     0.810     0.820     0.830
              0.840     0.850     0.860     0.870     0.900     0.935     0.985
              1.035
R      7      1.000     1.050     1.150     1.300     1.450     1.600     1.750
PR     7      2.7919    2.6900    2.2291    1.7682    1.2555    1.0000    1.0000
PR     7      3.6620    3.4065    2.9840    2.3828    1.7932    1.4743    1.3841
PR     7      4.6089    4.2515    3.7137    3.0474    2.3310    1.8951    1.7047
PR     7      5.3520    4.9930    4.4552    3.6870    2.9455    2.4078    2.1139
PR     7      6.1453    5.7094    5.2234    4.4552    3.6620    2.9840    2.5748
PR     7      7.2458    6.7732    6.2471    5.3771    4.5204    3.7522    3.1760
PR     7      8.2194    7.7969    7.2458    6.3373    5.3520    4.4552    3.7254
PR     7      8.8072    8.3981    7.7835    6.8233    5.8246    4.8393    4.0461
PR     7      9.3583    8.9609    8.3213    7.2708    6.1837    5.1600    4.2765
PR     7     10.0230    9.5754    8.9091    7.8086    6.6830    5.6075    4.6222
PR     7     10.6893   10.1900    9.5120    8.3597    7.1690    5.9532    4.9429
PR     7     12.3911   11.7264   10.9448    9.5754    8.2311    6.8617    5.6326
PR     7     13.7738   12.9923   12.1222   10.5992    9.1012    7.6299    6.1837
PR     7     14.9762   14.2347   13.2879   11.5978    9.9345    8.2695    6.7348
PR     7     15.7194   15.4505   14.2982   12.3777   10.6376    8.8590    7.1823
EOT
 1007      HIGH PRESSURE TURBINE WITH VARIABLE AREA
AREA  3       0.50      1.00      1.50
SPED  3      4000.     5000.     6000.
PR   14       1.000     1.300     1.500     1.600     1.800     2.000     2.200
              2.500     2.800     3.100     3.300     3.500     3.600     5.000
FLOW 14       0.000     7.650     8.550     8.887     9.313     9.575     9.730
              9.875     9.950     9.990    10.005    10.020    10.020    10.020
FLOW 14       0.000     7.887     8.550     8.787     9.112     9.350     9.520
              9.680     9.770     9.820     9.835     9.850     9.850     9.850
FLOW 14       0.000     8.112     8.563     8.750     9.020     9.225     9.375
              9.525     9.595     9.640     9.655     9.670     9.670     9.670
SPED  3      4000.     5000.     6000.
PR   14       1.000     1.300     1.500     1.600     1.800     2.000     2.200
              2.500     2.800     3.100     3.300     3.500     3.600     5.000
FLOW 14       0.000    15.300    17.100    17.775    18.625    19.150    19.460
             19.750    19.900    19.980    20.010    20.040    20.040    20.041
FLOW 14       0.000    15.775    17.100    17.575    18.225    18.700    19.040
             19.360    19.540    19.640    19.670    19.700    19.700    19.701
FLOW 14       0.000    16.225    17.125    17.500    18.040    18.450    18.750
             19.050    19.190    19.280    19.310    19.340    19.340    19.341
SPED  3      4000.     5000.     6000.
PR   14       1.000     1.300     1.500     1.600     1.800     2.000     2.200
              2.500     2.800     3.100     3.300     3.500     3.600     5.000
FLOW 14       0.000    22.950    25.650    26.662    27.938    28.725    29.190
             29.625    29.850    29.970    30.015    30.060    30.060    30.061
FLOW 14       0.000    23.662    25.650    26.362    27.337    28.050    28.560
             29.040    29.310    29.460    29.505    29.550    29.550    29.551
```

Series 1000 Engine Component Performance Maps. (cont.)

FLOW 14	0.000	24.337	25.688	26.250	27.060	27.675	28.125
	28.575	28.785	28.920	28.965	29.010	29.010	29.011
EOT							
1008	HIGH PRESSURE TURBINE WITH VARIABLE AREA						
AREA 3	0.50	1.00	1.50				
SPED 4	4000.0	5000.0	6000.0	8000.0			
PR 14	1.000	1.250	1.750	2.000	2.150	2.380	2.500
	2.750	3.250	3.500	4.000	4.500	4.750	5.000
EFF 14	0.7533	0.7577	0.7661	0.7702	0.7723	0.7753	0.7771
	0.7805	0.7861	0.7884	0.7907	0.7911	0.7904	0.7893
EFF 14	0.7560	0.7645	0.7791	0.7852	0.7888	0.7925	0.7930
	0.7933	0.7937	0.7938	0.7922	0.7886	0.7860	0.7830
EFF 14	0.7560	0.7643	0.7783	0.7834	0.7861	0.7895	0.7913
	0.7940	0.7981	0.7993	0.8002	0.7989	0.7976	0.7956
EFF 14	0.7560	0.7640	0.7772	0.7819	0.7840	0.7853	0.7859
	0.7862	0.7855	0.7848	0.7834	0.7819	0.7810	0.7801
SPED 4	4000.0	5000.0	6000.0	8000.0			
PR 14	1.000	1.250	1.750	2.000	2.150	2.380	2.500
	2.750	3.250	3.500	4.000	4.500	4.750	5.000
EFF 14	0.8370	0.8419	0.8512	0.8557	0.8581	0.8615	0.8635
	0.8672	0.8734	0.8760	0.8786	0.8790	0.8782	0.8770
EFF 14	0.8400	0.8495	0.8657	0.8725	0.8765	0.8806	0.8811
	0.8815	0.8819	0.8820	0.8802	0.8762	0.8733	0.8700
EFF 14	0.8400	0.8492	0.8648	0.8705	0.8735	0.8772	0.8792
	0.8822	0.8867	0.8881	0.8891	0.8877	0.8862	0.8840
EFF 14	0.8400	0.8489	0.8636	0.8687	0.8711	0.8726	0.8732
	0.8736	0.8727	0.8720	0.8705	0.8688	0.8678	0.8668
SPED 3	4000.	5000.	6000.				
PR 14	1.000	1.250	1.750	2.000	2.150	2.380	2.500
	2.750	3.250	3.500	4.000	4.500	4.750	5.000
EFF 14	0.7533	0.7577	0.7661	0.7702	0.7723	0.7753	0.7771
	0.7805	0.7861	0.7884	0.7907	0.7911	0.7904	0.7893
EFF 14	0.7560	0.7645	0.7791	0.7852	0.7888	0.7925	0.7930
	0.7933	0.7937	0.7938	0.7922	0.7886	0.7860	0.7830
EFF 14	0.7560	0.7643	0.7783	0.7834	0.7861	0.7895	0.7913
	0.7940	0.7981	0.7993	0.8002	0.7989	0.7976	0.7956
EFF 14	0.7560	0.7640	0.7772	0.7819	0.7840	0.7853	0.7859
	0.7862	0.7855	0.7848	0.7834	0.7819	0.7810	0.7801
EOT							
1009	LOW PRESSURE TURBINE WITH VARIABLE AREA						
AREA 3	0.50	1.00	1.50				
SPED 3	4000.0	5000.0	6000.0				
PR 14	1.000	1.020	1.100	1.150	1.200	1.300	1.350
	1.400	1.600	1.700	1.900	2.200	2.400	2.660
FLOW 14	0.000	9.250	17.100	19.550	21.200	24.000	25.250
	26.300	29.500	30.500	31.500	32.050	32.200	32.200
FLOW 14	0.000	7.750	15.600	18.400	20.300	23.250	24.350
	25.500	28.550	29.700	30.800	31.550	31.800	31.875
FLOW 14	0.000	7.750	15.100	17.300	19.125	22.100	23.300
	24.400	27.625	28.750	30.250	31.050	31.300	31.450
SPED 3	4000.0	5000.0	6000.0				
PR 14	1.000	1.020	1.100	1.150	1.200	1.300	1.350
	1.400	1.600	1.700	1.900	2.200	2.400	2.660
FLOW 14	0.000	18.500	34.200	39.100	42.400	48.000	50.500
	52.600	59.000	61.000	63.000	64.100	64.400	64.400
FLOW 14	0.000	15.500	31.200	36.800	40.600	46.500	48.700
	51.000	57.100	59.400	61.600	63.100	63.600	63.750
FLOW 14	0.000	15.500	30.200	34.600	38.250	44.200	46.600
	48.800	55.250	57.500	60.500	62.100	62.600	62.900
SPED 3	4000.0	5000.0	6000.0				

Series 1000 Engine Component Performance Maps. (cont.)

PR 14	1.000	1.020	1.100	1.150	1.200	1.300	1.350
	1.400	1.600	1.700	1.900	2.200	2.400	2.660
FLOW 14	0.000	27.750	51.300	58.650	63.600	72.000	75.750
	78.900	88.500	91.500	94.500	96.150	96.600	96.600
FLOW 14	0.000	23.250	46.800	55.200	60.900	69.750	73.050
	76.500	85.650	89.100	92.400	94.650	95.400	95.625
FLOW 14	0.000	23.250	45.300	51.900	57.375	66.300	69.900
	73.200	82.875	86.250	90.750	93.150	93.900	94.350
EOT							
1010	LOW PRESSURE TURBINE WITH VARIABLE AREA						
AREA 3	0.50	1.00	1.50				
SPED 5	3000.0	4000.0	4500.0	5000.0	6000.0		
PR 14	1.000	1.200	1.360	1.400	1.450	1.660	1.740
	1.820	2.000	2.100	2.300	2.500	2.600	2.660
EFF 14	0.7983	0.8132	0.8221	0.8231	0.8233	0.8156	0.8107
	0.8059	0.7956	0.7893	0.7830	0.7776	0.7767	0.7758
EFF 14	0.7998	0.8071	0.8127	0.8140	0.8156	0.8210	0.8227
	0.8236	0.8236	0.8219	0.8183	0.8140	0.8119	0.8105
EFF 14	0.7929	0.8005	0.8064	0.8077	0.8095	0.8163	0.8185
	0.8204	0.8231	0.8239	0.8240	0.8225	0.8213	0.8206
EFF 14	0.7961	0.8014	0.8052	0.8064	0.8075	0.8121	0.8138
	0.8154	0.8185	0.8201	0.8225	0.8239	0.8240	0.8242
EFF 14	0.8147	0.8158	0.8164	0.8167	0.8167	0.8176	0.8178
	0.8181	0.8185	0.8190	0.8195	0.8199	0.8199	0.8200
SPED 5	3000.0	4000.0	4500.0	5000.0	6000.0		
PR 14	1.000	1.200	1.360	1.400	1.450	1.660	1.740
	1.820	2.000	2.100	2.300	2.500	2.600	2.660
EFF 14	0.8870	0.9036	0.9135	0.9145	0.9148	0.9062	0.9007
	0.8955	0.8840	0.8770	0.8700	0.8640	0.8630	0.8620
EFF 14	0.8887	0.8967	0.9030	0.9044	0.9062	0.9122	0.9141
	0.9151	0.9151	0.9132	0.9092	0.9045	0.9021	0.9006
EFF 14	0.8810	0.8895	0.8960	0.8975	0.8995	0.9070	0.9095
	0.9116	0.9146	0.9155	0.9156	0.9139	0.9126	0.9117
EFF 14	0.8846	0.8905	0.8947	0.8960	0.8972	0.9023	0.9042
	0.9060	0.9095	0.9112	0.9139	0.9154	0.9156	0.9158
EFF 14	0.9052	0.9064	0.9071	0.9074	0.9075	0.9084	0.9087
	0.9090	0.9095	0.9100	0.9105	0.9110	0.9110	0.9111
SPED 5	3000.0	4000.0	4500.0	5000.0	6000.0		
PR 14	1.000	1.200	1.360	1.400	1.450	1.660	1.740
	1.820	2.000	2.100	2.300	2.500	2.600	2.660
EFF 14	0.7983	0.8132	0.8221	0.8231	0.8233	0.8156	0.8107
	0.8059	0.7956	0.7893	0.7830	0.7776	0.7767	0.7758
EFF 14	0.7998	0.8071	0.8127	0.8140	0.8156	0.8210	0.8227
	0.8236	0.8236	0.8219	0.8183	0.8140	0.8119	0.8105
EFF 14	0.7929	0.8005	0.8064	0.8077	0.8095	0.8163	0.8185
	0.8204	0.8231	0.8239	0.8240	0.8225	0.8213	0.8206
EFF 14	0.7961	0.8014	0.8052	0.8064	0.8075	0.8121	0.8138
	0.8154	0.8185	0.8201	0.8225	0.8239	0.8240	0.8242
EFF 14	0.8147	0.8158	0.8164	0.8167	0.8167	0.8176	0.8178
	0.8181	0.8185	0.8190	0.8195	0.8199	0.8199	0.8200
EOT							

Series 1000 Engine Component Performance Maps. (cont.)

4.2 INLET AND NOZZLE/AFTBODY DATA BASE

4.2.1 INLET CONFIGURATIONS AND PERFORMANCE MAPS

In this section each of the nineteen inlet configurations of the library data base will be depicted with a description of the inlet's design, a sketch of inlet geometry, a list of its derivative and non-changable parameters and its performance characteristics displayed in tabular and plotted formats. Since some inlet designs do not require bypass or bleed systems, the respective tables would be zeroed out and therefore, these plots will not be shown. Also, since some inlet configurations show no variation between local inlet Mach number and free-stream Mach number a plot of this table will be deleted.

A summary of the inlet types that are included in the inlet library is presented in Figure 1 as a function of design Mach number. A brief description of the sources used to obtain the inlet configurations and performance data is presented in Figure 2. The derivative parameters for each of the inlet configurations are summarized in Figure 3.

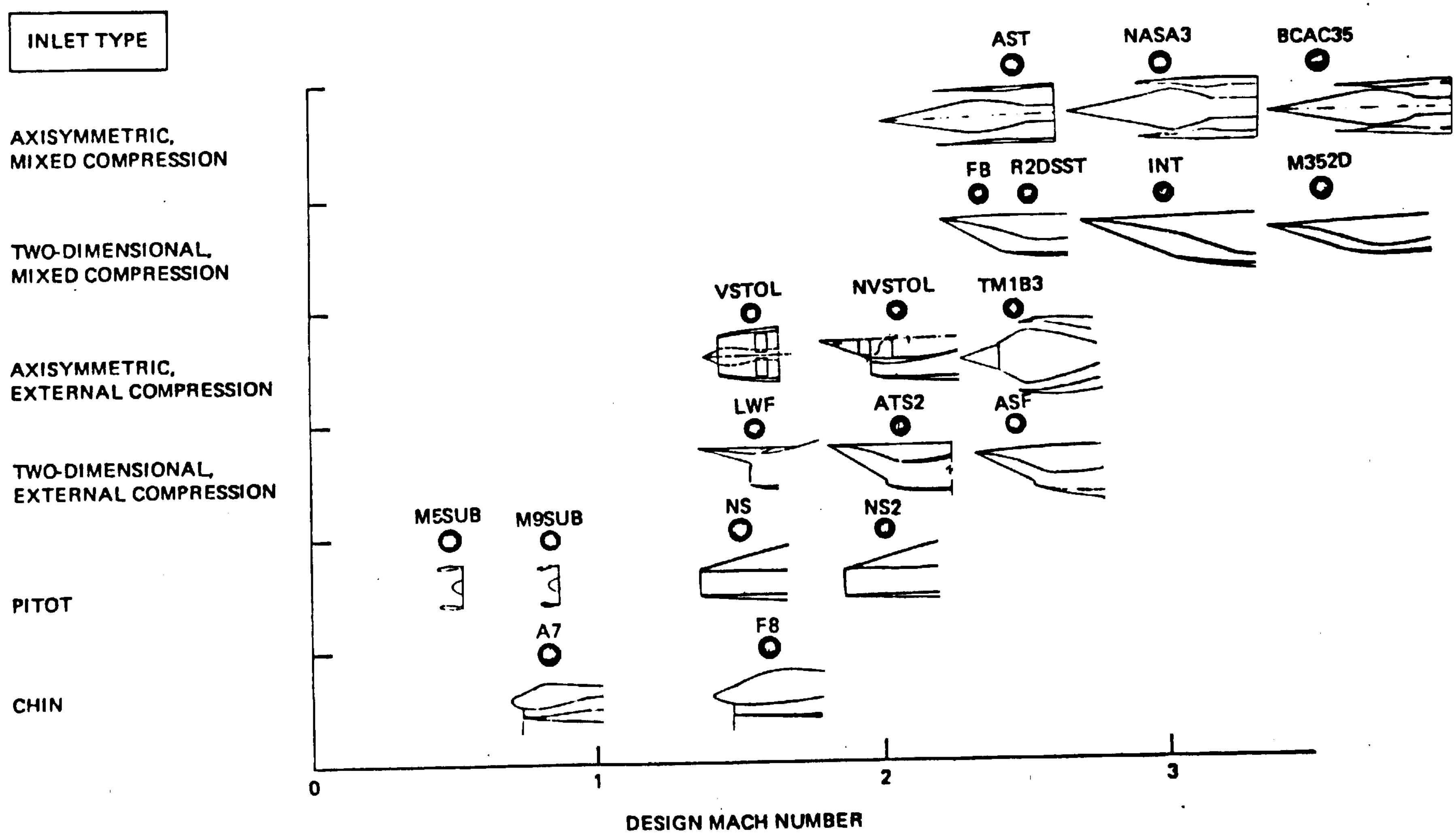

Figure 1 Matrix of Inlet Maps

INLET FILE NAME	INLET CONFIGURATIONS AND SOURCES OF DATA USED TO DEVELOP THE INLET MAPS
A7	A-7 type inlet; developed from published A-7 data and engineering analysis
F8	F-8 type inlet; developed from published F-8 inlet data and analysis
M5SUB	Subsonic inlet type; based on data and methods from Boeing subsonic inlet (i.e., 707,727, etc.)
M9SUB	Subsonic inlet type; based on data and methods used to develop Boeing 747-type inlets
NS	Normal shock inlet; based on data from Rockwell tests of F-100 airplane inlet
NS2	Normal shock-type inlet; based on data from Rockwell F-100 inlet, Boeing LWF inlet tests, and GD LWF inlet data
LWF	Fixed-Geometry, 2-shock inlet; based on data from Boeing LWF inlet tests
ATS2	Four-shock, variable ramp inlet; theoretical design based on analysis, optimized for $M_0 = 2.0$
ASF	Four-shock, variable ramp inlet; based on data from NR inlet tests of IPS model
VSTOL	Fixed-Geometry, single cone inlet; based on analytical design for a $M_0 = 1.6$ VTOL
NVSTOL	Three-Shock, half-round inlet with variable-diameter centerbody; analytical design for a supersonic Navy VTOL configuration
TM1B3	Three-shock, half-round inlet with variable second cone angle; GD tailor-mate tests
FB	Mixed-compression; analytical design documented in AFFDL-TR-72-147-vol IV
INT	Mixed compression; based on XB-70 type configuration and data
M352D	Mixed compression; based on NASA AMES configuration and tests of a mach 3.5, 2-D inlet
AST	Mixed compression axisymmetric; based on a Boeing analytical study of an AST inlet for NASA AMES
NASA3	Mixed compression axisymmetric; based on data from NASA AMES tests of $M_0 = 3.0$ inlet
BCAC35	Mixed compression axisymmetric; based on results of Boeing analytical studies for a NASA AMES mach 3.5 inlet
R2DSST	Mixed compression 2-D; based on results of Boeing/Rockwell studies for a SST inlet

Figure 2   Sources of Data for Inlet Maps

DERIVATIVE PARAMETERS	DEFI-NITION	A7	F8	M5SUB	M9SUB	NS	NS2	LWF	ATS2	ASF	VSTOL	NVSTO	TM183	FB	INT	M352D	AST	NASA3	RCAC35	R2DSST
		FILE NAME																		
1 Inlet Aspect Ratio	W_c/h_c	N/A	N/A	N/A	N/A	N/A	N/A	2.0	1.0	1.0	N/A	N/A	N/A	1.0	1.0	1.0	N A	N A	N A	.98
2 Sideplate Cutback	A_{cB}/A_{sp}	N/A	N/A	N/A	N/A	N/A	N/A	.75	.20	.25	N/A	N/A	N/A	0.0	0.0	0.0	N A	N A	N A	0.0
3 First Ramp Angle	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	7.0	7.3	6.0	25.0	22.0	18.0	7.0	7.0	7.0	10.4	10.0	10.0	5.0
4 Design Mach Number	~	.80	1.60	.50	.80	1.50	1.60	1.60	2.0	2.5	1.60	2.0	2.5	2.5	3.0	3.5	2.35	3.0	3.5	2.8
5 Cowl Lip Bluntness	R_{lip}/h_c	.03	.02	.030	.022	.022	0.	.012	.012	.006	.02	.015	.015	0.	0.	0.	0.	0.	0.	0
6 Takeoff Door Area	A_{to}/A_c	0.0	0.0	N/A	.026	.18	.22	.235	.20	.11	.462	.46	.25	.12	.50	.20	.20	.20	.20	.186
7 External Cowl Angle	Deg.	4.5	2.5	12.	17.	5.0	5.0	13.0	17.5	17.0	10.	19.	12.	12.	12	15.0	1.0	0.0	3.0	5.7
8 Bleed Exit Nozzle Type	Conv. or C-D	N/A	N/A	N/A	N/A	N/A	N/A	Conv.	Conv.	Conv.	N/A	Conv.	Conv.	Conv.	Conv.	Conv.	Conv.	Conv.	Conv	Conv
9 Bleed Exit Nozzle Angle	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	20.0	15.0	20.0	N/A	20.0	15.	20.0	0.0	15.	15.	15	10	15.
10 Bleed Exit Flap Aspect Ratio	W_f/h_f	N/A	N/A	N/A	N/A	N/A	N/A	1.0	2.0	.90	N/A	1.0	1.0	.90	N/A	1.0	1.0	1.0	1.0	0.0
11 Bleed Exit Flap Area	A_f/A_c	N/A	N/A	N/A	N/A	N/A	N/A	.10	.10	.50	N/A	.10	.10	.20	N/A	.20	.20	.20	20	0.0
12 Bypass Exit Nozzle Type	Conv. or C-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Conv.	C-D	N/A	Conv.	Conv.	C–D	C–D	C–D	C–D	C–D	C–D	C–D
13 Bypass Exit Nozzle Angle	Deg.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.0	20.	N/A	20.	15.	20.	15.	15	15	15	10	15.
14 Bypass Exit Flap Aspect Ratio	W_f/h_f	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0	.67	N/A	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.11
15 Bypass Exit Flap Area	A_f/A_c	N/A	N/A	N/A	N/A	N/A	N/A	N/A	.20	.268	N/A	.20	.20	.20	.20	.20	.20	.20	20	.767
16 Subsonic Diffuser Area Ratio	A_2/A_1	1.40	1.40	1.25	1.25	1.305	1.305	1.373	1.50	1.89	1.44	1.83	2.0	1.40	2.8	4.7	1.57	2.1	4.97	2.77
17 Diffuser Total Wall Angle	Deg.	2.5	3.5	12.0	12.0	4.0	4.0	5.0	10.0	8.5	6.0	9.0	15.0	9.0	12.0	11.5	7.0	12.0	9.0	14.0
18 Subsonic Diffuser Loss Coefficient	ϵ	.12	.12	.015	.015	.12	.12	.12	.12	.16	.08	.12	.14	.14	.12	.14	.06	.12	.12	.12
19 Throat/Capture Area Ratio	A_T/A_c	N/A	N/A	.80	.90	.96	1.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
INLET TYPE		Chin	Chin	Pitot	Pitot	Pitot (N.S.)	Pitot (N.S.)	E.C. 2-D	E.C. 2-D	E.C. 2-D	E.C. AXI	E.C. AXI	E.C. AXI	M.C 2-D	M.C. 2-D	M.C 2-D	M.C AXI	M.C AXI	M.C AXI	M.C. 2-D

Figure 3 Derivative Parameter Summary of Inlet Configurations

The inlet configurations that are represented in the library of performance characteristics have been selected after considering the following factors:

(1) At each design Mach number, the configuration must be typical of an inlet that could reasonably be used at that Mach number. Design Mach number affects such design features as variable geometry, number of compression ramps, boundary layer bleed system design, and mixed vs external compression scheme. The manner in which typical inlet design features vary as design Mach number is increased is illustrated in Figure 4. In general, the trend is toward more inlet complexity and more variable geometry as design Mach number is increased, (assuming a high level of total pressure recovery is to be maintained).

(2) Experimental data are available for several inlet configurations and were used to provide well-substantiated inlet performance maps. It has been an objective of the program to use experimental data whenever it is available. Examples of some of the useful sources of data that have been utilized in developing the inlet performance characteristics are:

Tailor-Mate tests (Reference 1), F-15 inlet tests (Reference 2), Boeing LWF tests (Reference 3), XB-70 tests (Reference 4), NAR F-100 inlet tests (Reference 5), and Boeing subsonic inlet tests (Reference 6).

(3) Several sets of inlet performance characteristics were available from previous Air Force Contract F33615-72-C-1580 (Reference 7). These data were used for Configurations NS2, LWF, ASF, VSTOL, FB, and INT, largely unchanged, except for some revisions in the data table formats.

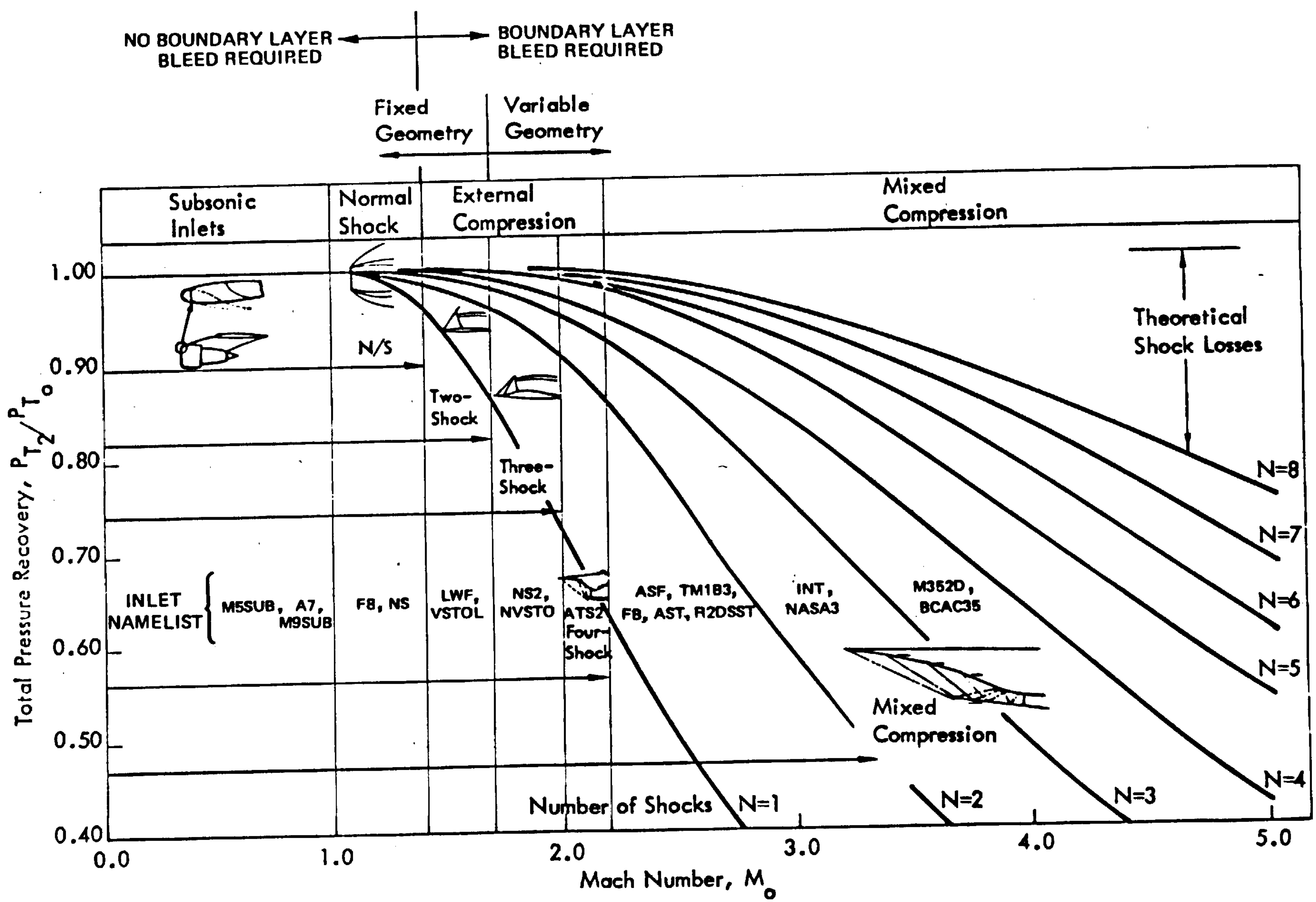

Figure 4. Representative Spectrum of Inlets

4.2.1.1 INLET CONFIGURATION - 'A7' - SUBSONIC, CHIN INLET FOR ALL INLETS

This inlet is a subsonic, scoop-type inlet mounted under the nose of the forebody. No boundary layer bleed or bypass are employed, and the configuration is characterized by a rather long subsonic diffuser. A reasonably blunt cowl lip is used and angle-of-attack shielding is provided by the presence of the fuselage forebody. This configuration is similar to the A-7 aircraft inlet. Available inlet test data from similar configurations were supplemented by engineering analyses (such as the calculation procedures in Reference 7) to develop the maps of inlet performance. A sketch of the inlet configuration is shown in Figure 4. The performance characteristics of the inlet are presented in Figure 5.

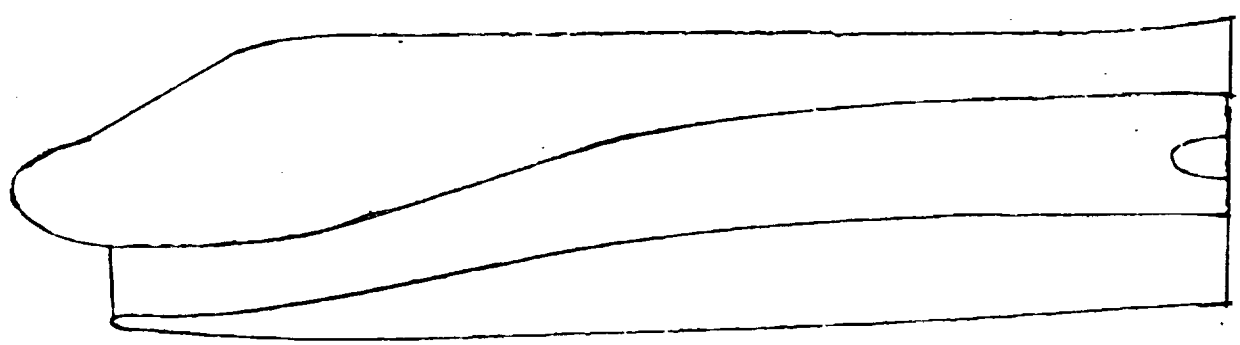

Figure 5 Subsonic Chin Inlet

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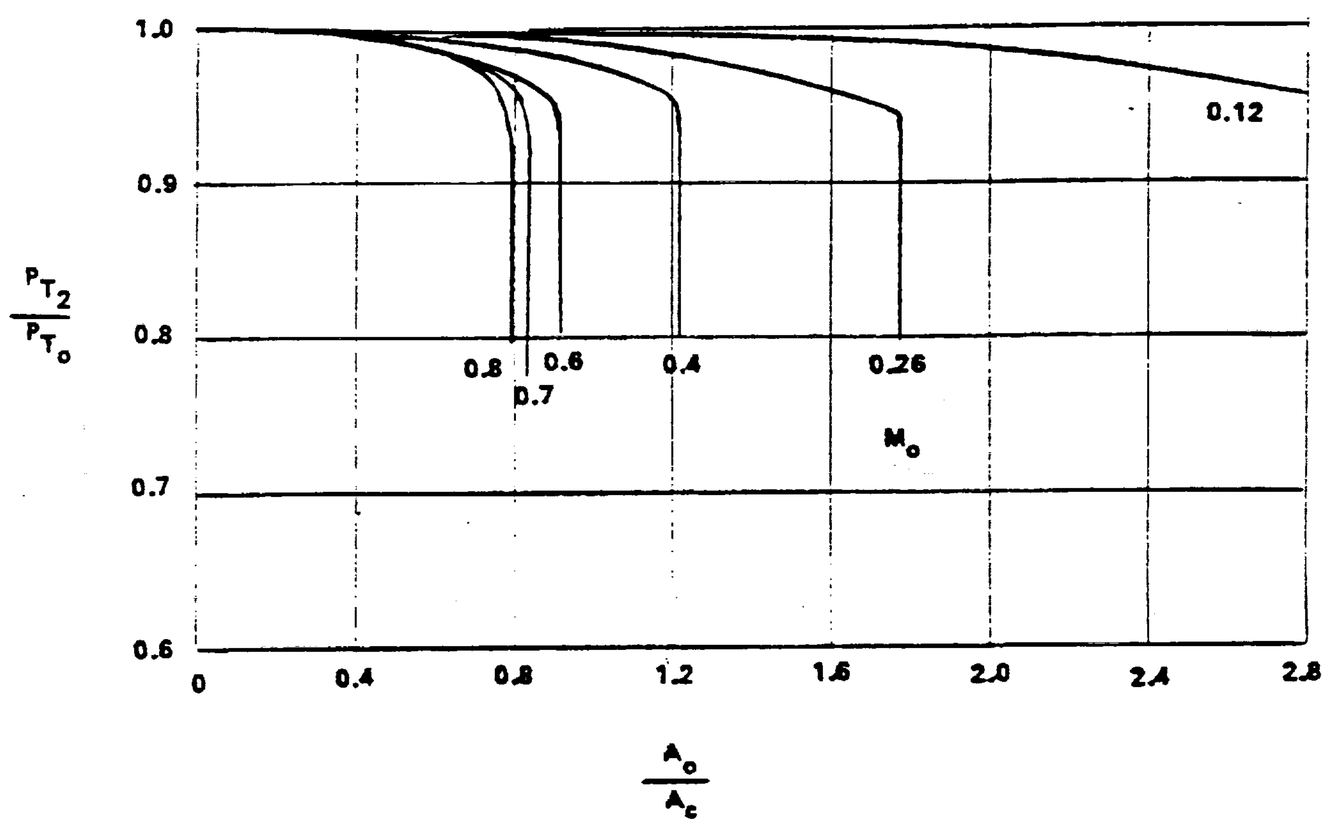
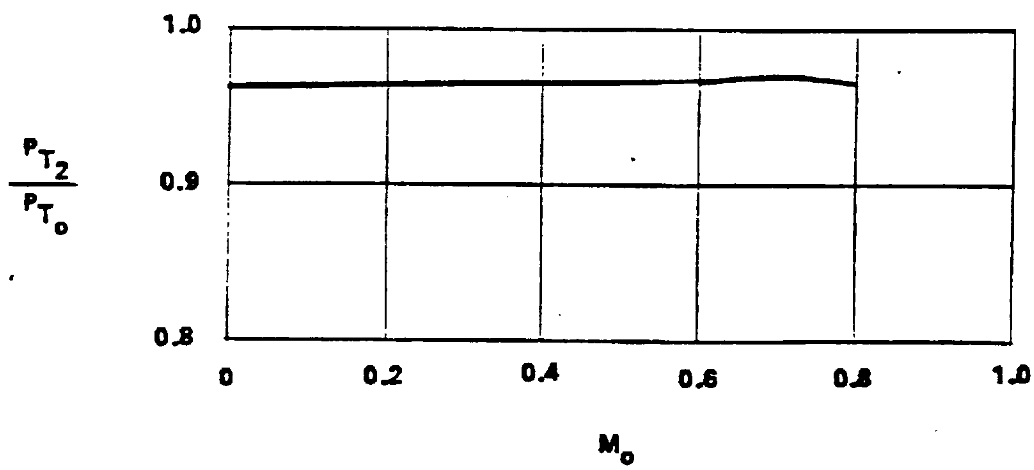


Figure 6. Performance Characteristics for Inlet Configuration - 'A7'



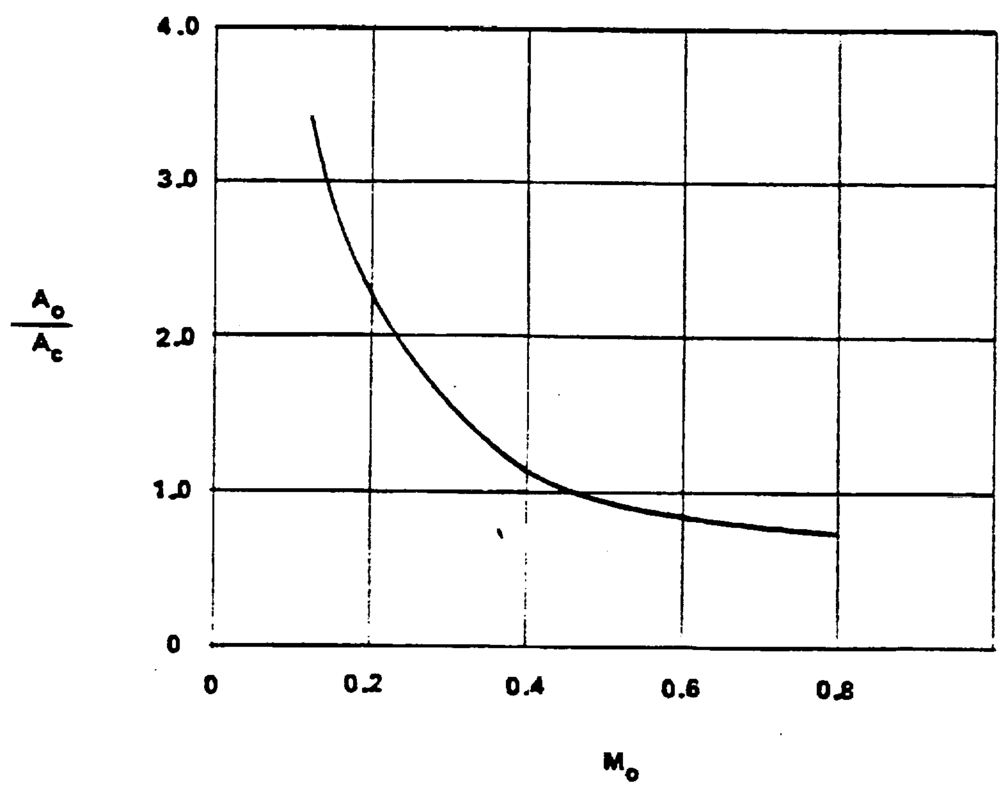
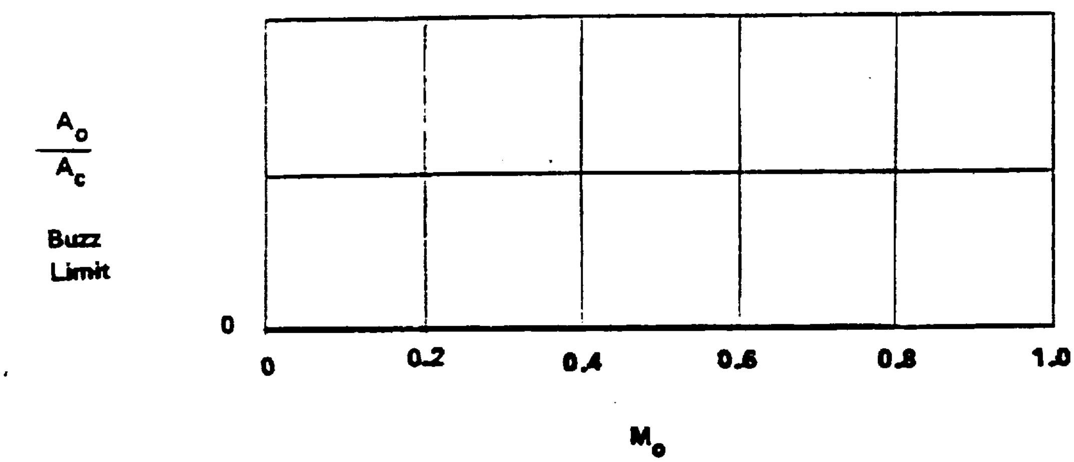


Figure 6. Performance Characteristics for Inlet Configuration - 'A7' - (continued)



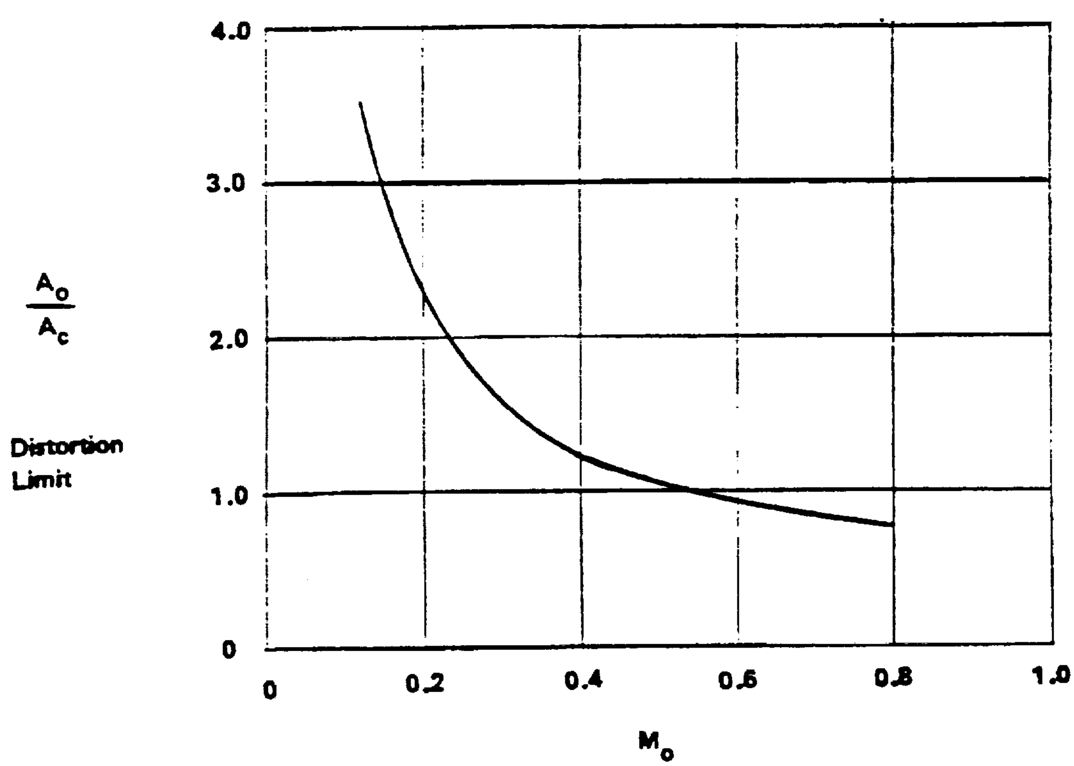
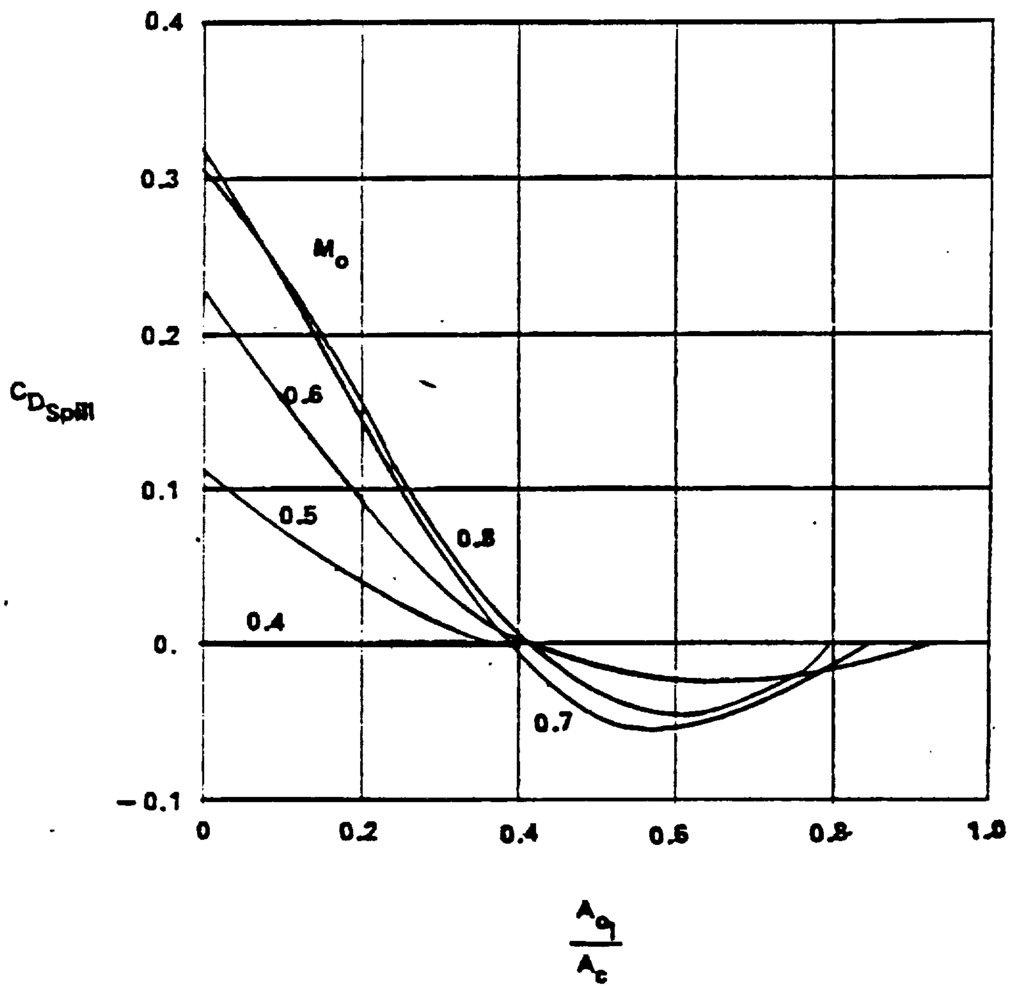


Figure 6. Performance Characteristics for Inlet Configuration- 'A7' - (continued)



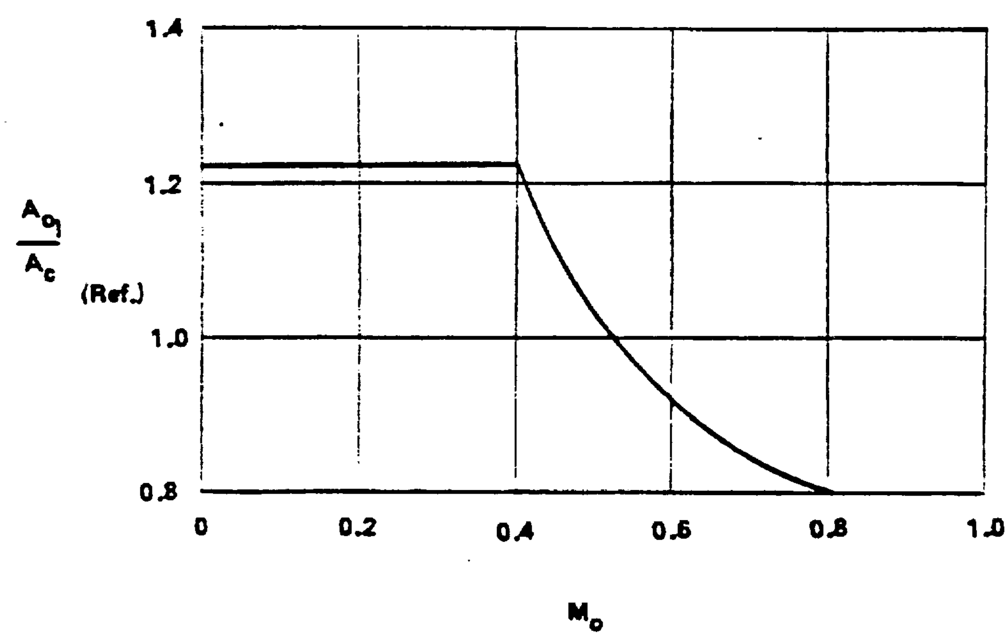


Figure 6. Performance Characteristics for Inlet Configuration - 'A7' - (continued)

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***********
*         *
* A7      *
*         *
***********
```

SUBSONIC CHIN INLET, MAX MACH =.8, NO BLEED OR BYPASS, BASED ON A7

INLET MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	0.0
4	DESIGN MACH NUMBER	0.8000
5	COWL LIP BLUNTNESS	0.0300
6	TAKEOFF DOOR AREA RATIO	0.0
7	EXTERNAL COWL ANGLE(DEG)	4.5000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.4000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	2.5000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.70

* TABLE 1 * LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.600	2.000	MNO
0.0	0.600	2.000	MNFS

* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.120	0.0	0.800	1.200	1.800	2.200	2.400	2.600	2.800	AO/AC
	1.000	0.998	0.996	0.990	0.980	0.972	0.965	0.955	PT2/PT0
MNO=0.260	0.0	0.400	0.600	0.800	1.200	1.400	1.780	1.781	AO/AC
	1.000	0.999	0.998	0.995	0.983	0.973	0.943	0.800	PT2/PT0
MNO=0.400	0.0	0.400	0.600	0.800	1.000	1.100	1.220	1.221	AO/AC
	1.000	0.998	0.995	0.985	0.975	0.968	0.950	0.800	PT2/PT0
MNO=0.600	0.0	0.200	0.400	0.600	0.700	0.800	0.920	0.921	AO/AC
	1.000	0.998	0.996	0.986	0.978	0.969	0.950	0.800	PT2/PT0
MNO=0.700	0.0	0.200	0.400	0.600	0.700	0.800	0.840	0.841	AO/AC
	1.000	0.998	0.995	0.985	0.979	0.963	0.940	0.800	PT2/PT0
MNO=0.800	0.0	0.200	0.400	0.600	0.700	0.740	0.780	0.800	AO/AC
	1.000	0.998	0.995	0.984	0.974	0.964	0.940	0.800	PT2/PT0

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.120	0.260	0.400	0.600	0.700	0.800	MNO
0.962	0.965	0.965	0.965	0.965	0.969	0.965	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.120	0.260	0.400	0.600	0.700	0.800	MNO
3.410	1.780	1.120	0.840	0.770	0.740	AO/AC

****
* TABLE 2D *
****

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.120	0.260	0.400	0.600	0.700	0.800	MNO
0.0	0.0	0.0	0.0	0.0	0.0	0.0	AO/AC

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************
* TABLE 2E *
************
```

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.120	0.260	0.400	0.600	0.700	0.800	MNO
3.500	1.800	1.220	0.940	0.850	0.790	AO/AC

```
************
* TABLE 3  *
************
```

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	0.800	4.000	AOI/AC							
	0.0	0.0	0.0	CDSPL							
MNO=0.400	0.0	0.800	4.000	AOI/AC							
	0.0	0.0	0.0	CDSPL							
MNO=0.500	0.0	0.200	0.300	0.400	2.000	AOI/AC					
	0.112	0.043	0.015	0.0	0.0	CDSPL					
MNO=0.600	0.0	0.200	0.300	0.400	0.420	1.400	AOI/AC				
	0.225	0.095	0.039	0.005	0.0	0.0	CDSPL				
MNO=0.700	0.0	0.200	0.300	0.400	0.500	0.550	0.600	0.700	0.840	1.200	AOI/AC
	0.320	0.143	0.060	-0.005	-0.045	-0.055	-0.053	-0.040	0.0	0.0	CDSPL
MNO=0.800	0.0	0.200	0.400	0.500	0.600	0.700	0.795	1.200	AOI/AC		
	0.308	0.156	0.005	-0.030	-0.045	-0.033	0.0	0.0	CDSPL		

```
************
* TABLE 3A *
************
```

REF SPILLAGE DRAG COEFF (REF CDSPL) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.500	0.600	0.700	0.800	MNO
0.0	0.0	0.0	0.0	0.0	0.0	REF CDSPL

```
************
* TABLE 3B *         REF INLET MASS FLOW RATIO (REF AOI/AC)      VS        LOCAL MACH NUMBER (MNO)
************

               0.0       0.400     0.500     0.600     0.700     0.800     MNO
               1.220     1.220     1.030     0.920     0.840     0.800     REF AOI/AC


************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

               0.0       0.800     MNO

MNO=0.0        0.0       1.000     AOBLD/AC
               0.0       0.0       CDBLD

MNO=0.800      0.0       1.000     AOBLD/AC
               0.0       0.0       CDBLD


************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND     LOCAL MACH NUMBER (MNO)
************

               0.0       0.800     MNO

MNO=0.0        0.0       1.000     AOBYP/AC
               0.0       0.0       CDBYP

MNO=0.800      0.0       1.000     AOBYP/AC
               0.0       0.0       CDBYP


************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0        0.0       1.000     AO/AC
               0.0       0.0       AOBLD/AC
```

```
MNO=0.800       0.0         1.000       AO/AC
                0.0         0.0         AOBLD/AC


************
* TABLE 6B *        OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS      LOCAL MACH NUMBER (MNO)
************

                0.0         0.800       MNO
                0.0         0.0         AOBLD/AC


************
* TABLE 7  *    BYPASS MASS FLOW RATIO (AOBYP/AC)     VS     ENGINE MASS FLOW RATIO (AOE/AC)    AND    LOCAL MACH NUMBER (MNO)
************


MNO=0.0         0.0         1.000       AOE/AC
                0.0         0.0         AOBYP/AC

MNO=0.800       0.0         1.000       AOE/AC
                0.0         0.0         AOBYP/AC
```

4.2.1.2 INLET CONFIGURATION 'F8'- SUPERSONIC, CHIN INLET

This inlet is a fixed geometry, nose-mounted cone-scoop configuration. The inlet has no boundary layer control bleed system or bypass system. It is designed for a maximum Mach number of 1.60. The cowl lip is relatively sharp, and the subsonic diffuser is relatively long. The inlet performance characteristics for this inlet were developed from the data published in Reference 8 and analyses methods described in Reference 1. A sketch of the inlet geometry is presented in Figure 6. The performance characteristics of the inlet are presented in Figure 7.

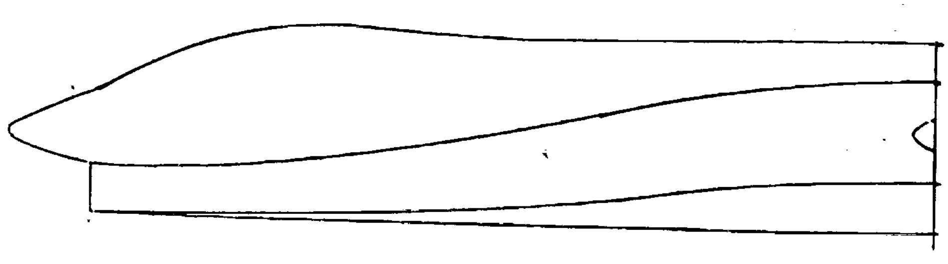


Figure 7 Supersonic Chin Inlet

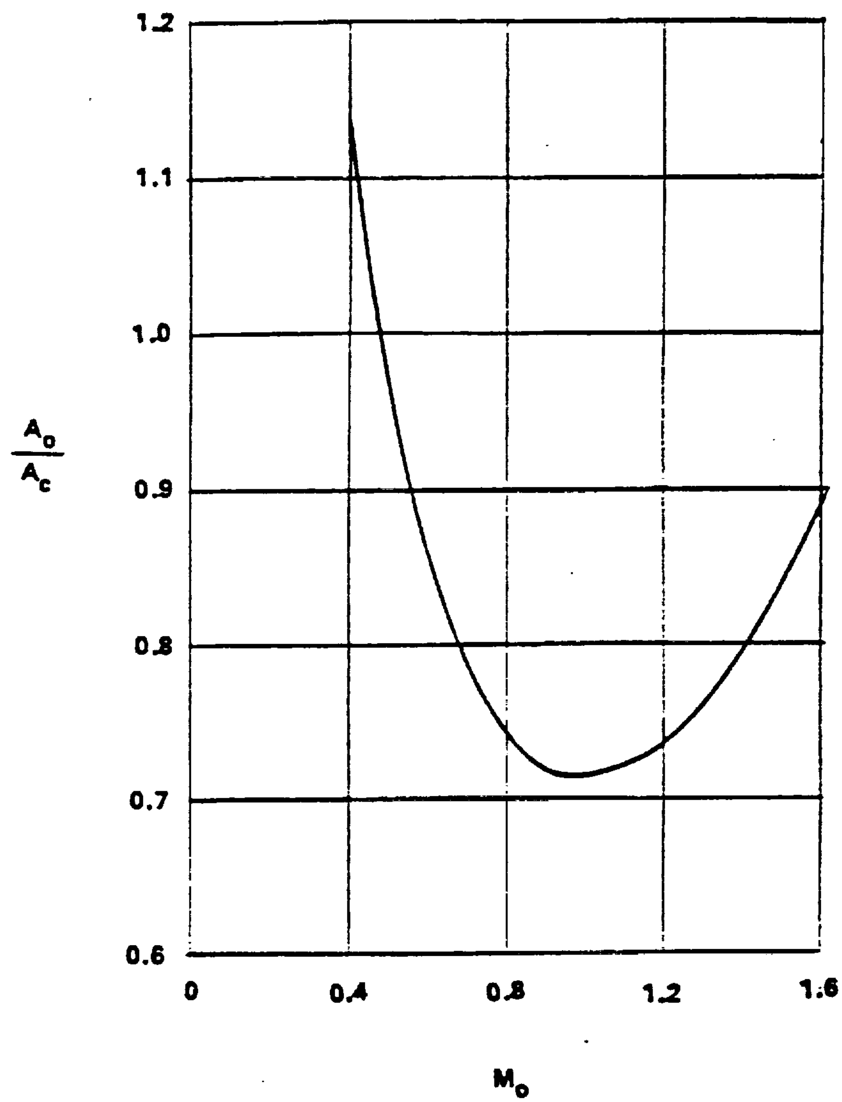
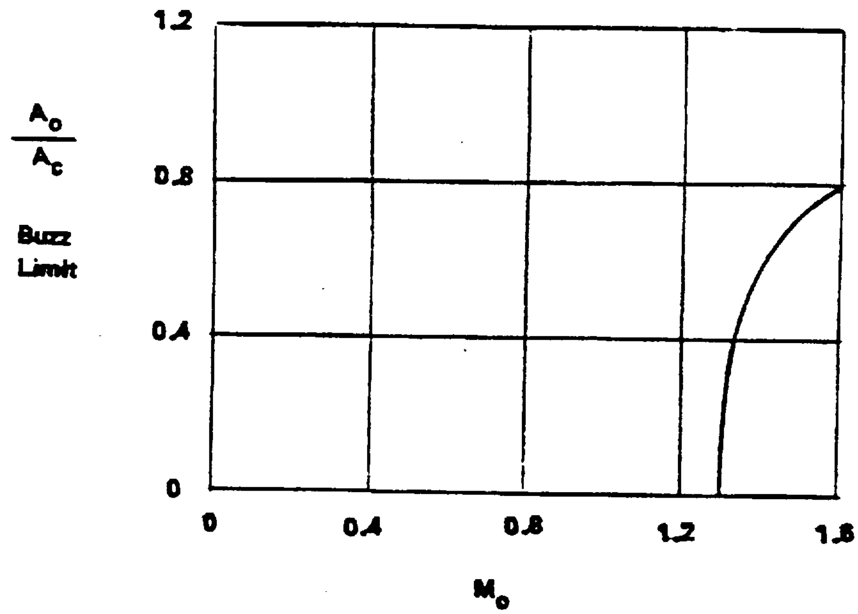


Figure 8. Performance Characteristics for Inlet Configuration - 'F8' - (continued)



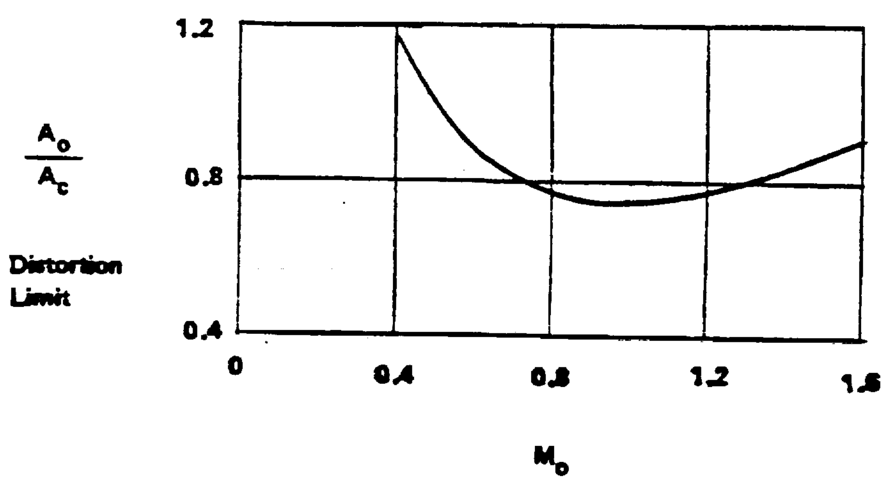


Figure 8. Performance Characteristics for Inlet Configuration - 'F8' - (continued)

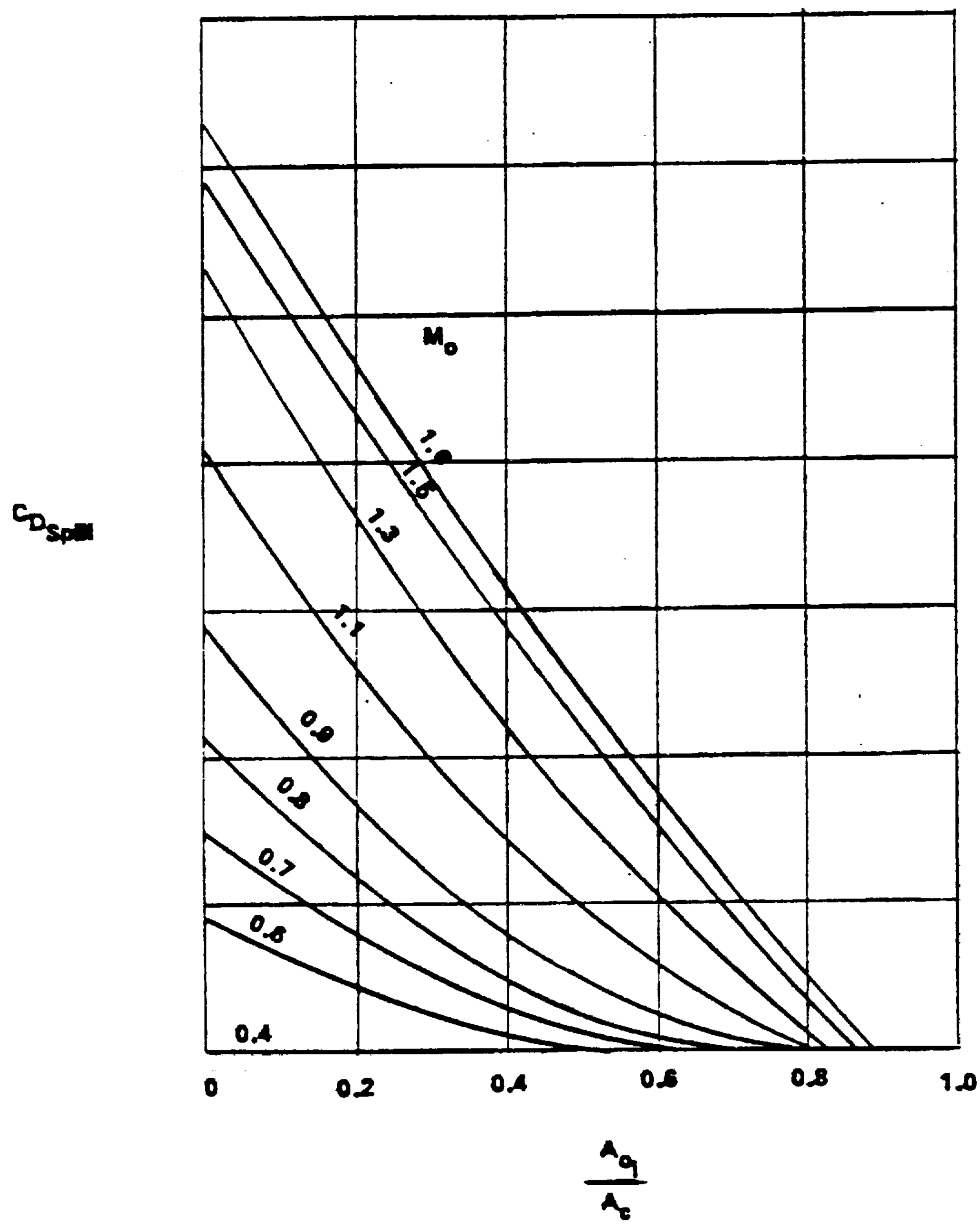
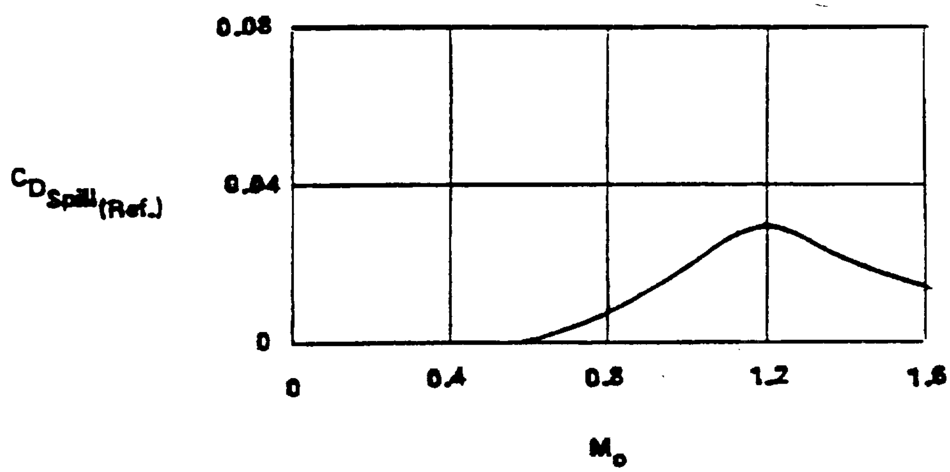


Figure 8. Performance Characteristics for Inlet Configuration - 'F8' - (continued)



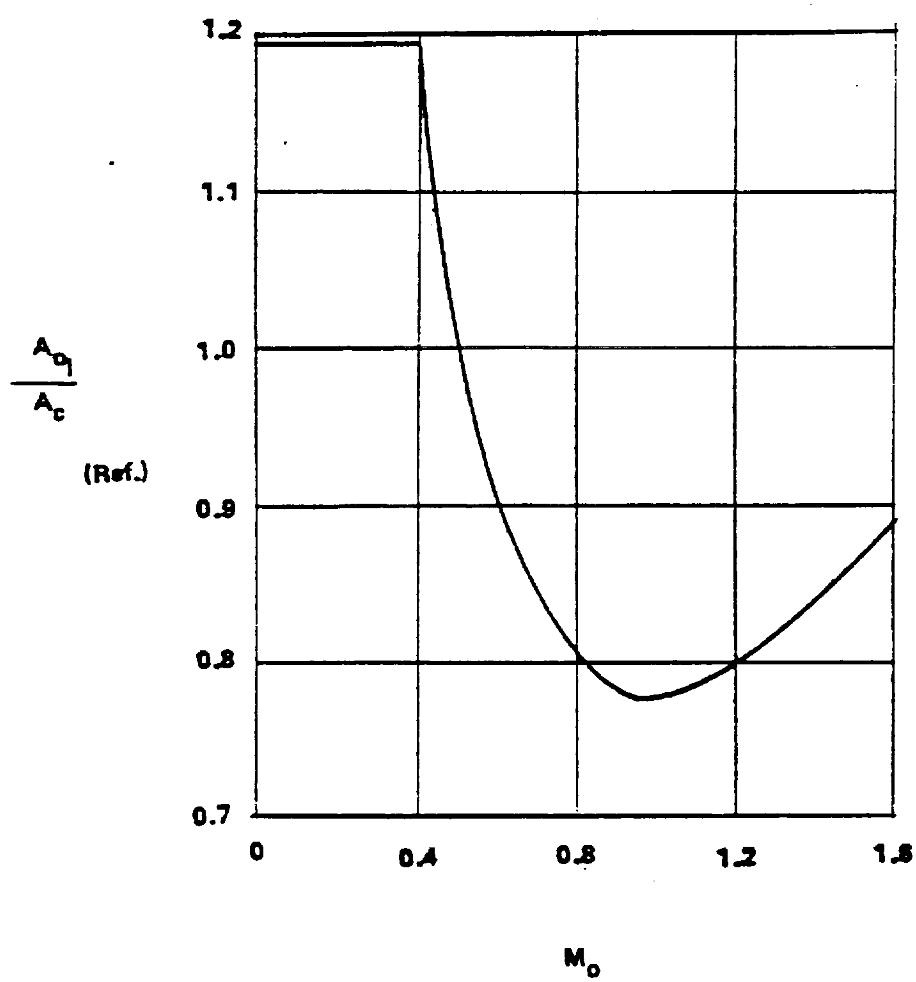


Figure 8. Performance Characteristics for Inlet Configuration - 'F8' - (continued)

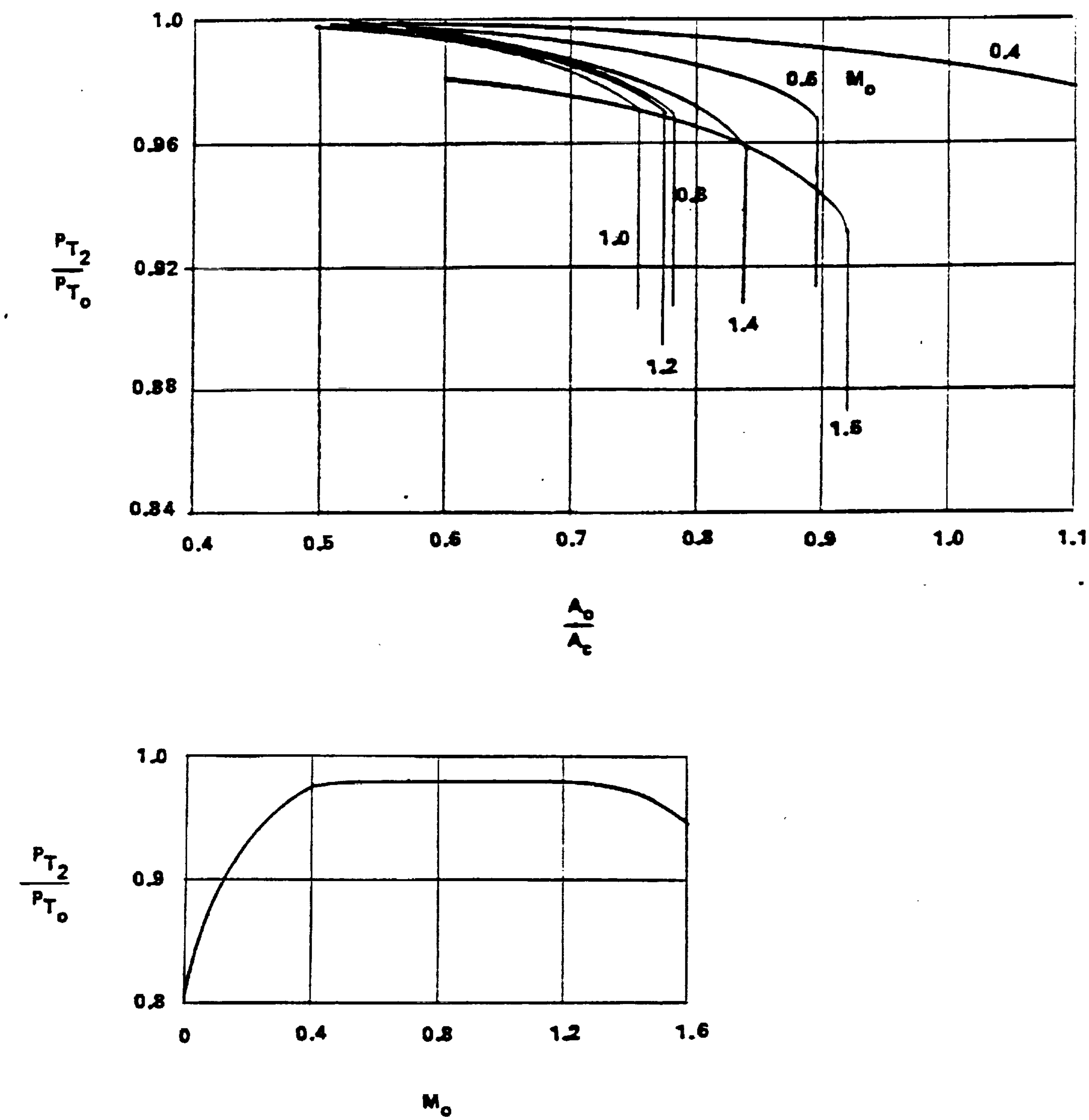


Figure 8. Performance Characteristics for Inlet Configuration - 'F8'

```
************
*          *
* F8       *
*          *
************
```

SUPERSONIC CHIN INLET, MAX MACH =1.6, NO BLEED OR BYPASS, BASED ON F8

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	0.0
4	DESIGN MACH NUMBER	1.6000
5	COWL LIP BLUNTNESS	0.0200
6	TAKEOFF DOOR AREA RATIO	0.0
7	EXTERNAL COWL ANGLE(DEG)	2.5000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.4000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	3.5000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.70

****
* TABLE 1 *   LOCAL MACH NUMBER (MNO)   VS   FREE STREAM MACH NUMBER (MNFS)
****

0.0	0.600	2.000	MNO
0.0	0.600	2.000	MNFS

****
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)   VS   MASS FLOW RATIO (AO/AC)   AND   LOCAL MACH NUMBER (MNO)
****

MNO=0.400	0.400	0.600	0.800	1.000	1.100	1.200	1.210	AO/AC
	0.999	0.998	0.995	0.986	0.978	0.965	0.840	PT2/PT0
MNO=0.600	0.400	0.600	0.700	0.800	0.850	0.895	0.896	AO/AC
	0.999	0.997	0.993	0.985	0.980	0.969	0.840	PT2/PT0
MNO=0.800	0.500	0.600	0.700	0.750	0.780	0.783	0.784	AO/AC
	0.999	0.996	0.986	0.978	0.970	0.968	0.840	PT2/PT0
MNO=1.000	0.500	0.600	0.700	0.725	0.753	0.755	AO/AC	
	0.998	0.994	0.984	0.979	0.972	0.840	PT2/PT0	
MNO=1.200	0.500	0.600	0.700	0.750	0.775	0.776	AO/AC	
	0.998	0.995	0.985	0.976	0.969	0.840	PT2/PT0	
MNO=1.400	0.500	0.600	0.700	0.750	0.800	0.835	0.840	AO/AC
	0.998	0.995	0.986	0.980	0.972	0.960	0.840	PT2/PT0
MNO=1.600	0.600	0.700	0.800	0.850	0.900	0.920	0.921	AO/AC
	0.980	0.976	0.966	0.957	0.942	0.932	0.840	PT2/PT0

```
************
* TABLE 2B *
************
```

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.600	0.800	1.000	1.200	1.400	1.600	MNO
0.800	0.975	0.980	0.980	0.980	0.980	0.973	0.945	PT2/PT0

```
************
* TABLE 2C *
************
```

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.400	0.600	0.800	1.000	1.200	1.400	1.600	MNO
1.135	0.850	0.740	0.715	0.735	0.797	0.890	AO/AC

```
************
* TABLE 2D *
```

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

```
************

               0.0        0.400      0.600      0.800      1.000      1.200      1.400      1.600      MNO
               0.0        0.0        0.0        0.0        0.0        0.0        0.600      0.800      AO/AC


************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)     VS        LOCAL MACH NUMBER (MNO)
************

               0.400      0.600      0.800      1.000      1.200      1.400      1.600      MNO
               1.180      0.880      0.770      0.740      0.770      0.830      0.910      AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS        INLET MASS FLOW RATIO (AOI/AC)    AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.0        0.0        2.000      AOI/AC
               0.0        0.0        CDSPL

MNO=0.400      0.0        2.000      AOI/AC
               0.0        0.0        CDSPL

MNO=0.600      0.0        0.200      0.400      0.500      1.000      AOI/AC
               0.180      0.085      0.020      0.0        0.0        CDSPL

MNO=0.700      0.0        0.200      0.400      0.500      0.600      1.000      AOI/AC
               0.290      0.160      0.060      0.025      0.0        0.0        CDSPL

MNO=0.800      0.0        0.200      0.400      0.500      0.700      1.000      AOI/AC
               0.420      0.235      0.100      0.050      0.0        0.0        CDSPL

MNO=0.900      0.0        0.200      0.400      0.600      0.800      1.000      AOI/AC
               0.575      0.335      0.160      0.050      0.0        0.0        CDSPL

MNO=1.100      0.0        0.200      0.400      0.600      0.810      1.000      AOI/AC
               0.820      0.530      0.280      0.120      0.0        0.0        CDSPL

MNO=1.300      0.0        0.200      0.400      0.600      0.820      1.000      AOI/AC
               1.065      0.730      0.440      0.210      0.0        0.0        CDSPL
```

```
MNO=1.500     0.0       0.400     0.600     0.860     1.000     AOI/AC
              1.180     0.580     0.300     0.0       0.0       CDSPL

MNO=1.600     0.0       0.400     0.600     0.800     0.890     1.000     AOI/AC
              1.260     0.635     0.360     0.105     0.0       0.0       CDSPL


************
* TABLE 3A *        REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

              0.0       0.400     0.600     0.700     0.800     0.900     1.100     1.300     1.500     1.600     MNO
              0.0       0.0       0.0       0.003     0.008     0.014     0.026     0.026     0.017     0.014     REF CDSPL

************
* TABLE 3B *        REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

              0.0       0.400     0.600     0.700     0.800     0.900     1.100     1.300     1.500     1.600     MNO
              1.195     1.195     0.910     0.845     0.810     0.782     0.785     0.820     0.863     0.890     REF AOI/AC

************
* TABLE 4  *    BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

              0.0       1.600     MNO

MNO=0.0       0.0       0.600     1.000     AOBLD/AC
              0.0       0.0       0.0       CDBLD

MNO=1.600     0.0       0.600     1.000     AOBLD/AC
              0.0       0.0       0.0       CDBLD


************
* TABLE 5  *    BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)     AND     LOCAL MACH NUMBER (MNO)
************

              0.0       1.600     MNO
```

```
MNO=0.0         0.0         0.600       1.000       AOBYP/AC
                0.0         0.0         0.0         CDBYP

MNO=1.600       0.0         0.600       1.000       AOBYP/AC
                0.0         0.0         0.0         CDBYP


************
* TABLE 6A *    BLEED MASS FLOW RATIO (AOBLD/AC)     VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0         0.0         1.000       AO/AC
                0.0         0.0         AOBLD/AC

MNO=1.600       0.0         1.600       AO/AC
                0.0         0.0         AOBLD/AC


************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                0.0         1.600       MNO
                0.0         0.0         AOBLD/AC


************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0         0.0         1.000       AOE/AC
                0.0         0.0         AOBYP/AC

MNO=1.600       0.0         1.000       AOE/AC
                0.0         0.0         AOBYP/AC
```

4.2.1.3 INLET CONFIGURATION 'M5SUB' - SUBSONIC, PITOT INLET

This inlet is designed for a Mach number of 0.5. It has a very blunt lip; no bleed or bypass systems are used and the subsonic diffuser is short.

The performance characteristics of this inlet were generated from test data obtained during wind tunnel tests to develop the 747 fixed-lip inlet (Reference 9). A sketch of the inlet is presented in Figure 8 and the inlet performance characteristics are presented in Figure 9.

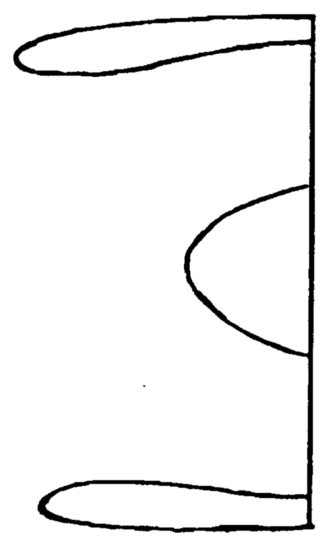


Figure 9 Subsonic Fixed Lip Inlet

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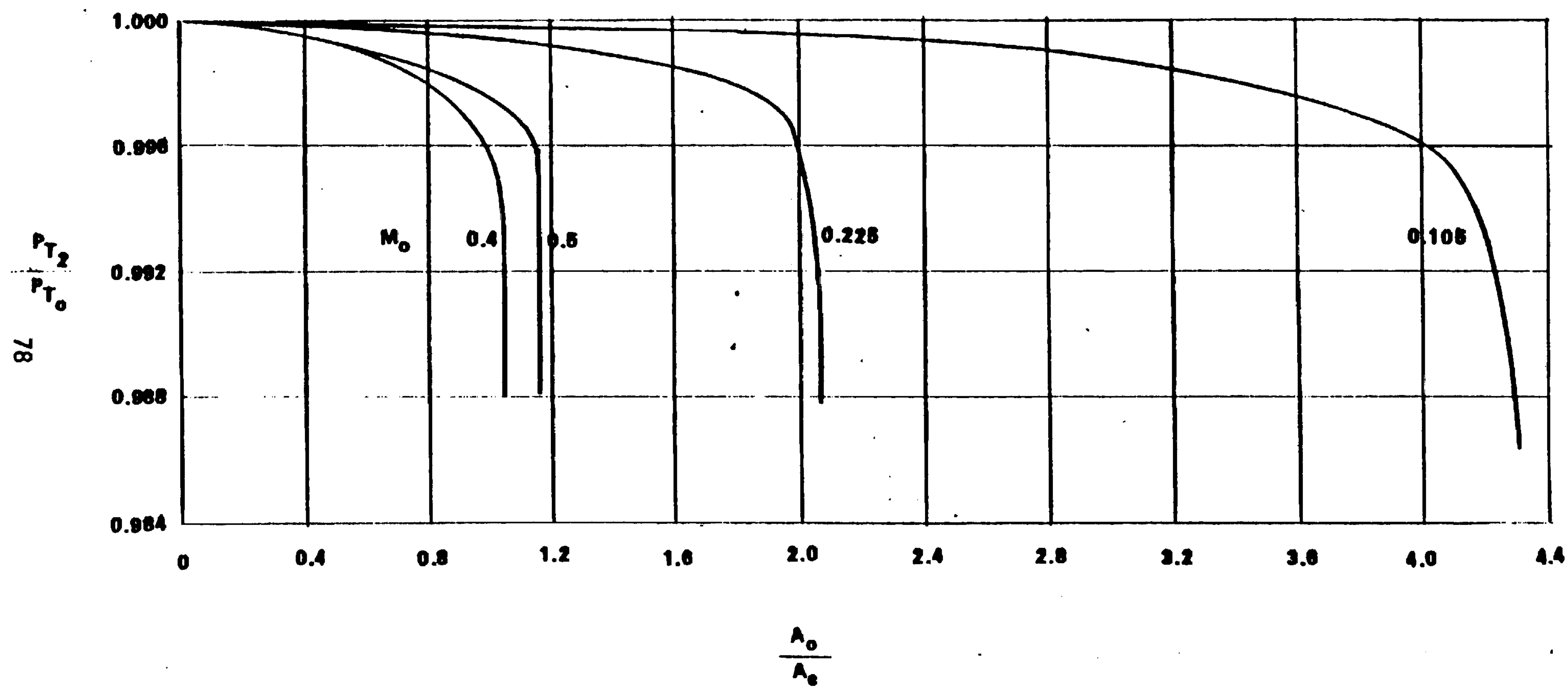


Figure 10. Performance Characteristics for Inlet Configuration - 'M5SUB'

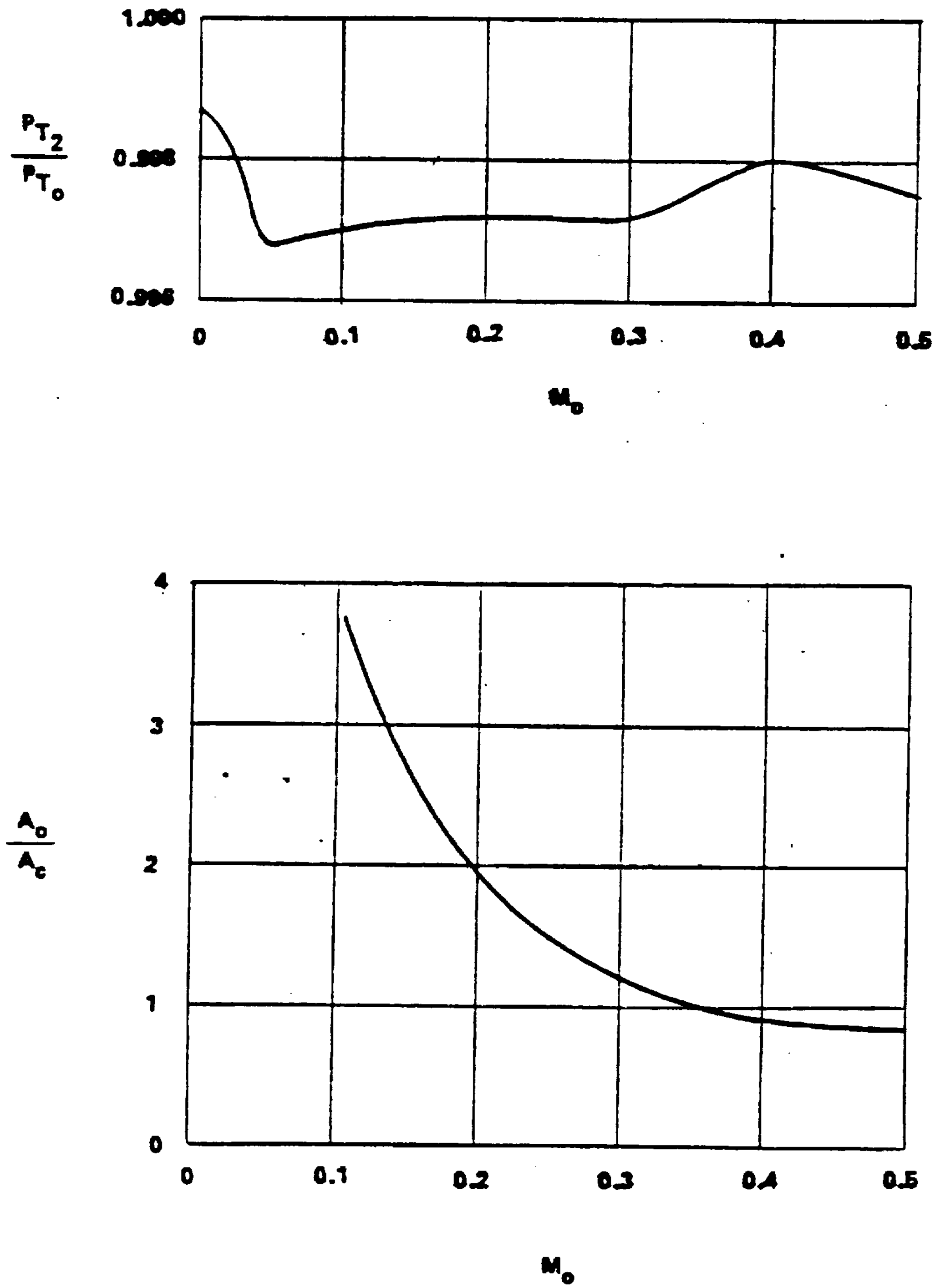
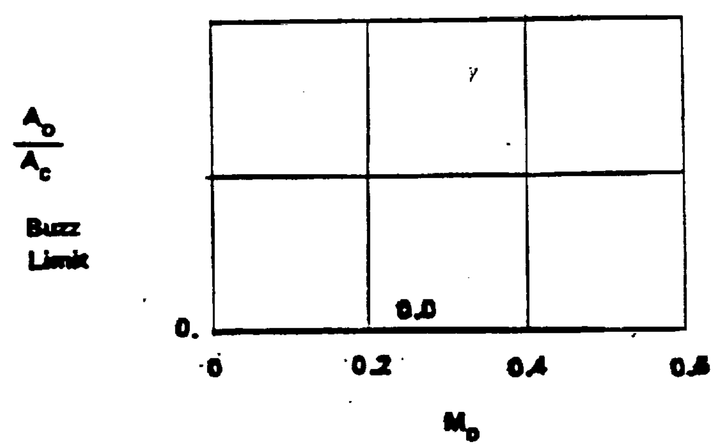
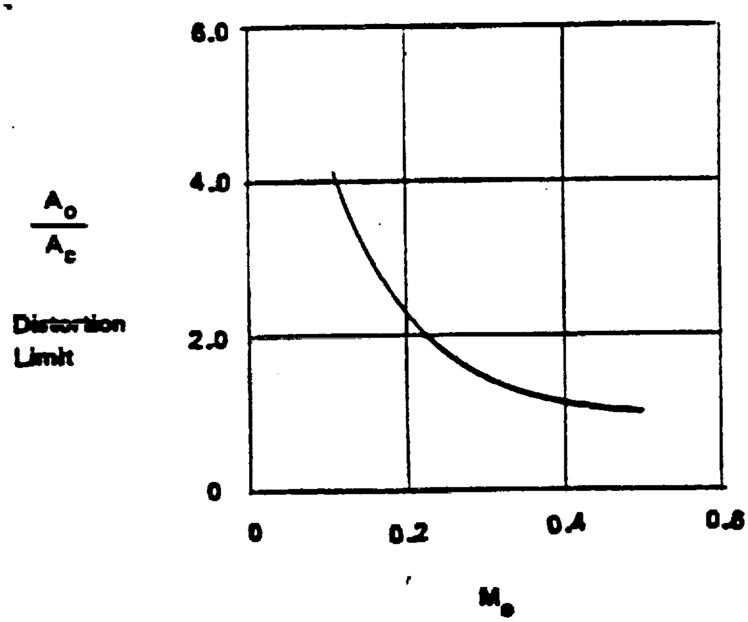


Figure 10. Performance Characteristics for Inlet Configuration - 'M5SUB' - (continued)





gure 10. Performance Characteristics for Inlet Configuration - 'M5SUB' - (continued)

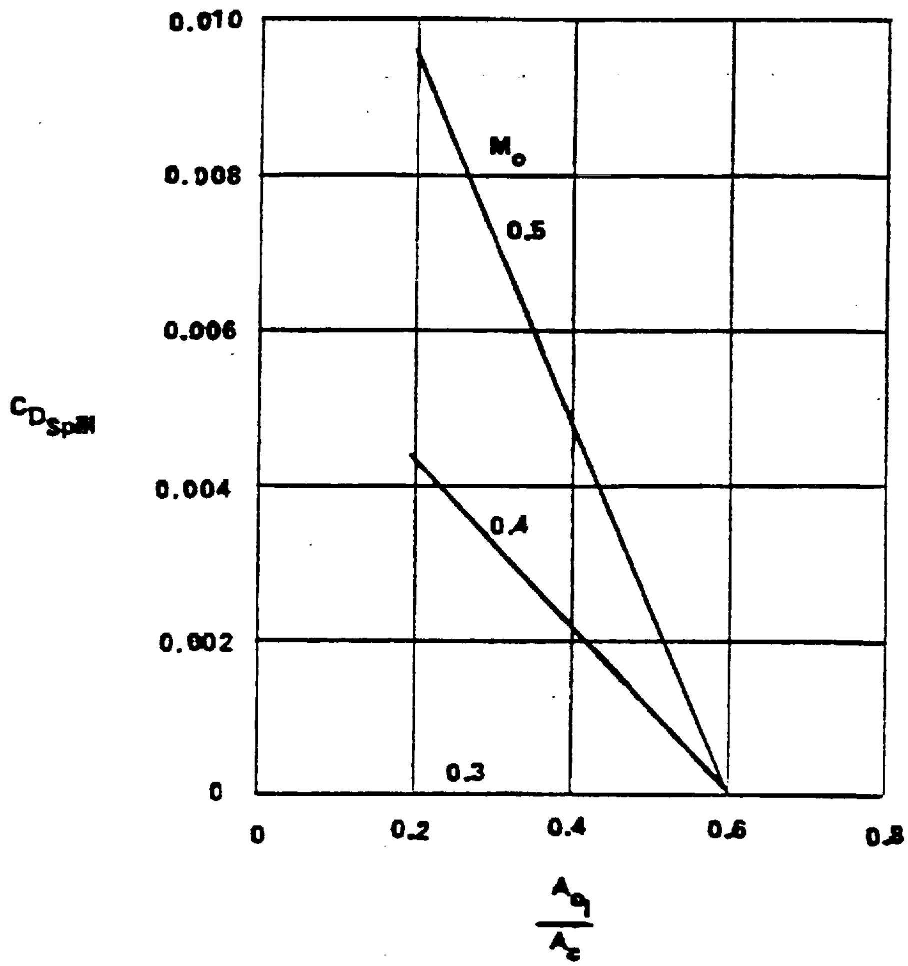
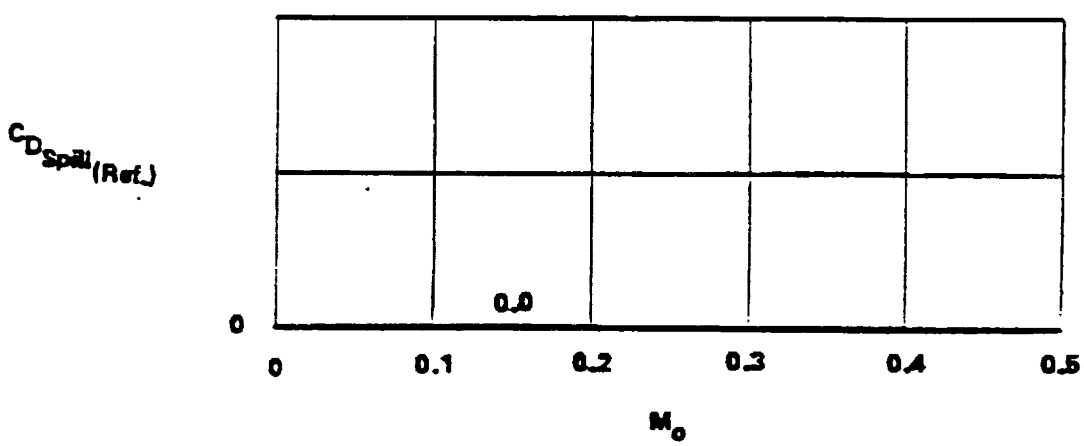


Figure 10. Performance Characteristics for Inlet Configuration - 'M5SUB'- (continued)



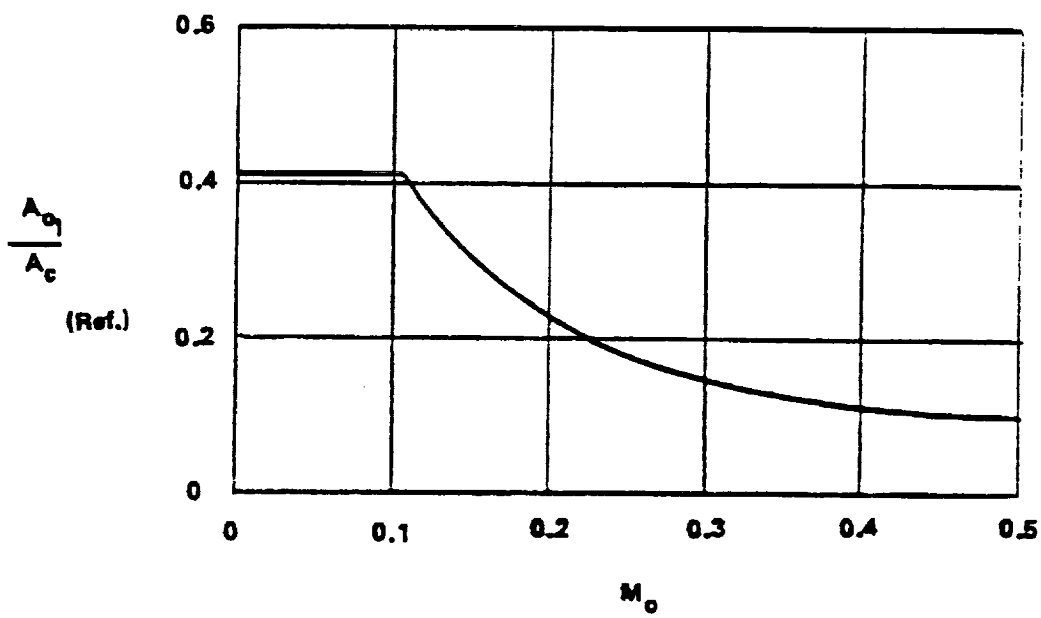


Figure 10. Performance Characteristics for Inlet Configuration - 'M5SUB' - (continued)

```
***********
*         *
* M5SUB   *
*         *
***********
```

SUBSONIC PITOT INLET, DESIGN MACH =.5,NO BLEED OR BYPASS,BLUNT LIP

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
4	DESIGN MACH NUMBER	0.5000
5	COWL LIP BLUNTNESS	0.0300
6	TAKEOFF DOOR AREA RATIO	0.0
7	EXTERNAL COWL ANGLE(DEG)	12.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.2500
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	12.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.0150
19	THROAT TO CAPTURE AREA RATIO	0.8000

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	PITOT OR CHIN
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.60

```
***********
* TABLE 1 *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.200	0.500	MNO
0.0	0.200	0.500	MNFS

```
***********
* TABLE 2A *
***********
```

INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

```
MNO=0.105     0.0      1.000    2.000    3.000    3.400    3.800    4.000    4.130    4.220    4.300    AO/AC
              1.000    1.000    1.000    0.999    0.998    0.997    0.996    0.994    0.992    0.987    PT2/PTO

MNO=0.225     0.0      1.000    1.300    1.600    1.800    1.900    2.000    2.060    2.061    AO/AC
              1.000    0.999    0.999    0.998    0.998    0.998    0.996    0.992    0.988    PT2/PTO

MNO=0.400     0.0      0.400    0.600    0.800    1.000    1.100    1.160    1.161    AO/AC
              1.000    0.999    0.999    0.998    0.998    0.997    0.996    0.988    PT2/PTO

MNO=0.500     0.0      0.400    0.600    0.800    0.900    1.000    1.040    1.042    AO/AC
              1.000    0.999    0.999    0.998    0.997    0.996    0.994    0.988    PT2/PTO


************
* TABLE 2B *           OPTIMUM INLET RECOVERY (PT2/PTO OPT)       VS       LOCAL MACH NUMBER (MNO)
************

              0.0      0.105    0.225    0.400    0.500    MNO
              0.999    0.997    0.997    0.998    0.998    PT2/PTO

************
* TABLE 2C *           OPTIMUM MASS FLOW RATIO (AO/AC OPT)        VS       LOCAL MACH NUMBER (MNO)
************

              0.105    0.225    0.400    0.500    MNO
              3.750    1.700    0.900    0.850    AO/AC

************
* TABLE 2D *           BUZZ LIMIT MASS FLOW RATIO (AO/AC)         VS       LOCAL MACH NUMBER (MNO)
************

              0.0      0.105    0.225    0.400    0.500    MNO
              0.0      0.0      0.0      0.0      0.0      AO/AC

************
* TABLE 2E *           DISTORTION LIMIT MASS FLOW RATIO (AO/AC)   VS       LOCAL MACH NUMBER (MNO)
************

              0.105    0.225    0.400    0.500    MNO
```

```
              4.100     2.000     1.150     1.020     AO/AC

************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS        INLET MASS FLOW RATIO (AOI/AC)    AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0       0.0       4.000     AOI/AC
              0.0       0.0       CDSPL

MNO=0.105     0.0       4.000     AOI/AC
              0.0       0.0       CDSPL

MNO=0.225     0.0       4.000     AOI/AC
              0.0       0.0       CDSPL

MNO=0.400     0.200     0.600     2.000     AOI/AC
              0.004     0.0       0.0       CDSPL

MNO=0.500     0.200     0.600     2.000     AOI/AC
              0.010     0.0       0.0       CDSPL
```



```
************
* TABLE 3A *         REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

              0.0       0.105     0.225     0.400     0.500     MNO
              0.0       0.0       0.0       0.0       0.0       REF CDSPL

************
* TABLE 3B *         REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

              0.0       0.105     0.225     0.400     0.500     MNO
              4.100     4.100     2.000     1.150     1.000     REF AOI/AC

************
* TABLE 4  *    BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```

C-2

```
                0.0       0.500     MNO

MNO=0.0         0.0       1.000     AOBLD/AC
                0.0       0.0       CDBLD

MNO=0.500       0.0       1.000     AOBLD/AC
                0.0       0.0       CDBLD


************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND     LOCAL MACH NUMBER (MNO)
************

                0.0       0.500     MNO

MNO=0.0         0.0       1.000     AOBYP/AC
                0.0       0.0       CDBYP

MNO=0.500       0.0       1.000     AOBYP/AC
                0.0       0.0       CDBYP


************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)           AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0         0.0       4.000     AO/AC
                0.0       0.0       AOBLD/AC

MNO=0.500       0.0       4.000     AO/AC
                0.0       0.0       AOBLD/AC


************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************
```

0.0	0.105	0.225	0.400	0.500	MNO
0.0	0.0	0.0	0.0	0.0	AOBLD/AC

```
************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)   VS   ENGINE MASS FLOW RATIO (AOE/AC)   AND   LOCAL MACH NUMBER (MNO)
************
```

MNO=0.0	0.0	5.000	AOE/AC
	0.0	0.0	AOBYP/AC
MNO=0.500	0.0	5.000	AOE/AC
	0.0	0.0	AOBYP/AC

4.2.1.4 INLET CONFIGURATION 'M9SUB' - SUBSONIC, PITOT-TYPE INLET

This subsonic inlet is designed for a Mach number of 0.8. It has a relatively thin lip (for a subsonic inlet) and has no boundary layer bleed or bypass system. Blow-in doors are used at takeoff and low speed.

The performance characteristics of this inlet were developed from the data of Reference 9. A sketch of the inlet is presented in Figure 10 and the inlet performance characteristics are presented in Figure 11.

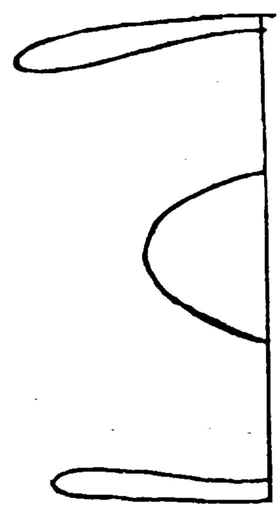


Figure 11 Subsonic Blow-In Door Inlet

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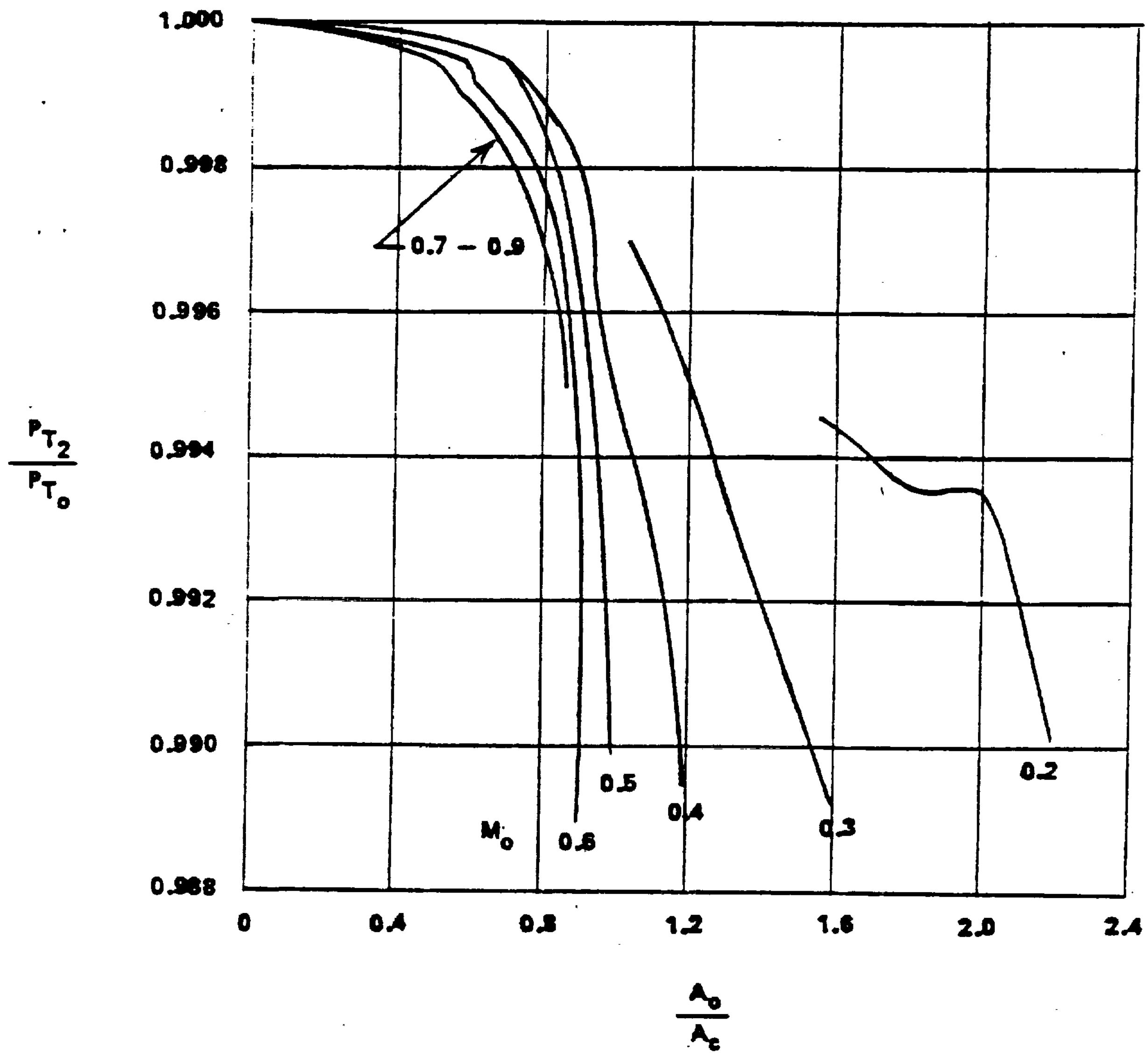
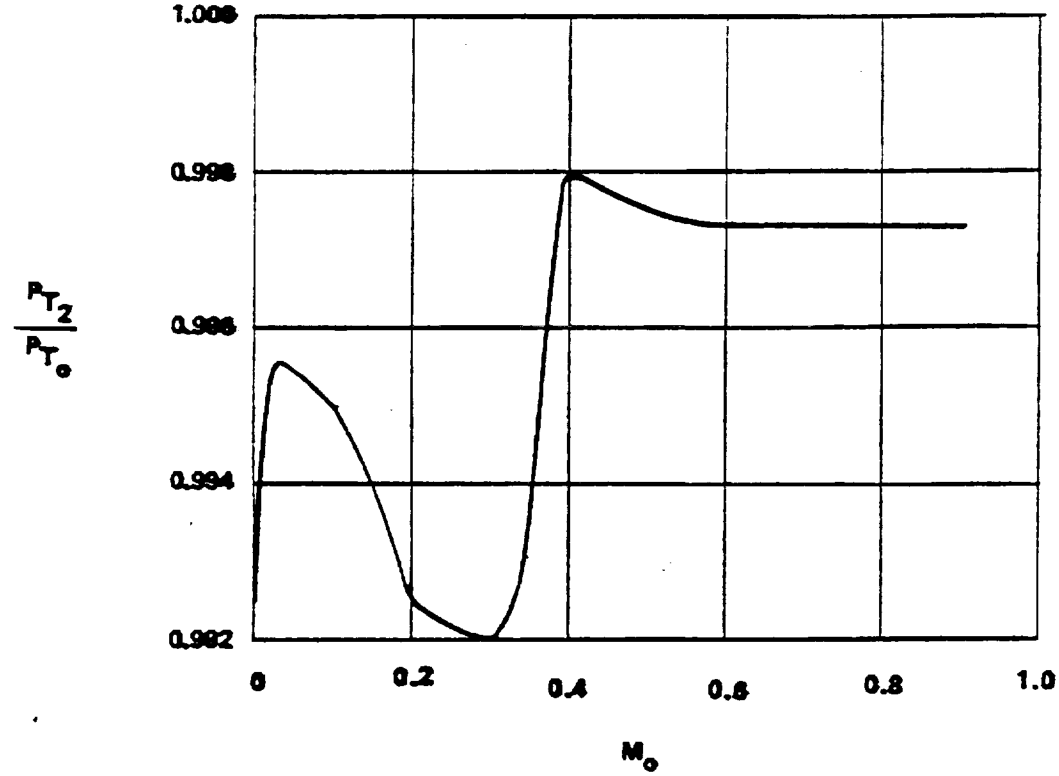


Figure 12. Performance Characteristics for Inlet Configuration - 'M9SUB'



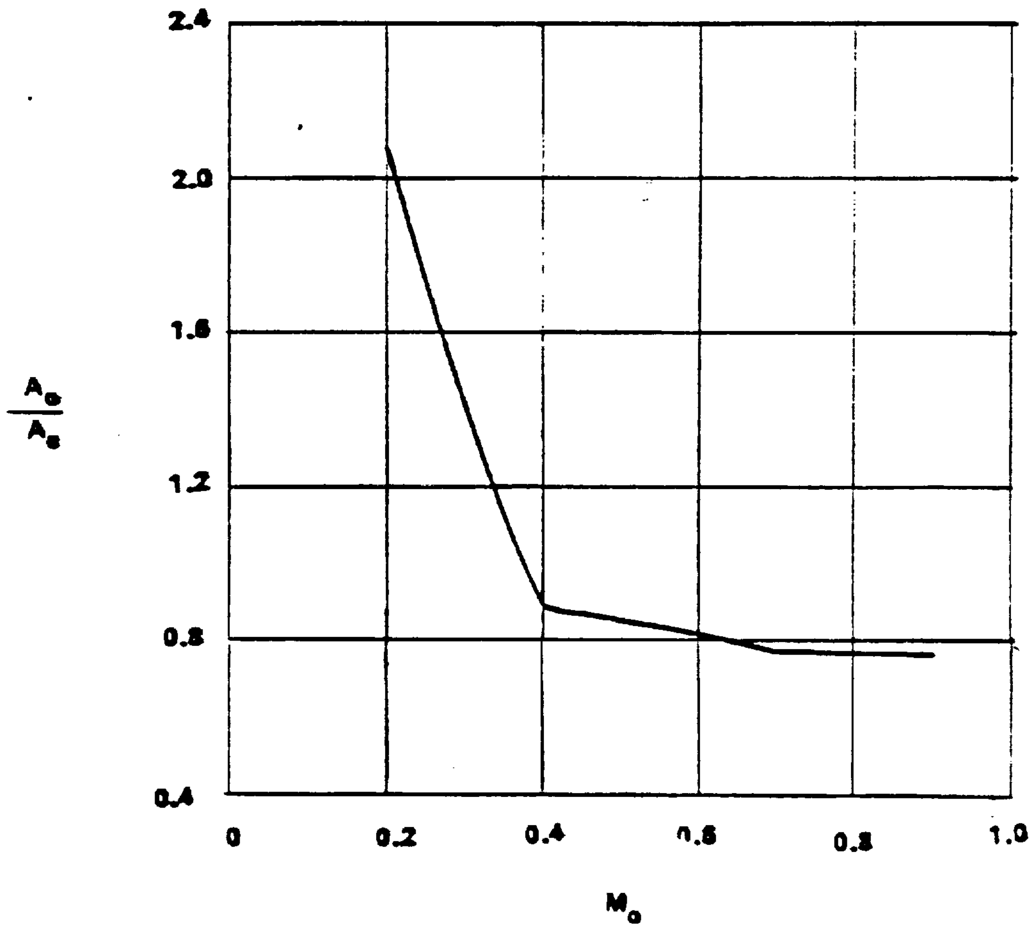


Figure 12. Performance Characteristics for Inlet Configuration - 'M9SUB' - (continued)

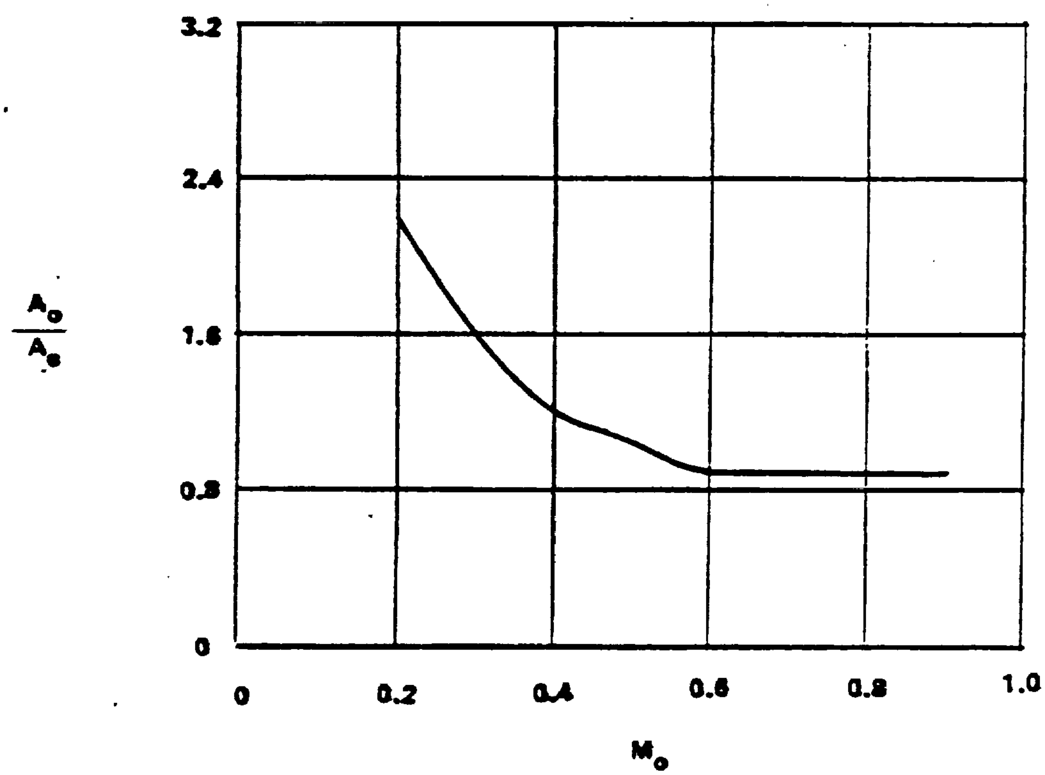


Figure 12. Performance Characteristics for Inlet Configuration - 'M9SUB' - (continued)

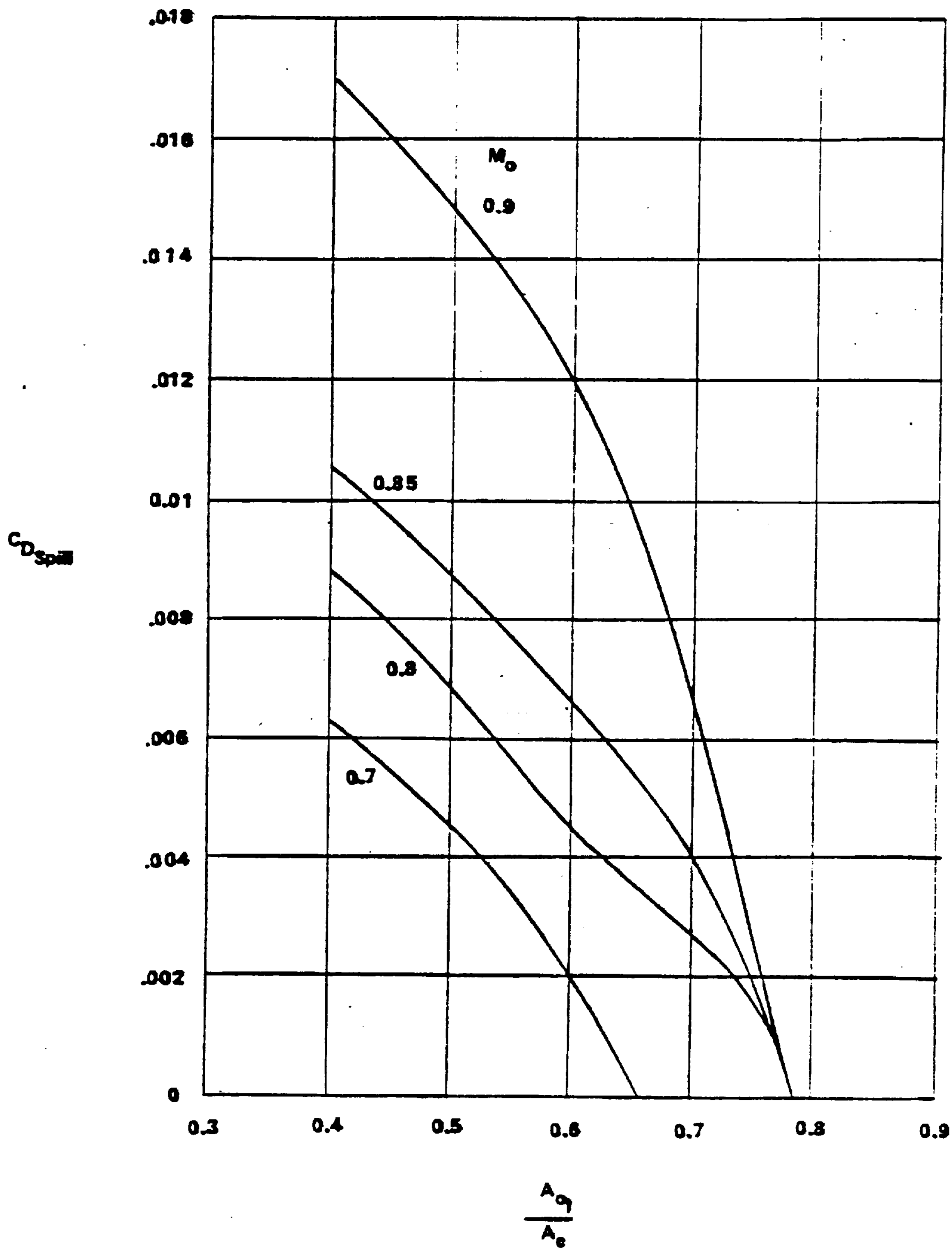


Figure 12. Performance Characteristics for Inlet Configuration - 'M9SUB' - (continued)

```
***********
*         *
* M9SUB   *
*         *
***********
```

SUBSONIC PITOT INLET, MDES =.9, NO BLEED OR BYPASS,T/O DOORS,THIN LIP

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
4	DESIGN MACH NUMBER	0.8000
5	COWL LIP BLUNTNESS	0.0220
6	TAKEOFF DOOR AREA RATIO	0.0260
7	EXTERNAL COWL ANGLE(DEG)	17.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.2500
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	12.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.0150
19	THROAT TO CAPTURE AREA RATIO	0.9000

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	PITOT OR CHIN
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.60

```
************
* TABLE 1  *
************
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.200	1.000	MNO
0.0	0.200	1.000	MNFS

```
************
* TABLE 2A *
************
```

INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.200	1.500	1.800	2.000	2.100	2.200	AO/AC		
	0.995	0.994	0.993	0.992	0.990	PT2/PT0		
MNO=0.300	1.000	1.200	1.400	1.600	AO/AC			
	0.997	0.995	0.992	0.989	PT2/PT0			
MNO=0.400	0.400	0.600	0.800	0.890	0.950	1.100	1.200	AO/AC
	1.000	1.000	0.999	0.998	0.996	0.993	0.989	PT2/PT0
MNO=0.500	0.400	0.600	0.700	0.800	0.900	0.960	1.000	AO/AC
	1.000	1.000	0.999	0.998	0.996	0.993	0.990	PT2/PT0
MNO=0.600	0.400	0.570	0.600	0.700	0.800	0.880	0.900	AO/AC
	1.000	0.999	0.999	0.999	0.998	0.995	0.989	PT2/PT0
MNO=0.700	0.400	0.500	0.570	0.700	0.800	0.850	AO/AC	
	1.000	0.999	0.999	0.998	0.997	0.995	PT2/PT0	
MNO=0.800	0.400	0.500	0.570	0.700	0.800	0.850	AO/AC	
	1.000	0.999	0.999	0.998	0.997	0.995	PT2/PT0	
MNO=0.900	0.400	0.500	0.570	0.700	0.800	0.850	AO/AC	
	1.000	0.999	0.999	0.998	0.997	0.995	PT2/PT0	

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.025	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.900	MNO
0.993	0.996	0.995	0.993	0.992	0.998	0.998	0.997	0.997	0.997	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900	MNO
2.070	1.400	0.890	0.850	0.820	0.770	0.770	0.770	AO/AC

```
************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)        VS        LOCAL MACH NUMBER (MNO)
************

             0.0       0.500     1.000     MNO
             0.0       0.0       0.0       AO/AC


************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)   VS        LOCAL MACH NUMBER (MNO)
************

             0.200     0.300     0.400     0.500     0.600     0.700     0.900     MNO
             2.200     1.600     1.200     1.050     0.900     0.900     0.900     AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)       VS       INLET MASS FLOW RATIO (AOI/AC)    AND    LOCAL MACH NUMBER (MNO)
************


MNO=0.0      0.0       2.500     AOI/AC
             0.0       0.0       CDSPL

MNO=0.700    0.400     0.500     0.600     0.655     2.500     AOI/AC
             0.006     0.005     0.002     0.0       0.0       CDSPL

MNO=0.800    0.400     0.500     0.600     0.700     0.770     0.785     2.500     AOI/AC
             0.009     0.007     0.005     0.003     0.001     0.0       0.0       CDSPL

MNO=0.850    0.400     0.500     0.600     0.700     0.750     0.785     2.500     AOI/AC
             0.011     0.009     0.007     0.004     0.002     0.0       0.0       CDSPL

MNO=0.900    0.400     0.500     0.600     0.700     0.750     0.785     2.500     AOI/AC
             0.017     0.015     0.012     0.007     0.003     0.0       0.0       CDSPL


************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

             0.0       1.000     MNO
```

```
                0.0         0.0         REF CDSPL

************
* TABLE 3B *         REF INLET MASS FLOW RATIO (REF AOI/AC)      VS        LOCAL MACH NUMBER (MNO)
************

                0.0         1.000       MNO
                0.0         0.0         REF AOI/AC

************
* TABLE 4  *    BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

                0.0         9.000       MNO

MNO=0.0         0.0         4.000       AOBLD/AC
                0.0         0.0         CDBLD

MNO=9.000       0.0         4.000       AOBLD/AC
                0.0         0.0         CDBLD
```



```
************
* TABLE 5  *     BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND     LOCAL MACH NUMBER (MNO)
************

                0.0         9.000       MNO

MNO=0.0         0.0         4.000       AOBYP/AC
                0.0         0.0         CDBYP

MNO=9.000       0.0         4.000       AOBYP/AC
                0.0         0.0         CDBYP

************
* TABLE 6A *    BLEED MASS FLOW RATIO (AOBLD/AC)     VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************
```

4.2.1.5 INLET CONFIGURATION 'NS' - SUPERSONIC, NORMAL SHOCK INLET

This inlet is designed for a Mach number of 1.50. It has no bleed or bypass system. The subsonic diffuser is relatively long and the cowl lip is relatively sharp, for reduced drag at supersonic speeds.

The inlet performance characteristics are based on the test data contained in Reference 5. The inlet geometry is shown in Figue 12 and the inlet performance characteristics are presented in Figure 13.

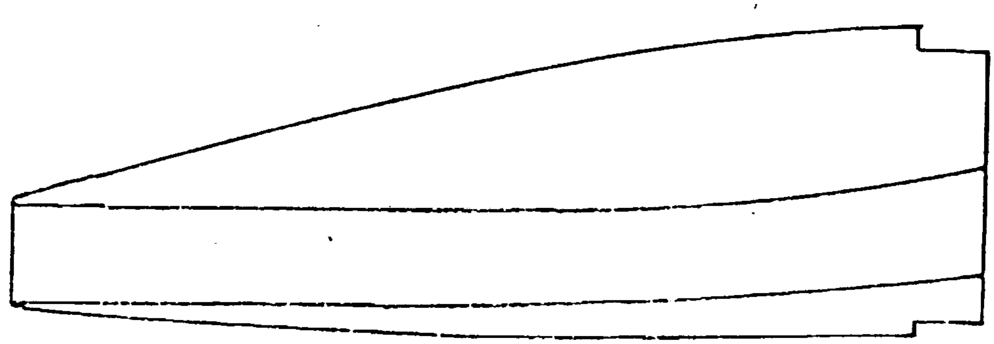


Figure 13 Supersonic Normal Shock Inlet (First Version)

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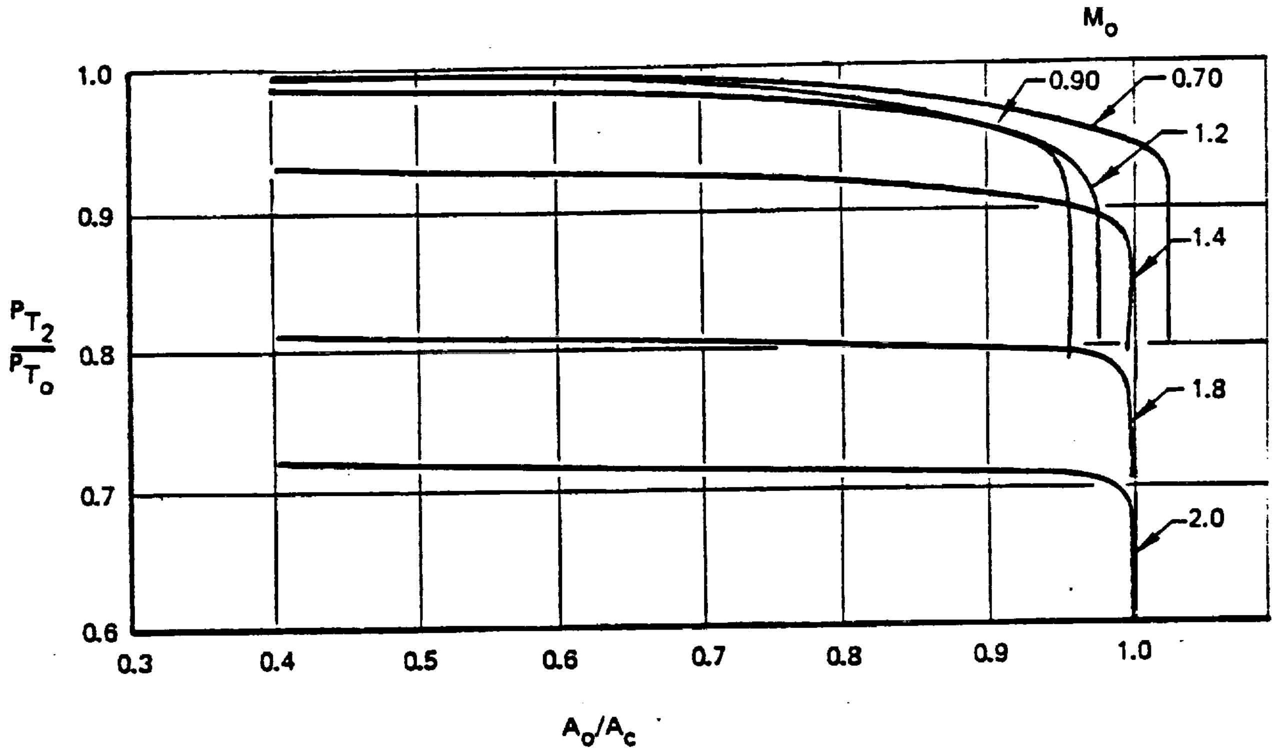

Figure 14. Performance Characteristics for Inlet Configuration - 'NS'

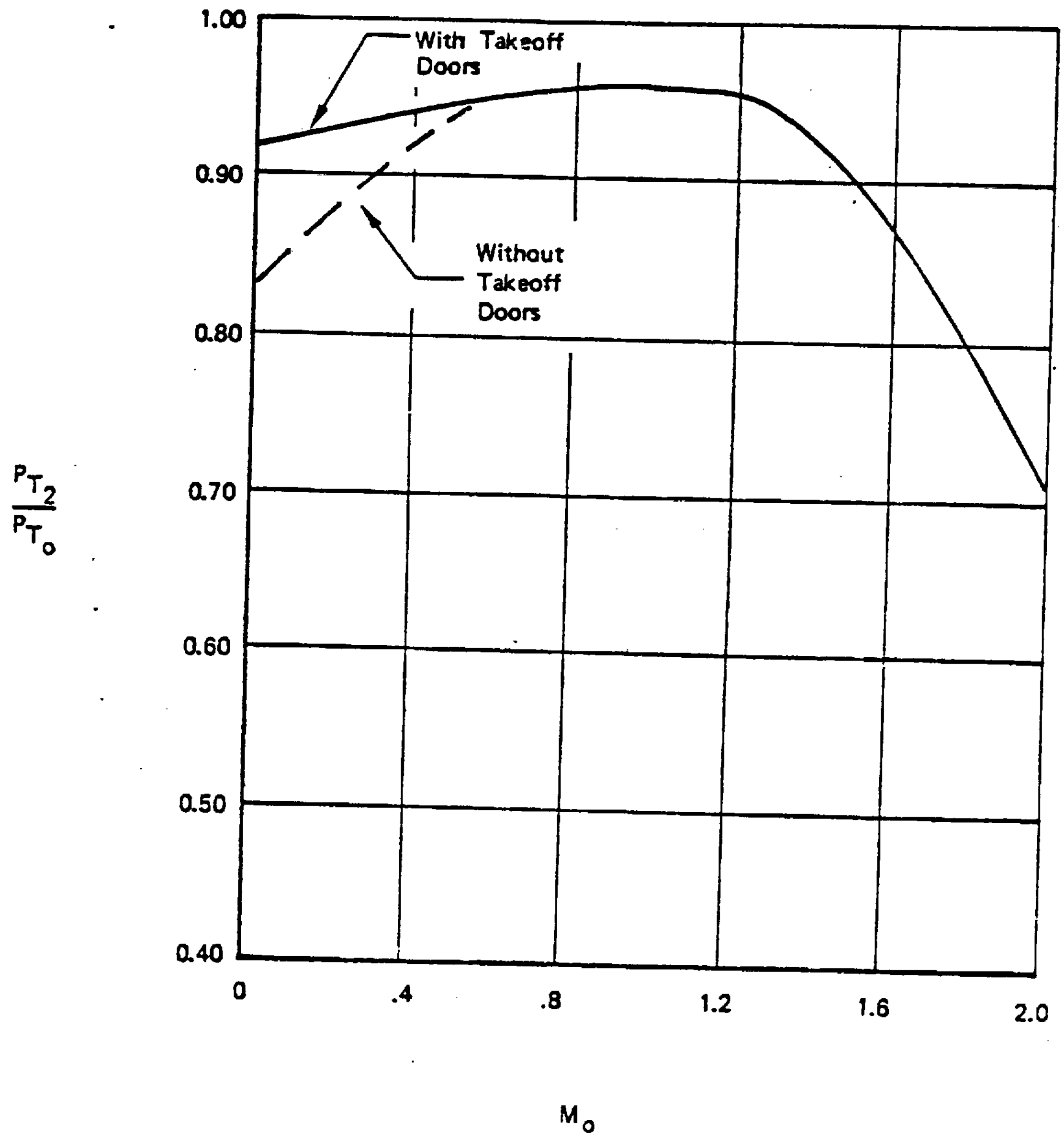

Figure 14. Performance Characteristics for Inlet Configuration - 'NS' - (continued)

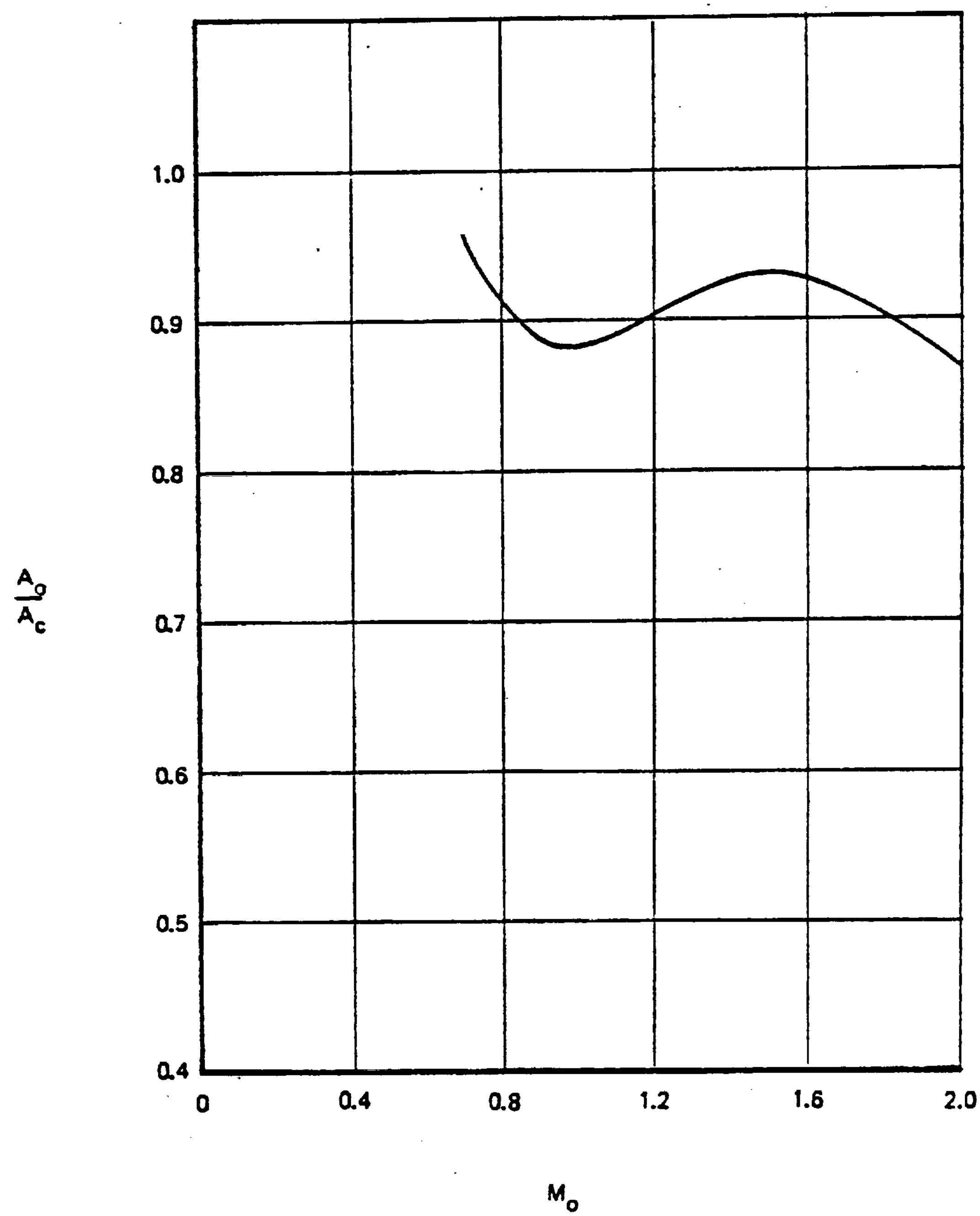

Figure 14. Performance Characteristics for Inlet Configuration - 'NS' - (continued)

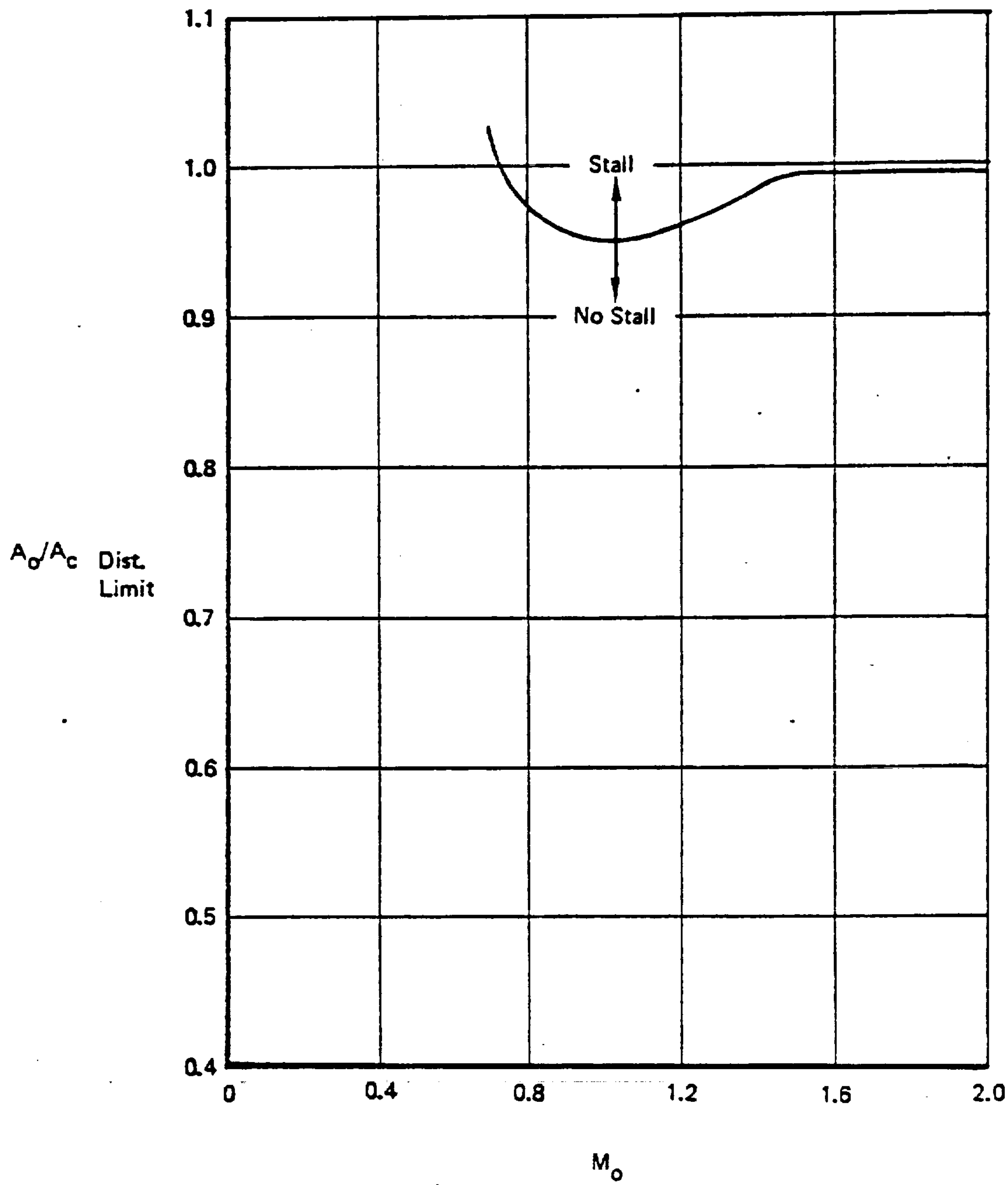

Figure 14. Performance Characteristics for Inlet Configuration - 'NS' - (continued)

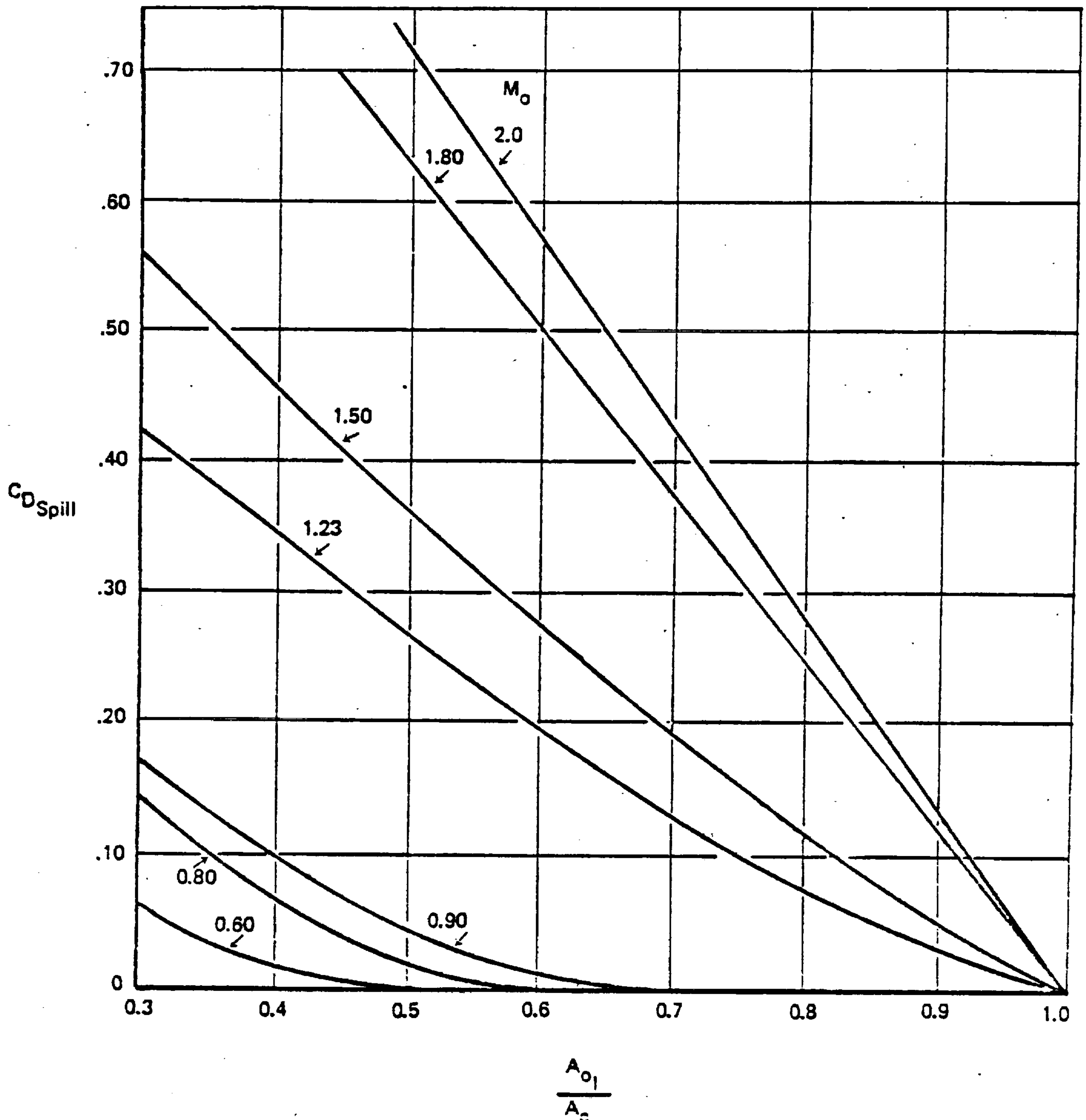

Figure 14. Performance Characteristics for Inlet Configuration - 'NS' - (continued)

```
***********
*         *
* NS      *
*         *
***********
```

SUPERSONIC N.S. INLET, MDES=1.5, NO BLEED OR BYPASS,SHARP LIP,F-100

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
4	DESIGN MACH NUMBER	1.5000
5	COWL LIP BLUNTNESS	0.0220
6	TAKEOFF DOOR AREA RATIO	0.1800
7	EXTERNAL COWL ANGLE(DEG)	5.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.3050
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	4.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200
19	THROAT TO CAPTURE AREA RATIO	0.9600

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	PITOT OR CHIN
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.70

```
************
* TABLE 1  *
************
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.260	2.000	MNO
0.0	0.260	2.000	MNFS

```
************
* TABLE 2A *
************
```

INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (A0/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.260	0.400	0.600	0.800	1.000	1.200	1.400	1.600	AO/AC
	0.995	0.994	0.990	0.984	0.973	0.962	0.975	PT2/PTO
MNO=0.400	0.400	0.600	0.800	1.000	1.200	1.400	AO/AC	
	0.995	0.993	0.987	0.982	0.960	0.940	PT2/PTO	
MNO=0.700	0.400	0.600	0.800	0.900	1.000	1.025	AO/AC	
	0.995	0.992	0.981	0.966	0.942	0.930	PT2/PTO	
MNO=0.900	0.400	0.600	0.800	0.900	0.950	0.960	AO/AC	
	0.995	0.989	0.975	0.955	0.927	0.895	PT2/PTO	
MNO=1.230	0.400	0.600	0.800	0.900	0.950	0.975	0.980	AO/AC
	0.988	0.980	0.969	0.900	0.936	0.900	0.850	PT2/PTO
MNO=1.500	0.400	0.600	0.800	0.900	0.950	0.975	1.000	AO/AC
	0.930	0.925	0.916	0.908	0.900	0.892	0.870	PT2/PTO
MNO=1.800	0.400	0.600	0.800	0.900	0.950	0.975	1.000	AO/AC
	0.810	0.805	0.800	0.796	0.795	0.790	0.770	PT2/PTO
MNO=2.000	0.400	0.600	0.800	0.900	0.950	0.975	1.000	AO/AC
	0.720	0.716	0.710	0.708	0.706	0.703	0.680	PT2/PTO

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PTO OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.700	0.900	1.100	1.230	1.500	1.800	2.000	MNO
0.920	0.942	0.955	0.959	0.958	0.954	0.904	0.797	0.709	PT2/PTO

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.700	0.900	1.000	1.230	1.500	1.600	1.800	2.000	MNO
0.960	0.960	0.890	0.882	0.907	0.930	0.928	0.905	0.870	AO/AC

```
************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)          VS        LOCAL MACH NUMBER (MNO)
************

                0.0       1.300     1.400     1.500     1.800     2.000     MNO
                0.0       0.0       0.600     0.675     0.770     0.800     AO/AC


************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                0.0       0.700     0.900     1.000     1.230     1.460     2.000     MNO
                1.025     1.025     0.955     0.950     0.963     0.995     0.995     AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS        INLET MASS FLOW RATIO (AOI/AC)    AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.600       0.300     0.400     0.500     1.000     AOI/AC
                0.060     0.015     0.0       0.0       CDSPL

MNO=0.800       0.300     0.400     0.500     0.600     1.000     AOI/AC
                0.143     0.070     0.020     0.0       0.0       CDSPL

MNO=0.900       0.300     0.400     0.500     0.600     0.700     1.000     AOI/AC
                0.173     0.097     0.043     0.012     0.0       0.0       CDSPL

MNO=1.230       0.300     0.400     0.500     0.600     0.700     1.000     AOI/AC
                0.425     0.343     0.268     0.195     0.132     0.0       CDSPL

MNO=1.500       0.300     0.400     0.500     0.600     0.700     1.000     AOI/AC
                0.560     0.458     0.363     0.275     0.190     0.0       CDSPL

MNO=1.800       0.300     0.400     0.500     0.600     0.700     1.000     AOI/AC
                0.900     0.760     0.630     0.505     0.376     0.0       CDSPL

MNO=2.000       0.300     AOI/AC
                1.010     CDSPL
```

```
************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

              0.0        MNO
              0.0        REF CDSPL


************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)      VS        LOCAL MACH NUMBER (MNO)
************

              0.000      0.0        MNO
              1.000      0.0        REF AOI/AC


************
* TABLE 4  *    BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

              0.0        2.000      MNO

MNO=0.0       0.0        1.000      AOBLD/AC
              0.0        0.0        CDBLD

MNO=2.000     0.0        1.000      AOBLD/AC
              0.0        0.0        CDBLD


************
* TABLE 5  *    BYPASS DRAG COEFFICIENT (CDBYP)      VS    BYPASS MASS FLOW RATIO (AOBYP/AC)     AND     LOCAL MACH NUMBER (MNO)
************

              0.0        2.000      MNO

MNO=0.0       0.0        1.000      AOBYP/AC
              0.0        0.0        CDBYP

MNO=2.000     0.0        1.000      AOBYP/AC
              0.0        0.0        CDBYP
```

```
************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)           AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0          0.0        1.000      AO/AC
                 0.0        0.0        AOBLD/AC

MNO=2.000        0.0        1.000      AO/AC
                 0.0        0.0        AOBLD/AC


************
* TABLE 6B *           OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                 0.0        2.000      MNO
                 0.0        0.0        AOBLD/AC

************
* TABLE 7  *    BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0          0.0        1.000      AOE/AC
                 0.0        0.0        AOBYP/AC

MNO=2.000        0.0        1.000      AOE/AC
                 0.0        0.0        AOBYP/AC
```

4.2.1.6 INLET CONFIGURATION 'NS2' - SUPERSONIC, NORMAL SHOCK INLET

This inlet has no boundary layer bleed or bypass system. Cowl lips are sharp, for reduced drag at higher supersonic Mach numbers.

The inlet performance characteristics are based on the test data from Reference 5 up to Mach 1.5. Above Mach 1.5 inlet performance is calculated from normal shock total pressure losses and subsonic diffuser losses for a duct loss coefficient, $\varepsilon = .12$. Unpublished test data were also available for a normal shock inlet up to Mach 2.0 from Boeing Lightweight Fighter inlet development tests. These data were used to substantiate the recovery predictions. The inlet geometry is shown in Figure 14 and the inlet performance characteristics are presented in Figure 15.

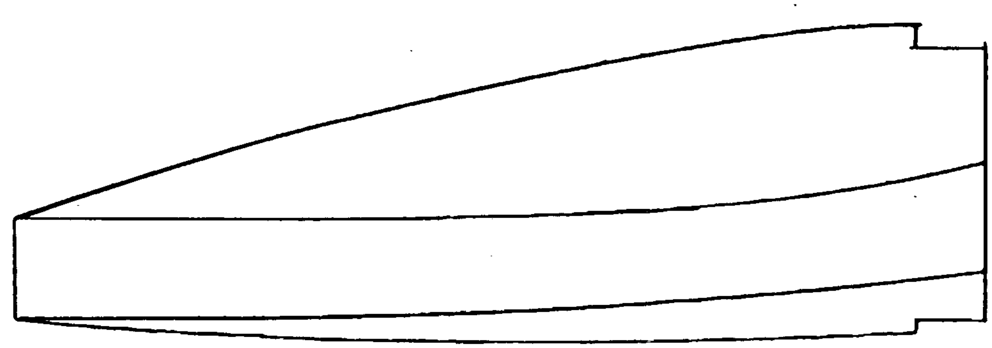

Figure 15 Supersonic Normal Shock Inlet (Second Version)

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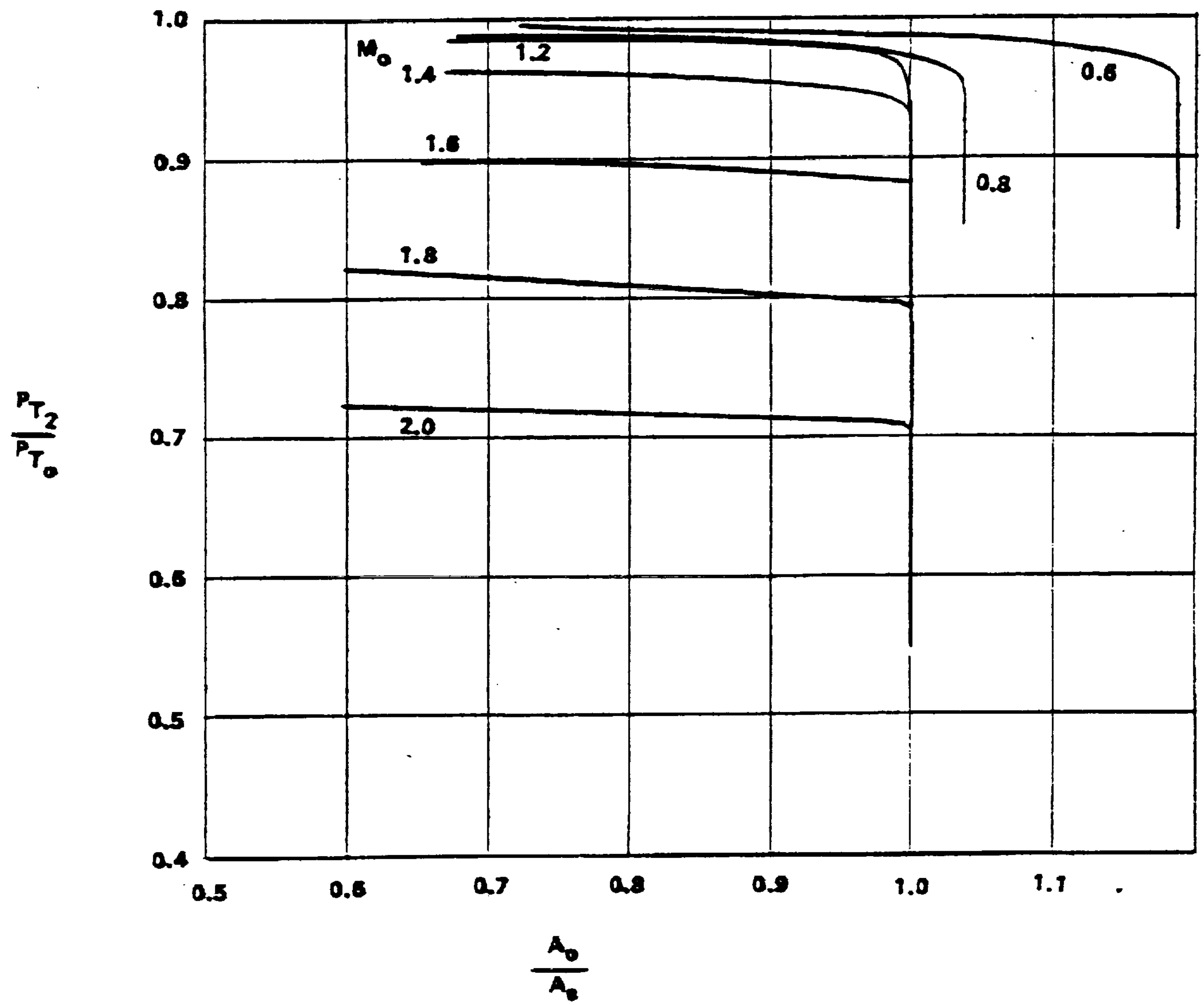


Figure 16. Performance Characteristics for Inlet Configuration - 'NS2'

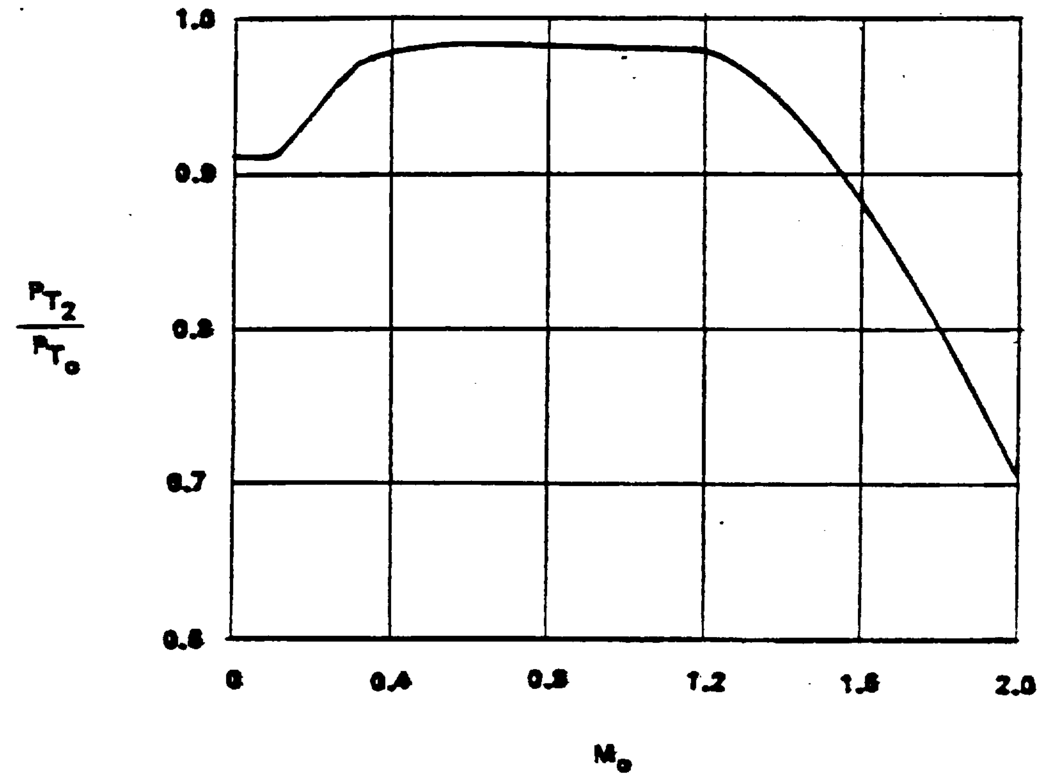


Figure 16. Performance Characteristics for Inlet Configuration - 'NS2' - (continued)

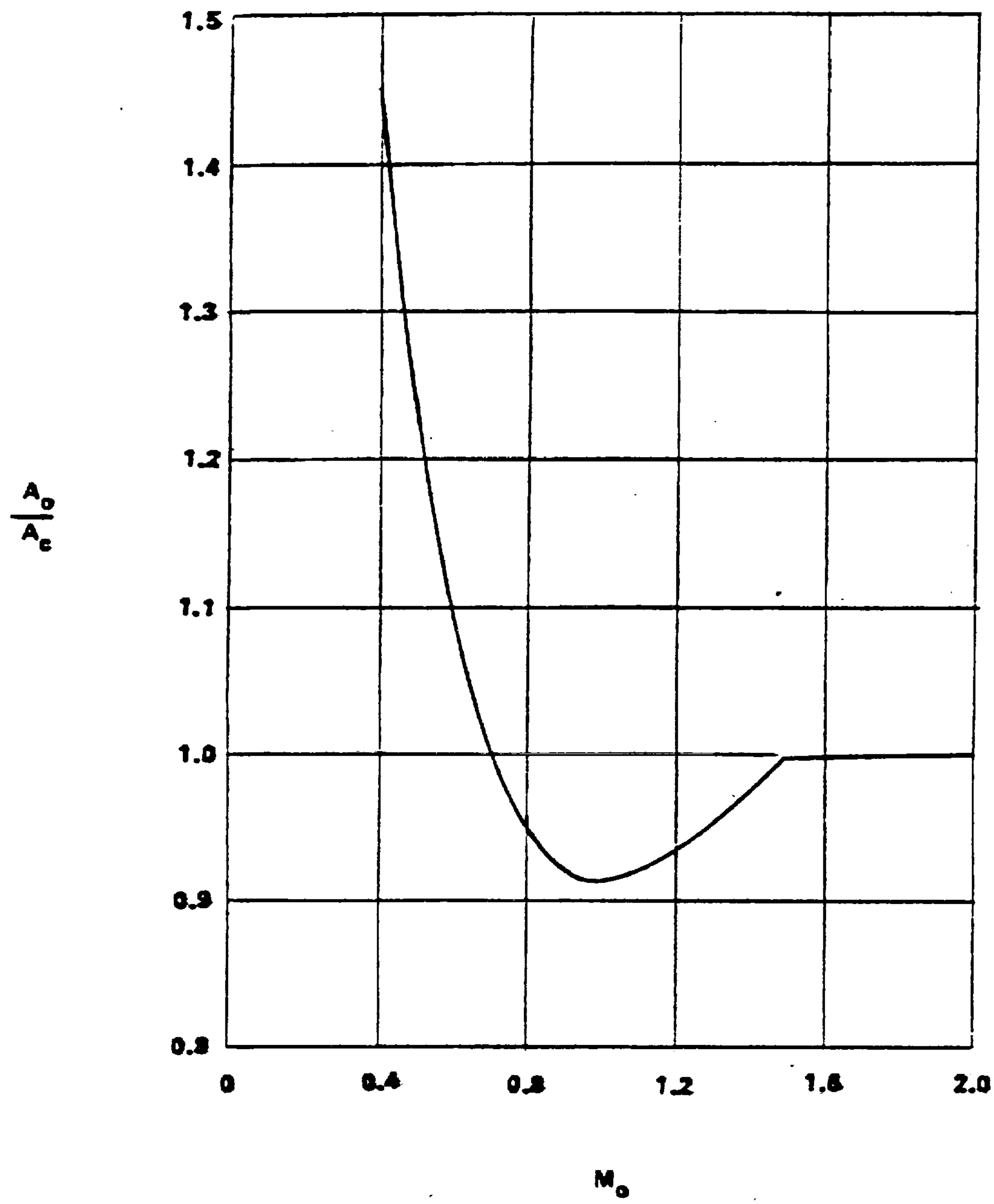
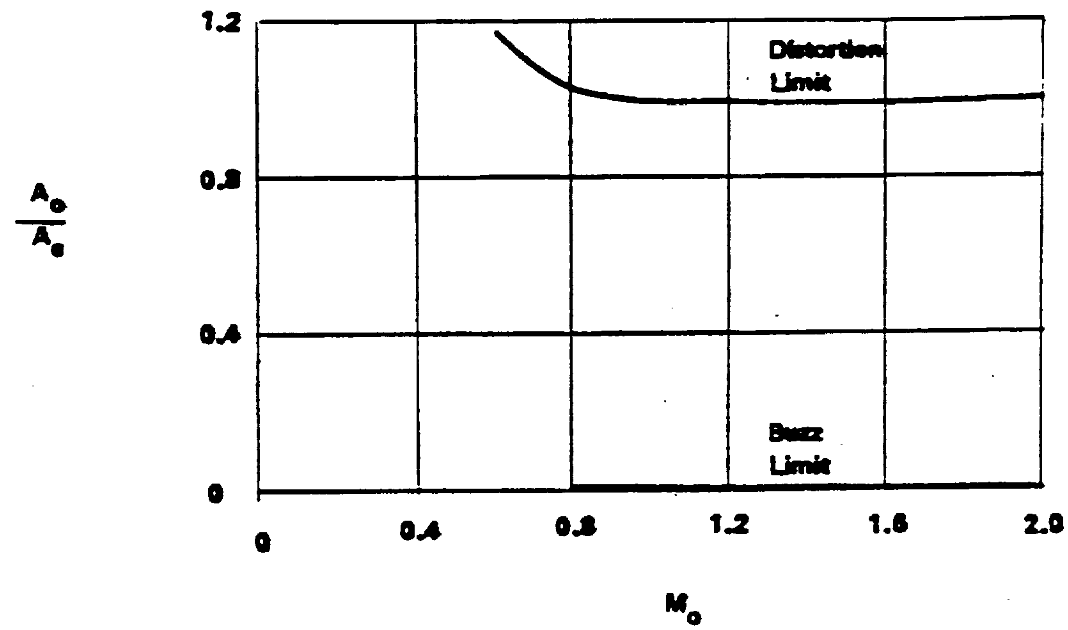


Figure 16. Performance Characteristics for Inlet Configuration - 'NS2' - (continued)



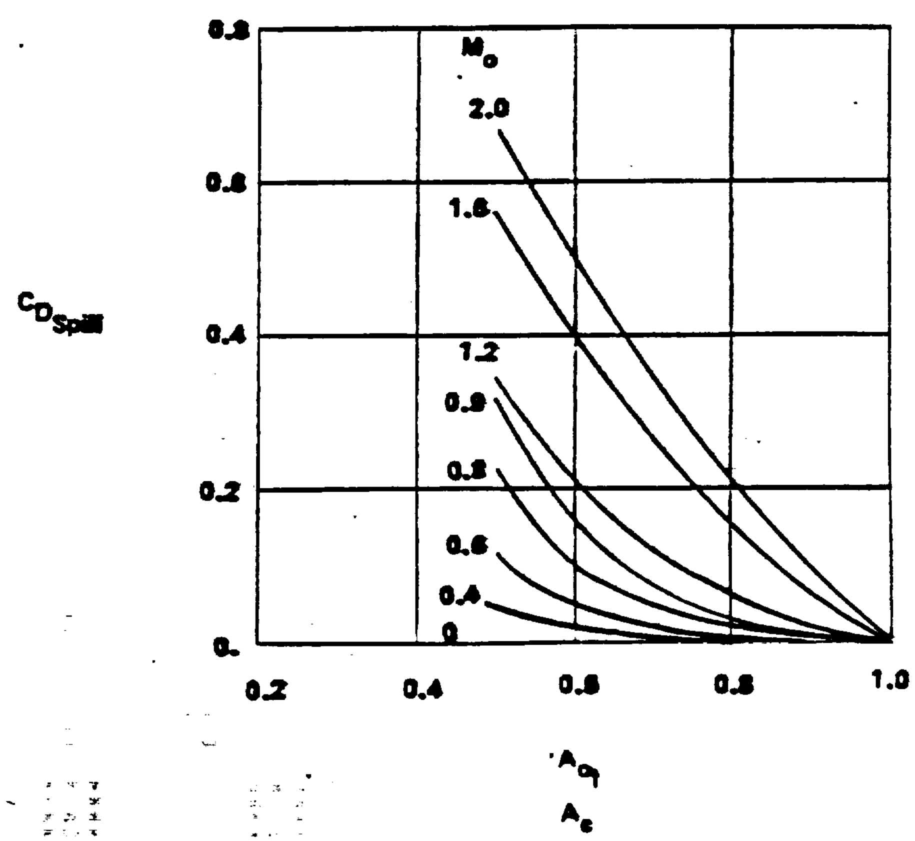


Figure 16. Performance Characteristics for Inlet Configuration - 'NS2' - (continued)

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*         *
* NS2     *
*         *
***********
```

SUPERSONIC N.S. INLET, MDES=2.0, NO BLEED OR BYPASS,SHARP LIP,F-100

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
4	DESIGN MACH NUMBER	1.6000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.2200
7	EXTERNAL COWL ANGLE(DEG)	5.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.3050
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	4.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200
19	THROAT TO CAPTURE AREA RATIO	1.0000

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	PITOT OR CHIN
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.70

```
***********
* TABLE 1  *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.600	2.000	MNO
0.0	0.600	2.000	MNFS

```
***********
* TABLE 2A *
***********
```

INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.600	0.600 0.995	0.800 0.993	0.900 0.991	1.000 0.990	1.050 0.986	1.100 0.980	1.150 0.970	1.180 0.960	1.185 0.700	AO/AC PT2/PT0
MNO=0.800	0.600 0.995	0.800 0.991	0.900 0.982	0.950 0.980	1.000 0.970	1.035 0.960	1.038 0.700	AO/AC PT2/PT0		
MNO=1.200	0.600 0.985	0.800 0.983	0.900 0.980	0.950 0.978	0.975 0.975	0.990 0.970	1.000 0.950	1.020 0.700	AO/AC PT2/PT0	
MNO=1.400	0.600 0.965	0.800 0.960	0.900 0.955	0.950 0.950	0.975 0.945	1.000 0.935	1.010 0.600	AO/AC PT2/PT0		
MNO=1.600	0.600 0.900	0.800 0.895	0.900 0.890	0.950 0.885	1.000 0.882	1.010 0.700	AO/AC PT2/PT0			
MNO=1.800	0.600 0.822	0.800 0.810	0.900 0.802	1.000 0.796	1.010 0.700	AO/AC PT2/PT0				
MNO=2.000	0.600 0.725	0.800 0.718	0.900 0.715	1.000 0.710	1.010 0.500	AO/AC PT2/PT0				

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.600	0.800	1.200	1.400	1.600	1.800	2.000	MNO
0.910	0.985	0.982	0.980	0.946	0.882	0.800	0.706	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.200	1.400	1.600	1.800	2.000	MNO
1.450	0.950	0.934	0.975	0.998	1.000	1.000	AO/AC

****
* TABLE 2D *

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

****

	0.0	2.000	MNO
	0.0	0.0	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.200	1.400	1.600	1.800	2.000	MNO
1.170	1.020	0.990	0.990	0.990	0.995	1.000	AO/AC

****
* TABLE 3 *
****

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	4.000	AOI/AC					
	0.0	0.0	CDSPL					
MNO=0.400	0.500	0.600	0.800	4.000	AOI/AC			
	0.043	0.020	0.0	0.0	CDSPL			
MNO=0.600	0.500	0.600	0.700	0.900	2.000	AOI/AC		
	0.110	0.050	0.020	0.0	0.0	CDSPL		
MNO=0.800	0.500	0.600	0.700	0.800	1.000	2.000	AOI/AC	
	0.220	0.100	0.050	0.016	0.0	0.0	CDSPL	
MNO=0.900	0.500	0.600	0.700	0.800	1.000	2.000	AOI/AC	
	0.315	0.160	0.076	0.035	0.0	0.0	CDSPL	
MNO=1.200	0.500	0.600	0.700	0.800	0.900	1.000	2.000	AOI/AC
	0.345	0.215	0.120	0.065	0.020	0.0	0.0	CDSPL
MNO=1.600	0.500	0.600	0.700	0.800	0.900	1.000	2.000	AOI/AC
	0.560	0.400	0.260	0.150	0.060	0.0	0.0	CDSPL
MNO=2.000	0.500	0.700	0.800	0.900	1.000	2.000	AOI/AC	
	0.670	0.345	0.210	0.100	0.0	0.0	CDSPL	

```
************
* TABLE 3A *        REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

          0.0       0.400     0.600     0.800     0.900     1.200     1.600     2.000     MNO
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       REF CDSPL

************
* TABLE 3B *        REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

          0.0       0.400     0.600     0.800     0.900     1.200     1.600     2.000     MNO
          1.000     1.000     1.000     1.000     1.000     1.000     1.000     1.000     REF AOI/AC

************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)     VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

          0.0       2.000     MNO

MNO=0.0   0.0       2.000     AOBLD/AC
          0.0       0.0       CDBLD

MNO=2.000 0.0       2.000     AOBLD/AC
          0.0       0.0       CDBLD


************
* TABLE 5  *     BYPASS DRAG COEFFICIENT (CDBYP)     VS     BYPASS MASS FLOW RATIO (AOBYP/AC)     AND     LOCAL MACH NUMBER (MNO)
************

          0.0       2.000     MNO

MNO=0.0   0.0       2.000     AOBYP/AC
          0.0       0.0       CDBYP

MNO=2.000 0.0       2.000     AOBYP/AC
          0.0       0.0       CDBYP
```

```
************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.0         0.0         2.000       AO/AC
                0.0         0.0         AOBLD/AC


MNO=2.000       0.0         2.000       AO/AC
                0.0         0.0         AOBLD/AC



************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                0.0         2.000       MNO
                0.0         0.0         AOBLD/AC

************
* TABLE 7  *    BYPASS MASS FLOW RATIO (AOBYP/AC)     VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.0         0.0         2.000       AOE/AC
                0.0         0.0         AOBYP/AC


MNO=2.000       0.0         2.000       AOE/AC
                0.0         0.0         AOBYP/AC
```

4.2.1.7 INLET CONFIGURATION 'LWF' - FIXED GEOMETRY, TWO-SHOCK INLET

This inlet configuration has a single 7o external ramp compression surface and is equipped with a throat slot for boundary layer bleed. Bleed air is dumped overboard through a fixed geometry convergent nozzle at an exit angle of 15o. The sideplates are cutback 75% (as compared to full sideplates-ramp tip to cowl lip). The inlet is designed for Mach 1.6, but will operate up to Mach 2.0 without ramp shock ingestion. The performance characteristics of this inlet are based on test data from Reference 10 and engineering analysis. A sketch of the inlet geometry is shown in Figure 16 and the inlet performance characteristics are presented in Figure 17.

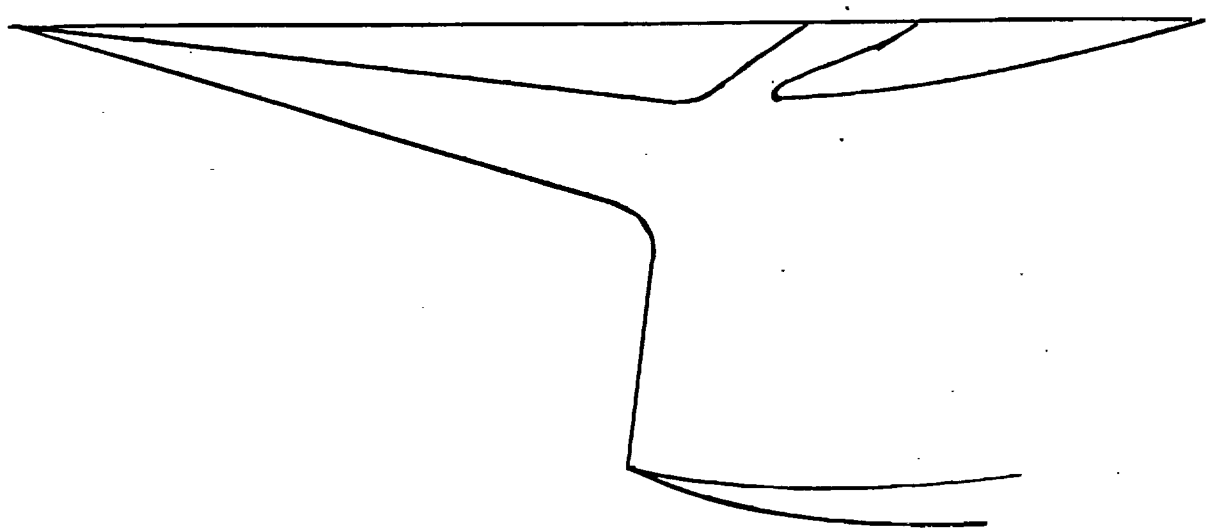


Figure 17 Fixed-Geometry Two-Shock Inlet Design for Mach 1.60

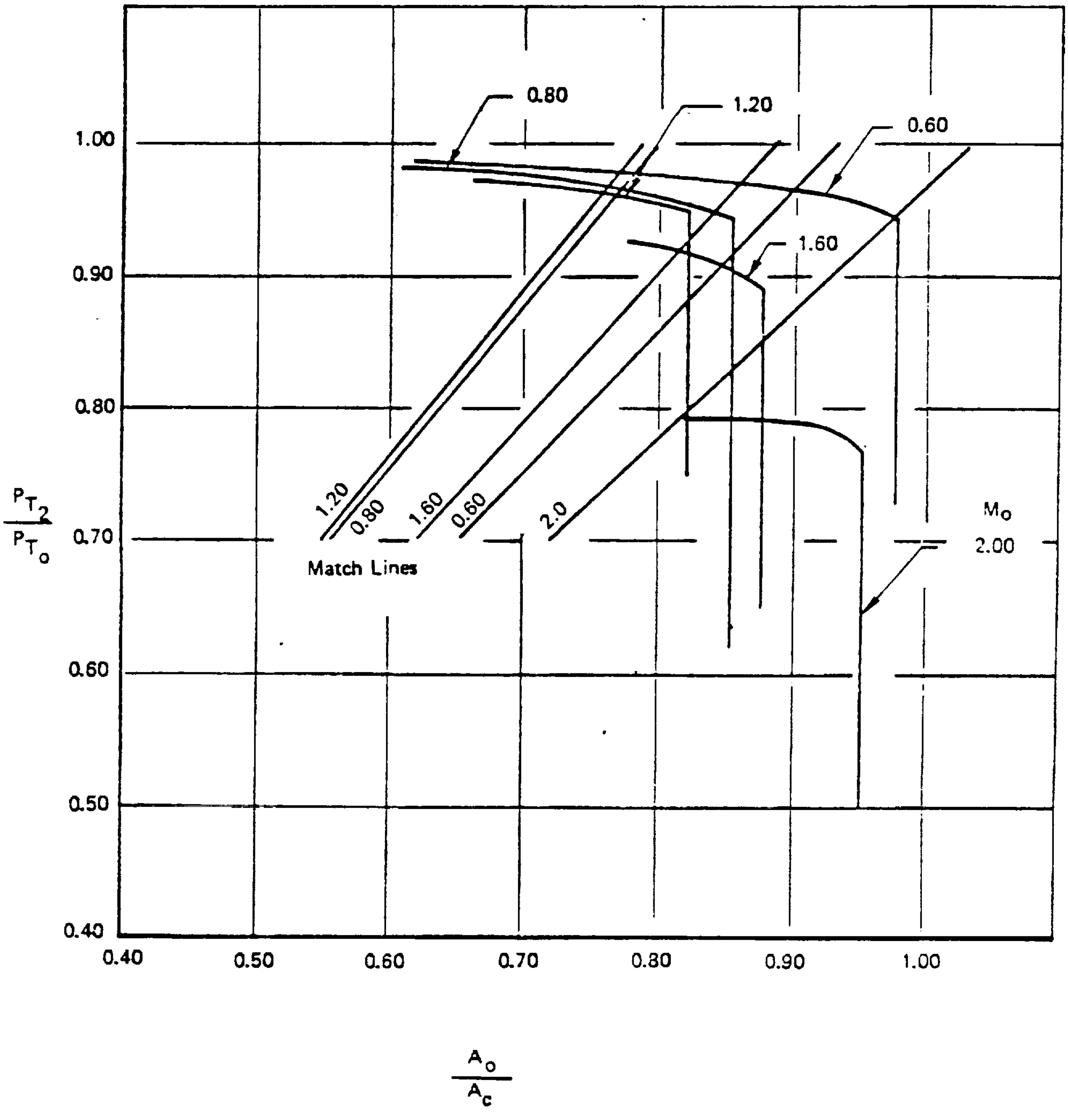


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF

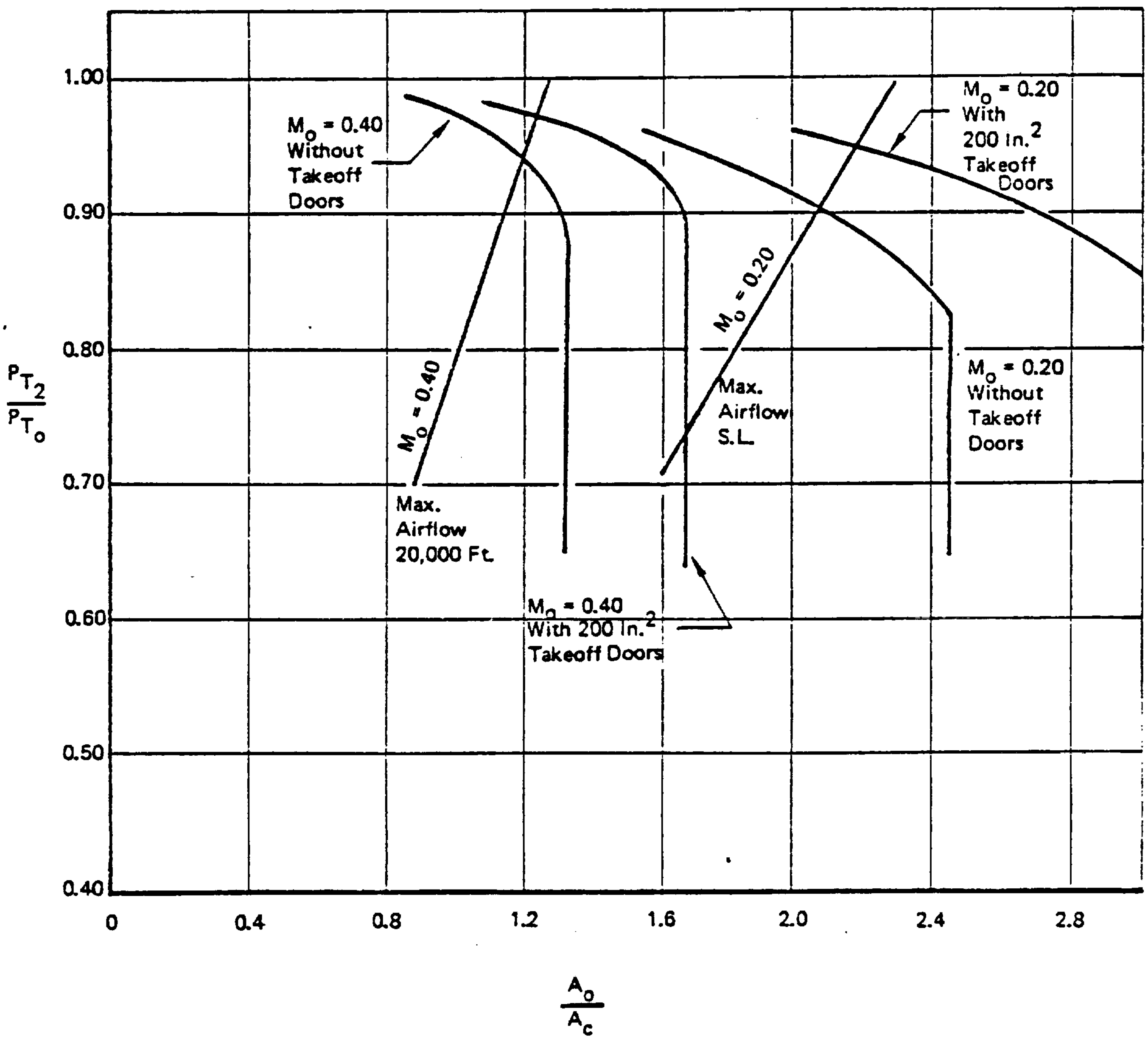


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

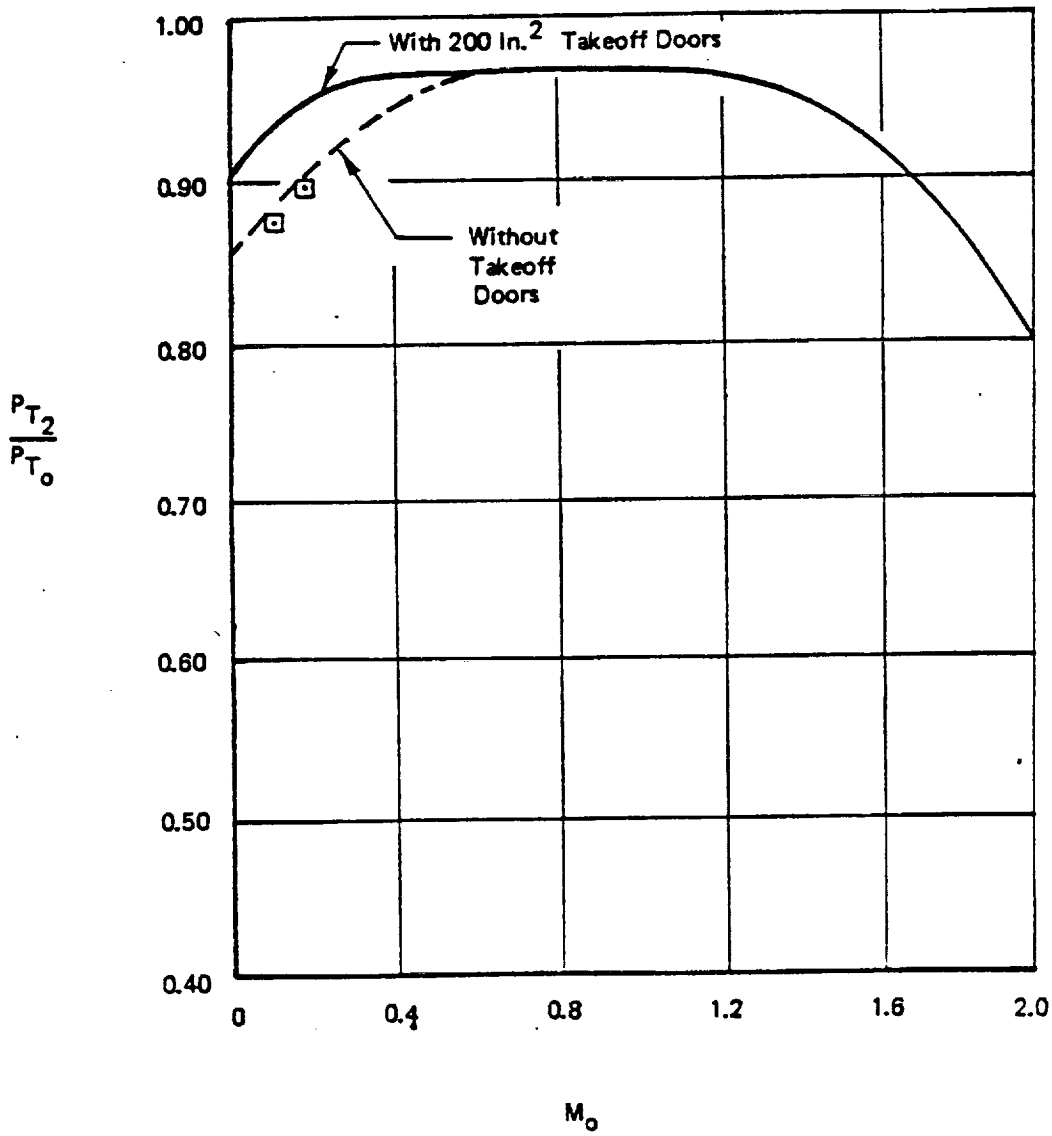


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

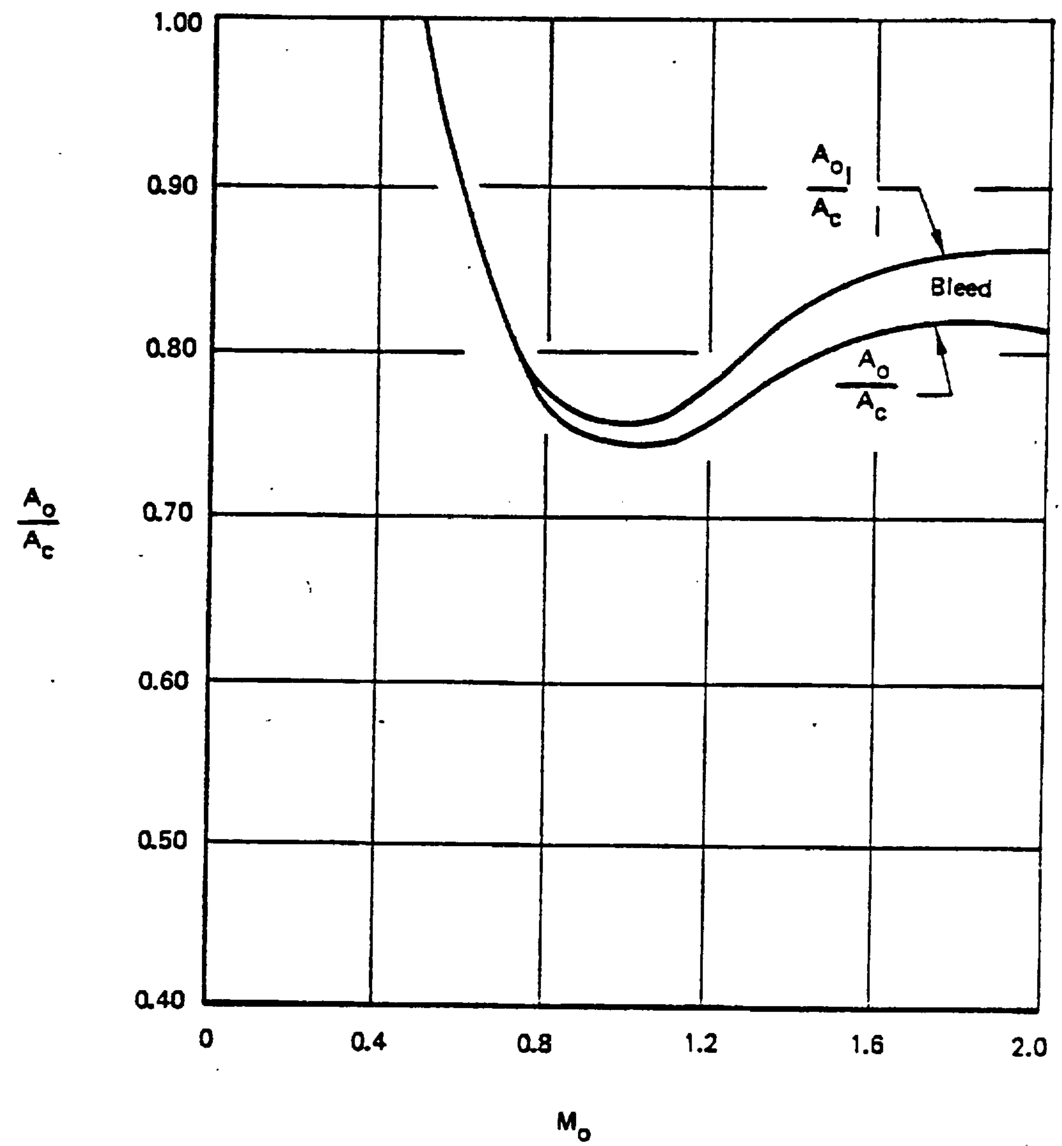


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

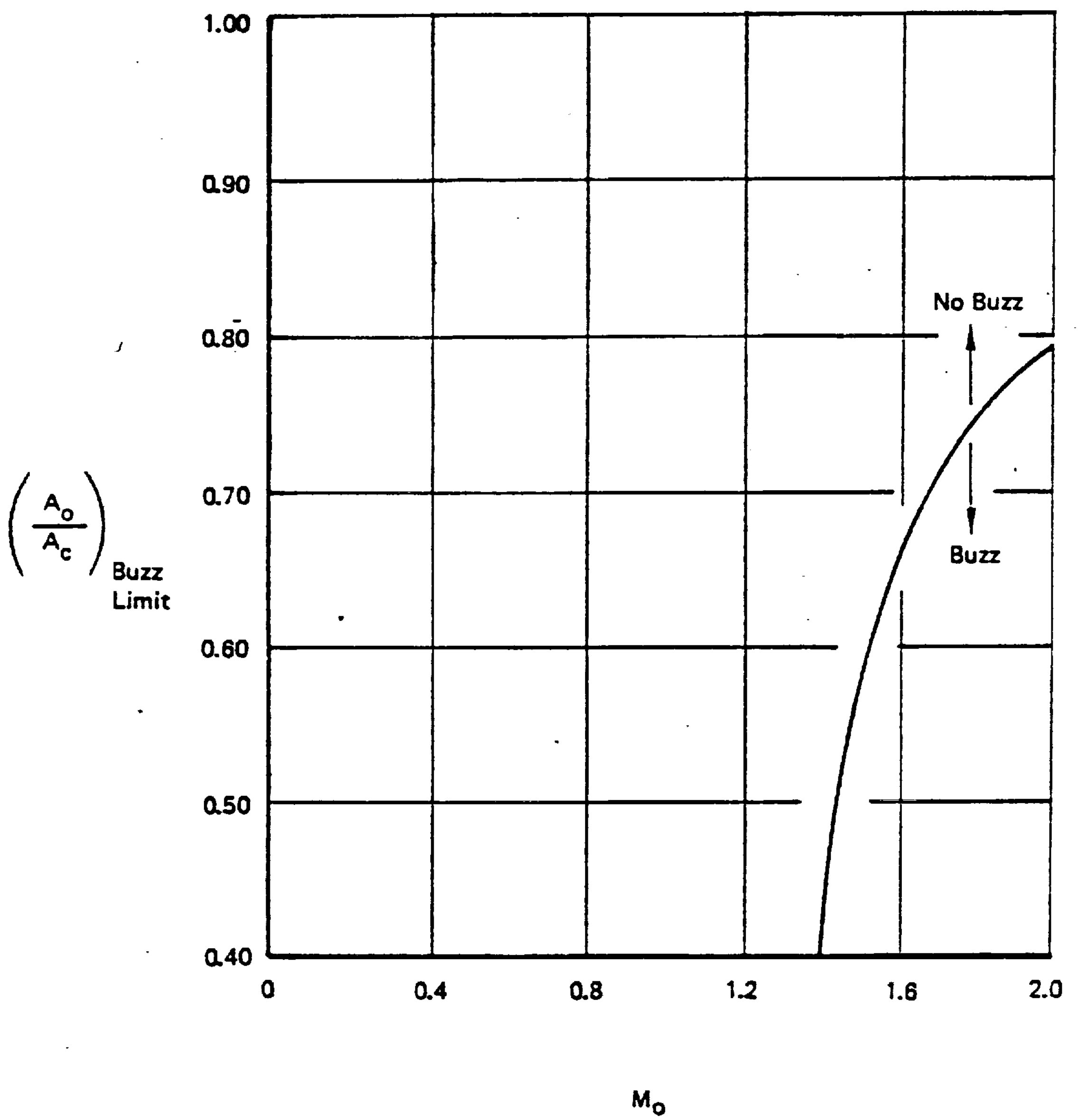


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

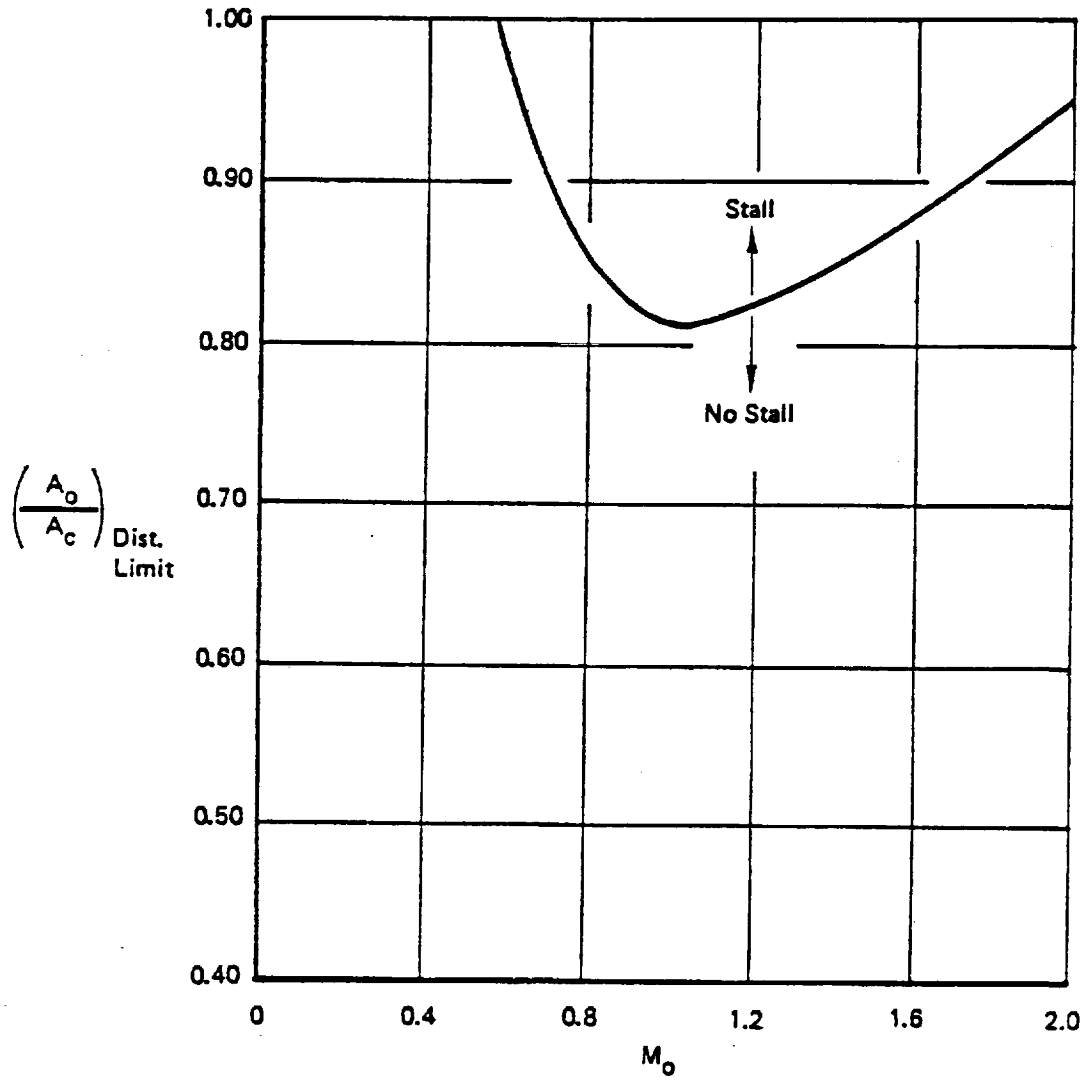
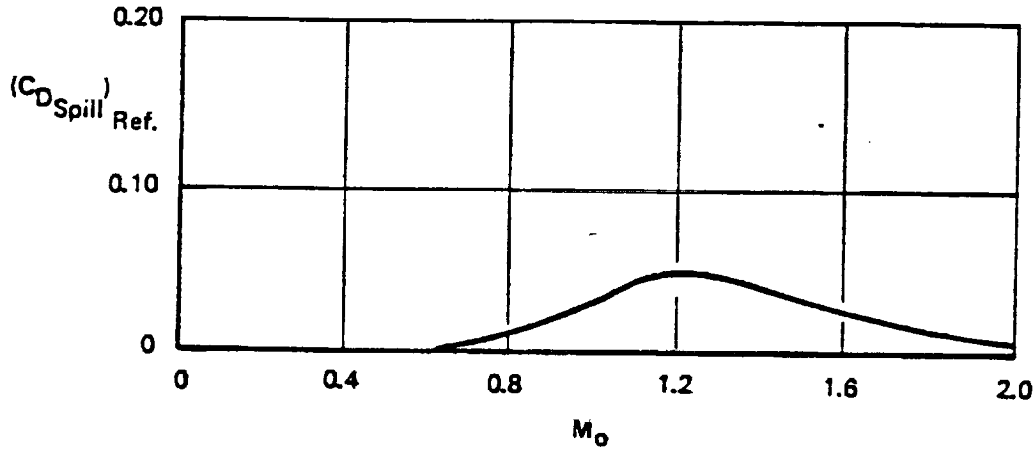


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)



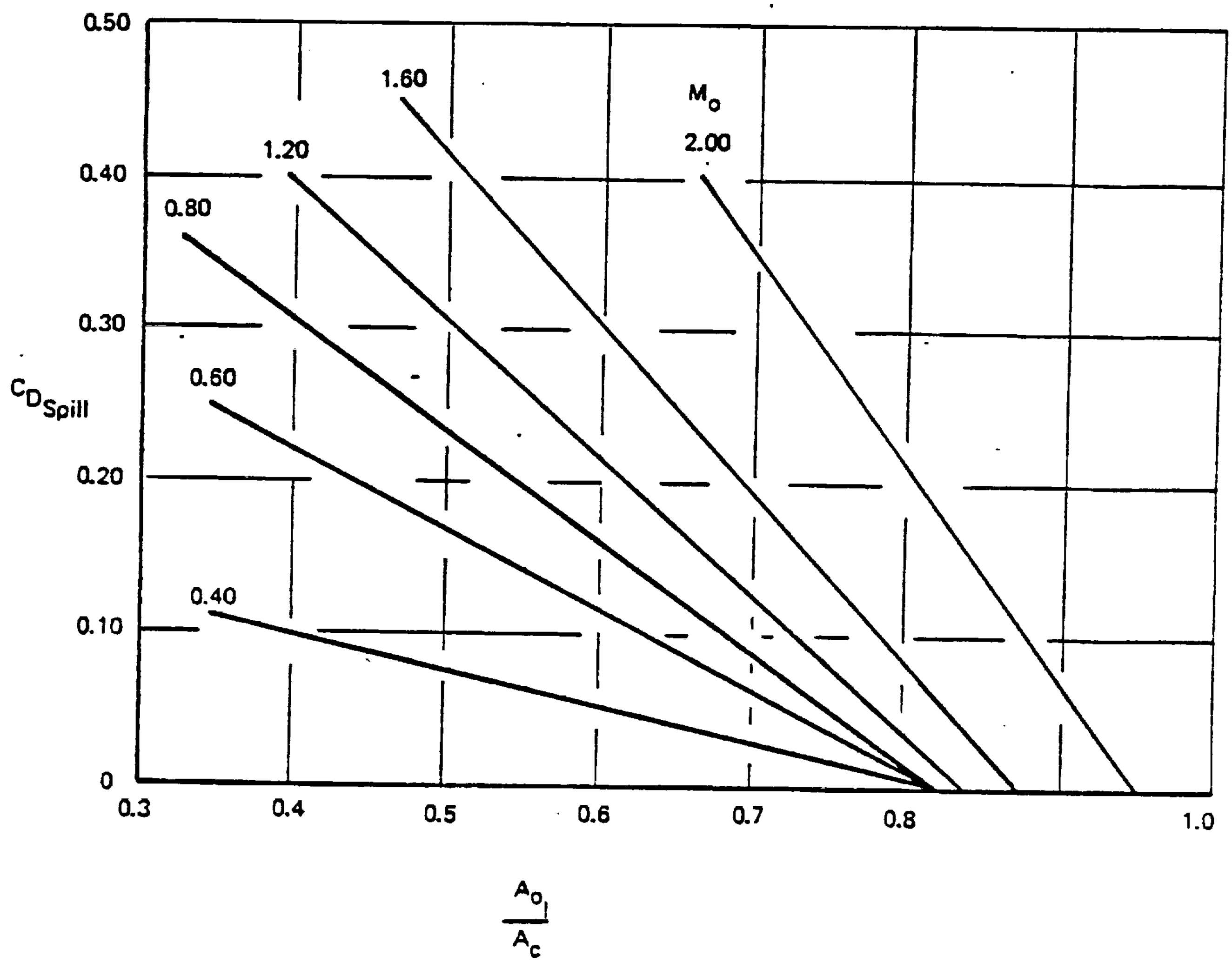


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

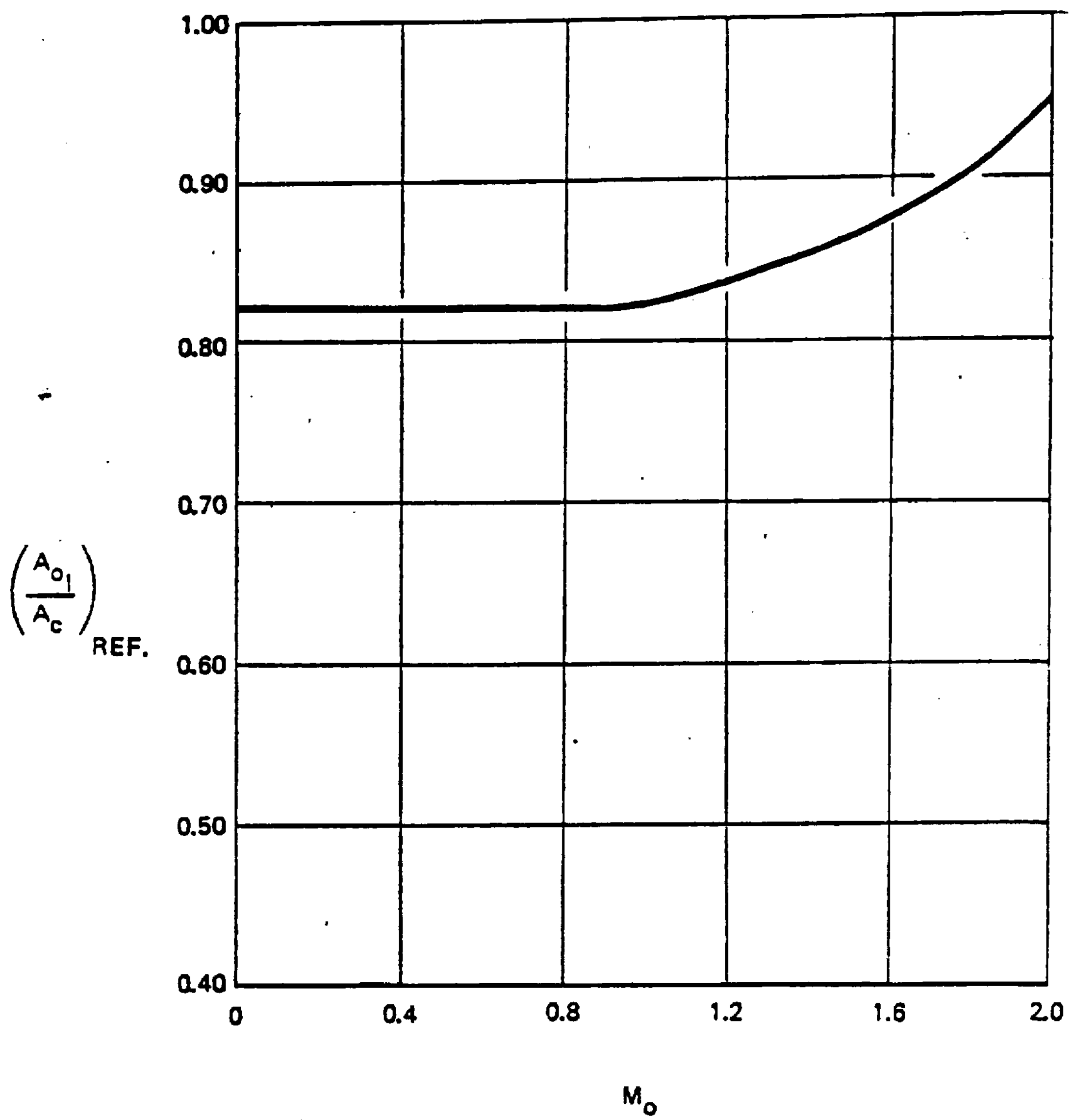


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

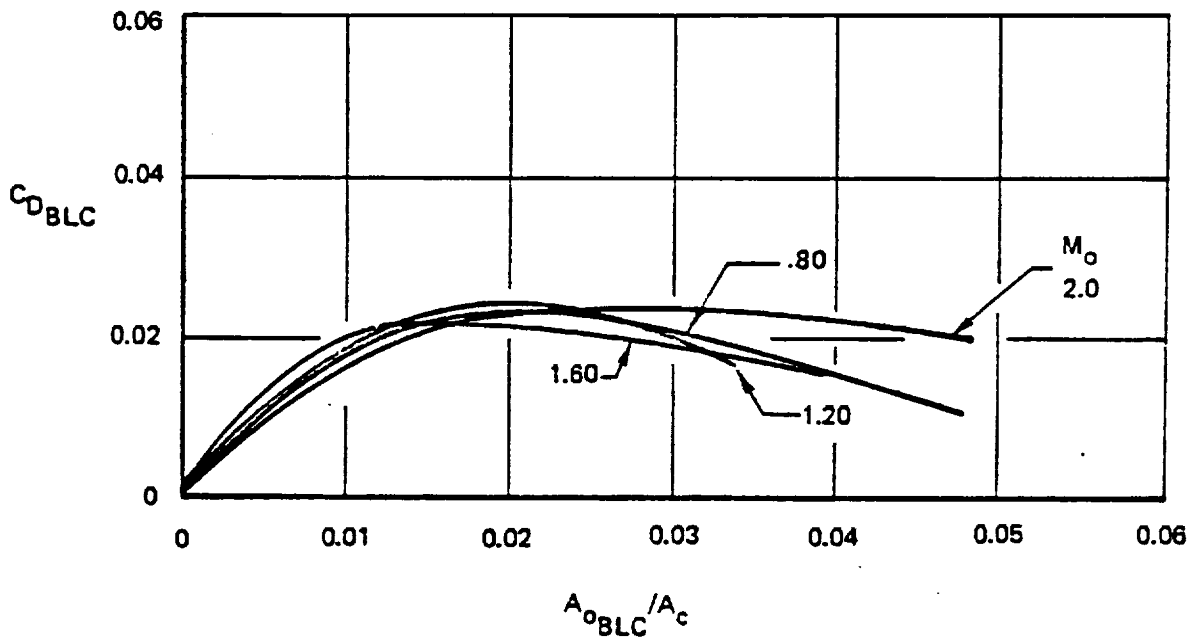


Figure 103: BOUNDARY LAYER BLEED DRAG

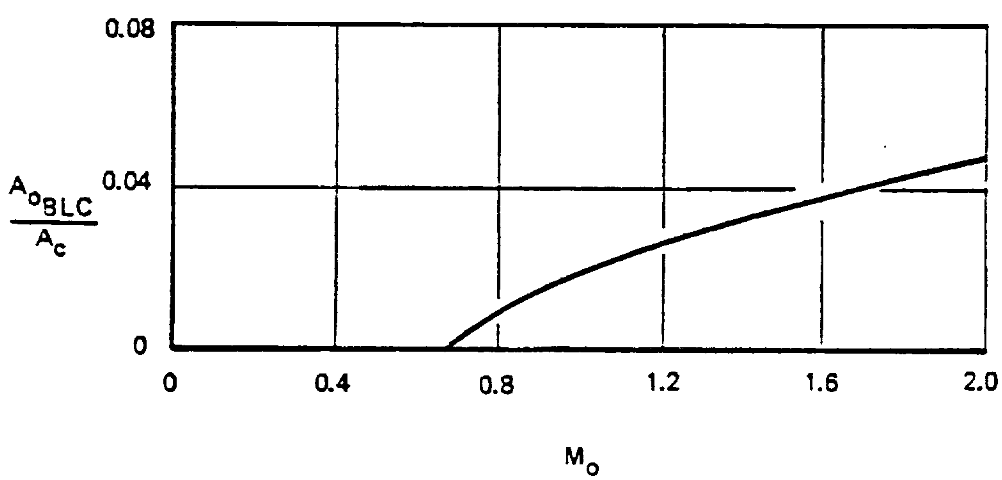


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

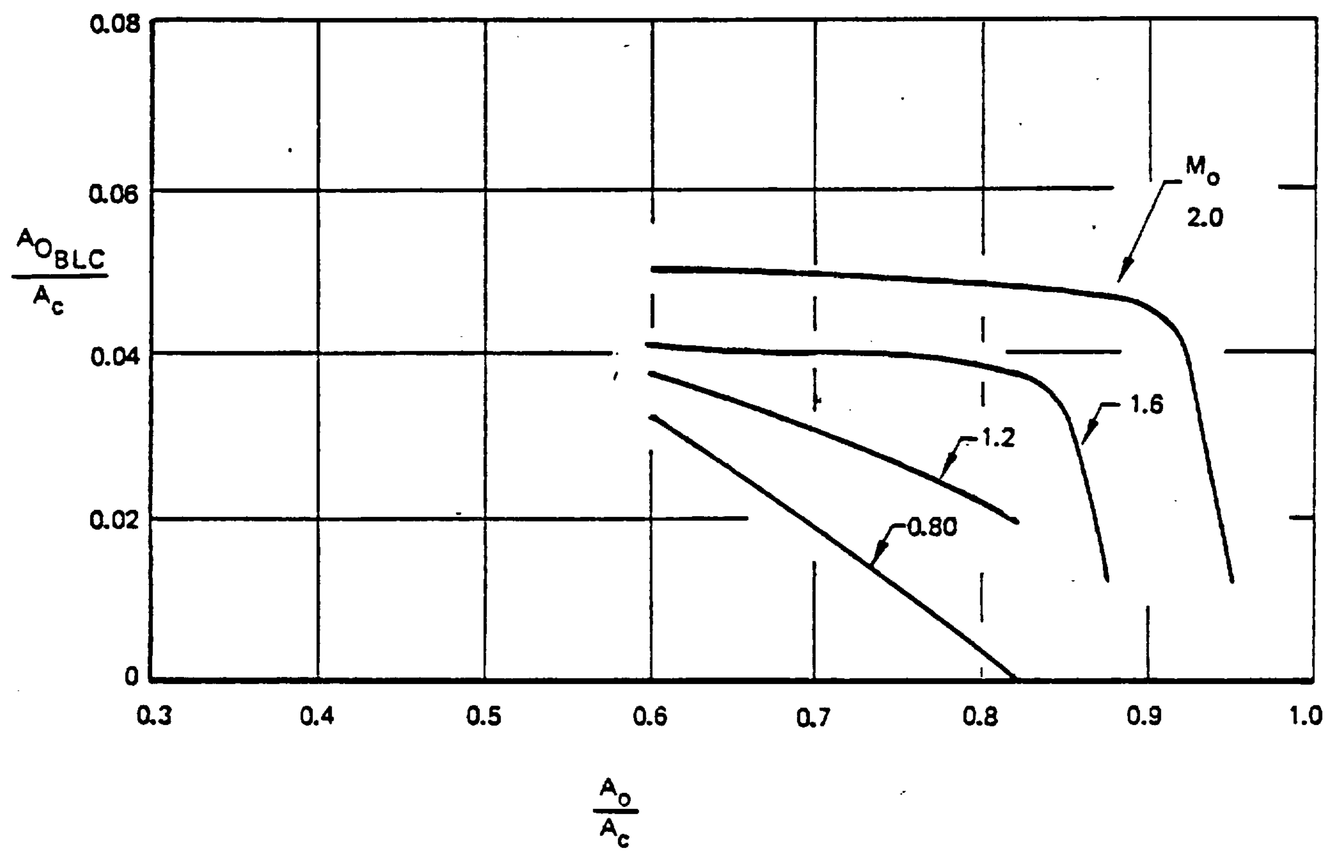


Figure 18. Performance Characteristics for Inlet Configuration - 'LWF' - (continued)

```
***********
*         *
* LWF     *
*         *
***********
```

SUPERSONIC FIX.GEO.2-D,2-SHOCK INLET, MDES=1.6, THROAT SLOT BLEED

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	2.0000
2	SIDEPLATE CUTBACK	0.7500
3	FIRST RAMP ANGLE(DEG)	7.0000
4	DESIGN MACH NUMBER	1.6000
5	COWL LIP BLUNTNESS	0.0120
6	TAKEOFF DOOR AREA RATIO	0.2350
7	EXTERNAL COWL ANGLE(DEG)	13.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	20.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.1000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.3730
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	5.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.75

```
************
* TABLE 1  *
************
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.600	2.000	MNO
0.0	0.600	2.000	MNFS

****

```
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PTO)        VS        MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.600      0.615     0.700     0.800     0.900     0.950     0.975     AO/AC
               0.985     0.983     0.975     0.963     0.954     0.943     PT2/PTO

MNO=0.800      0.605     0.700     0.800     0.855     AO/AC
               0.982     0.975     0.960     0.942     PT2/PTO

MNO=1.200      0.665     0.700     0.750     0.800     0.821     AO/AC
               0.971     0.969     0.963     0.954     0.948     PT2/PTO

MNO=1.600      0.675     0.750     0.800     0.850     0.876     AO/AC
               0.932     0.929     0.920     0.907     0.890     PT2/PTO

MNO=2.000      0.750     0.800     0.850     0.900     0.950     AO/AC
               0.792     0.791     0.790     0.789     0.770     PT2/PTO


************
* TABLE 2B *           OPTIMUM INLET RECOVERY (PT2/PTO OPT)        VS        LOCAL MACH NUMBER (MNO)
************

               0.0       0.200     0.400     0.800     1.000     1.200     1.600     1.800     2.000     MNO
               0.900     0.950     0.964     0.965     0.965     0.961     0.918     0.871     0.793     PT2/PTO

************
* TABLE 2C *           OPTIMUM MASS FLOW RATIO (AO/AC OPT)         VS        LOCAL MACH NUMBER (MNO)
************

               0.400     0.600     0.800     1.000     1.200     1.400     1.600     1.800     2.000     MNO
               1.175     0.900     0.770     0.743     0.756     0.790     0.813     0.819     0.815     AO/AC

************
* TABLE 2D *           BUZZ LIMIT MASS FLOW RATIO (AO/AC)          VS        LOCAL MACH NUMBER (MNO)
************

               0.0       1.400     1.600     1.800     2.000     MNO
               0.0       0.0       0.660     0.746     0.790     AO/AC
```

```
************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)    VS       LOCAL MACH NUMBER (MNO)
************

              0.400    0.600    0.800    1.000    1.200    1.400    1.600    1.800    2.000    MNO
              1.300    0.975    0.855    0.813    0.821    0.844    0.874    0.910    0.948    AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)       VS      INLET MASS FLOW RATIO (AOI/AC)   AND    LOCAL MACH NUMBER (MNO)
************

MNO=0.0       0.400    0.500    0.600    0.700    0.822    0.855    0.876    0.950    AOI/AC
              0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      CDSPL

MNO=0.699     0.400    0.500    0.600    0.700    0.822    0.855    0.876    0.950    AOI/AC
              0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      CDSPL

MNO=0.700     0.400    0.500    0.600    0.700    0.822    1.000    AOI/AC
              0.110    0.070    0.038    0.015    0.0      0.0      CDSPL

MNO=0.900     0.400    0.500    0.600    0.700    0.822    1.000    AOI/AC
              0.160    0.115    0.075    0.035    0.0      0.0      CDSPL

MNO=1.100     0.400    0.500    0.600    0.700    0.822    0.855    1.000    AOI/AC
              0.210    0.146    0.095    0.048    0.002    0.0      0.0      CDSPL

MNO=1.400     0.400    0.500    0.600    0.700    0.822    0.855    1.000    AOI/AC
              0.317    0.237    0.167    0.102    0.023    0.0      0.0      CDSPL

MNO=1.600     0.400    0.500    0.600    0.700    0.822    0.855    0.876    1.000    AOI/AC
              0.605    0.485    0.360    0.230    0.070    0.028    0.0      0.0      CDSPL

MNO=2.000     0.400    0.500    0.600    0.700    0.822    0.855    0.876    0.950    1.000    AOI/AC
              0.900    0.735    0.575    0.412    0.210    0.158    0.125    0.0      0.0      CDSPL


************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)       VS       LOCAL MACH NUMBER (MNO)
************
```

0.0	0.600	0.800	1.000	1.200	1.600	1.800	2.000	MNO
0.0	0.0	0.014	0.032	0.050	0.029	0.015	0.009	REF CDSPL

```
************
* TABLE 3B *
************
```

REF INLET MASS FLOW RATIO (REF AOI/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.800	1.000	1.200	1.400	1.600	2.000	MNO
0.822	0.822	0.822	0.825	0.839	0.856	0.878	0.950	REF AOI/AC

```
************
* TABLE 4  *
************
```

BLEED DRAG COEFFICIENT (CD BLD) VS BLEED MASS FLOW RATIO (AOBLD/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	0.700	0.800	1.200	1.600	2.000	MNO
MNO=0.0	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD
MNO=0.700	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD
MNO=0.800	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.017	0.023	0.020	0.018	0.016	CDBLD
MNO=1.200	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.018	0.024	0.020	0.013	0.010	CDBLD
MNO=1.600	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.010	0.020	0.019	0.015	0.013	CDBLD
MNO=2.000	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.016	0.023	0.023	0.022	0.019	CDBLD

```
************
* TABLE 5  *
************
```

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

0.0	2.000	MNO

MNO=0.0	0.0 0.0	1.000 0.0	AOBYP/AC CDBYP
MNO=2.000	0.0 0.0	1.000 0.0	AOBYP/AC CDBYP

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.500 0.0	0.600 0.0	0.700 0.0	0.820 0.0	0.850 0.0	0.875 0.0	0.900 0.0	0.925 0.0	0.950 0.0	AO/AC AOBLD/AC
MNO=0.700	0.500 0.0	0.600 0.0	0.700 0.0	0.820 0.0	0.850 0.0	0.875 0.0	0.900 0.0	0.925 0.0	0.950 0.0	AO/AC AOBLD/AC
MNO=0.800	0.500 0.043	0.600 0.032	0.700 0.019	0.820 0.0	0.850 0.0	0.875 0.0	0.900 0.0	0.925 0.0	0.950 0.0	AO/AC AOBLD/AC
MNO=1.200	0.500 0.044	0.600 0.038	0.700 0.031	0.820 0.019	0.850 0.014	0.875 0.010	0.900 0.010	0.925 0.010	0.950 0.010	AO/AC AOBLD/AC
MNO=1.600	0.500 0.046	0.600 0.044	0.700 0.041	0.820 0.037	0.850 0.033	0.875 0.012	0.900 0.012	0.925 0.012	0.950 0.012	AO/AC AOBLD/AC
MNO=2.000	0.500 0.052	0.600 0.051	0.700 0.050	0.820 0.048	0.850 0.047	0.875 0.046	0.900 0.045	0.925 0.036	0.950 0.012	AO/AC AOBLD/AC

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.700	0.800	1.200	1.600	2.000	MNO
0.0	0.009	0.026	0.038	0.048	AOBLD/AC

```
************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.0         0.0        1.000      AOE/AC
                0.0        0.0        AOBYP/AC

MNO=2.000       0.0        1.000      AOE/AC
                0.0        0.0        AOBYP/AC
```

4.2.1.8 INLET CONFIGURATION 'ATS2' - VARIABLE RAMP, FOUR-SHOCK, TWO-DIMENSIONAL, EXTERNAL COMPRESSION INLET

This inlet has two movable external ramps, a 7.3° initial ramp angle, a boundary layer control bleed system consisting of porous bleed on the second and third ramp surfaces, sideplates, and a throat bleed slot located aft of the normal shock. The throat slot also acts as a bypass to remove excess inlet airflow for matching engine airflow demand with inlet supply.

The inlet performance characteristics were build up from engineering analyses and available data from similar configurations and components. The inlet geometry is shown in Figure 18 and the inlet performance characteristics are presented in Figure 19.

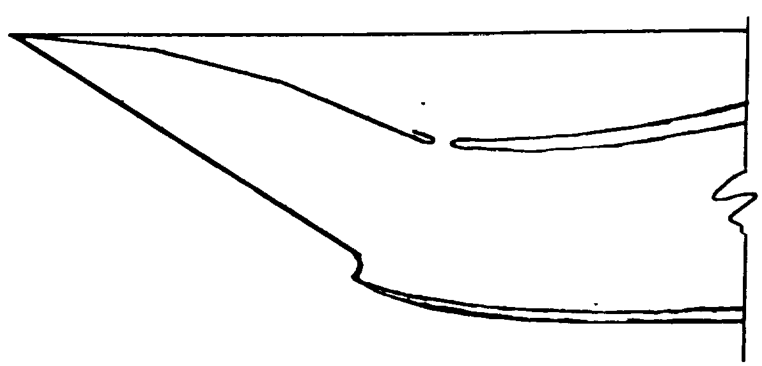


Figure 19 Mach 2.0 Four-Shock Variable-Geometry Inlet

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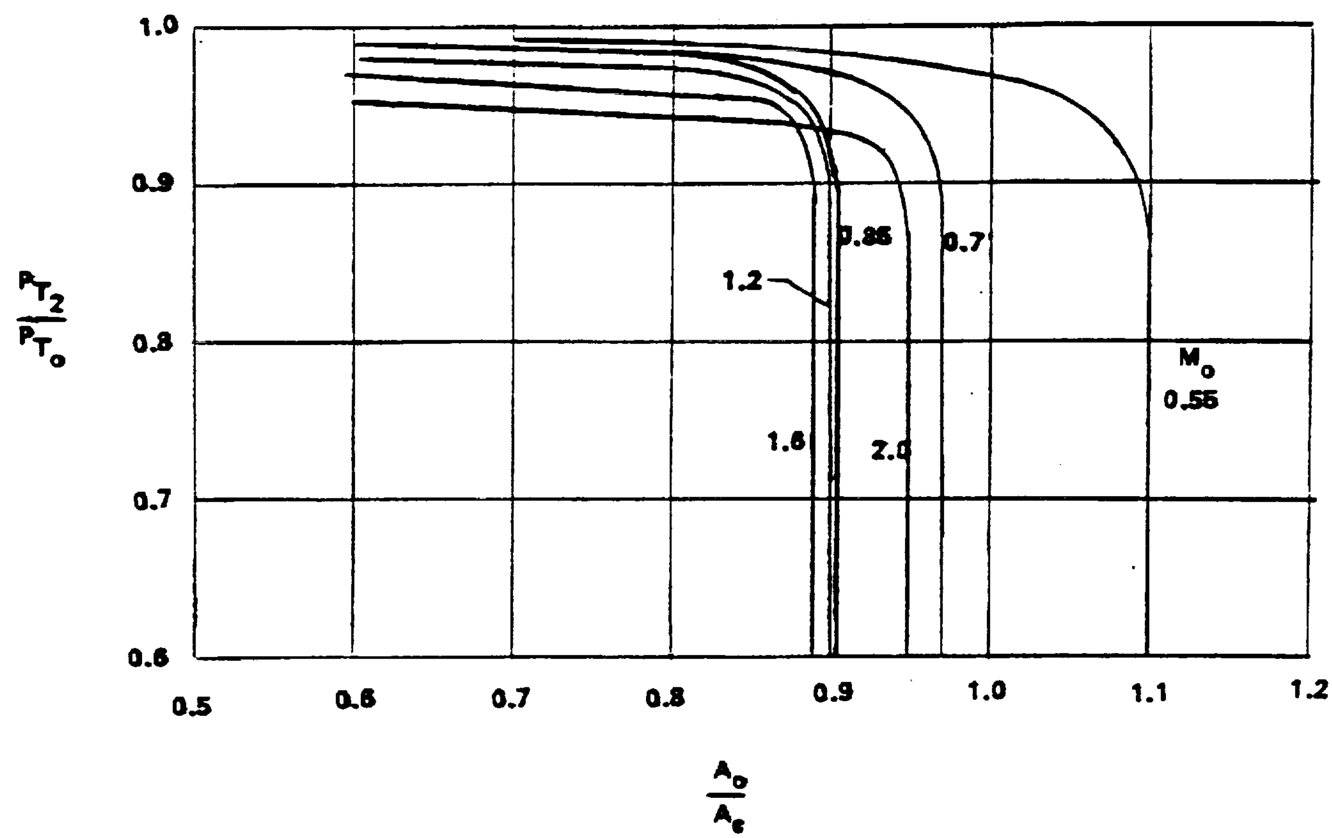


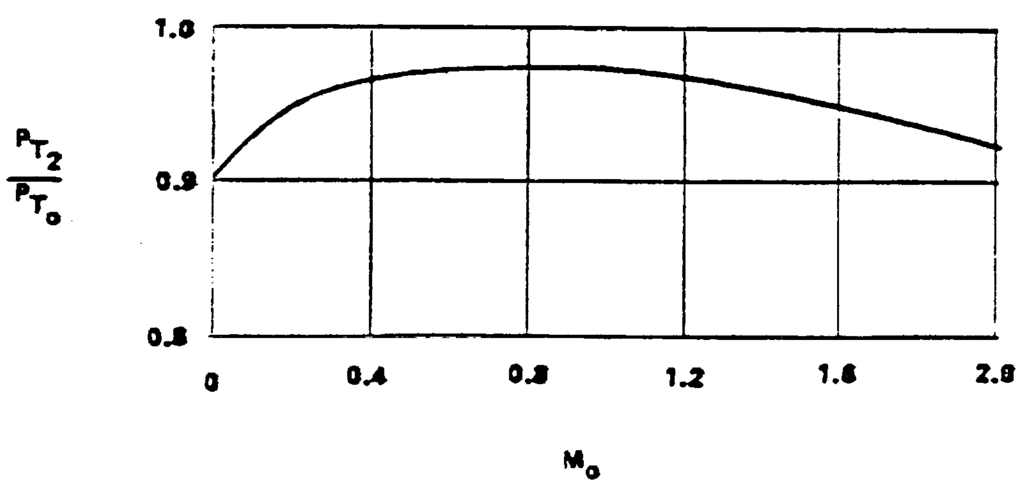


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2'

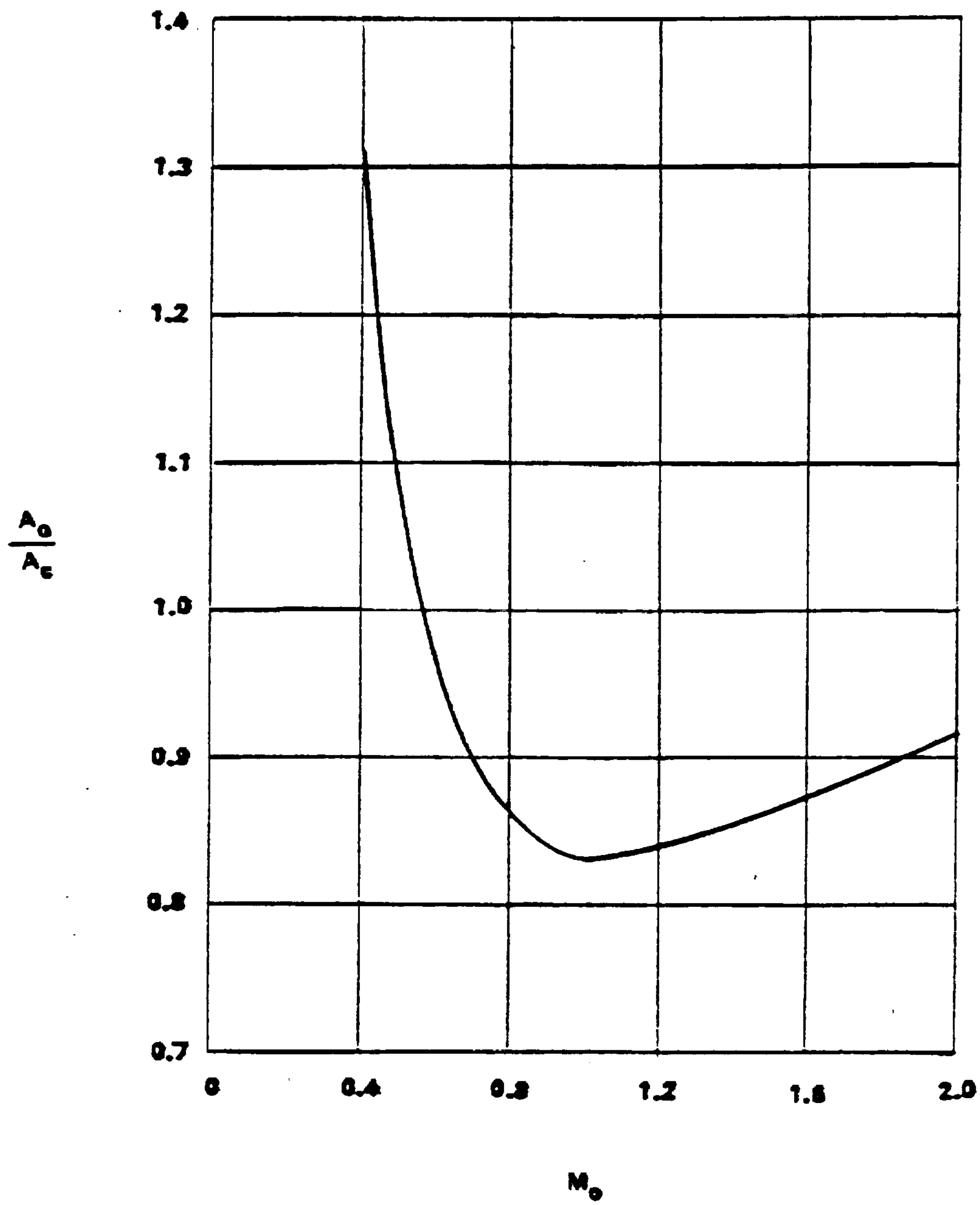
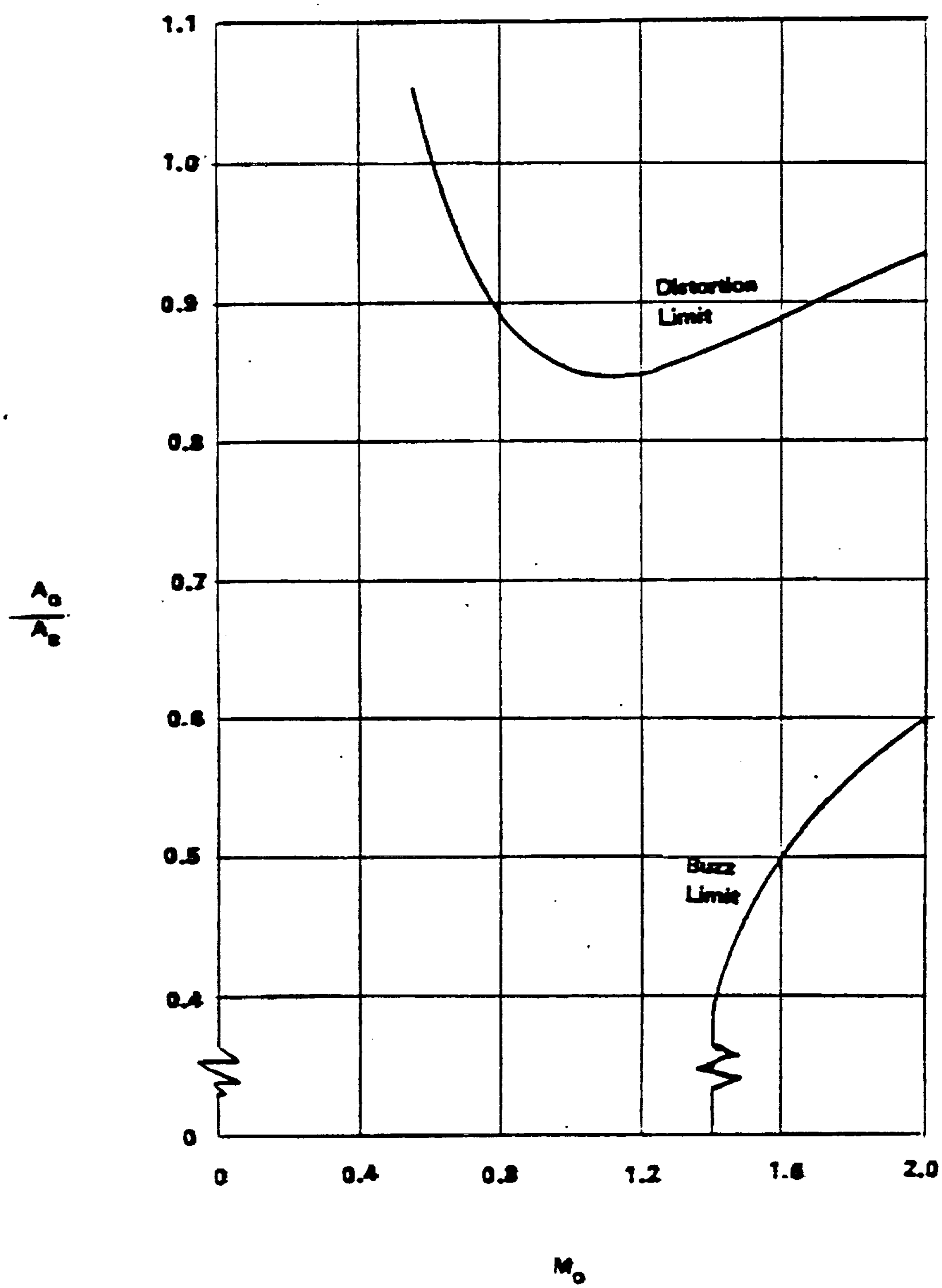
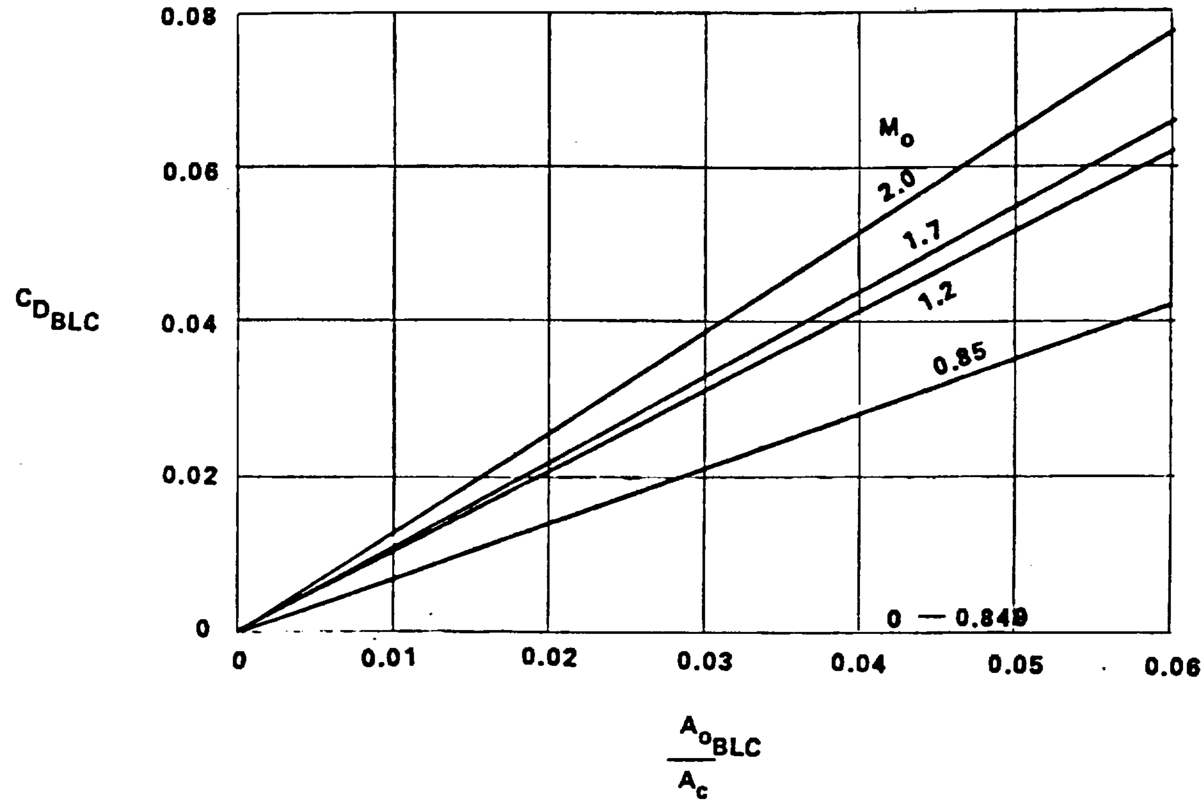


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)



ure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)



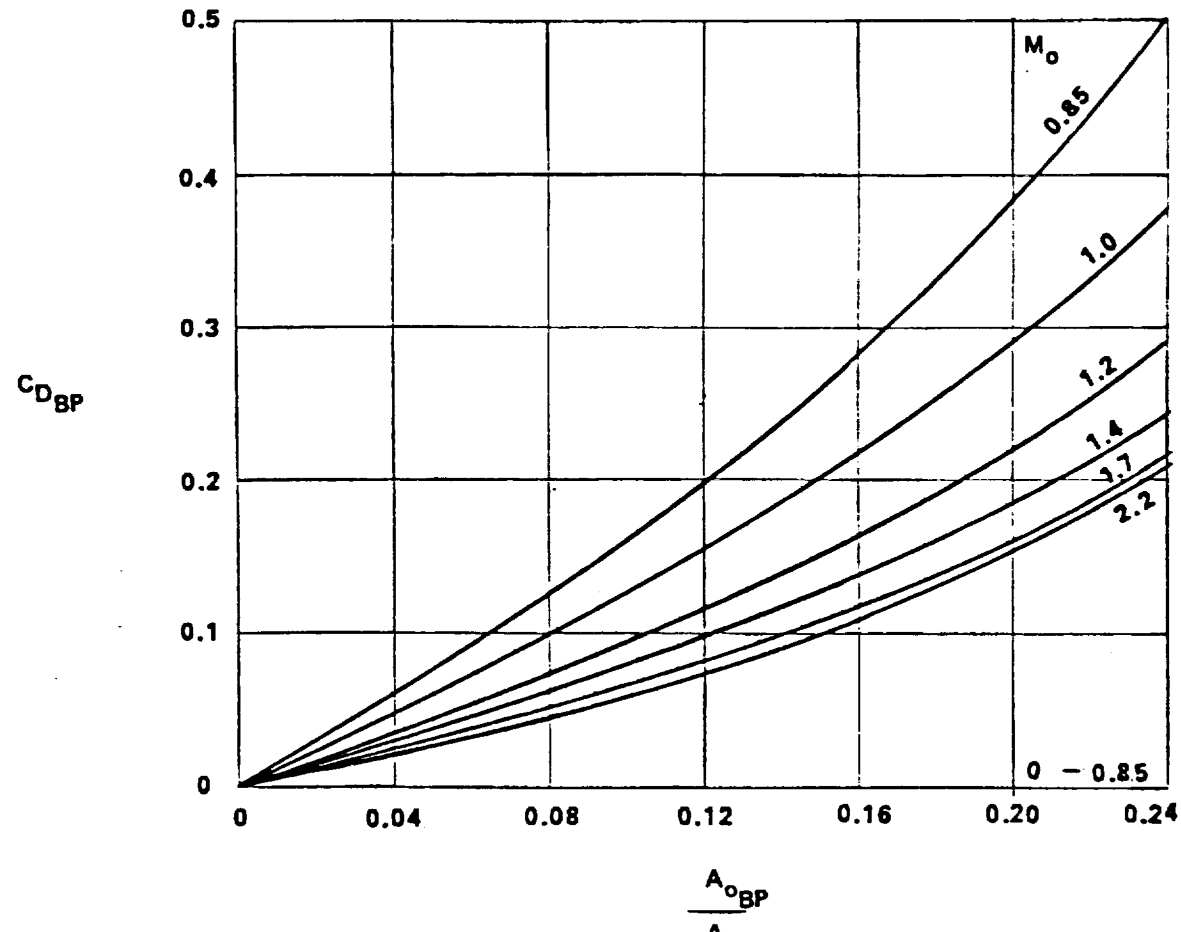


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)

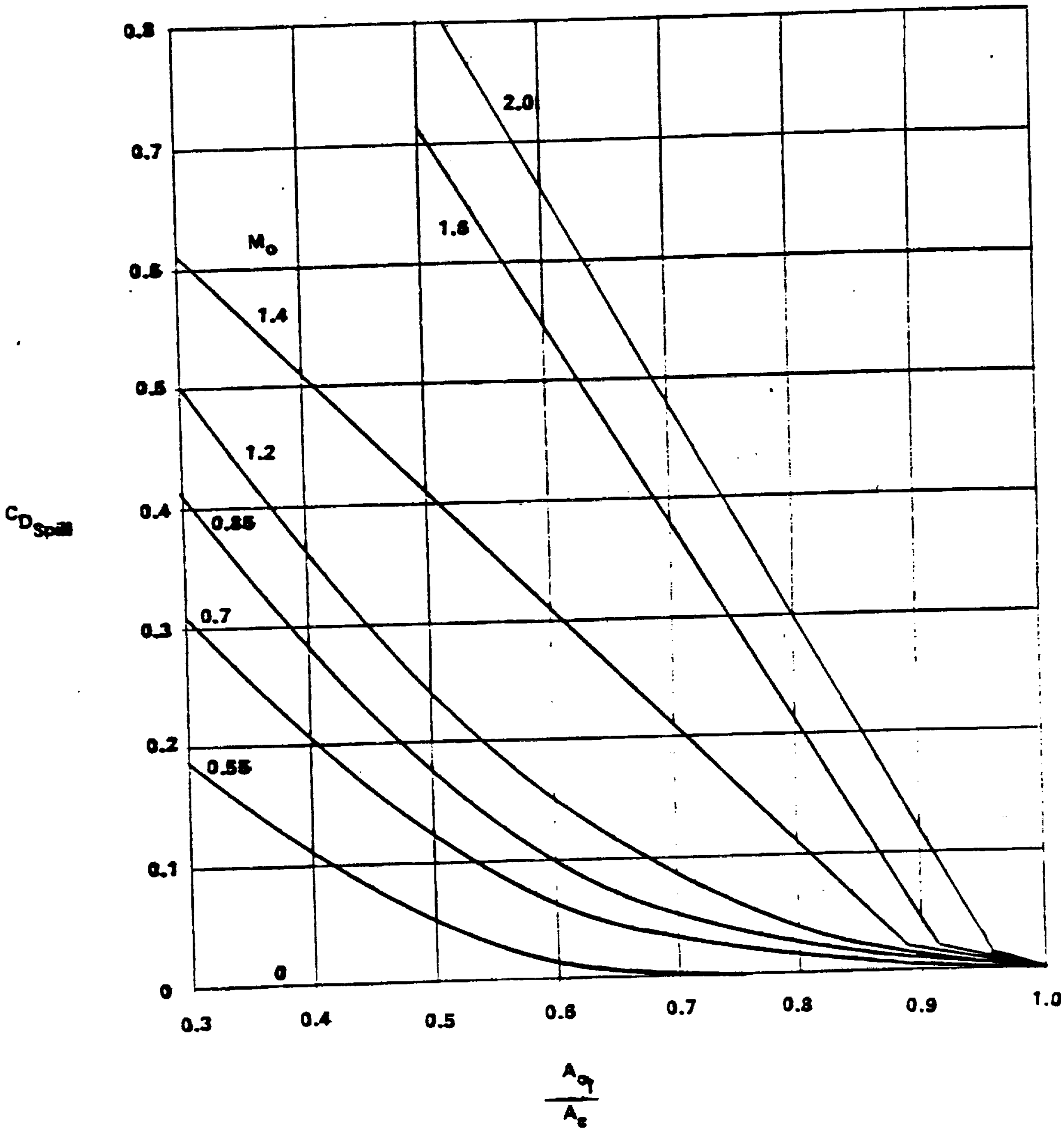
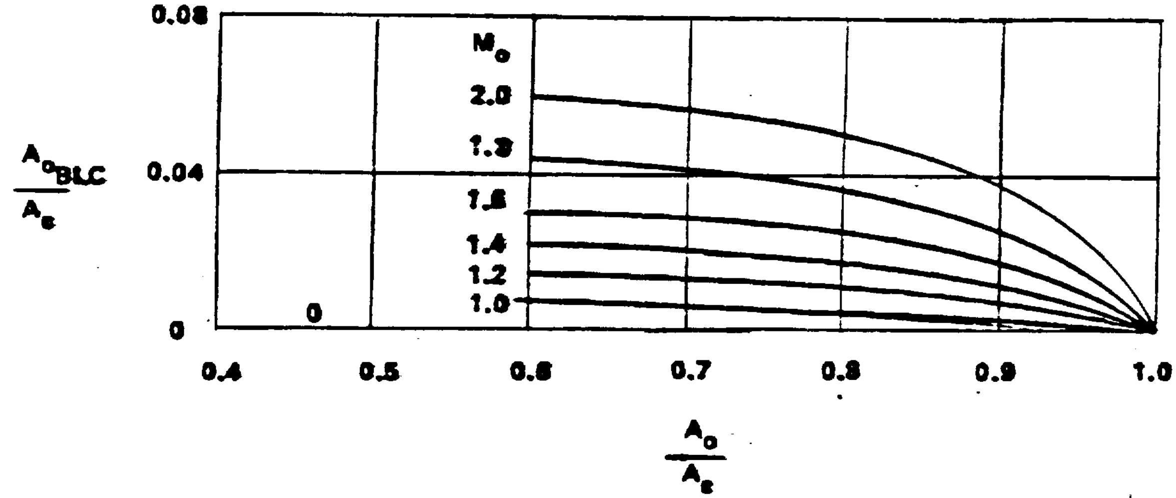


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)



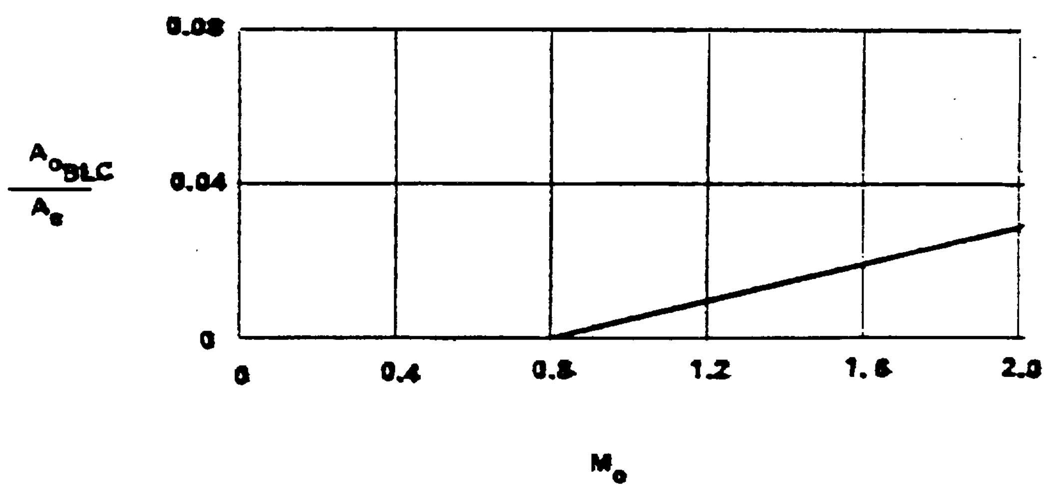


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)

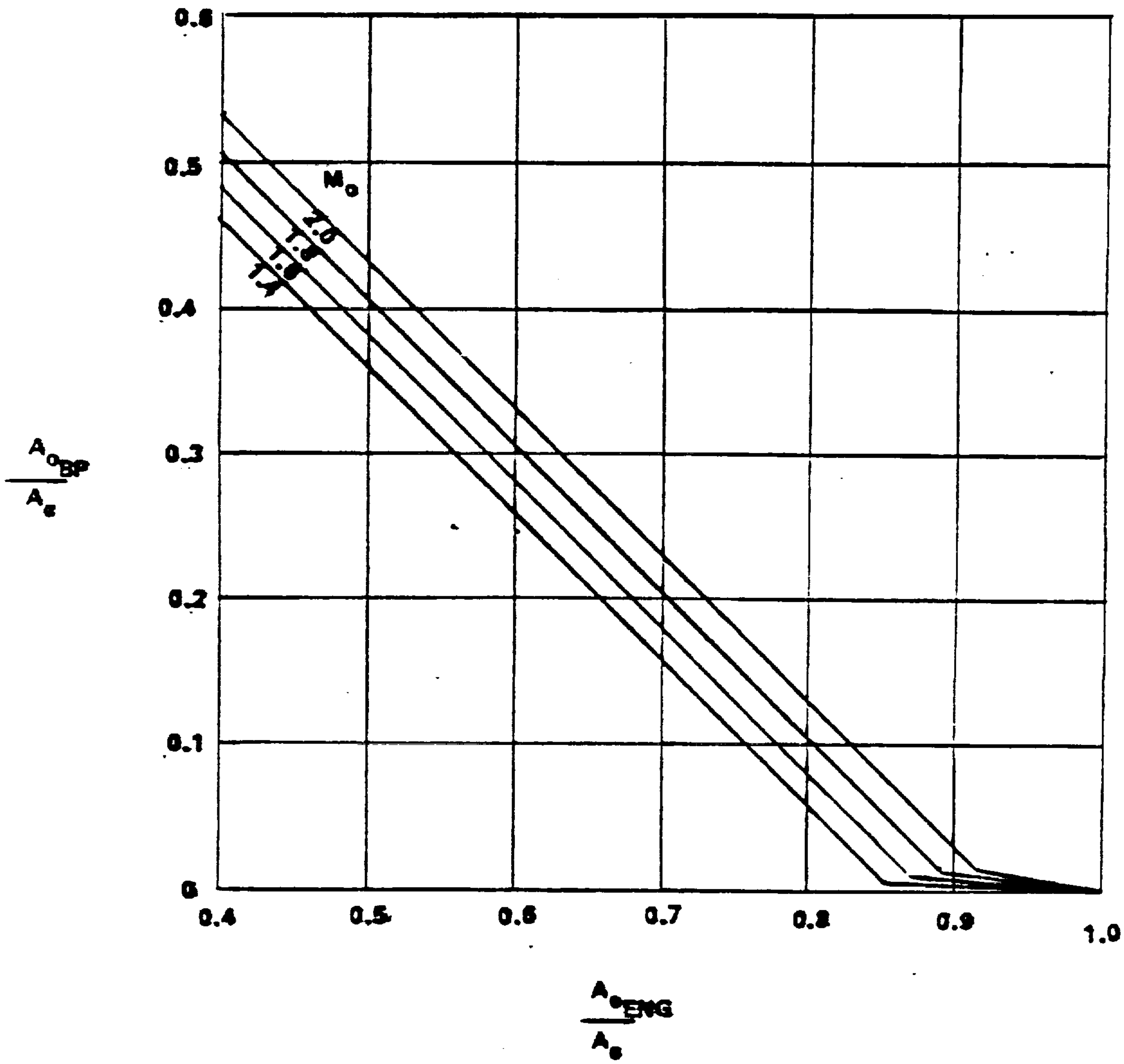


Figure 20. Performance Characteristics for Inlet Configuration - 'ATS2' - (continued)

```
***********
*         *
* ATS2    *
*         *
***********
```

MACH 2.4-SHOCK VARIABLE RAMP INLET, THROAT SLOT BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	1.0000
2	SIDEPLATE CUTBACK	0.2000
3	FIRST RAMP ANGLE(DEG)	7.3000
4	DESIGN MACH NUMBER	2.0000
5	COWL LIP BLUNTNESS	0.0120
6	TAKEOFF DOOR AREA RATIO	20.0000
7	EXTERNAL COWL ANGLE(DEG)	17.5000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	2.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.1000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	2.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	1.5000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	10.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.75

```
************
* TABLE 1  *
************
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	0.200	2.000	MNO
0.0	0.200	2.000	MNFS

****

```
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)        VS        MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************
```

MNO=0.550	0.700	0.800	0.900	1.000	1.055	1.075	1.100	AO/AC		
	0.992	0.991	0.985	0.969	0.950	0.933	0.875	PT2/PT0		
MNO=0.700	0.600	0.700	0.800	0.900	0.950	0.970	AO/AC			
	0.990	0.990	0.985	0.974	0.945	0.900	PT2/PT0			
MNO=0.850	0.500	0.600	0.700	0.800	0.850	0.875	0.905	AO/AC		
	0.999	0.990	0.989	0.983	0.975	0.962	0.900	PT2/PT0		
MNO=1.200	0.500	0.600	0.700	0.800	0.850	0.875	0.902	AO/AC		
	0.980	0.979	0.977	0.973	0.967	0.955	0.900	PT2/PT0		
MNO=1.600	0.500	0.600	0.700	0.800	0.850	0.875	0.885	0.890	AO/AC	
	0.976	0.970	0.965	0.958	0.955	0.940	0.925	0.900	PT2/PT0	
MNO=2.000	0.500	0.600	0.700	0.800	0.900	0.930	0.935	0.943	0.950	AO/AC
	0.958	0.953	0.949	0.944	0.935	0.925	0.920	0.900	0.850	PT2/PT0


```
************
* TABLE 2B *          OPTIMUM INLET RECOVERY (PT2/PT0 OPT)        VS        LOCAL MACH NUMBER (MNO)
************
```

0.0	0.200	0.400	0.600	0.800	1.000	1.200	1.600	2.000	MNO
0.900	0.950	0.965	0.972	0.975	0.975	0.967	0.948	0.925	PT2/PT0

```
************
* TABLE 2C *          OPTIMUM MASS FLOW RATIO (AO/AC OPT)        VS        LOCAL MACH NUMBER (MNO)
************
```

0.400	0.600	0.800	1.000	1.200	1.600	2.000	MNO
1.310	0.968	0.863	0.830	0.840	0.872	0.915	AO/AC

```
************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)        VS        LOCAL MACH NUMBER (MNO)
************
```

0.0	1.399	1.400	1.600	1.800	2.000	MNO
0.0	0.0	0.400	0.500	0.560	0.600	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.550	0.700	0.800	1.200	1.600	2.000	MNO
1.055	0.935	0.890	0.846	0.890	0.935	AO/AC

****
* TABLE 3 *
****

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	1.000	AOI/AC						
	0.0	0.0	CDSPL						
MNO=0.549	0.0	1.000	AOI/AC						
	0.0	0.0	CDSPL						
MNO=0.550	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000	AOI/AC
	0.185	0.110	0.052	0.015	0.002	0.0	0.0	0.0	CDSPL
MNO=0.700	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000	AOI/AC
	0.310	0.207	0.123	0.062	0.032	0.015	0.005	0.0	CDSPL
MNO=0.850	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000	AOI/AC
	0.410	0.280	0.175	0.098	0.050	0.026	0.010	0.0	CDSPL
MNO=1.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000	AOI/AC
	0.500	0.360	0.240	0.150	0.086	0.038	0.014	0.0	CDSPL
MNO=1.400	0.300	0.500	0.700	0.800	0.887	1.000	AOI/AC		
	0.750	0.437	0.210	0.110	0.022	0.0	CDSPL		
MNO=1.600	0.500	0.600	0.700	0.800	0.915	1.000	AOI/AC		
	0.715	0.550	0.370	0.210	0.021	0.0	CDSPL		
MNO=2.000	0.500	0.700	0.800	0.900	0.957	1.000	AOI/AC		
	0.840	0.480	0.298	0.118	0.010	0.0	CDSPL		

```
************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

                0.0        1.000      2.000      MNO
                0.0        0.0        0.0        REF CDSPL

************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

                0.0        1.000      2.000      MNO
                1.000      1.000      1.000      REF AOI/AC

************
* TABLE 4  *    BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND      LOCAL MACH NUMBER (MNO)
************

                0.0        0.849      0.850      1.200      1.700      2.000      MNO

MNO=0.0         0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.0        0.0        0.0        0.0        CDBLD

MNO=0.849       0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.0        0.0        0.0        0.0        CDBLD

MNO=0.850       0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.007      0.014      0.028      0.042      CDBLD

MNO=1.200       0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.010      0.021      0.041      0.062      CDBLD

MNO=1.700       0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.011      0.022      0.044      0.066      CDBLD

MNO=2.000       0.0        0.010      0.020      0.040      0.060      AOBLD/AC
                0.0        0.013      0.026      0.052      0.078      CDBLD
```

```
************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)       AND      LOCAL MACH NUMBER (MNO)
************

              0.0      0.849    0.850    1.000    1.200    1.400    1.700    2.000    MNO

MNO=0.0       0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.0      0.0      0.0      0.0      0.0      0.0      CDBYP

MNO=0.849     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.0      0.0      0.0      0.0      0.0      0.0      CDBYP

MNO=0.850     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.062    0.125    0.198    0.280    0.380    0.500    CDBYP

MNO=1.000     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.050    0.100    0.156    0.217    0.290    0.375    CDBYP

MNO=1.200     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.036    0.075    0.117    0.162    0.220    0.290    CDBYP

MNO=1.400     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.030    0.062    0.097    0.135    0.185    0.241    CDBYP

MNO=1.700     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.025    0.052    0.081    0.116    0.160    0.216    CDBYP

MNO=2.000     0.0      0.040    0.080    0.120    0.160    0.200    0.240    AOBYP/AC
              0.0      0.020    0.045    0.074    0.110    0.153    0.210    CDBYP


************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)            AND      LOCAL MACH NUMBER (MNO)
************

MNO=0.0       0.0      1.000    AO/AC
              0.0      0.0      AOBLD/AC
```

MNO=0.800	0.0	1.000	AO/AC				
	0.0	0.0	AOBLD/AC				
MNO=1.000	0.600	0.700	0.831	0.900	1.000	AO/AC	
	0.008	0.007	0.005	0.003	0.0	AOBLD/AC	
MNO=1.200	0.600	0.700	0.840	0.900	1.000	AO/AC	
	0.014	0.013	0.010	0.008	0.0	AOBLD/AC	
MNO=1.400	0.600	0.700	0.859	0.900	1.000	AO/AC	
	0.022	0.020	0.015	0.012	0.0	AOBLD/AC	
MNO=1.600	0.600	0.700	0.800	0.881	0.930	1.000	AO/AC
	0.030	0.029	0.026	0.020	0.014	0.0	AOBLD/AC
MNO=1.800	0.600	0.700	0.800	0.906	0.930	1.000	AO/AC
	0.044	0.042	0.037	0.025	0.021	0.0	AOBLD/AC
MNO=2.000	0.600	0.700	0.800	0.900	0.930	1.000	AO/AC
	0.060	0.056	0.050	0.037	0.030	0.0	AOBLD/AC

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.800	1.200	1.600	2.000	MNO
0.0	0.0	0.010	0.020	0.030	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	1.000	AOE/AC
	0.0	0.0	AOBYP/AC
MNO=1.399	0.0	1.000	AOE/AC
	0.0	0.0	AOBYP/AC

MNO=1.400	0.400	0.854	1.000	AOE/AC
	0.461	0.005	0.0	AOBYP/AC
MNO=1.600	0.400	0.872	1.000	AOE/AC
	0.483	0.010	0.0	AOBYP/AC
MNO=1.800	0.400	0.892	1.000	AOE/AC
	0.506	0.014	0.0	AOBYP/AC
MNO=2.000	0.400	0.915	1.000	AOE/AC
	0.532	0.015	0.0	AOBYP/AC

4.2.1.9 INLET CONFIGURATION 'ASF' - FOUR-SHOCK, VARIABLE-GEOMETRY, EXTERNAL COMPRESSION, TWO-DIMENSIONAL INLET

This inlet is designed to have shock-on-lip at Mach 2.5. The inlet is an external compression, horizontal ramp design. It has internal boundary layer bleed through a porous third ramp panel and a throat panel. The bleed from each of these panels is collected in separate, divided plenum compartments and then is exited overboard through convergent nozzles provided by exit louvers. The bleed flow is exited at an angle of 20 degrees relative to the fuselage reference line. The inlet is oriented down at an angle of 2 degrees relative to the F.R.P. so that the initial fixed ramp angle of 4 degrees (relative to the F.R.P.) will provide 6 degrees of compression at the +2 degrees angle of attack flight attitude.

The first two ramps are fixed, but the third ramp and throat panel are movable. This provides capability to vary shock geometry and throat area. The maximum throat area corresponds to $A_{throat}/A_c = .70$. This is obtainable by collapsing the third ramp to the 6-degree position.

A bypass system is provided forward of the engine entrance to dump excess inlet air overboard. The bypass doors are convergent-divergent nozzles provided by movable doors. The bypass air is collected through porous material into a plenum chamber surrounding the duct, then is exited through the doors.

To achieve high performance at takeoff (M = .20), either the maximum throat area would have to be increased or takeoff doors may be added.

This inlet configuration is based on the model configuration and data of Reference 11. The inlet configuration in shown in Figure 20, and the inlet performance characteristics are presented in Figure 21.

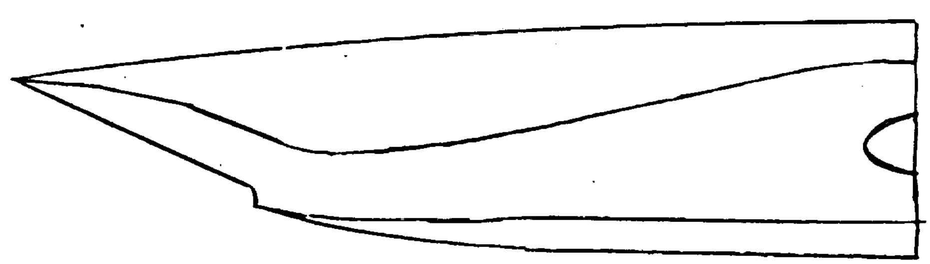


Figure 21 Mach 2.5 External Compression Inlet

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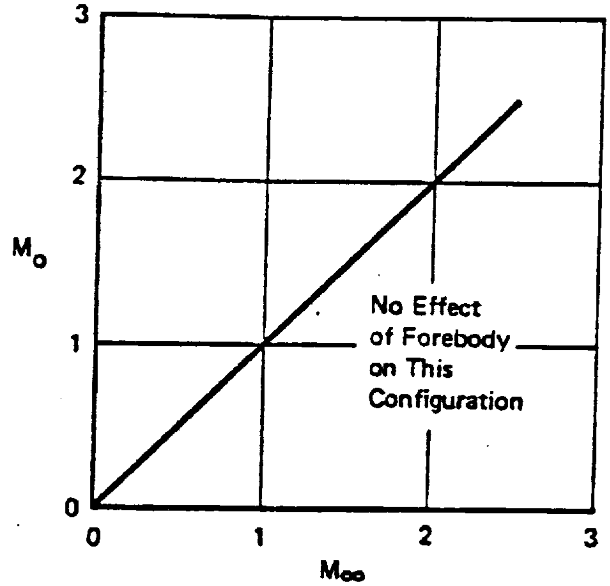


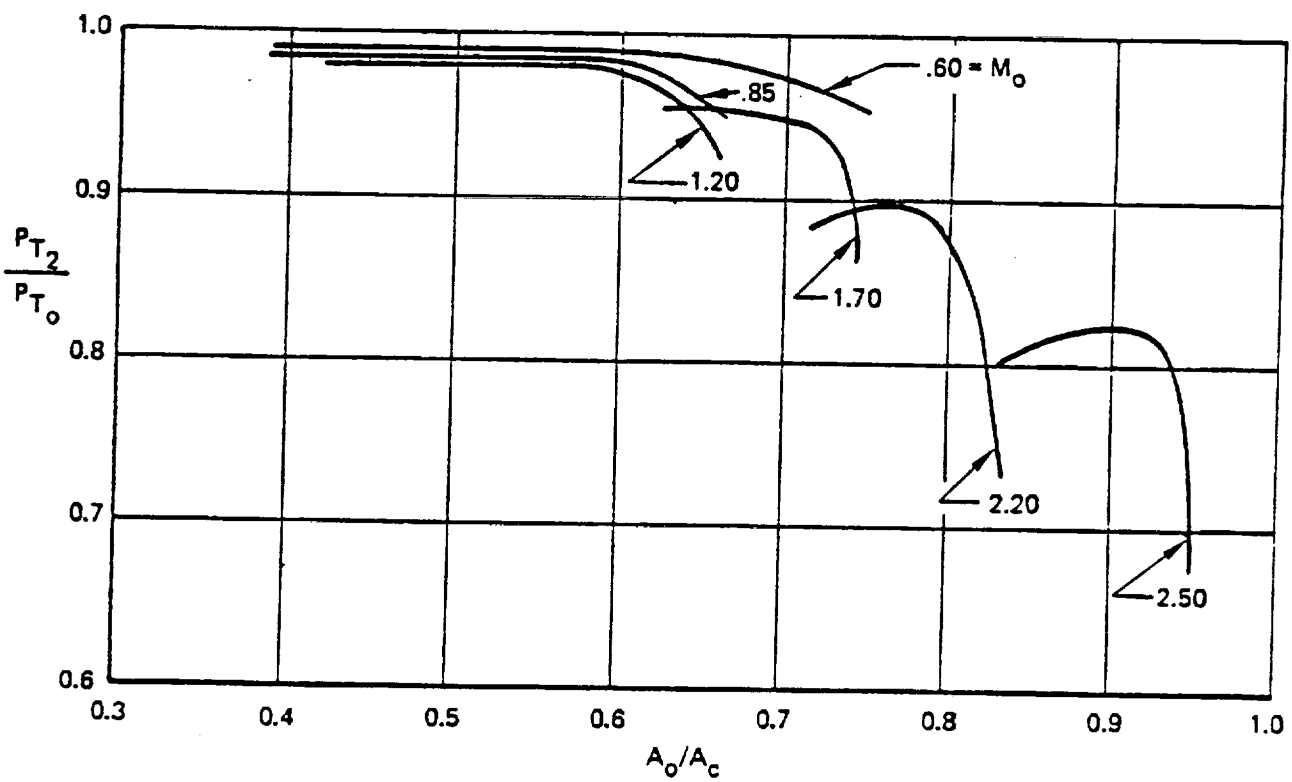


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF'

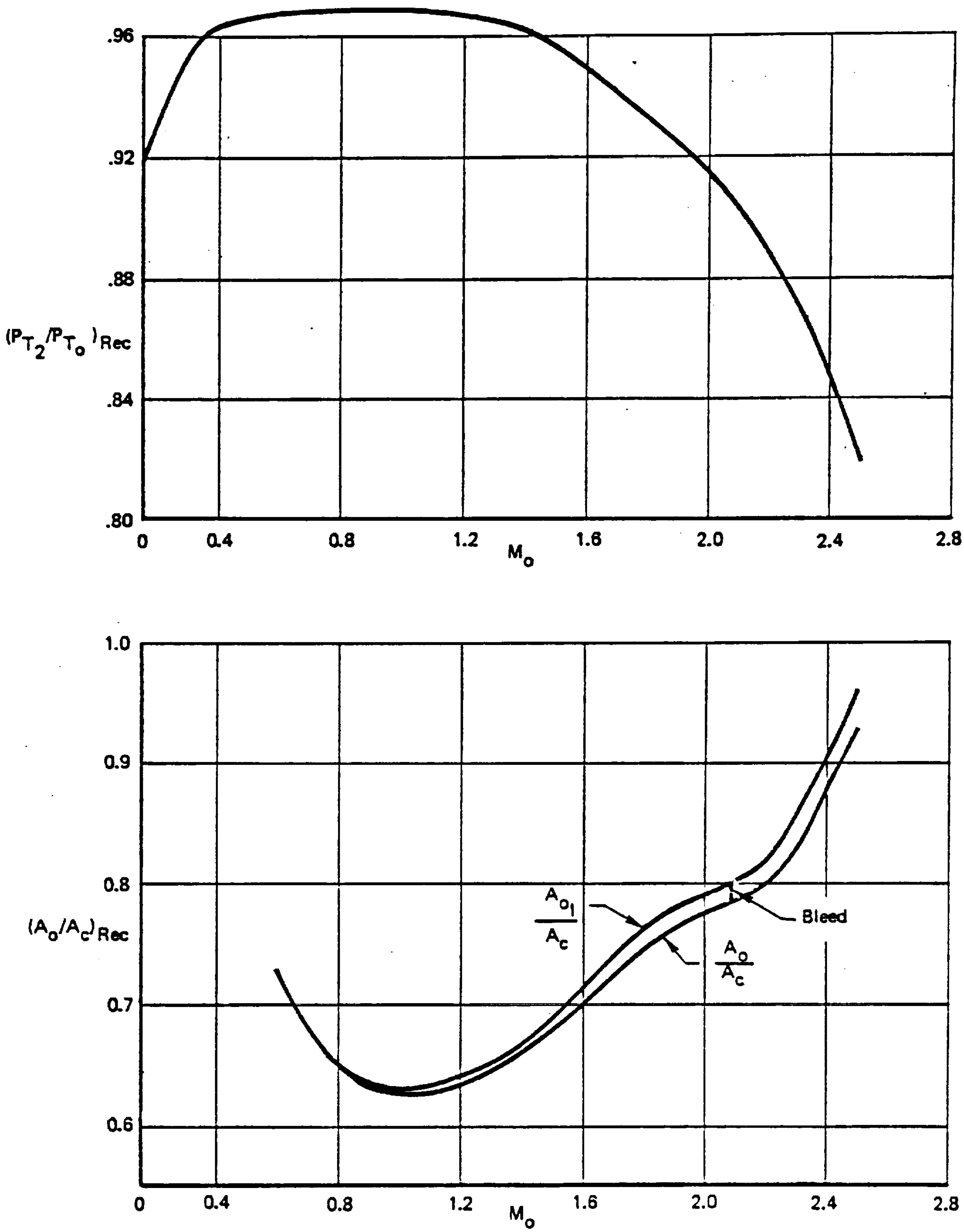


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued)

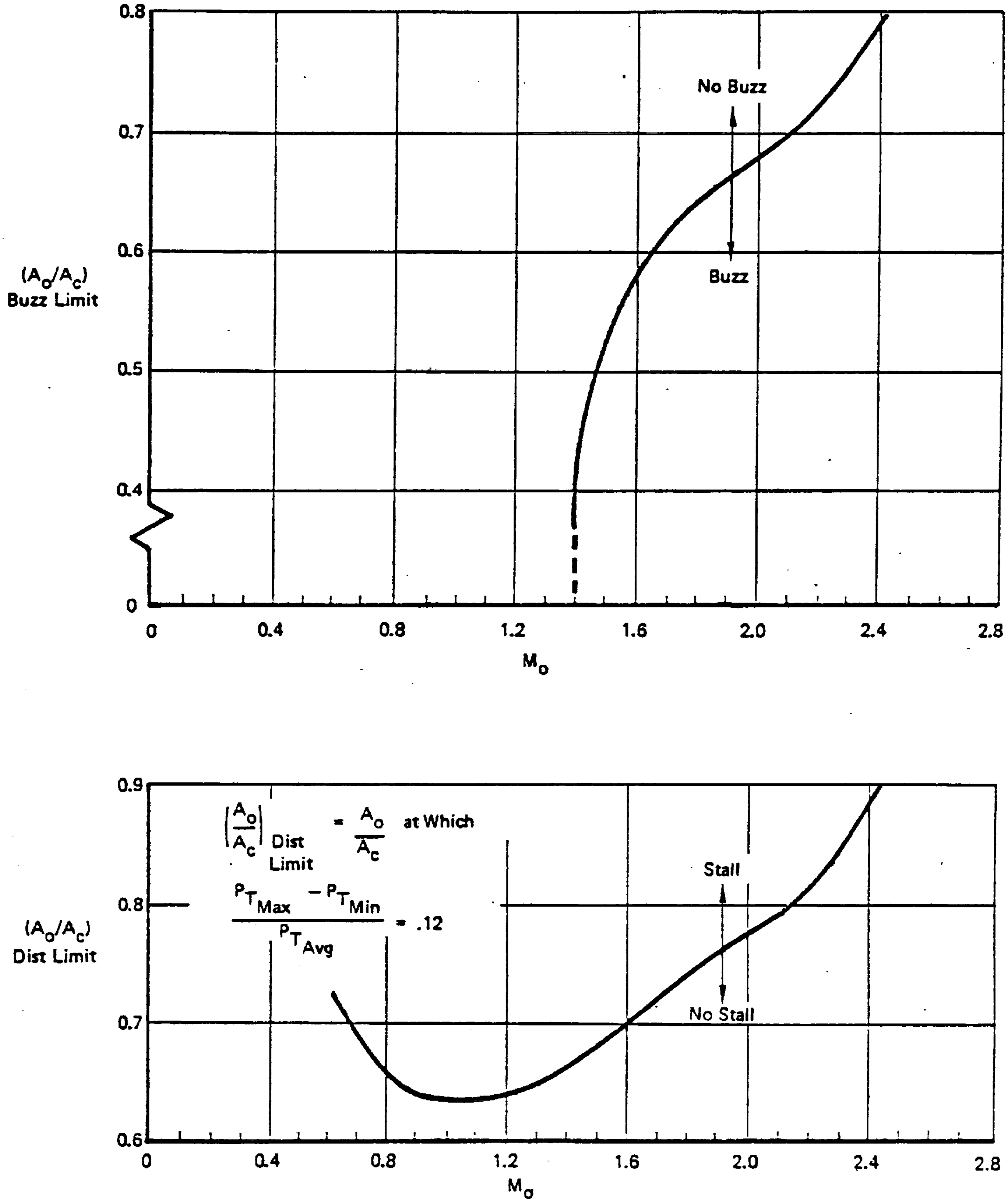
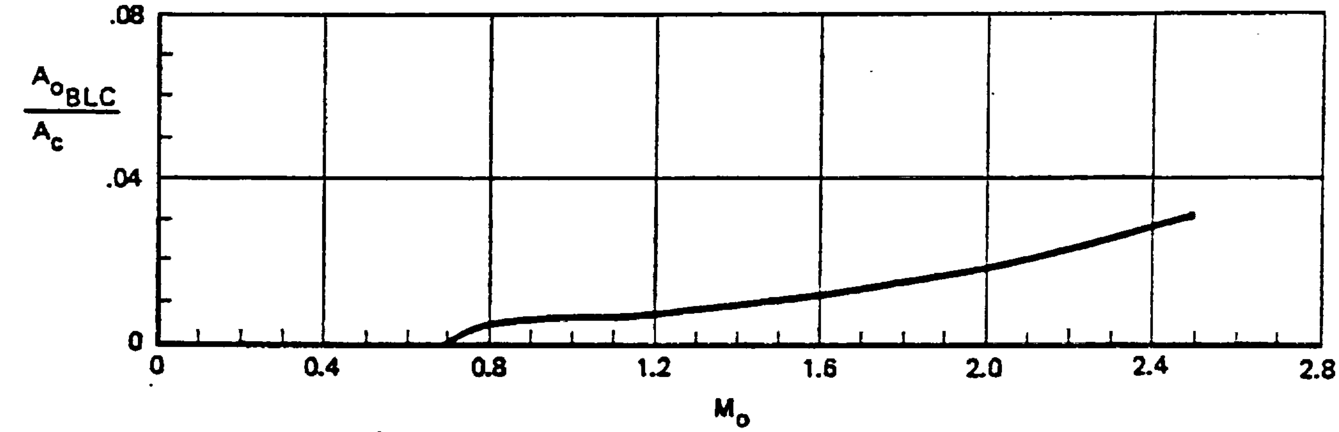


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued)



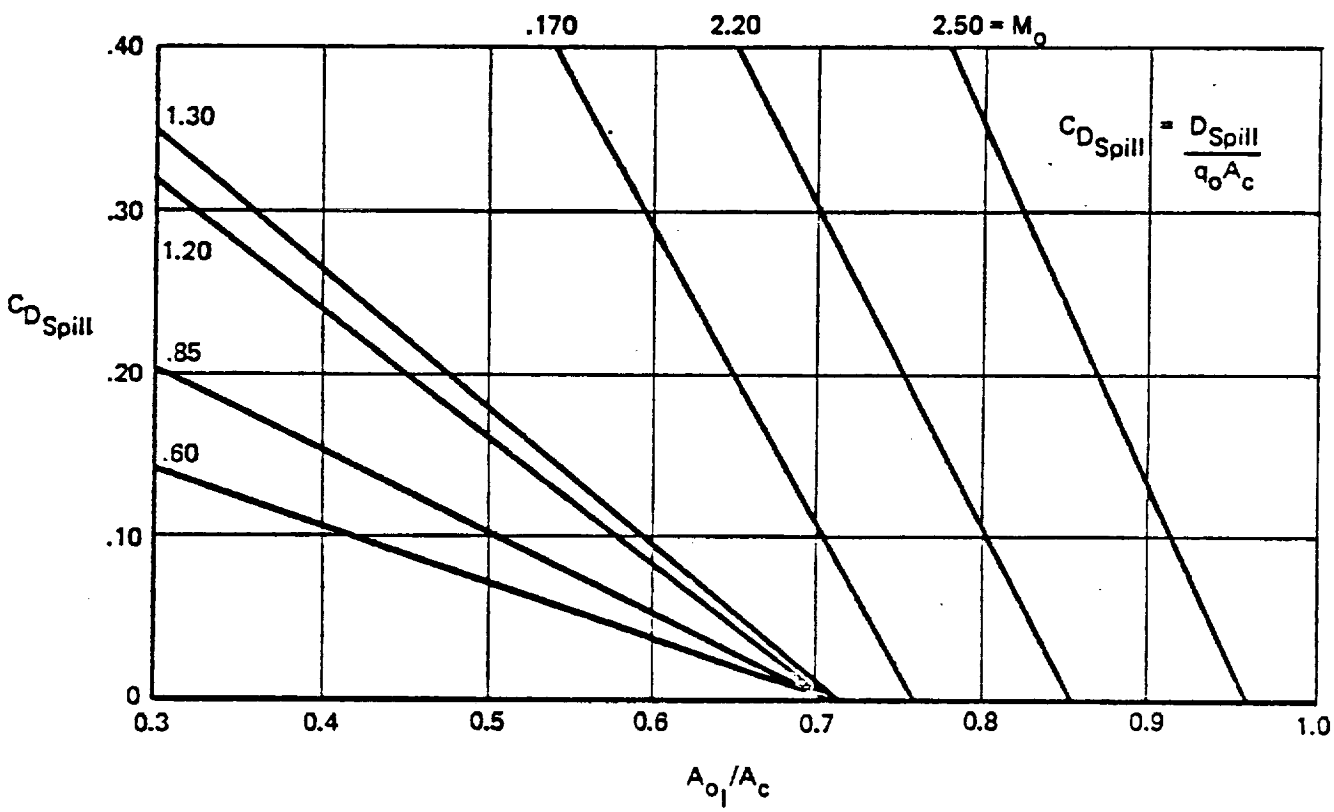
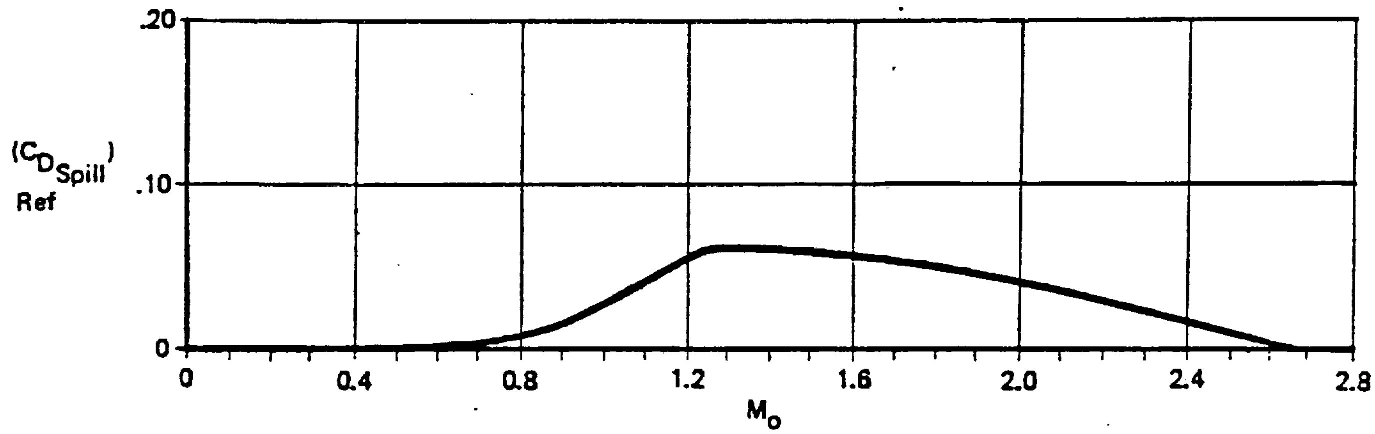


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued)



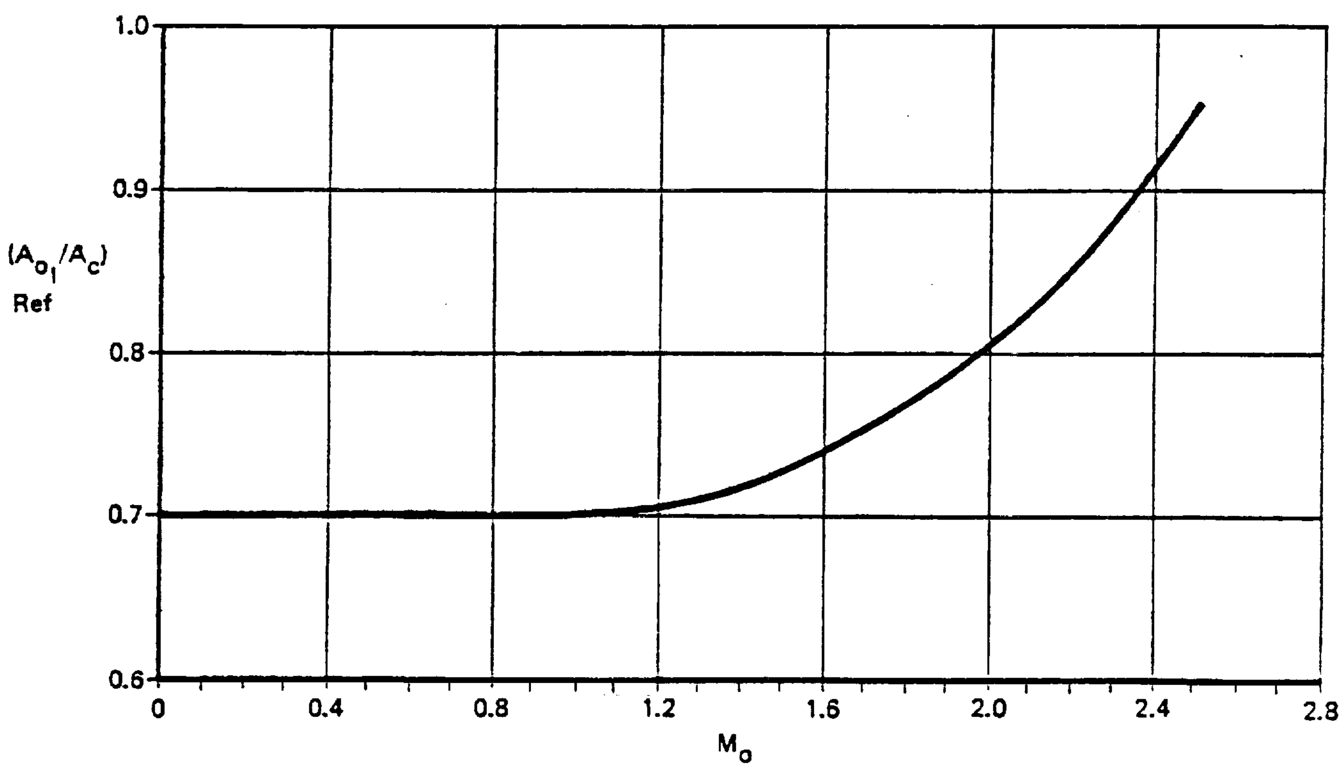
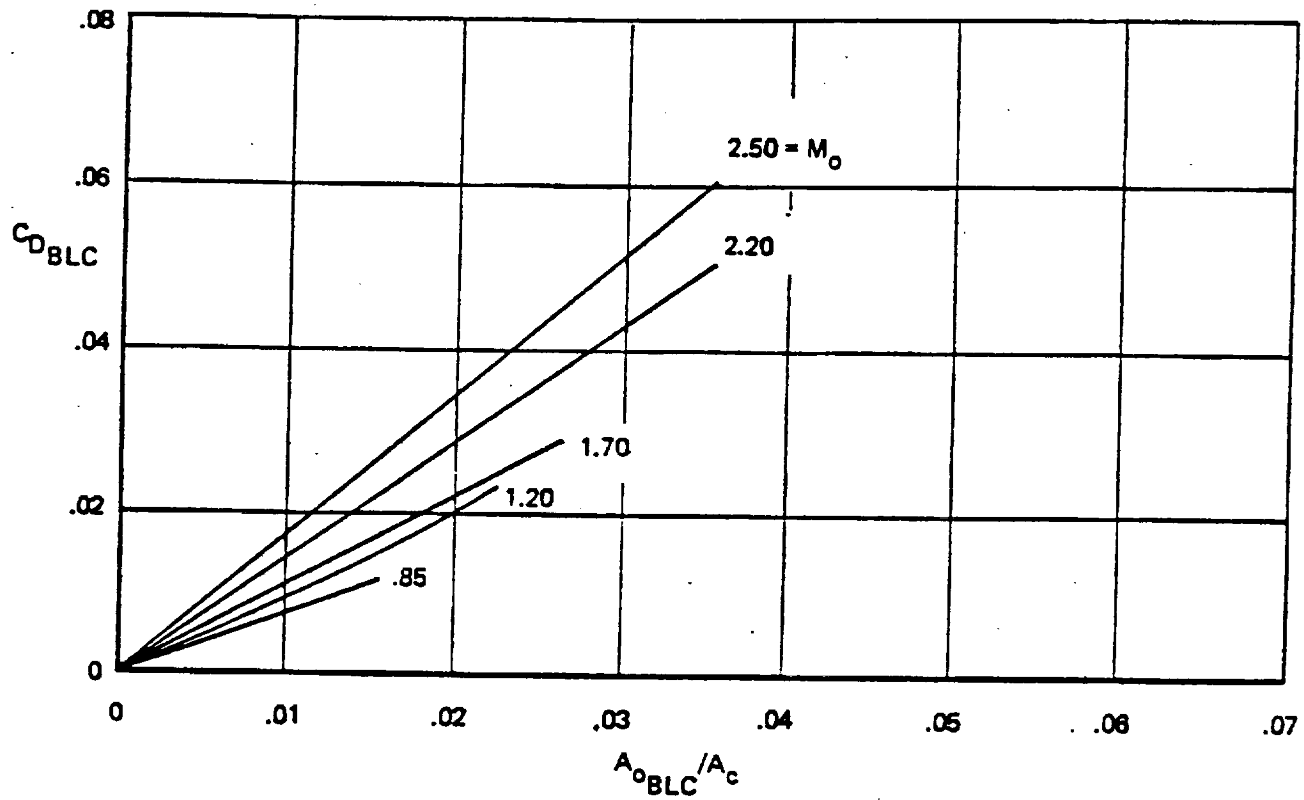


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued)



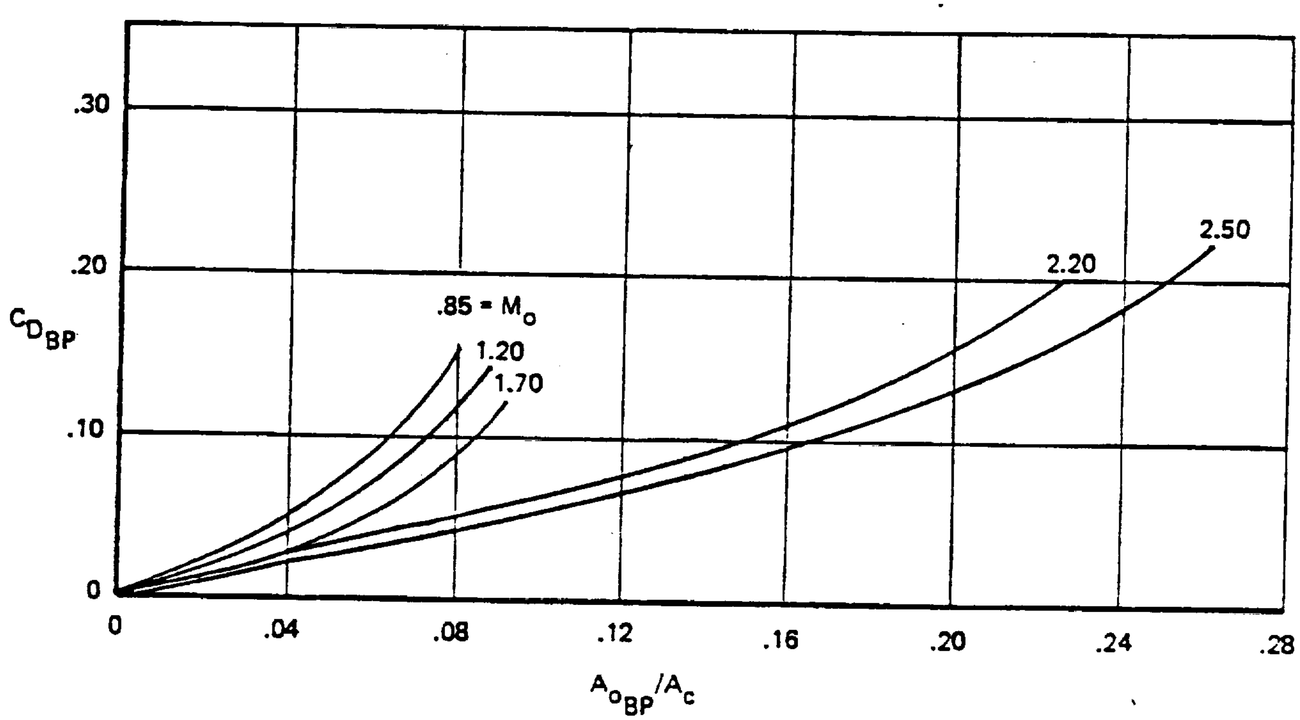


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued

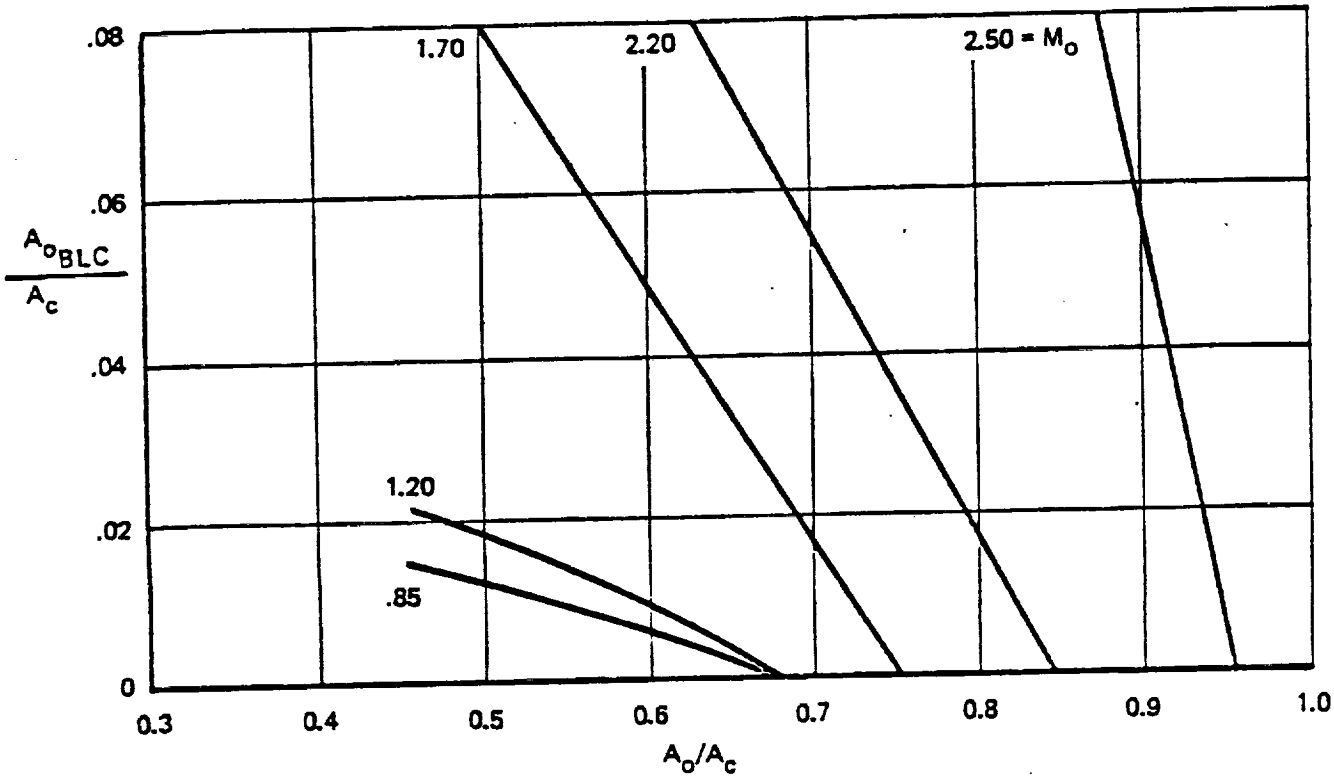


Figure 22. Performance Characteristics for Inlet Configuration - 'ASF' - (continued)

```
***********
*         *
* ASF     *
*         *
***********
```

MACH 2.5, 4-SHOCK, VARIABLE RAMP,EXT COMPR.,POROUS RAMP BLEED,BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	1.0000
2	SIDEPLATE CUTBACK	0.2500
3	FIRST RAMP ANGLE(DEG)	6.0000
4	DESIGN MACH NUMBER	2.5000
5	COWL LIP BLUNTNESS	0.0060
6	TAKEOFF DOOR AREA RATIO	0.1100
7	EXTERNAL COWL ANGLE(DEG)	17.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	20.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.9000
11	EXIT FLAP AREA RATIO FOR BLEED	0.5000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	20.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.6700
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2680
16	SUBSONIC DIFFUSER AREA RATIO	1.8900
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	8.5000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1600

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.75

```
************
* TABLE 1  *
************
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	1.000	2.000	3.000	MNO
0.0	1.000	2.000	3.000	MNFS

****

```
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)         VS         MASS FLOW RATIO (AO/AC)            AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.600      0.490      0.500      0.600      0.700      0.750      AO/AC
               0.990      0.990      0.988      0.972      0.955      PT2/PT0

MNO=0.850      0.490      0.500      0.575      0.600      0.668      AO/AC
               0.985      0.985      0.985      0.980      0.950      PT2/PT0

MNO=1.200      0.550      0.575      0.600      0.625      0.650      0.665      AO/AC
               0.980      0.980      0.976      0.969      0.945      0.920      PT2/PT0

MNO=1.700      0.600      0.625      0.700      0.725      0.735      0.745      AO/AC
               0.955      0.955      0.950      0.938      0.925      0.864      PT2/PT0

MNO=2.200      0.720      0.750      0.775      0.790      0.805      0.825      0.835      AO/AC
               0.882      0.894      0.894      0.888      0.875      0.800      0.730      PT2/PT0

MNO=2.500      0.825      0.850      0.875      0.900      0.925      0.937      0.950      AO/AC
               0.795      0.812      0.820      0.823      0.820      0.800      0.675      PT2/PT0
```



```
************
* TABLE 2B *          OPTIMUM INLET RECOVERY (PT2/PT0 OPT)         VS         LOCAL MACH NUMBER (MNO)
************

               0.0        0.200      0.400      0.800      1.200      1.400      1.700      2.000      2.300      2.500      MNO
               0.920      0.960      0.966      0.968      0.966      0.960      0.940      0.914      0.870      0.820      PT2/PT0

************
* TABLE 2C *          OPTIMUM MASS FLOW RATIO (AO/AC OPT)          VS         LOCAL MACH NUMBER (MNO)
************

               0.0        0.600      0.800      1.000      1.200      1.400      1.600      2.000      2.000      2.500      MNO
               0.725      0.725      0.645      0.620      0.630      0.655      0.695      0.770      0.793      0.925      AO/AC

************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)           VS         LOCAL MACH NUMBER (MNO)
************
```

0.0	1.400	1.500	1.600	1.800	2.000	2.200	2.500	MNO
0.0	0.0	0.535	0.590	0.650	0.680	0.725	0.850	AO/AC

```
************
* TABLE 2E *
************
```

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.600	0.800	1.000	1.200	1.400	1.700	2.000	2.200	2.500	MNO
0.730	0.730	0.650	0.635	0.640	0.668	0.725	0.780	0.815	0.955	AO/AC

```
************
* TABLE 3  *
************
```

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300	0.400	0.500	0.600	0.700	0.705	0.710	0.755	0.850	0.955	AOI/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDSPL
MNO=0.590	0.300	0.400	0.500	0.600	0.700	0.705	0.710	0.755	0.850	0.955	AOI/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDSPL
MNO=0.600	0.300	0.400	0.500	0.600	0.700	1.000	AOI/AC				
	0.140	0.105	0.069	0.035	0.0	0.0	CDSPL				
MNO=0.850	0.300	0.400	0.500	0.600	0.700	1.000	AOI/AC				
	0.202	0.150	0.100	0.050	0.0	0.0	CDSPL				
MNO=1.200	0.300	0.400	0.500	0.600	0.700	0.705	1.000	AOI/AC			
	0.315	0.235	0.156	0.080	0.020	0.0	0.0	CDSPL			
MNO=1.300	0.300	0.400	0.500	0.600	0.700	0.705	0.710	1.000	AOI/AC		
	0.347	0.262	0.177	0.092	0.008	0.006	0.0	0.0	CDSPL		
MNO=1.700	0.300	0.400	0.500	0.600	0.700	0.705	0.710	0.755	1.000	AOI/AC	
	0.850	0.660	0.475	0.290	0.104	0.097	0.087	0.0	0.0	CDSPL	
MNO=2.200	0.300	0.400	0.500	0.600	0.700	0.705	0.710	0.755	0.850	1.000	AOI/AC
	1.100	0.887	0.696	0.497	0.298	0.291	0.280	0.190	0.0	0.0	CDSPL
MNO=2.500	0.300	0.400	0.500	0.600	0.700	0.705	0.710	0.850	0.955	1.000	AOI/AC
	1.478	1.254	1.030	0.806	0.575	0.565	0.555	0.235	0.0	0.0	CDSPL

```
************
* TABLE 3A *
************
```

REF SPILLAGE DRAG COEFF (REF CDSPL) VS LOCAL MACH NUMBER (MNO)

0.0	0.500	0.800	1.200	1.600	2.000	2.500	MNO
0.0	0.0	0.010	0.060	0.060	0.040	0.015	REF CDSPL

```
************
* TABLE 3B *
************
```

REF INLET MASS FLOW RATIO (REF AOI/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.800	1.200	1.600	2.000	2.200	2.500	MNO
0.700	0.700	0.710	0.740	0.810	0.850	0.950	REF AOI/AC

```
************
* TABLE 4  *
************
```

BLEED DRAG COEFFICIENT (CD BLD) VS BLEED MASS FLOW RATIO (AOBLD/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	0.700	0.800	0.850	1.200	1.700	2.200	2.500	MNO
MNO=0.0	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD		
MNO=0.700	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD		
MNO=0.800	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.006	0.012	0.017	0.023	0.029	CDBLD		
MNO=0.850	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.008	0.015	0.023	0.030	0.038	CDBLD		
MNO=1.200	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.010	0.021	0.031	0.041	0.052	CDBLD		
MNO=1.700	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC		
	0.0	0.011	0.022	0.033	0.044	0.055	CDBLD		

MNO=2.200	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.014	0.028	0.043	0.057	0.071	CDBLD
MNO=2.500	0.0	0.010	0.020	0.030	0.040	0.050	AOBLD/AC
	0.0	0.017	0.034	0.051	0.068	0.082	CDBLD

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	0.700	1.000	1.010	1.200	1.700	2.200	2.500	MNO	
MNO=0.0	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBYP
MNO=0.700	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBYP
MNO=1.000	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBYP
MNO=1.010	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.045	0.082	0.135	0.350	0.565	0.780	0.995	1.210	CDBYP
MNO=1.200	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.040	0.070	0.115	0.270	0.424	0.578	0.732	0.886	CDBYP
MNO=1.700	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.025	0.050	0.085	0.205	0.450	0.650	0.850	1.050	CDBYP
MNO=2.200	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.024	0.033	0.048	0.076	0.110	0.156	0.218	0.318	CDBYP
MNO=2.500	0.0	0.040	0.060	0.080	0.120	0.160	0.200	0.240	0.280	AOBYP/AC
	0.0	0.018	0.027	0.039	0.063	0.092	0.129	0.180	0.268	CDBYP

****

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************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0        0.400    0.500    0.600    0.680    0.755    0.850    0.955    AO/AC
               0.0      0.0      0.0      0.0      0.0      0.0      0.0      AOBLD/AC

MNO=0.700      0.400    0.500    0.600    0.680    0.755    0.850    0.955    AO/AC
               0.0      0.0      0.0      0.0      0.0      0.0      0.0      AOBLD/AC

MNO=0.800      0.400    0.500    0.600    0.680    AO/AC
               0.136    0.011    0.006    0.0      AOBLD/AC

MNO=0.850      0.400    0.500    0.600    0.680    AO/AC
               0.017    0.013    0.008    0.0      AOBLD/AC

MNO=1.200      0.400    0.500    0.600    0.680    0.755    AO/AC
               0.024    0.018    0.009    0.001    0.0      AOBLD/AC

MNO=1.700      0.400    0.500    0.600    0.680    0.755    AO/AC
               1.130    0.081    0.049    0.024    0.0      AOBLD/AC

MNO=2.200      0.400    0.500    0.600    0.680    0.755    0.850    AO/AC
               1.630    1.278    0.092    0.063    0.034    0.0      AOBLD/AC

MNO=2.500      0.400    0.500    0.600    0.680    0.755    0.850    0.955    AO/AC
               0.205    0.205    0.205    0.205    0.205    0.093    0.0      AOBLD/AC


************
* TABLE 6B *           OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS       LOCAL MACH NUMBER (MNO)
************

               0.0      0.700    0.800    1.200    1.600    2.000    2.500    MNO
               0.0      0.0      0.006    0.009    0.014    0.020    0.030    AOBLD/AC

************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```

MNO=0.0	0.0	1.000	AOE/AC	
	0.0	0.0	AOBYP/AC	
MNO=1.190	0.0	1.000	AOE/AC	
	0.0	0.0	AOBYP/AC	
MNO=1.200	0.400	0.500	0.595	AOE/AC
	0.210	0.094	0.0	AOBYP/AC
MNO=1.700	0.400	0.500	0.670	AOE/AC
	0.270	0.170	0.0	AOBYP/AC
MNO=2.000	0.400	0.550	0.720	AOE/AC
	0.320	0.170	0.0	AOBYP/AC
MNO=2.200	0.400	0.550	0.770	AOE/AC
	0.370	0.220	0.0	AOBYP/AC
MNO=2.500	0.400	0.600	0.920	AOE/AC
	0.520	0.320	0.0	AOBYP/AC

4.2.1.10 INLET CONFIGURATION 'VSTOL' - HALF-ROUND, EXTERNAL COMPRESSION, TRANSLATING-SPIKE INLET

The side mounted half-round inlets have translating 25 degrees half-angle cone centerbodies. The movable centerbody is used to provide a large throat area for low speed operation and, by translating forward, can also provide shock-on-lip for high recovery, low drag supersonic operation at Mach 1.60.

A moderately blunted, fixed cowl lip and large blow-in doors are used to achieve high total pressure recovery and low distortion at static and low-speed conditions.

No boundary layer bleed or bypass are used. In the normal process of developing an inlet of this type, wind tunnel tests would be conducted to optimize the inlet configuration. If these tests show that the addition of internal boundary layer bleed is necessary, no more than 1 - 2% of inlet air would be required for bleed. The addition of this bleed would not significantly change the configuration.

The inlet performance characteristics of this configuration are based on engineering analysis. The inlet configuration is shown in Figure 22 and the inlet performance characteristics are presented in Figure 23.

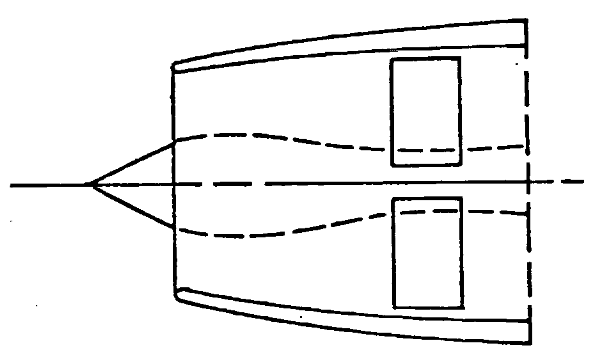

Figure 23 Supersonic (M_0=1.60) Half-Round Inlet

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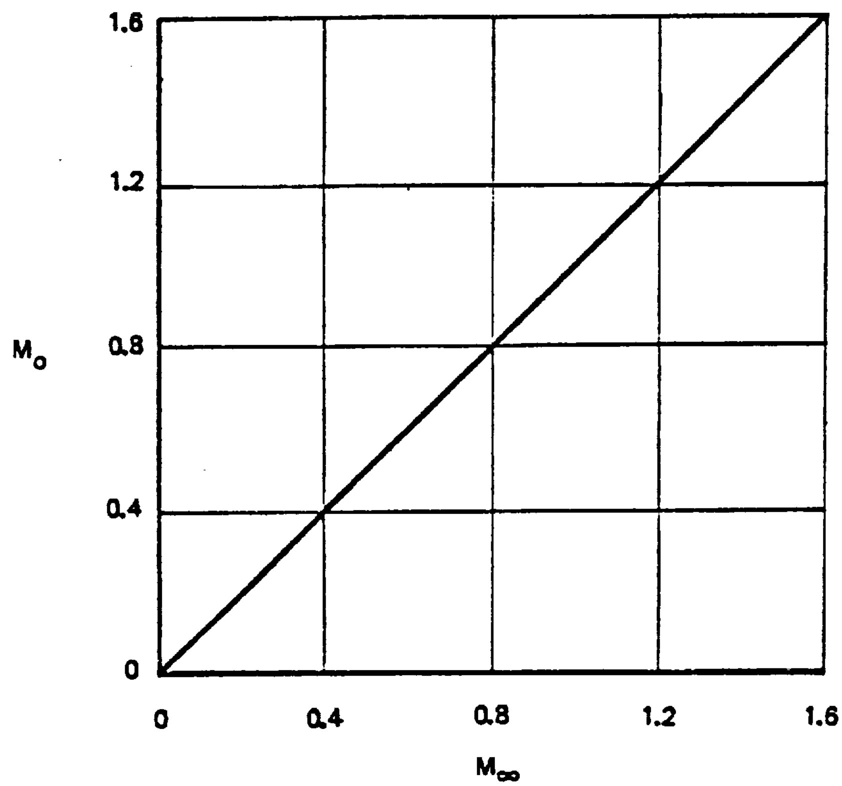


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL'

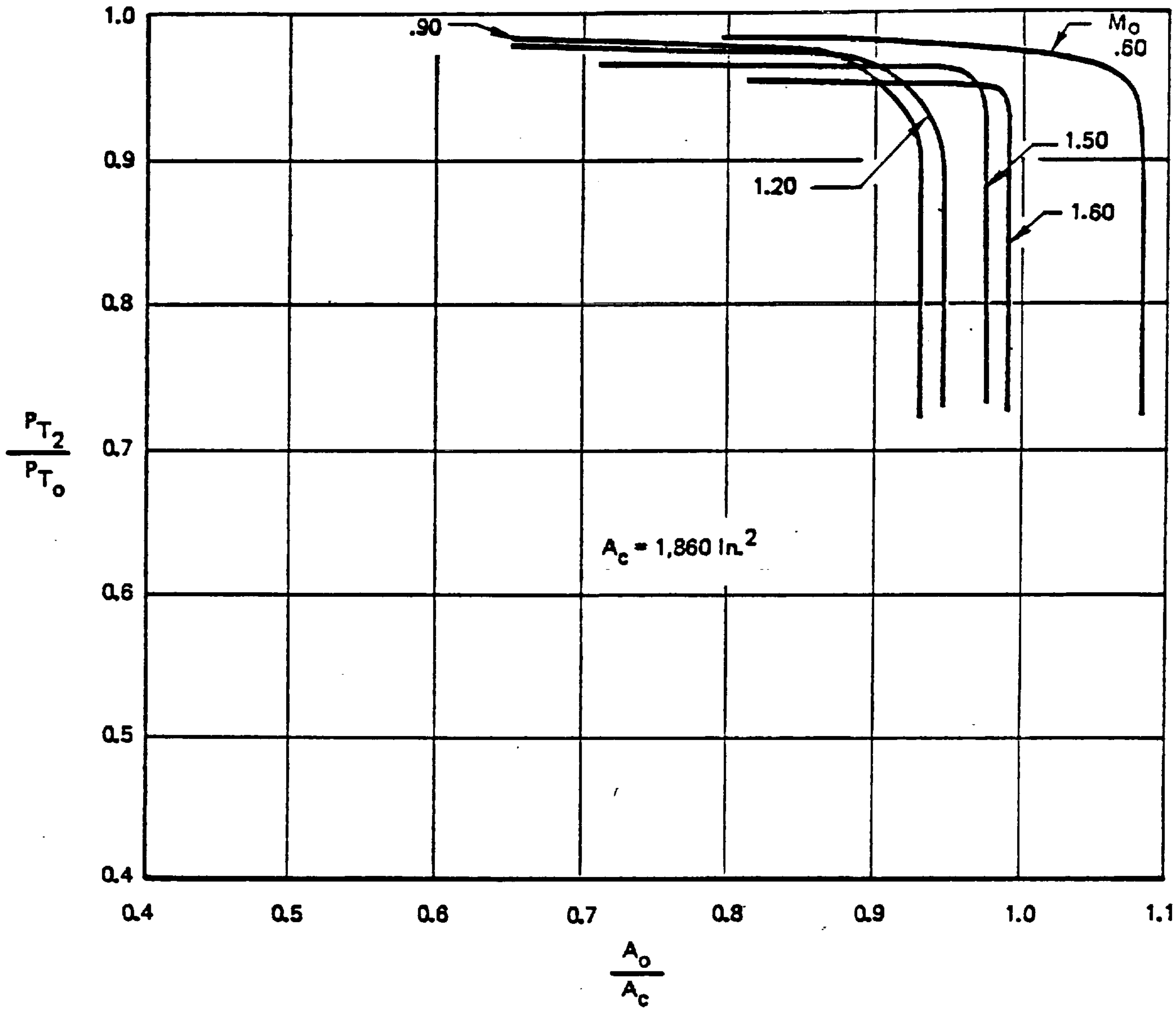


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL'- (continued

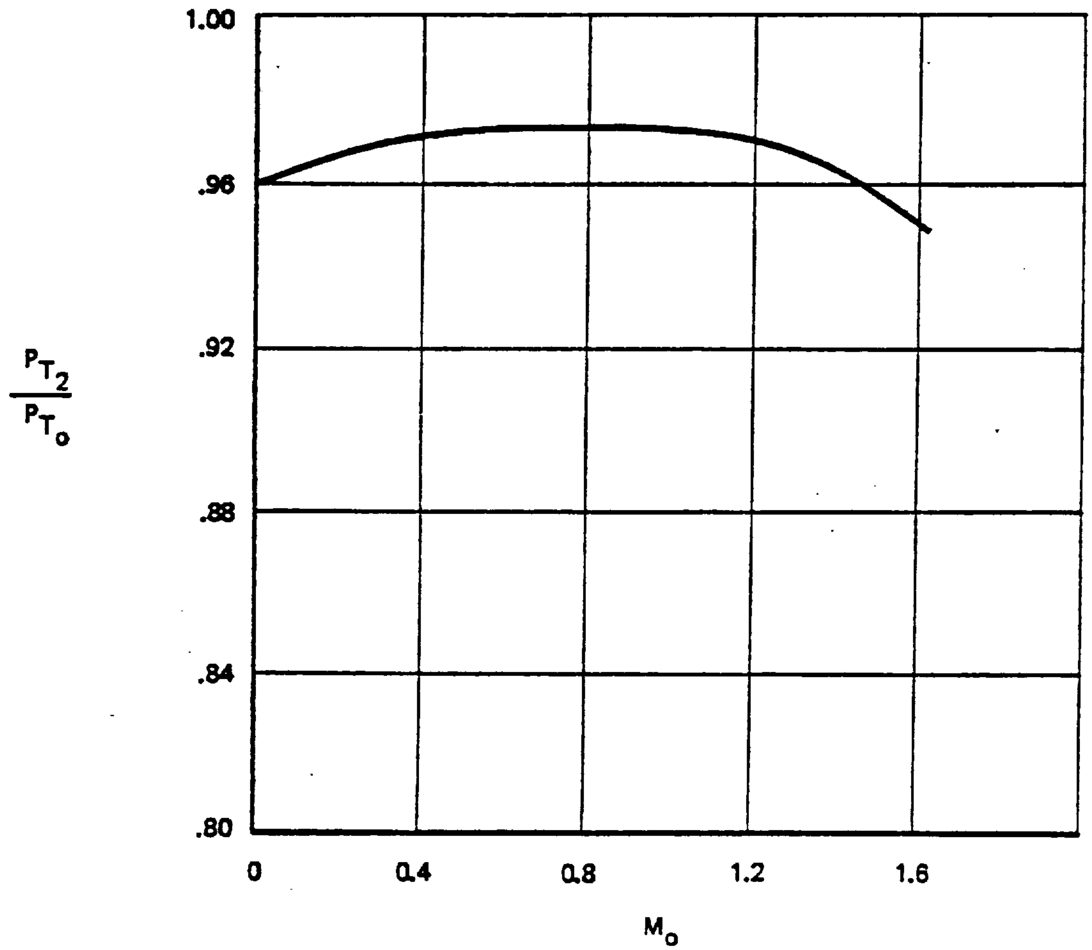


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued)

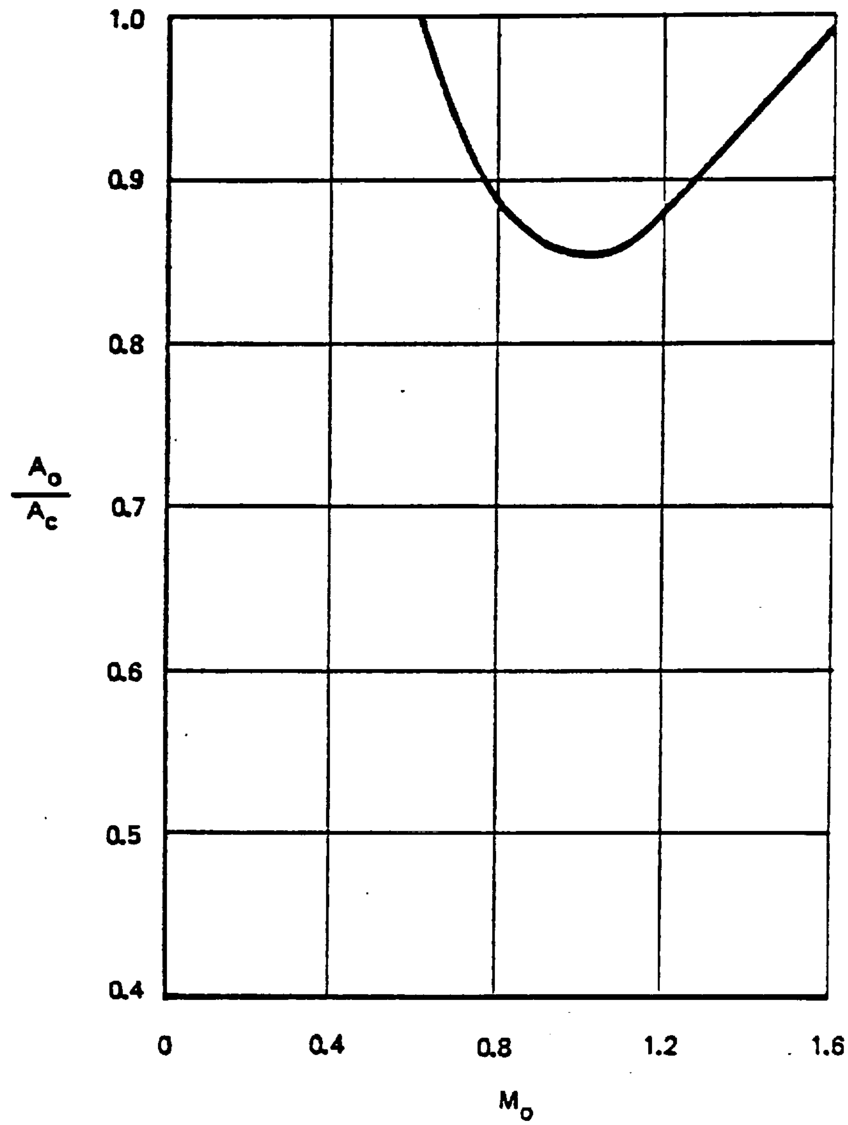


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued)

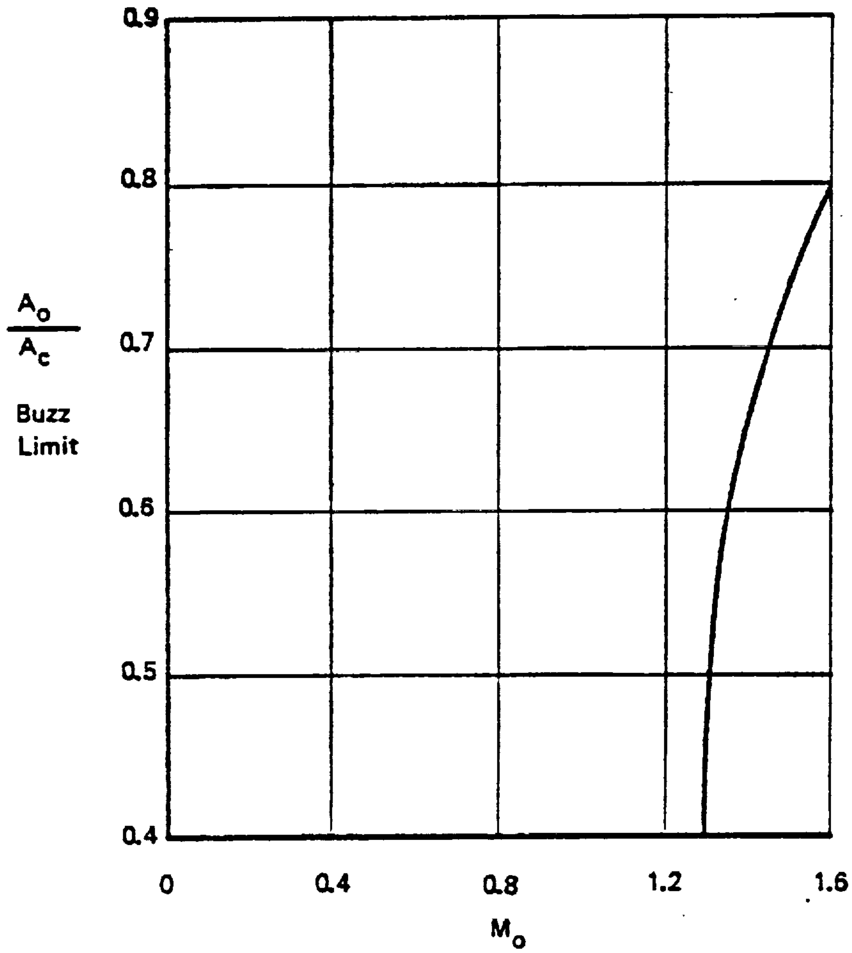


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued)

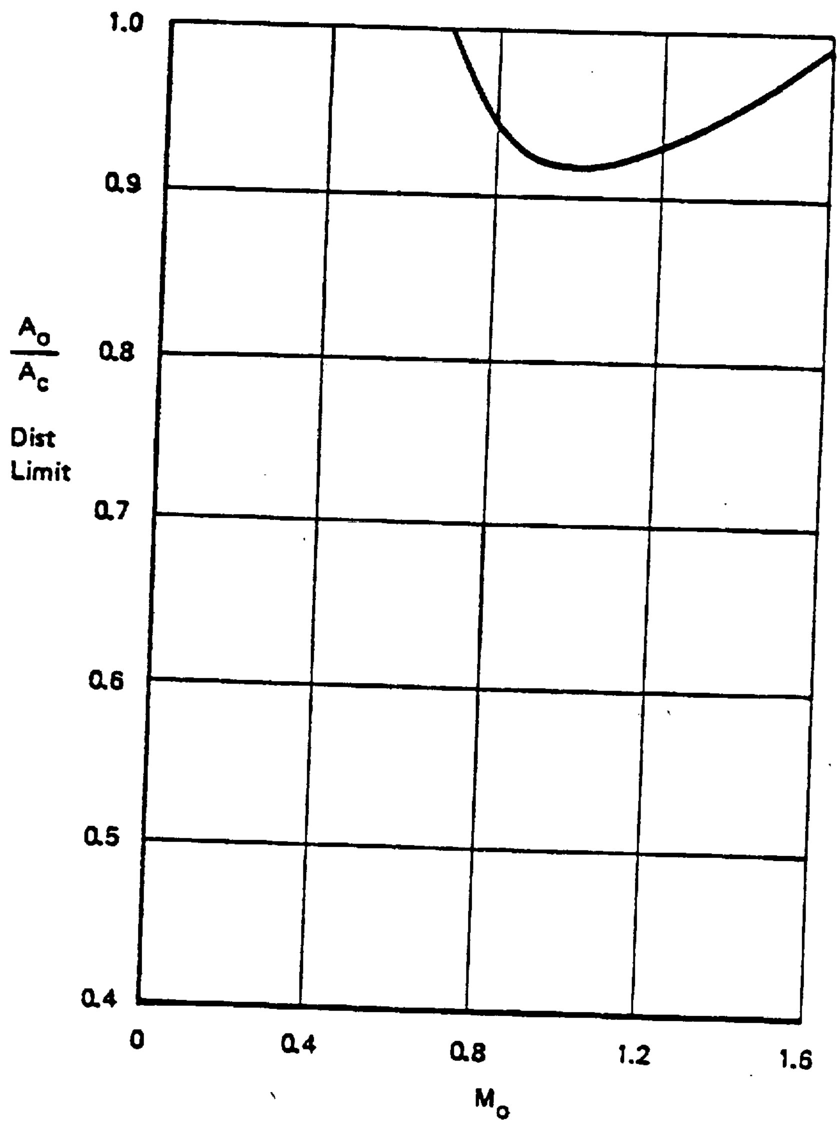


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued)

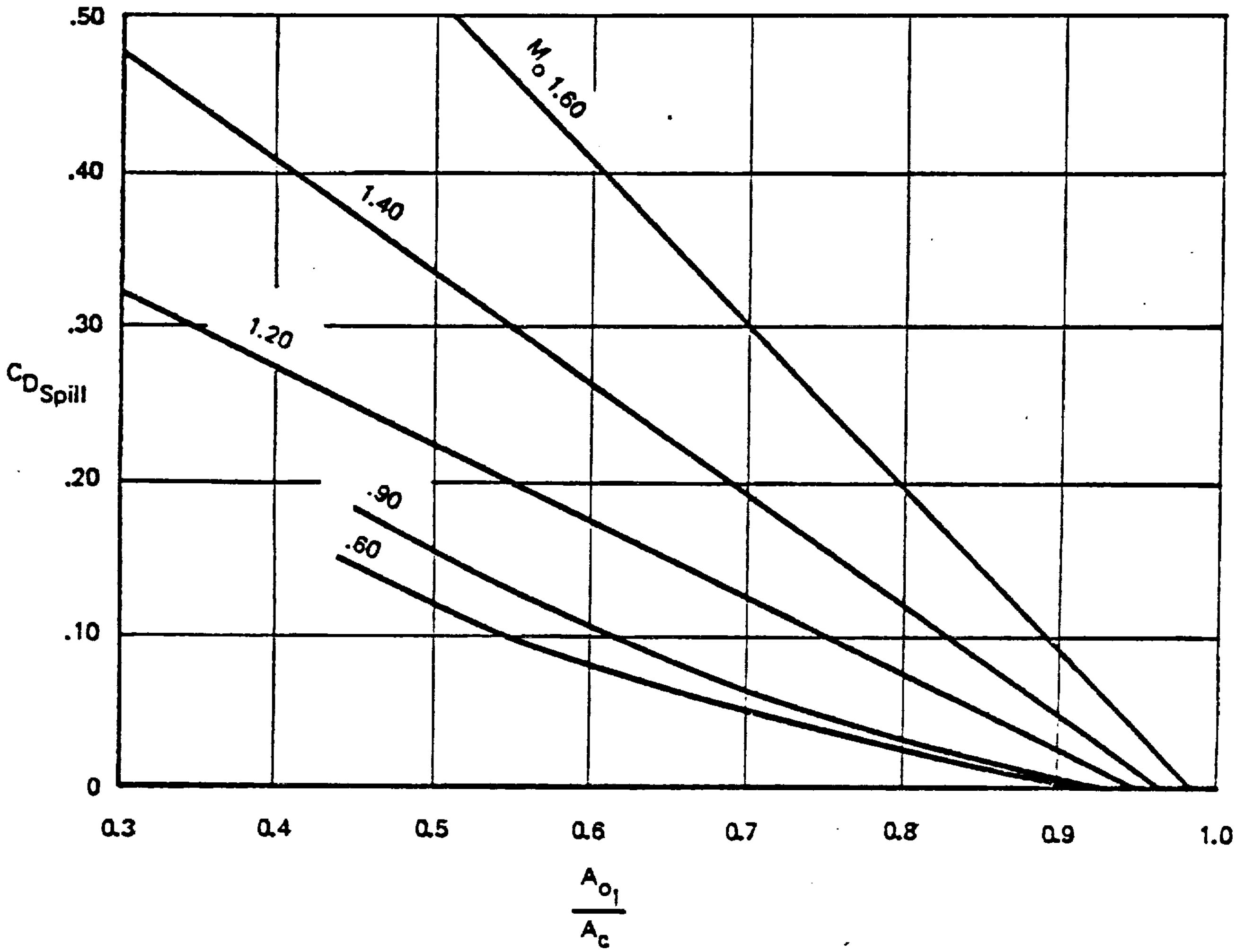
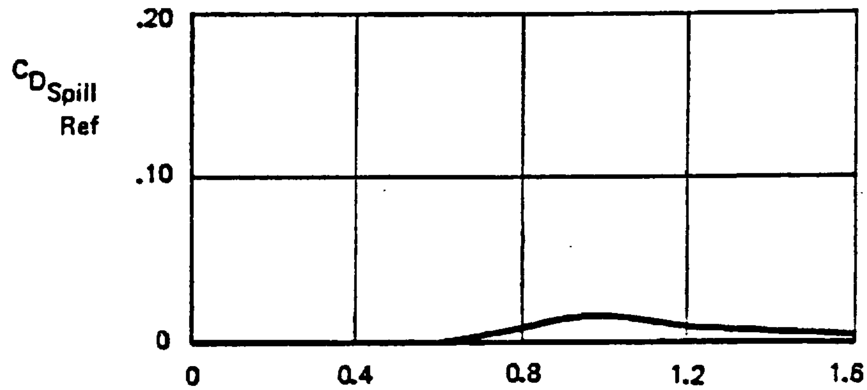


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued)



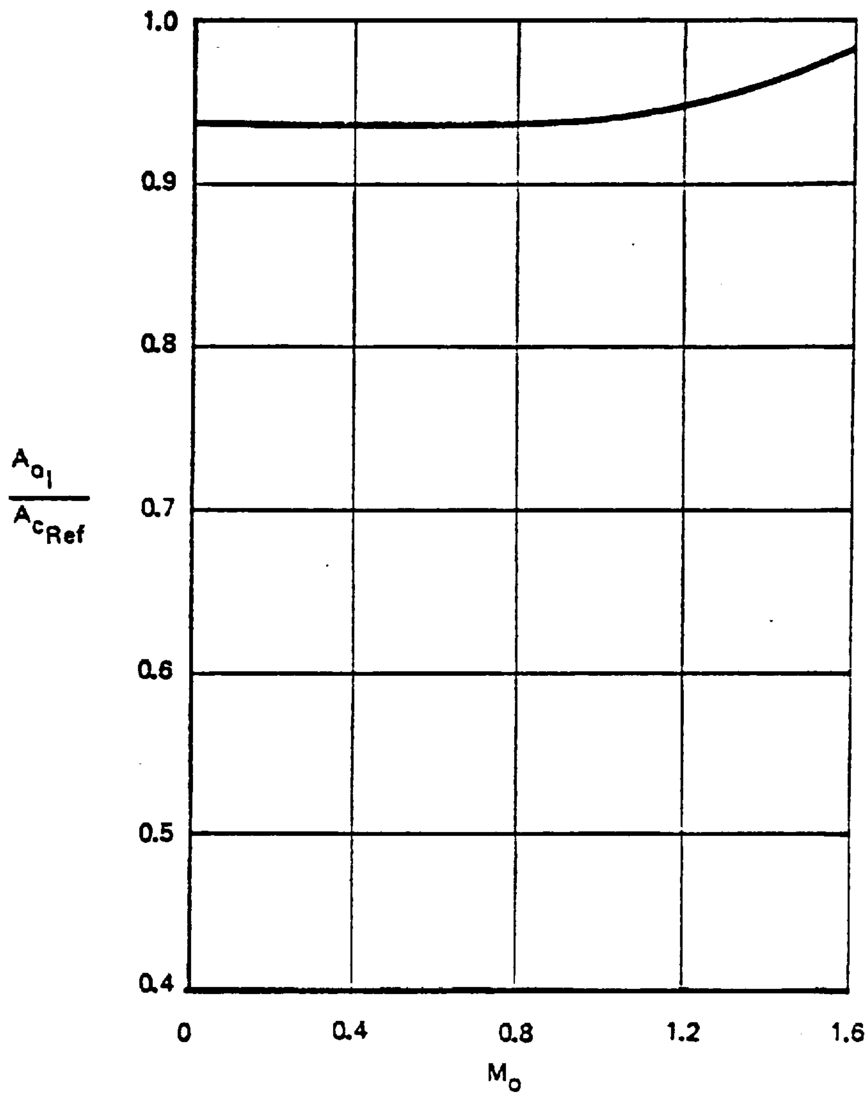


Figure 24. Performance Characteristics for Inlet Configuration - 'VSTOL' - (continued

```
***********
*         *
* VSTOL   *
*         *
***********
```

MACH 1.6,HALF-ROUND,TRANSLATING SPIKE, NO BLEED OR BYPASS,T/O DOORS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	25.0000
4	DESIGN MACH NUMBER	1.6000
5	COWL LIP BLUNTNESS	0.0200
6	TAKEOFF DOOR AREA RATIO	0.4620
7	EXTERNAL COWL ANGLE(DEG)	10.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	0.0
14	EXIT FLAP ASPECT RATIO FOR BYPASS	0.0
15	EXIT FLAP AREA RATIO FOR BYPASS	0.0
16	SUBSONIC DIFFUSER AREA RATIO	1.4400
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	6.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.0800

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.75

```
***********
* TABLE 1 *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	1.000	2.000	MNO
0.0	1.000	2.000	MNFS

```
************
* TABLE 2A *
************
```

INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (A0/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.600	0.850	0.950	1.000	1.025	1.050	1.075	1.085	AO/AC	
	0.983	0.978	0.975	0.971	0.964	0.952	0.925	PT2/PT0	
MNO=0.900	0.700	0.800	0.850	0.875	0.900	0.925	0.935	AO/AC	
	0.982	0.978	0.975	0.970	0.958	0.932	0.900	PT2/PT0	
MNO=1.200	0.700	0.800	0.850	0.875	0.900	0.925	0.940	0.950	AO/AC
	0.982	0.978	0.973	0.970	0.963	0.948	0.927	0.900	PT2/PT0
MNO=1.500	0.750	0.850	0.900	0.925	0.950	0.970	0.980	AO/AC	
	0.965	0.965	0.963	0.961	0.958	0.950	0.925	PT2/PT0	
MNO=1.600	0.800	0.900	0.950	0.975	0.990	0.995	AO/AC		
	0.955	0.953	0.951	0.949	0.942	0.925	PT2/PT0		

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.200	0.400	0.600	1.000	1.200	1.400	1.500	1.600	MNO
0.960	0.968	0.971	0.972	0.972	0.970	0.963	0.958	0.948	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	0.900	1.000	1.200	1.400	1.500	1.600	MNO
1.020	0.887	0.863	0.853	0.878	0.937	0.960	0.986	AO/AC

****
* TABLE 2D *
****

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	1.300	1.400	1.500	1.600	MNO
0.400	0.400	0.658	0.746	0.798	AO/AC

****

```
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)    VS       LOCAL MACH NUMBER (MNO)
************

               0.600      0.800      0.900      1.000      1.200      1.500      1.600      MNO
               1.075      0.945      0.922      0.917      0.927      0.972      0.990      AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS       INLET MASS FLOW RATIO (AOI/AC)    AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.600      0.300      0.500      0.700      0.900      0.935      1.000      AOI/AC
               0.215      0.118      0.050      0.005      0.0        0.0        CDSPL

MNO=0.900      0.300      0.500      0.700      0.900      0.935      1.000      AOI/AC
               0.275      0.153      0.063      0.008      0.0        0.0        CDSPL

MNO=1.200      0.300      0.500      0.700      0.900      0.935      0.950      1.000      AOI/AC
               0.322      0.223      0.124      0.025      0.008      0.0        0.0        CDSPL

MNO=1.400      0.300      0.500      0.700      0.900      0.935      0.950      0.970      1.000      AOI/AC
               0.475      0.335      0.190      0.050      0.025      0.013      0.0        0.0        CDSPL

MNO=1.600      0.300      0.500      0.700      0.900      0.935      0.950      0.970      0.985      1.000      AOI/AC
               0.720      0.510      0.300      0.090      0.050      0.038      0.015      0.0        0.0        CDSPL


************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS       LOCAL MACH NUMBER (MNO)
************

               0.0        0.600      0.800      1.000      1.200      1.600      MNO
               0.0        0.0        0.010      0.018      0.011      0.007      REF CDSPL

************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)     VS       LOCAL MACH NUMBER (MNO)
************

               0.0        0.800      1.200      1.600      MNO
               0.940      0.940      0.950      0.980      REF AOI/AC
```

```
************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

                0.600     2.000     MNO

MNO=0.600       0.0       0.100     AOBLD/AC
                0.0       0.0       CDBLD

MNO=2.000       0.0       0.100     AOBLD/AC
                0.0       0.0       CDBLD


************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND     LOCAL MACH NUMBER (MNO)
************

                0.600     2.000     MNO

MNO=0.600       0.0       0.100     AOBYP/AC
                0.0       0.0       CDBYP

MNO=2.000       0.0       0.100     AOBYP/AC
                0.0       0.0       CDBYP


************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)           AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.600       0.0       1.000     AO/AC
                0.0       0.0       AOBLD/AC

MNO=2.000       0.0       1.000     AO/AC
                0.0       0.0       AOBLD/AC
```

```
************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)     VS        LOCAL MACH NUMBER (MNO)
************

               0.0         1.600      MNO
               0.0         0.0        AOBLD/AC


************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.600      0.0         1.000      AOE/AC
               0.0         0.0        AOBYP/AC

MNO=2.000      0.0         1.000      AOE/AC
               0.0         0.0        AOBYP/AC
```

4.2.1.11 INLET CONFIGURATION 'NVSTOL' - HALF-ROUND, EXPANDING-CENTERBODY, THREE-SHOCK, EXTERNAL COMPRESSION INLET

This inlet uses an expanding second cone to achieve changes in compression surface angle and throat area. Boundary layer bleed is provided in the form of porosity on the second cone and a throat slot.

The inlet performance characteristics are based on the results of engineering analysis. The geometric features of the inlet are shown in Figure 24. The inlet performance characteristics are presented in Figure 25.

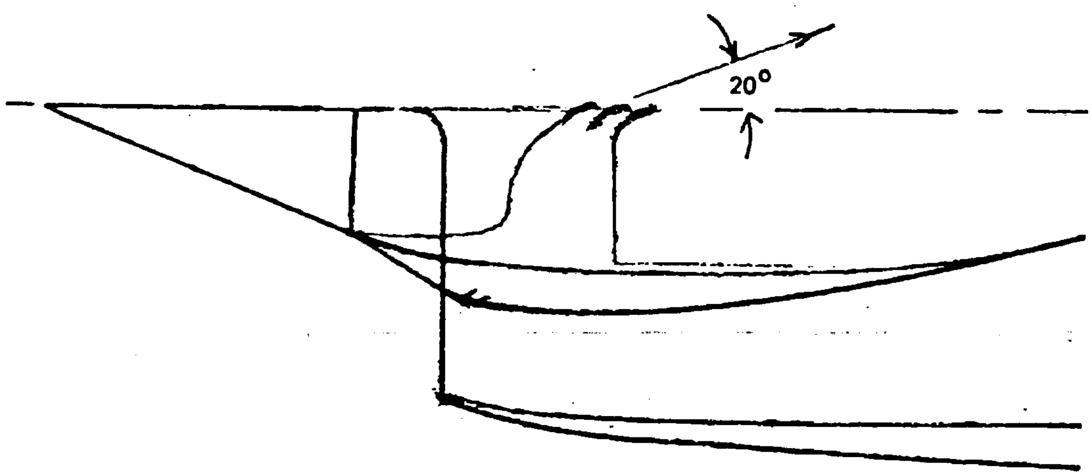


Figure 25 Half Round External Compression Mach 2.0 Inlet

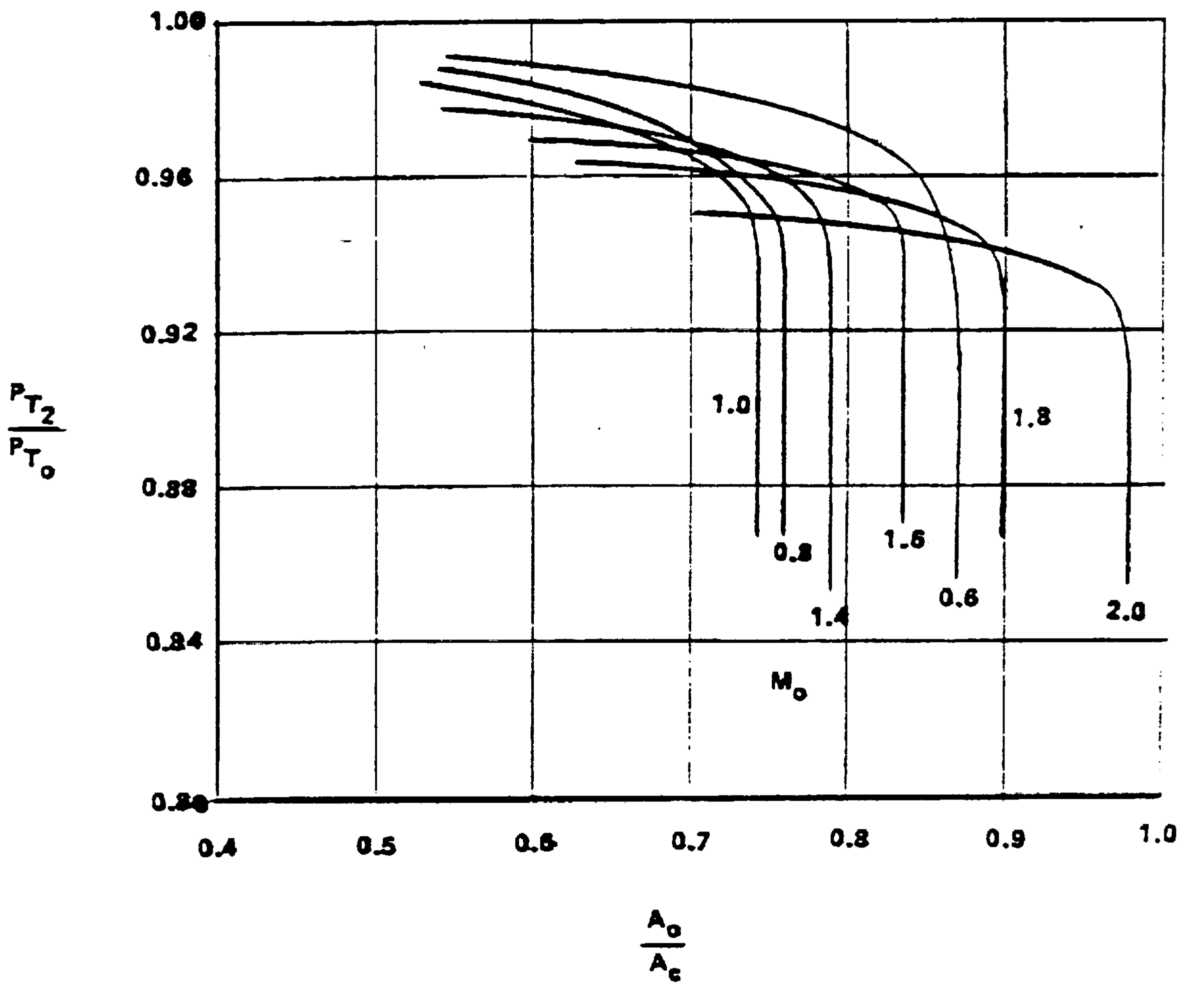
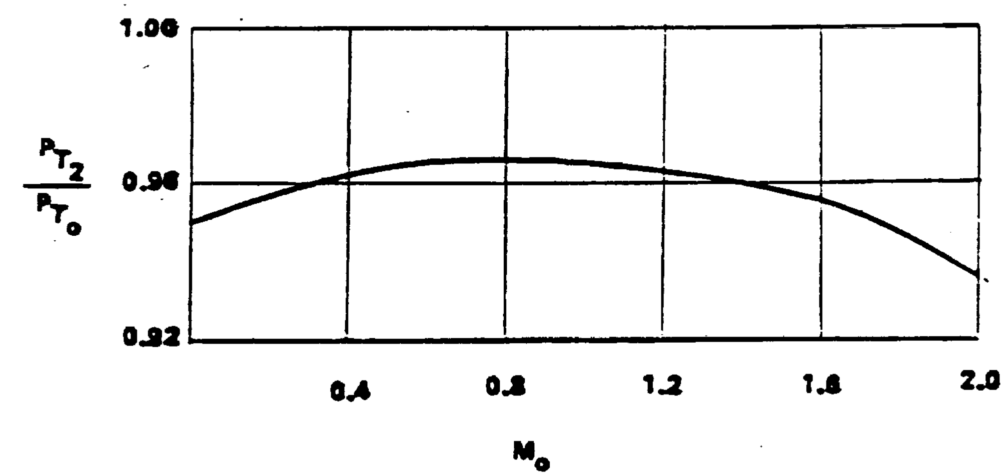


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL'



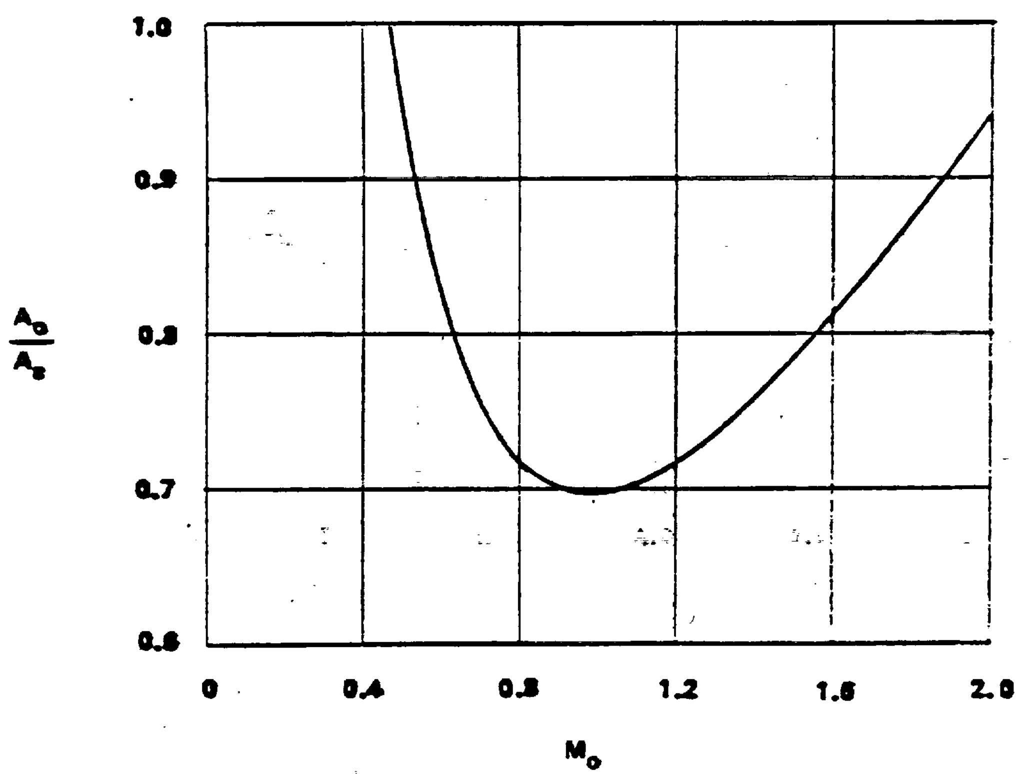


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)

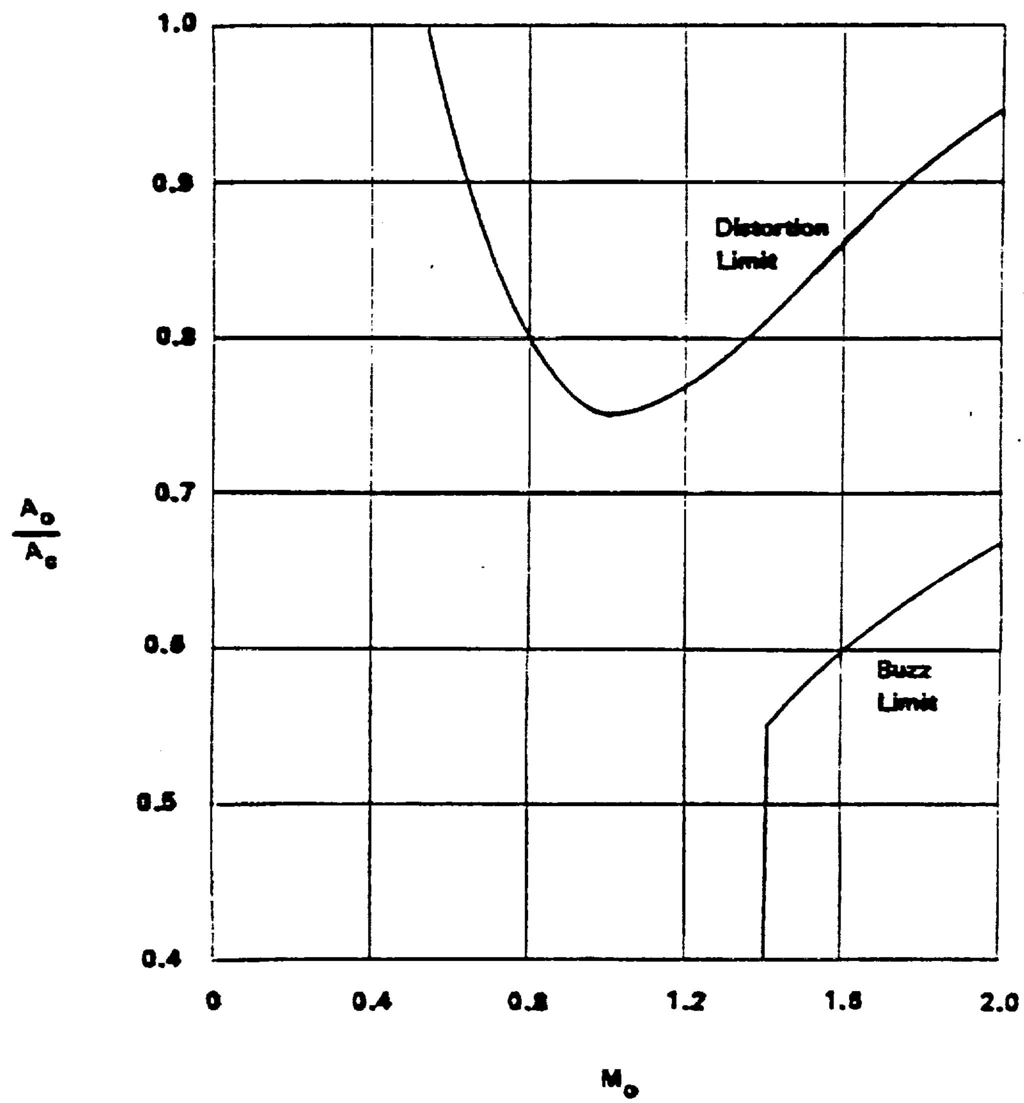


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)

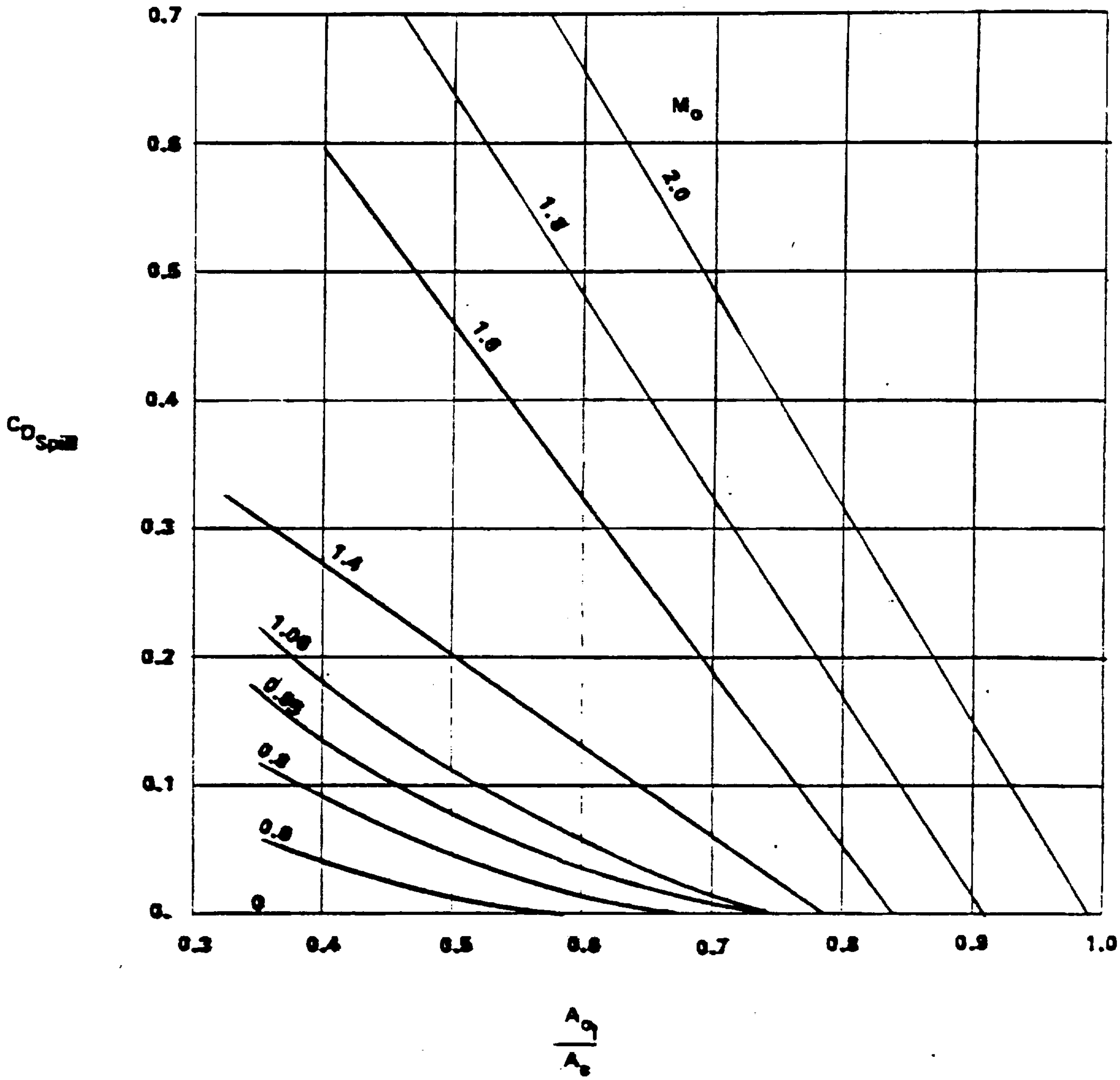
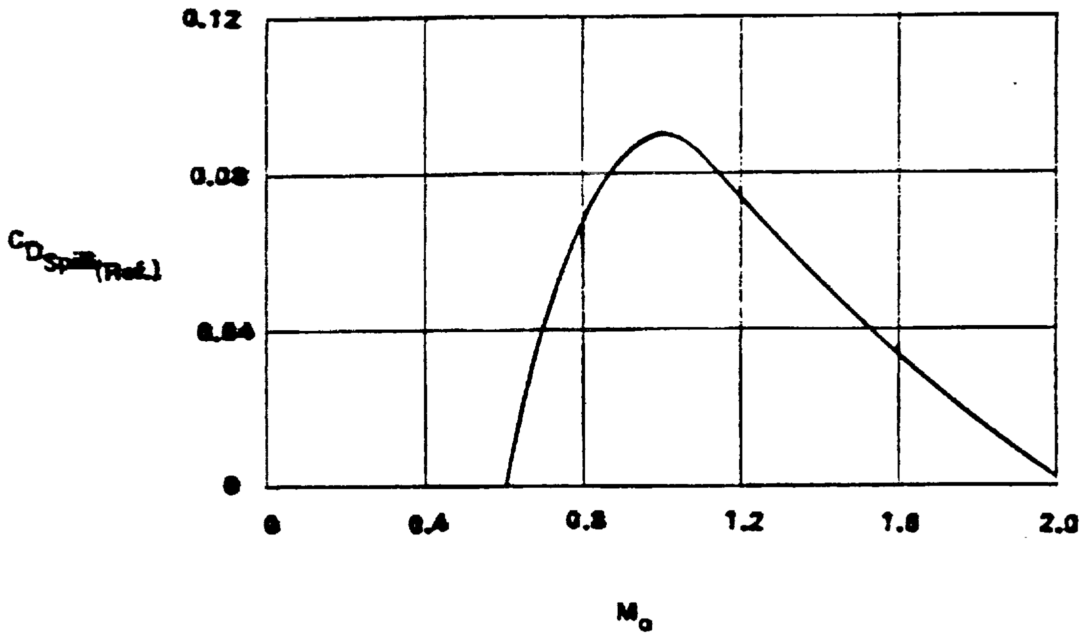


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)

C - 3



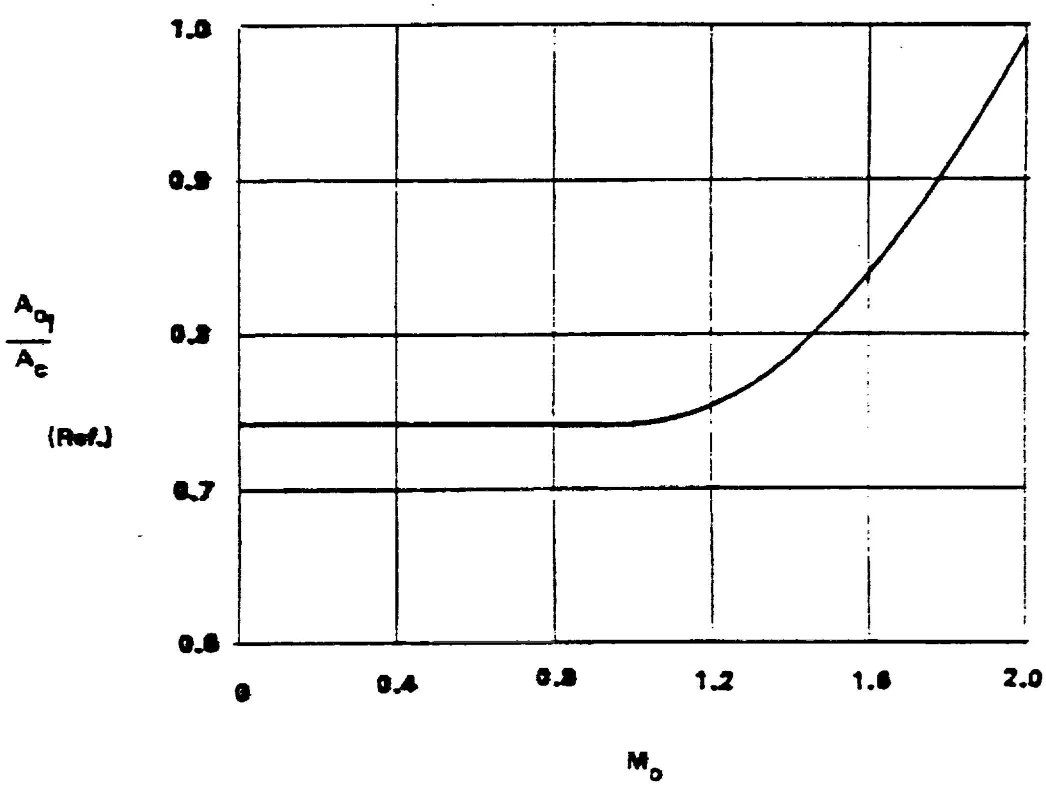


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)

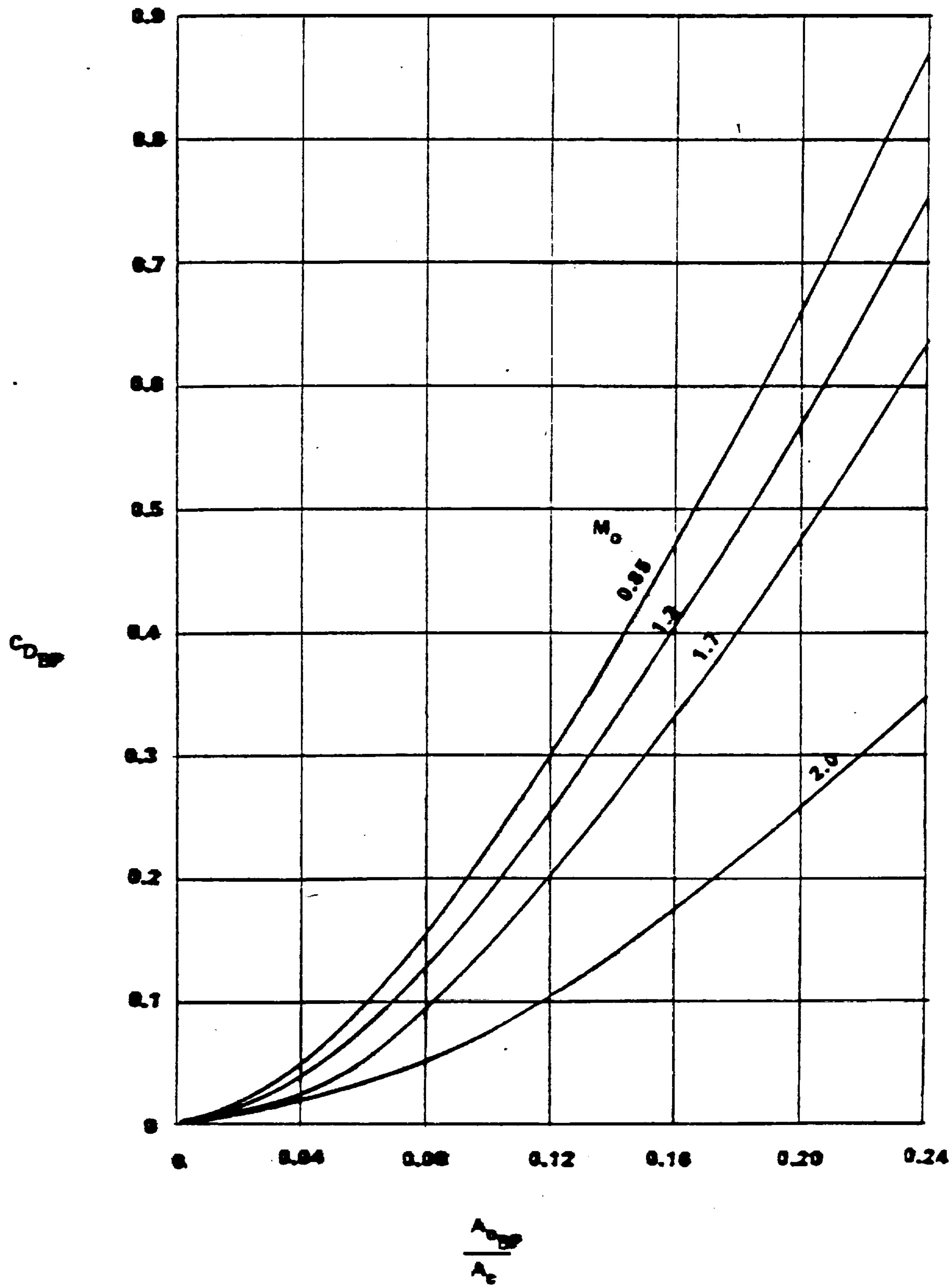
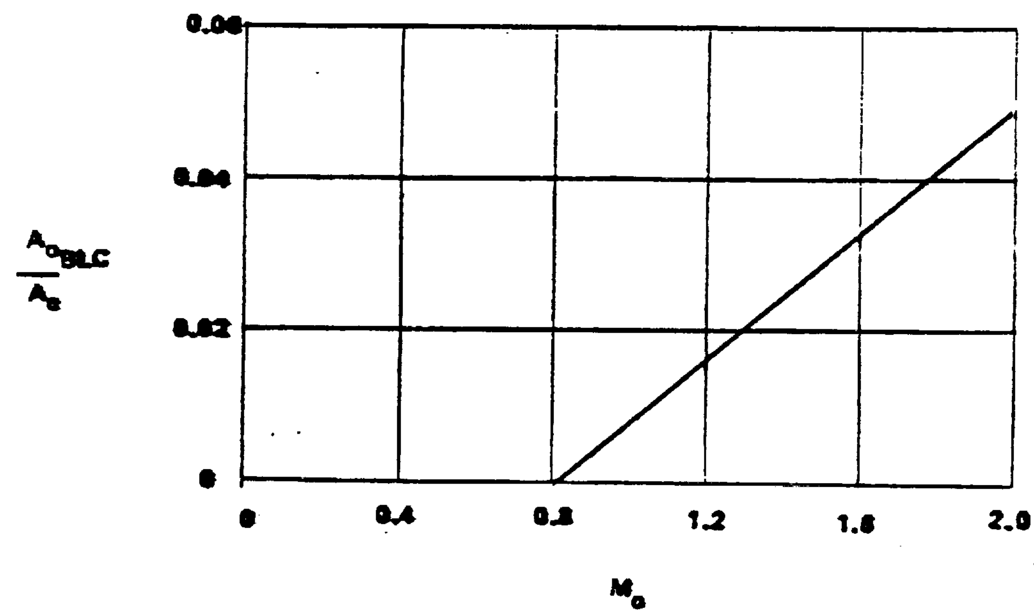


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)



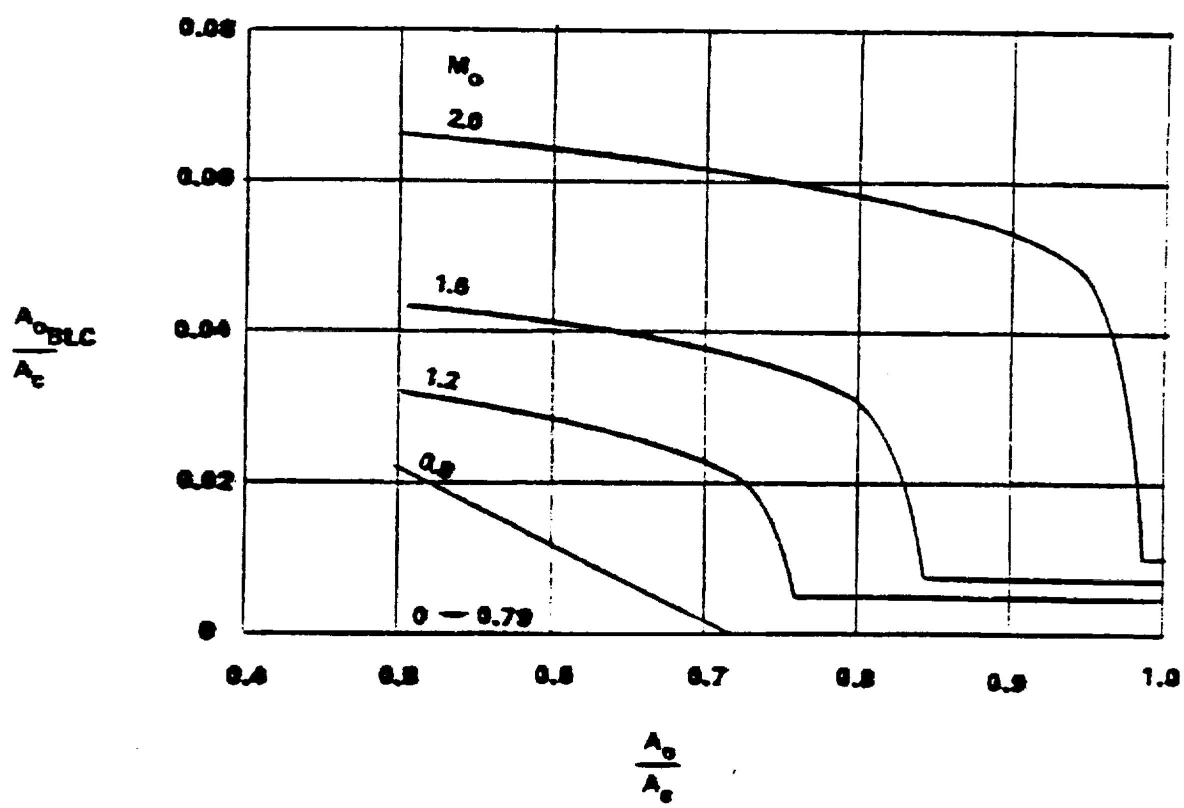
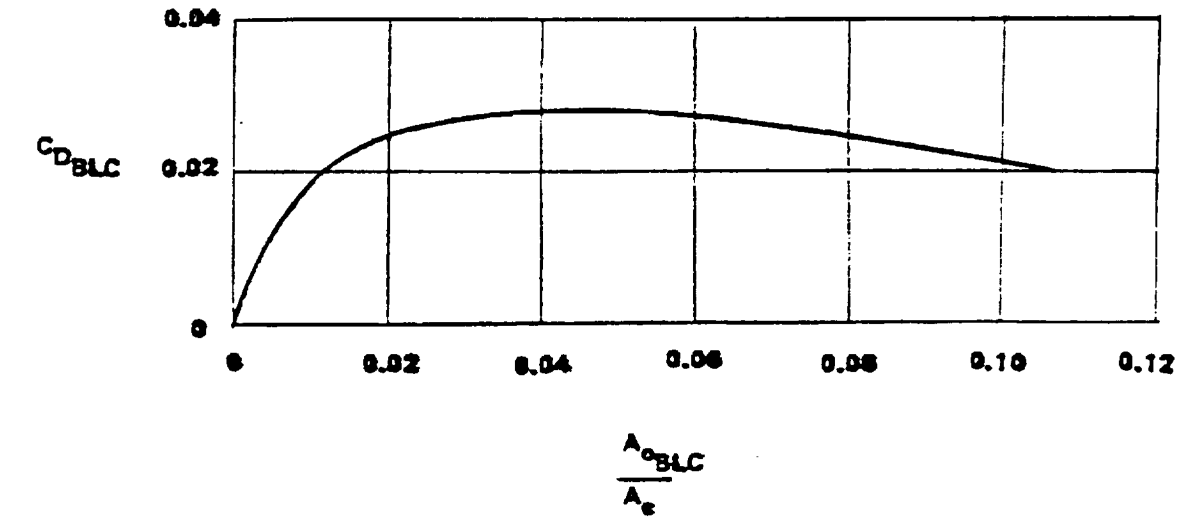


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)



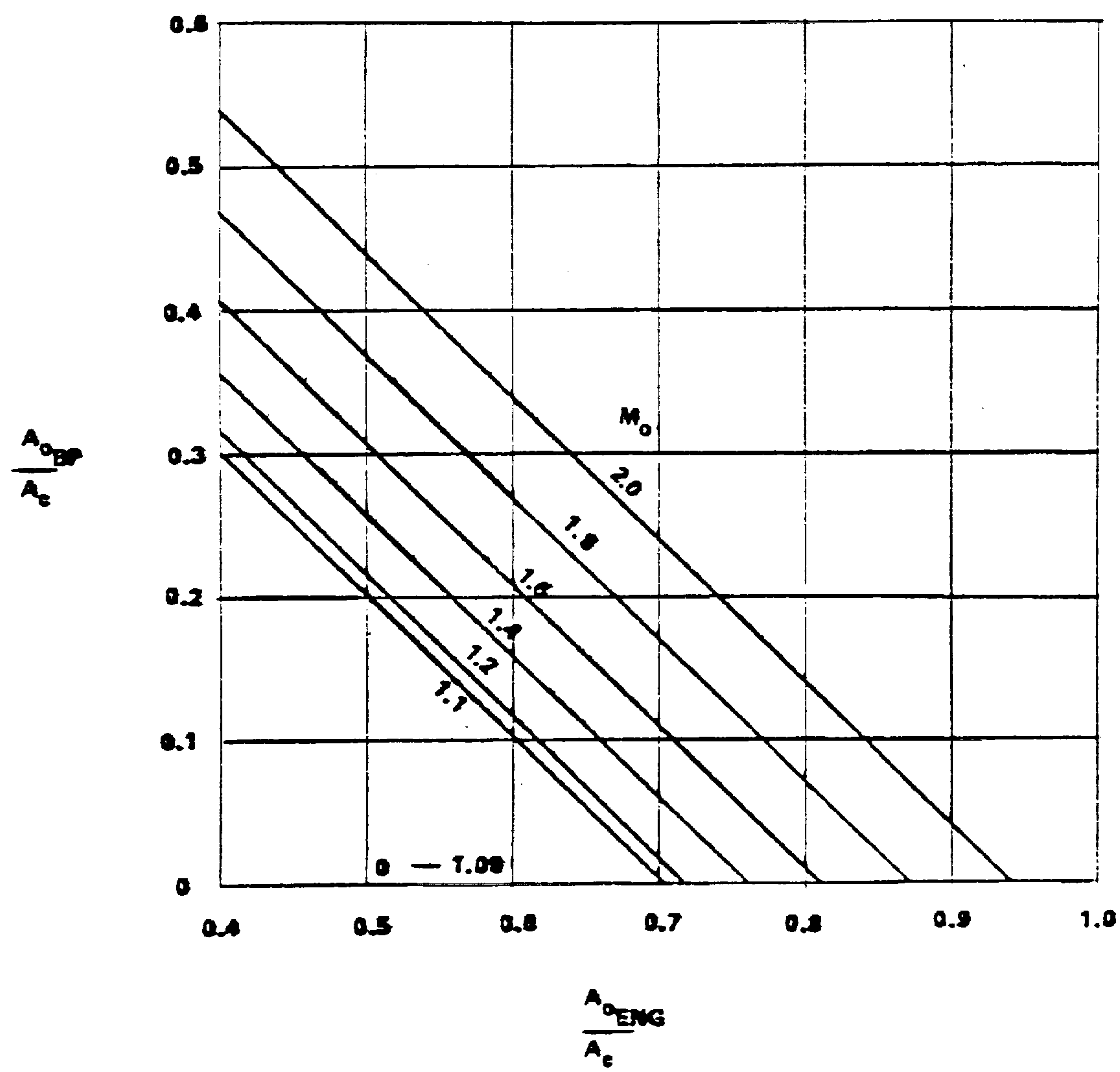


Figure 26. Performance Characteristics for Inlet Configuration - 'NVSTOL' - (continued)

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*         *
* NVSTO   *
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MACH 2.0 HALF-ROUND,EXPANDING CB, 3-SHOCK,EXT.COMPR.,BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	22.0000
4	DESIGN MACH NUMBER	2.0000
5	COWL LIP BLUNTNESS	0.0150
6	TAKEOFF DOOR AREA RATIO	0.4600
7	EXTERNAL COWL ANGLE(DEG)	19.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	20.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.1000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	20.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	1.8300
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	9.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.75

```
***********
 TABLE 1  *         LOCAL MACH NUMBER (MNO)          VS        FREE STREAM MACH NUMBER (MNFS)
***********
```

0.0	0.600	2.000	MNO
0.0	0.600	2.000	MNFS

```
***********
 TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)       VS       MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
***********
```

MNO=0.600	0.548 0.991	0.647 0.987	0.748 0.978	0.791 0.972	0.823 0.965	0.846 0.959	0.856 0.950	0.865 0.934	0.869 0.914	0.870 0.856	AO/AC PT2/PT0
MNO=0.800	0.535 0.988	0.596 0.984	0.664 0.975	0.711 0.965	0.729 0.960	0.744 0.953	0.753 0.948	0.757 0.942	0.759 0.935	0.756 0.867	AO/AC PT2/PT0
MNO=1.000	0.519 0.984	0.578 0.980	0.636 0.975	0.678 0.969	0.715 0.959	0.730 0.953	0.738 0.948	0.740 0.943	0.741 0.933	0.742 0.866	AO/AC PT2/PT0
MNO=1.400	0.546 0.978	0.608 0.975	0.663 0.971	0.713 0.966	0.748 0.961	0.767 0.956	0.779 0.952	0.785 0.944	0.788 0.932	0.788 0.851	AO/AC PT2/PT0
MNO=1.600	0.598 0.969	0.649 0.968	0.698 0.967	0.750 0.963	0.771 0.961	0.793 0.958	0.815 0.954	0.827 0.949	0.833 0.943	0.833 0.869	AO/AC PT2/PT0
MNO=1.800	0.623 0.964	0.698 0.962	0.772 0.958	0.823 0.953	0.866 0.948	0.881 0.944	0.888 0.941	0.895 0.935	0.897 0.928	0.898 0.865	AO/AC PT2/PT0
MNO=2.000	0.698 0.950	0.766 0.949	0.823 0.947	0.883 0.942	0.923 0.938	0.947 0.933	0.963 0.928	0.973 0.921	0.977 0.909	0.979 0.854	AO/AC PT2/PT0

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.000	0.257	0.430	0.568	0.695	0.949	1.182	1.475	1.711	1.991	MNO
0.950	0.959	0.964	0.965	0.966	0.966	0.964	0.958	0.951	0.936	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.448	0.532	0.652	0.736	0.791	0.896	1.018	1.212	1.583	1.982	MNO
1.001	0.883	0.776	0.734	0.717	0.699	0.696	0.721	0.812	0.942	AO/AC

****
* TABLE 2D *

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

****

1.380	1.398	1.435	1.477	1.551	1.634	1.707	1.790	1.873	1.988	MNO
0.400	0.548	0.560	0.571	0.590	0.606	0.621	0.635	0.650	0.669	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.534	0.678	0.858	0.931	0.996	1.098	1.295	1.527	1.691	1.988	MNO
0.999	0.869	0.776	0.758	0.750	0.755	0.787	0.842	0.887	0.948	AO/AC

****
* TABLE 3 *
****

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300	1.000	AOI/AC								
	0.0	0.0	CDSPL								
MNO=0.590	0.300	1.000	AOI/AC								
	0.0	0.0	CDSPL								
MNO=0.600	0.350	0.382	0.417	0.449	0.479	0.503	0.548	0.568	0.586	1.000	AOI/AC
	0.059	0.046	0.034	0.025	0.017	0.011	0.004	0.001	0.0	0.0	CDSPL
MNO=0.800	0.351	0.383	0.416	0.450	0.490	0.528	0.606	0.639	0.671	1.000	AOI/AC
	0.118	0.100	0.083	0.066	0.050	0.036	0.013	0.005	0.0	0.0	CDSPL
MNO=0.950	0.344	0.384	0.422	0.462	0.500	0.541	0.591	0.691	0.746	1.000	AOI/AC
	0.179	0.145	0.119	0.096	0.077	0.059	0.038	0.009	0.0	0.0	CDSPL
MNO=1.060	0.347	0.394	0.442	0.488	0.531	0.579	0.621	0.703	0.746	1.000	AOI/AC
	0.224	0.183	0.149	0.120	0.093	0.067	0.047	0.013	0.0	0.0	CDSPL
MNO=1.400	0.325	0.390	0.443	0.510	0.564	0.617	0.716	0.754	0.787	1.000	AOI/AC
	0.326	0.278	0.241	0.195	0.156	0.120	0.051	0.022	0.001	0.0	CDSPL
MNO=1.600	0.378	0.451	0.517	0.573	0.625	0.674	0.768	0.805	0.840	1.000	AOI/AC
	0.615	0.518	0.431	0.357	0.287	0.220	0.096	0.048	0.0	0.0	CDSPL

```
MNO=1.800    0.443   0.504   0.563   0.614   0.673   0.728   0.786   0.876   0.910   1.000   AOI/AC
             0.721   0.624   0.535   0.456   0.364   0.279   0.190   0.052   0.001   0.0     CDSPL

MNO=2.000    0.509   0.584   0.646   0.702   0.753   0.855   0.905   0.951   0.990   1.000   AOI/AC
             0.799   0.672   0.571   0.479   0.392   0.223   0.141   0.064   0.0     0.0     CDSPL


************
* TABLE 3A *        REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

             0.0     0.600   0.700   0.800   1.000   1.200   1.600   2.000   MNO
             0.0     0.0     0.040   0.068   0.090   0.074   0.034   0.002   REF CDSPL


************
* TABLE 3B *        REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

             0.0     0.400   1.000   1.200   1.400   1.600   1.800   2.000   MNO
             0.743   0.743   0.743   0.752   0.785   0.839   0.907   0.990   REF AOI/AC


************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)     VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

             0.0     2.000   MNO

MNO=0.0      0.0     0.004   0.010   0.014   0.020   0.030   0.040   0.064   0.088   0.107   AOBLD/AC
             0.0     0.010   0.018   0.022   0.025   0.027   0.023   0.027   0.024   0.020   CDBLD

MNO=2.000    0.0     0.004   0.010   0.014   0.020   0.030   0.040   0.064   0.088   0.107   AOBLD/AC
             0.0     0.010   0.018   0.022   0.025   0.027   0.028   0.027   0.024   0.020   CDBLD


************
* TABLE 5  *     BYPASS DRAG COEFFICIENT (CDBYP)     VS     BYPASS MASS FLOW RATIO (AOBYP/AC)     AND     LOCAL MACH NUMBER (MNO)
************

             0.850   1.200   1.700   2.000   MNO
```

MNO=0.850	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.050	0.155	0.300	0.470	0.660	0.870	CDBYP
MNO=1.200	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.040	0.127	0.257	0.405	0.570	0.750	CDBYP
MNO=1.700	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.024	0.093	0.202	0.331	0.478	0.635	CDBYP
MNO=2.000	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.020	0.050	0.105	0.175	0.258	0.348	CDBYP

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	1.000	AO/AC								
	0.0	0.0	AOBLD/AC								
MNO=0.790	0.0	1.000	AO/AC								
	0.0	0.0	AOBLD/AC								
MNO=0.800	0.499	0.534	0.557	0.581	0.605	0.631	0.656	0.678	0.695	0.715	AO/AC
	0.022	0.018	0.016	0.014	0.011	0.009	0.006	0.004	0.002	0.000	AOBLD/AC
MNO=1.200	0.500	0.549	0.588	0.627	0.667	0.704	0.728	0.747	0.762	1.001	AO/AC
	0.032	0.030	0.029	0.027	0.025	0.023	0.020	0.013	0.005	0.005	AOBLD/AC
MNO=1.600	0.502	0.575	0.655	0.737	0.785	0.800	0.813	0.832	0.847	1.001	AO/AC
	0.043	0.042	0.040	0.036	0.033	0.031	0.028	0.020	0.007	0.007	AOBLD/AC
MNO=2.000	0.498	0.648	0.781	0.872	0.914	0.937	0.955	0.971	0.988	1.001	AO/AC
	0.066	0.063	0.059	0.055	0.052	0.049	0.046	0.035	0.010	0.010	AOBLD/AC

****
* TABLE 6B *

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

****

0.816	0.988	1.129	1.243	1.358	1.488	1.607	1.732	1.857	1.998	MNO
0.0	0.008	0.014	0.018	0.023	0.028	0.033	0.039	0.044	0.050	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.398	1.000	AOE/AC								
	0.0	0.0	AOBYP/AC								
MNO=1.090	0.398	1.000	AOE/AC								
	0.0	0.0	AOBYP/AC								
MNO=1.100	0.398	0.427	0.455	0.486	0.525	0.569	0.612	0.650	0.679	0.703	AOE/AC
	0.303	0.274	0.246	0.215	0.177	0.136	0.092	0.053	0.025	0.001	AOBYP/AC
MNO=1.200	0.398	0.432	0.466	0.502	0.541	0.578	0.621	0.659	0.689	0.716	AOE/AC
	0.318	0.282	0.248	0.212	0.174	0.138	0.097	0.058	0.029	0.001	AOBYP/AC
MNO=1.400	0.399	0.436	0.475	0.519	0.563	0.598	0.637	0.676	0.716	0.760	AOE/AC
	0.356	0.317	0.280	0.236	0.194	0.161	0.122	0.084	0.042	0.0	AOBYP/AC
MNO=1.600	0.397	0.454	0.502	0.545	0.595	0.635	0.677	0.728	0.766	0.808	AOE/AC
	0.408	0.350	0.303	0.260	0.214	0.173	0.132	0.080	0.042	0.001	AOBYP/AC
MNO=1.800	0.397	0.464	0.520	0.573	0.628	0.684	0.734	0.785	0.824	0.869	AOE/AC
	0.468	0.404	0.348	0.294	0.239	0.186	0.135	0.085	0.044	0.000	AOBYP/AC
MNO=2.000	0.397	0.471	0.540	0.605	0.664	0.722	0.777	0.837	0.890	0.939	AOE/AC
	0.539	0.466	0.398	0.333	0.274	0.215	0.161	0.100	0.048	0.0	AOBYP/AC

4.2.1.12 INLET CONFIGURATION 'TM1B3' - HALF-ROUND, THREE-SHOCK, EXTERNAL COMPRESSION, VARIABLE CONE INLET

This inlet has a fixed 18o first cone angle and a variable second cone angle. Porous plate boundary layer bleed is provided on the second cone in the region of the design terminal shock location. The boundary layer bleed flow is routed aft and exits through low angle louvers or a door well aft of the cowl lip. Design throat Mach number is 0.7.

The inlet performance characteristics of this configuration are based on data from Reference 1 and engineering analysis. The geometry of the inlet is shown in Figure 26 and the inlet performance characteristics are presented in Figure 27.

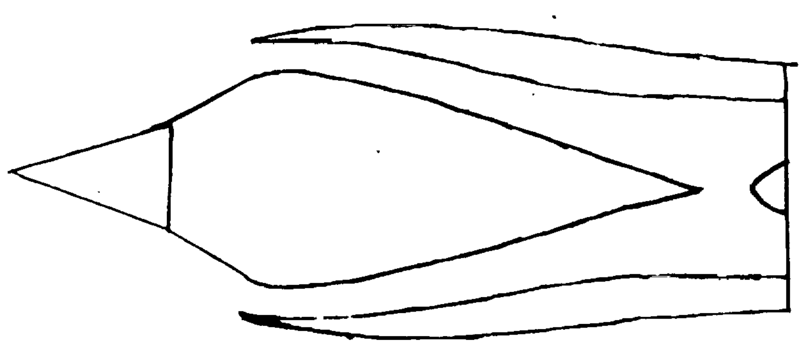

Figure 27 Half-Round External-Compression Inlet for Mach 2.5

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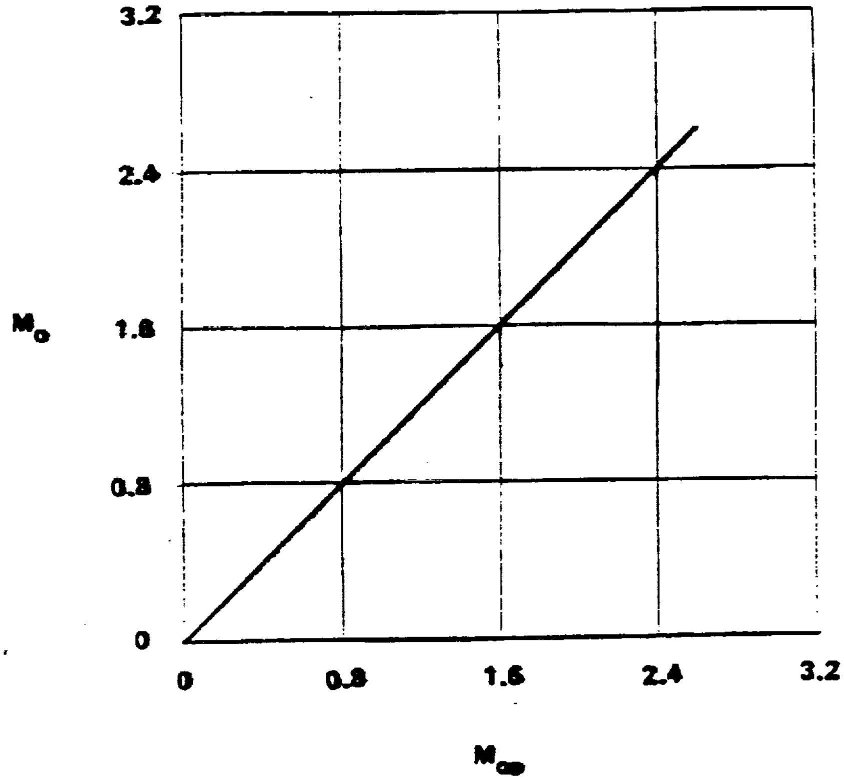


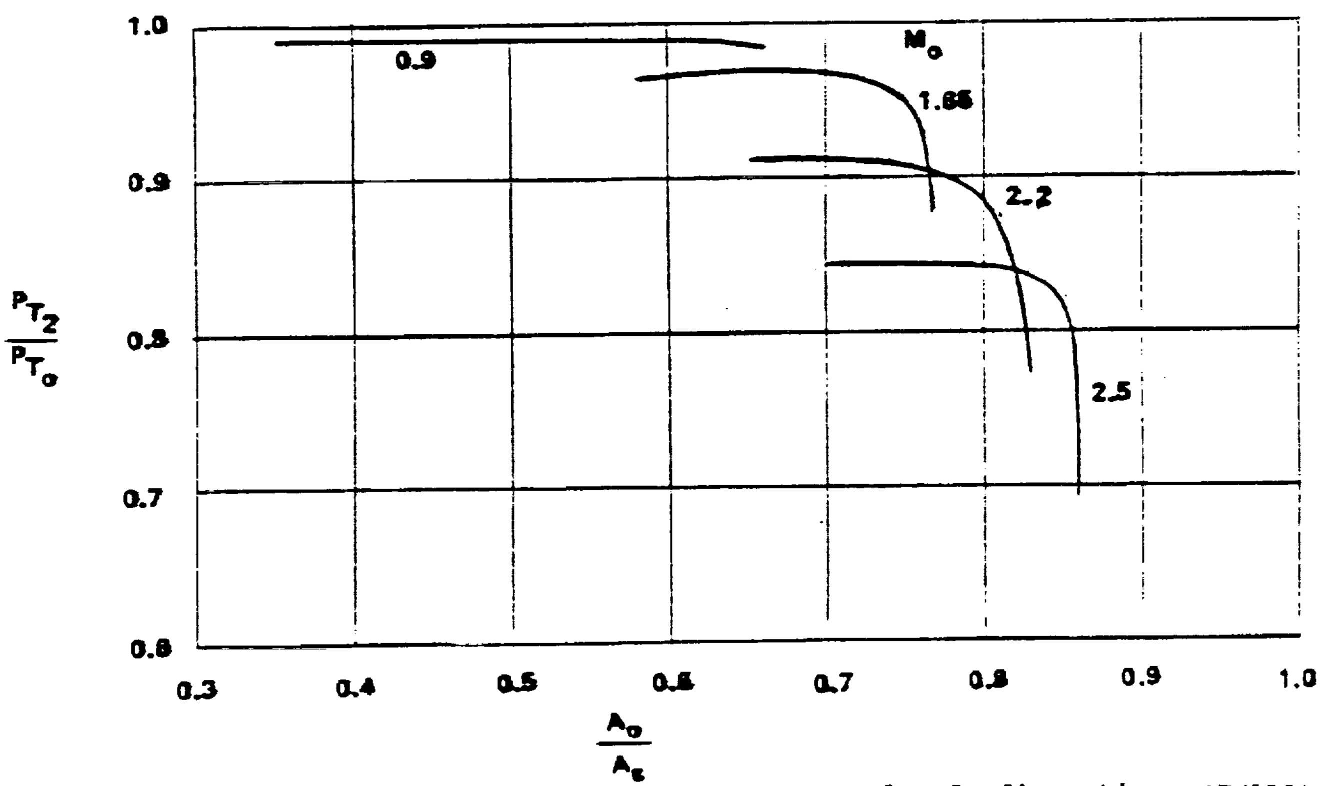


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3'

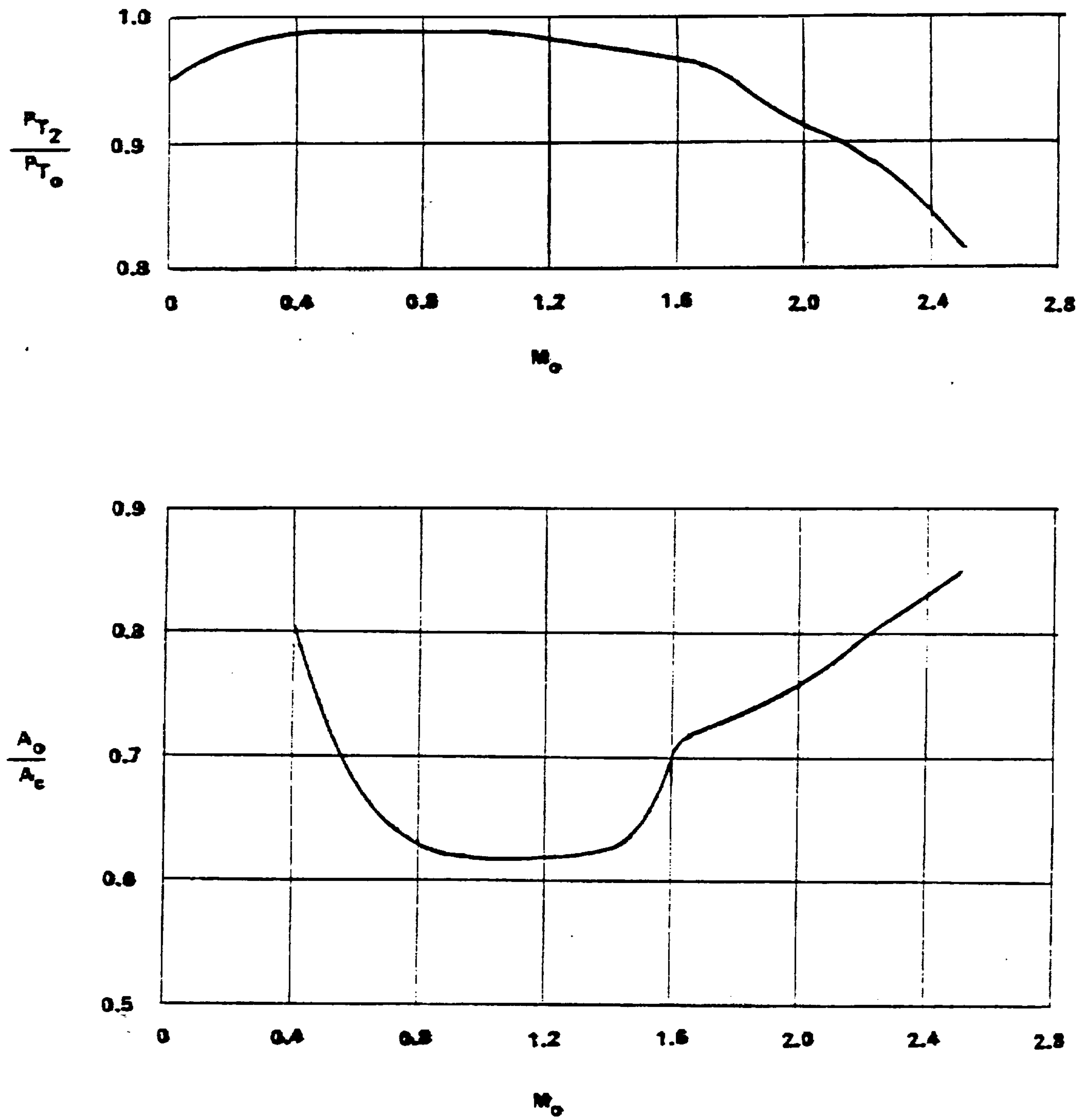
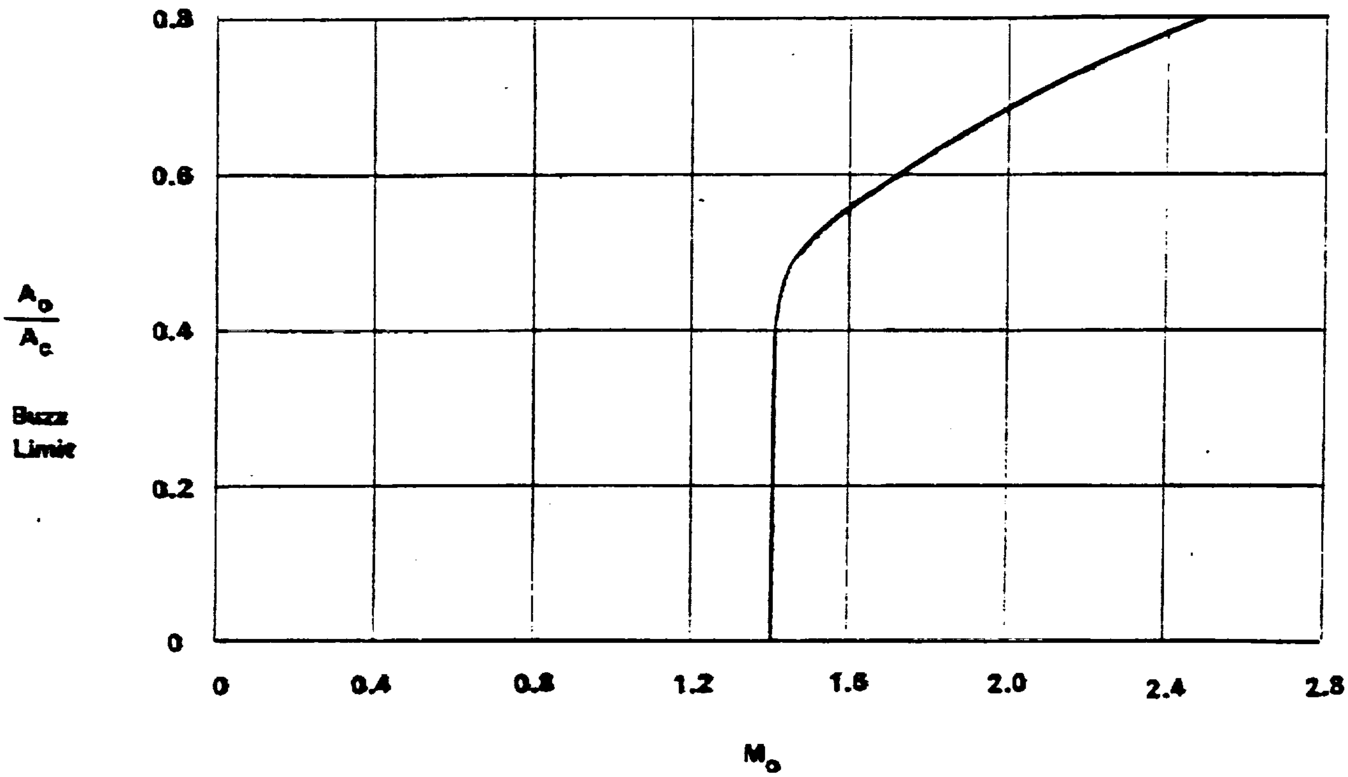


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)



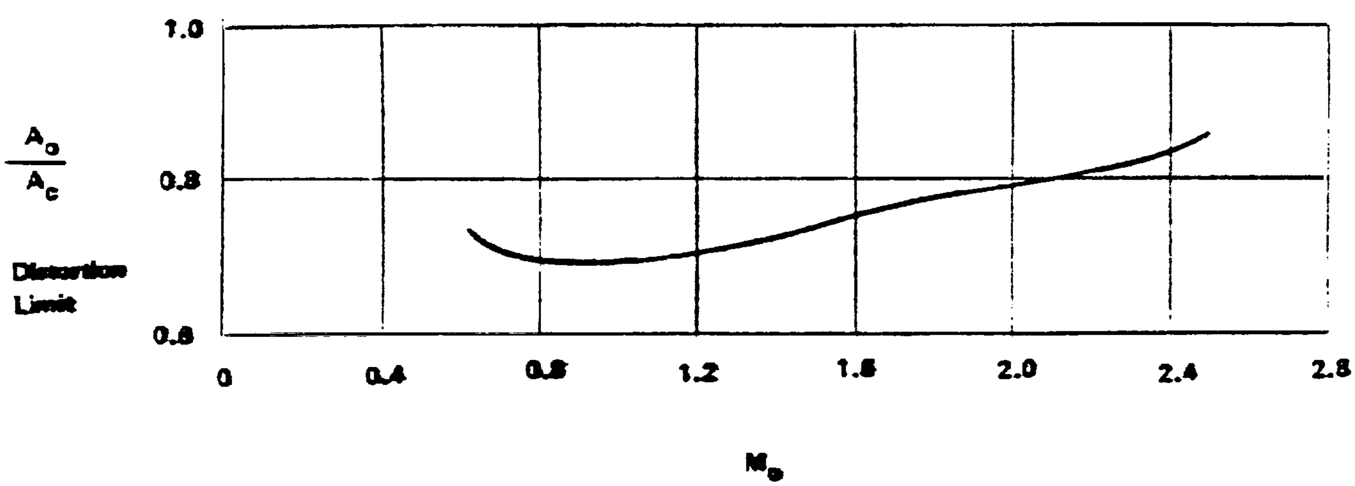


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)

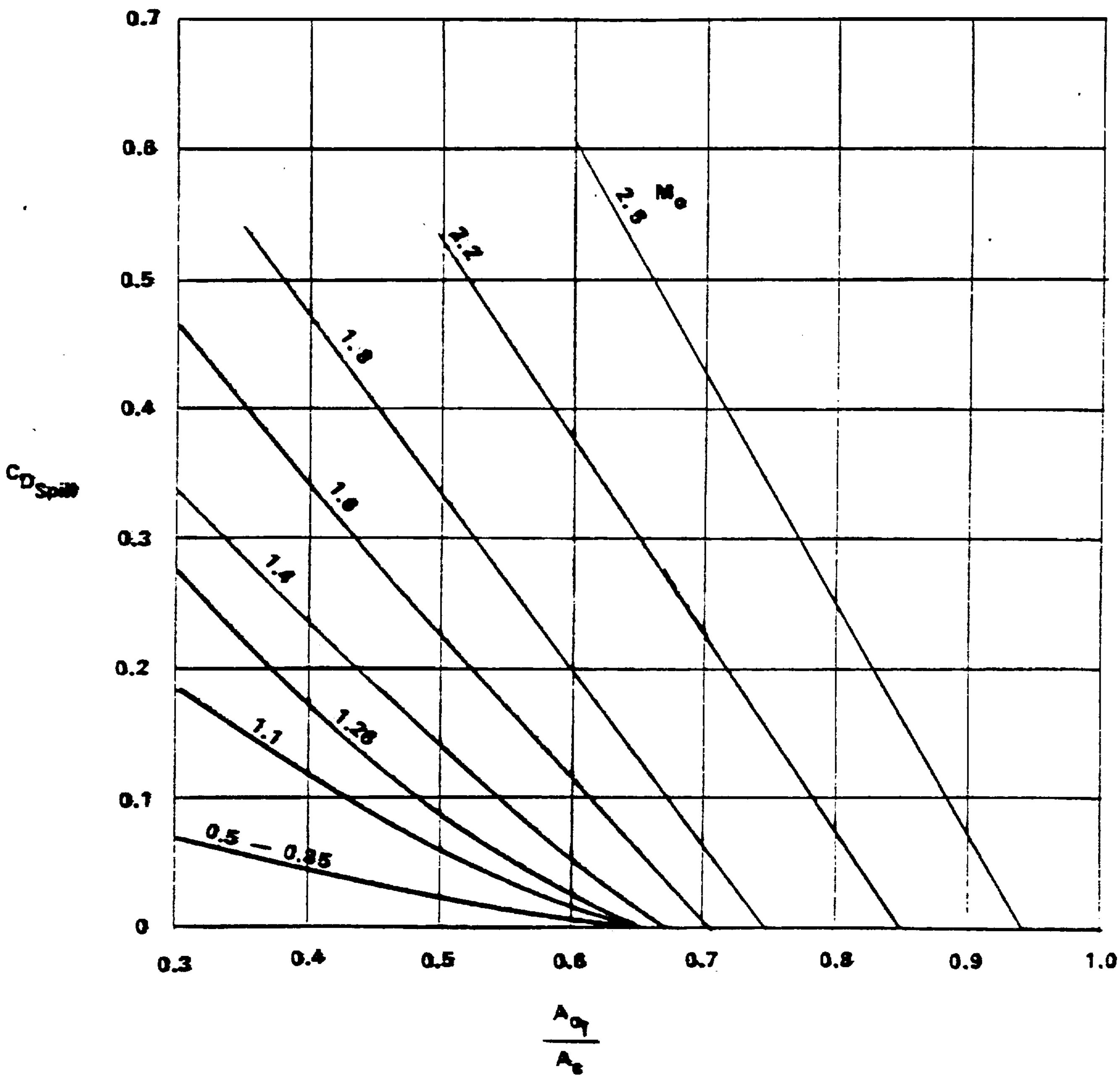
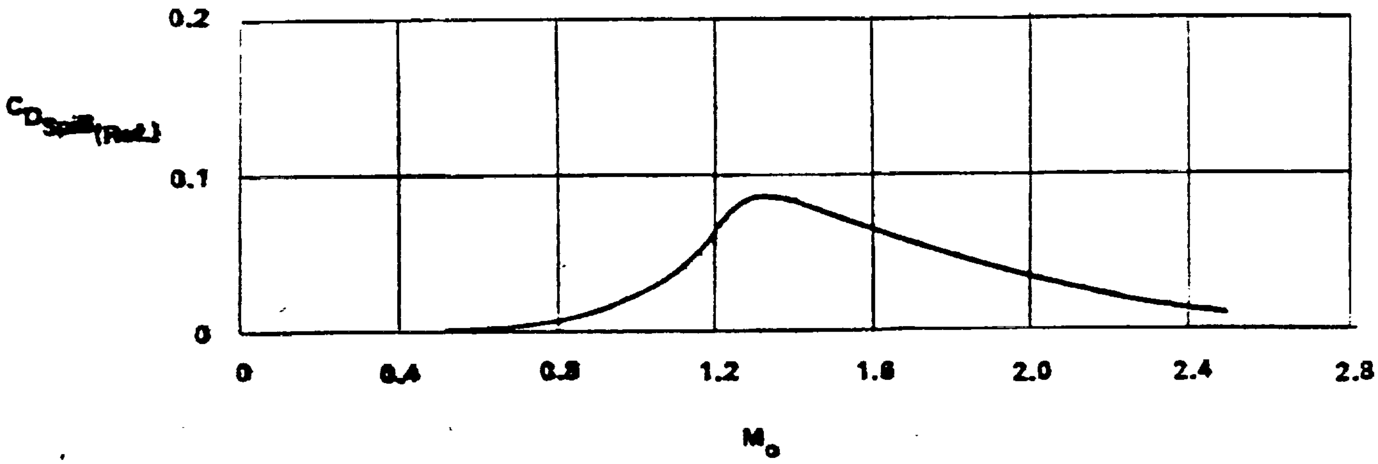


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3'- (continued)



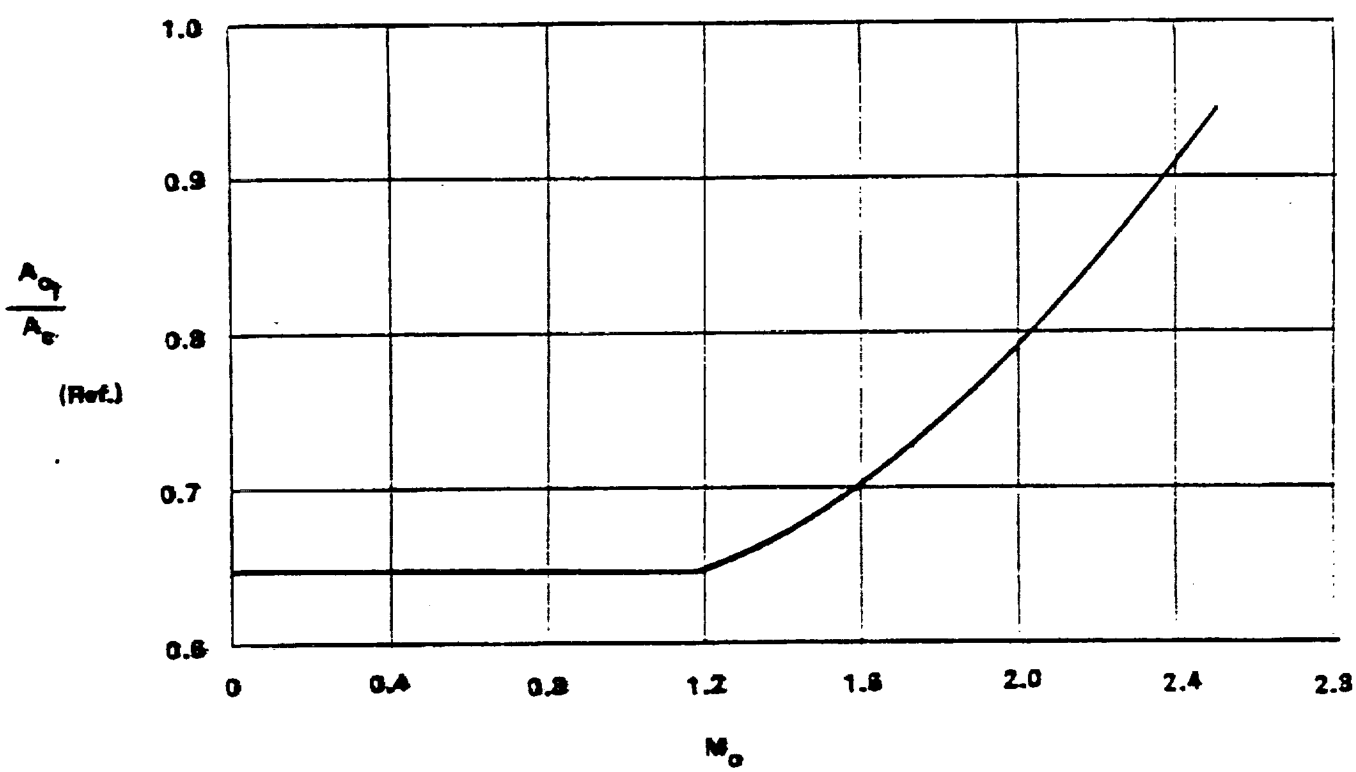


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)

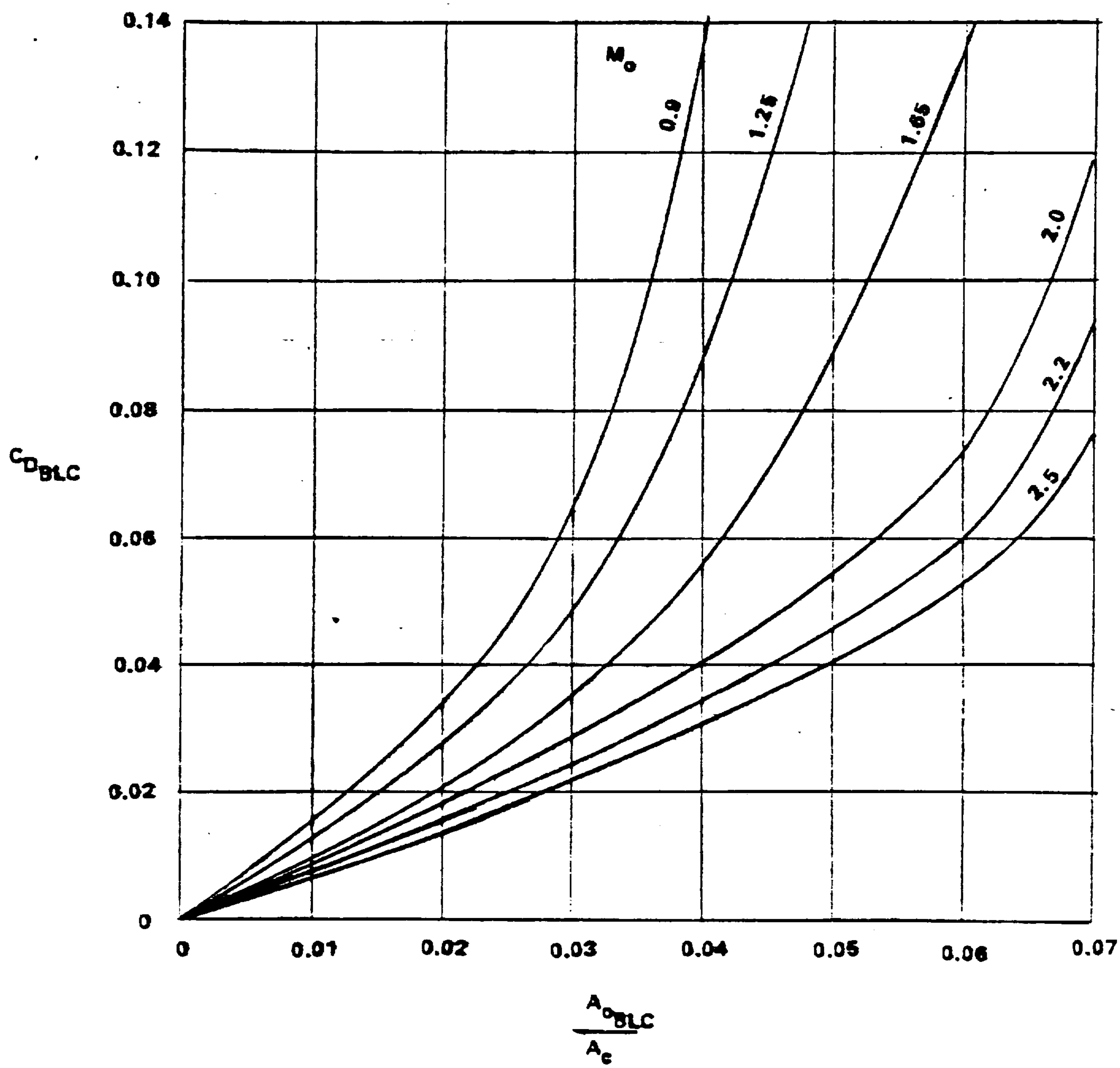


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)

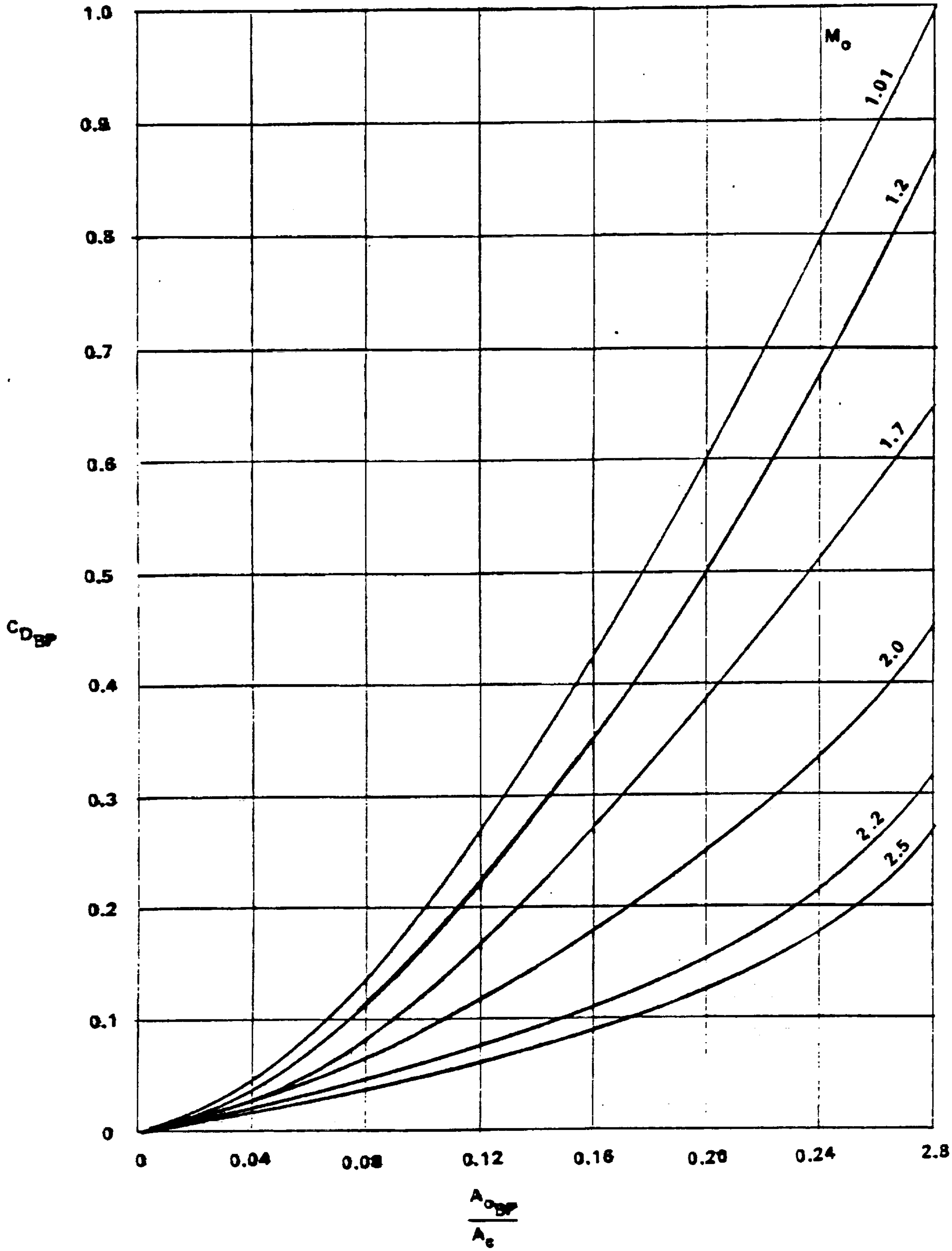
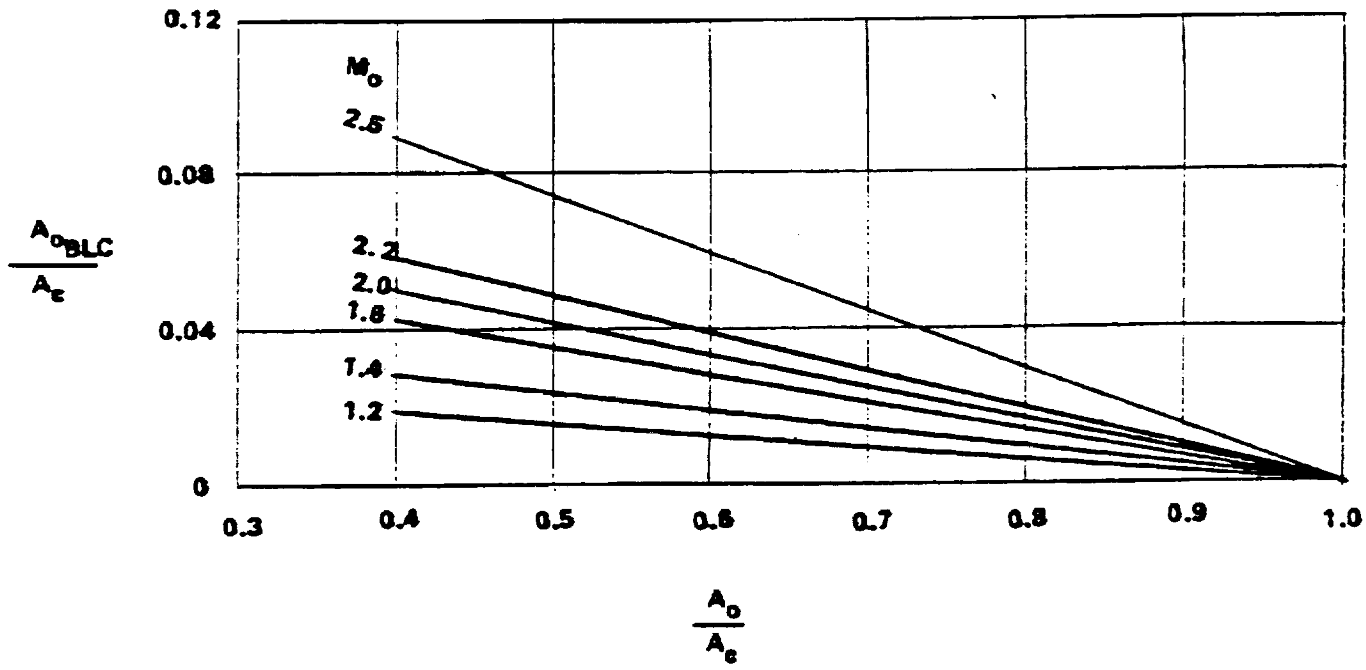


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)



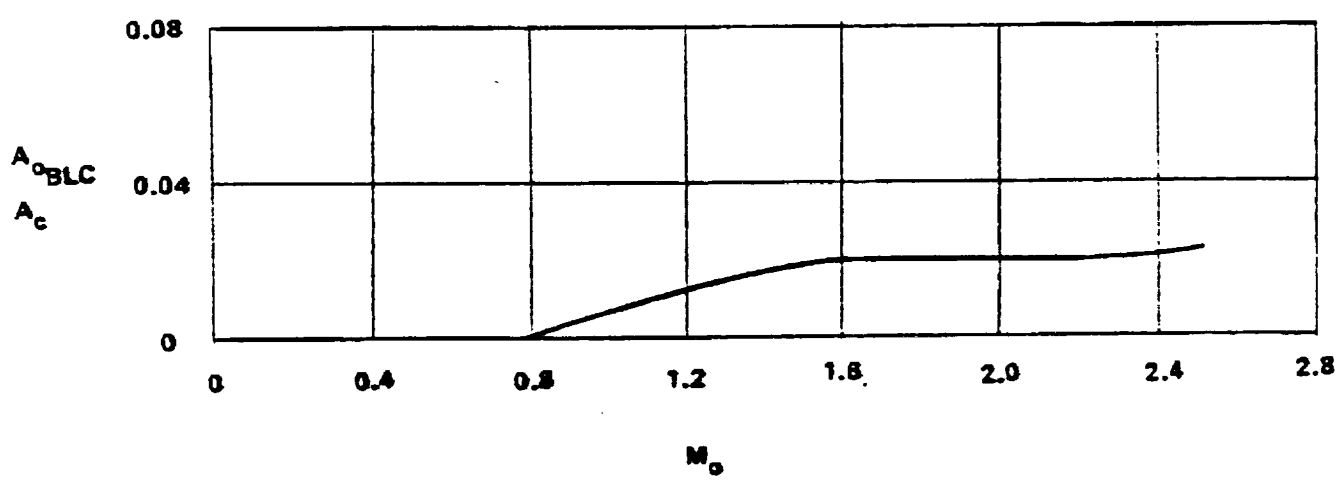


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3' - (continued)

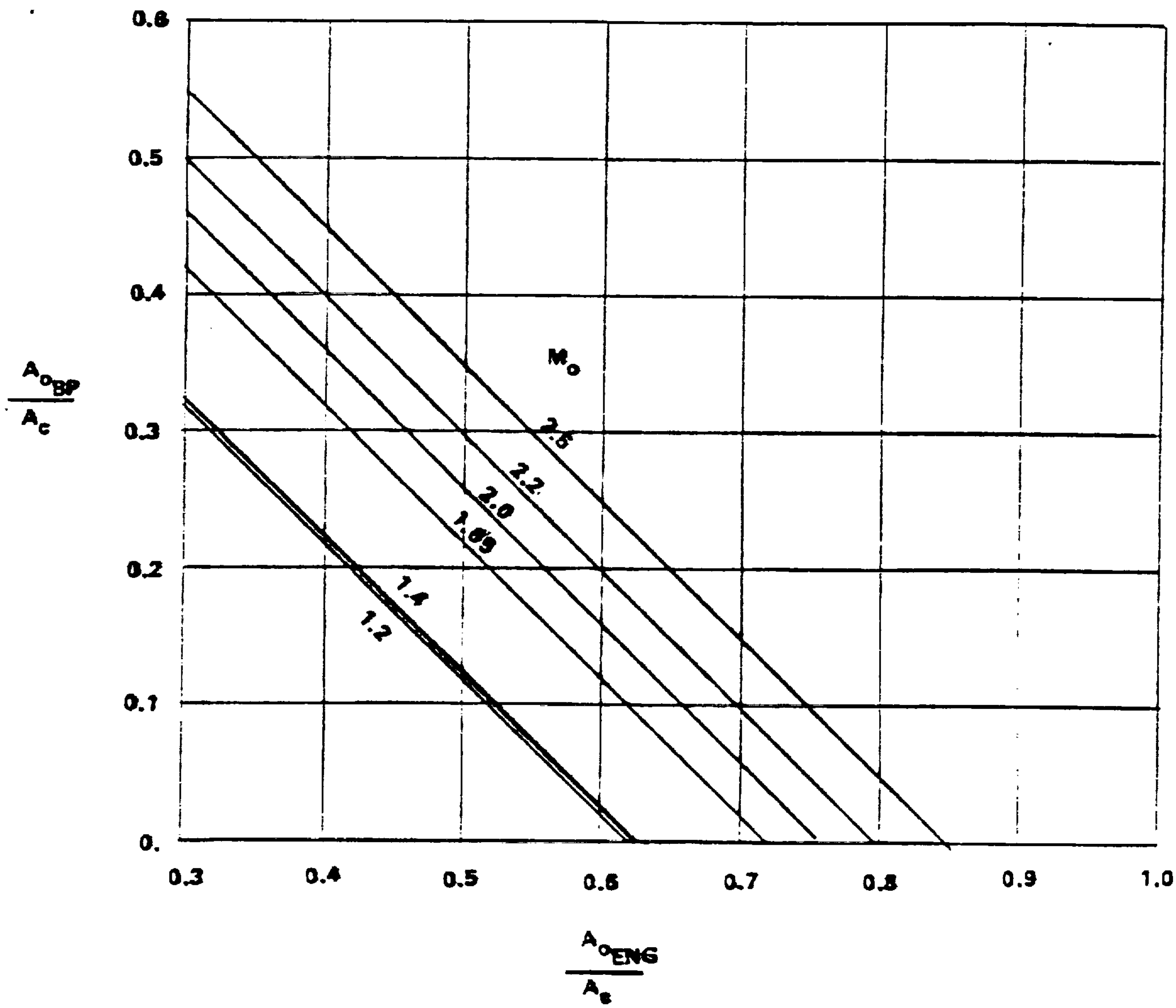


Figure 28. Performance Characteristics for Inlet Configuration - 'TM1B3'- (continued)

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***********
*         *
* TM1B3   *
*         *
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MACH 2.5,HALF-ROUND,EXPAND. CB,3-SHOCK,EXT.COMPR.,BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	18.0000
4	DESIGN MACH NUMBER	2.5000
5	COWL LIP BLUNTNESS	0.0150
6	TAKEOFF DOOR AREA RATIO	0.2500
7	EXTERNAL COWL ANGLE(DEG)	12.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.1000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	0.0
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	2.0000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	15.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1400

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	3.00
NOMINAL THROAT MACH NUMBER	0.70

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***********
* TABLE 1 *          LOCAL MACH NUMBER (MNO)          VS          FREE STREAM MACH NUMBER (MNFS)
***********
```

0.0	1.000	2.500	MNO
0.0	1.000	2.500	MNFS

```
************
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)      VS      MASS FLOW RATIO (AO/AC)      AND      LOCAL MACH NUMBER (MNO)
************
```

MNO=0.900	0.350 0.990	0.500 0.990	0.600 0.990	0.660 0.985	AO/AC PT2/PTO			
MNO=1.650	0.580 0.965	0.650 0.970	0.700 0.968	0.750 0.950	0.762 0.925	0.770 0.875	0.775 0.700	AO/AC PT2/PTO
MNO=2.200	0.650 0.912	0.750 0.908	0.800 0.885	0.825 0.825	0.830 0.775	0.835 0.600	AO/AC PT2/PTO	
MNO=2.500	0.700 0.846	0.800 0.843	0.825 0.838	0.850 0.820	0.860 0.755	0.861 0.690	AO/AC PT2/PTO	

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PTO OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.900	1.200	1.650	2.200	2.500	MNO
0.950	0.990	0.990	0.983	0.965	0.885	0.818	PT2/PTO

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.400	0.900	1.200	1.650	2.200	2.500	MNO
0.800	0.620	0.620	0.720	0.800	0.850	AO/AC

****
* TABLE 2D *
****

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	1.400	1.650	2.200	2.500	MNO
0.0	0.0	0.580	0.740	0.800	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.900	1.200	1.650	2.200	2.500	MNO

	0.730	0.690	0.700	0.760	0.810	0.850	AO/AC

****
* TABLE 3 * SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.0	0.0 0.0	1.000 0.0	AOI/AC CDSPL				
MNO=0.500	0.300 0.070	0.400 0.044	0.500 0.021	0.650 0.0	1.000 0.0	AOI/AC CDSPL	
MNO=0.850	0.300 0.070	0.400 0.044	0.500 0.021	0.650 0.0	1.000 0.0	AOI/AC CDSPL	
MNO=1.100	0.300 0.185	0.400 0.115	0.500 0.060	0.600 0.015	0.650 0.0	1.000 0.0	AOI/AC CDSPL
MNO=1.260	0.300 0.273	0.400 0.170	0.500 0.085	0.600 0.027	0.650 0.0	1.000 0.0	AOI/AC CDSPL
MNO=1.400	0.300 0.335	0.500 0.140	0.600 0.052	0.670 0.0	1.000 0.0	AOI/AC CDSPL	
MNO=1.600	0.300 0.460	0.500 0.225	0.700 0.0	1.000 0.0	AOI/AC CDSPL		
MNO=1.800	0.400 0.470	0.550 0.265	0.745 0.0	1.000 0.0	AOI/AC CDSPL		
MNO=2.200	0.500 0.530	0.650 0.300	0.850 0.0	1.000 0.0	AOI/AC CDSPL		
MNO=2.500	0.600 0.605	0.940 0.0	1.000 0.0	AOI/AC CDSPL			

****

*** TABLE 3A ***
****

REF SPILLAGE DRAG COEFF (REF CDSPL) VS LOCAL MACH NUMBER (MNO)

0.0	0.500	0.850	1.100	1.260	1.400	1.600	1.800	2.200	2.500	MNO
0.0	0.0	0.010	0.015	0.085	0.083	0.065	0.050	0.020	0.010	REF CDSPL

****
*** TABLE 3B ***
****

REF INLET MASS FLOW RATIO (REF AOI/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.500	0.850	1.100	1.260	1.400	1.600	1.800	2.200	2.500	MNO
0.645	0.645	0.645	0.645	0.651	0.670	0.700	0.745	0.850	0.942	REF AOI/AC

****
*** TABLE 4 ***
****

BLEED DRAG COEFFICIENT (CD BLD) VS BLEED MASS FLOW RATIO (AOBLD/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	0.890	0.900	1.250	1.650	2.000	2.200	2.500	MNO
MNO=0.0	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD
MNO=0.890	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBLD
MNO=0.900	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.016	0.034	0.065	0.136	0.140	0.140	0.140	CDBLD
MNO=1.250	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.012	0.027	0.049	0.089	0.140	0.140	0.140	CDBLD
MNO=1.650	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.010	0.021	0.035	0.056	0.089	0.135	0.140	CDBLD
MNO=2.000	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.008	0.018	0.028	0.040	0.054	0.073	0.120	CDBLD
MNO=2.200	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.007	0.016	0.025	0.034	0.046	0.059	0.093	CDBLD
MNO=2.500	0.0	0.010	0.020	0.030	0.040	0.050	0.060	0.070	AOBLD/AC
	0.0	0.006	0.014	0.022	0.031	0.040	0.052	0.076	CDBLD

```
************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND     LOCAL MACH NUMBER (MNO)
************

               1.010      1.200      1.700      2.000      2.200      2.500      MNO

MNO=1.010      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.048      0.138      0.270      0.425      0.600      0.800      1.000      CDBYP

MNO=1.200      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.042      0.114      0.230      0.350      0.500      0.675      0.875      CDBYP

MNO=1.700      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.028      0.083      0.167      0.275      0.390      0.510      0.650      CDBYP

MNO=2.000      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.025      0.062      0.118      0.180      0.250      0.335      0.450      CDBYP

MNO=2.200      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.024      0.048      0.077      0.110      0.155      0.220      0.320      CDBYP

MNO=2.500      0.0        0.040      0.080      0.120      0.160      0.200      0.240      0.280      AOBYP/AC
               0.0        0.017      0.038      0.060      0.090      0.130      0.180      0.270      CDBYP


************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)          AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0        0.400      1.000      AO/AC
               0.0        0.0        AOBLD/AC

MNO=0.800      0.400      1.000      AO/AC
               0.0        0.0        AOBLD/AC

MNO=1.200      0.400      1.000      AO/AC
```

```
               0.019      0.0        AOBLD/AC

MNO=1.400      0.400      1.000      AO/AC
               0.028      0.0        AOBLD/AC

MNO=1.600      0.400      1.000      AO/AC
               0.042      0.0        AOBLD/AC

MNO=2.000      0.400      1.000      AO/AC
               0.050      0.0        AOBLD/AC

MNO=2.200      0.400      1.000      AO/AC
               0.058      0.0        AOBLD/AC

MNO=2.500      0.400      1.000      AO/AC
               0.089      0.0        AOBLD/AC


************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                0.0        0.800      1.200      1.400      1.600      2.000      2.200      2.500      MNO
                0.0        0.0        0.012      0.017      0.020      0.020      0.020      0.023      AOBLD/AC

************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)       VS       ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************

MNO=0.0         0.300      1.000      AOE/AC
                0.0        0.0        AOBYP/AC

MNO=1.190       0.300      1.000      AOE/AC
                0.0        0.0        AOBYP/AC

MNO=1.200       0.300      0.620      1.000      AOE/AC
                0.320      0.0        0.0        AOBYP/AC

MNO=1.400       0.300      0.625      1.000      AOE/AC
```

	0.325	0.0	0.0	AOBYP/AC
MNO=1.650	0.300	0.720	1.000	AOE/AC
	0.420	0.0	0.0	AOBYP/AC
MNO=2.000	0.300	0.760	1.000	AOE/AC
	0.460	0.0	0.0	AOBYP/AC
MNO=2.200	0.300	0.800	1.000	AOE/AC
	0.500	0.0	0.0	AOBYP/AC
MNO=2.500	0.300	0.850	1.000	AOE/AC
	0.550	0.0	0.0	AOBYP/AC

4.2.1.13 INLET CONFIGURATION 'FB' - MIXED COMPRESSION, TWO-DIMENSIONAL, VARIABLE-GEOMETRY INLET

The mixed compression inlet is a suitable candidate for the fighter/bomber mission instead of an external compression inlet because it offers the potential for higher pressure recovery, lower drag, and better matching characteristics for the sustained Mach 2.5 high speed flight condition. Also, it does not have to meet the same requirements for extremely high maneuverability (high angles-of-attack), which would be difficult to control for the mixed compression inlet.

Boundary layer bleed is accomplished by use of porous ramps, cowl, and side-plates. Bleed air is collected in divided plenum chambers behind the porous walls and is then dumped overboard through choked convergent nozzles as near the plenum chamber as possible. Divided plenums are used to provide optimum bleed capability at lowest drag penalty. Movable ramp and throat panels are used to achieve the best inlet geometry over a wide range of flight Mach numbers.

A bypass system is also used to dump excess inlet air overboard and maintain the terminal shock in its design location just downstream of the geometric throat during started operation and just forward of the lip during external compression operation ($M < 2.0$). Bypass doors are assumed to be variable geometry C-D nozzles.

For takeoff and low speed operation, the ramp system is collapsed to provide a maximum throat area equal to $0.765A_C$. Takeoff doors having a throat area equal to $.12\ A_C$ per engine will also be required. These should be located near the aft end of the subsonic diffuser near the engine.

The ramp geometry was selected to provide shock on lip operation at Mach 2.60. This provides a small margin for angle-of-attack transients and overspeed at Mach 2.50.

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The inlet performance characteristics are based largely on the results of a study documented in Reference 12. The inlet geometry is shown in Figure 28 and the inlet performance characteristics are presented in Figure 29.

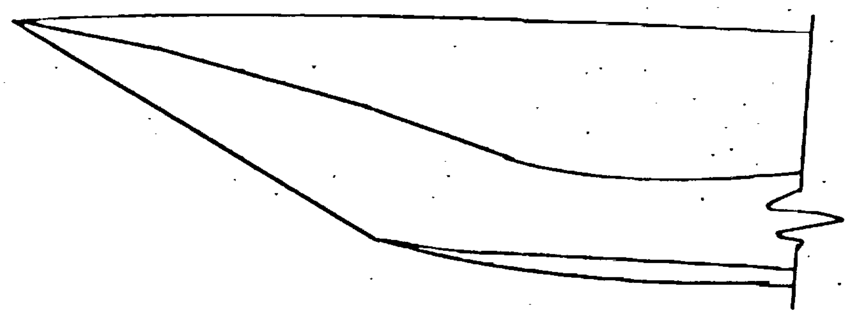


Figure 29   Mach 2.5 Mixed-Compression Two-Dimensional Inlet

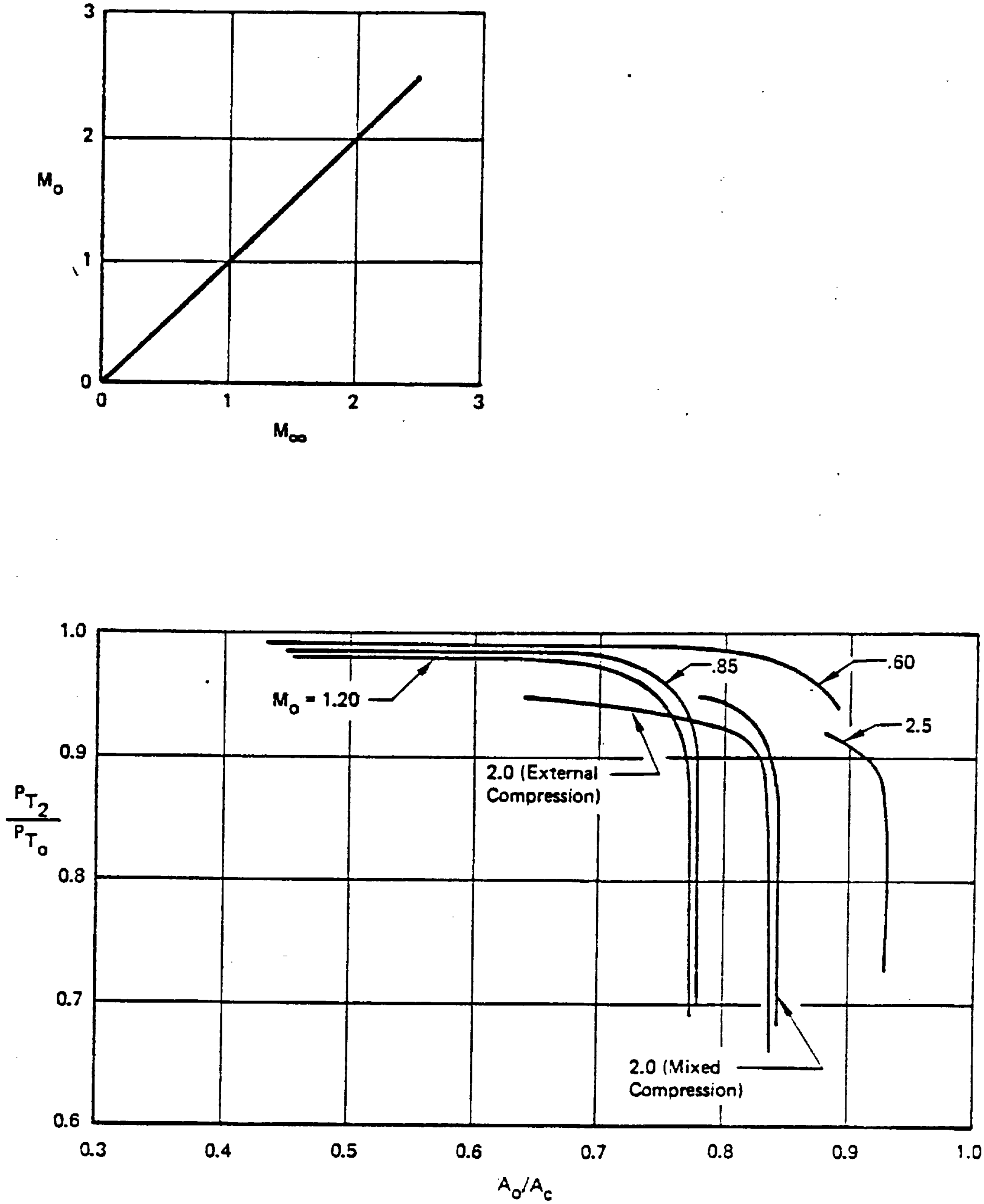
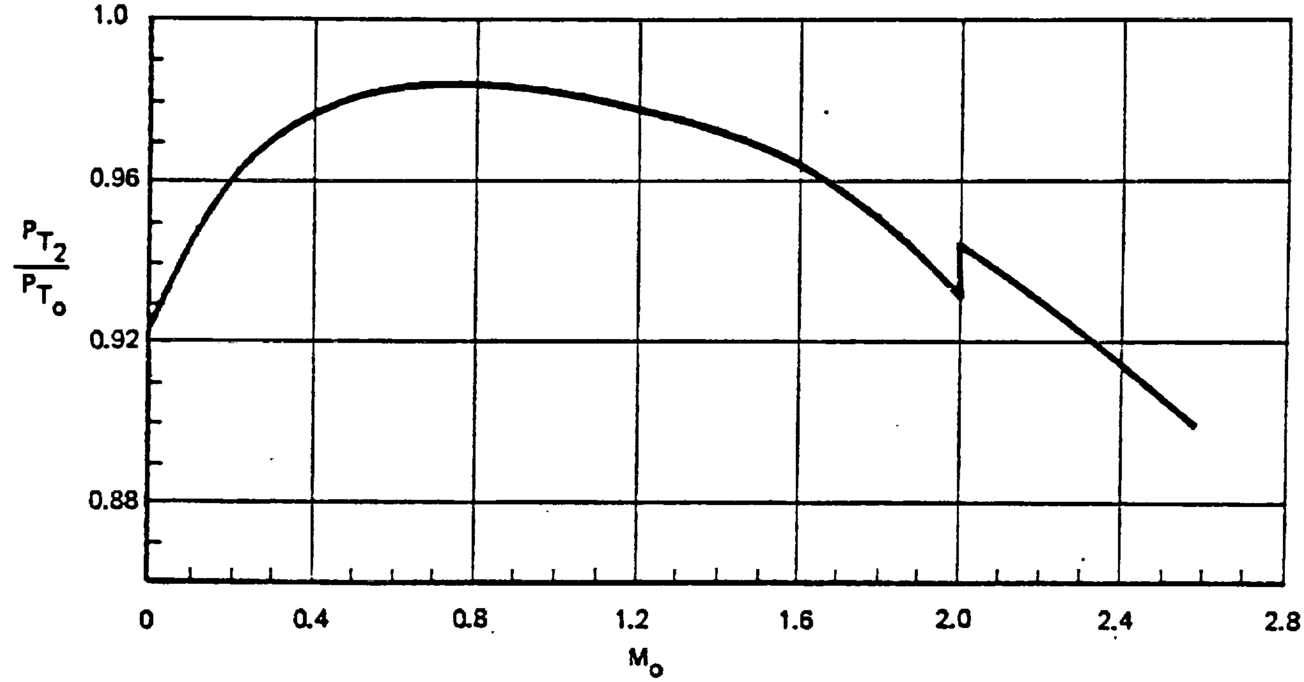


Figure 30. Performance Characteristics for Inlet Configuration - 'FB'



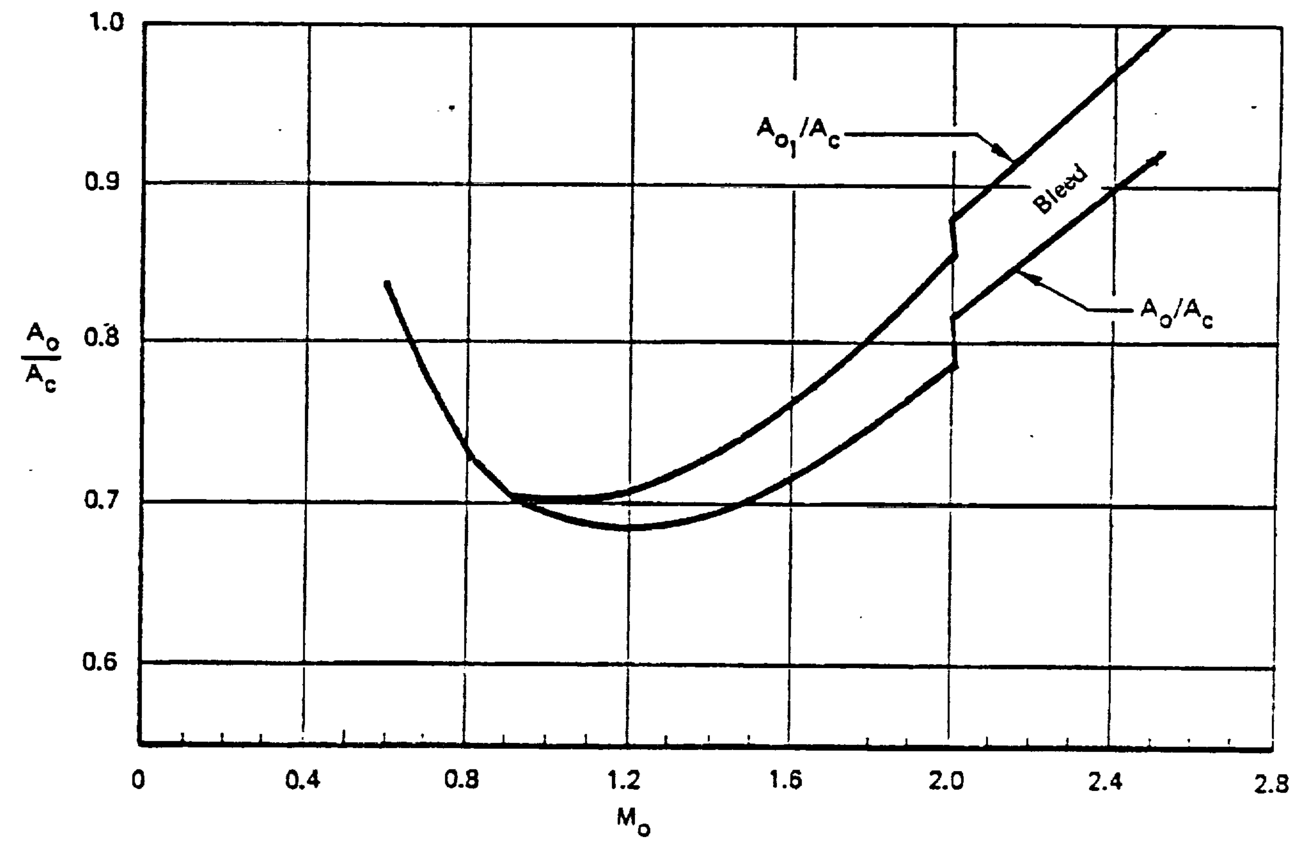
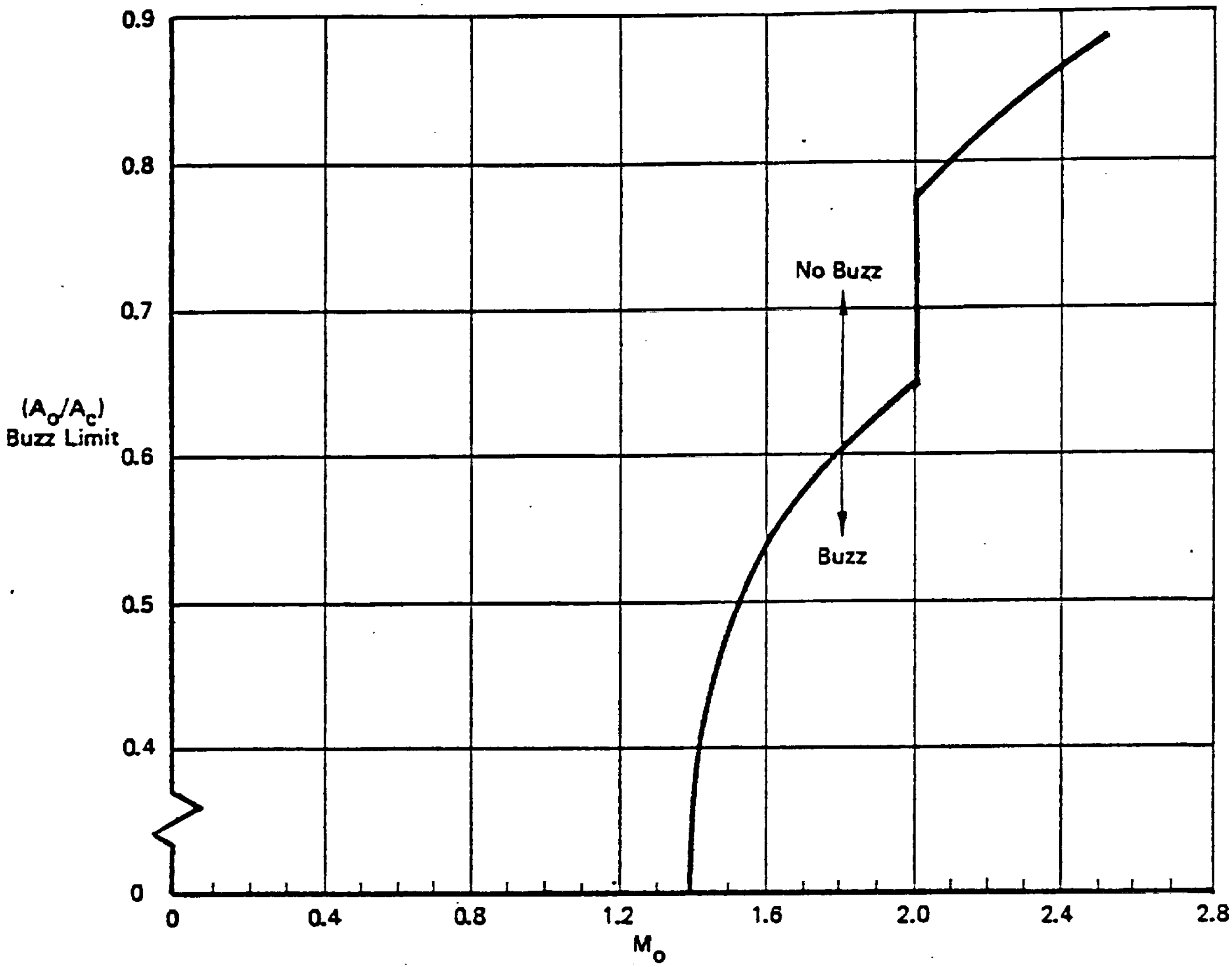


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)



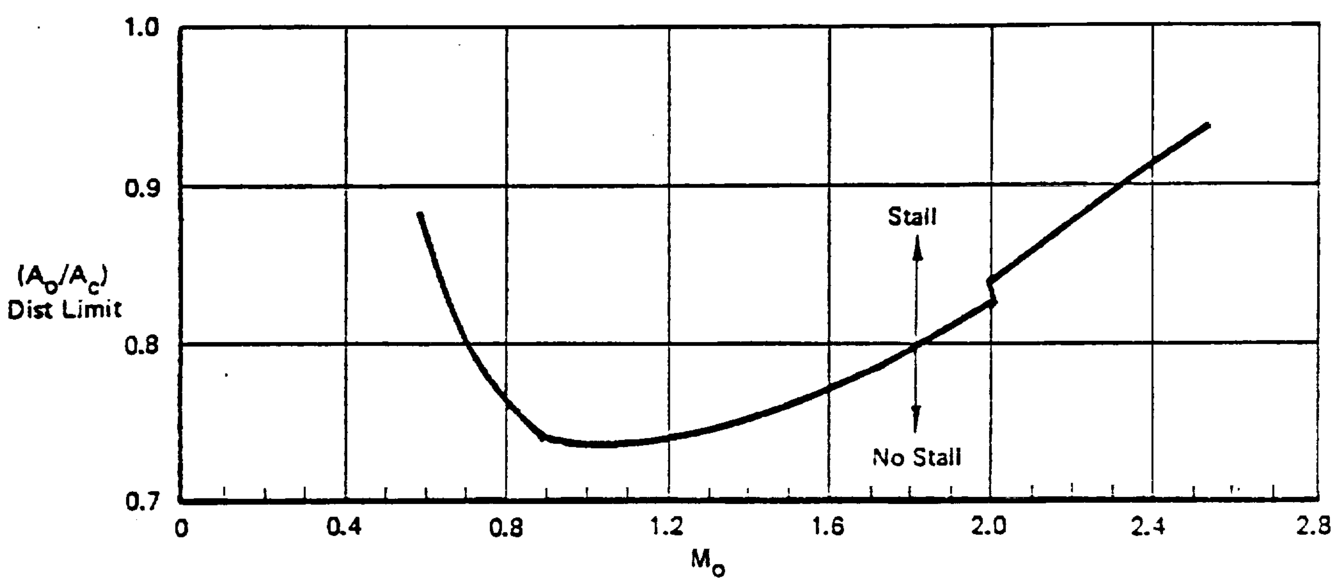


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)

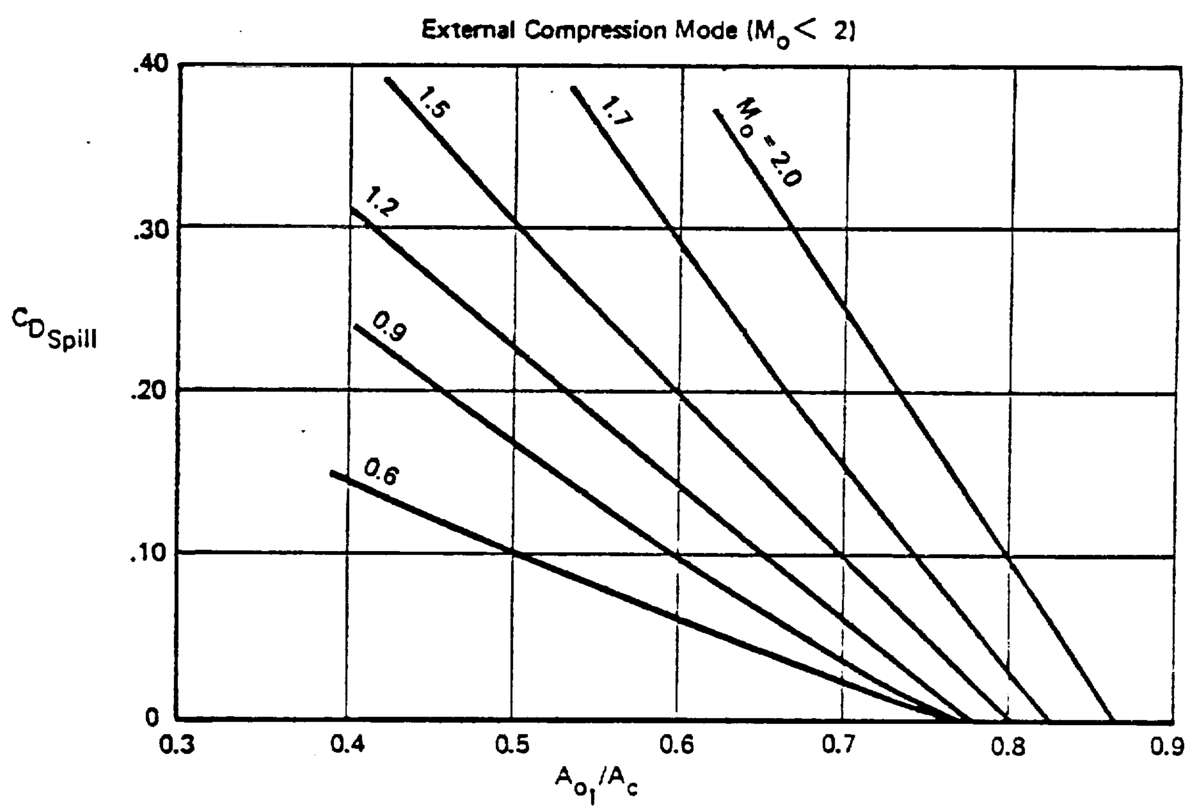
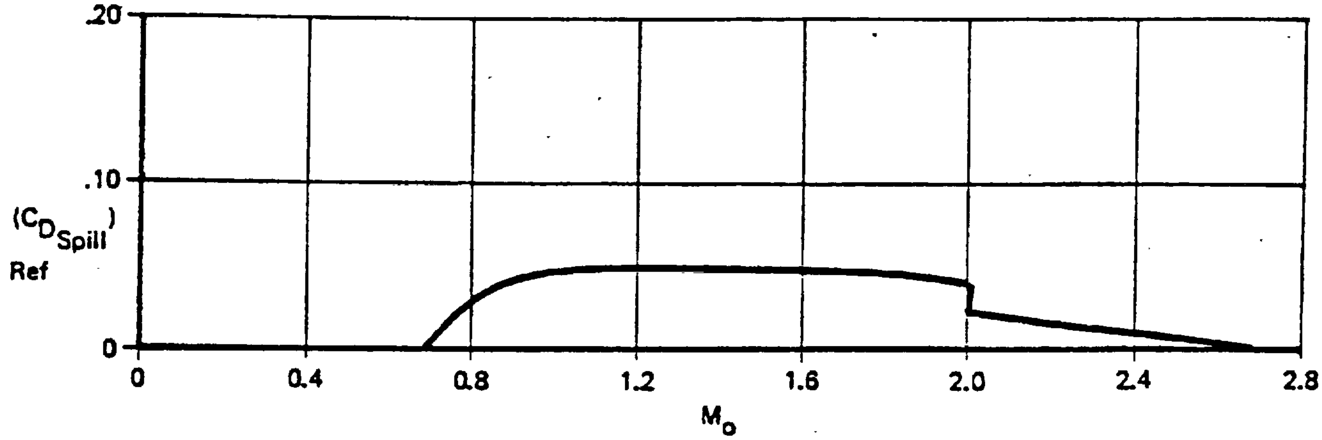


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)



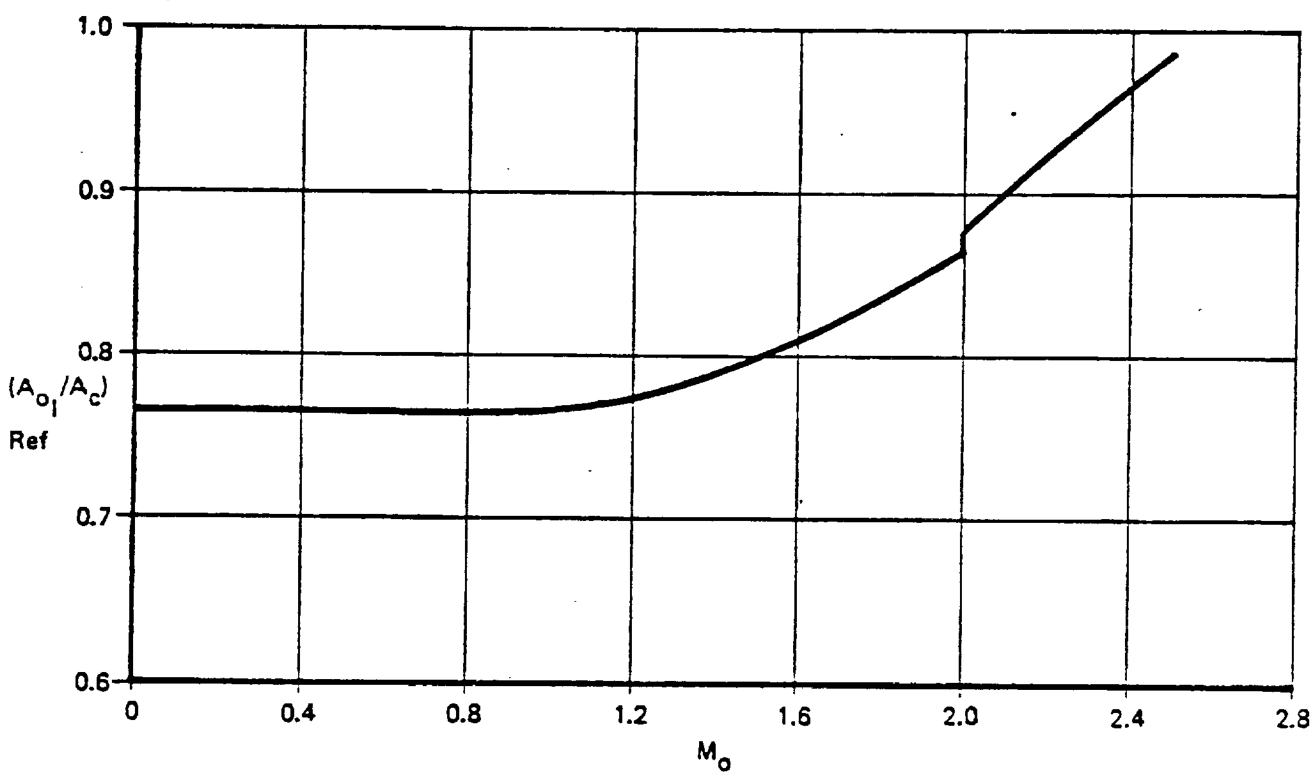
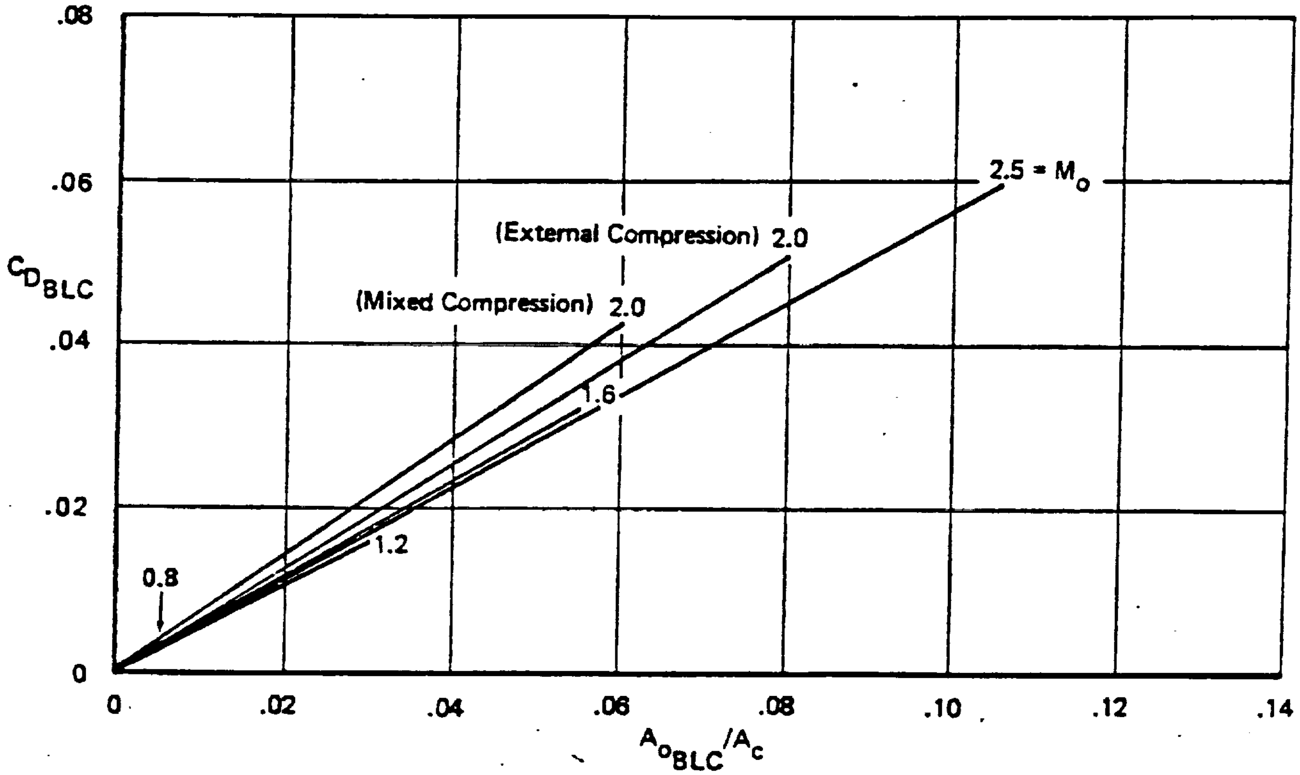


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)



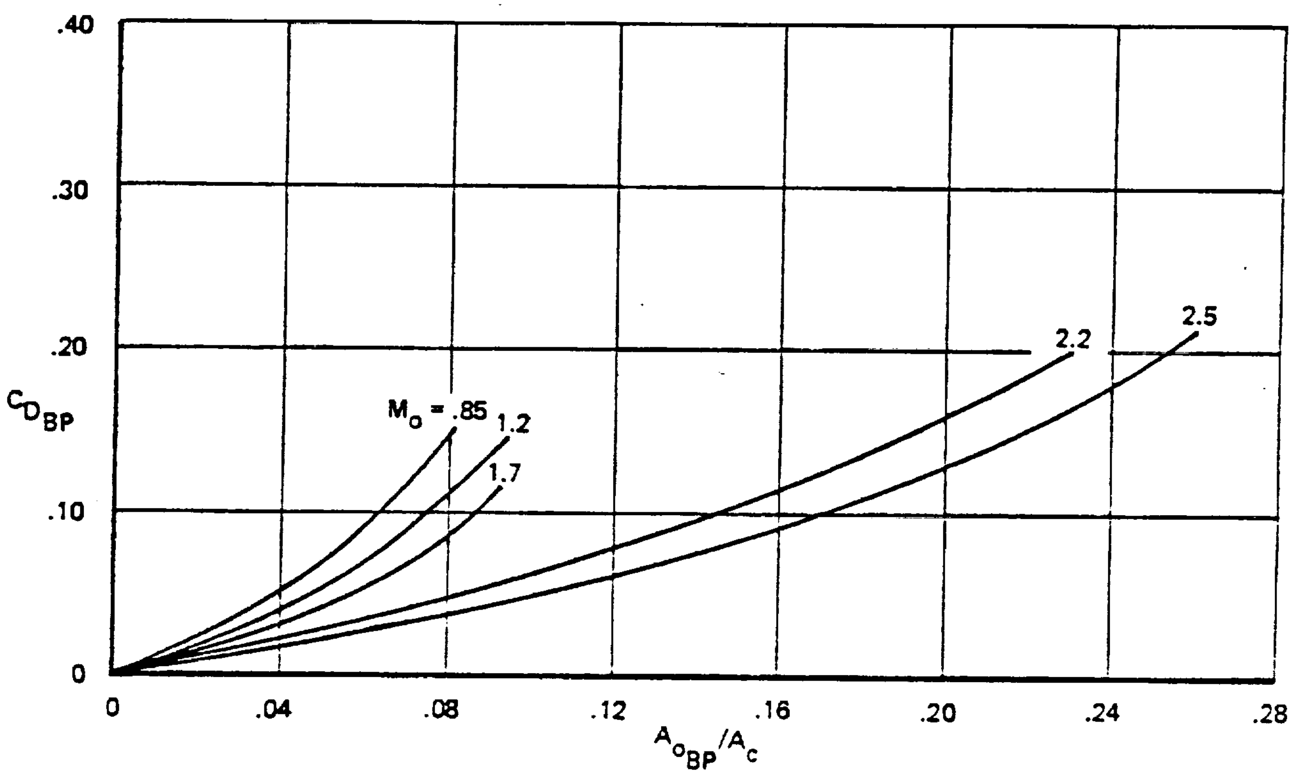
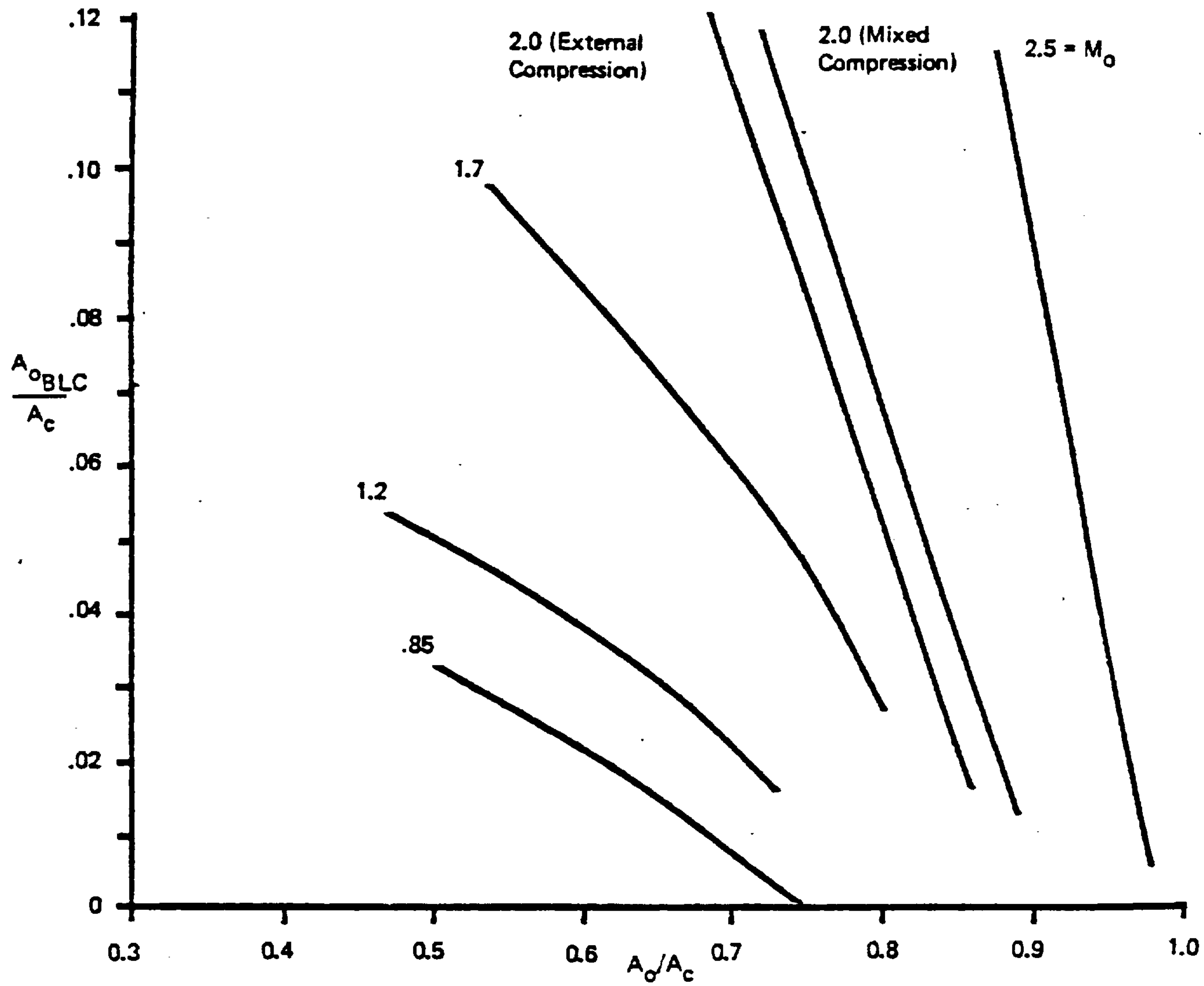


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)



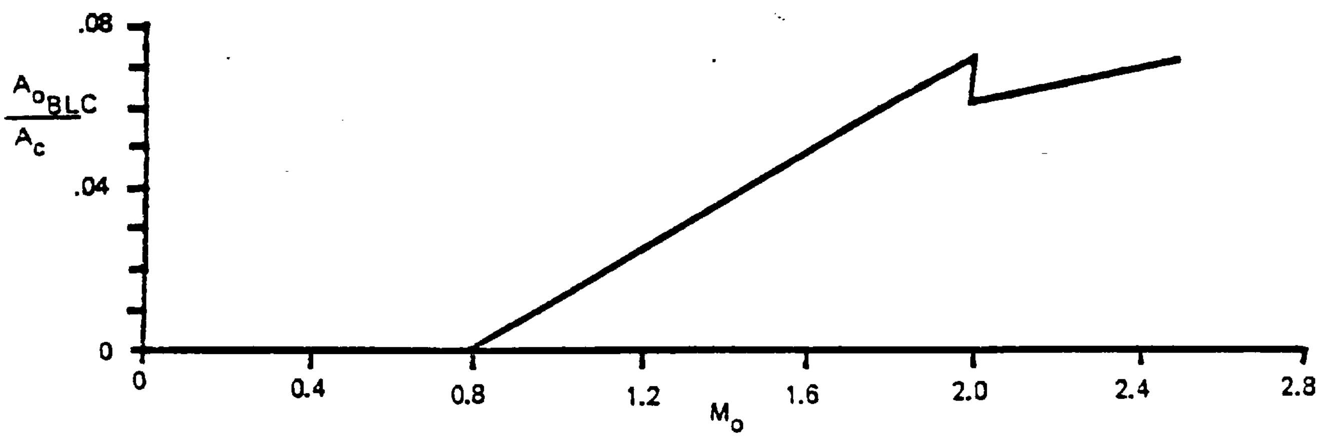


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)

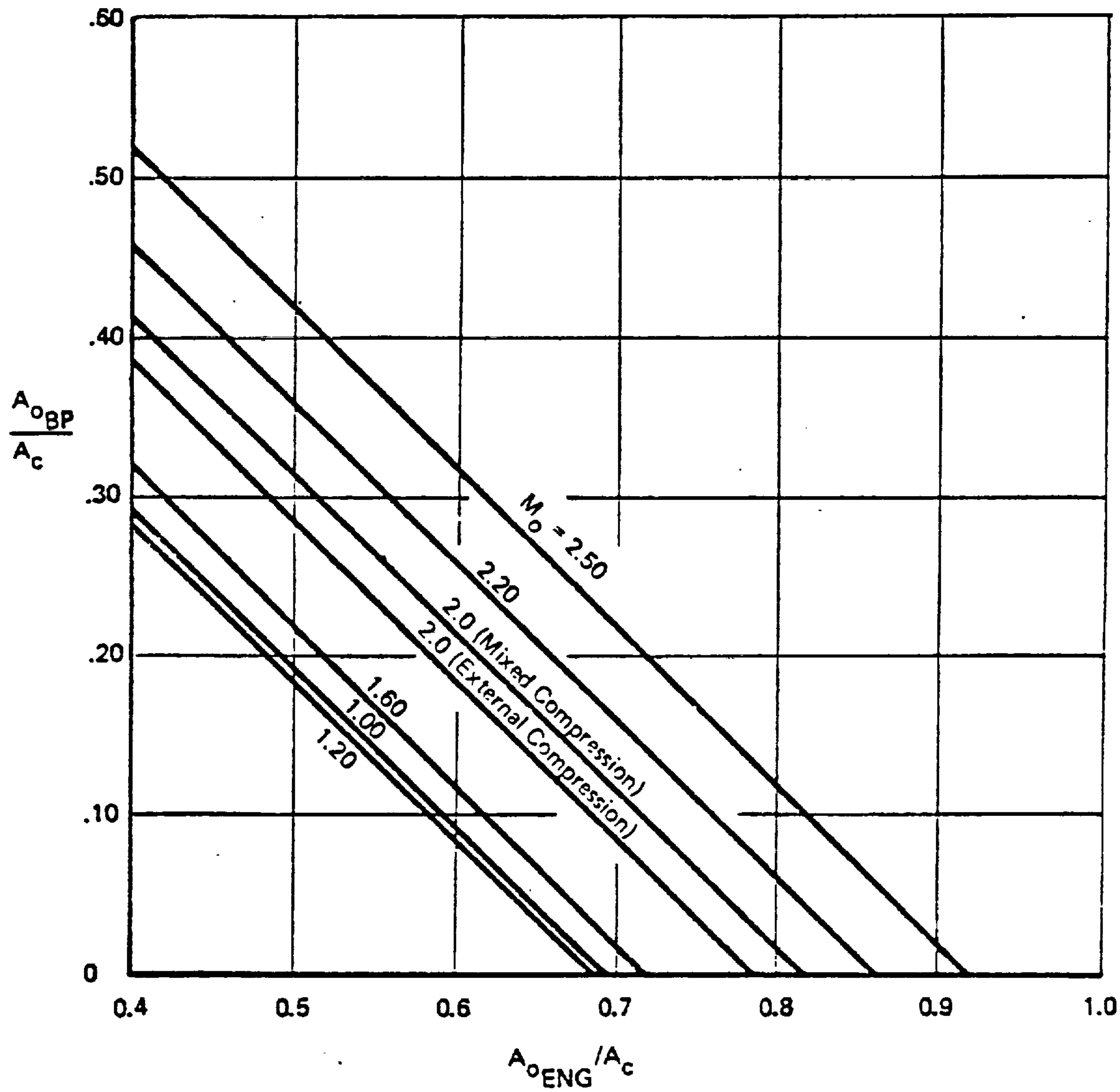


Figure 30. Performance Characteristics for Inlet Configuration - 'FB' - (continued)

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*         *
* FB      *
*         *
***********
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MACH 2.5,2-D,MIXED COMPR.,VARIABLE RAMP,POROUS BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	1.0000
2	SIDEPLATE CUTBACK	0.0
3	FIRST RAMP ANGLE(DEG)	7.0000
4	DESIGN MACH NUMBER	2.5000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.1200
7	EXTERNAL COWL ANGLE(DEG)	12.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	20.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.9000
11	EXIT FLAP AREA RATIO FOR BLEED	0.2000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	20.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	1.4000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	9.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1400

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	2.01
NOMINAL THROAT MACH NUMBER	0.80

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***********
* TABLE 1 *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	1.000	2.000	3.000	MNO
0.0	1.000	2.000	3.000	MNFS

****

* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.600	0.750	0.775	0.800	0.825	0.850	0.875	0.900	AO/AC	
	0.990	0.990	0.985	0.982	0.973	0.958	0.928	PT2/PT0	
MNO=0.850	0.625	0.650	0.675	0.700	0.725	0.750	0.775	0.780	AO/AC
	0.985	0.985	0.983	0.980	0.975	0.962	0.925	0.900	PT2/PT0
MNO=1.200	0.625	0.650	0.675	0.700	0.725	0.750	0.765	0.775	AO/AC
	0.980	0.980	0.976	0.972	0.965	0.947	0.920	0.850	PT2/PT0
MNO=2.000	0.700	0.725	0.750	0.775	0.800	0.820	0.830	0.840	AO/AC
	0.942	0.939	0.935	0.930	0.923	0.913	0.895	0.825	PT2/PT0
MNO=2.001	0.700	0.725	0.750	0.775	0.800	0.820	0.835	0.845	AO/AC
	0.958	0.956	0.954	0.950	0.945	0.933	0.908	0.850	PT2/PT0
MNO=2.500	0.800	0.825	0.850	0.875	0.900	0.915	0.925	0.930	AO/AC
	0.933	0.930	0.925	0.920	0.912	0.900	0.880	0.850	PT2/PT0

****
* TABLE 2B * OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)
****

0.0	0.300	0.600	1.000	1.400	1.700	2.000	2.001	2.200	2.500	MNO
0.920	0.969	0.980	0.979	0.970	0.955	0.929	0.940	0.925	0.900	PT2/PT0

****
* TABLE 2C * OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)
****

0.600	0.800	1.000	1.200	1.400	1.600	2.000	2.001	2.200	2.500	MNO
0.833	0.728	0.688	0.683	0.694	0.716	0.787	0.812	0.856	0.916	AO/AC

****
* TABLE 2D * BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)
****

0.0	1.400	1.500	1.600	1.800	2.000	2.001	2.200	2.500	MNO
0.0	0.0	0.490	0.545	0.610	0.650	0.775	0.822	0.875	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.000	1.200	1.400	1.600	2.000	2.001	2.200	2.500	MNO
0.885	0.765	0.740	0.745	0.755	0.775	0.830	0.838	0.880	0.928	AO/AC

****
* TABLE 3 *
****

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.600	0.400	0.500	0.600	0.700	0.765	1.000	AOI/AC			
	0.143	0.100	0.060	0.022	0.0	0.0	CDSPL			
MNO=0.900	0.400	0.500	0.600	0.700	0.765	1.000	AOI/AC			
	0.243	0.167	0.095	0.033	0.0	0.0	CDSPL			
MNO=1.200	0.400	0.500	0.600	0.700	0.765	0.775	1.000	AOI/AC		
	0.310	0.225	0.140	0.058	0.008	0.0	0.0	CDSPL		
MNO=1.500	0.400	0.500	0.600	0.700	0.765	0.775	0.800	1.000	AOI/AC	
	0.410	0.302	0.195	0.095	0.033	0.023	0.0	0.0	CDSPL	
MNO=1.700	0.400	0.500	0.600	0.700	0.765	0.775	0.800	0.823	1.000	AOI/AC
	0.440	0.440	0.393	0.155	0.070	0.060	0.028	0.0	0.0	CDSPL
MNO=1.990	0.400	0.500	0.600	0.700	0.765	0.775	0.800	0.823	0.865	1.000 AOI/AC
	0.400	0.400	0.400	0.250	0.150	0.136	0.097	0.060	0.0	0.0 CDSPL
MNO=2.000	0.400	0.700	1.000	AOI/AC						
	0.023	0.023	0.023	CDSPL						
MNO=2.200	0.400	0.700	1.000	AOI/AC						
	0.013	0.013	0.013	CDSPL						
MNO=2.400	0.400	0.700	1.000	AOI/AC						
	0.005	0.005	0.005	CDSPL						

```
MNO=2.500      0.400    0.700    1.000    AOI/AC
               0.002    0.002    0.002    CDSPL


************
* TABLE 3A *        REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

               0.0      0.700    0.800    1.200    1.600    2.000    2.010    2.500    MNO
               0.0      0.0      0.030    0.050    0.050    0.045    0.025    0.010    REF CDSPL


************
* TABLE 3B *        REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

               0.0      0.400    0.800    1.200    1.600    2.000    2.010    2.500    MNO
               0.770    0.770    0.770    0.778    0.810    0.865    0.880    0.985    REF AOI/AC


************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

               0.600    0.790    0.800    1.200    1.600    2.000    2.001    2.500    MNO

MNO=0.600      0.0      0.105    AOBLD/AC
               0.0      0.0      CDBLD

MNO=0.790      0.0      0.105    AOBLD/AC
               0.0      0.0      CDBLD

MNO=0.800      0.0      0.105    AOBLD/AC
               0.0      0.067    CDBLD

MNO=1.200      0.0      0.105    AOBLD/AC
               0.0      0.055    CDBLD

MNO=1.600      0.0      0.105    AOBLD/AC
               0.0      0.061    CDBLD
```

MNO=2.000	0.0 0.0	0.105 0.067	AOBLD/AC CDBLD
MNO=2.001	0.0 0.0	0.105 0.075	AOBLD/AC CDBLD
MNO=2.500	0.0 0.0	0.105 0.060	AOBLD/AC CDBLD

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	1.200	1.201	1.700	2.200	2.500	MNO				
MNO=0.0	0.0 0.0	0.040 0.0	0.060 0.0	0.080 0.0	0.100 0.0	0.120 0.0	0.140 0.0	0.180 0.0	0.220 0.0	0.260 0.0	AOBYP/AC CDBYP
MNO=1.200	0.0 0.0	0.040 0.0	0.060 0.0	0.080 0.0	0.100 0.0	0.120 0.0	0.140 0.0	0.180 0.0	0.220 0.0	0.260 0.0	AOBYP/AC CDBYP
MNO=1.201	0.0 0.0	0.040 0.040	0.060 0.070	0.080 0.112	0.100 0.163	0.120 0.235	0.140 0.330	0.180 0.330	0.220 0.330	0.260 0.330	AOBYP/AC CDBYP
MNO=1.700	0.0 0.0	0.040 0.030	0.060 0.053	0.080 0.085	0.100 0.135	0.120 0.200	0.140 0.290	0.180 0.290	0.220 0.290	0.260 0.290	AOBYP/AC CDBYP
MNO=2.200	0.0 0.0	0.040 0.025	0.060 0.037	0.080 0.050	0.100 0.063	0.120 0.080	0.140 0.095	0.180 0.135	0.220 0.185	0.260 0.257	AOBYP/AC CDBYP
MNO=2.500	0.0 0.0	0.040 0.020	0.060 0.028	0.080 0.040	0.100 0.050	0.120 0.063	0.140 0.075	0.180 0.108	0.220 0.150	0.260 0.215	AOBYP/AC CDBYP

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.500	0.600	0.700	0.800	0.850	0.875	AO/AC
	0.0	0.0	0.0	0.0	0.0	0.0	AOBLD/AC
MNO=0.799	0.500	0.600	0.700	0.800	0.850	0.875	AO/AC
	0.0	0.0	0.0	0.0	0.0	0.0	AOBLD/AC
MNO=0.800	0.500	0.600	0.700	0.800	AO/AC		
	0.030	0.019	0.005	0.0	AOBLD/AC		
MNO=1.200	0.500	0.600	0.700	0.800	AO/AC		
	0.049	0.038	0.021	0.0	AOBLD/AC		
MNO=1.700	0.500	0.600	0.700	0.800	0.850	AO/AC	
	0.104	0.083	0.058	0.025	0.0	AOBLD/AC	
MNO=2.000	0.500	0.600	0.700	0.800	0.850	0.875	AO/AC
	0.110	0.110	0.110	0.051	0.021	0.007	AOBLD/AC

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

2.001	2.500	MNO
0.060	0.070	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.400	0.685	0.715	0.785	0.815	0.855	0.915	AOE/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	AOBYP/AC
MNO=1.190	0.400	0.685	0.715	0.785	0.815	0.855	0.915	AOE/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	AOBYP/AC
MNO=1.200	0.400	0.685	AOE/AC					
	0.285	0.0	AOBYP/AC					

MNO=1.600	0.400	0.685	0.715	AOE/AC				
	0.315	0.003	0.0	AOBYP/AC				
MNO=2.000	0.400	0.685	0.715	0.785	AOE/AC			
	0.388	0.100	0.068	0.0	AOBYP/AC			
MNO=2.001	0.400	0.685	0.715	0.785	0.815	AOE/AC		
	0.413	0.128	0.098	0.030	0.0	AOBYP/AC		
MNO=2.200	0.400	0.685	0.715	0.785	0.815	0.855	AOE/AC	
	0.457	0.170	0.140	0.070	0.040	0.0	AOBYP/AC	
MNO=2.500	0.400	0.685	0.715	0.785	0.815	0.855	0.915	AOE/AC
	0.517	0.230	0.200	0.130	0.100	0.060	0.0	AOBYP/AC

4.2.1.14 INLET CONFIGURATION 'INT' - MIXED COMPRESSION, VARIABLE GEOMETRY, TWO-DIMENSIONAL INLET

The inlet is a mixed-compression type, with inlet "starting" occurring at Mach 2.0. Below Mach 2.0, the inlet operates in the external compression mode. Extensive boundary layer bleed is used on the inlet internal ramps, sideplates, and cowl to avoid problems with shock-boundary layer interactions. Three separate plenum chambers are used for collecting the boundary layer bleed air before it is exited overboard through choked convergent exit nozzles. The use of three separate plenums makes it possible to operate with a relatively high plenum pressure and hence, less drag.

The inlet ramp system is designed to provide shock-on-lip operation at Mach 3.0. Approximately 1% supersonic spillage is allowed to help insure that shocks are not ingested at inadvertent overspeed conditions or transient angle-of-attack maneuvers. Full sideplates are provided to minimize sideplate spillage.

A variable bypass sytem is provided ahead of the engine to bypass excess inlet airflow and help restart the inlet. The maximum bypass door throat area is 0.50 A_C. It is assumed that a maximum inlet throat area equal to at least 0.70 A_C can be achieved by retracting the ramps. The requirement for takeoff doors to provide good recovery and low distortion during takeoff can be examined when engine airflow demand characteristics are known.

The total pressure recovery versus mass flow plots have been estimated by using the test results from XB-70, (Reference 4), SST, Boeing in-house studies and tests, and theory. The inlet geometry is shown in Figure 30 and the inlet performance characteristics are presented in Figure 31.

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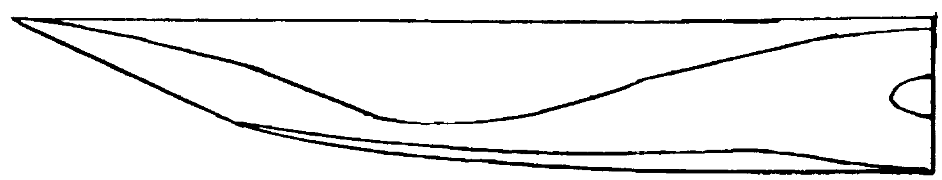


Figure 31 Mach 3.0 Mixed-Compression Two-Dimensional Inlet

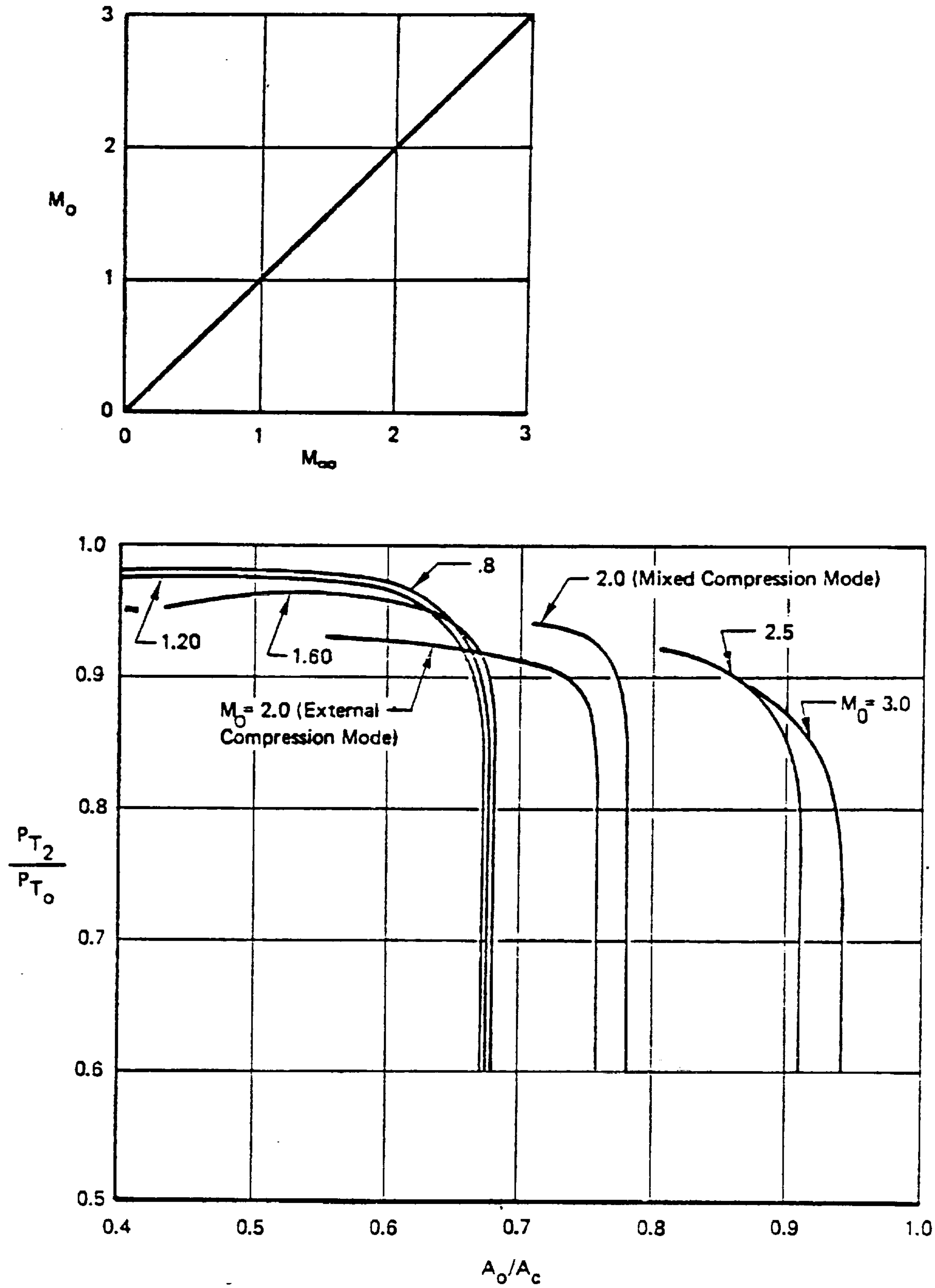
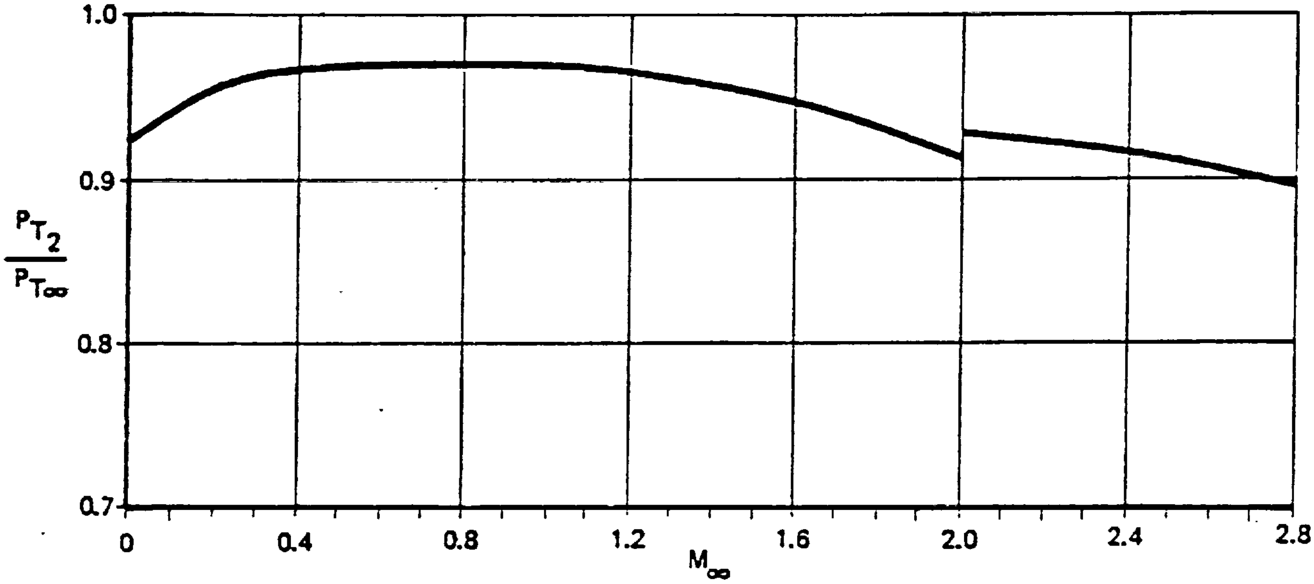


Figure 32. Performance Characteristics for Inlet Configuration - 'INT'



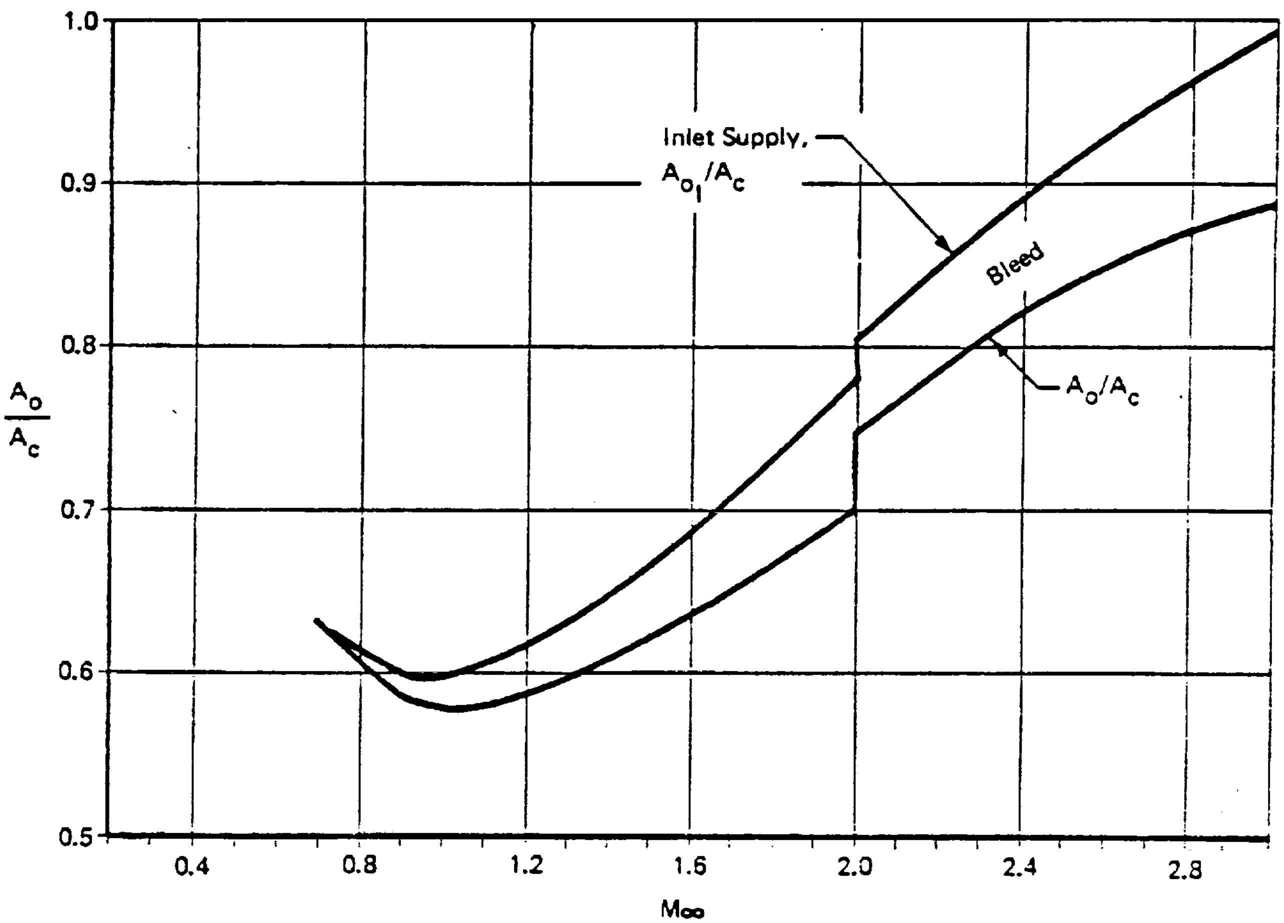


Figure 32. Performance Characteristics for Inlet Configuration - 'INT'- (continued)

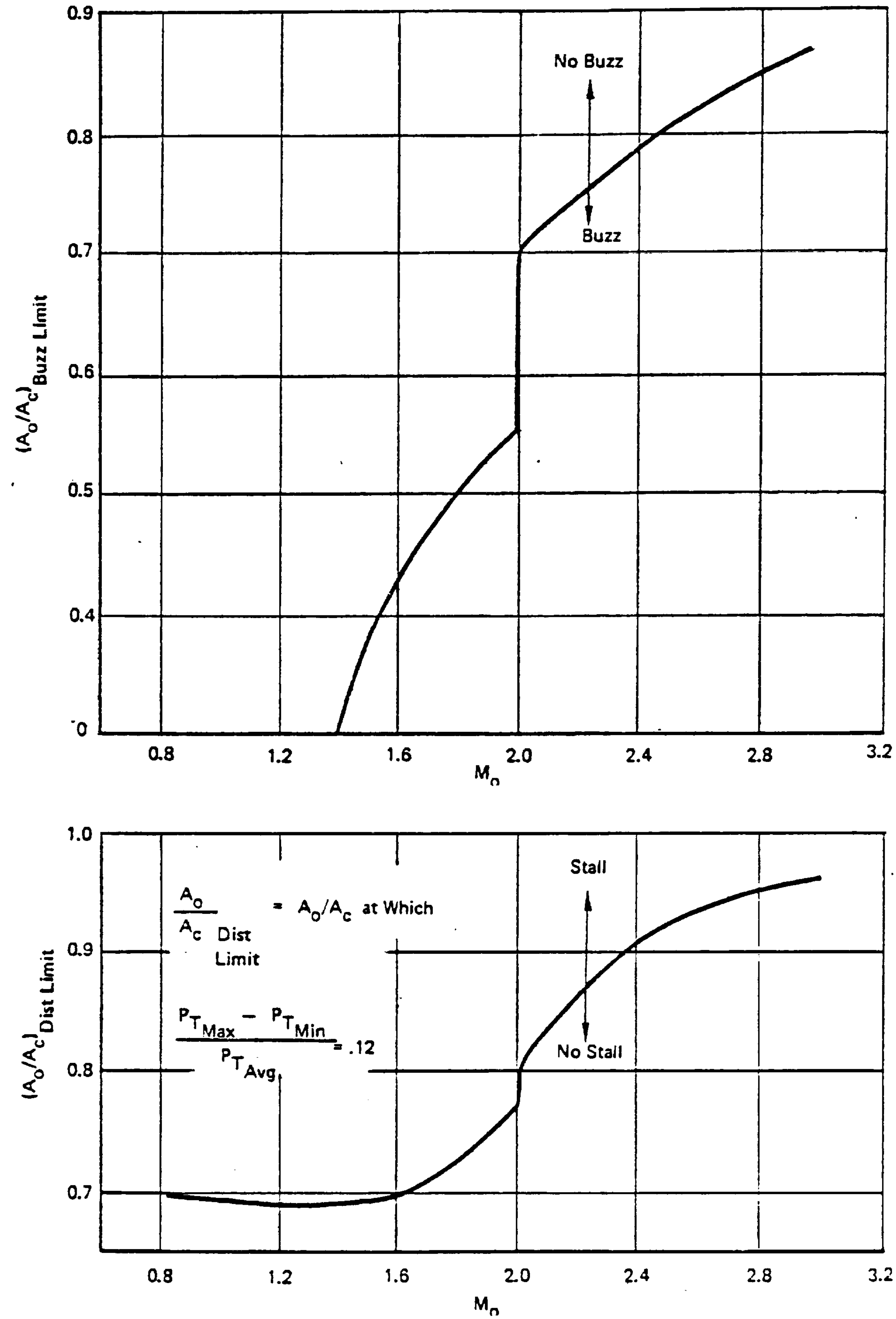


Figure 32. Performance Characteristics for Inlet Configuration - 'INT'- (continued)

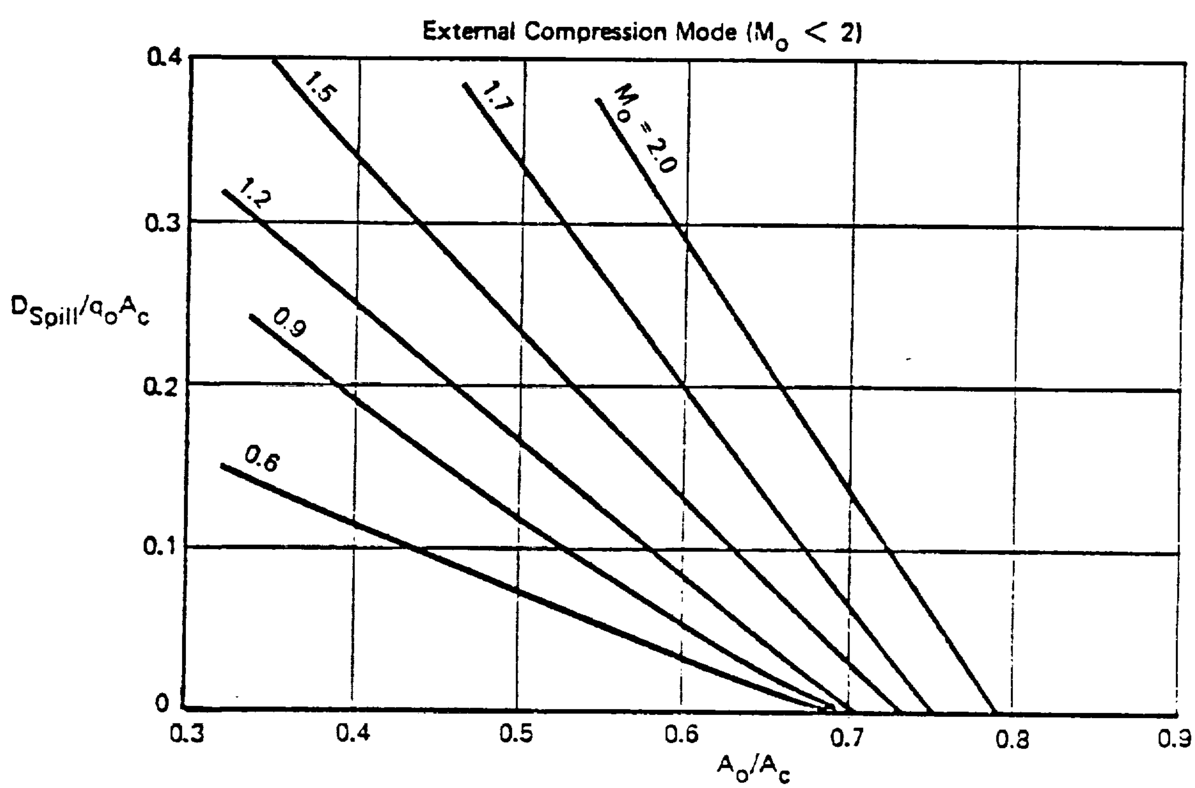


Figure 32. Performance Characteristics for Inlet Configuration - 'INT' - (continued)

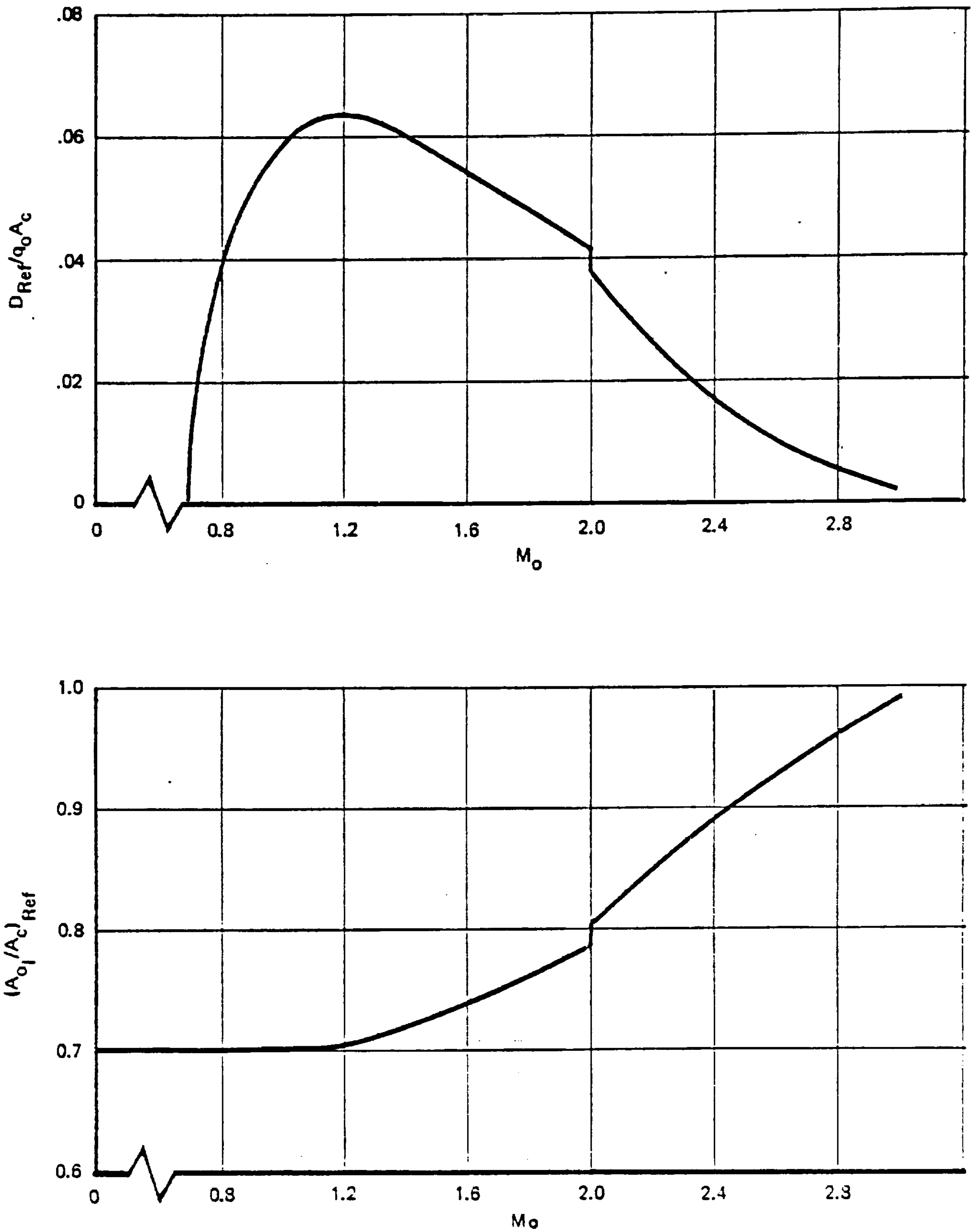
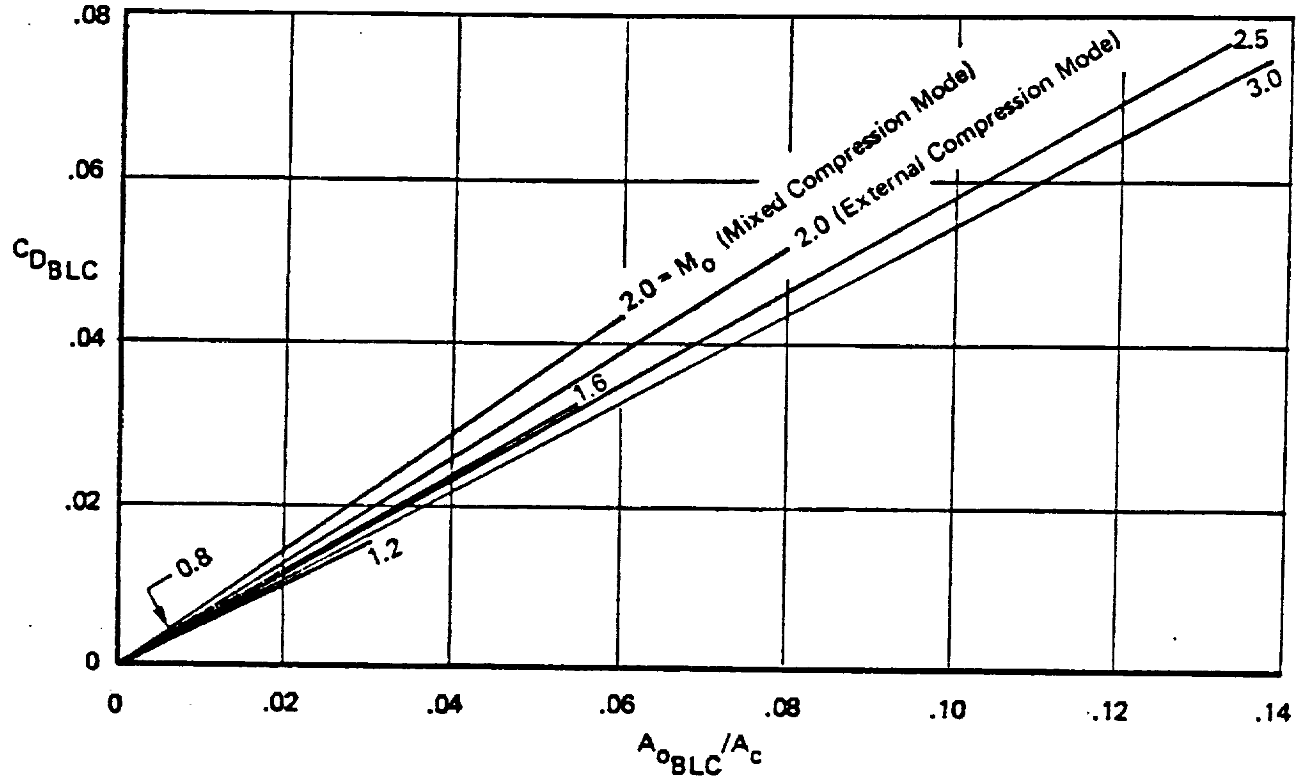


Figure 32. Performance Characteristics ~~for Inlet~~ Configuration - 'INT' - (continued)



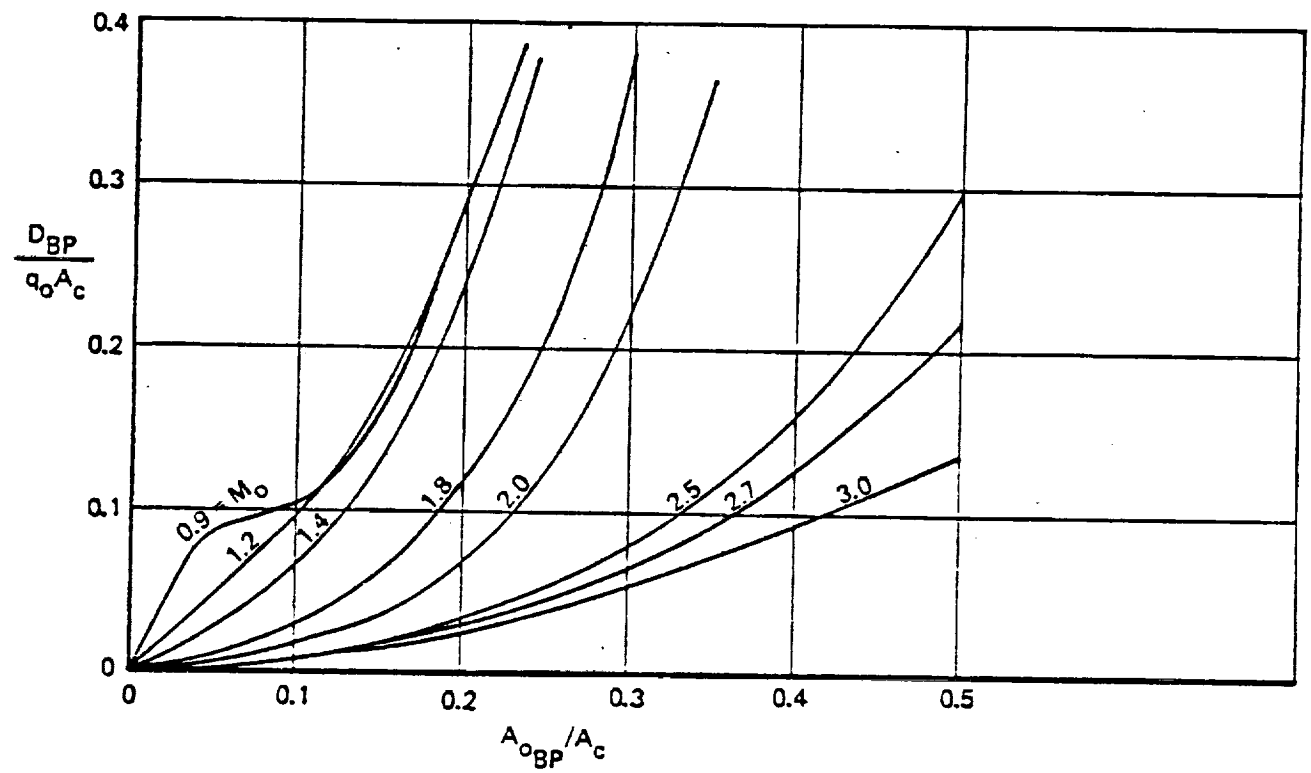
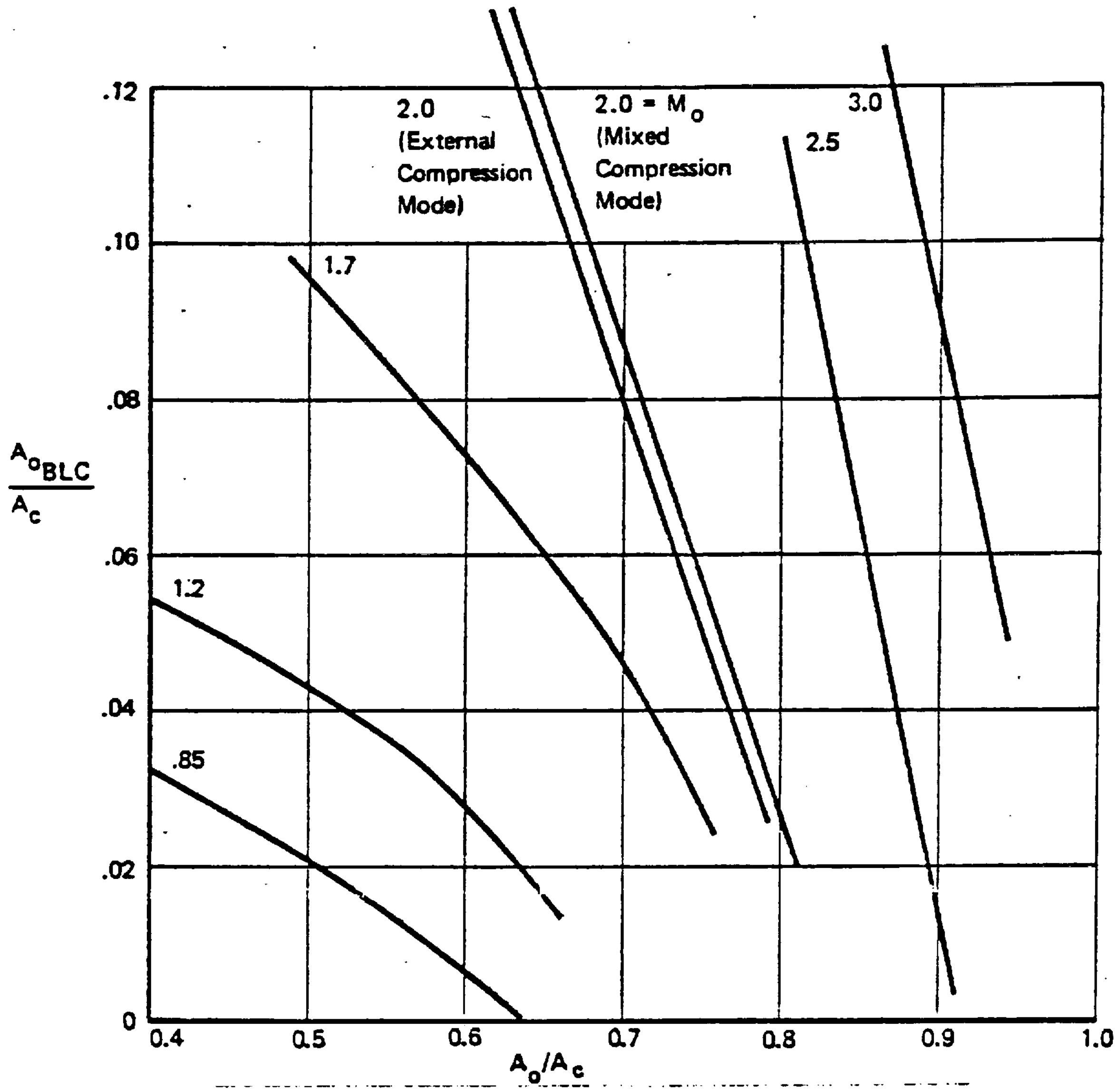


Figure 32. Performance Characteristics for Inlet Configuration - 'INT' - (continued)



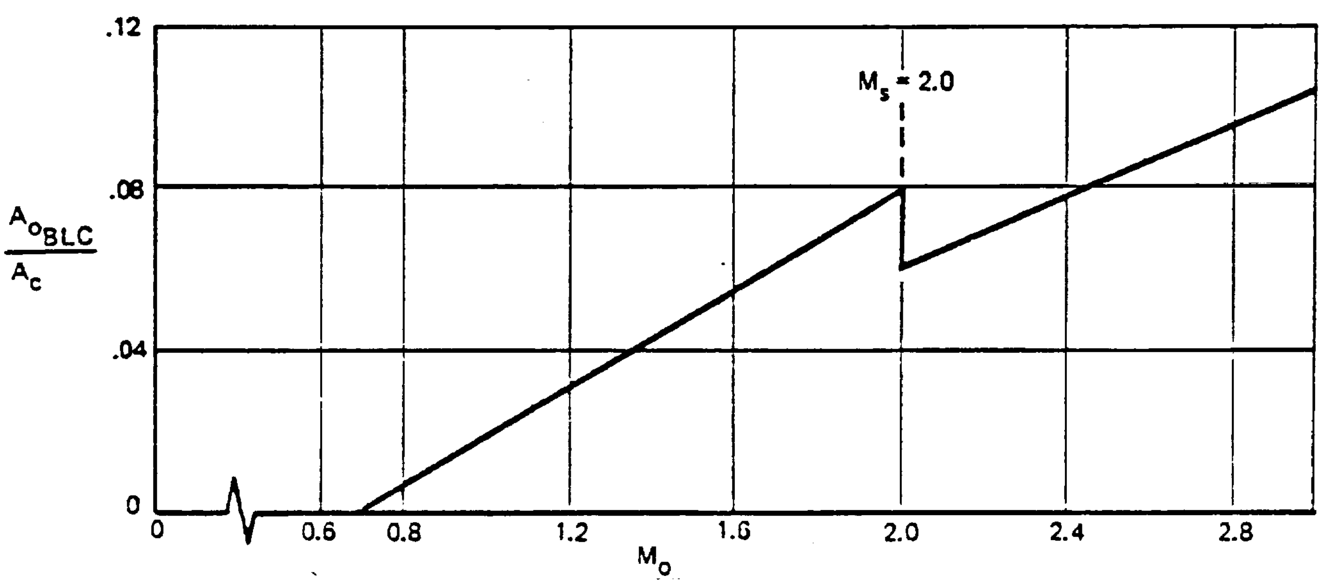


Figure 32. Performance Characteristics for Inlet Configuration - 'INT' - (continued)

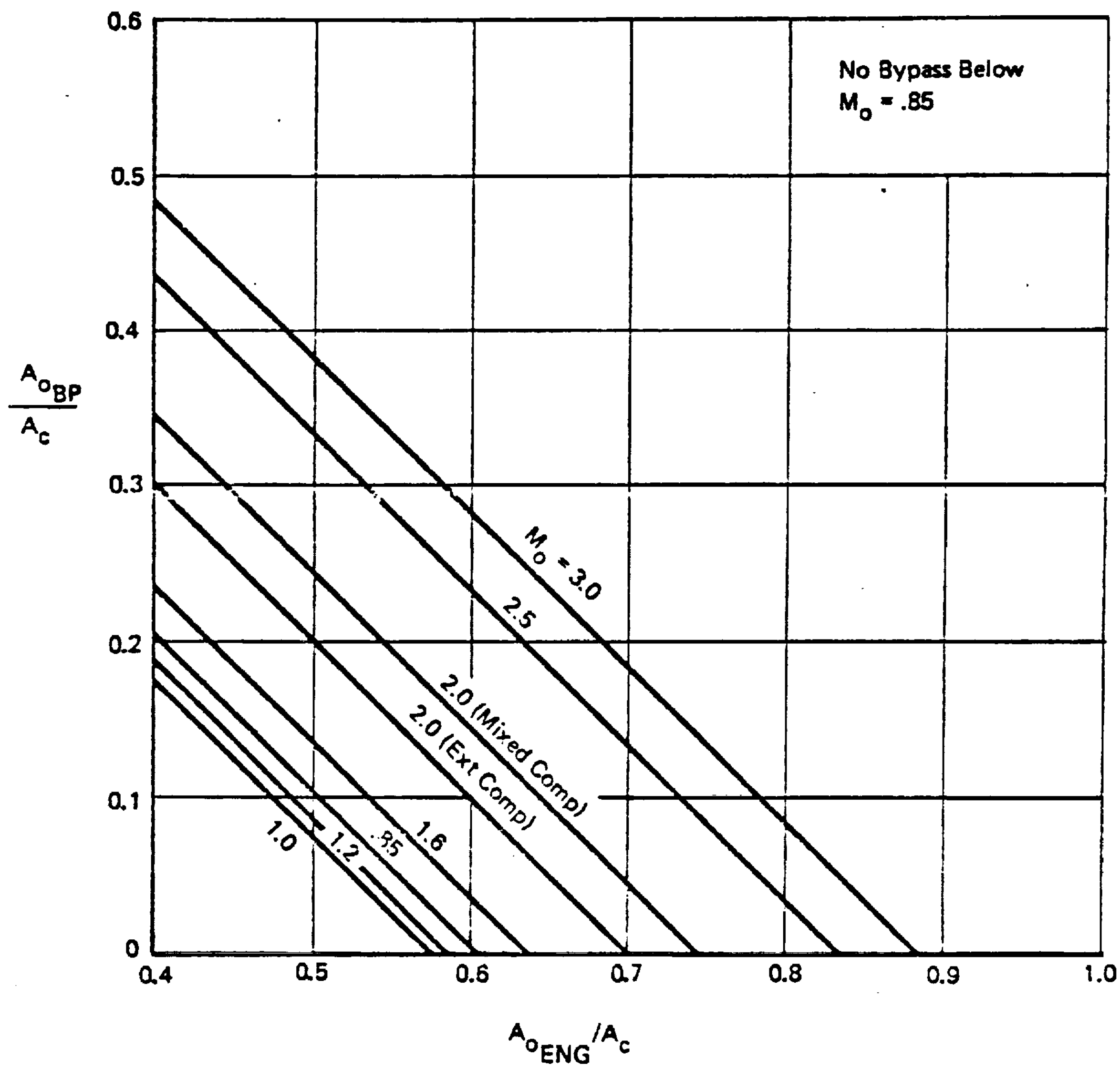


Figure 32. Performance Characteristics for Inlet Configuration - 'INT' - (continued)

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***********
*         *
* INT     *
*         *
***********
```

MACH 3.0,2-D,MIXED COMPR.,VARIABLE RAMP POROUS BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	1.0000
2	SIDEPLATE CUTBACK	0.0
3	FIRST RAMP ANGLE(DEG)	7.0000
4	DESIGN MACH NUMBER	3.0000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.5000
7	EXTERNAL COWL ANGLE(DEG)	12.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	0.0
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	2.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	2.8000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	12.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	2.01
NOMINAL THROAT MACH NUMBER	0.81

```
***********
* TABLE 1 *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	1.000	2.000	3.000	MNO
0.0	1.000	2.000	3.000	MNFS

****

* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.600	0.500 0.990	0.550 0.990	0.600 0.988	0.700 0.972	0.750 0.955	AO/AC PT2/PT0		
MNO=0.800	0.450 0.980	0.500 0.980	0.600 0.970	0.625 0.958	0.650 0.935	0.675 0.855	AO/AC PT2/PT0	
MNO=1.200	0.450 0.975	0.500 0.975	0.600 0.962	0.625 0.951	0.650 0.925	0.672 0.850	AO/AC PT2/PT0	
MNO=1.600	0.450 0.955	0.500 0.960	0.600 0.955	0.625 0.950	0.650 0.925	0.680 0.860	AO/AC PT2/PT0	
MNO=2.000	0.450 0.935	0.550 0.930	0.700 0.910	0.725 0.904	0.740 0.891	0.750 0.876	0.755 0.810	AO/AC PT2/PT0
MNO=2.010	0.600 0.950	0.700 0.940	0.725 0.932	0.750 0.928	0.765 0.910	0.780 0.850	AO/AC PT2/PT0	
MNO=2.500	0.800 0.920	0.825 0.915	0.850 0.905	0.875 0.885	0.900 0.843	0.960 0.800	AO/AC PT2/PT0	
MNO=3.000	0.800 0.904	0.850 0.895	0.875 0.887	0.900 0.868	0.925 0.835	0.940 0.775	AO/AC PT2/PT0	

****
* TABLE 2B * OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)
****

0.0	0.200	0.400	0.600	0.800	1.600	2.010	2.200	2.600	3.000	MNO
0.920	0.958	0.970	0.975	0.975	0.947	0.930	0.923	0.906	0.880	PT2/PT0

****
* TABLE 2C * OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)
****

0.600	0.800	1.000	1.200	1.400	1.600	2.000	2.010	2.400	3.000	MNO

0.690	0.560	0.540	0.555	0.600	0.638	0.700	0.745	0.820	0.886	AO/AC

```
************
* TABLE 2D *
************
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BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	1.400	1.600	1.800	2.000	2.010	2.200	2.000	2.700	3.000	MNO
0.0	0.0	0.430	0.500	0.550	0.705	0.745	0.770	0.830	0.865	AO/AC

```
************
* TABLE 2E *
************
```

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.800	1.200	1.600	1.800	2.000	2.010	2.200	2.500	3.000	MNO
0.665	0.665	0.660	0.670	0.695	0.750	0.775	0.835	0.895	0.925	AO/AC

```
************
* TABLE 3  *
************
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SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.600	0.300	0.400	0.500	0.600	0.700	1.000	AOI/AC		
	0.160	0.115	0.073	0.034	0.0	0.0	CDSPL		
MNO=0.900	0.300	0.400	0.500	0.600	0.700	1.000	AOI/AC		
	0.270	0.190	0.116	0.050	0.0	0.0	CDSPL		
MNO=1.200	0.300	0.400	0.500	0.600	0.700	1.000	AOI/AC		
	0.332	0.250	0.165	0.073	0.0	0.0	CDSPL		
MNO=1.500	0.300	0.400	0.500	0.600	0.700	0.705	0.732	1.000	AOI/AC
	0.453	0.343	0.234	0.128	0.030	0.025	0.0	0.0	CDSPL
MNO=1.700	0.300	0.400	0.500	0.600	0.700	0.705	0.732	0.755	1.000	AOI/AC
	0.630	0.480	0.334	0.195	0.065	0.058	0.028	0.0	0.0	CDSPL
MNO=2.000	0.300	0.400	0.500	0.600	0.700	0.705	0.732	0.755	1.000	AOI/AC
	0.745	0.595	0.440	0.288	0.135	0.127	0.090	0.0	0.0	CDSPL
MNO=2.010	0.400	1.000	AOI/AC						
	0.038	0.038	CDSPL						

MNO=2.200	0.400	1.000	AOI/AC
	0.025	0.025	CDSPL
MNO=2.500	0.400	1.000	AOI/AC
	0.014	0.014	CDSPL
MNO=3.000	0.400	1.000	AOI/AC
	0.002	0.002	CDSPL

```
************
* TABLE 3A *
************
```

REF SPILLAGE DRAG COEFF (REF CDSPL) VS LOCAL MACH NUMBER (MNO)

0.0	0.680	0.800	1.200	1.600	2.000	2.010	2.400	3.000	MNO
0.0	0.0	0.040	0.064	0.054	0.042	0.038	0.017	0.002	REF CDSPL

```
************
* TABLE 3B *
************
```

REF INLET MASS FLOW RATIO (REF AOI/AC) VS LOCAL MACH NUMBER (MNO)

0.0	1.000	1.200	1.600	2.000	2.010	2.400	3.000	MNO
0.700	0.700	0.710	0.740	0.784	0.810	0.890	0.990	REF AOI/AC


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************
* TABLE 4  *
************
```

BLEED DRAG COEFFICIENT (CD BLD) VS BLEED MASS FLOW RATIO (AOBLD/AC) AND LOCAL MACH NUMBER (MNO)

1.200	1.600	2.000	2.010	2.500	3.000	MNO

MNO=1.200	0.0	0.140	AOBLD/AC
	0.0	0.073	CDBLD
MNO=1.600	0.0	0.140	AOBLD/AC
	0.0	0.081	CDBLD
MNO=2.000	0.0	0.140	AOBLD/AC
	0.0	0.089	CDBLD

MNO=2.010	0.0 0.0	0.140 0.099	AOBLD/AC CDBLD
MNO=2.500	0.0 0.0	0.140 0.080	AOBLD/AC CDBLD
MNO=3.000	0.0 0.0	0.140 0.076	AOBLD/AC CDBLD

```
************
* TABLE 5  *
************
```

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	1.200	1.400	1.800	2.000	2.500	2.700	3.000	MNO
MNO=1.200	0.0 0.0	0.100 0.094	0.200 0.290	0.300 0.400	0.400 0.400	0.500 0.400	AOBYP/AC CDBYP	
MNO=1.400	0.0 0.0	0.100 0.066	0.200 0.240	0.300 0.400	0.400 0.400	0.500 0.400	AOBYP/AC CDBYP	
MNO=1.800	0.0 0.0	0.100 0.030	0.200 0.117	0.300 0.380	0.400 0.400	0.500 0.400	AOBYP/AC CDBYP	
MNO=2.000	0.0 0.0	0.100 0.018	0.200 0.068	0.300 0.225	0.400 0.400	0.500 0.400	AOBYP/AC CDBYP	
MNO=2.500	0.0 0.0	0.100 0.008	0.200 0.034	0.300 0.082	0.400 0.160	0.500 0.296	AOBYP/AC CDBYP	
MNO=2.700	0.0 0.0	0.100 0.008	0.200 0.028	0.300 0.065	0.400 0.128	0.500 0.218	AOBYP/AC CDBYP	
MNO=3.000	0.0 0.0	0.100 0.008	0.200 0.024	0.300 0.054	0.400 0.090	0.500 0.133	AOBYP/AC CDBYP	

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************
```

* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.850	0.400	0.500	0.640	AO/AC						
	0.032	0.021	0.0	AOBLD/AC						
MNO=1.200	0.400	0.500	0.640	0.700	AO/AC					
	0.054	0.043	0.019	0.0	AOBLD/AC					
MNO=1.700	0.400	0.500	0.640	0.700	0.800	AO/AC				
	0.115	0.095	0.062	0.045	0.0	AOBLD/AC				
MNO=2.000	0.400	0.500	0.640	0.700	0.800	0.832	AO/AC			
	0.197	0.197	0.114	0.079	0.019	0.0	AOBLD/AC			
MNO=2.010	0.400	0.500	0.640	0.700	0.800	0.832	0.842	AO/AC		
	0.203	0.203	0.122	0.087	0.025	0.005	0.0	AOBLD/AC		
MNO=2.500	0.400	0.500	0.640	0.700	0.800	0.832	0.842	0.913	AO/AC	
	0.203	0.203	0.122	0.122	0.112	0.082	0.070	0.0	AOBLD/AC	
MNO=3.000	0.400	0.500	0.640	0.700	0.800	0.832	0.842	0.913	0.990	AO/AC
	0.203	0.203	0.203	0.203	0.163	0.158	0.149	0.078	0.0	AOBLD/AC

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

2.010	2.400	3.000	MNO
0.060	0.077	0.104	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.400	0.585	0.605	0.635	0.700	0.734	0.835	0.885	AOE/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	AOBYP/AC

MNO=1.190	0.400 0.0	0.585 0.0	AOE/AC AOBYP/AC						
MNO=1.200	0.400 0.185	0.585 0.0	AOE/AC AOBYP/AC						
MNO=1.600	0.400 0.235	0.585 0.050	0.605 0.0	AOE/AC AOBYP/AC					
MNO=2.000	0.400 0.300	0.585 0.115	0.605 0.095	0.635 0.0	AOE/AC AOBYP/AC				
MNO=2.010	0.400 0.345	0.585 0.160	0.605 0.138	0.635 0.108	0.700 0.0	AOE/AC AOBYP/AC			
MNO=2.500	0.400 0.435	0.585 0.250	0.605 0.230	0.635 0.198	0.700 0.134	0.734 0.090	0.835 0.0	AOE/AC AOBYP/AC	
MNO=3.000	0.400 0.480	0.585 0.300	0.605 0.280	0.635 0.250	0.700 0.185	0.734 0.140	0.835 0.050	0.885 0.0	AOE/AC AOBYP/AC

4.2.1.15 INLET CONFIGURATION 'M352D' - MIXED COMPRESSION, VARIABLE-GEOMETRY, TWO-DIMENSIONAL INLET

The initial ramp surface angle is fixed at 7°. Boundary layer bleed is collected in three divided plenum chambers.

The inlet performance characteristics for this configuration are based on the data contained in Reference 13 and engineering analysis. The geometry of the inlet is shown in Figure 31 and the inlet performance characteristics are presented in Figure 32.

Figure 33 Mach 3.5 Two-Dimensional Mixed-Compression Inlet

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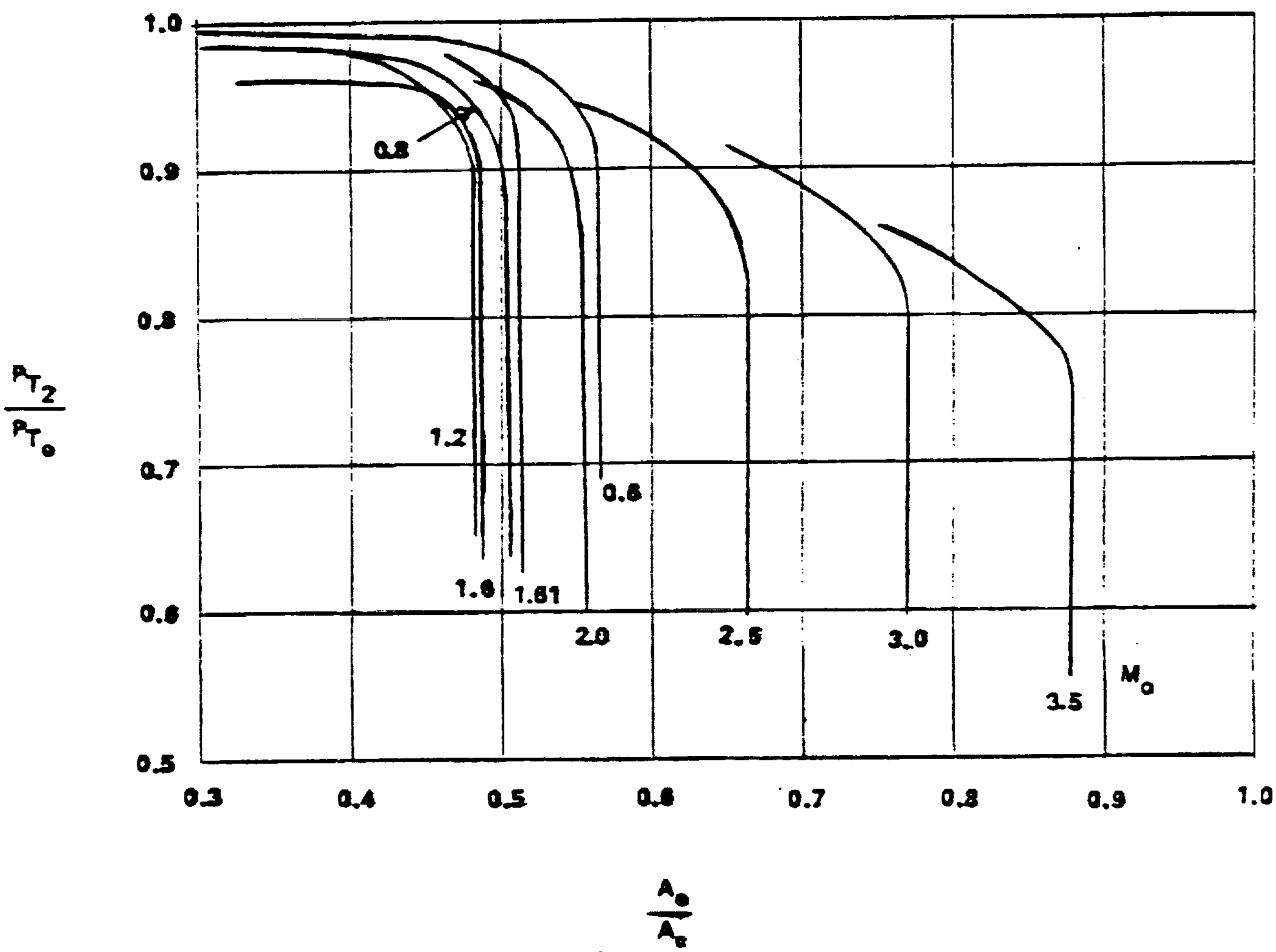

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D'

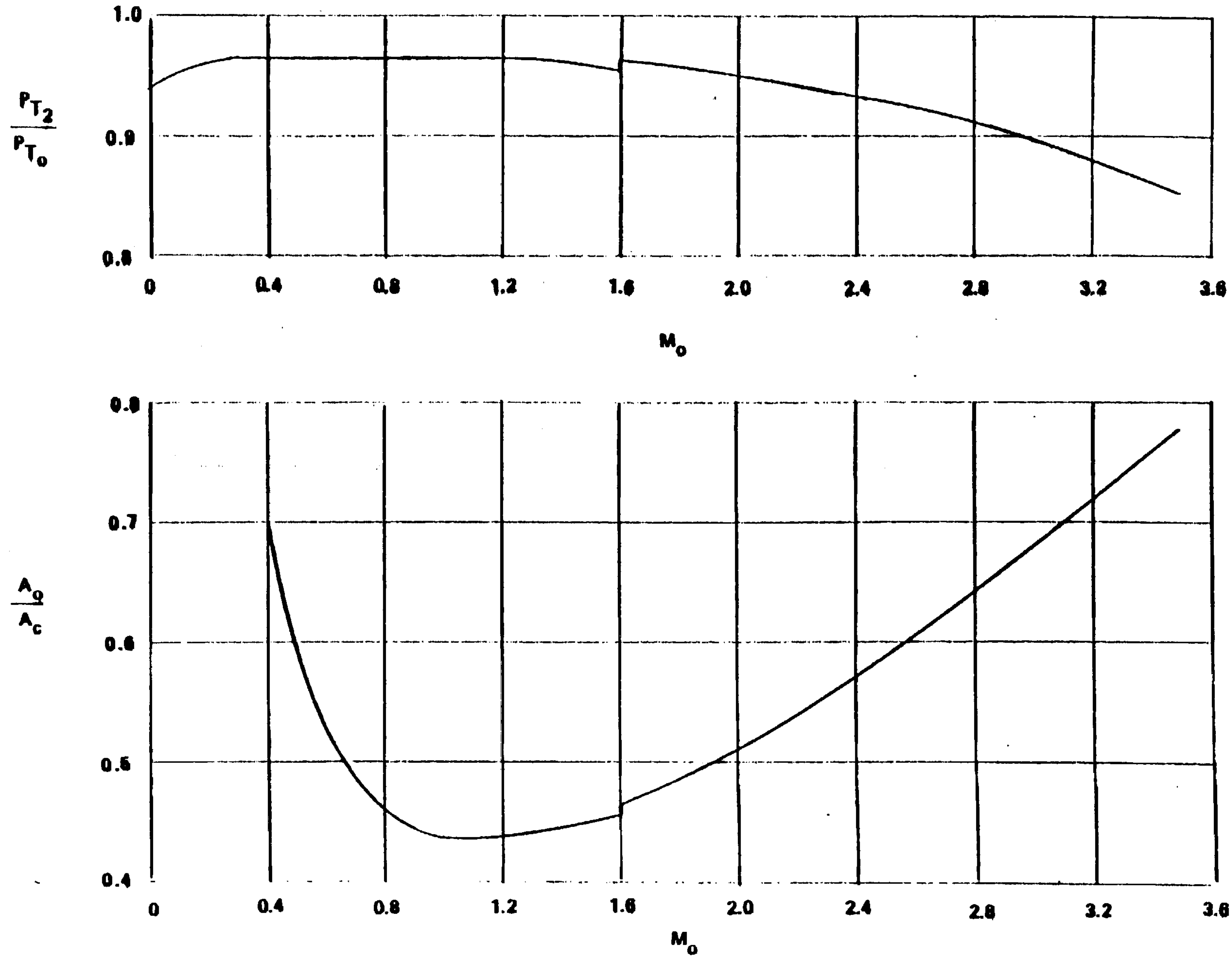

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (continued)

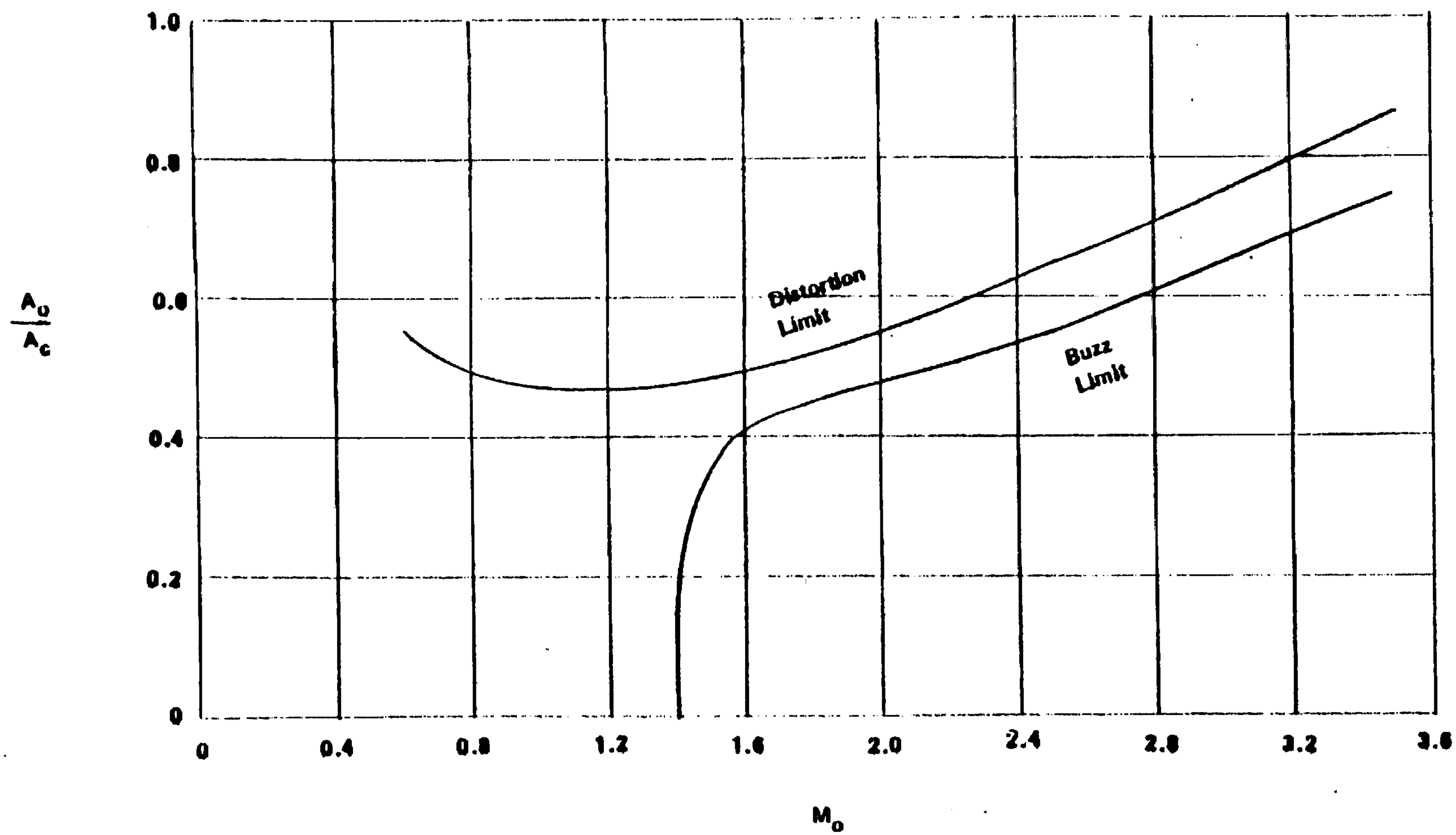

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (continued)

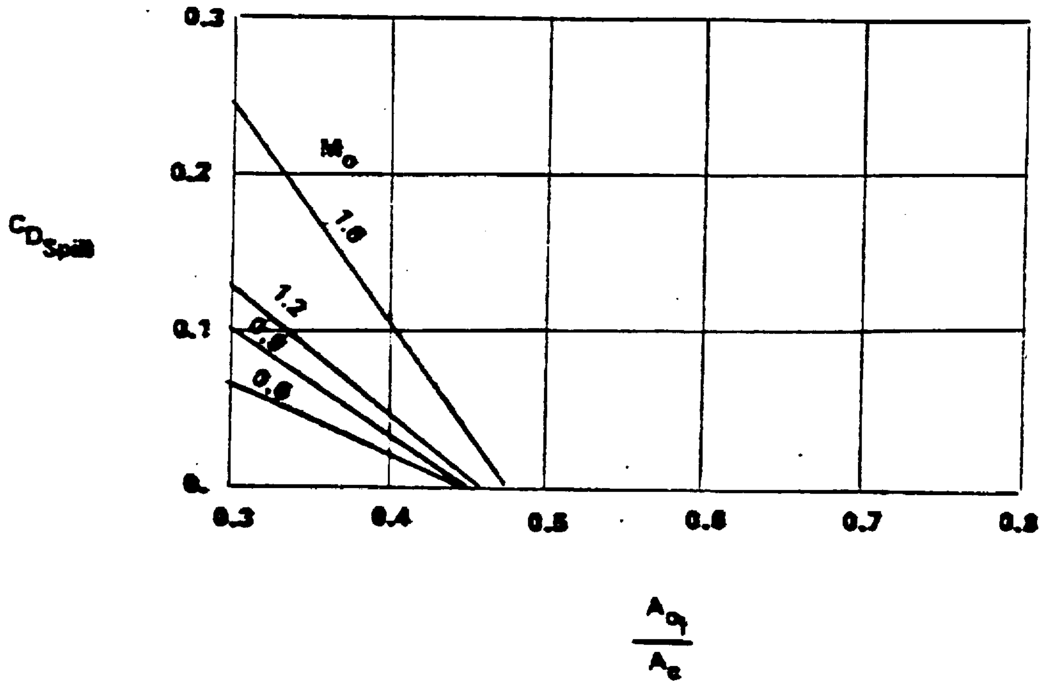

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D'- (continued)

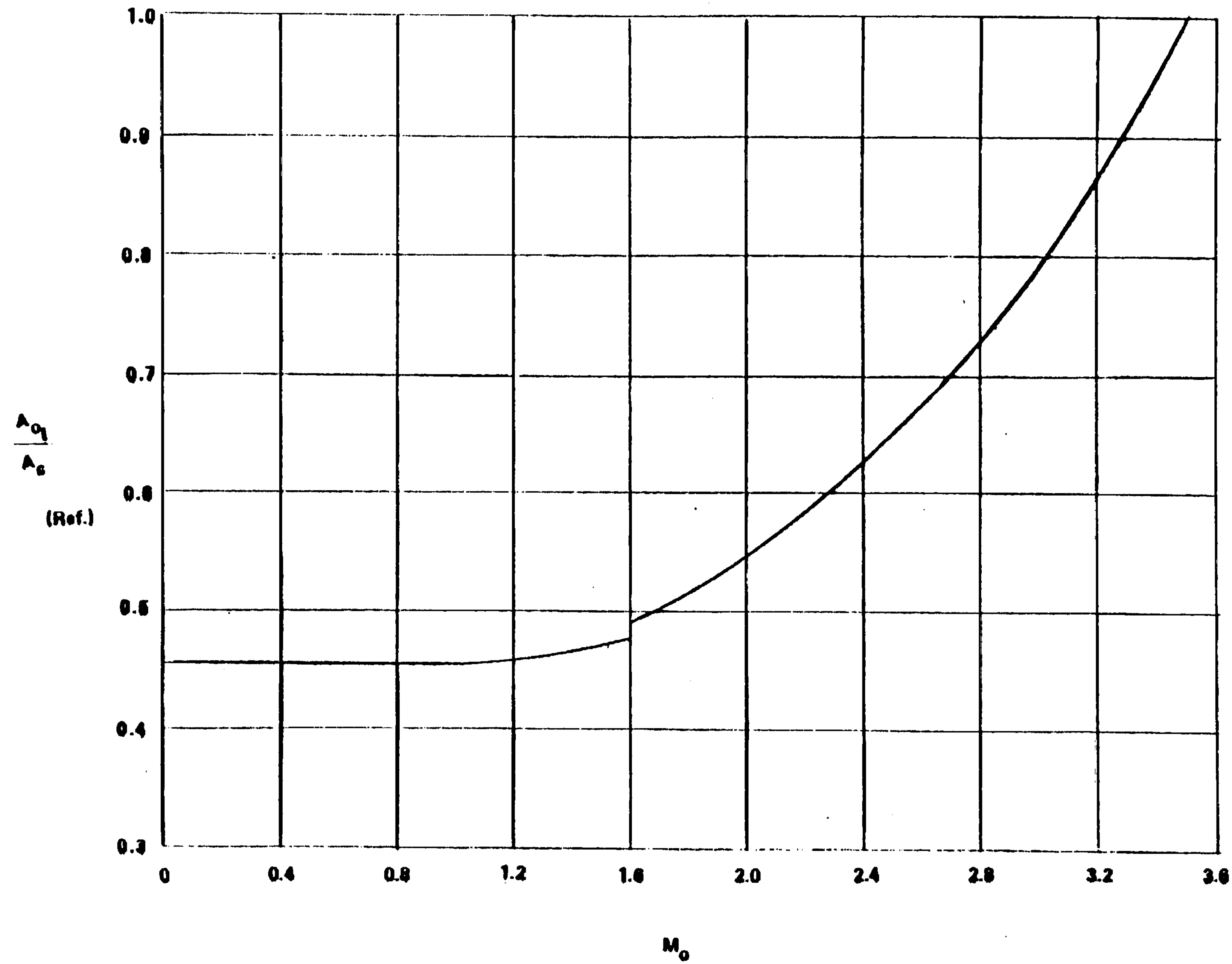

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (continued)

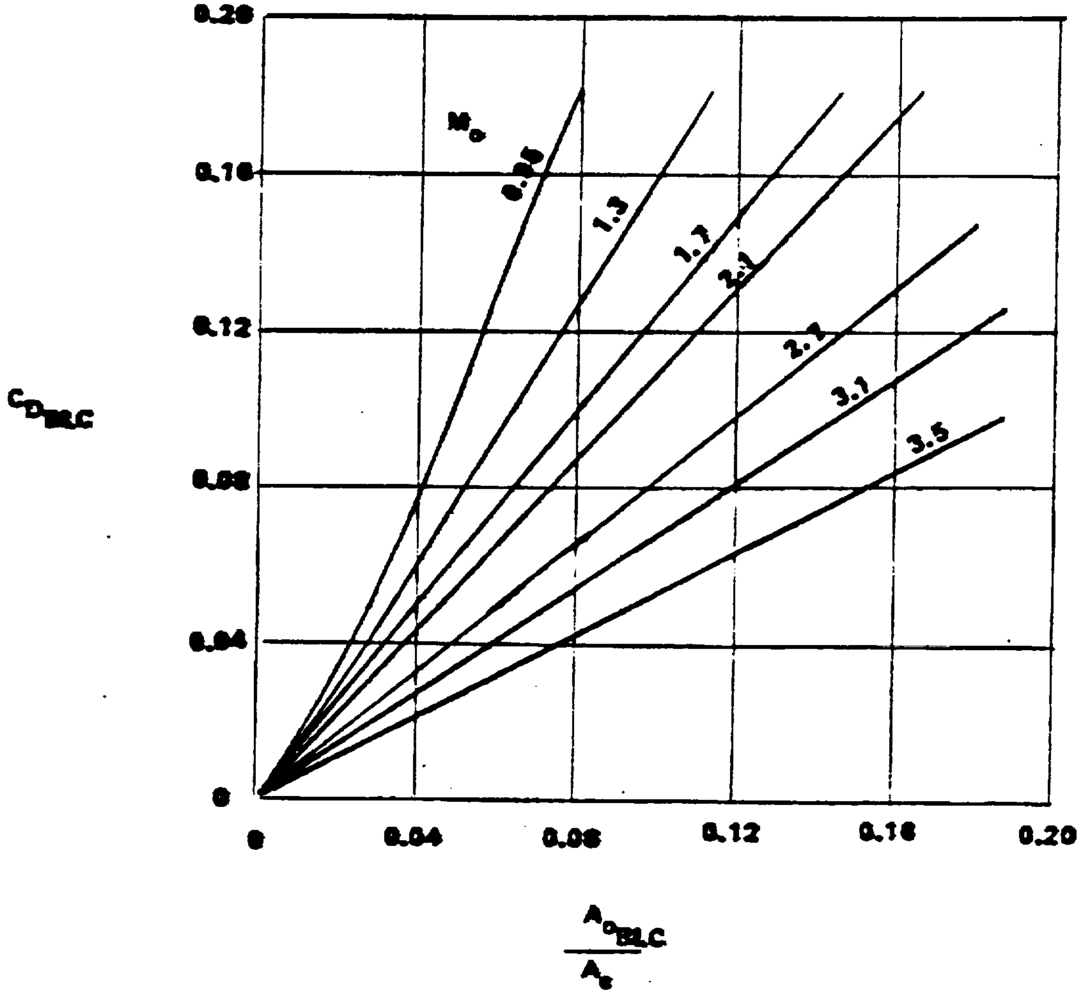

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D'- (continued)

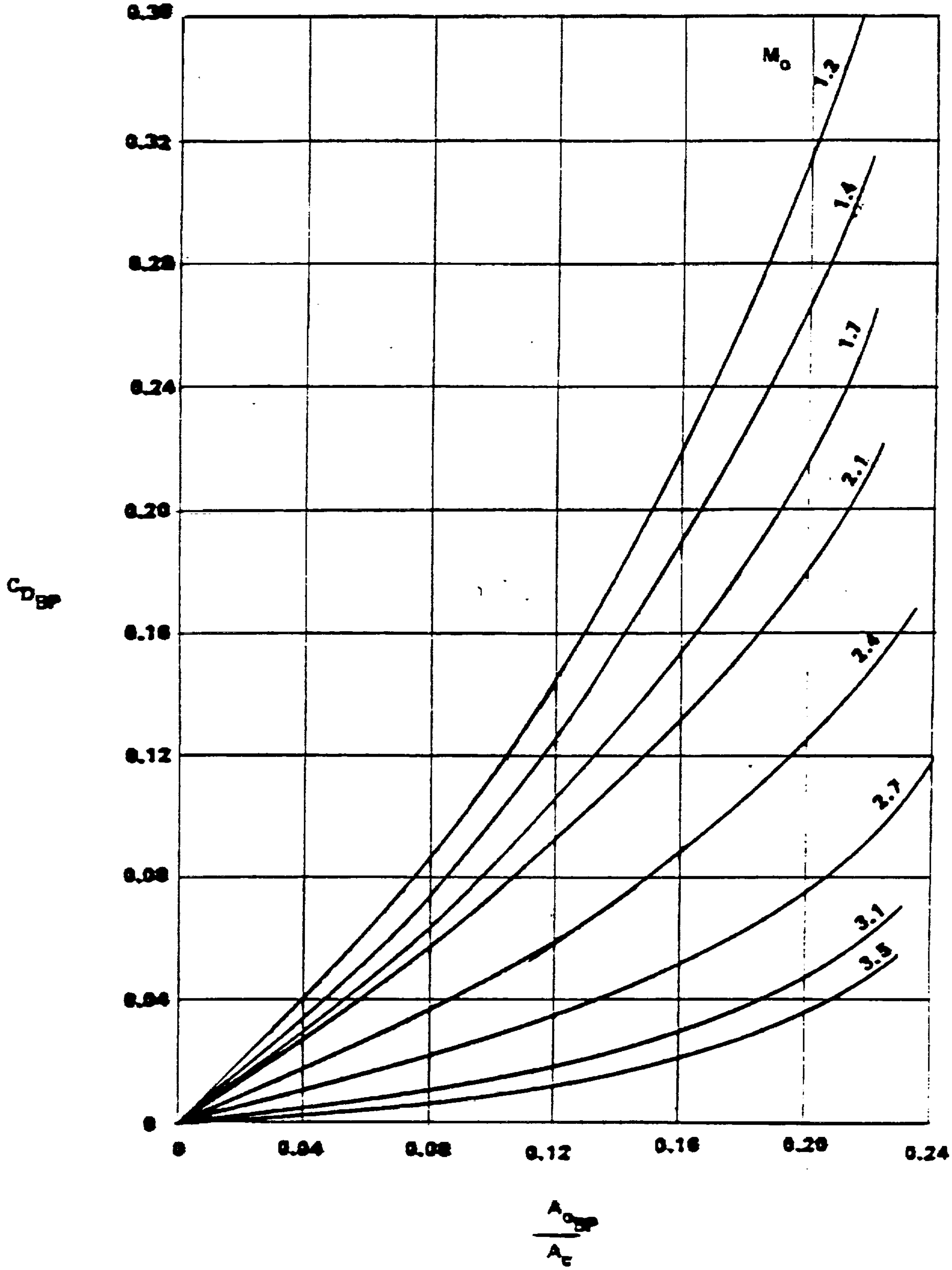

Figure 34. Performance Characteristics for Inlet Configuration- 'M352D'- (continued)

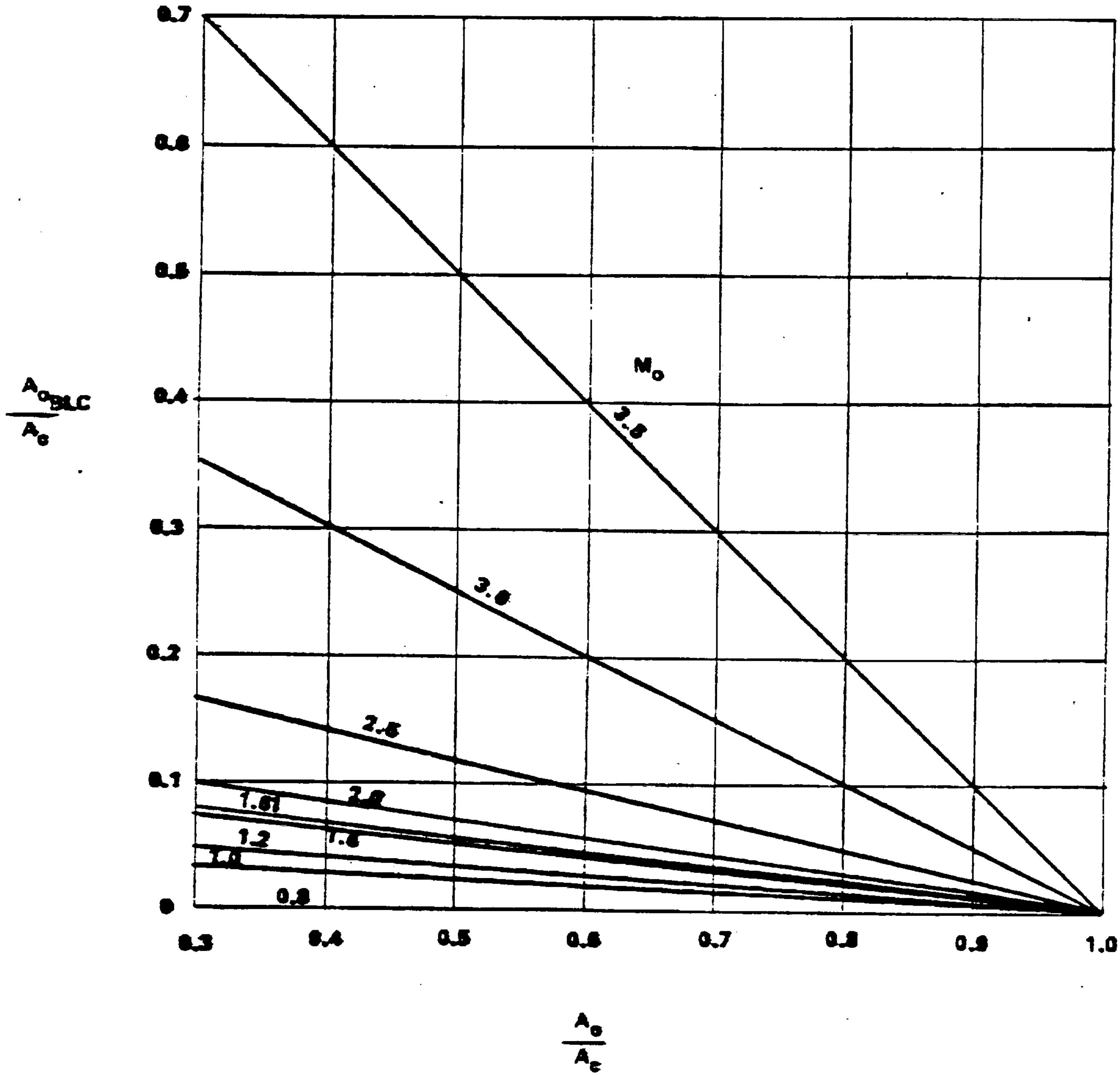

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (cont')

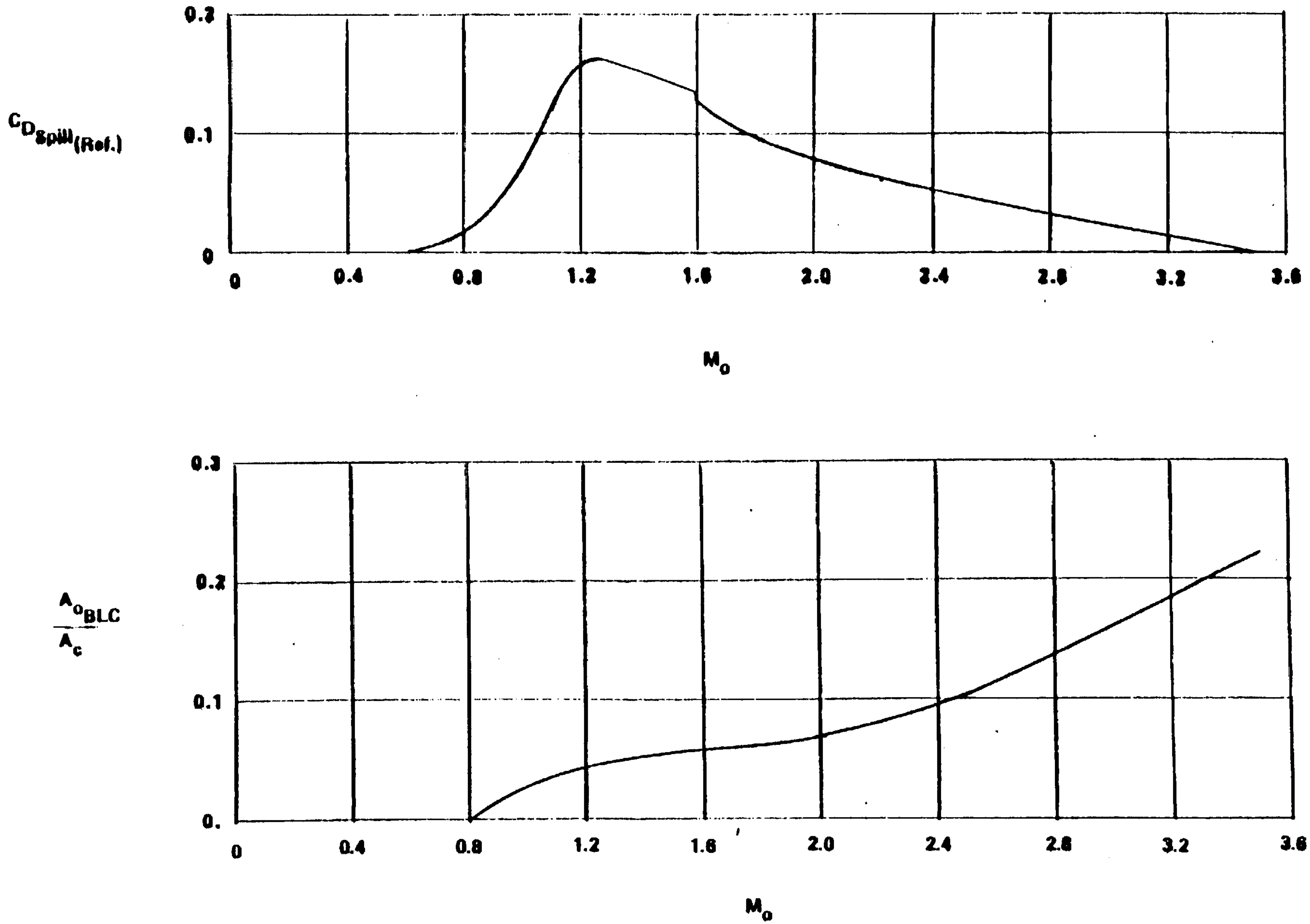

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (continued)

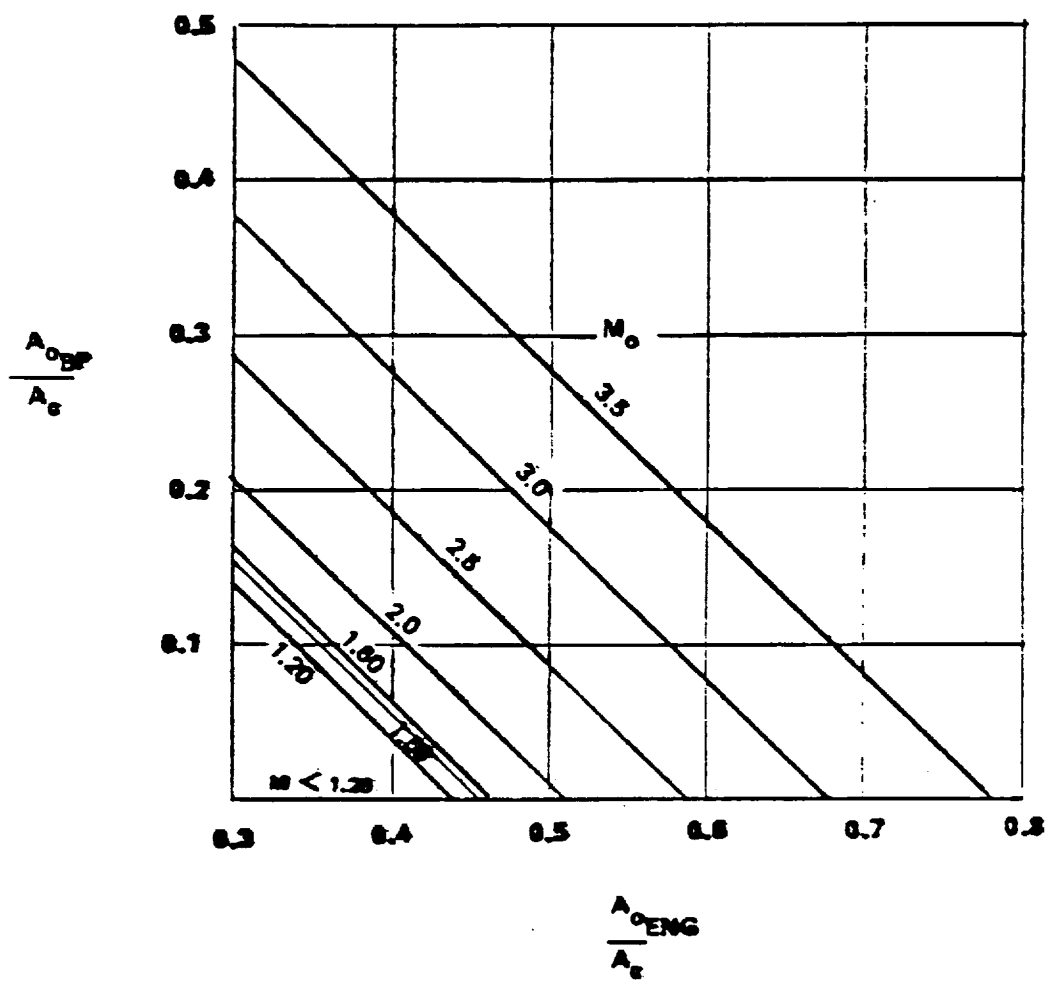

Figure 34. Performance Characteristics for Inlet Configuration - 'M352D' - (continued)

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***********
*         *
* M352D   *
*         *
***********
```

MACH 3.5,2-D,MIXED COMPR.,VARIABLE RAMP,POROUS BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	1.0000
2	SIDEPLATE CUTBACK	0.0
3	FIRST RAMP ANGLE(DEG)	7.0000
4	DESIGN MACH NUMBER	3.5000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.2000
7	EXTERNAL COWL ANGLE(DEG)	15.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.2000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	4.7000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	11.5000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1400

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	1.61
NOMINAL THROAT MACH NUMBER	0.74

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***********
* TABLE 1 *
***********
```

LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	1.000	3.500	MNO
0.0	1.000	3.500	MNFS

****

* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PTO) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.600	0.300	0.400	0.500	0.550	0.565	0.566	AO/AC
	0.990	0.989	0.980	0.943	0.900	0.700	PT2/PTO
MNO=0.800	0.300	0.400	0.480	0.500	0.510	AO/AC	
	0.985	0.981	0.950	0.910	0.800	PT2/PTO	
MNO=1.200	0.300	0.400	0.450	0.475	0.480	AO/AC	
	0.981	0.978	0.955	0.920	0.850	PT2/PTO	
MNO=1.600	0.300	0.400	0.450	0.475	0.485	0.490	AO/AC
	0.960	0.960	0.955	0.935	0.900	0.650	PT2/PTO
MNO=1.610	0.455	0.500	0.512	0.515	AO/AC		
	0.980	0.953	0.900	0.700	PT2/PTO		
MNO=2.000	0.485	0.510	0.545	0.555	AO/AC		
	0.960	0.950	0.900	0.850	PT2/PTO		
MNO=2.500	0.555	0.600	0.650	0.665	0.667	AO/AC	
	0.945	0.920	0.875	0.825	0.600	PT2/PTO	
MNO=3.000	0.650	0.700	0.750	0.765	0.770	AO/AC	
	0.915	0.885	0.850	0.825	0.600	PT2/PTO	
MNO=3.500	0.750	0.800	0.850	0.875	0.880	AO/AC	
	0.863	0.837	0.800	0.770	0.600	PT2/PTO	

****
* TABLE 2B * OPTIMUM INLET RECOVERY (PT2/PTO OPT) VS LOCAL MACH NUMBER (MNO)
****

0.0	0.600	0.800	1.200	1.600	1.610	2.000	2.500	3.000	3.500	MNO
0.940	0.965	0.965	0.965	0.955	0.965	0.950	0.930	0.900	0.850	PT2/PTO

****

```
************
* TABLE 2C *          OPTIMUM MASS FLOW RATIO (AO/AC OPT)          VS          LOCAL MACH NUMBER (MNO)
************

           0.400     0.600     0.800     1.200     1.600     1.610     2.000     2.500     3.000     3.500     MNO
           0.695     0.520     0.460     0.440     0.455     0.465     0.510     0.587     0.680     0.780     AO/AC

************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)           VS          LOCAL MACH NUMBER (MNO)
************

           0.0       0.600     0.800     1.200     1.600     1.610     2.000     2.500     3.000     3.500     MNO
           0.0       0.0       0.0       0.0       0.420     0.423     0.480     0.550     0.650     0.750     AO/AC

************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)     VS          LOCAL MACH NUMBER (MNO)
************

           0.600     0.800     1.200     1.600     1.610     2.000     2.500     3.000     3.500     MNO
           0.555     0.490     0.470     0.510     0.511     0.545     0.650     0.750     0.865     AO/AC

************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS        INLET MASS FLOW RATIO (AOI/AC)    AND    LOCAL MACH NUMBER (MNO)
************

MNO=0.0        0.300     1.000     AOI/AC
               0.0       0.0       CDSPL

MNO=0.600      0.300     0.450     1.000     AOI/AC
               0.065     0.0       0.0       CDSPL

MNO=0.900      0.300     0.455     1.000     AOI/AC
               0.100     0.0       0.0       CDSPL

MNO=1.200      0.300     0.460     1.000     AOI/AC
               0.127     0.0       0.0       CDSPL

MNO=1.600      0.300     0.475     1.000     AOI/AC
               0.245     0.0       0.0       CDSPL
```

```
************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)          VS          LOCAL MACH NUMBER (MNO)
************
```

0.0	0.600	0.800	1.200	1.600	1.610	2.000	2.500	3.000	3.500	MNO
0.0	0.0	0.017	0.159	0.135	0.125	0.078	0.049	0.023	0.0	REF CDSPL

```
************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)          VS          LOCAL MACH NUMBER (MNO)
************
```

0.0	0.600	0.800	1.200	1.600	1.610	2.000	2.500	3.000	3.500	MNO
0.453	0.453	0.453	0.459	0.475	0.490	0.550	0.650	0.790	1.000	REF AOI/AC

```
************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)     VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```

0.950   1.300   1.700   2.100   2.700   3.100   3.500   MNO

MNO=0.950	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.075	0.180	0.180	CDBLD
MNO=1.300	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.058	0.123	0.180	CDBLD
MNO=1.700	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.050	0.100	0.180	CDBLD
MNO=2.100	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.043	0.086	0.180	CDBLD
MNO=2.700	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.033	0.066	0.130	CDBLD
MNO=3.100	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.027	0.055	0.107	CDBLD
MNO=3.500	0.0	0.040	0.080	0.016	AOBLD/AC
	0.0	0.022	0.043	0.084	CDBLD

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	1.200	1.400	1.700	2.100	2.400	2.700	3.100	3.500	MNO
MNO=1.200	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.040	0.085	0.142	0.220	0.312	0.370	CDBYP	
MNO=1.400	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.035	0.074	0.124	0.190	0.263	0.314	CDBYP	
MNO=1.700	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.028	0.064	0.106	0.155	0.215	0.262	CDBYP	
MNO=2.100	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.025	0.056	0.094	0.132	0.180	0.214	CDBYP	
MNO=2.400	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.017	0.036	0.062	0.087	0.123	0.146	CDBYP	
MNO=2.700	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.010	0.021	0.034	0.052	0.075	0.092	CDBYP	
MNO=3.100	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.004	0.011	0.018	0.029	0.047	0.060	CDBYP	
MNO=3.500	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.002	0.006	0.012	0.021	0.035	0.047	CDBYP	

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300	1.000	AO/AC
	0.0	0.0	AOBLD/AC

MNO=0.800	0.300	1.000	AO/AC
	0.0	0.0	AOBLD/AC
MNO=1.000	0.300	1.000	AO/AC
	0.035	0.0	AOBLD/AC
MNO=1.200	0.300	1.000	AO/AC
	0.048	0.0	AOBLD/AC
MNO=1.600	0.300	1.000	AO/AC
	0.075	0.0	AOBLD/AC
MNO=1.610	0.300	1.000	AO/AC
	0.079	0.0	AOBLD/AC
MNO=2.000	0.300	1.000	AO/AC
	0.100	0.0	AOBLD/AC
MNO=2.500	0.300	1.000	AO/AC
	0.165	0.0	AOBLD/AC
MNO=3.000	0.300	1.000	AO/AC
	0.355	0.0	AOBLD/AC
MNO=3.500	0.300	1.000	AO/AC
	0.700	0.0	AOBLD/AC

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.600	0.800	1.200	1.600	1.610	2.000	2.500	3.000	3.500	MNO
0.0	0.0	0.0	0.042	0.060	0.061	0.070	0.100	0.160	0.220	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (M

MNO=0.0	0.0 0.0	1.000 0.0	AOE/AC AOBYP/AC	
MNO=1.190	0.0 0.0	1.000 0.0	AOE/AC AOBYP/AC	
MNO=1.200	0.300 0.140	0.440 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=1.600	0.300 0.155	0.455 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=1.610	0.300 0.165	0.465 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.000	0.300 0.210	0.510 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.500	0.300 0.285	0.585 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=3.000	0.300 0.380	0.680 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=3.500	0.300 0.480	0.780 0.0	1.000 0.0	AOE/AC AOBYP/AC

4.2.1.16 INLET CONFIGURATION 'AST' - MIXED-COMPRESSION, AXISYMMETRIC, TRANSLATING-CENTERBODY INLET

This inlet configuration utilizes a sophisticated boundary layer control bleed system developed using the analytical techniques described in Reference 11. The inlet starting Mach number is 1.60.

The inlet performance characteristics of this configuration were obtained from information contained in Reference 15 and engineering analysis. The geometry of the inlet is shown in Figure 33 and the performance characteristics are presented in Figure 34.

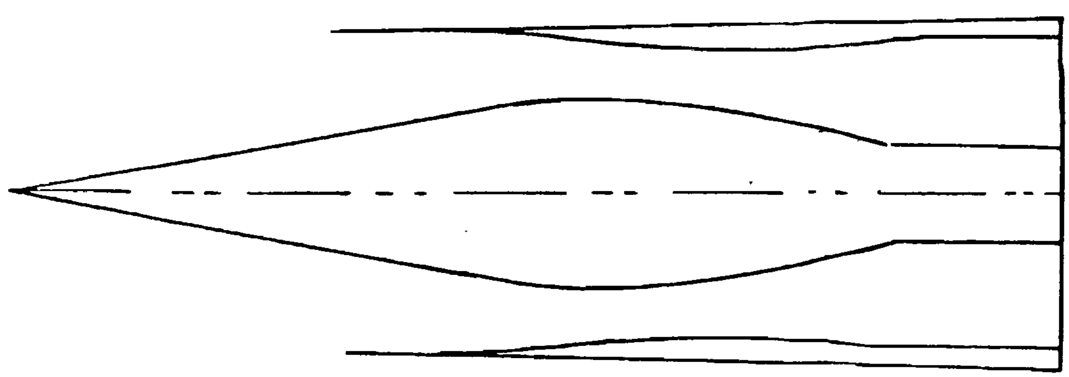


Figure 35 Mach 2.35 Mixed-Compression Axisymmetric Inlet

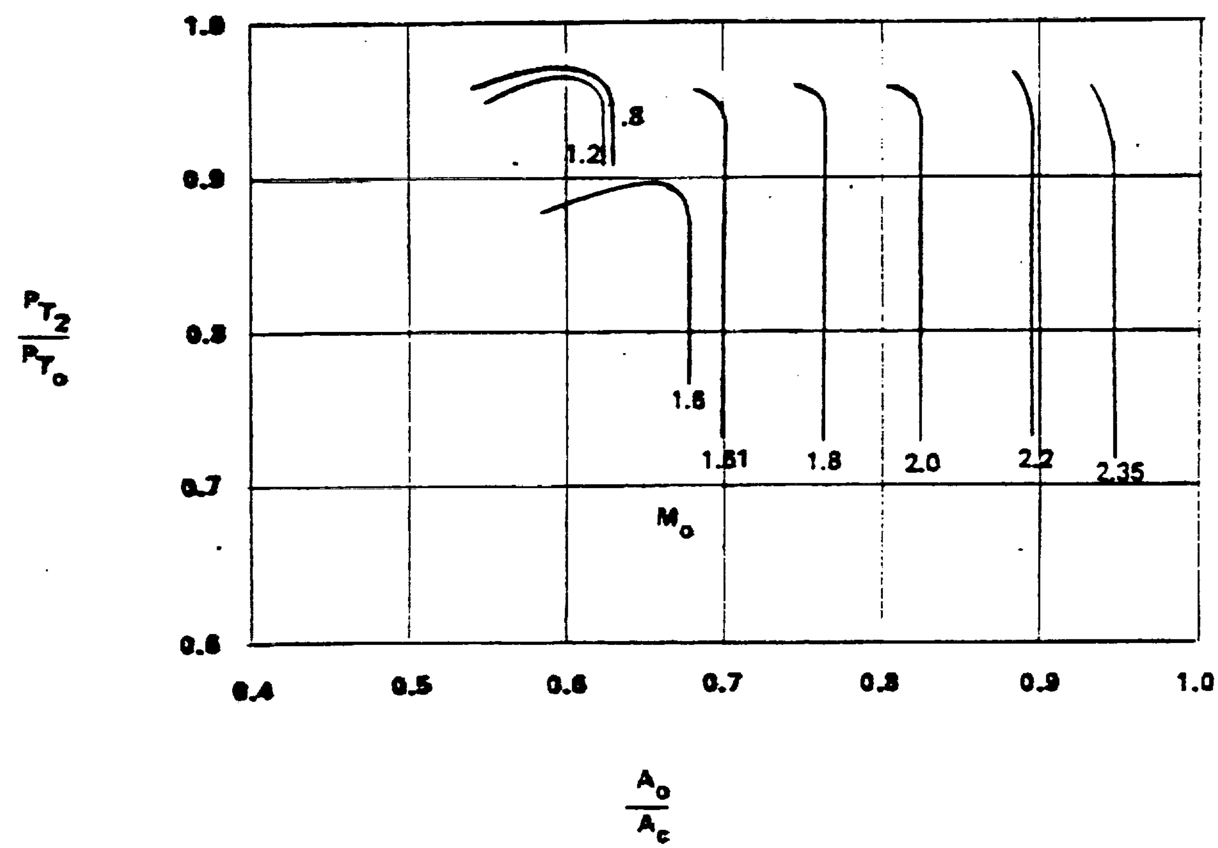


Figure 36. Performance Characteristics for Inlet Configuration - 'AST'

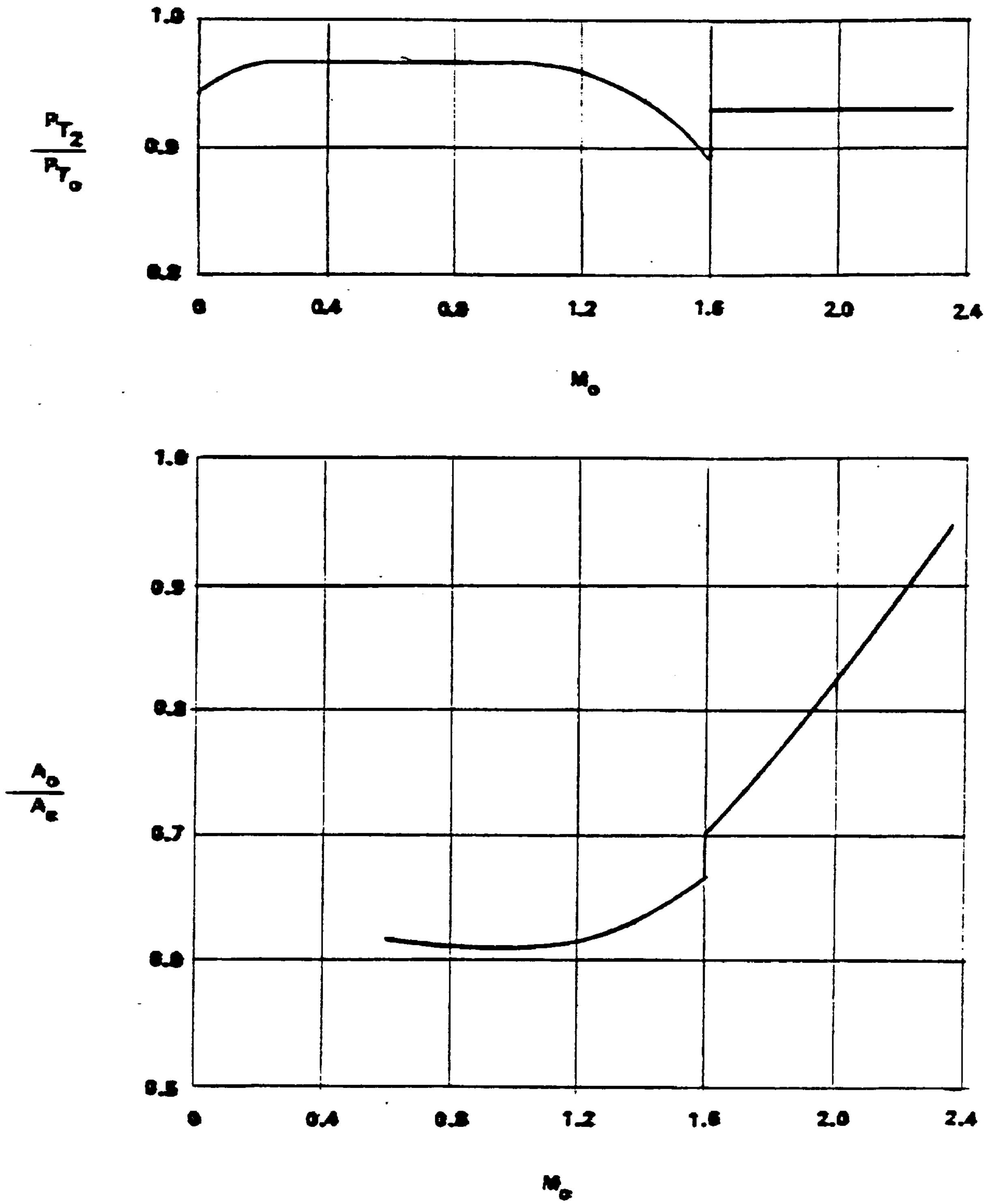


Figure 36. Performance Characteristics for Inlet Configuration - 'AST'- (continued)

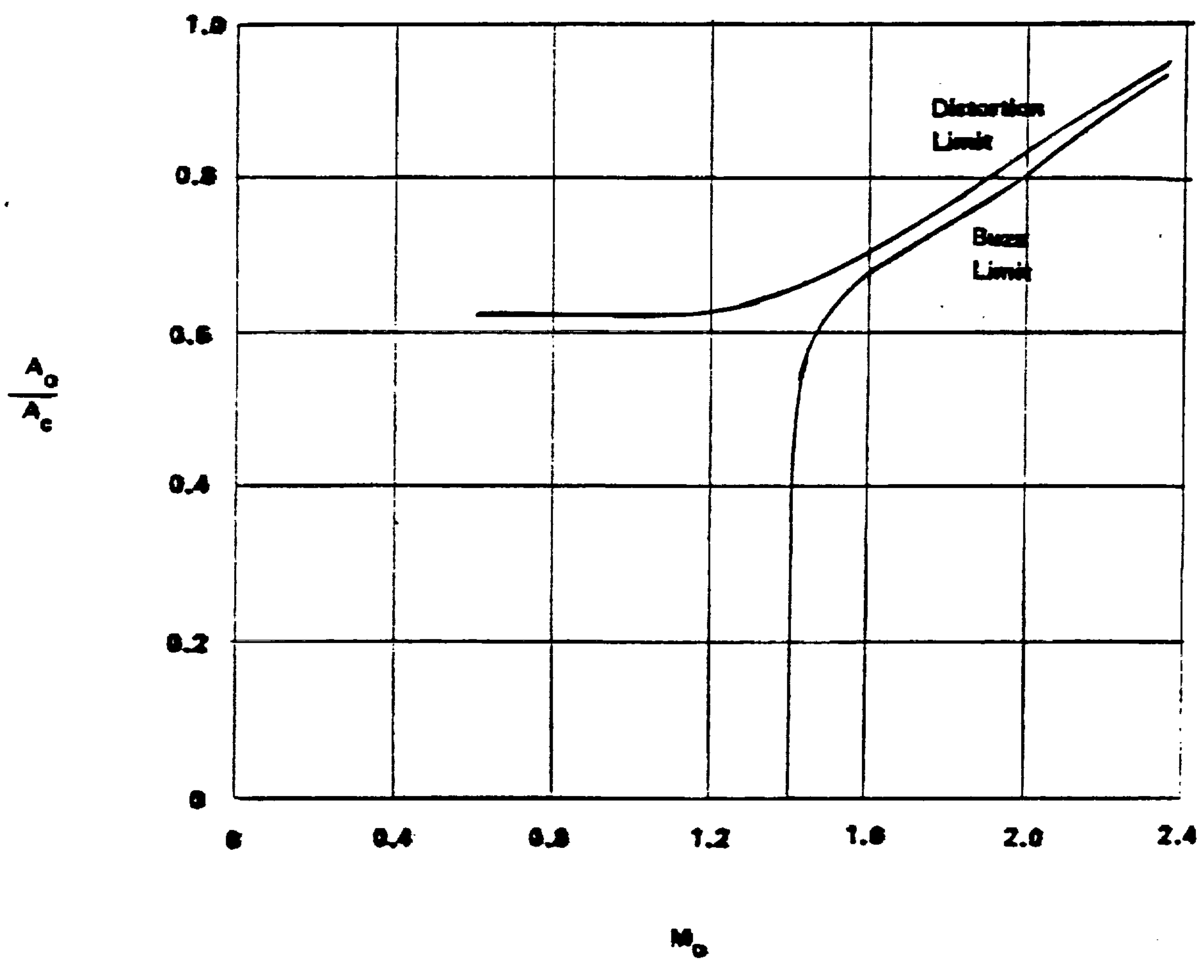


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)

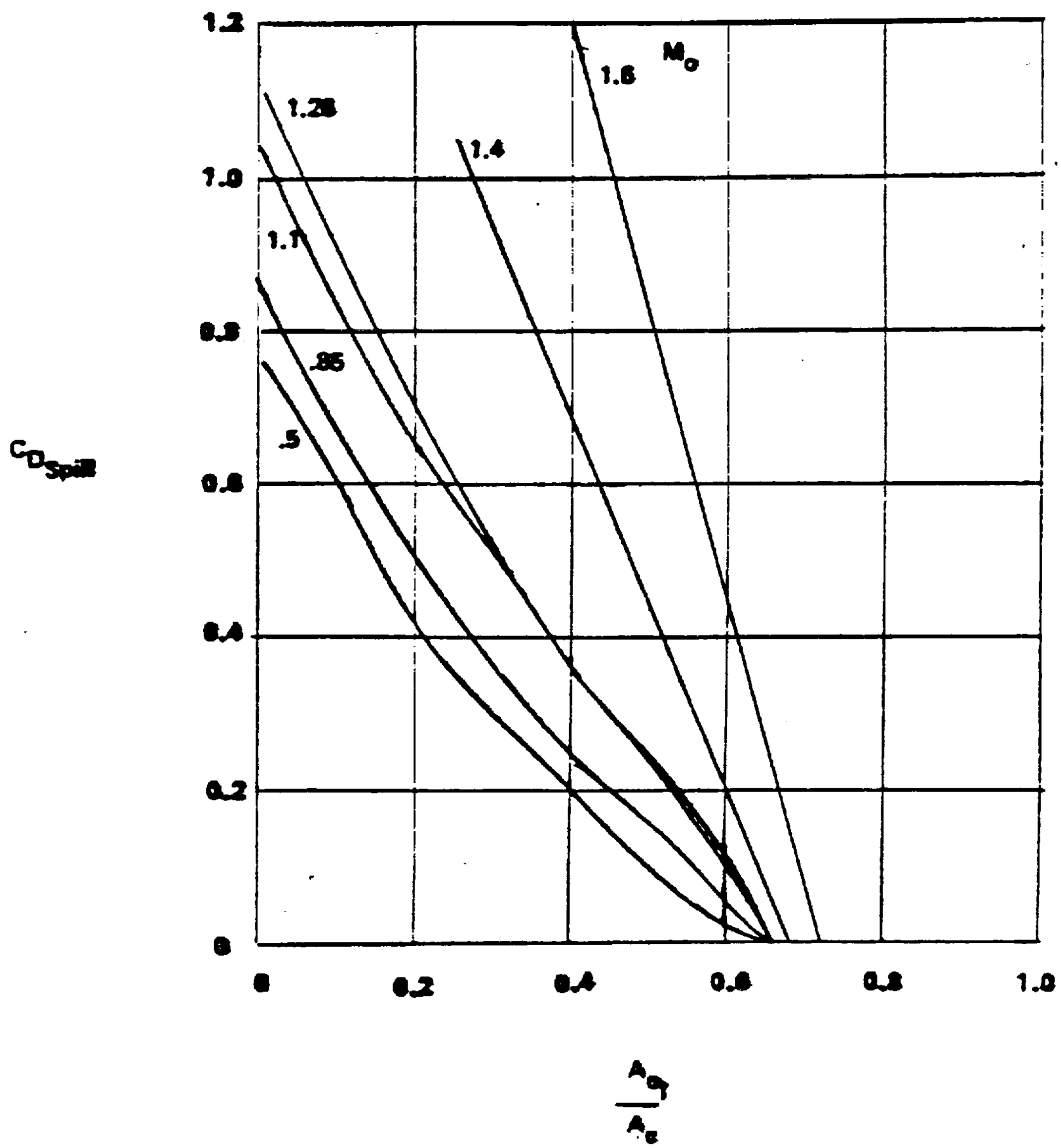
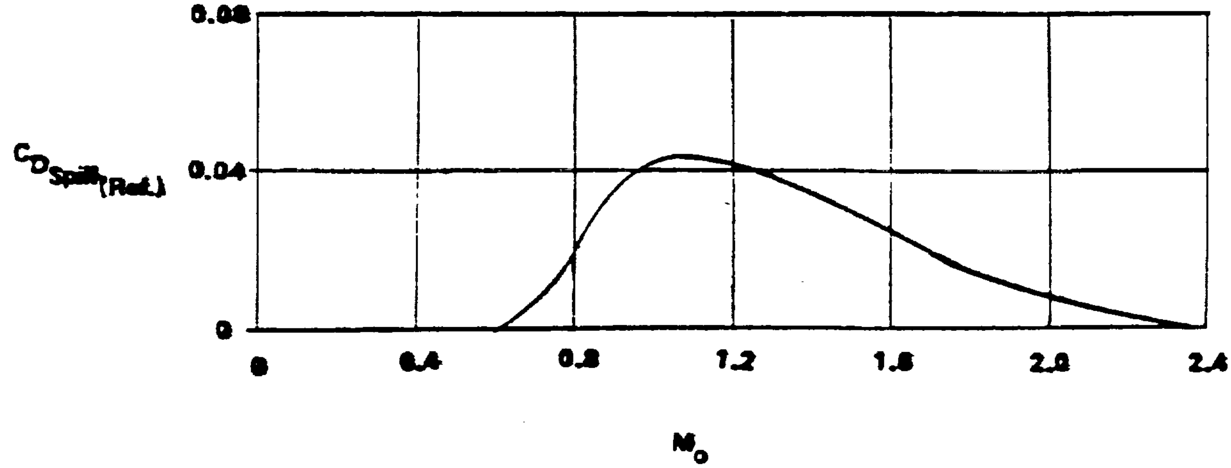


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)



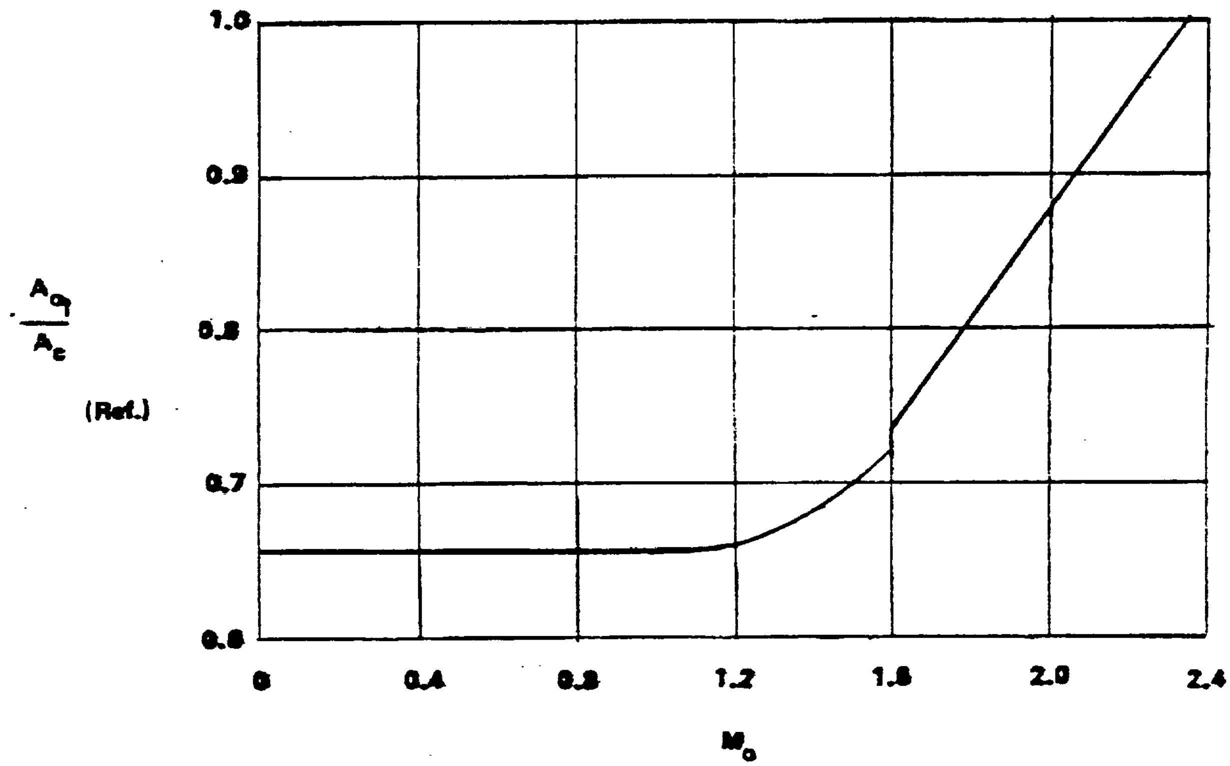


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)

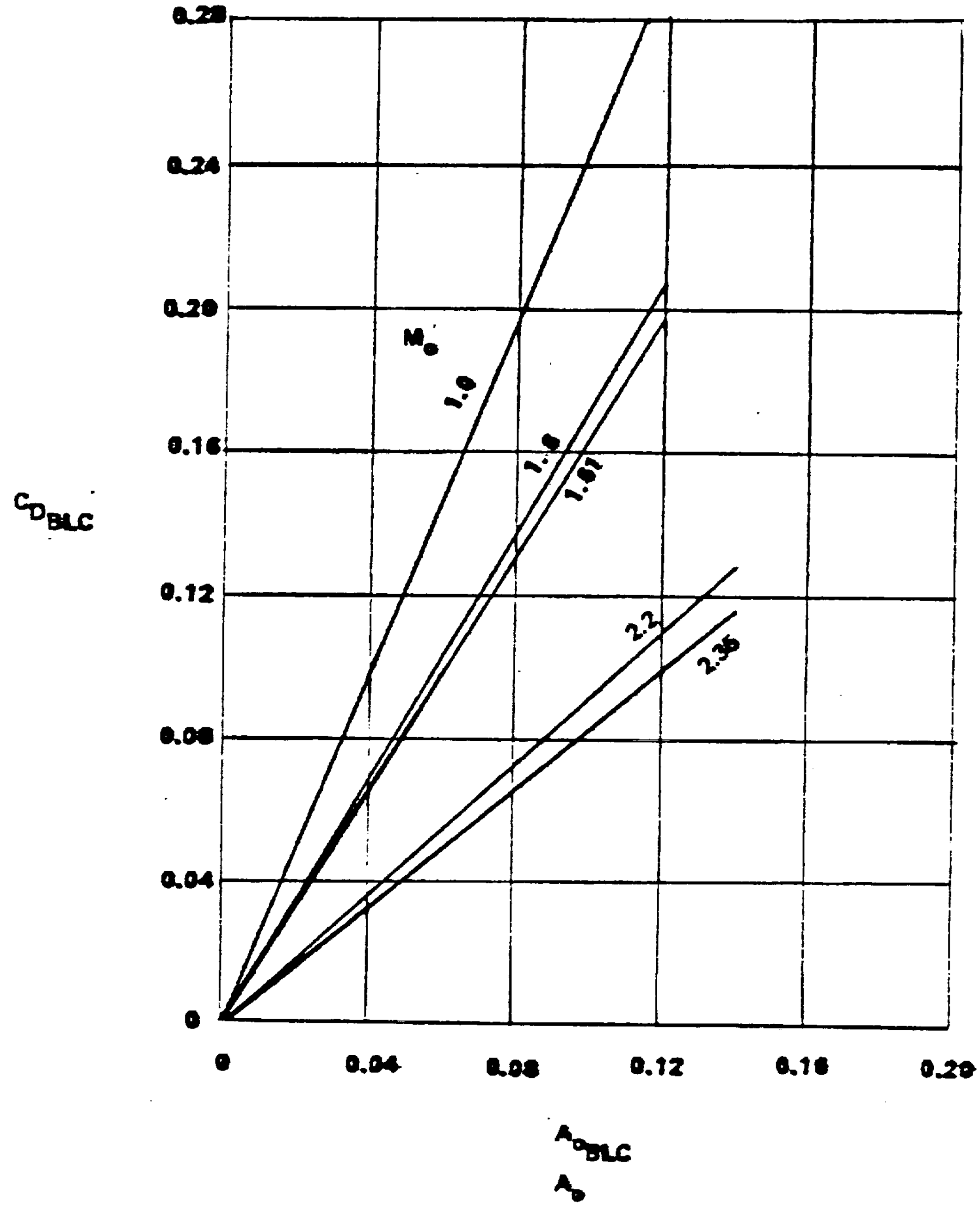


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)

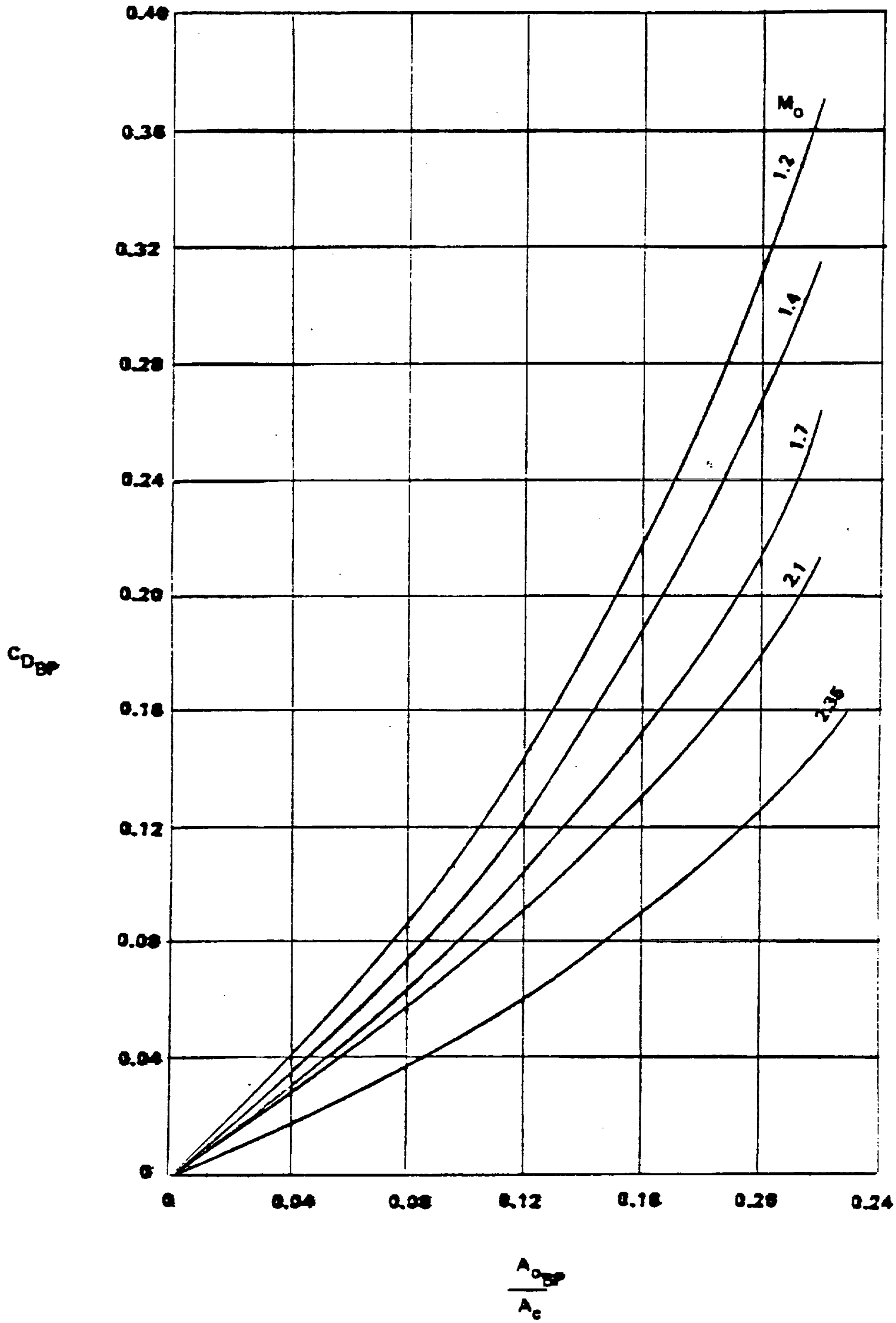
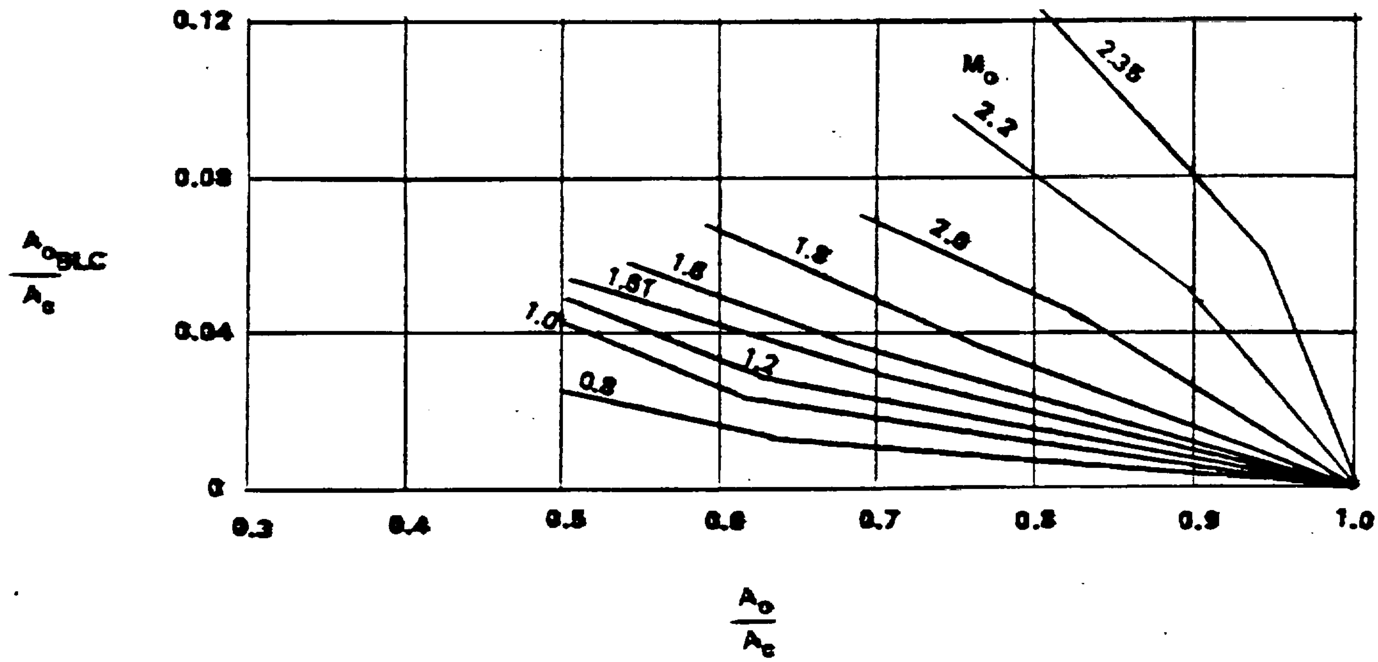


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)



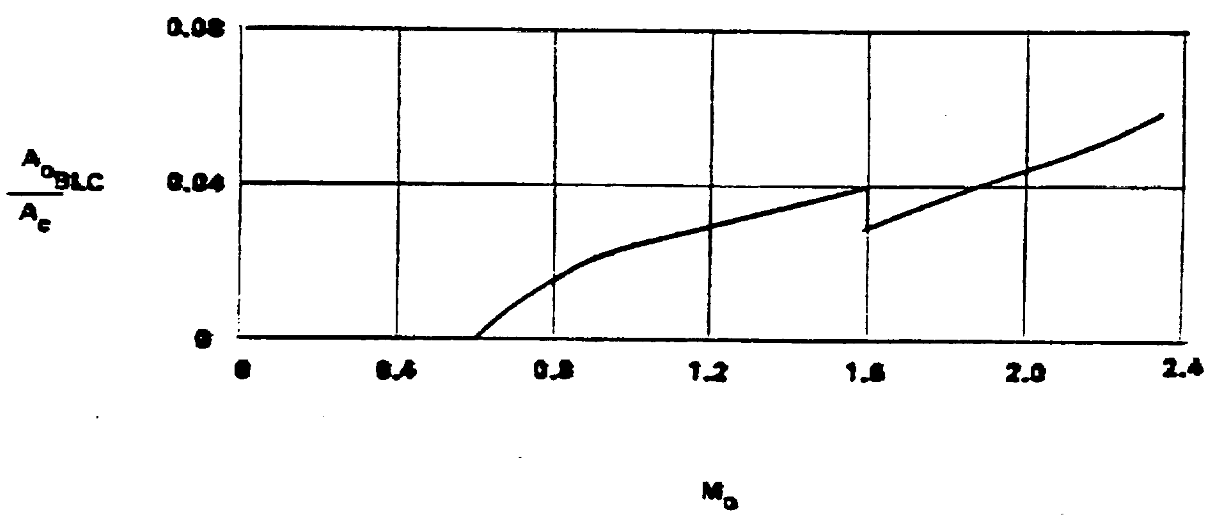


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)

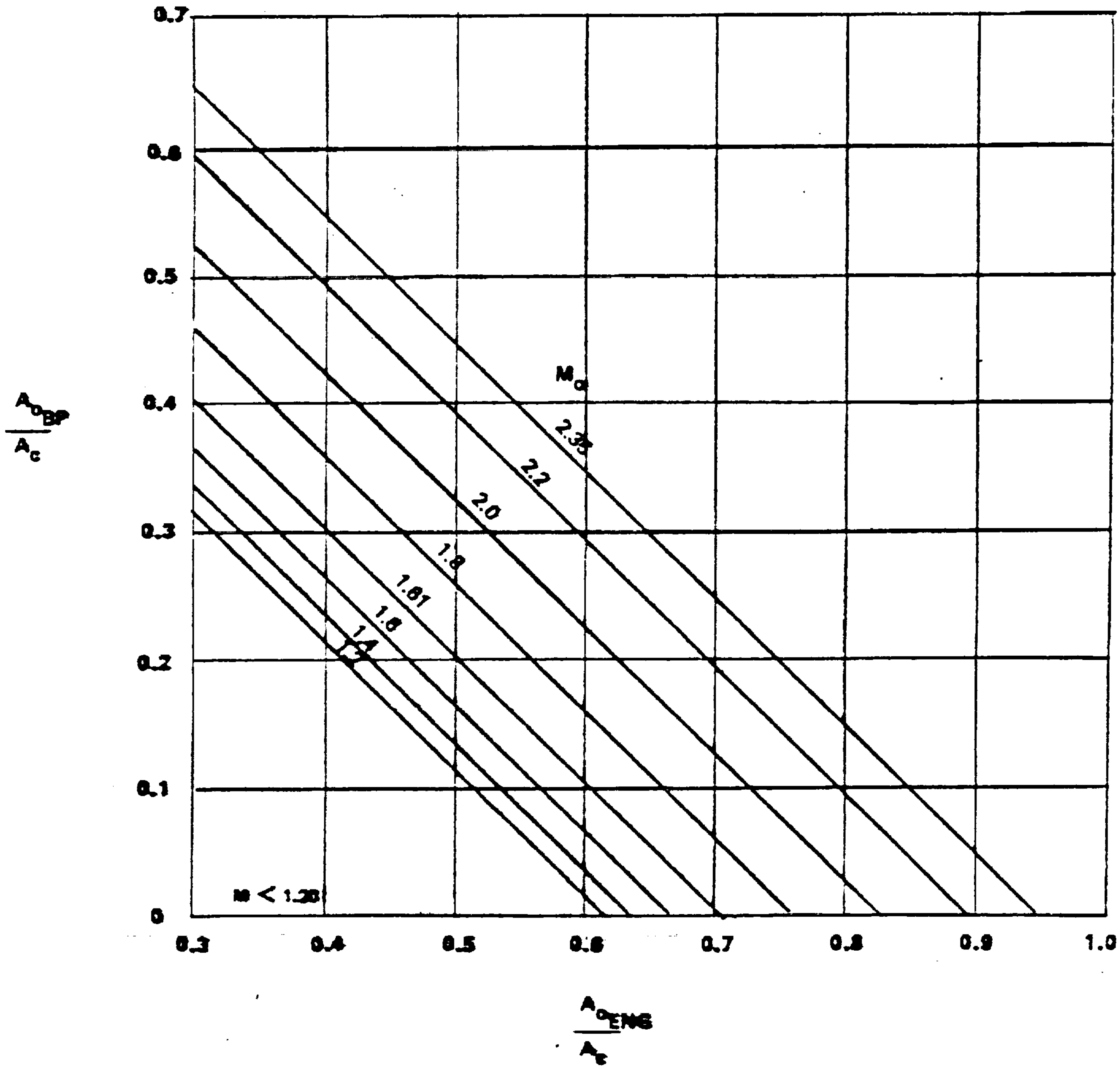


Figure 36. Performance Characteristics for Inlet Configuration - 'AST' - (continued)

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*         *
* AST     *
*         *
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MACH 2.35,MIXED COMPR, AXISYMMETRIC,TRANSLATING CB, BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	10.4000
4	DESIGN MACH NUMBER	2.3500
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.2000
7	EXTERNAL COWL ANGLE(DEG)	1.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.2000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	1.5700
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	7.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.0600

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	1.61
NOMINAL THROAT MACH NUMBER	0.81

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************
* TABLE 1  *        LOCAL MACH NUMBER (MNO)        VS        FREE STREAM MACH NUMBER (MNFS)
************
```

0.0	1.200	2.350	MNO
0.0	1.200	2.350	MNFS

```
************
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)      VS      MASS FLOW RATIO (AO/AC)       AND     LOCAL MACH NUMBER (MNO)
************
```

MNO=0.800	0.540	0.575	0.600	0.625	0.626	AO/AC		
	0.960	0.970	0.973	0.940	0.700	PT2/PTO		
MNO=1.200	0.550	0.575	0.600	0.615	0.625	0.630	0.631	AO/AC
	0.950	0.961	0.965	0.961	0.960	0.900	0.800	PT2/PTO
MNO=1.600	0.580	0.650	0.670	0.680	0.682	AO/AC		
	0.880	0.898	0.895	0.875	0.700	PT2/PTO		
MNO=1.610	0.680	0.700	0.710	AO/AC				
	0.960	0.940	0.750	PT2/PTO				
MNO=1.800	0.740	0.765	0.766	AO/AC				
	0.960	0.950	0.800	PT2/PTO				
MNO=2.000	0.805	0.820	0.825	0.826	AO/AC			
	0.960	0.950	0.940	0.800	PT2/PTO			
MNO=2.200	0.885	0.892	0.895	0.896	AO/AC			
	0.968	0.950	0.930	0.800	PT2/PTO			
MNO=2.350	0.930	0.940	0.945	0.950	AO/AC			
	0.958	0.940	0.930	0.800	PT2/PTO			

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PTO OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.800	1.200	1.600	1.610	1.800	2.000	2.200	2.350	MNO
0.943	0.970	0.970	0.962	0.895	0.930	0.930	0.930	0.930	0.930	PT2/PTO

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.200	1.600	1.610	1.800	2.000	2.200	2.350	MNO
0.615	0.610	0.615	0.665	0.702	0.760	0.825	0.895	0.945	AO/AC

```
************
* TABLE 2D *        BUZZ LIMIT MASS FLOW RATIO (AO/AC)        VS        LOCAL MACH NUMBER (MNO)
************

          0.0       0.400     0.800     1.200     1.600     1.610     1.800     2.000     2.200     2.350     MNO
          0.0       0.0       0.0       0.0       0.680     0.681     0.740     0.810     0.885     0.930     AO/AC

************
* TABLE 2E *        DISTORTION LIMIT MASS FLOW RATIO (AO/AC)  VS        LOCAL MACH NUMBER (MNO)
************

          0.600     0.800     1.200     1.600     1.610     1.800     2.000     2.200     2.350     MNO
          0.630     0.622     0.628     0.710     0.711     0.765     0.840     0.900     0.950     AO/AC

************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)      VS     INLET MASS FLOW RATIO (AOI/AC)    AND    LOCAL MACH NUMBER (MNO)
************

MNO=0.500 0.0       0.200     0.400     0.600     0.630     2.000     AOI/AC
          0.760     0.420     0.200     0.020     0.0       0.0       CDSPL

MNO=0.850 0.0       0.200     0.400     0.600     0.630     1.000     AOI/AC
          0.860     0.500     0.240     0.055     0.0       0.0       CDSPL

MNO=1.100 0.0       0.200     0.400     0.600     0.630     1.000     AOI/AC
          1.040     0.650     0.360     0.110     0.0       0.0       CDSPL

MNO=1.260 0.0       0.200     0.400     0.600     0.630     1.000     AOI/AC
          1.110     0.700     0.360     0.112     0.0       0.0       CDSPL

MNO=1.400 0.300     0.680     1.000     AOI/AC
          0.935     0.0       0.0       CDSPL

MNO=1.600 0.400     0.720     1.000     AOI/AC
          1.200     0.0       0.0       CDSPL

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```

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* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS        LOCAL MACH NUMBER (MNO)
************

          0.0      0.400    0.800    1.200    1.600    1.610    1.800    2.000    2.200    2.350    MNO
          0.0      0.0      0.020    0.040    0.024    0.024    0.014    0.008    0.003    0.0      REF CDSPL


************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)     VS        LOCAL MACH NUMBER (MNO)
************

          0.0      0.400    0.800    1.200    1.600    1.610    1.800    2.000    2.200    2.350    MNO
          0.655    0.655    0.655    0.660    0.720    0.735    0.805    0.875    0.946    1.000    REF AOI/AC


************
* TABLE 4  *      BLEED DRAG COEFFICIENT (CD BLD)      VS      BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

          0.0      0.600    1.000    1.600    1.610    2.200    2.350    MNO

MNO=0.0     0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.0      0.0      0.0      CDBLD

MNO=0.600   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.0      0.0      0.0      CDBLD

MNO=1.000   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.098    0.197    0.295    CDBLD

MNO=1.600   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.070    0.138    0.206    CDBLD

MNO=1.610   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.065    0.133    0.197    CDBLD

MNO=2.200   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.037    0.073    0.109    CDBLD

MNO=2.350   0.0      0.040    0.080    0.120    AOBLD/AC
            0.0      0.033    0.066    0.099    CDBLD
```

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************
* TABLE 5  *      BYPASS DRAG COEFFICIENT (CDBYP)     VS   BYPASS MASS FLOW RATIO (AOBYP/AC)      AND      LOCAL MACH NUMBER (MNO)
************

              1.200      1.400      1.700      2.100      2.350      MNO

MNO=1.200     0.0        0.040      0.080      0.120      0.160      0.200      0.220      AOBYP/AC
              0.0        0.042      0.087      0.144      0.220      0.310      0.370      CDBYP

MNO=1.400     0.0        0.040      0.080      0.120      0.160      0.200      0.220      AOBYP/AC
              0.0        0.035      0.074      0.124      0.189      0.268      0.314      CDBYP

MNO=1.700     0.0        0.040      0.080      0.120      0.160      0.200      0.220      AOBYP/AC
              0.0        0.030      0.063      0.105      0.154      0.215      0.263      CDBYP

MNO=2.100     0.0        0.040      0.080      0.120      0.160      0.200      0.220      AOBYP/AC
              0.0        0.027      0.057      0.092      0.131      0.180      0.214      CDBYP

MNO=2.350     0.0        0.040      0.080      0.120      0.160      0.200      0.220      AOBYP/AC
              0.0        0.018      0.038      0.060      0.090      0.125      0.147      CDBYP
```



```
************
* TABLE 6A *     BLEED MASS FLOW RATIO (AOBLD/AC)     VS        MASS FLOW RATIO (AO/AC)          AND      LOCAL MACH NUMBER (MNO)
************

MNO=0.600     0.300      3.000      AO/AC
              0.0        0.0        AOBLD/AC

MNO=0.800     0.500      0.610      1.000      AO/AC
              0.025      0.015      0.0        AOBLD/AC

MNO=1.000     0.500      0.610      1.000      AO/AC
              0.044      0.024      0.0        AOBLD/AC

MNO=1.200     0.500      0.615      1.000      AO/AC
              0.052      0.030      0.0        AOBLD/AC

MNO=1.600     0.500      0.610      0.700      1.000      AO/AC
```

	0.055	0.040	0.030	0.0	AOBLD/AC
MNO=1.610	0.600 0.050	0.700 0.036	1.000 0.0	AO/AC AOBLD/AC	
MNO=1.800	0.600 0.067	0.760 0.038	1.000 0.0	AO/AC AOBLD/AC	
MNO=2.000	0.700 0.068	0.825 0.045	1.000 0.0	AO/AC AOBLD/AC	
MNO=2.200	0.750 0.095	0.895 0.051	1.000 0.0	AO/AC AOBLD/AC	
MNO=2.350	0.800 0.124	0.945 0.060	1.000 0.0	AO/AC AOBLD/AC	

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.800	1.200	1.600	1.610	1.800	2.000	2.200	2.350	MNO
0.0	0.0	0.015	0.030	0.040	0.030	0.038	0.045	0.052	0.060	AOBLD/AC

****
* TABLE 7 *
****

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0 0.0	0.600 0.0	3.000 0.0	AOE/AC AOBYP/AC
MNO=1.190	0.0 0.0	6.000 0.0	3.000 0.0	AOE/AC AOBYP/AC
MNO=1.200	0.300 0.315	0.615 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=1.400	0.300	0.635	1.000	AOE/AC

	0.335	0.0	0.0	AOBYP/AC
MNO=1.600	0.300	0.665	1.000	AOE/AC
	0.365	0.0	0.0	AOBYP/AC
MNO=1.610	0.300	0.700	1.000	AOE/AC
	0.400	0.0	0.0	AOBYP/AC
MNO=1.800	0.300	0.760	1.000	AOE/AC
	0.460	0.0	0.0	AOBYP/AC
MNO=2.000	0.300	0.825	1.000	AOE/AC
	0.525	0.0	0.0	AOBYP/AC
MNO=2.200	0.300	0.894	1.000	AOE/AC
	0.594	0.0	0.0	AOBYP/AC
MNO=2.350	0.300	0.945	1.000	AOE/AC
	0.645	0.0	0.0	AOBYP/AC

4.2.1.17 INLET CONFIGURATION 'NASA3' - MIXED-COMPRESSION, AXISYMMETRIC, TRANSLATING CENTERBODY INLET

The design Mach number for this inlet is 3.0. The initial cone angle is 10°. Boundary layer control bleed flow is removed through porous bleed holes on cowl and centerbody surfaces. Four individual bleed zones were provided.

The performance characteristics of this inlet are based on the design studies and data reported in Reference 16 and engineering analysis. The inlet geometry is shown in Figure 35 and the inlet performance characteristics are presented in Figure 36.

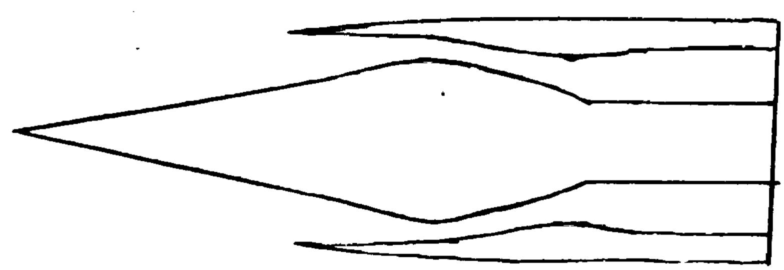

Figure 37 Mach 3.0 Axisymmetric Mixed-Compression Inlet

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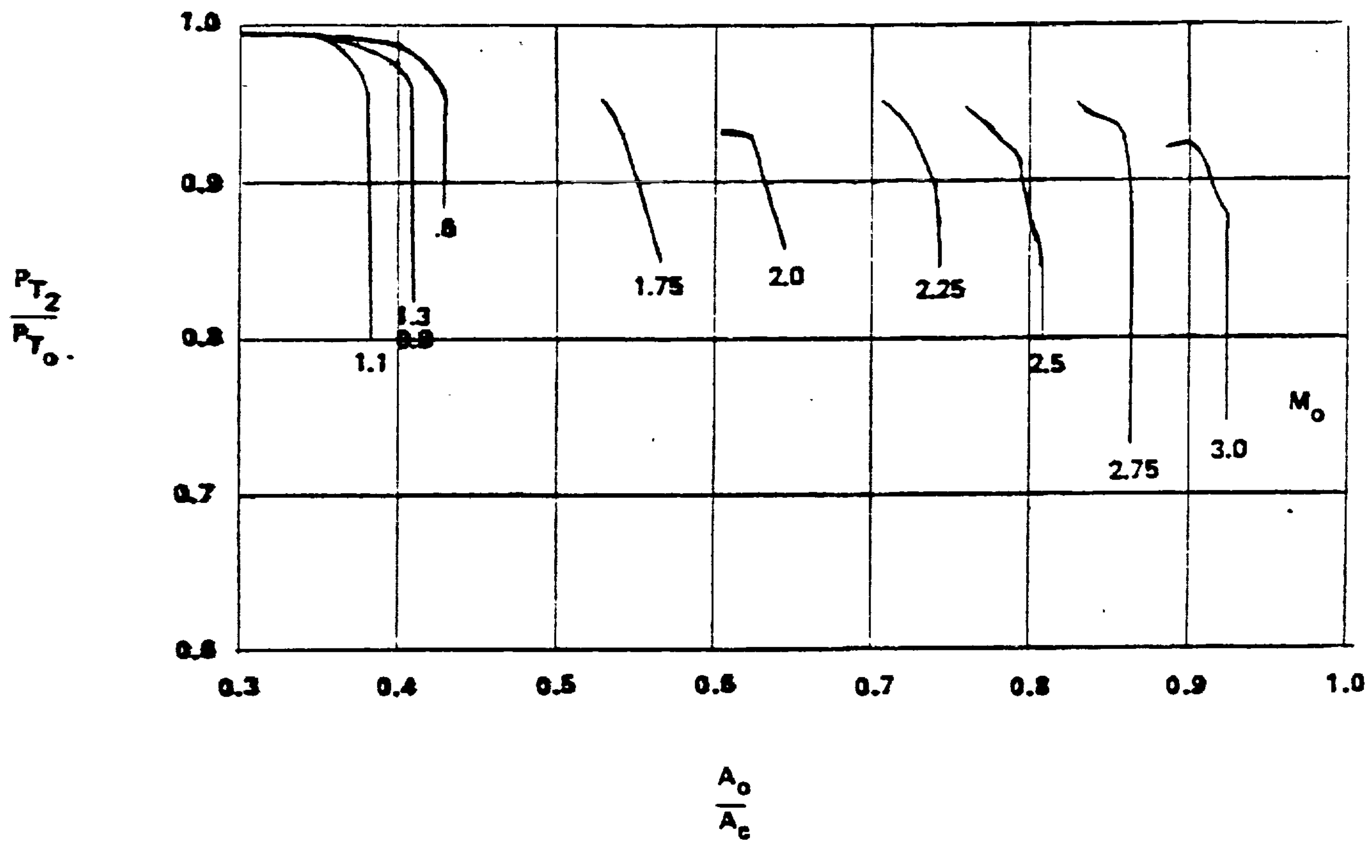


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3'

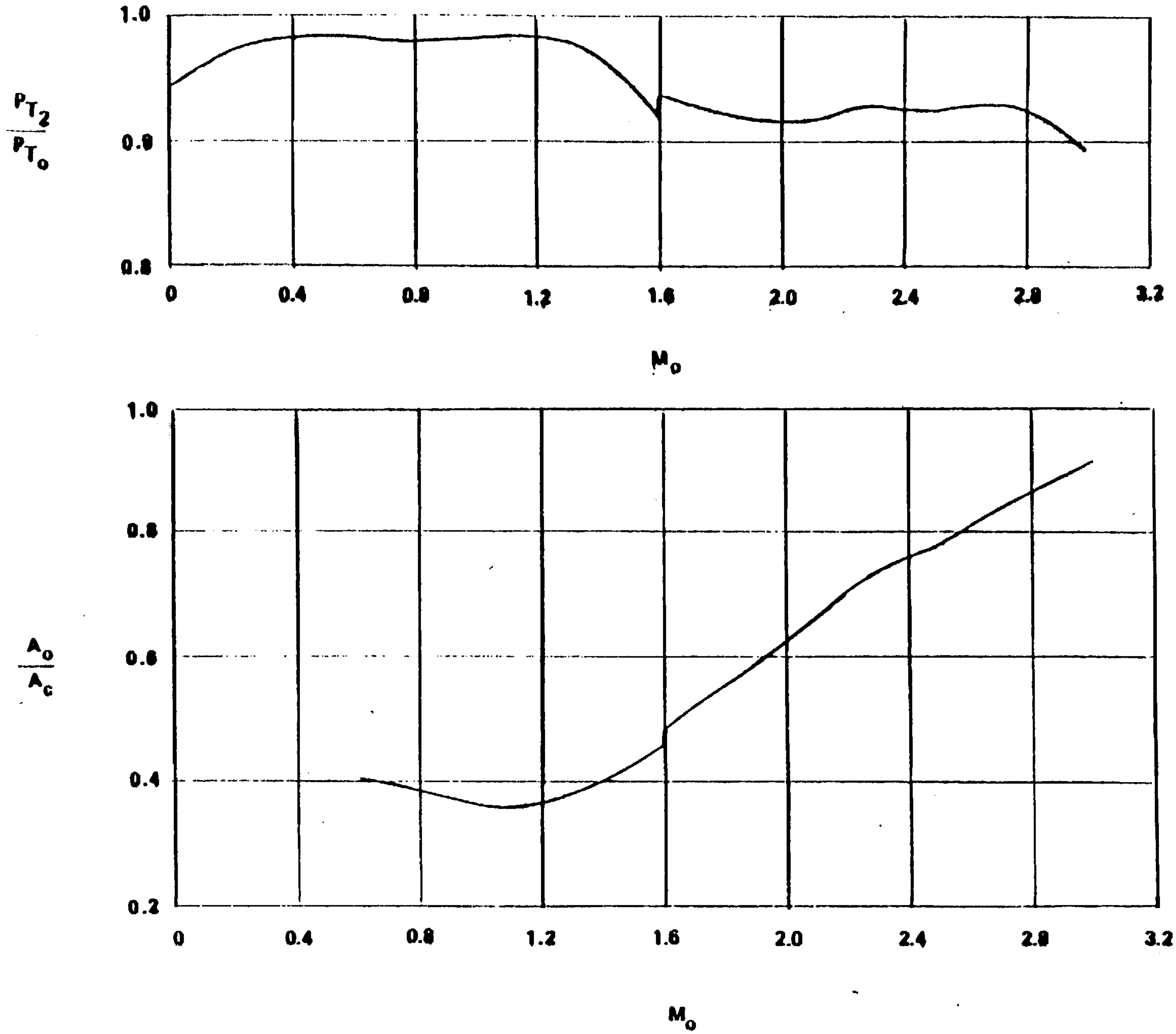


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (continued)

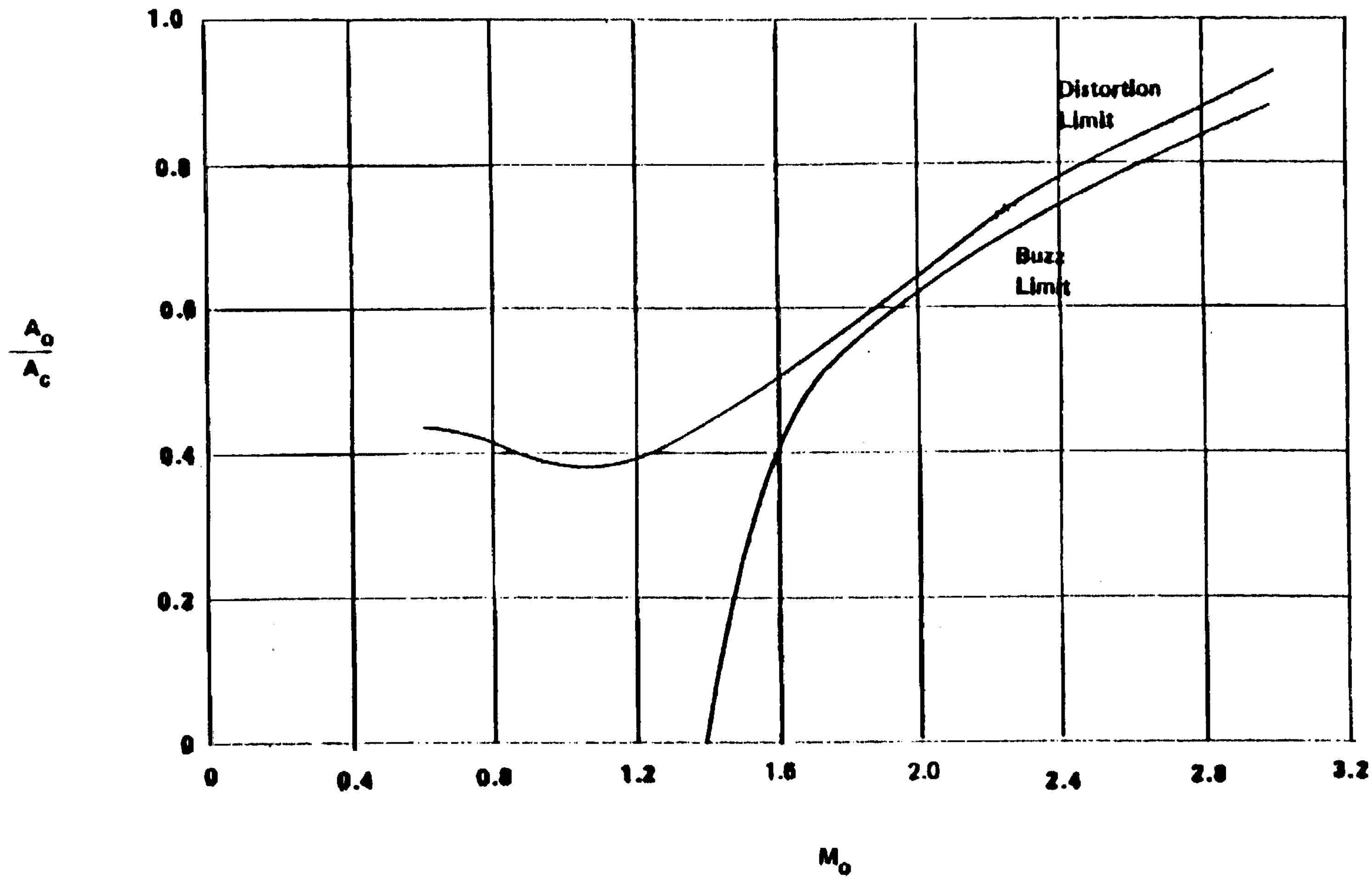
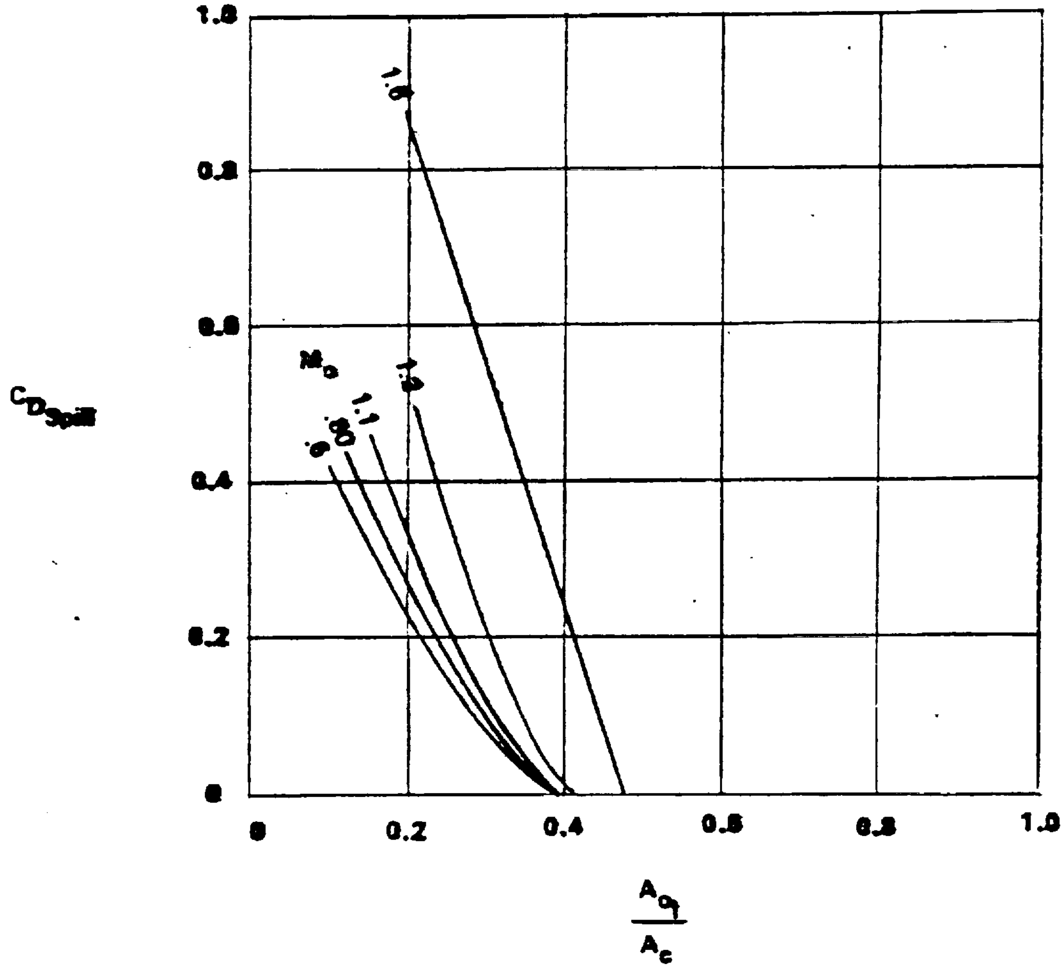


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3'- (continued)



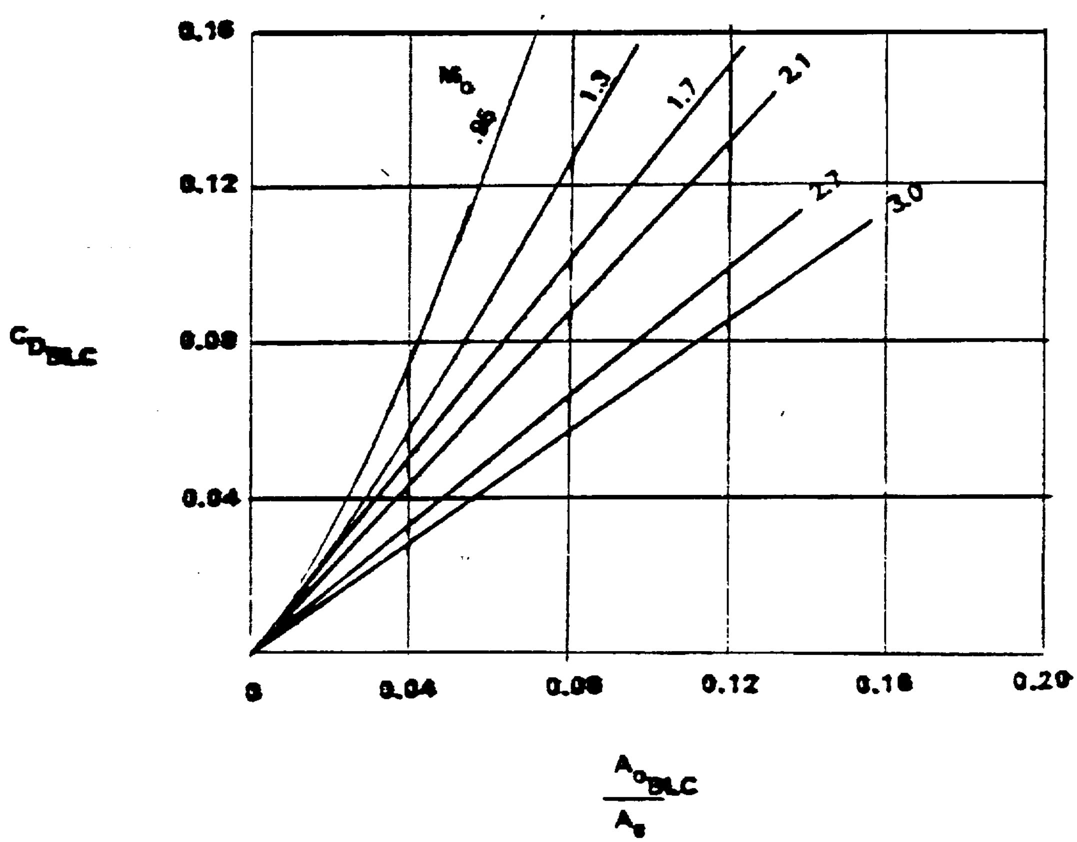


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (continued)

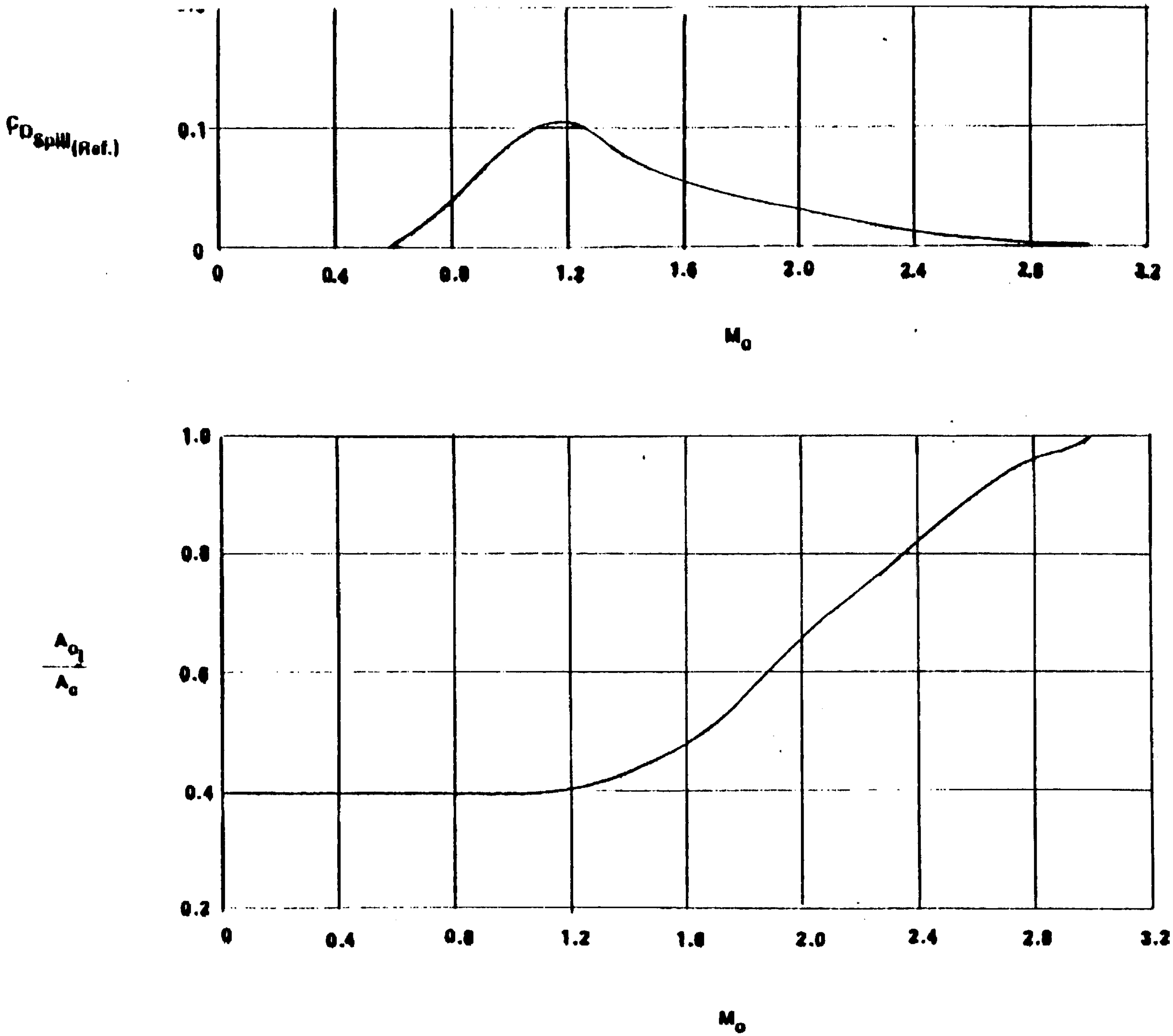


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (continued)

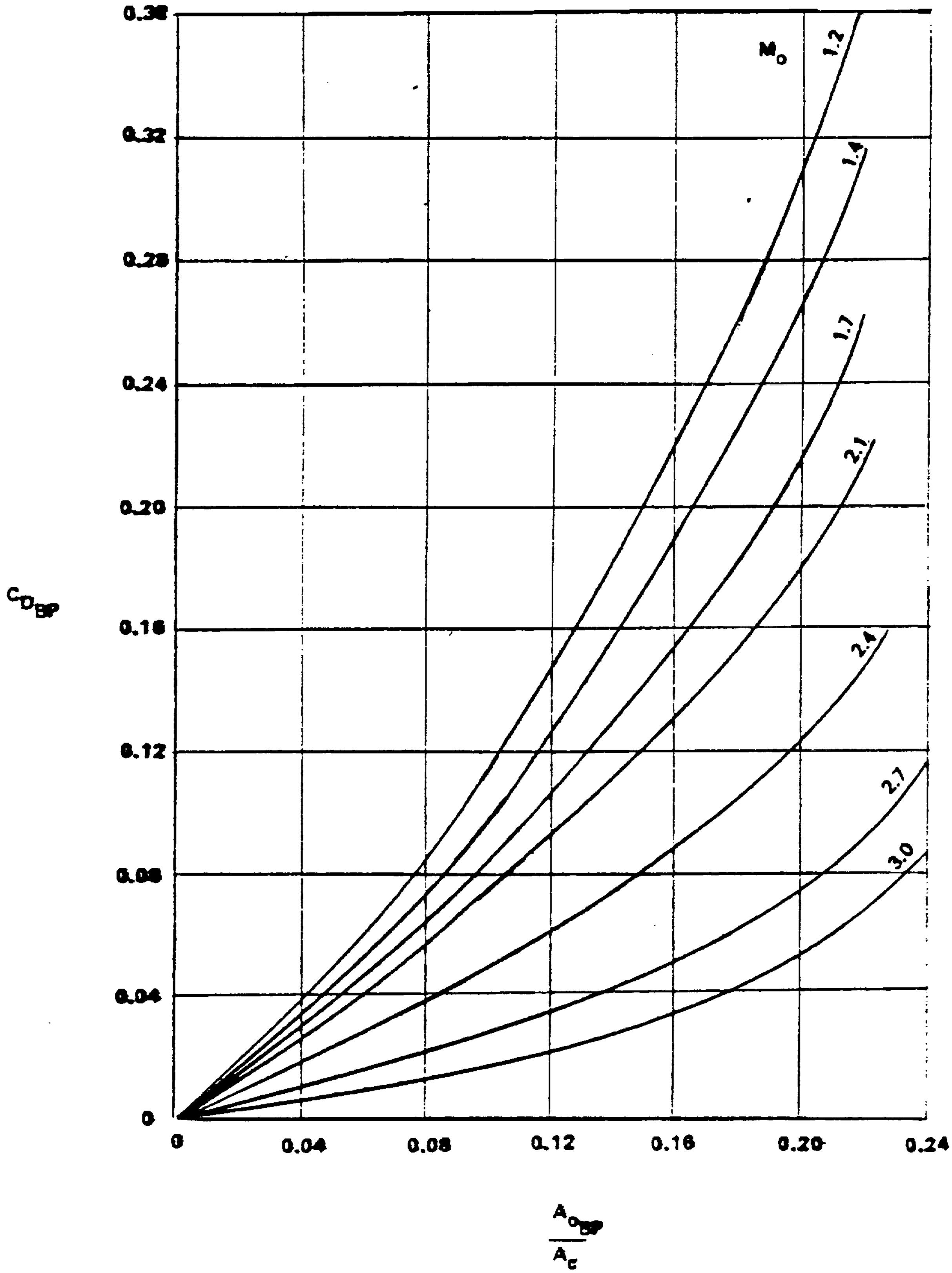


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (continued)

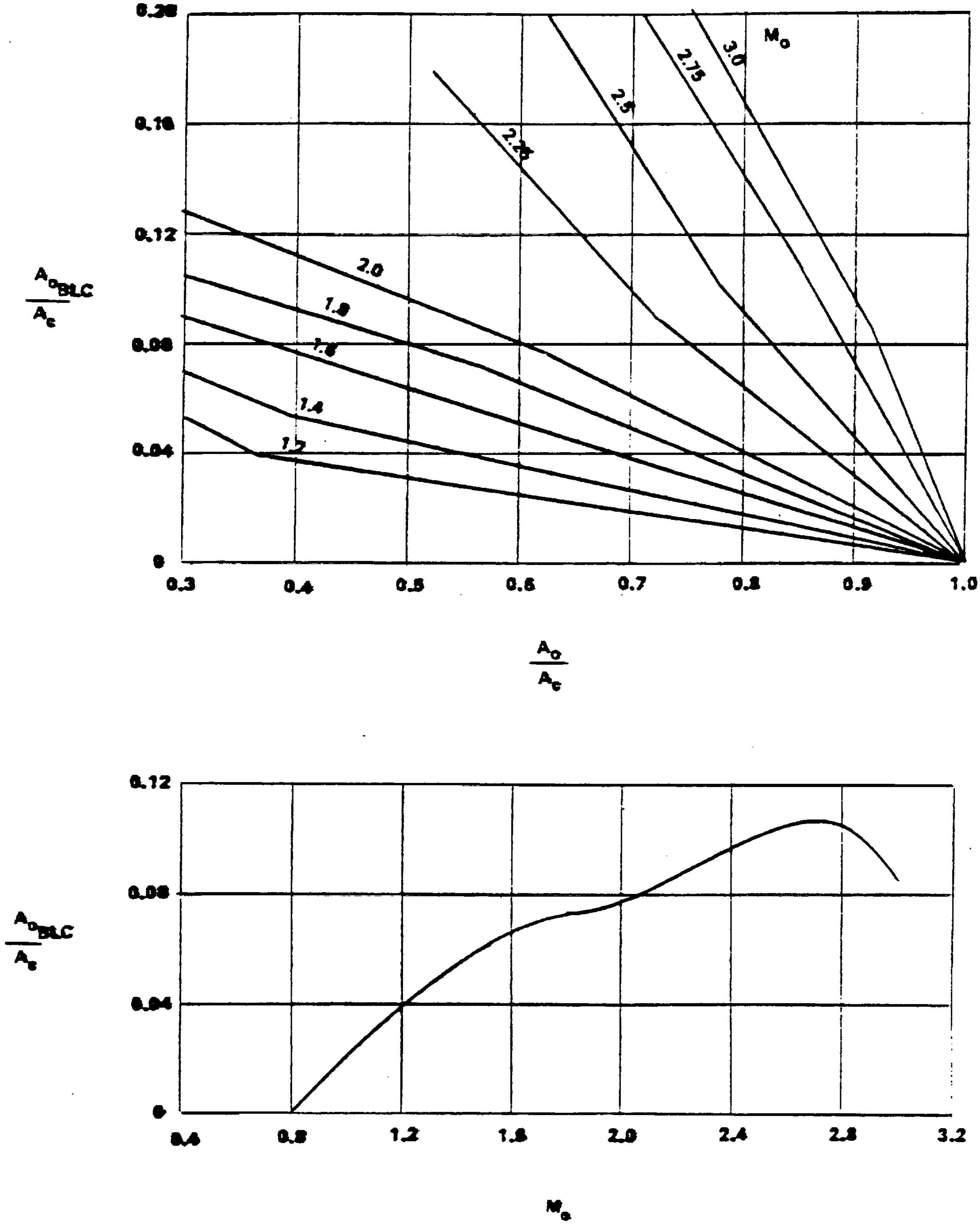


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (cont')

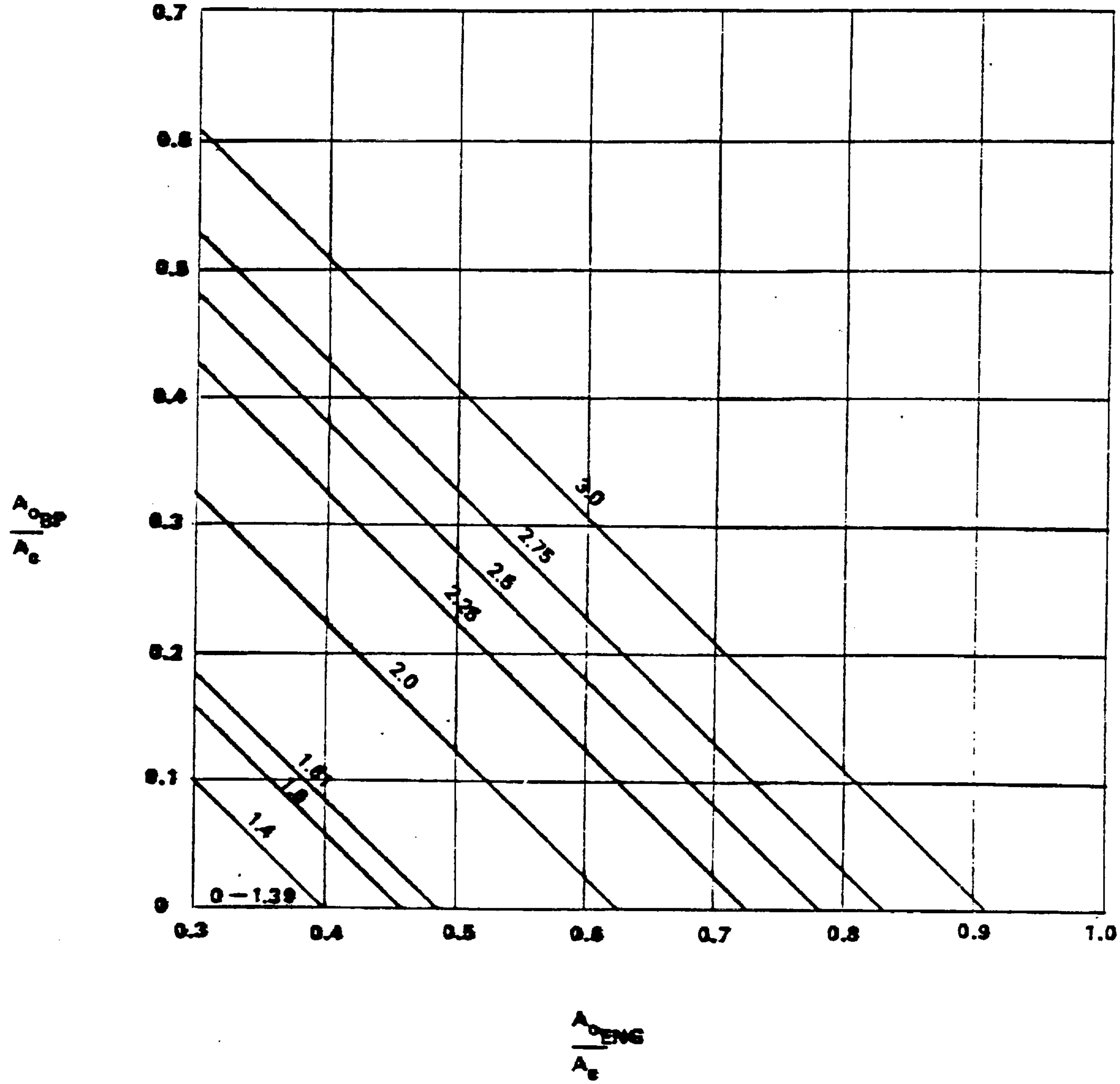


Figure 38. Performance Characteristics for Inlet Configuration - 'NASA3' - (continued)

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*         *
* NASA3   *
*         *
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MACH 3.0,MIXED COMPR, AXISYMMETRIC,TRANSLATING CB, BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	10.0000
4	DESIGN MACH NUMBER	3.0000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.2000
7	EXTERNAL COWL ANGLE(DEG)	0.0
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.2000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	2.1000
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	12.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	1.61
NOMINAL THROAT MACH NUMBER	0.83

```
************
* TABLE 1  *        LOCAL MACH NUMBER (MNO)        VS        FREE STREAM MACH NUMBER (MNFS)
************
```

0.0	1.000	3.000	MNO
0.0	1.000	3.000	MNFS

```
************
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)     VS     MASS FLOW RATIO (AO/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```

MNO=0.600	0.300	0.350	0.400	0.425	0.430	0.431	AO/AC	
	0.995	0.994	0.937	0.968	0.960	0.900	PT2/PT0	
MNO=0.800	0.340	0.380	0.400	0.410	0.420	AO/AC		
	0.994	0.985	0.970	0.950	0.850	PT2/PT0		
MNO=1.100	0.300	0.325	0.350	0.365	0.375	0.380	0.383	AO/AC
	0.995	0.994	0.993	0.985	0.974	0.950	0.800	PT2/PT0
MNO=1.300	0.340	0.375	0.400	0.410	0.412	AO/AC		
	0.994	0.985	0.973	0.965	0.850	PT2/PT0		
MNO=1.750	0.530	0.540	0.550	0.565	AO/AC			
	0.950	0.935	0.900	0.850	PT2/PT0			
MNO=2.000	0.610	0.620	0.630	0.645	AO/AC			
	0.930	0.930	0.903	0.860	PT2/PT0			
MNO=2.250	0.706	0.720	0.740	0.745	AO/AC			
	0.950	0.940	0.895	0.850	PT2/PT0			
MNO=2.500	0.760	0.725	0.740	0.750	0.758	0.760	AO/AC	
	0.945	0.930	0.920	0.875	0.858	0.800	PT2/PT0	
MNO=2.750	0.830	0.840	0.853	0.860	0.865	0.866	AO/AC	
	0.950	0.940	0.938	0.925	0.890	0.730	PT2/PT0	
MNO=3.000	0.885	0.900	0.925	0.926	AO/AC			
	0.922	0.925	0.875	0.750	PT2/PT0			

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.800	1.300	1.600	1.610	2.000	2.250	2.750	3.000	MNO
0.943	0.984	0.980	0.980	0.920	0.937	0.915	0.930	0.930	0.894	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.100	1.300	1.600	1.610	2.000	2.250	2.750	3.000	MNO
0.400	0.385	0.360	0.380	0.460	0.485	0.625	0.725	0.855	0.915	AO/AC

****
* TABLE 2D *
****

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.800	1.100	1.300	1.600	1.610	2.000	2.250	2.750	3.000	MNO
0.0	0.0	0.0	0.0	0.400	0.405	0.620	0.705	0.830	0.880	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.800	1.100	1.300	1.600	1.610	2.000	2.250	2.750	3.000	MNO
0.440	0.410	0.390	0.415	0.510	0.511	0.640	0.740	0.865	0.925	AO/AC

****
* TABLE 3 *
****

SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.0	3.000	AOI/AC				
	0.0	0.0	CDSPL				
MNO=0.600	0.100	0.200	0.300	0.390	2.000	AOI/AC	
	0.420	0.235	0.080	0.0	0.0	CDSPL	
MNO=0.800	0.150	0.200	0.300	0.390	1.000	AOI/AC	
	0.375	0.270	0.100	0.0	0.0	CDSPL	
MNO=1.100	0.150	0.200	0.300	0.390	1.000	AOI/AC	
	0.435	0.330	0.125	0.0	0.0	CDSPL	
MNO=1.300	0.200	0.250	0.300	0.350	0.410	1.000	AOI/AC
	0.530	0.360	0.205	0.090	0.0	0.0	CDSPL

```
MNO=1.600     0.200    0.400    0.480    1.000    AOI/AC
              0.870    0.250    0.0      0.0      CDSPL


***********
* TABLE 3A *        REF SPILLAGE DRAG COEFF (REF CDSPL)       VS       LOCAL MACH NUMBER (MNO)
***********

              0.0      0.600    0.800    1.100    1.300    1.600    1.610    2.000    2.250    3.000    MNO
              0.0      0.0      0.038    0.100    0.095    0.053    0.053    0.030    0.018    0.0      REF CDSPL


***********
* TABLE 3B *        REF INLET MASS FLOW RATIO (REF AOI/AC)    VS       LOCAL MACH NUMBER (MNO)
***********

              0.0      0.600    0.800    1.100    1.300    1.600    2.000    2.500    2.750    3.000    MNO
              0.390    0.390    0.390    0.395    0.413    0.480    0.660    0.870    0.950    1.000    REF AOI/AC


***********
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
***********

              0.600    0.950    1.300    1.700    2.100    2.700    3.000    MNO

MNO=0.600     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.0      0.0      0.0      0.0      CDBLD

MNO=0.950     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.075    0.180    0.180    0.180    CDBLD

MNO=1.300     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.058    0.127    0.180    0.180    CDBLD

MNO=1.700     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.050    0.100    0.152    0.176    CDBLD

MNO=2.100     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.043    0.087    0.132    0.154    CDBLD

MNO=2.700     0.0      0.040    0.080    0.120    0.140    AOBLD/AC
              0.0      0.033    0.066    0.099    0.115    CDBLD
```

MNO=3.000	0.0	0.040	0.080	0.120	0.140	AOBLD/AC
	0.0	0.028	0.057	0.085	0.100	CDBLD

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	1.200	1.400	1.700	2.100	2.400	2.700	3.000 MNO
MNO=1.200	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.039	0.085	0.147	0.220	0.310	CDBYP
MNO=1.400	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.035	0.075	0.127	0.191	0.265	CDBYP
MNO=1.700	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.029	0.063	0.108	0.154	0.215	CDBYP
MNO=2.100	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.025	0.057	0.094	0.131	0.180	CDBYP
MNO=2.400	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.019	0.038	0.061	0.088	0.124	CDBYP
MNO=2.700	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.011	0.022	0.035	0.051	0.075	CDBYP
MNO=3.000	0.0	0.040	0.080	0.120	0.160	0.200	AOBYP/AC
	0.0	0.006	0.013	0.022	0.035	0.054	CDBYP

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300	3.000	AO/AC

	0.0	0.0	AOBLD/AC	
MNO=1.200	0.300	0.362	1.000	AO/AC
	0.054	0.040	0.0	AOBLD/AC
MNO=1.400	0.300	0.400	1.000	AO/AC
	0.070	0.054	0.0	AOBLD/AC
MNO=1.600	0.300	0.485	1.000	AO/AC
	0.090	0.066	0.0	AOBLD/AC
MNO=1.800	0.300	0.560	1.000	AO/AC
	0.106	0.074	0.0	AOBLD/AC
MNO=2.000	0.300	0.625	1.000	AO/AC
	0.128	0.076	0.0	AOBLD/AC
MNO=2.250	0.550	0.725	1.000	AO/AC
	0.166	0.089	0.0	AOBLD/AC
MNO=2.500	0.650	0.780	1.000	AO/AC
	0.183	0.102	0.0	AOBLD/AC
MNO=2.750	0.750	0.855	1.000	AO/AC
	0.173	0.106	0.0	AOBLD/AC
MNO=3.000	0.750	0.915	1.000	AO/AC
	0.203	0.085	0.0	AOBLD/AC


```
***********
* TABLE 6B *
***********
```

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.600	0.800	1.100	1.300	1.600	2.000	2.500	2.750	3.000	MNO
0.0	0.0	0.0	0.030	0.047	0.066	0.077	0.101	0.106	0.085	AOBLD/AC

```
***********
* TABLE 7  *
***********
```

BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300 0.0	3.000 0.0	AOE/AC AOBYP/AC	
MNO=1.390	0.300 0.0	2.000 0.0	AOE/AC AOBYP/AC	
MNO=1.400	0.300 0.100	0.400 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=1.600	0.300 0.160	0.460 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=1.610	0.300 0.185	0.485 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.000	0.300 0.325	0.625 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.250	0.300 0.425	0.725 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.500	0.300 0.480	0.780 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=2.750	0.300 0.530	0.830 0.0	1.000 0.0	AOE/AC AOBYP/AC
MNO=3.000	0.300 0.608	0.908 0.0	1.000 0.0	AOE/AC AOBYP/AC

4.2.1.18 INLET CONFIGURATION 'BCAC35' - MIXED-COMPRESSION, AXISYMMETRIC, TRANSLATING CENTERBODY INLET

The mixed-compression inlet was designed for a Mach number of 3.5. A sophisticated boundary layer control bleed system was provided based on the results of detailed analyses. The cowl bleed system included four separate bleed plenums with separate overboard exits for each plenum. The centerbody includes 12 bleed plenums in a "traveling" bleed arrangement. Excess inlet airflow can be exited through bypass doors.

The inlet performance characteristics of this configuration are based on the data and design in Reference 17, supplemented with additional engineering analyses. The inlet geometry is shown in Figure 37 and the performance characteristics are presented in Figure 38.

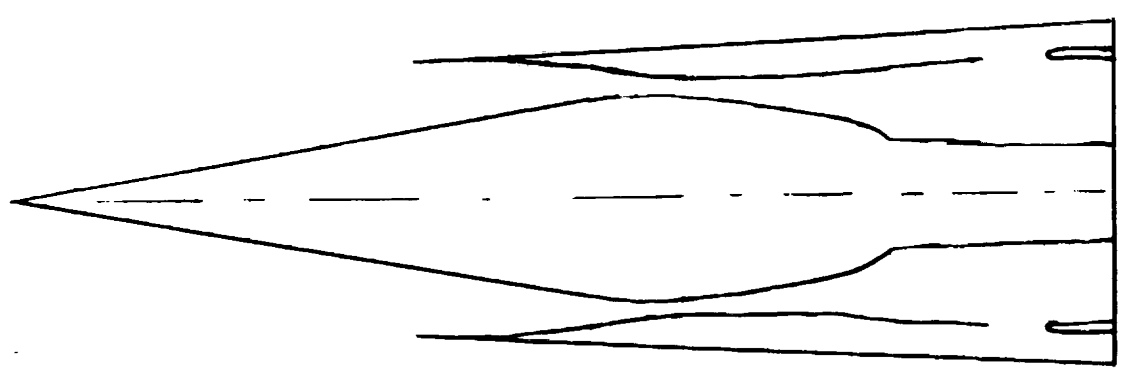


Figure 39 Mach 3.5 Axisymmetric Mixed-Compression Inlet

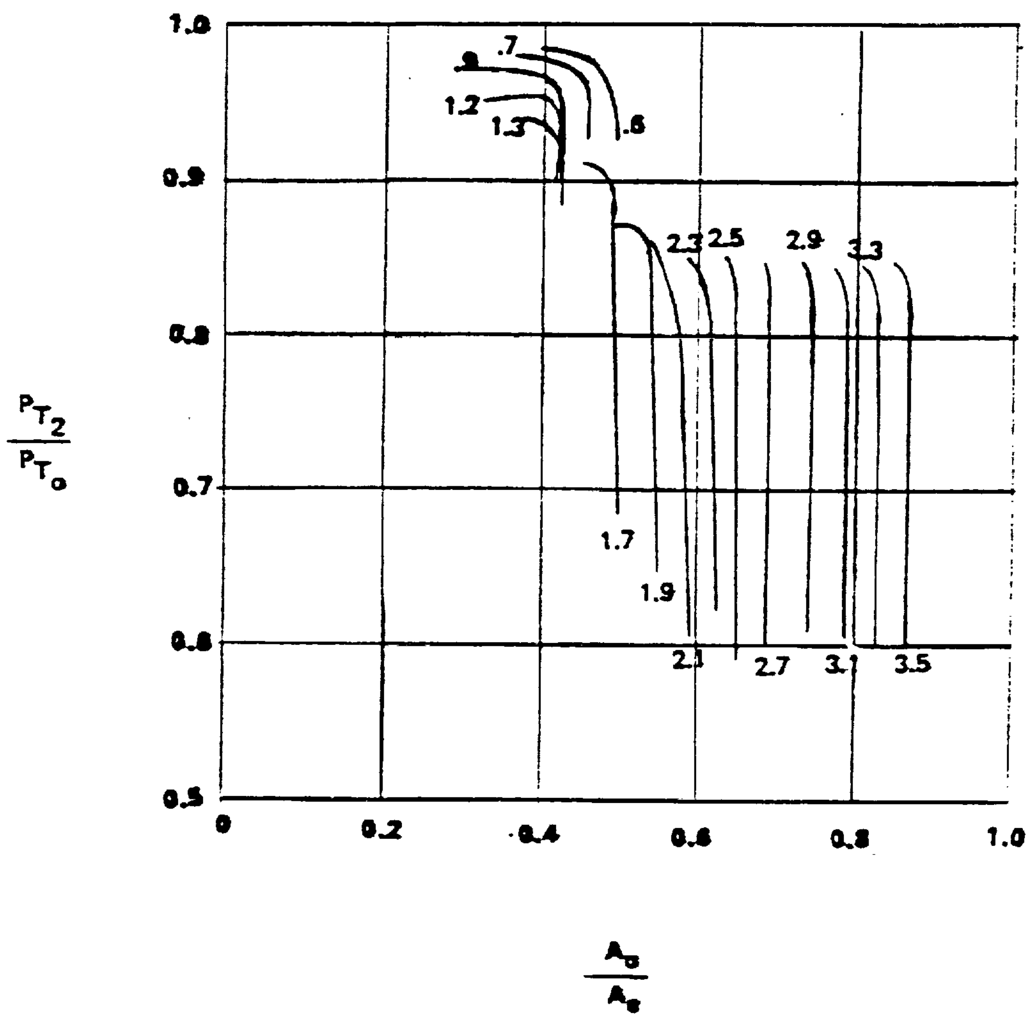


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35'

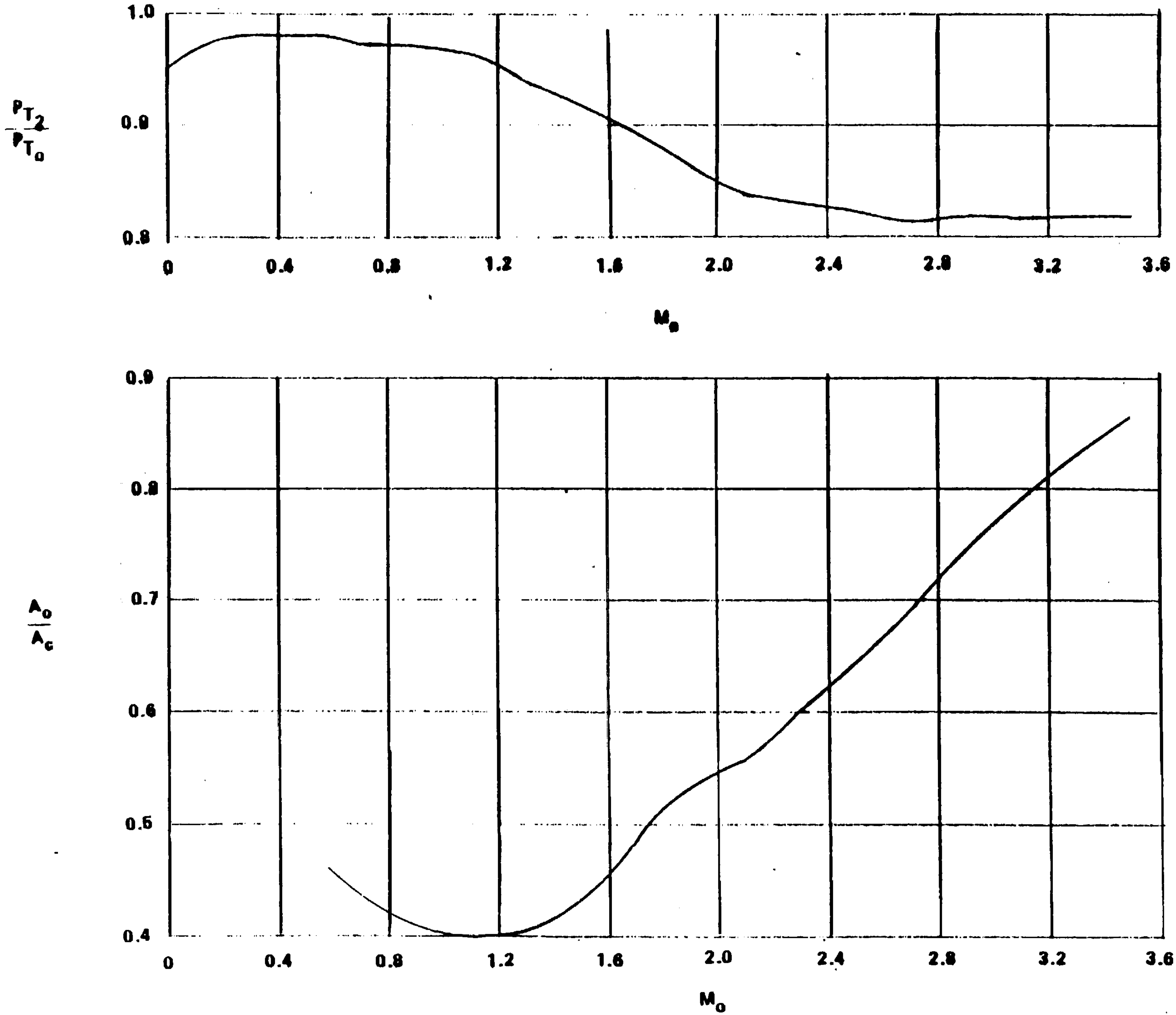


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

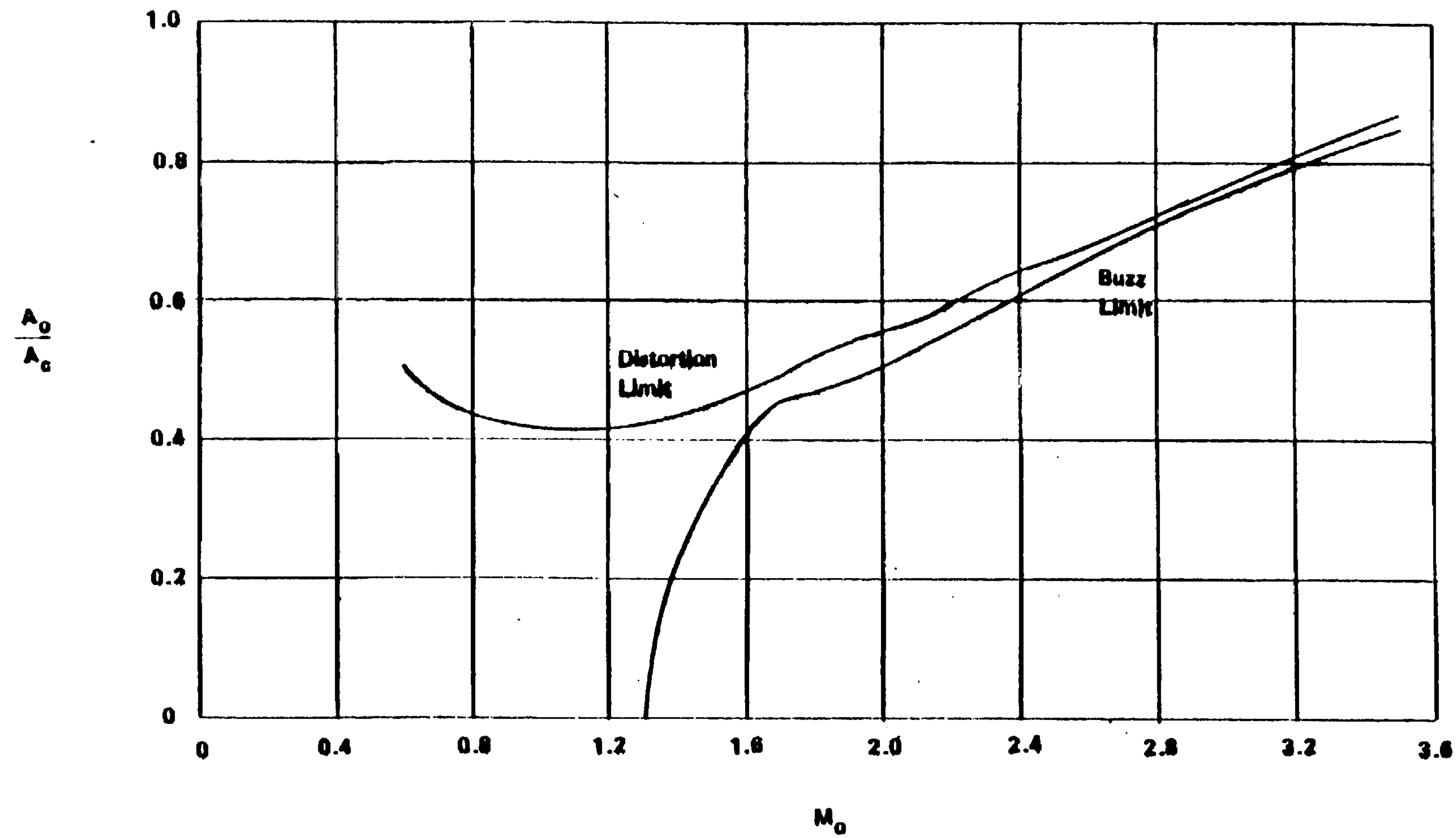


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

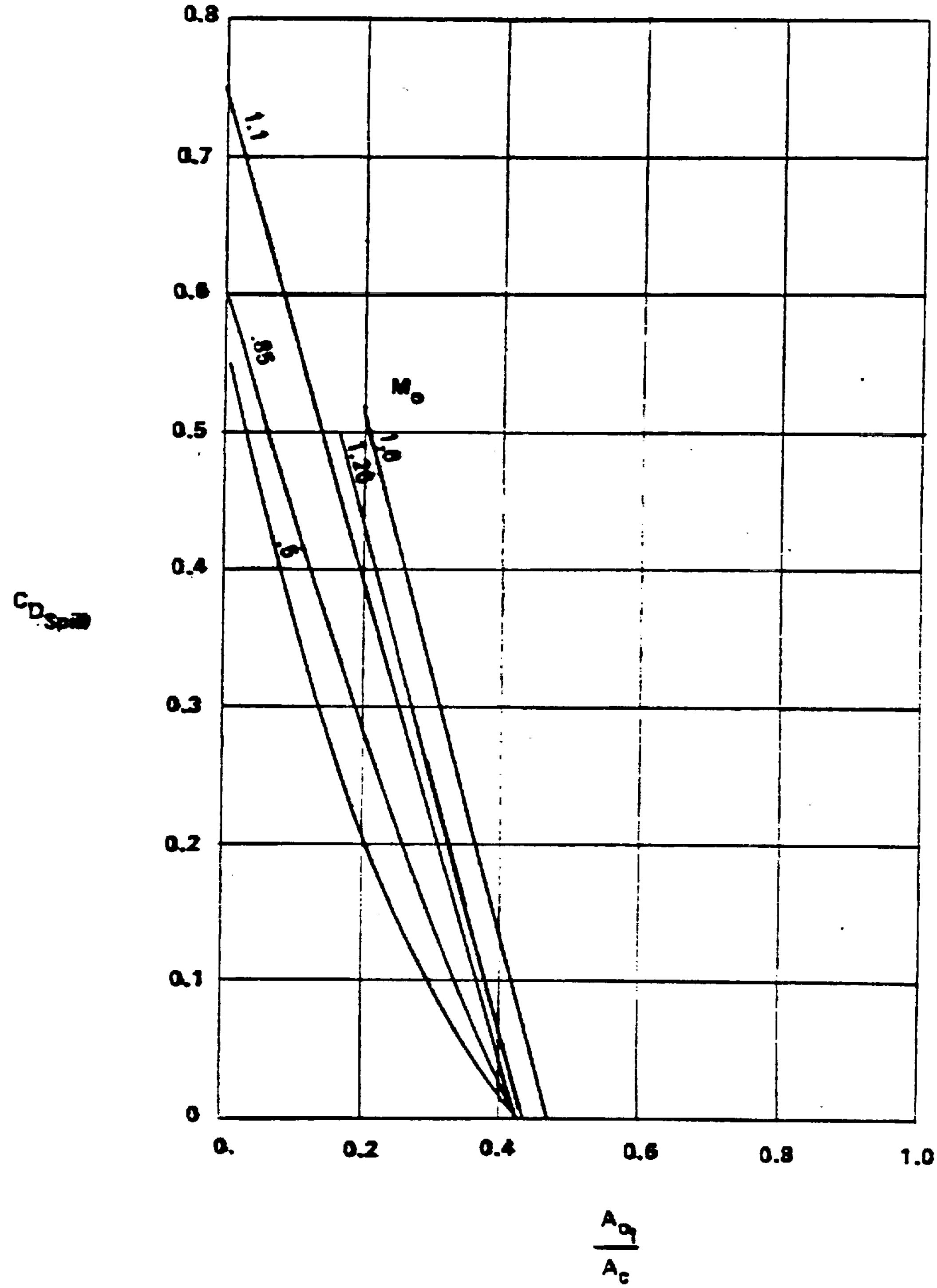


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

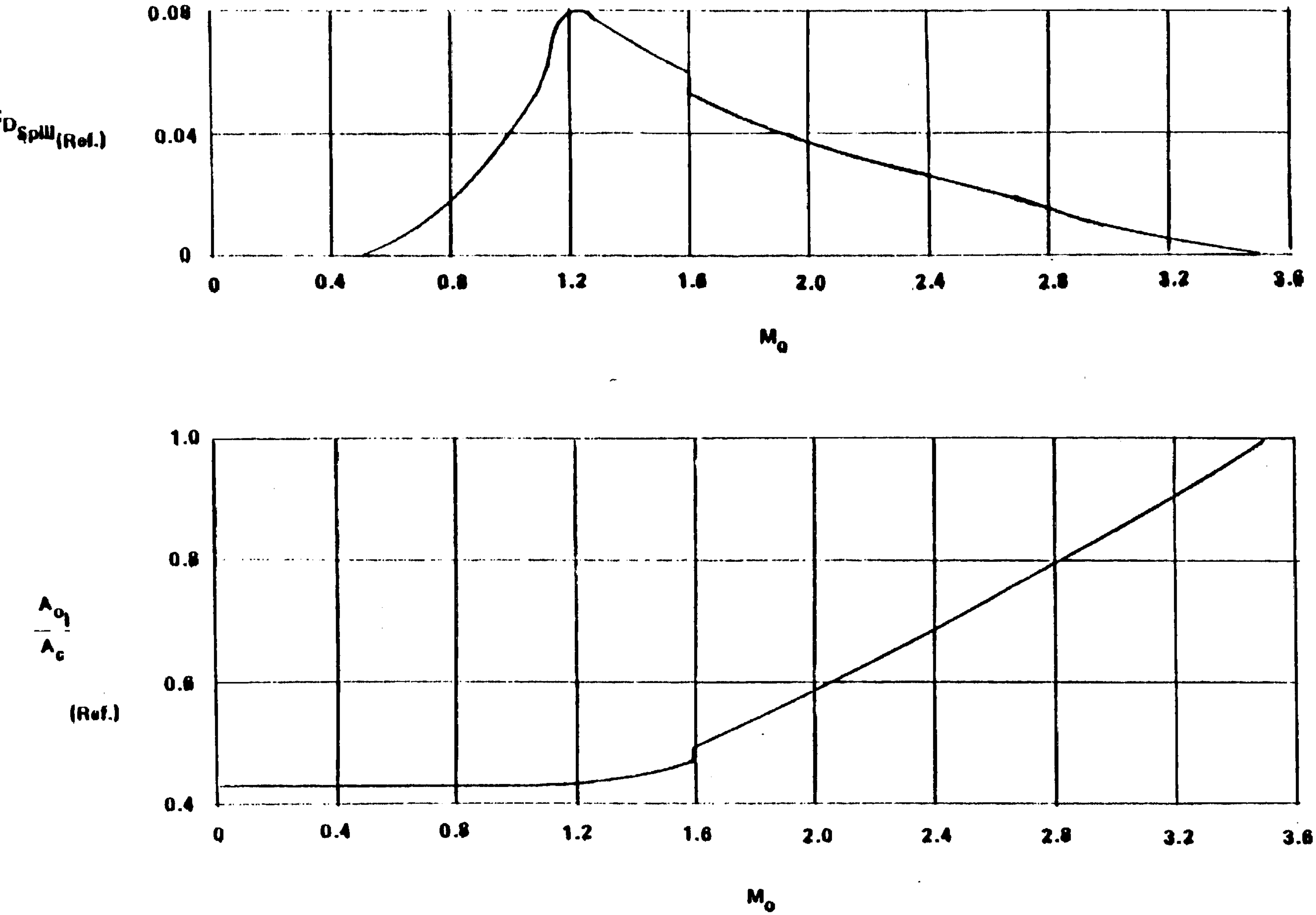
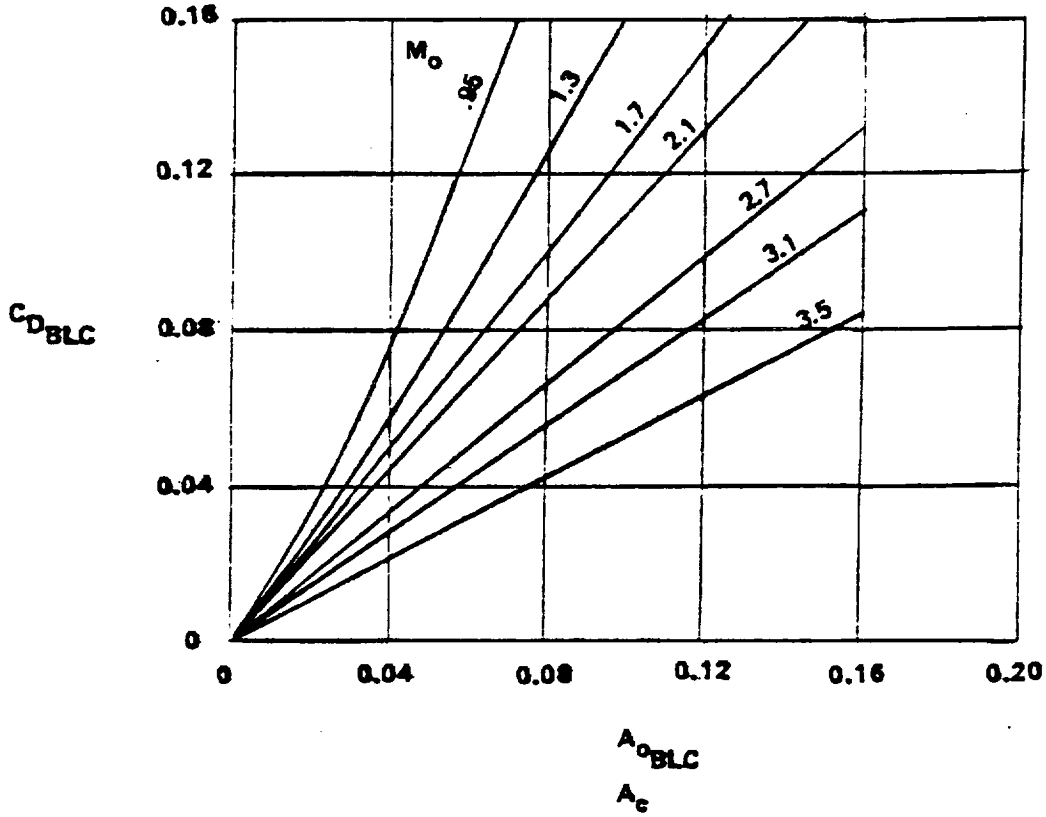


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)



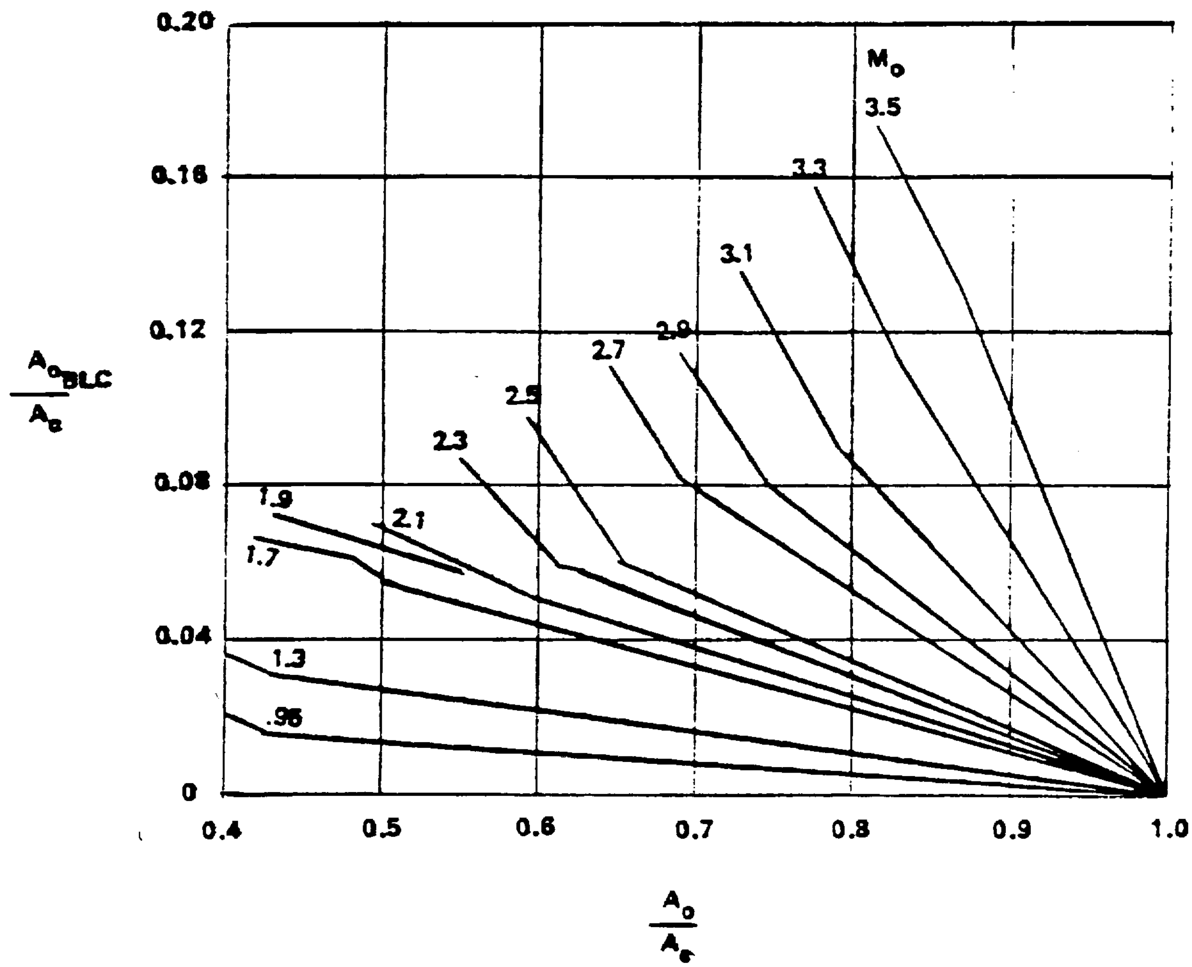


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (cont')

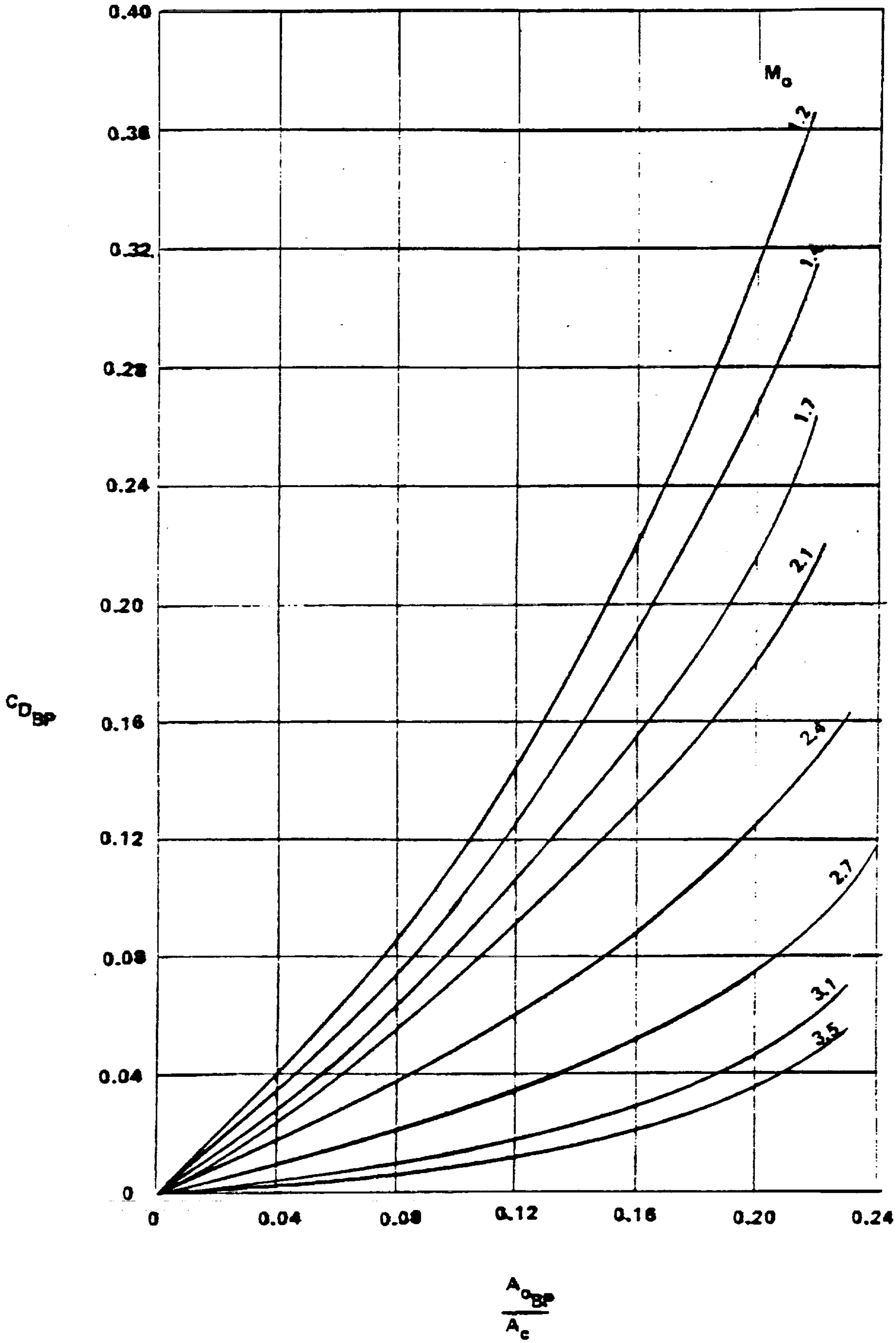


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

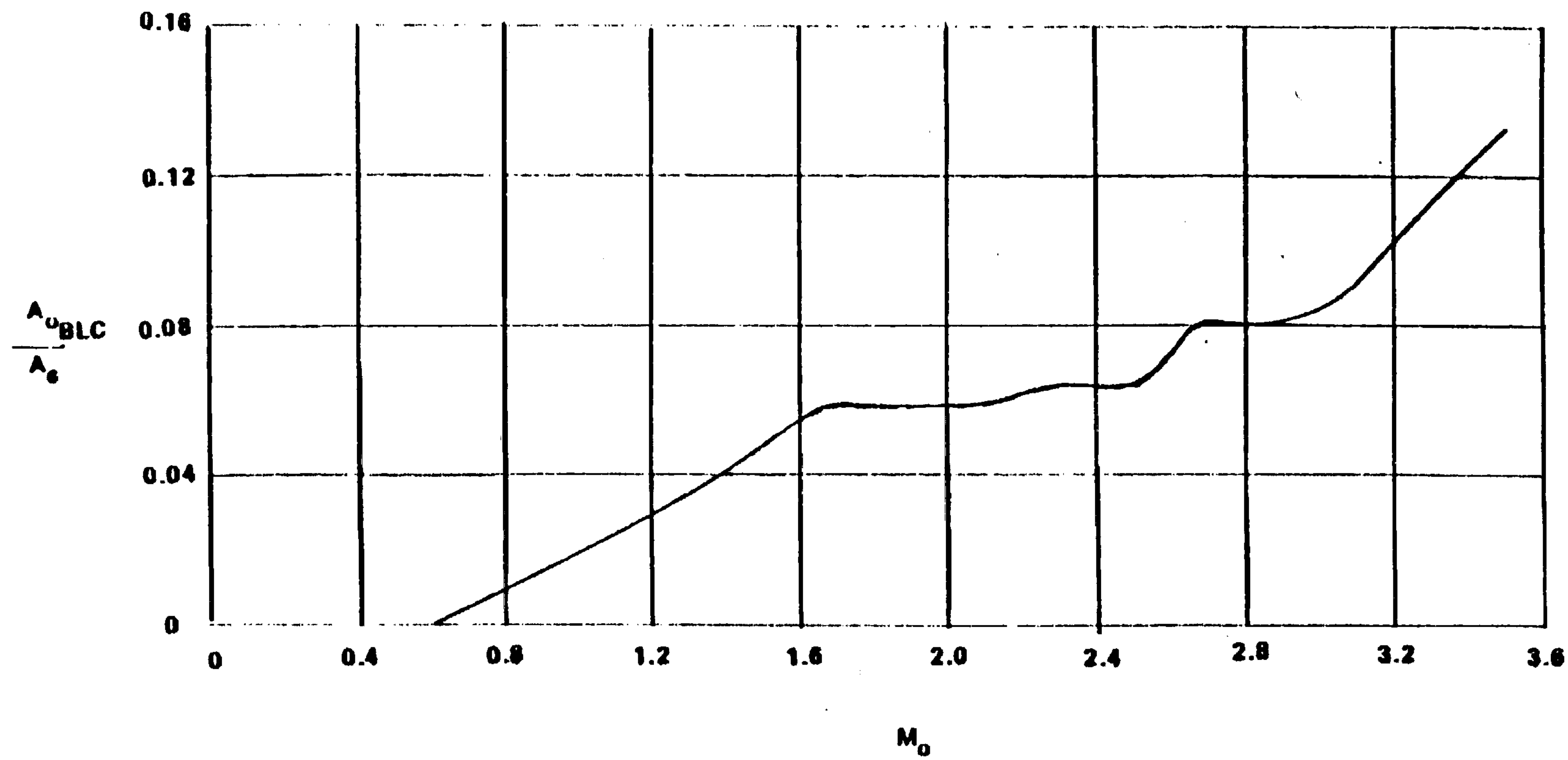


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

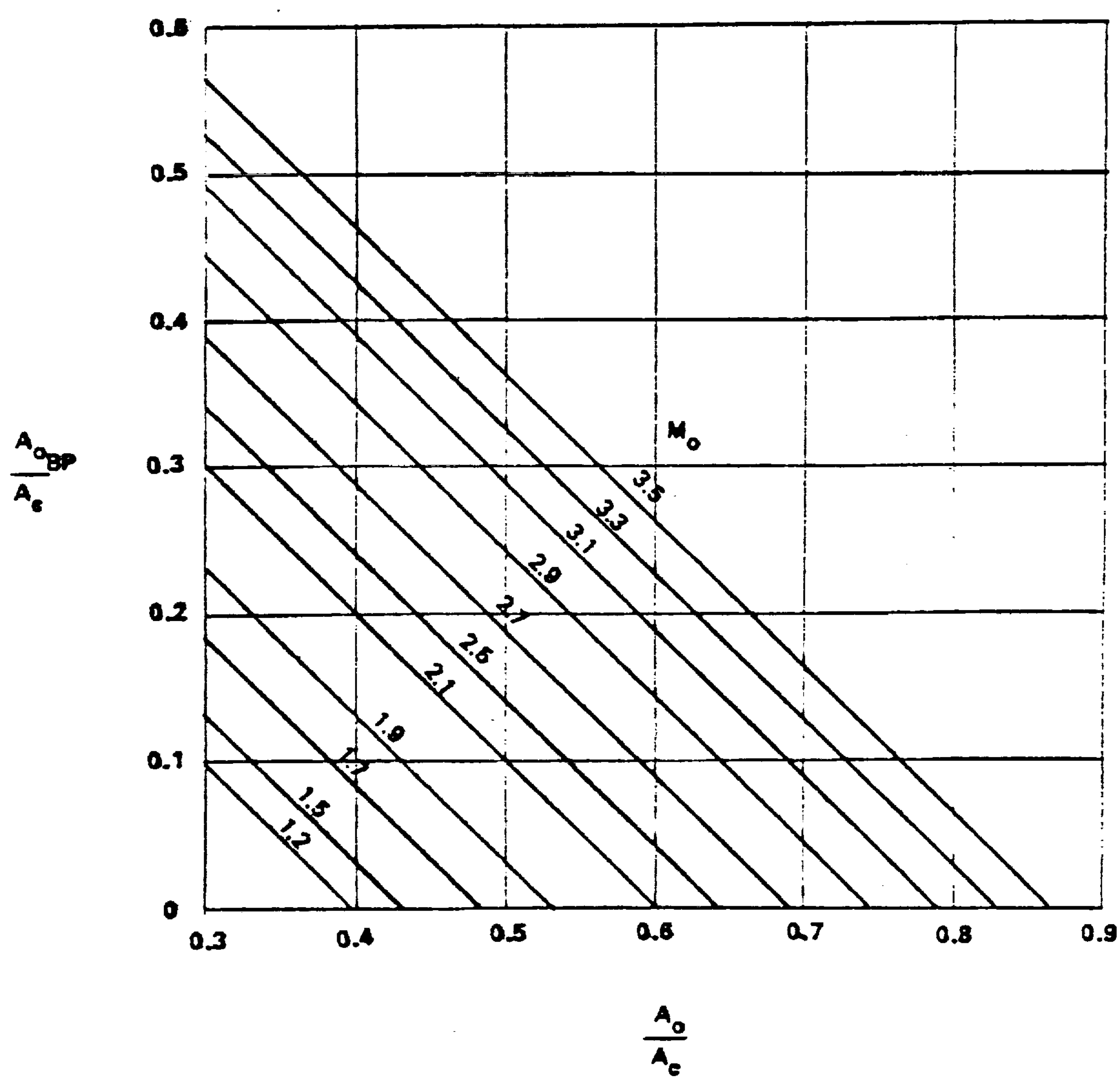


Figure 40. Performance Characteristics for Inlet Configuration - 'BCAC35' - (continued)

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***********
*         *
* BCAC35  *
*         *
***********
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MACH 3.5, MIXED COMPR, AXISYMMETRIC,TRANSLATING CB, BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	FIRST RAMP ANGLE(DEG)	10.0000
4	DESIGN MACH NUMBER	3.5000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.2000
7	EXTERNAL COWL ANGLE(DEG)	3.0000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	10.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	1.0000
11	EXIT FLAP AREA RATIO FOR BLEED	0.2000
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	10.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.0000
15	EXIT FLAP AREA RATIO FOR BYPASS	0.2000
16	SUBSONIC DIFFUSER AREA RATIO	4.9700
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	9.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS
****

INLET GEOMETRY TYPE	AXISYMMETRIC
NOMINAL NORMAL SHOCK MACH NUMBER	1.30
STARTING MACH NUMBER	1.61
NOMINAL THROAT MACH NUMBER	0.81

```
************
* TABLE 1  *        LOCAL MACH NUMBER (MNO)        VS        FREE STREAM MACH NUMBER (MNFS)
************
```

0.0	1.000	3.500	MNO
0.0	1.000	3.500	MNFS

```
************
* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0)     VS     MASS FLOW RATIO (AO/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```

MNO=0.600	0.400 0.985	0.425 0.980	0.433 0.975	0.440 0.965	0.448 0.930	AO/AC PT2/PTO	
MNO=0.900	0.310 0.973	0.350 0.971	0.400 0.969	0.420 0.962	0.425 0.950	0.425 0.900	AO/AC PT2/PTO
MNO=1.100	0.320 0.965	0.400 0.963	0.425 0.950	0.425 0.900	AO/AC PT2/PTO		
MNO=1.300	0.380 0.940	0.400 0.936	0.420 0.925	0.421 0.900	AO/AC PT2/PTO		
MNO=1.700	0.460 0.910	0.480 0.902	0.490 0.890	0.500 0.680	AO/AC PT2/PTO		
MNO=1.900	0.490 0.870	0.525 0.867	0.540 0.850	0.550 0.650	AO/AC PT2/PTO		
MNO=2.300	0.585 0.850	0.600 0.835	0.615 0.810	0.625 0.620	AO/AC PT2/PTO		
MNO=2.700	0.682 0.850	0.690 0.833	0.691 0.800	0.692 0.600	AO/AC PT2/PTO		
MNO=3.100	0.775 0.842	0.790 0.825	0.792 0.600	AO/AC PT2/PTO			
MNO=3.500	0.850 0.845	0.860 0.835	0.865 0.815	0.867 0.600	AO/AC PT2/PTO		

****
* TABLE 2B *
****

OPTIMUM INLET RECOVERY (PT2/PTO OPT) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.900	1.100	1.300	1.700	1.900	2.700	3.100	3.500	MNO
0.950	0.980	0.970	0.965	0.940	0.895	0.862	0.813	0.816	0.817	PT2/PTO

```
************
* TABLE 2C *          OPTIMUM MASS FLOW RATIO (AO/AC OPT)          VS        LOCAL MACH NUMBER (MNO)
************

          0.600    0.900    1.100    1.300    1.700    1.900    2.300    2.700    3.100    3.500    MNO
          0.455    0.410    0.400    0.403    0.485    0.535    0.602    0.690    0.790    0.865    AO/AC


************
* TABLE 2D *          BUZZ LIMIT MASS FLOW RATIO (AO/AC)           VS        LOCAL MACH NUMBER (MNO)
************

          0.0      0.400    0.900    1.100    1.300    1.700    1.900    2.700    3.100    3.500    MNO
          0.0      0.0      0.0      0.0      0.0      0.460    0.490    0.680    0.775    0.850    AO/AC


************
* TABLE 2E *          DISTORTION LIMIT MASS FLOW RATIO (AO/AC)     VS        LOCAL MACH NUMBER (MNO)
************

          0.600    0.900    1.100    1.300    1.700    1.900    2.300    2.700    3.100    3.500    MNO
          0.500    0.425    0.415    0.425    0.495    0.540    0.625    0.700    0.790    0.865    AO/AC


************
* TABLE 3  * SPILLAGE DRAG COEFFICIENT (CDSPL)        VS        INLET MASS FLOW RATIO (AOI/AC)    AND     LOCAL MACH NUMBER (MNO)
************


MNO=0.500 0.0      0.100    0.200    0.300    0.400    0.420    2.000    AOI/AC
          0.560    0.360    0.210    0.100    0.055    0.0      0.0      CDSPL

MNO=0.850 0.0      0.100    0.200    0.300    0.400    0.420    1.000    AOI/AC
          0.600    0.440    0.285    0.145    0.025    0.0      0.0      CDSPL

MNO=1.100 0.0      0.420    1.000    AOI/AC
          0.750    0.0      0.0      CDSPL

MNO=1.260 0.150    0.300    0.438    1.000    AOI/AC
          0.525    0.250    0.0      0.0      CDSPL

MNO=1.600 0.200    0.470    1.000    AOI/AC
          0.515    0.0      0.0      CDSPL
```

```
************
* TABLE 3A *
************
```

REF SPILLAGE DRAG COEFF (REF CDSPL) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.900	1.100	1.300	1.600	1.610	2.700	3.100	3.500	MNO
0.0	0.0	0.028	0.056	0.077	0.060	0.053	0.018	0.007	0.0	REF CDSPL

```
************
* TABLE 3B *
************
```

REF INLET MASS FLOW RATIO (REF AOI/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.400	0.900	1.100	1.300	1.600	1.610	2.700	3.100	3.500	MNO
0.425	0.425	0.425	0.428	0.438	0.470	0.490	0.770	0.875	0.995	REF AOI/AC

```
************
* TABLE 4  *
************
```

BLEED DRAG COEFFICIENT (CD BLD) VS BLEED MASS FLOW RATIO (AOBLD/AC) AND LOCAL MACH NUMBER (MNO)

0.600	0.950	1.300	1.700	2.100	2.700	3.100	3.500	MNO

MNO=0.600	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.0	0.0	0.0	0.0	CDBLD
MNO=0.950	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.075	0.174	0.174	0.174	CDBLD
MNO=1.300	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.058	0.125	0.174	0.174	CDBLD
MNO=1.700	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.050	0.100	0.152	0.174	CDBLD
MNO=2.100	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.043	0.087	0.132	0.174	CDBLD
MNO=2.700	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.033	0.065	0.100	0.132	CDBLD
MNO=3.100	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.027	0.055	0.082	0.110	CDBLD

MNO=3.500	0.0	0.040	0.080	0.120	0.160	AOBLD/AC
	0.0	0.022	0.042	0.063	0.084	CDBLD

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	1.200	1.400	1.700	2.100	2.400	2.700	3.100	3.500	MNO
MNO=1.200	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.040	0.087	0.144	0.220	0.310	0.370	CDBYP	
MNO=1.400	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.034	0.074	0.125	0.190	0.264	0.314	CDBYP	
MNO=1.700	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.028	0.063	0.106	0.155	0.215	0.263	CDBYP	
MNO=2.100	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.025	0.057	0.093	0.132	0.180	0.214	CDBYP	
MNO=2.400	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.017	0.037	0.062	0.088	0.124	0.148	CDBYP	
MNO=2.700	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.010	0.022	0.035	0.052	0.075	0.092	CDBYP	
MNO=3.100	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.005	0.010	0.014	0.030	0.047	0.060	CDBYP	
MNO=3.500	0.0	0.040	0.080	0.120	0.160	0.200	0.220	AOBYP/AC	
	0.0	0.003	0.007	0.009	0.021	0.036	0.047	CDBYP	

****
* TABLE 6A *
****

BLEED MASS FLOW RATIO (AOBLD/AC) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.600	0.0	2.000	AO/AC		
	0.0	0.0	AOBLD/AC		
MNO=0.950	0.400	0.420	1.000	AO/AC	
	0.020	0.016	0.0	AOBLD/AC	
MNO=1.300	0.400	0.425	1.000	AO/AC	
	0.036	0.031	0.0	AOBLD/AC	
MNO=1.700	0.400	0.480	0.500	1.000	AO/AC
	0.067	0.060	0.055	0.0	AOBLD/AC
MNO=2.100	0.500	0.600	1.000	AO/AC	
	0.070	0.050	0.0	AOBLD/AC	
MNO=2.300	0.550	0.610	0.625	1.000	AO/AC
	0.087	0.060	0.059	0.0	AOBLD/AC
MNO=2.500	0.600	0.650	1.000	AO/AC	
	0.092	0.062	0.0	AOBLD/AC	
MNO=2.700	0.650	0.690	1.000	AO/AC	
	0.107	0.080	0.0	AOBLD/AC	
MNO=3.100	0.750	0.790	1.000	AO/AC	
	0.120	0.090	0.0	AOBLD/AC	
MNO=3.500	0.825	0.865	1.000	AO/AC	
	0.165	0.133	0.0	AOBLD/AC	

****
* TABLE 6B *
****

OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC) VS LOCAL MACH NUMBER (MNO)

0.0	0.600	0.950	1.700	2.100	2.300	2.500	2.700	3.100	3.500	MNO
0.0	0.0	0.018	0.060	0.060	0.064	0.064	0.081	0.090	0.133	AOBLD/AC

****
* TABLE 7 *
****

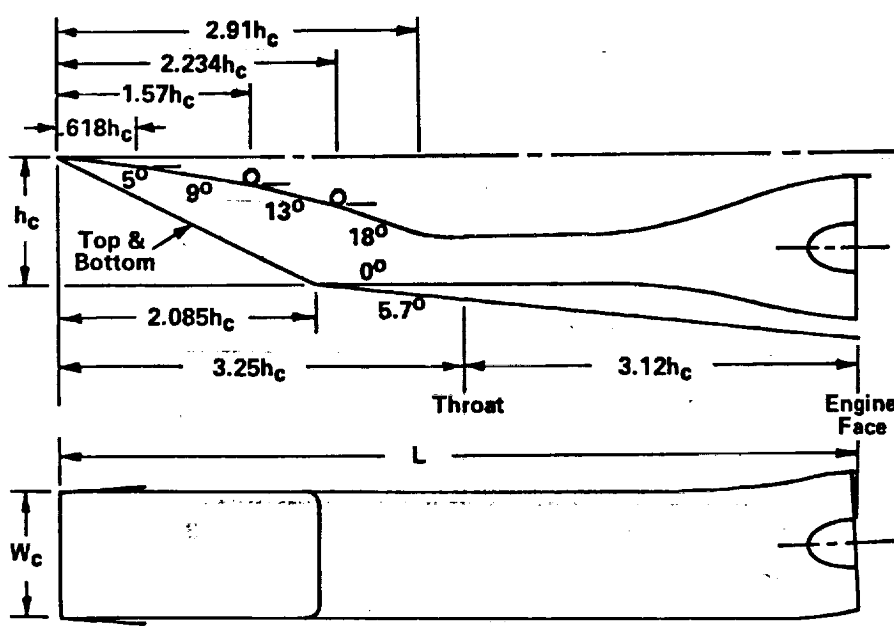
BYPASS MASS FLOW RATIO (AOBYP/AC) VS ENGINE MASS FLOW RATIO (AOE/AC) AND LOCAL MACH NUMBER (MNO)

MNO=0.0	0.300	0.400	2.000	AOE/AC
	0.0	0.0	0.0	AOBYP/AC
MNO=1.190	0.300	0.400	1.000	AOE/AC
	0.0	0.0	0.0	AOBYP/AC
MNO=1.200	0.300	0.400	1.000	AOE/AC
	0.100	0.0	0.0	AOBYP/AC
MNO=1.500	0.300	0.432	1.000	AOE/AC
	0.132	0.0	0.0	AOBYP/AC
MNO=1.700	0.300	0.485	1.000	AOE/AC
	0.185	0.0	0.0	AOBYP/AC
MNO=1.900	0.300	0.532	1.000	AOE/AC
	0.232	0.0	0.0	AOBYP/AC
MNO=2.100	0.300	0.603	1.000	AOE/AC
	0.303	0.0	0.0	AOBYP/AC
MNO=2.700	0.300	0.690	1.000	AOE/AC
	0.390	0.0	0.0	ACBYP/AC
MNO=3.100	0.300	0.790	1.000	AOE/AC
	0.490	0.0	0.0	AOBYP/AC
MNO=3.500	0.300	0.864	1.000	AOE/AC
	0.564	0.0	0.0	AOBYP/AC

4.2.1.19 INLET CONFIGURATION 'R2DSST' - MACH 2.6 MIXED-COMPRESSION VARIABLE GEOMETRY, TWO DIMENSIONAL INLET

The initial two ramp surface angles are fixed at 5o and 9o. Boundary layer bleed is provided on the third, fourth, and throat ramp panels, sidewalls, and cowl. The boundary layer bleed air is collected in four divided plenum chambers.

The inlet configuration and performance characteristics are based on data contained in Reference 18 and engineering analysis. The geometry of the inlet is shown in Figure 41 and the inlet performance characteristics are presented in Figure 42.



DESIGN MACH = 2.60

W_c / h_c = .98

A_{Throat} = .358 A_{Capt} (Design & Minimum)

= .745 A_{Capt} (Maximum)

A_{Capt} = W_c x h_c

Figure 41 NR 2-D SST Inlet

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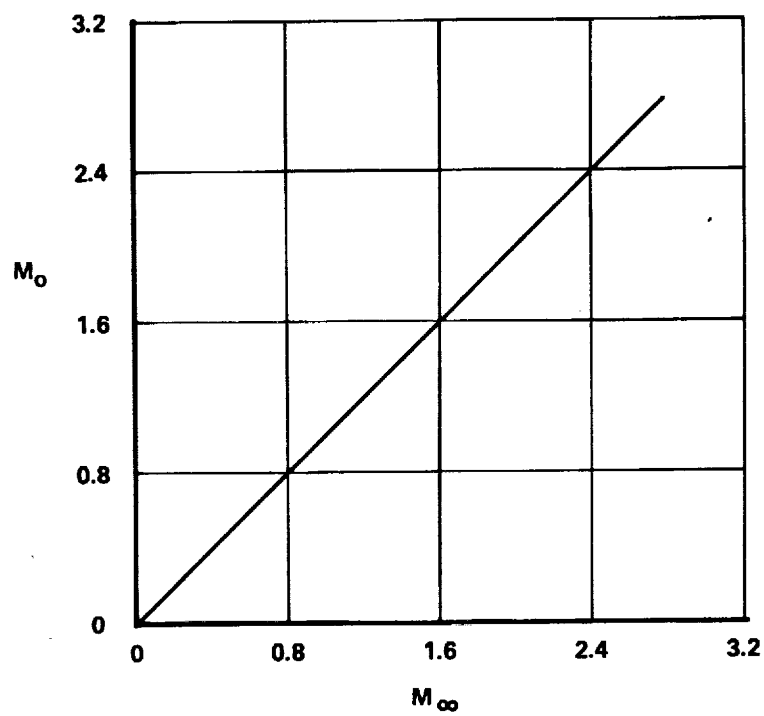


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST'

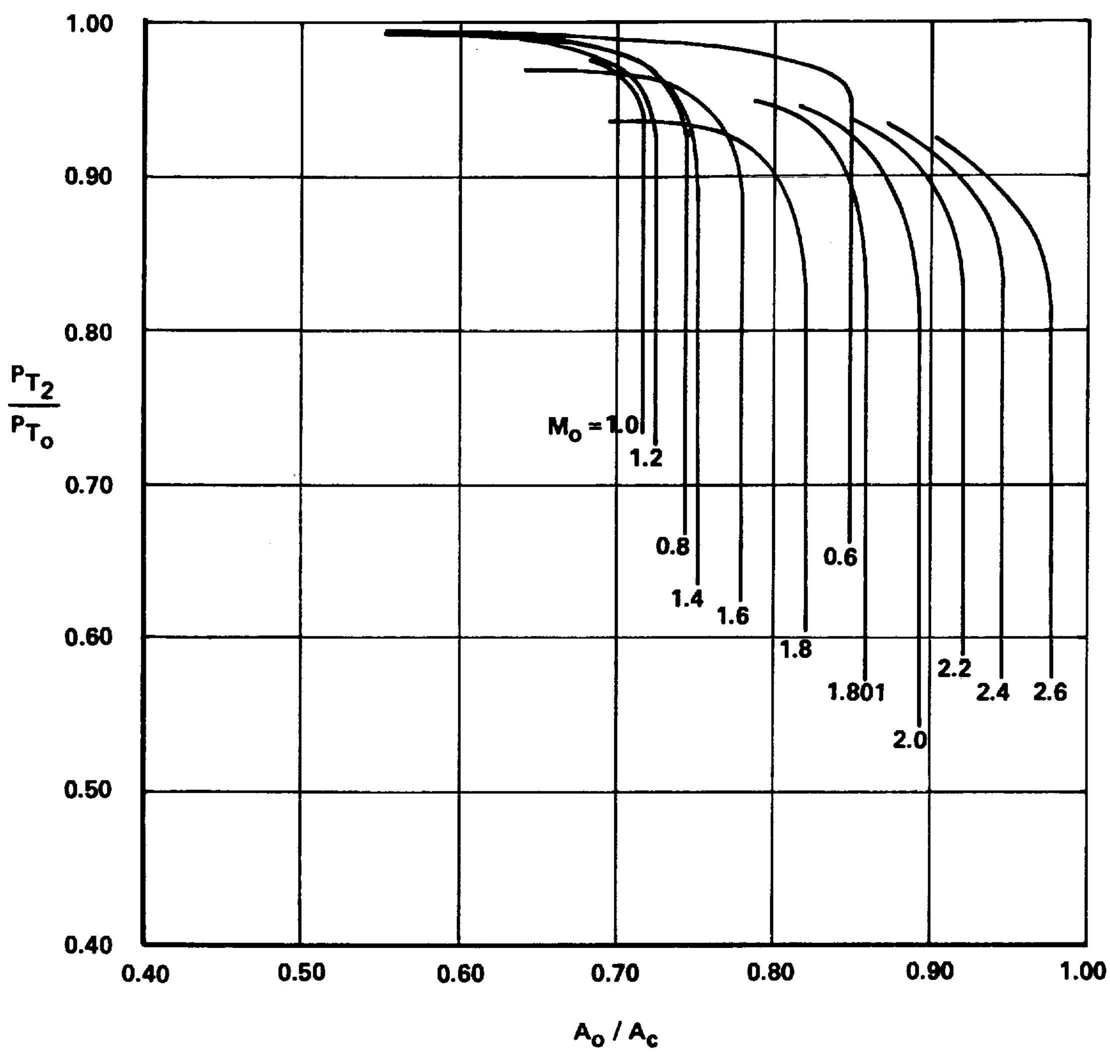


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

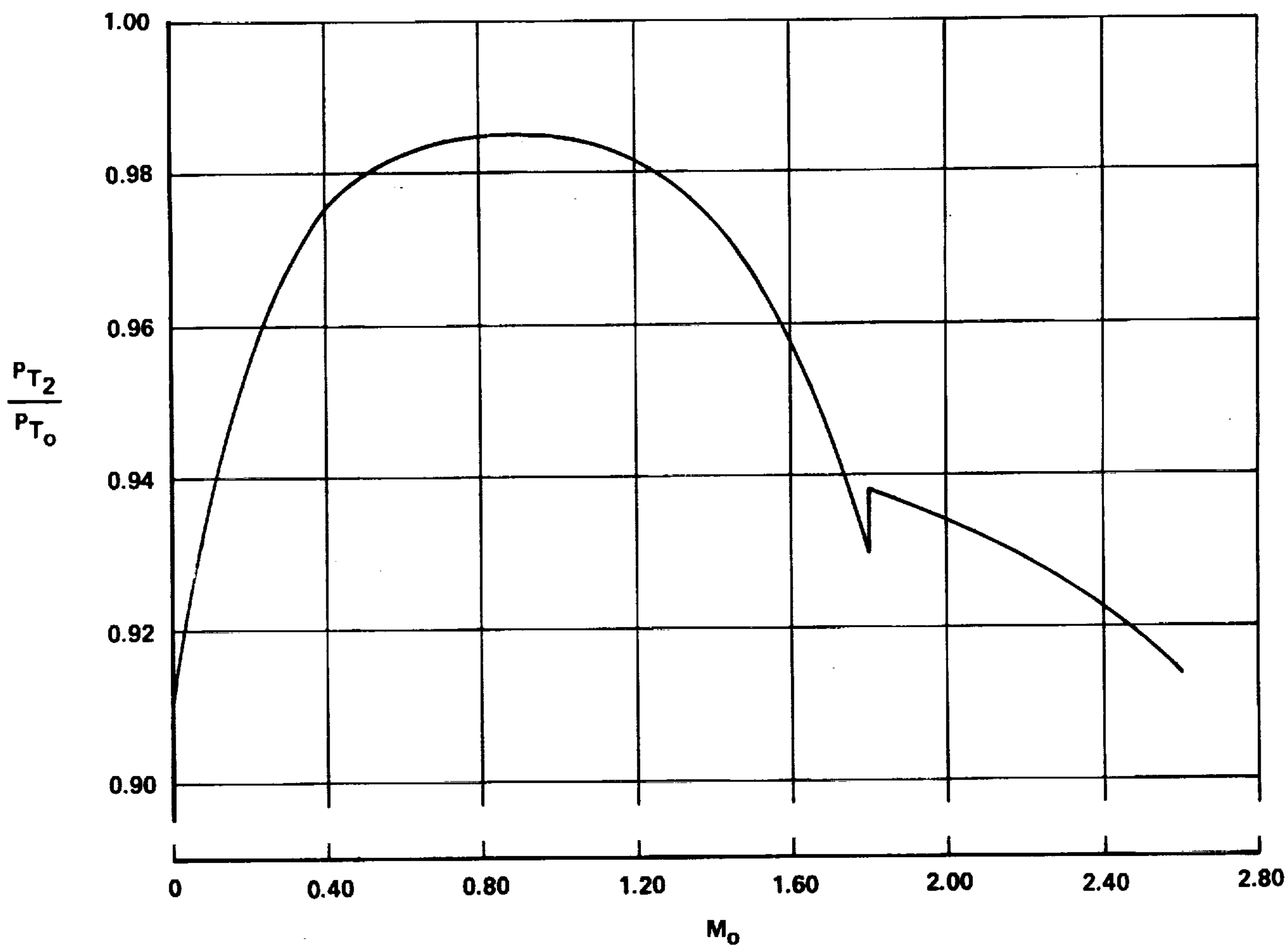


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

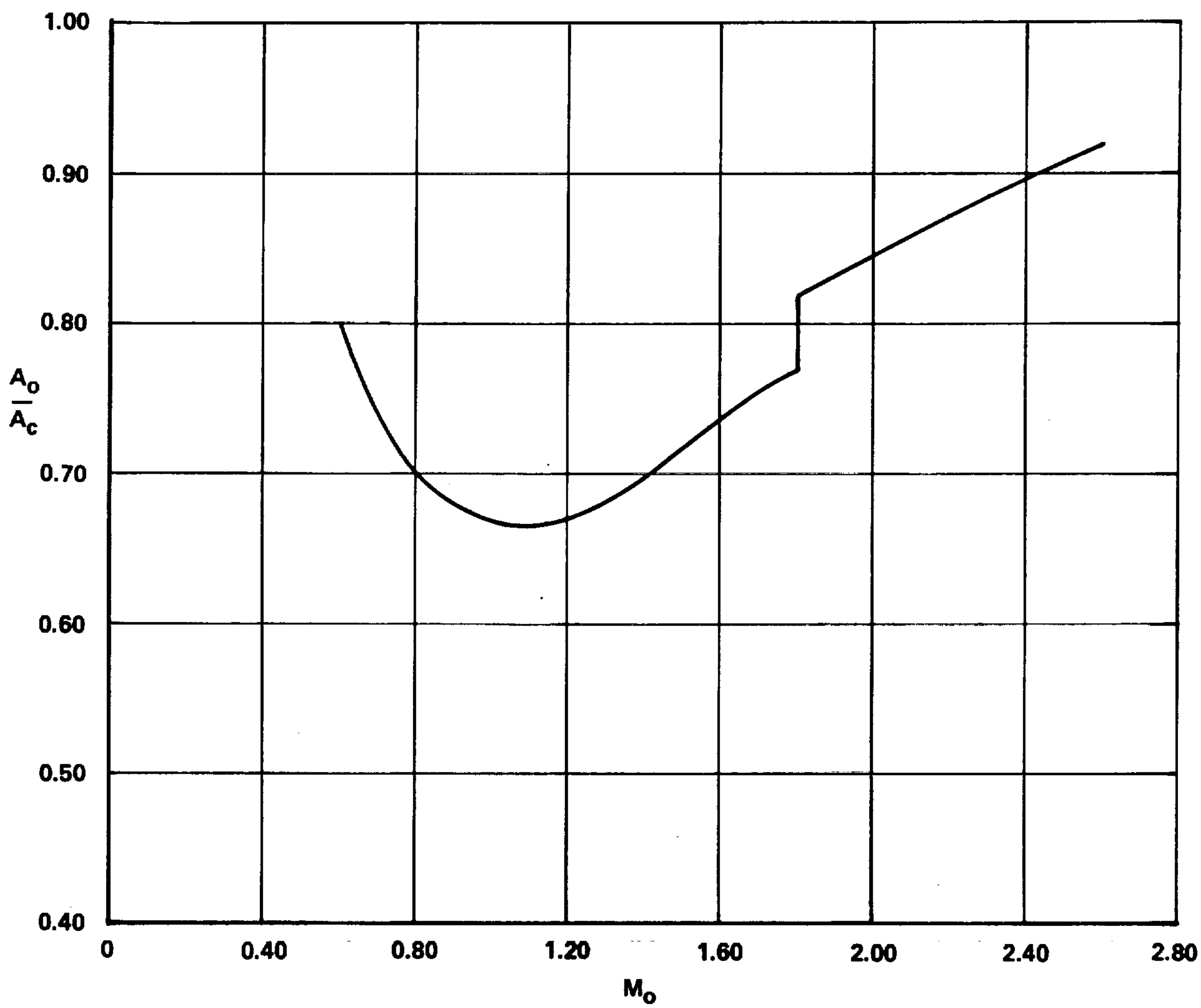


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

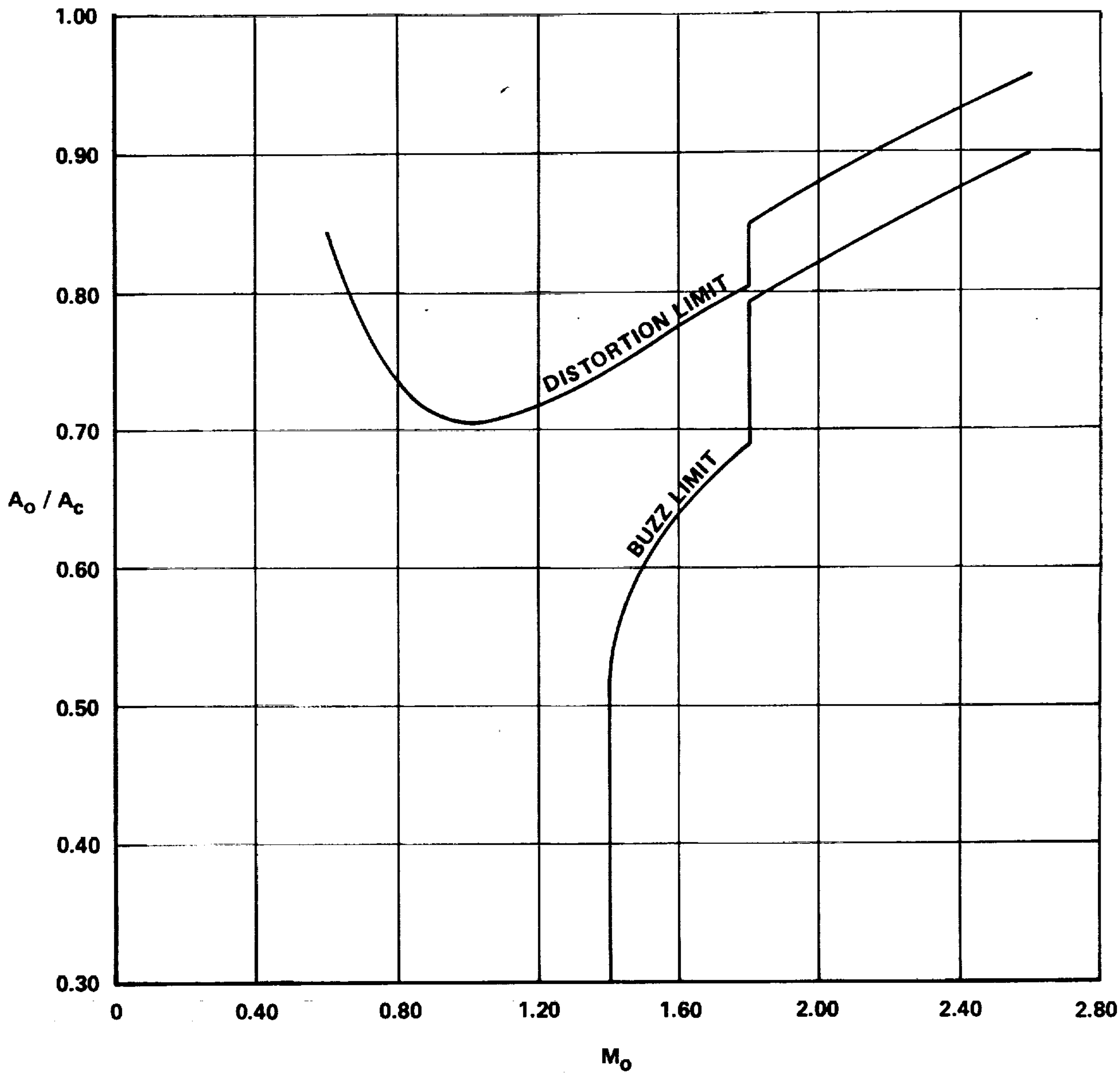


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

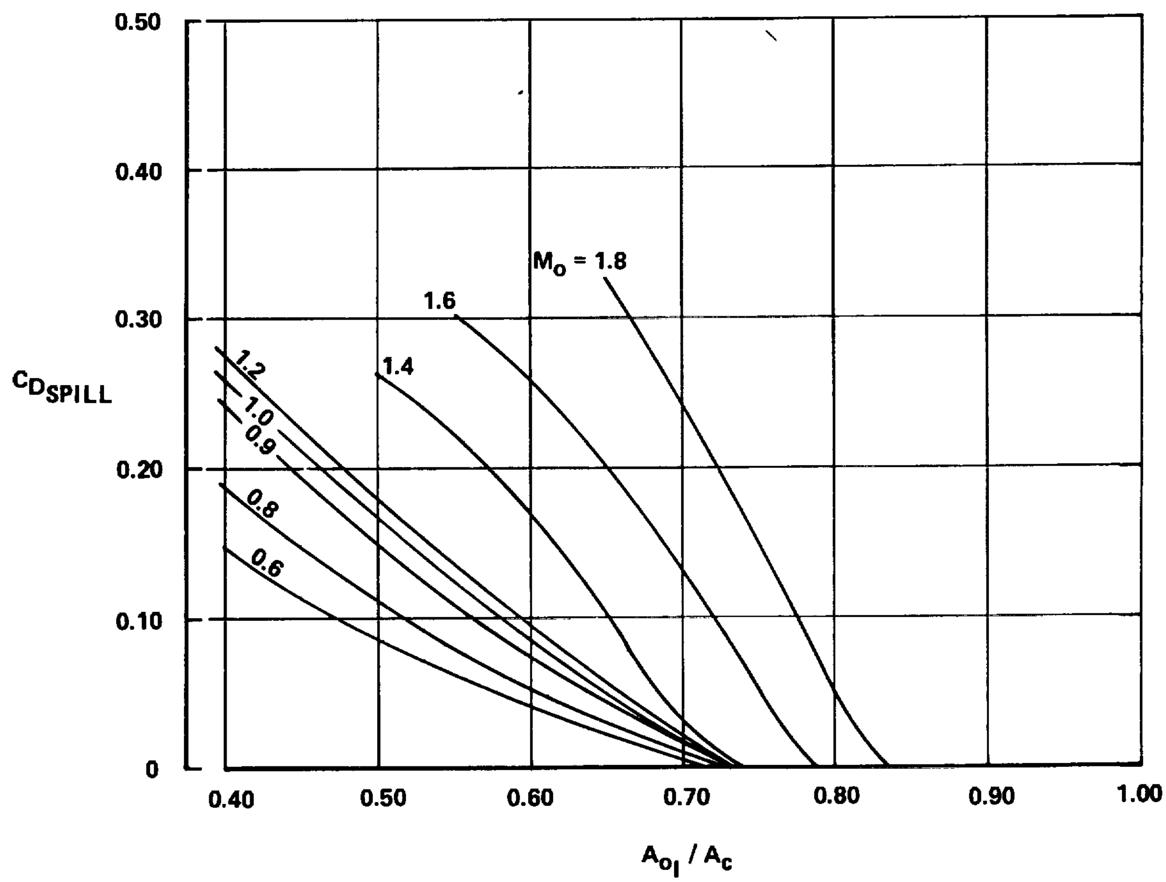
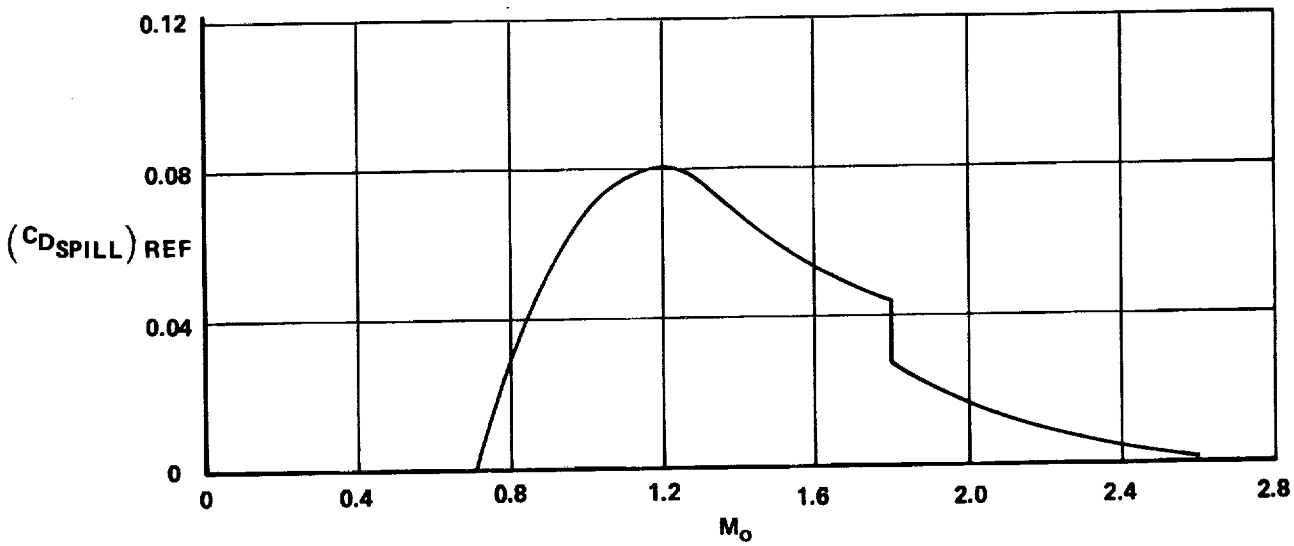


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)



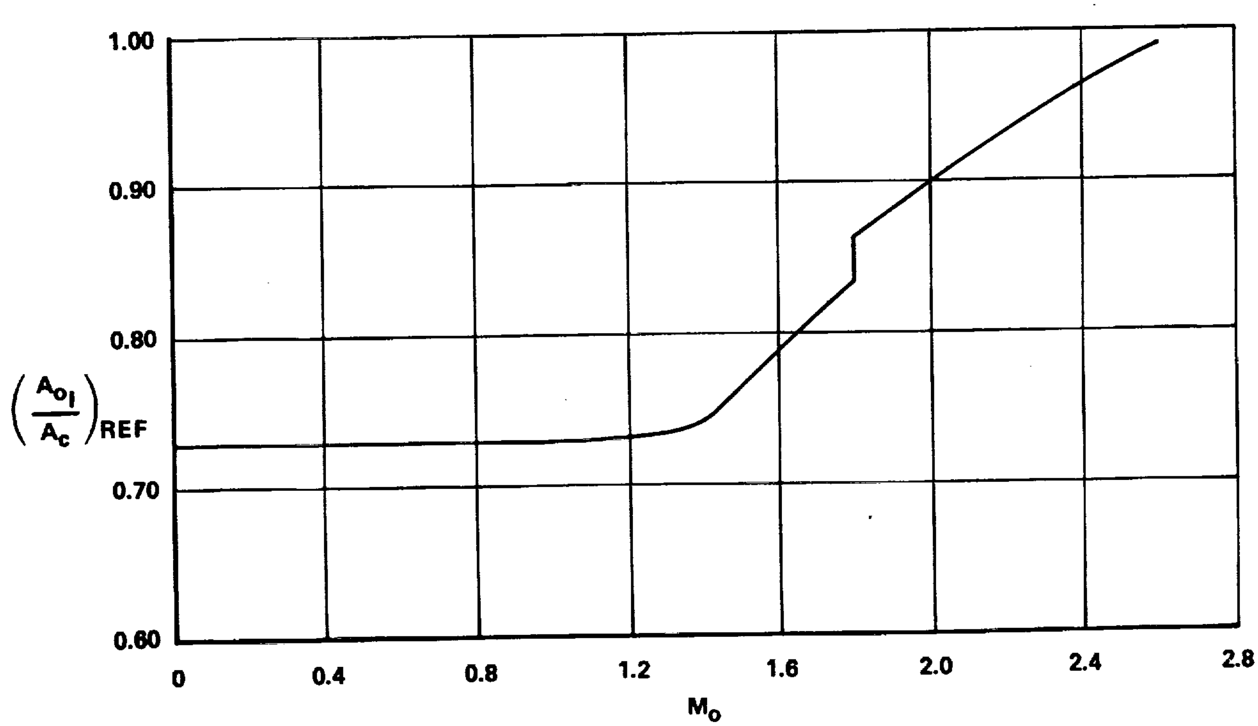


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

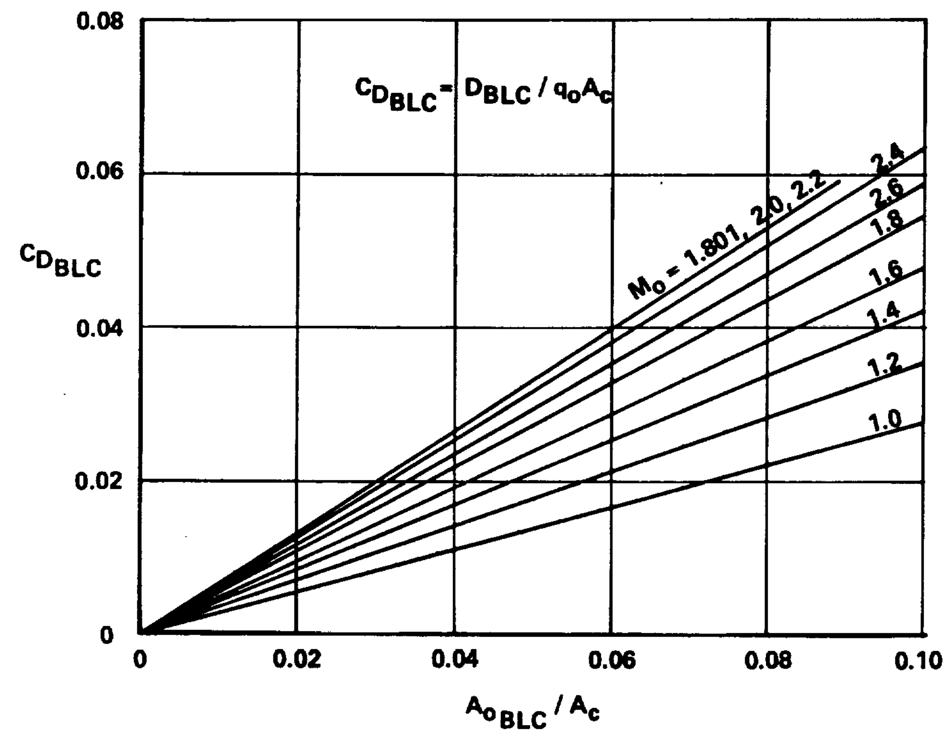


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

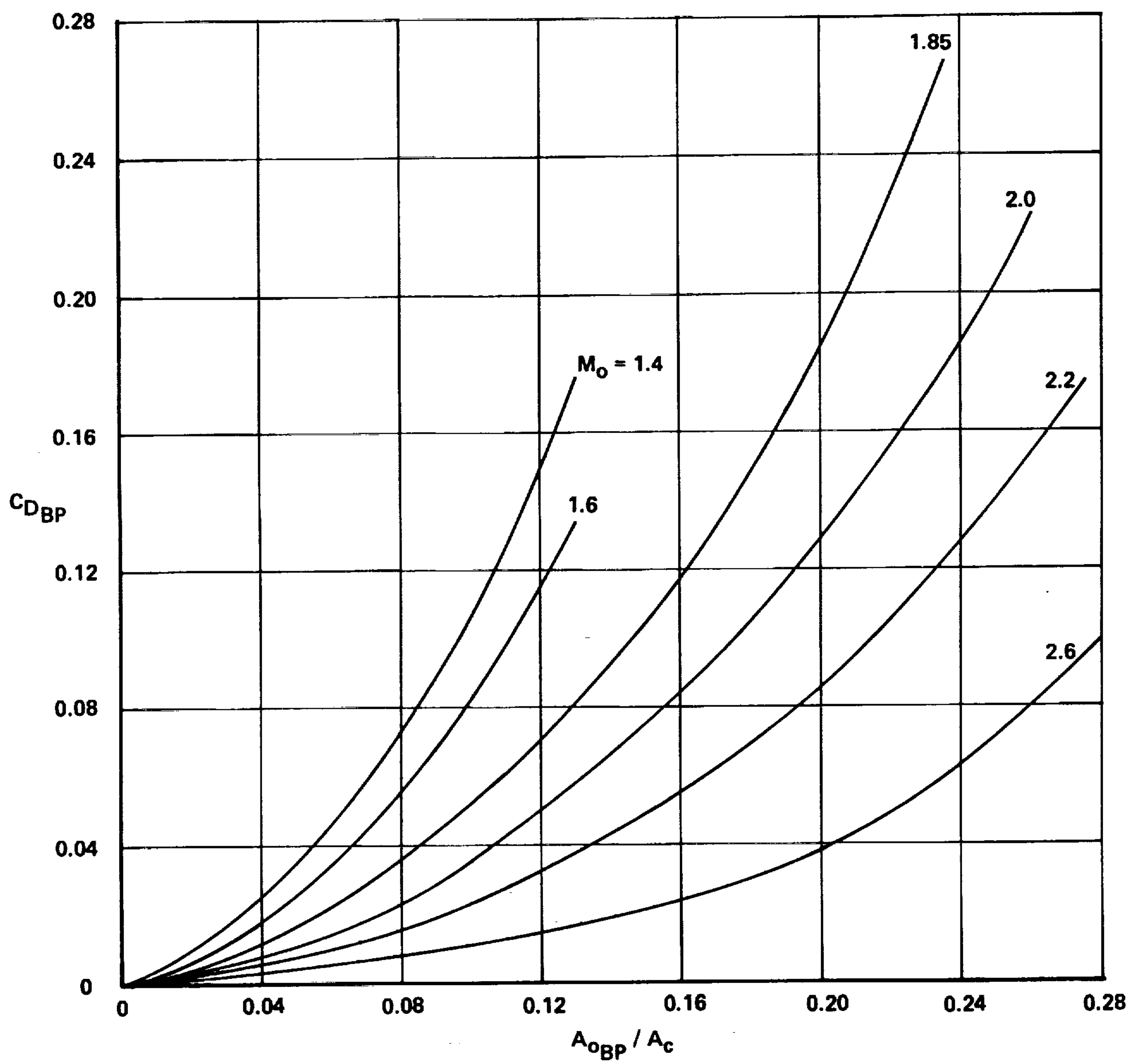
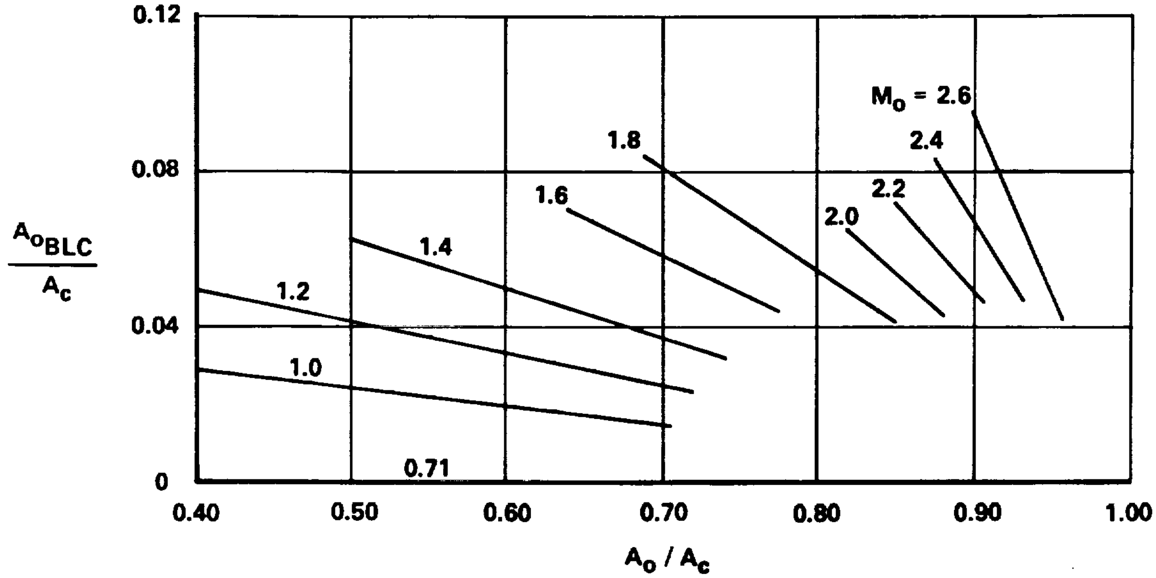


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)



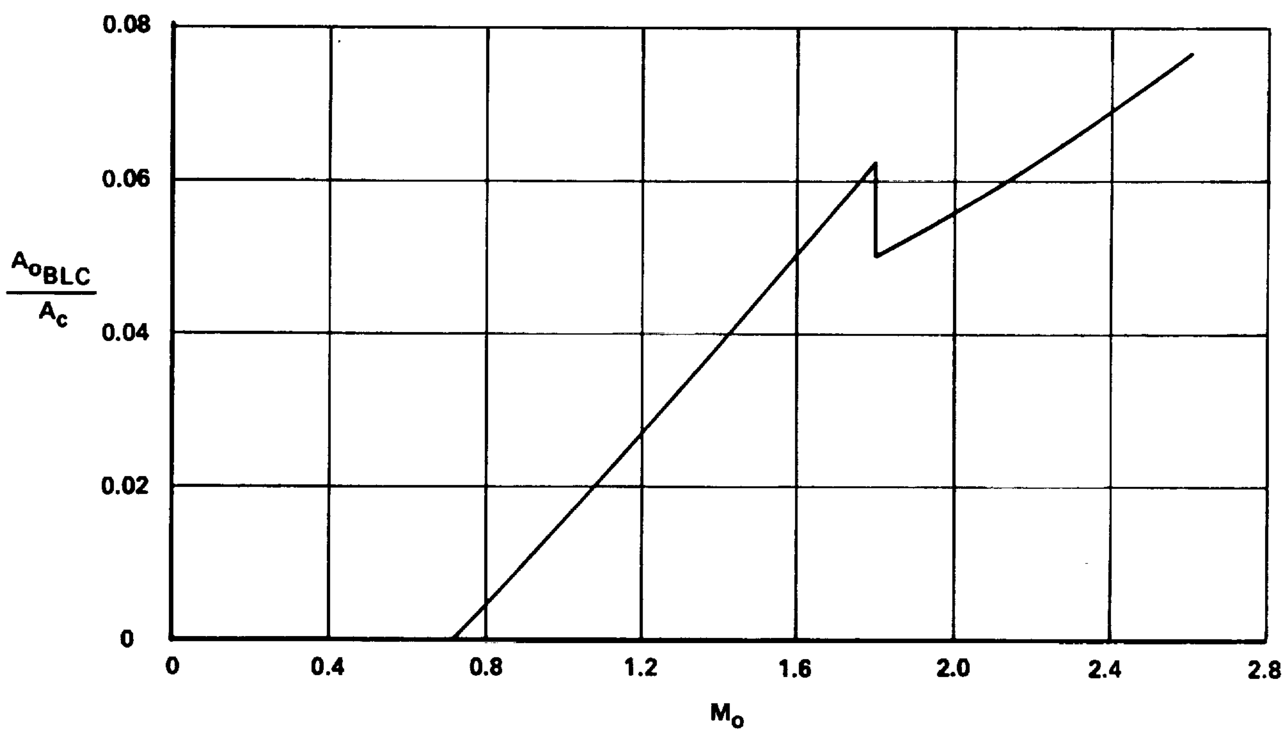


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

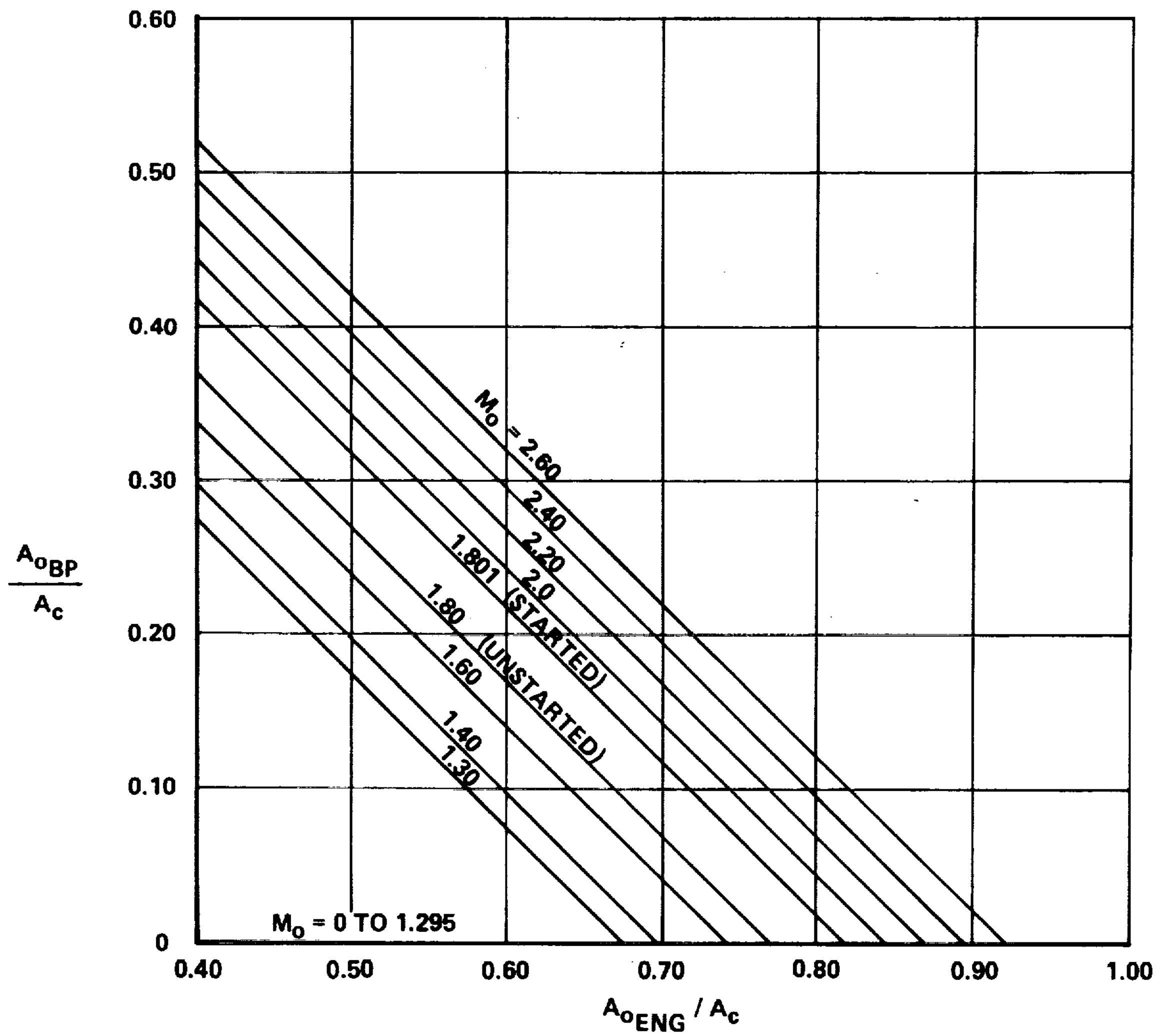


Figure 42. Performance Characteristics for Inlet Configuration 'R2DSST' (continued)

R2DSST

MACH 2.6,2-D MIXED-COMPRESSION INLET WITH T/O DOORS, BLEED AND BYPASS

INLET MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	ASPECT RATIO	0.9800
2	SIDEPLATE CUTBACK	0.0
3	FIRST RAMP ANGLE(DEG)	5.0000
4	DESIGN MACH NUMBER	2.6000
5	COWL LIP BLUNTNESS	0.0
6	TAKEOFF DOOR AREA RATIO	0.1550
7	EXTERNAL COWL ANGLE(DEG)	5.7000
8	EXIT NOZZLE TYPE FOR BLEED(CN=0 CDN=1)	0.0
9	EXIT NOZZLE ANGLE FOR BLEED(DEG)	15.0000
10	EXIT FLAP ASPECT RATIO FOR BLEED	0.0
11	EXIT FLAP AREA RATIO FOR BLEED	0.0
12	EXIT NOZZLE TYPE FOR BYPASS(CN=0 CDN=1)	1.0000
13	EXIT NOZZLE ANGLE FOR BYPASS(DEG)	15.0000
14	EXIT FLAP ASPECT RATIO FOR BYPASS	1.1100
15	EXIT FLAP AREA RATIO FOR BYPASS	0.7670
16	SUBSONIC DIFFUSER AREA RATIO	2.7700
17	SUBSONIC DIFFUSER TOTAL WALL ANGLE(DEG)	14.0000
18	SUBSONIC DIFFUSER LOSS COEFFICIENT	0.1200

FIXED PARAMETERS

INLET GEOMETRY TYPE	TWO DIMENSIONAL
NOMINAL NORMAL SHOCK MACH NUMBER	0.70
STARTING MACH NUMBER	1.80
NOMINAL THROAT MACH NUMBER	1.25

TABLE 1 LOCAL MACH NUMBER (MNO) VS FREE STREAM MACH NUMBER (MNFS)

0.0	2.600	MNO
0.0	2.600	MNFS

* TABLE 2A * INLET PRESSURE RECOVERY (PT2/PT0) VS MASS FLOW RATIO (AO/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.600	0.550	0.700	0.750	0.800	0.825	0.840	0.850	0.851	AO/AC
	0.995	0.990	0.987	0.980	0.970	0.965	0.950	0.700	PT2/PT0
MNO=0.800	0.550	0.650	0.700	0.725	0.737	0.745	0.745	AO/AC	
	0.995	0.990	0.985	0.965	0.950	0.925	0.700	PT2/PT0	
MNO=1.000	0.550	0.600	0.650	0.685	0.700	0.710	0.715	0.715	AO/AC
	0.994	0.992	0.990	0.975	0.970	0.950	0.925	0.750	PT2/PT0
MNO=1.400	0.550	0.650	0.700	0.725	0.737	0.745	0.750	0.751	AO/AC
	0.994	0.990	0.983	0.965	0.950	0.930	0.900	0.700	PT2/PT0
MNO=1.600	0.640	0.700	0.725	0.750	0.770	0.780	0.781	AO/AC	
	0.970	0.968	0.964	0.950	0.928	0.890	0.700	PT2/PT0	
MNO=1.800	0.690	0.750	0.775	0.800	0.812	0.820	0.821	AO/AC	
	0.937	0.935	0.925	0.904	0.875	0.840	0.600	PT2/PT0	
MNO=1.801	0.790	0.820	0.835	0.840	0.855	0.860	0.861	AO/AC	
	0.950	0.938	0.923	0.915	0.875	0.845	0.600	PT2/PT0	
MNO=2.000	0.815	0.842	0.865	0.880	0.890	0.895	0.896	AO/AC	
	0.948	0.934	0.913	0.880	0.825	0.800	0.600	PT2/PT0	
MNO=2.400	0.875	0.895	0.919	0.935	0.945	0.946	AO/AC		
	0.935	0.923	0.900	0.875	0.850	0.600	PT2/PT0		
MNO=2.600	0.900	0.920	0.935	0.950	0.970	0.975	0.976	AO/AC	
	0.926	0.914	0.901	0.885	0.850	0.825	0.600	PT2/PT0	

****
* TABLE 2B * OPTIMUM INLET RECOVERY (PT2/PT0 OPT) VS LOCAL MACH NUMBER (MNO)
****

0.0	2.000	0.400	0.600	1.000	1.400	1.800	1.801	2.200	2.600	MNO
0.910	0.955	0.975	0.982	0.984	0.974	0.930	0.938	0.929	0.914	PT2/PT0

****
* TABLE 2C *
****

OPTIMUM MASS FLOW RATIO (AO/AC OPT) VS LOCAL MACH NUMBER (MNO)

0.600	0.700	0.800	1.000	1.200	1.400	1.800	1.801	2.200	2.600	MNO
0.800	0.740	0.700	0.670	0.670	0.695	0.770	0.820	0.870	0.920	AO/AC

****
* TABLE 2D *
****

BUZZ LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.700	0.800	1.000	1.200	1.400	1.800	1.801	2.200	2.600	MNO
0.843	0.780	0.735	0.705	0.720	0.742	0.803	0.850	0.906	0.955	AO/AC

****
* TABLE 2E *
****

DISTORTION LIMIT MASS FLOW RATIO (AO/AC) VS LOCAL MACH NUMBER (MNO)

0.600	0.700	0.800	1.390	1.400	1.600	1.800	1.801	2.200	2.600	MNO
0.0	0.0	0.0	0.0	0.500	0.640	0.690	0.790	0.848	0.900	AO/AC

****
* TABLE 3 * SPILLAGE DRAG COEFFICIENT (CDSPL) VS INLET MASS FLOW RATIO (AOI/AC) AND LOCAL MACH NUMBER (MNO)
****

MNO=0.0	0.0	0.300	1.000	AOI/AC				
	0.0	0.0	0.0	CDSPL				
MNO=0.600	0.400	0.500	0.600	0.700	0.730	0.900	1.000	AOI/AC
	0.145	0.085	0.040	0.005	0.0	0.0	0.0	CDSPL
MNO=0.800	0.400	0.500	0.600	0.700	0.730	0.900	1.000	AOI/AC
	0.187	0.111	0.052	0.010	0.0	0.0	0.0	CDSPL
MNO=0.900	0.400	0.500	0.600	0.700	0.730	0.900	1.000	AOI/AC
	0.240	0.150	0.075	0.018	0.0	0.0	0.0	CDSPL
MNO=1.200	0.400	0.500	0.600	0.700	0.732	0.900	1.000	AOI/AC
	0.275	0.180	0.095	0.024	0.0	0.0	0.0	CDSPL

```
MNO=1.400      0.500     0.600     0.650     0.700     0.740     0.900     1.000     AOI/AC
               0.261     0.168     0.100     0.030     0.0       0.0       0.0       CDSPL

MNO=1.600      0.550     0.600     0.700     0.750     0.790     0.900     1.000     AOI/AC
               0.300     0.257     0.130     0.050     0.0       0.0       0.0       CDSPL

MNO=1.800      0.650     0.700     0.750     0.800     0.835     0.900     1.000     AOI/AC
               0.325     0.243     0.148     0.050     0.0       0.0       0.0       CDSPL


************
* TABLE 3A *          REF SPILLAGE DRAG COEFF (REF CDSPL)        VS       LOCAL MACH NUMBER (MNO)
************

               0.0       0.700     0.800     1.000     1.200     1.400     1.800     1.801     2.200     2.600     MNO
               0.0       0.0       0.030     0.070     0.080     0.068     0.044     0.028     0.010     0.001     REF CDSPL

************
* TABLE 3B *          REF INLET MASS FLOW RATIO (REF AOI/AC)     VS       LOCAL MACH NUMBER (MNO)
************

               0.0       0.700     0.800     1.000     1.200     1.400     1.800     1.801     2.200     2.600     MNO
               0.730     0.730     0.730     0.730     0.732     0.740     0.833     0.863     0.935     0.990     REF AOI/AC

************
* TABLE 4  *     BLEED DRAG COEFFICIENT (CD BLD)      VS     BLEED MASS FLOW RATIO (AOBLD/AC)     AND     LOCAL MACH NUMBER (MNO)
************

               0.0       0.990     1.000     1.200     1.400     1.600     1.800     1.801     2.400     2.600     MNO

MNO=0.0        0.0       0.100     AOBLD/AC
               0.0       0.0       CDBLD

MNO=0.990      0.0       0.100     AOBLD/AC
               0.0       0.0       CDBLD

MNO=1.000      0.0       0.100     AOBLD/AC
               0.0       0.028     CDBLD
```

MNO=1.200	0.0	0.100	AOBLD/AC					
	0.0	0.036	CDBLD					
MNO=1.400	0.0	0.100	AOBLD/AC					
	0.0	0.042	CDBLD					
MNO=1.600	0.0	0.100	AOBLD/AC					
	0.0	0.048	CDBLD					
MNO=1.800	0.0	0.100	AOBLD/AC					
	0.0	0.055	CDBLD					
MNO=1.801	0.0	0.100	AOBLD/AC					
	0.0	0.059	CDBLD					
MNO=2.400	0.0	0.100	AOBLD/AC					
	0.0	0.063	CDBLD					
MNO=2.600	0.0	0.100	AOBLD/AC					
	0.0	0.067	CDBLD					

****
* TABLE 5 *
****

BYPASS DRAG COEFFICIENT (CDBYP) VS BYPASS MASS FLOW RATIO (AOBYP/AC) AND LOCAL MACH NUMBER (MNO)

	0.0	1.399	1.400	1.600	1.850	2.000	2.200	2.600 MNO
MNO=0.0	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBYP
MNO=1.399	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	CDBYP
MNO=1.400	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.025	0.073	0.150	0.263	0.383	0.480	CDBYP
MNO=1.600	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.018	0.056	0.115	0.200	0.280	0.400	CDBYP

MNO=1.850	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.012	0.037	0.071	0.117	0.185	0.280	CDBYP
MNO=2.000	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.008	0.023	0.051	0.084	0.129	0.186	CDBYP
MNO=2.200	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.006	0.016	0.033	0.055	0.086	0.128	CDBYP
MNO=2.600	0.0	0.040	0.080	0.120	0.160	0.200	0.240	AOBYP/AC
	0.0	0.004	0.008	0.015	0.021	0.038	0.064	CDBYP

****
* TABLE 6A *   BLEED MASS FLOW RATIO (AOBLD/AC)   VS   MASS FLOW RATIO (AO/AC)   AND   LOCAL MACH NUMBER (MNO)
****

MNO=0.0	0.0	1.000	AO/AC	
	0.0	0.0	AOBLD/AC	
MNO=0.710	0.0	1.000	AO/AC	
	0.0	0.0	AOBLD/AC	
MNO=1.000	0.400	0.705	1.000	AO/AC
	0.029	0.015	0.0	AUBLD/AC
MNO=1.200	0.400	0.715	1.000	AO/AC
	0.050	0.024	0.0	AOBLD/AC
MNO=1.400	0.500	0.740	1.000	AO/AC
	0.062	0.032	0.0	AOBLD/AC
MNO=1.600	0.640	0.775	1.000	AO/AC
	0.070	0.044	0.0	AOBLD/AC
MNO=1.800	0.690	0.850	1.000	AO/AC
	0.084	0.041	0.0	AOBLD/AC
MNO=2.000	0.820	0.880	1.000	AO/AC

```
                 0.065      0.043      0.0        AOBLD/AC

MNO=2.400        0.875      0.905      1.000      AO/AC
                 0.083      0.047      0.0        AOBLD/AC

MNO=2.600        0.900      0.955      1.000      AO/AC
                 0.094      0.042      0.0        AOBLD/AC



************
* TABLE 6B *          OPTIMUM BLEED MASS FLOW RATIO (AOBLD/AC)    VS        LOCAL MACH NUMBER (MNO)
************

                 0.0        0.710      1.800      1.801      2.200      2.600      MNO
                 0.0        0.0        0.063      0.050      0.063      0.076      AOBLD/AC


************
* TABLE 7  *   BYPASS MASS FLOW RATIO (AOBYP/AC)      VS      ENGINE MASS FLOW RATIO (AOE/AC)     AND     LOCAL MACH NUMBER (MNO)
************
```



```
MNO=0.0          0.400      1.000      AOE/AC
                 0.0        0.0        AOBYP/AC

MNO=1.299        0.400      1.000      AOE/AC
                 0.0        0.0        AOBYP/AC

MNO=1.300        0.400      0.675      1.000      AOE/AC
                 0.275      0.0        0.0        AOBYP/AC

MNO=1.600        0.400      0.740      1.000      AOE/AC
                 0.340      0.0        0.0        AOBYP/AC

MNO=1.800        0.400      0.770      1.000      AOE/AC
                 0.370      0.0        0.0        AOBYP/AC

MNO=1.801        0.400      0.816      1.000      AOE/AC
                 0.417      0.0        0.0        AOBYP/AC

MNO=2.000        0.400      0.844      1.000      AOE/AC
```

	0.442	0.0	0.0	AOBYP/AC
MNO=2.200	0.400	0.870	1.000	AOE/AC
	0.470	0.0	0.0	AOBYP/AC
MNO=2.400	0.400	0.895	1.000	AOE/AC
	0.495	0.0	0.0	AOBYP/AC
MNO=2.600	0.400	0.920	1.000	AOE/AC
	0.520	0.0	0.0	AOBYP/AC

4.2.2 NOZZLE/AFTBODY CONFIGURATIONS AND PERFORMANCE CHARACTERISTICS

Nine different nozzle/aftbody configuration concepts were selected to use for generating a library of aftbody drag characteristics. The types of aftbodies selected are shown in Figure 43, together with the four basic nozzle types used to generate nozzle C_{F_G} maps.

As shown in Figure 43, each of the aftbodies has a namelist name associated with it that represents the aftbody drag map data in tabulated form. Figure 44 presents a summary of each of the aftbody configurations and sources of the aftbody drag maps.

Following Figure 44, each of the nozzle/aftbody configuration area distributions is presented along with the predicted drag map for that configuration. The drag maps shown are for the fully-expanded (P_9/P_0 = 1.0) condition.

The derivative parameters for each of the baseline aftbody configurations are summarized in Figure 45. These derivative parameters consist of the following items:

1) A "baseline" area distribution that consists of a table of coordinates of body cross-sectional area versus fuselage station

2) A "baseline" radial tail orientation angle. (The program is structured to accept an input table of incremental drag coefficient as a function of free-stream Mach number and radial tail attachment angle. Insufficient data are available at present, however, to complete the data tables; therefore, the incremental drag correction is zero for all configurations.)

3) A "baseline" fore-and-aft tail position, $(X - X_9)/(X_{10} - X_9)$

4) A "baseline" base area ratio, A_B/A_{10}

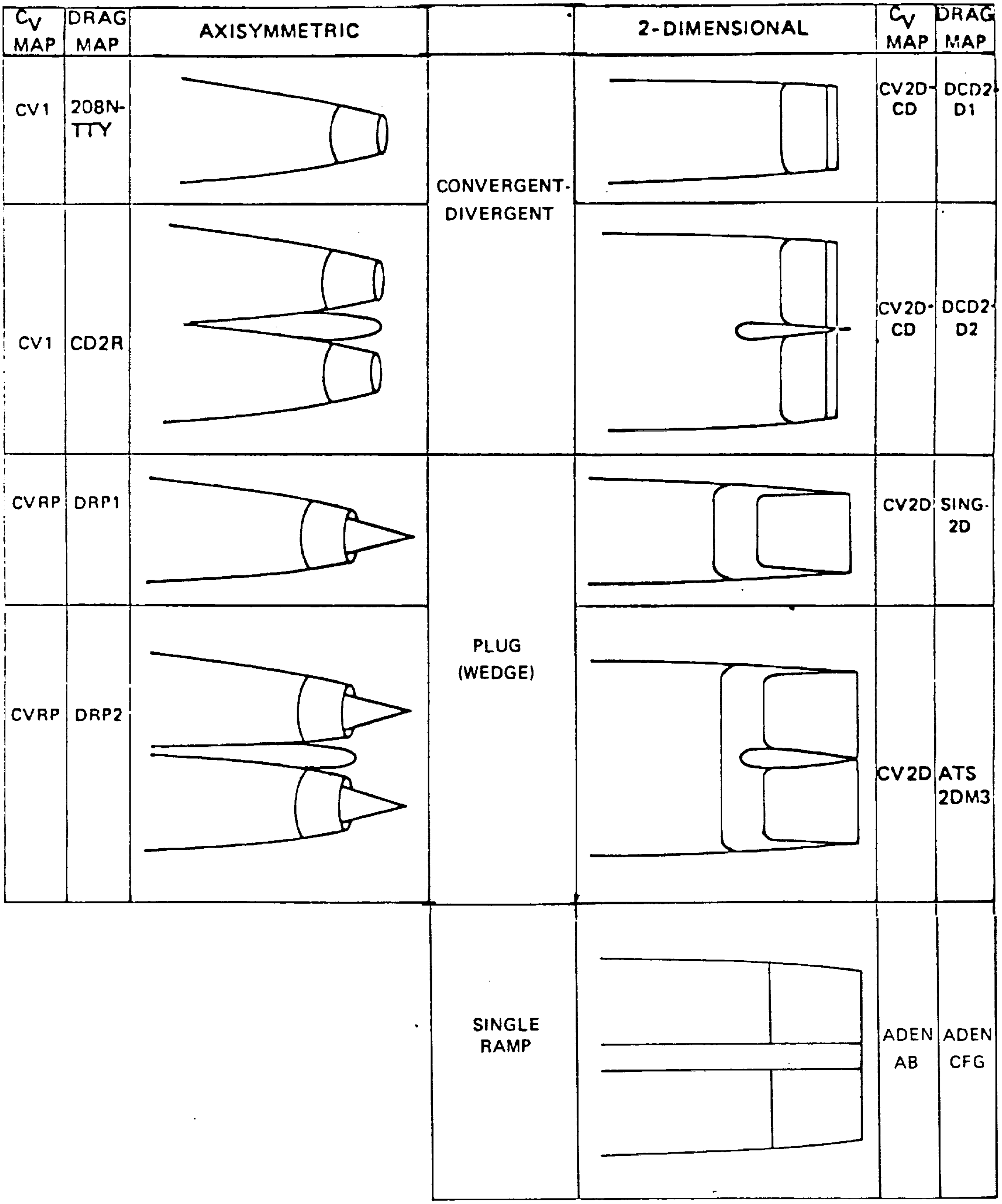


Figure 43. Matrix of Nozzle/Aftbody Maps

DESCRIPTION	NAMELIST	SOURCE OF DRAG MAP DATA
Single axisymmetric convergent-divergent nozzle installation based on Boeing LWF configuration	208NTTY	Predicted from parametric data relating drag as a function of R/D_M, , Pg/P_o, and Dg/D_{10}, checked by single nozzle experimental data in IMS method.
Twin axisymmetric convergent-divergent nozzles in a closely-spaced aftbody installation based on Boeing ATS studies	CD2R	Calculated IMS_T parameters from area distribution; Drag correlations vs. IMS_T from ESIP contract test results.
Single axisymmetric plug nozzle installation based on using a plug nozzle installed on the same aftbody as in Configuraation #1 above	DRP1	Calculated IMS_T parameters from area distribution; Drag correlations vs. IMS_T from plug nozzle test data
Twin axisymmetric plug nozzle installation based on using a twin plug nozzle installed on the same aftbody as in Configuration 2 above	DRP2	Calculated IMS_T parameters from area distributions; Drag correlations vs. IMS_T from plug nozzle test data
Single two-dimensional convergent-divergent nozzle in an ATS-type aftbody configuration	DCD2D1	Calculated IMS_T parameters from area distributions; Drag correlations vs. IMS_T were same as 2-D wedge nozzle correlations

Figure 44 - Summary of Nozzle/Aftbody Drag Maps

Twin-two dimensional convergent-divergent nozzles in an ATS-type closely-spaced aftbody configuration	DCD2D2	Calculated IMS_T parameters from area distributions; Drag correlations vs. IMS_T were same as 2-D wedge nozzle correlations
Single two-dimensional wedge nozzle installed in a supercruiser aftbody	SING2D	Calculated IMS_T parameters from area distributions; Drag correlations vs. IMS_T from two-dimensional nozzle test data
Twin two-dimensional wedge nozzles installed in closely-spaced ATS-type configuration aftbody	ATS2DM3	Calculated IMS_T parameters from area distributions. Drag correlations vs. IMS_T from two-dimensional nozzle test data
Two-dimensional, variable external expansion exhaust system utilizing a 2-D variable geometry CD flap assembly to control A_8 and a 2-D variable ventrol flap to control internal area ratio.	ADENAB	Calculated IMS_T parameters from area distributions; Drag correlations vs. IMS_T were same as 2-D wedge nozzle. Drag levels were then refined based on nozle test data obtained from a Non-Axisymmetric Nozzle Test Program. AF Contract F33615-76-C-3019

Figure 44. (cont') Summary of Nozzle/Afbody Drag Maps

		CONFIGURATION NAMELIST								
Derivative Parameters	Definition	208NTTY	CD2R	DRP1	DRP2	DCD2D1	DCD2D2	SING2D	ATS2DM3	ADEN
Nozzle Static Pressure Ratio	P_9/P_{AMB}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Tail Fin Configuration	(0,1,2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Tail Fin Angle	Deg.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tail Fin Fore-and-Aft Location Ratio	$(X-X_9) / (X_9-X_{10})$	0.29	0.1736	0.18	0.133	0.67	0.45	0.62	0.28	0.20
Base Area Ratio	A_{BASE} / A_{10}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 45 Derivative Parameter Summary of Nozzle/Aftbody Configurations

The baseline area distributions are presented in this section for each of the library aftbody configurations. As discussed above, radial tail location effects data maps are not available due to insufficient data. Baseline fore-and-aft tail locations for each configuration are shown in the figures that accompany each area distribution plot. Each of the baseline nozzle/aftbody configurations has no base area; therefore the "baseline" base area ratios, A_B/A_{10} for all configurations is zero. The nozzle/aftbody configurations and their associated drag maps are presented in Figure 46 through 63.

4.2.2.1 SINGLE ROUND C-D NOZZLE INSTALLATION - '208NTTY'

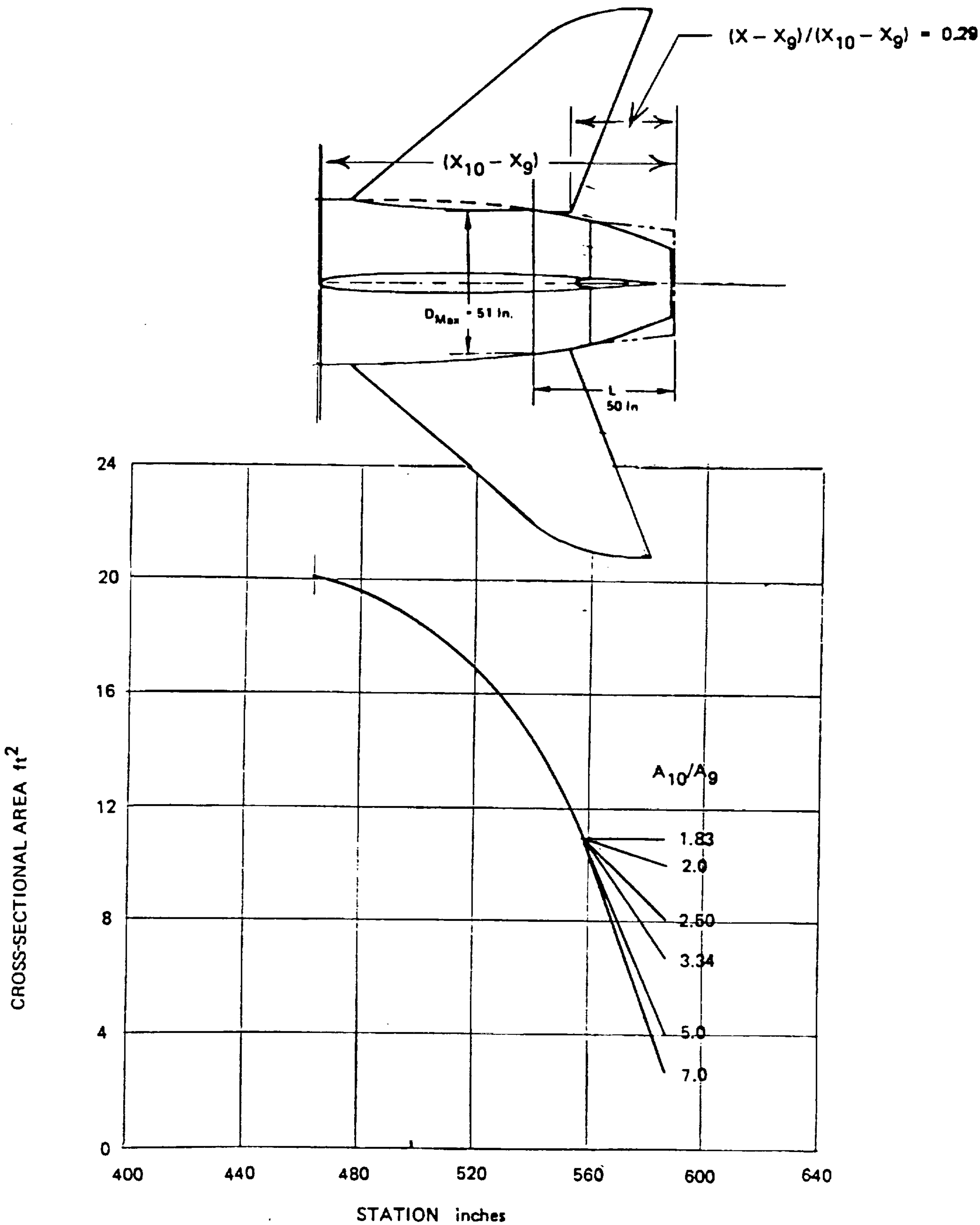


Figure 46 Nozzle/Aftbody Area Distribution for a Single Round C-D Nozzle Installation - '208NTTY'

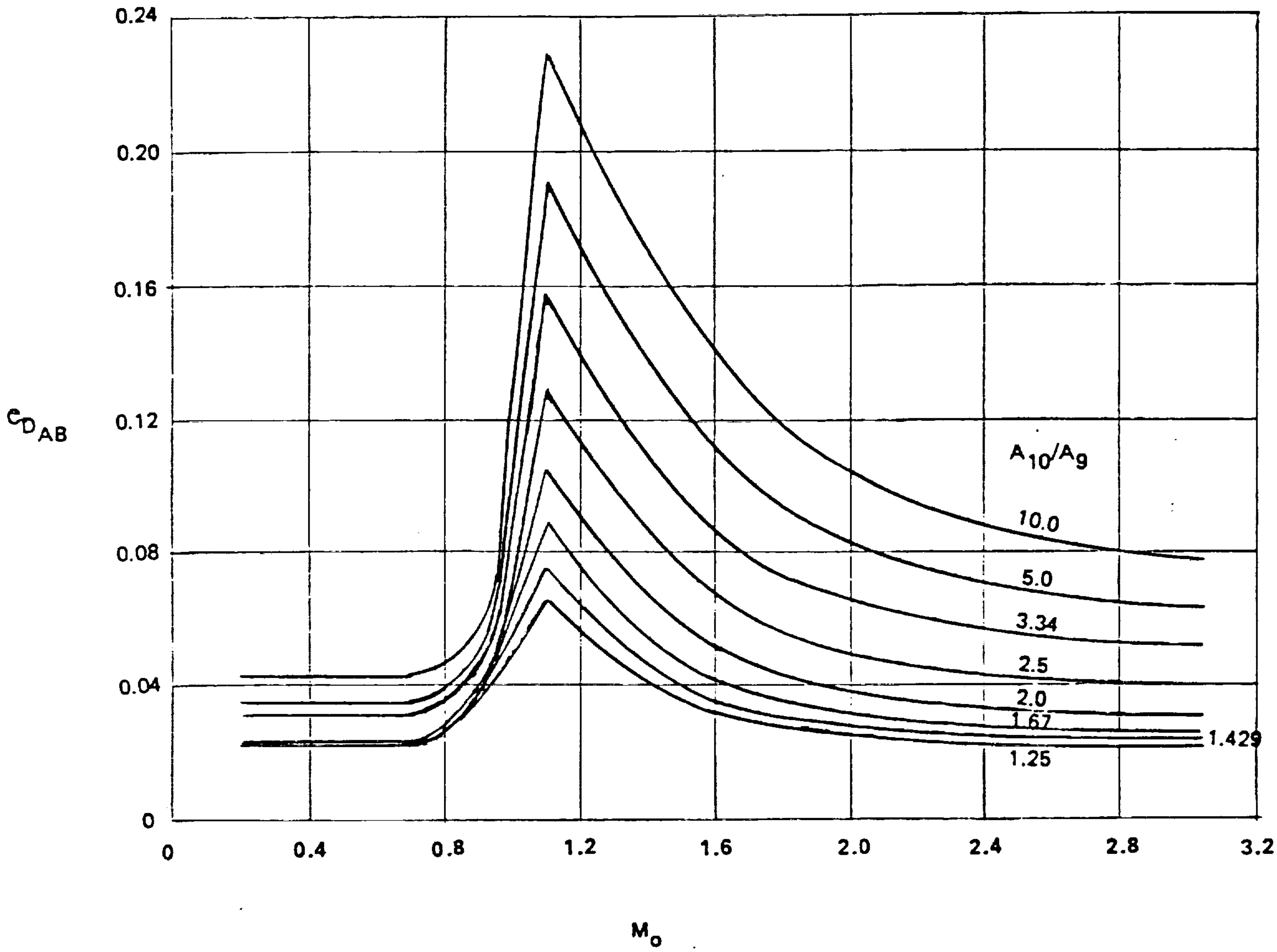


Figure 47. Drag for a Single Round C-D Nozzle Installation - '208NTTY'

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*         *
* 208HTTY *
*         *
***********
```

SINGLE AXISYMMETRIC CONVERGENT-DIVERGENT NOZZLE INSTALLATION

AFTBODY MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.2900
5	BASE AREA RATIO	0.0

FIXED PARAMETERS

NOZZLE/AFTBODY TYPE   CD-AXISYMMETRIC SINGLE NOZZLE

AREA VERSUS STATION

A10/A9 = 1.67

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	11.0000

A10/A9 = 2.00

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	10.1000

A10/A9 = 2.50

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	8.1000

A10/A9 = 3.34

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	6.8000

A10/A9 = 5.00

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	4.2000

A10/A9 = 7.00

STATION (IN) =	463.0000	500.0000	530.0000	550.0000	558.0000	587.0000
AREA (FT**2) =	20.2000	18.6000	15.8000	12.8000	11.0000	3.8000

****
* TABLE AB *
****

AFT-BODY DRAG COEFFICIENT (CD A/B) VS FREE STREAM MACH NUMBER (MNFS) AND AFT-BODY AREA RATIO (A10/A9)

1.670 2.000 2.500 3.340 5.000 7.000 A10/A9

A10/A9= 1.670	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.022	0.022	0.036	0.063	0.089	0.075	0.041	0.032	0.028	0.025	CD A/B
A10/A9= 2.000	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.022	0.022	0.037	0.067	0.105	0.090	0.051	0.038	0.033	0.030	CD A/B
A10/A9= 2.500	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.023	0.023	0.040	0.075	0.128	0.113	0.067	0.050	0.043	0.040	CD A/B
A10/A9= 3.340	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.031	0.031	0.045	0.090	0.157	0.139	0.087	0.065	0.056	0.052	CD A/B
A10/A9= 5.000	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.035	0.035	0.050	0.108	0.191	0.171	0.112	0.083	0.071	0.064	CD A/B
A10/A9= 7.000	0.200	0.700	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.042	0.042	0.058	0.128	0.230	0.209	0.140	0.104	0.088	0.077	CD A/B

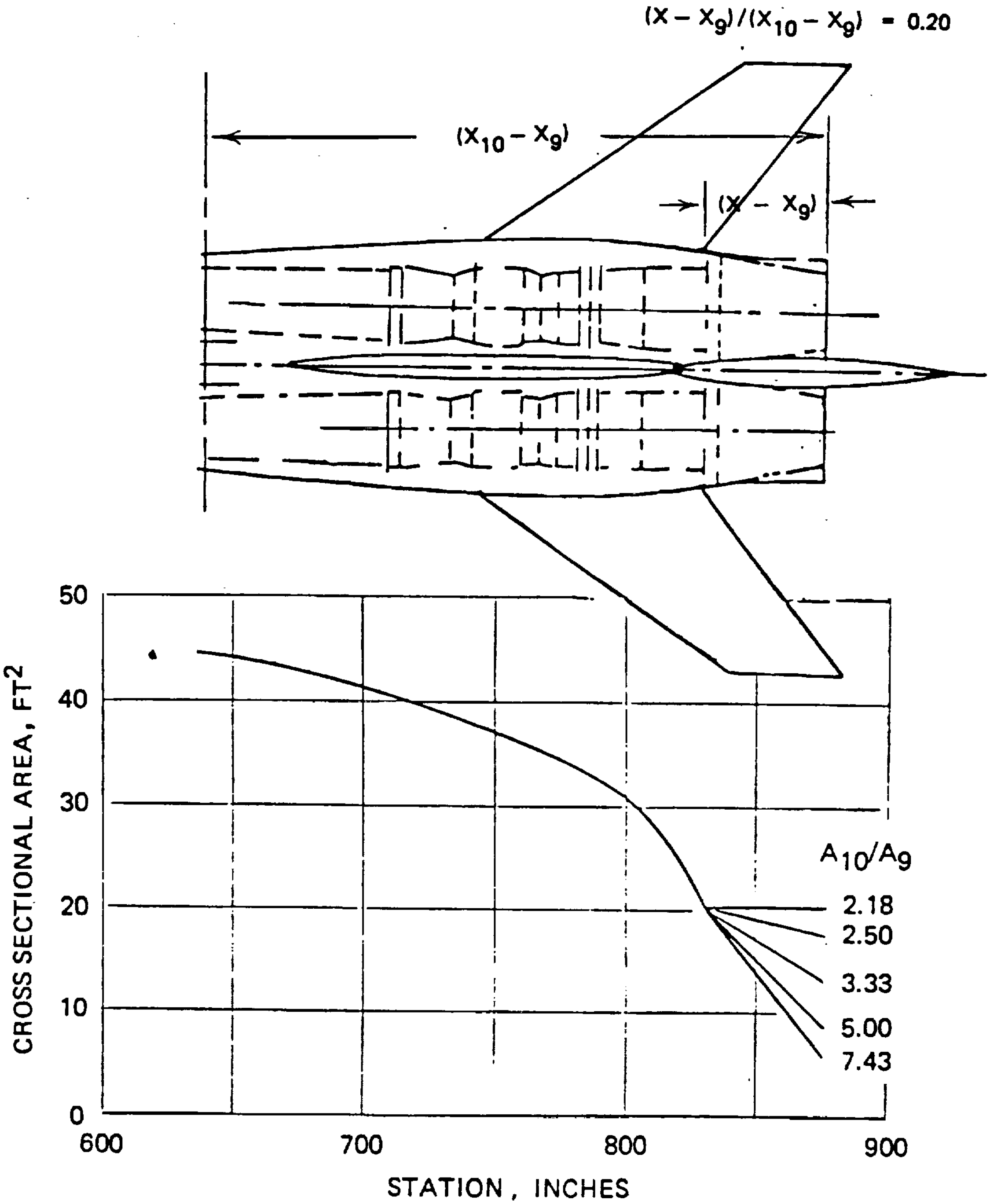

Figure 48. Nozzle/Aftbody Area Distribution for a Twin Round Nozzle Configuration - 'CD2R'

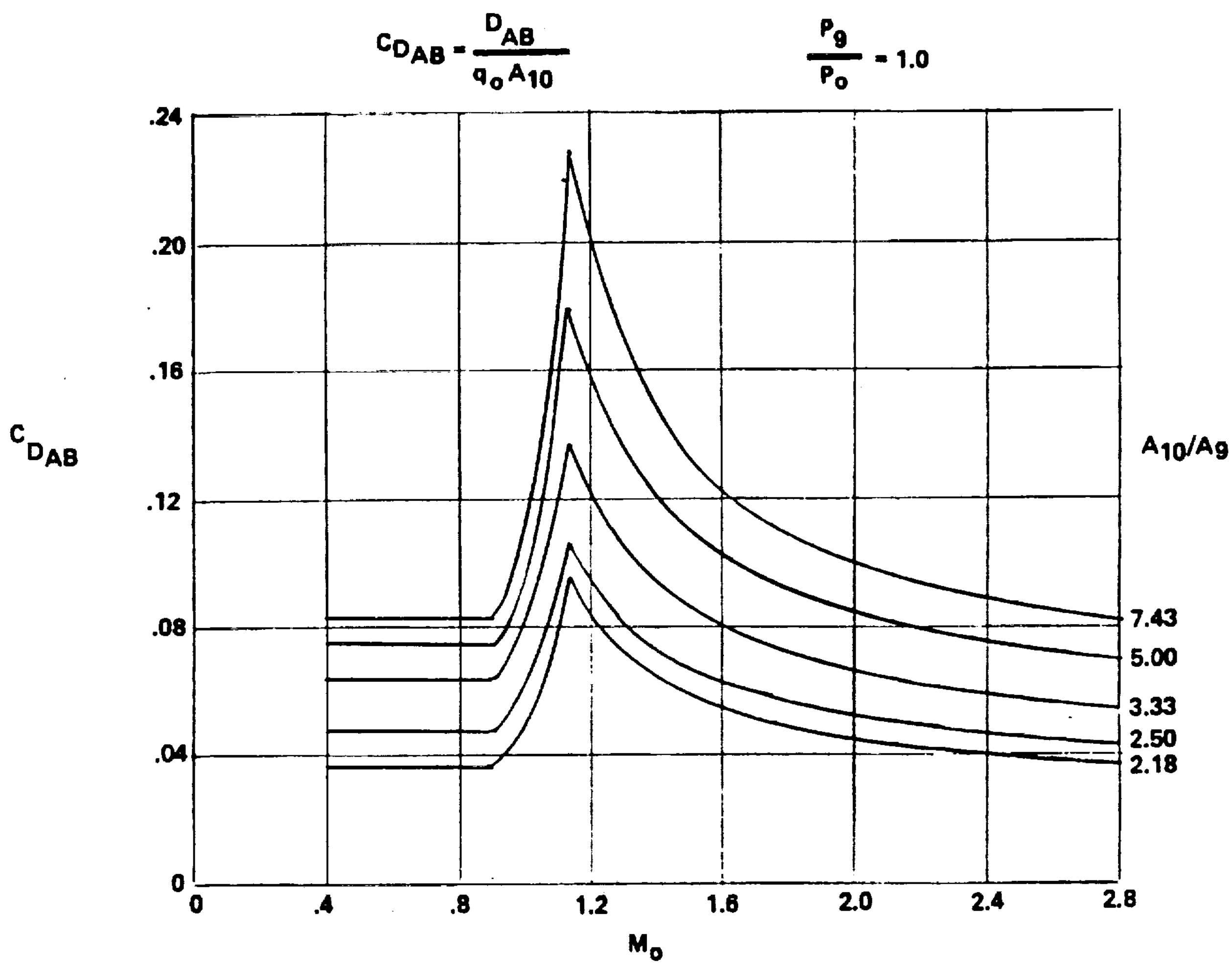

Figure 49   Drag for a Twin Round C-D Nozzle Installation - 'CD2R'

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*         *
* CD2R    *
*         *
***********
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TWIN AXISYMMETRIC CONVERGENT-DIVERGENT NOZZLES, CLOSELY SPACED

AFTBODY MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.1736
5	BASE AREA RATIO	0.0

FIXED PARAMETERS

NOZZLE/AFTBODY TYPE CD-AXISYMMETRIC DUAL NOZZLE

AREA VERSUS STATION

A10/A9 = 2.18

STATION (IN) =	637.0000	700.0000	760.0000	800.0000	820.0000	830.0000	876.0000
AREA (FT**2) =	44.5000	41.5000	36.0000	31.0000	25.0000	20.5000	20.5000

A10/A9 = 2.50

STATION (IN) =	637.0000	700.0000	760.0000	800.0000	820.0000	830.0000	876.0000
AREA (FT**2) =	44.5000	41.5000	36.0000	31.0000	25.0000	20.5000	17.4000

A10/A9 = 3.33

STATION (IN) =	637.0000	700.0000	760.0000	800.0000	820.0000	830.0000	876.0000
AREA (FT**2) =	44.5000	41.5000	36.0000	31.0000	25.0000	20.5000	13.3500

A10/A9 = 5.00

STATION (IN) =	637.0000	700.0000	760.0000	800.0000	820.0000	830.0000	876.0000
AREA (FT**2) =	44.5000	41.5000	36.0000	31.0000	25.0000	20.5000	8.9200

A10/A9 = 7.43

STATION (IN) =	637.0000	700.0000	760.0000	800.0000	820.0000	830.0000	876.0000
AREA (FT**2) =	44.5000	41.5000	36.0000	31.0000	25.0000	20.5000	6.0000

****
* TABLE AB *   AFT-BODY DRAG COEFFICIENT (CD A/B)   VS   FREE STREAM MACH NUMBER (MNFS)   AND AFT-BODY AREA RATIO (A10/A9)
****

2.180   2.500   3.330   5.000   7.430   A10/A9

A10/A9= 2.180	0.400	0.900	1.000	1.130	1.300	1.600	2.000	2.300	3.000	MNFS
	0.037	0.037	0.050	0.096	0.073	0.055	0.045	0.042	0.036	CD A/B
A10/A9= 2.500	0.400	0.900	1.000	1.130	1.300	1.600	2.000	2.300	3.000	MNFS
	0.048	0.048	0.063	0.107	0.082	0.063	0.052	0.048	0.042	CD A/B
A10/A9= 3.330	0.400	0.900	1.000	1.130	1.300	1.600	2.000	2.300	3.000	MNFS
	0.064	0.064	0.083	0.138	0.105	0.081	0.066	0.060	0.053	CD A/B
A10/A9= 5.000	0.400	0.900	1.000	1.130	1.300	1.600	2.000	2.300	3.000	MNFS
	0.074	0.074	0.100	0.180	0.137	0.103	0.084	0.077	0.068	CD A/B
A10/A9= 7.430	0.400	0.900	1.000	1.130	1.300	1.600	2.000	2.300	3.000	MNFS
	0.083	0.083	0.115	0.228	0.170	0.121	0.100	0.090	0.078	CD A/B

4.2.2.3 SINGLE ROUND PLUG NOZZLE INSTALLATION - 'DRP1'

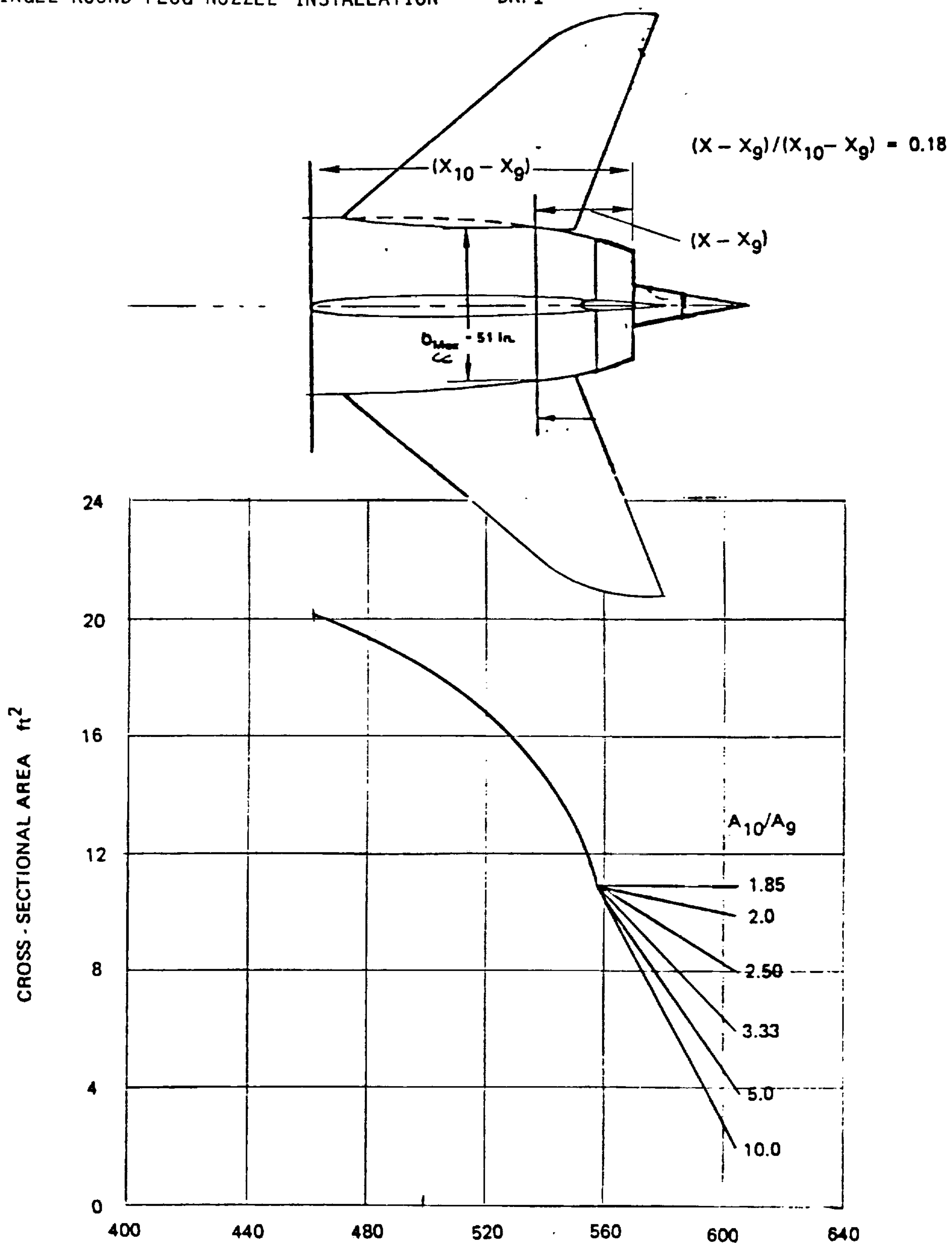

Figure 50 Nozzle/Aftbody Area Distribution for a Single Round Plug Nozzle Installation - 'DRP1'

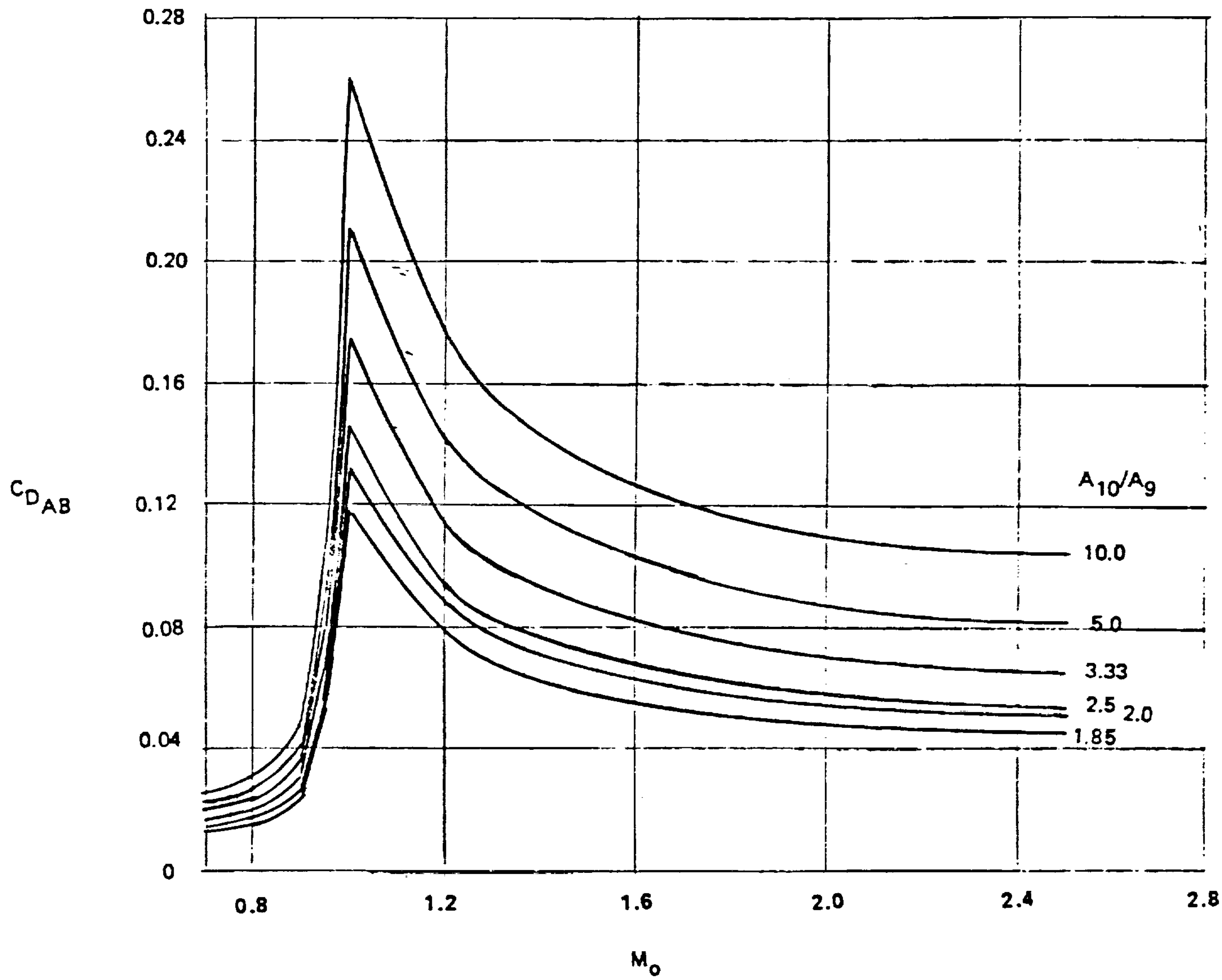

Figure 51 Drag for a Single Round Plug Nozzle Installation - 'DRP1'

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**********
*        *
* DRP1   *
*        *
**********
```

SINGLE AXISYMMETRIC PLUG NOZZLE INSTALLATION

AFTBODY MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.1800
5	BASE AREA RATIO	0.0

FIXED PARAMETERS
****

NOZZLE/AFTBODY TYPE PLUG AXISYMMETRIC SINGLE NOZZLE

AREA VERSUS STATION
****

A10/A9 = 1.85

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	11.0000

A10/A9 = 2.00

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	10.0000

A10/A9 = 2.50

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	8.0000

A10/A9 = 3.33

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	6.0000

A10/A9 = 5.00

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	4.0000

A10/A9 = 10.00

STATION (IN) =	463.0000	500.0000	520.0000	540.0000	558.0000	605.0000
AREA (FT**2) =	20.2000	18.3000	16.8000	14.7000	11.0000	2.0000

****
* TABLE AB *   AFT-BODY DRAG COEFFICIENT (CD A/B)   VS   FREE STREAM MACH NUMBER (MNFS)   AND AFT-BODY AREA RATIO (A10/A9)
****

	1.850	2.000	2.500	3.330	5.000	10.000	A10/A9		
A10/A9= 1.850	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.013	0.015	0.024	0.119	0.078	0.066	0.046	0.044	0.042	CD A/B
A10/A9= 2.000	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.014	0.017	0.026	0.130	0.088	0.075	0.052	0.052	0.050	CD A/B
A10/A9= 2.500	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.017	0.020	0.031	0.146	0.093	0.078	0.057	0.056	0.054	CD A/B
A10/A9= 3.330	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.020	0.024	0.037	0.174	0.113	0.095	0.067	0.065	0.063	CD A/B
A10/A9= 5.000	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.023	0.028	0.042	0.210	0.140	0.119	0.083	0.082	0.080	CD A/B
A10/A9=10.000	0.700	0.800	0.900	1.000	1.200	1.600	2.200	2.500	3.000	MNFS
	0.027	0.033	0.049	0.260	0.177	0.150	0.104	0.103	0.101	CD A/B

4.2.2.4 TWIN ROUND PLUG NOZZLE INSTALLATION - 'DRP2'

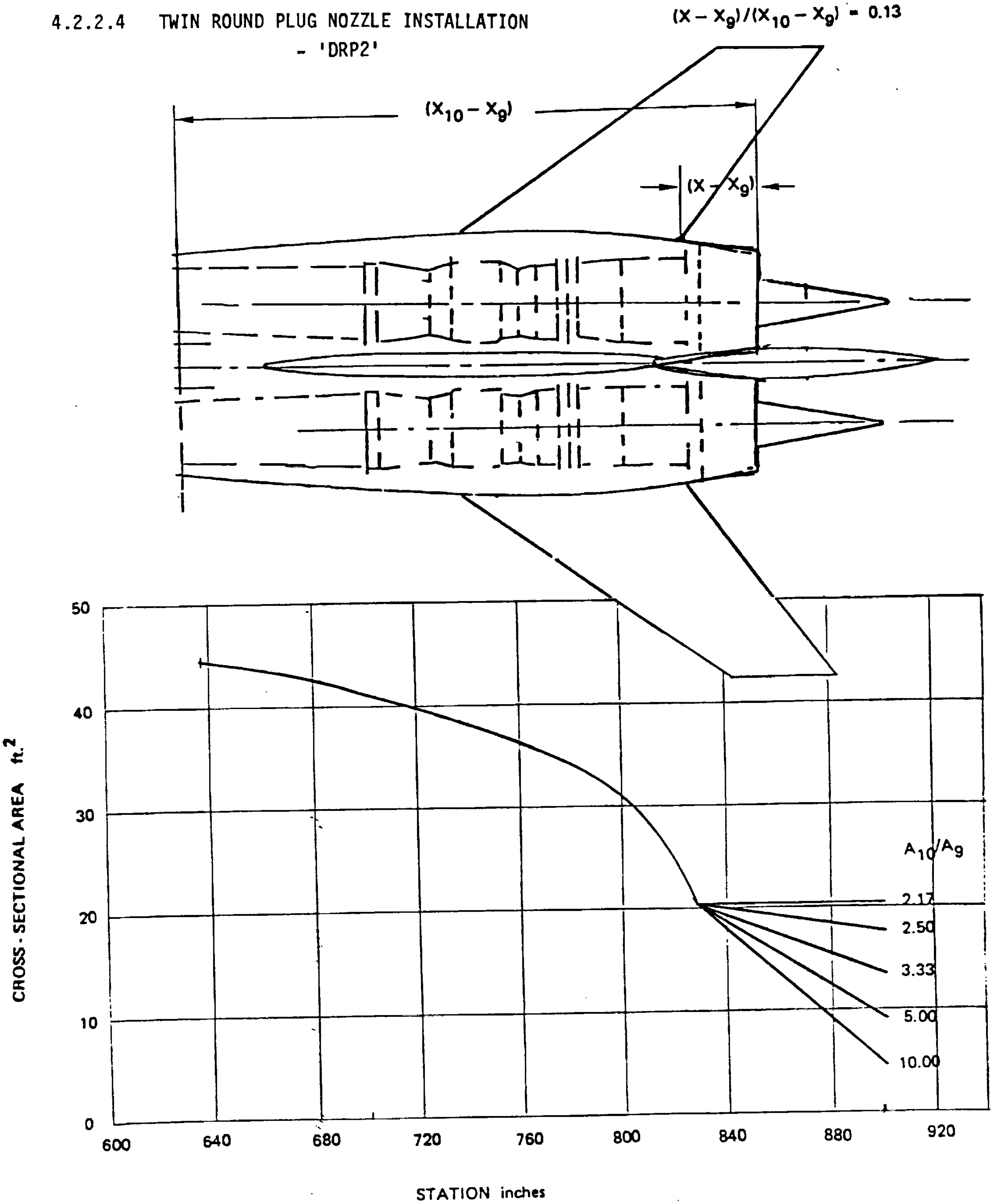

Figure 52 Nozzle/Aftbody area Distribution for a Twin Round Plug Nozzle Installation - 'DRP2'

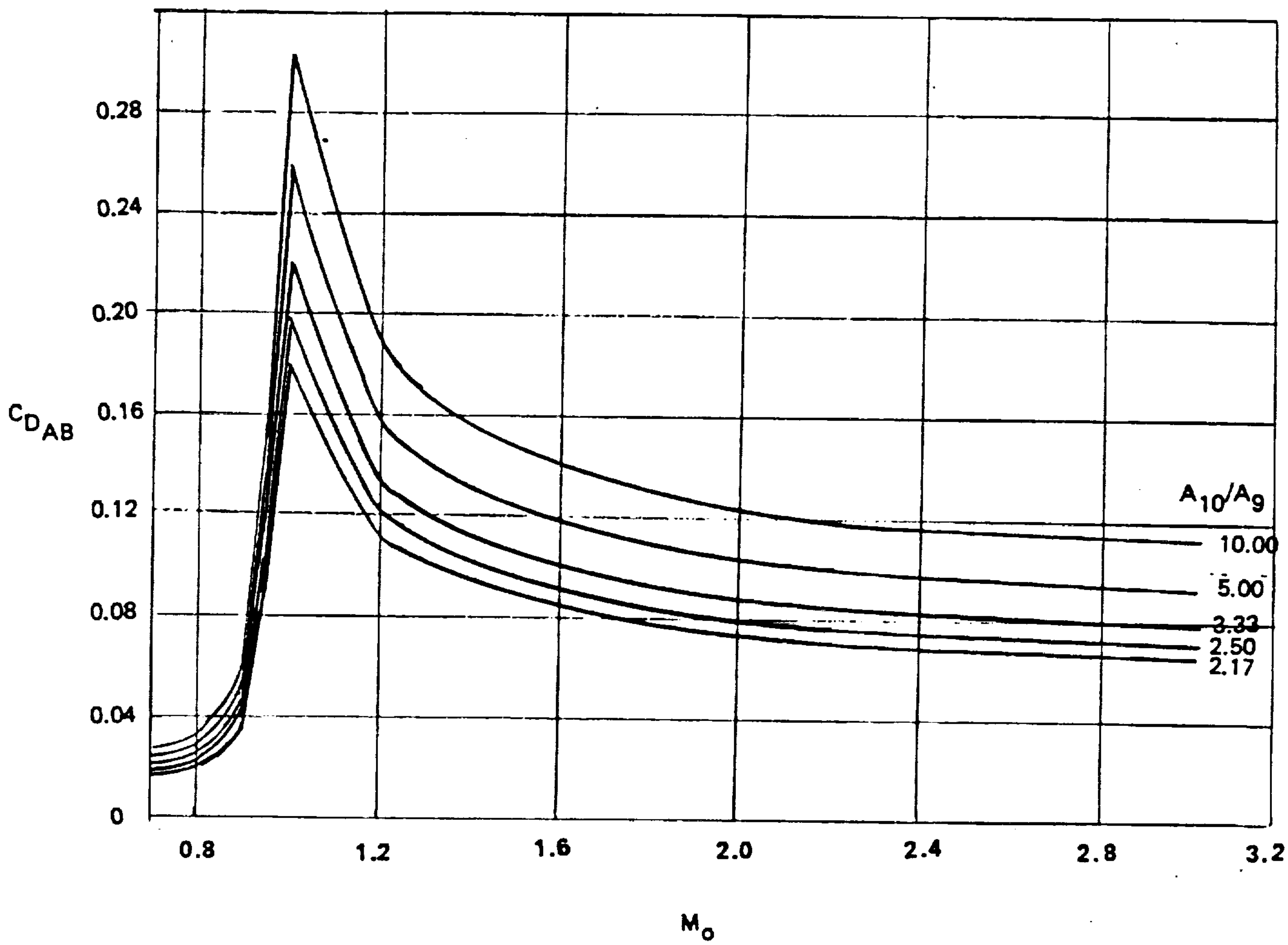

Figure 53   Drag for a Twin-Round Plug Nozzle Installation - 'DRP2'

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*         *
* DRP2    *
*         *
***********
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TWIN AXISYMMETRIC PLUG NOZZLE INSTALLATION, CLOSELY SPACED

AFTBODY MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.1330
5	BASE AREA RATIO	0.0

FIXED PARAMETERS
****

NOZZLE/AFTBODY TYPE   PLUG AXISYMMETRIC DUAL NOZZLE

AREA VERSUS STATION
****

A10/A9 = 2.17

STATION (IN) =	637.0000	680.0000	740.0000	780.0000	800.0000	828.0000	902.0000
AREA (FT**2) =	44.5000	43.0000	38.5000	34.2000	31.2000	20.5000	20.5000

A10/A9 = 2.50

STATION (IN) =	637.0000	680.0000	740.0000	780.0000	800.0000	828.0000	902.0000
AREA (FT**2) =	44.5000	43.0000	38.5000	34.2000	31.2000	20.5000	17.6000

A10/A9 = 3.33

STATION (IN) =	637.0000	680.0000	740.0000	780.0000	800.0000	828.0000	902.0000
AREA (FT**2) =	44.5000	43.0000	38.5000	34.2000	31.2000	20.5000	13.5000

A10/A9 = 5.00

STATION (IN) =	637.0000	680.0000	740.0000	780.0000	800.0000	828.0000	902.0000
AREA (FT**2) =	44.5000	43.0000	38.5000	34.2000	31.2000	20.5000	9.0000

A10/A9 = 10.00

STATION (IN) =	637.0000	680.0000	740.0000	780.0000	800.0000	828.0000	902.0000
AREA (FT**2) =	44.5000	43.0000	38.5000	34.2000	31.2000	20.5000	4.5000

****
* TABLE AB * AFT-BODY DRAG COEFFICIENT (CD A/B) VS FREE STREAM MACH NUMBER (MNFS) AND AFT-BODY AREA RATIO (A10/A9)
****

2.170 2.500 3.330 5.000 10.000 A10/A9

A10/A9= 2.170	0.700	0.800	0.900	1.000	1.200	1.300	1.700	2.200	3.000	MNFS
	0.017	0.020	0.036	0.180	0.113	0.110	0.093	0.070	0.067	CD A/B
A10/A9= 2.500	0.700	0.800	0.900	1.000	1.200	1.300	1.700	2.200	3.000	MNFS
	0.019	0.022	0.038	0.197	0.121	0.120	0.100	0.076	0.070	CD A/B
A10/A9= 3.330	0.700	0.800	0.900	1.000	1.200	1.300	1.700	2.200	3.000	MNFS
	0.021	0.026	0.045	0.220	0.134	0.130	0.110	0.084	0.077	CD A/B
A10/A9= 5.000	0.700	0.800	0.900	1.000	1.200	1.300	1.700	2.200	3.000	MNFS
	0.026	0.030	0.053	0.259	0.159	0.156	0.130	0.100	0.094	CD A/B
A10/A9=10.000	0.700	0.800	0.900	1.000	1.200	1.300	1.700	2.200	3.000	MNFS
	0.030	0.034	0.058	0.304	0.190	0.186	0.155	0.118	0.115	CD A/B

4.2.2.5 SINGLE C-D, 2-D NOZZLE INSTALLATION - 'DCD2D1'

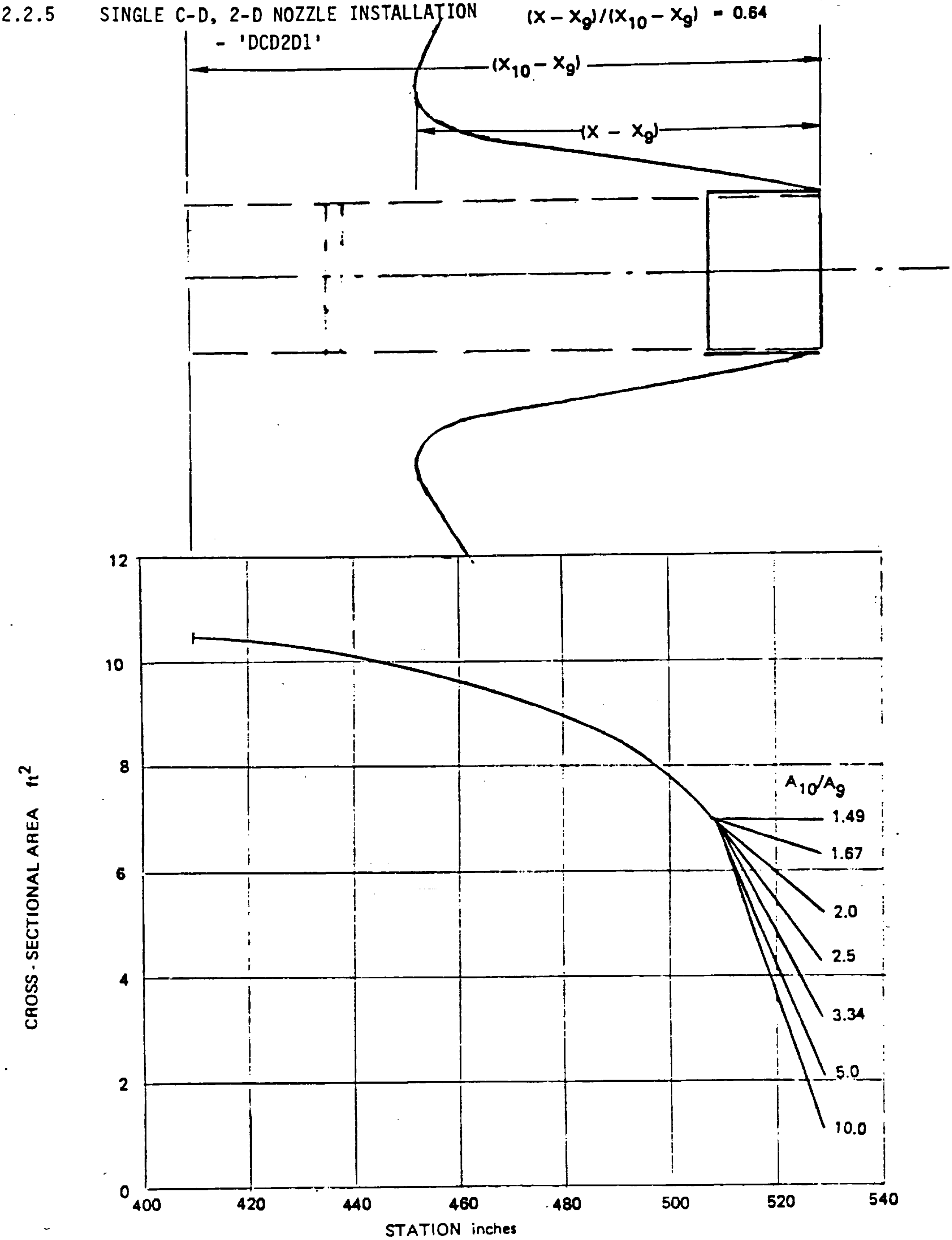

Figure 54 Nozzle/Aftbody Area Distribution for a Single 2-D C-D Nozzle Installation - 'DCD2D1'

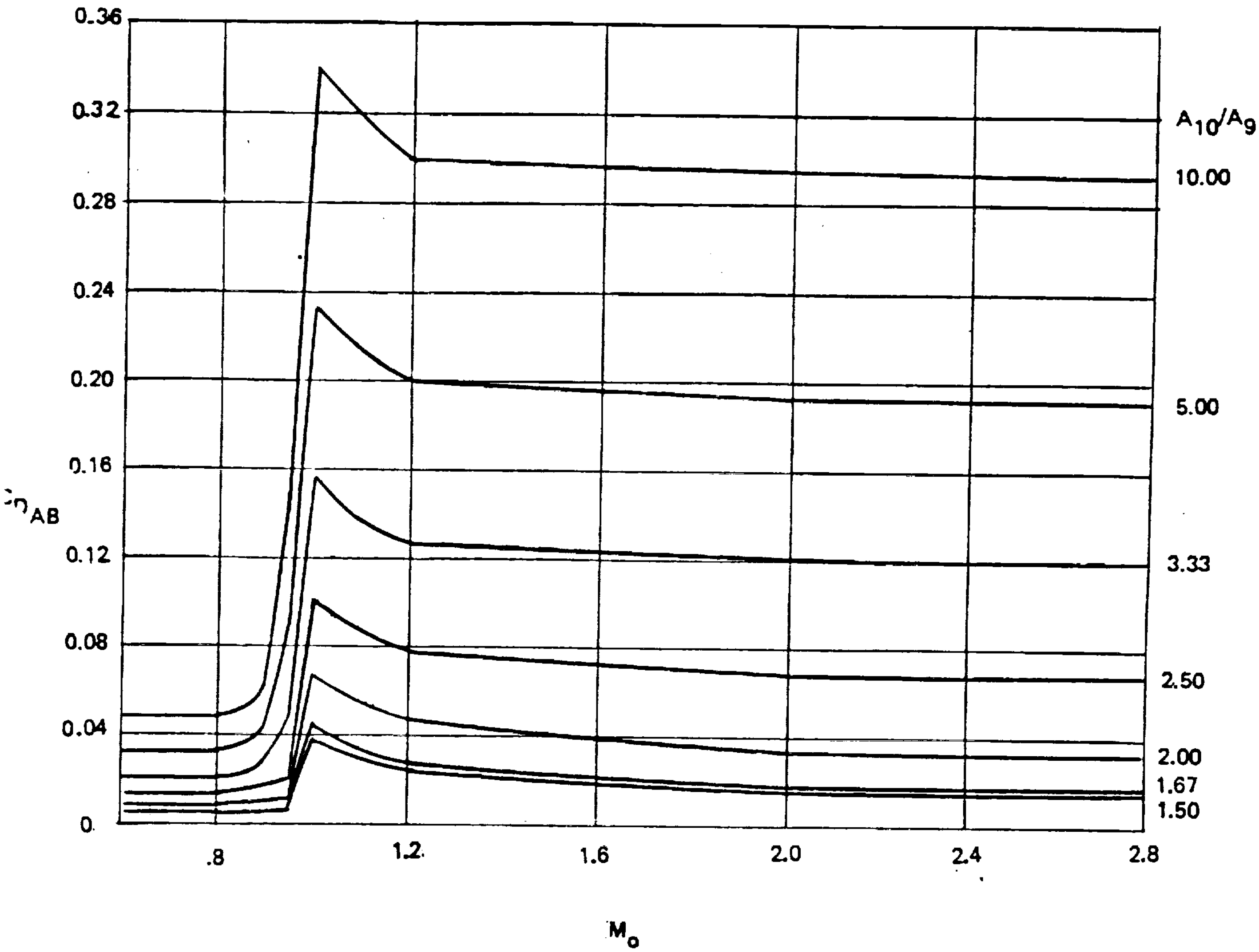

Figure 55 Drag for a Single 2-D C-D Nozzle/Aftbody Installation - 'DCD2D1'

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**********
*        *
* DCD2D1 *
*        *
**********
```

SINGLE TWO-DIMENSIONAL CONVERGENT-DIVERGENT NOZZLE INSTALLATION

AFTBODY MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.6700
5	BASE AREA RATIO	0.0

FIXED PARAMETERS
****

NOZZLE/AFTBODY TYPE   CD-TWO DIMENSIONAL SINGLE NOZZLE

AREA VERSUS STATION
****

A10/A9 = 1.50

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	7.1000

A10/A9 = 1.67

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	6.4000

A10/A9 = 2.00

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	5.3000

A10/A9 = 2.50

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	4.3500

A10/A9 = 3.33

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	3.3000

A10/A9 = 5.00

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	2.3000

A10/A9 = 10.00

STATION (IN) =	410.0000	440.0000	470.0000	490.0000	508.0000	528.0000
AREA (FT**2) =	10.5000	10.1000	9.4000	8.5000	7.1000	1.0500

****
* TABLE AB *
****

AFT-BODY DRAG COEFFICIENT (CD A/B) VS FREE STREAM MACH NUMBER (MNFS) AND AFT-BODY AREA RATIO (A10/A9)

	1.500	1.670	2.000	2.500	3.330	5.000	10.000	A10/A9			
A10/A9= 1.500	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.006	0.006	0.007	0.038	0.030	0.025	0.020	0.015	0.014	0.013	CD A/B
A10/A9= 1.670	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.006	0.006	0.007	0.044	0.034	0.029	0.023	0.017	0.016	0.015	CD A/B
A10/A9= 2.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.010	0.010	0.012	0.068	0.055	0.048	0.040	0.035	0.033	0.031	CD A/B
A10/A9= 2.500	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.015	0.015	0.018	0.100	0.088	0.080	0.074	0.068	0.067	0.065	CD A/B
A10/A9= 3.330	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.020	0.020	0.030	0.155	0.137	0.127	0.124	0.120	0.118	0.116	CD A/B
A10/A9= 5.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.033	0.033	0.044	0.233	0.213	0.200	0.196	0.194	0.193	0.190	CD A/B
A10/A9=10.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.048	0.048	0.063	0.340	0.317	0.300	0.296	0.294	0.292	0.290	CD A/B

4.2.2.6 TWIN C-D, 2-D NOZZLE INSTALLATION - 'DCD2D2'

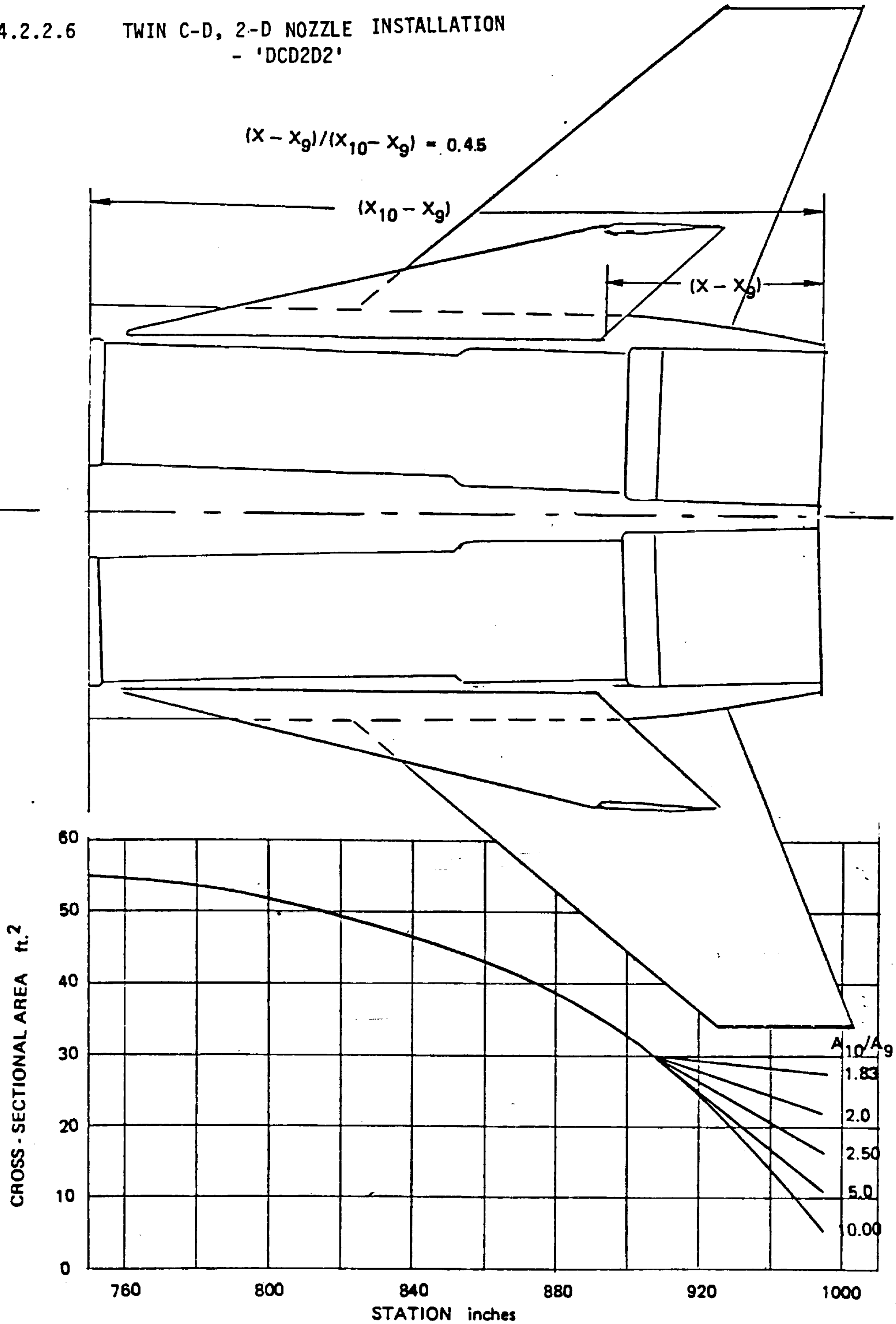


Figure 56 Nozzle/Aftbody Area Distribution for a Twin 2-D C-D Nozzle Installation - 'DCD2D2'

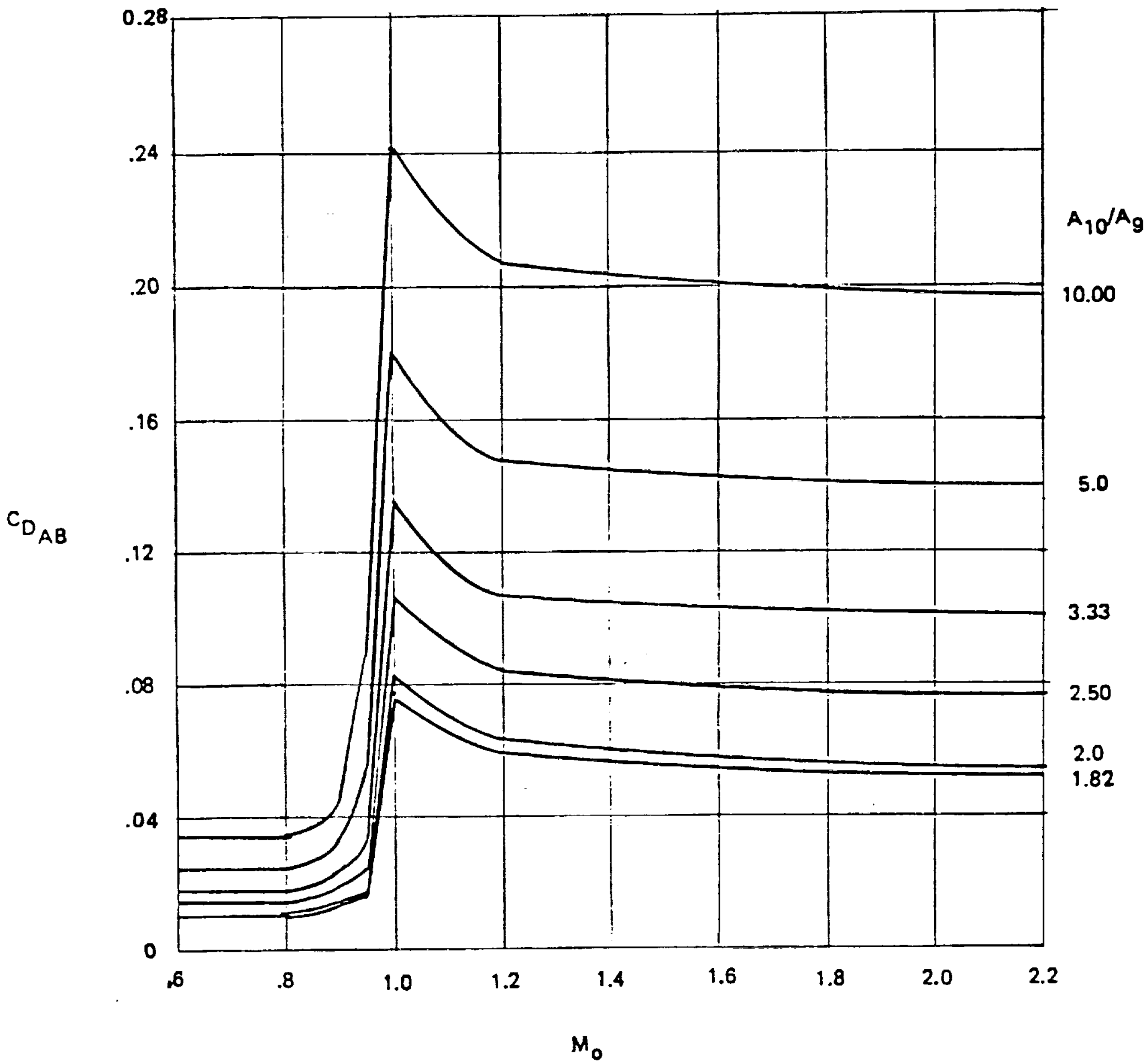


Figure 57 Drag for a Twin 2-D C-D Nozzle Installation - 'DCD2D2'

```
**********
*        *
* DCD2D2 *
*        *
**********
```

TWIN TWO-DIMENSIONAL CONVERGENT-DIVERGENT NOZZLES, CLOSELY SPACED

AFTBODY MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.4500
5	BASE AREA RATIO	0.0

FIXED PARAMETERS

NOZZLE/AFTBODY TYPE CD-TWO DIMENSIONAL DUAL NOZZLE

AREA VERSUS STATION

A10/A9 = 1.82

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	30.0000

A10/A9 = 2.00

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	27.5000

A10/A9 = 2.50

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	22.0000

A10/A9 = 3.33

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	16.5000

A10/A9 = 5.00

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	11.0000

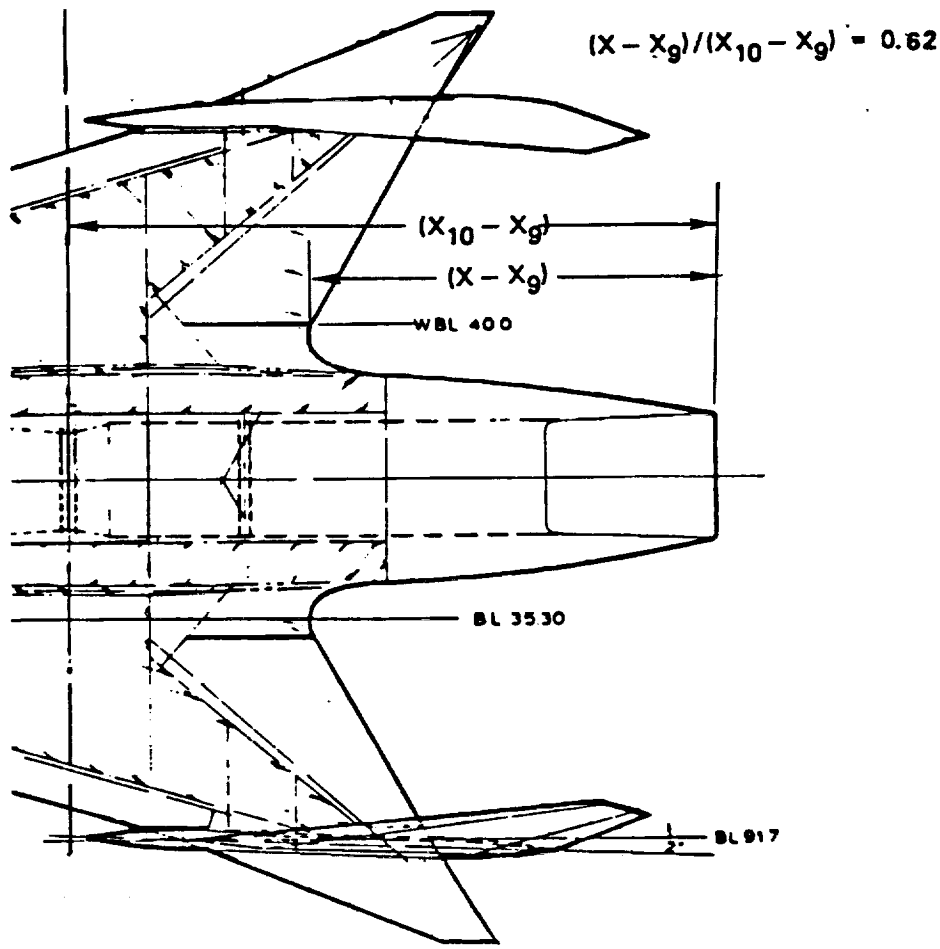
A10/A9 = 10.00

STATION (IN) =	750.0000	800.0000	850.0000	880.0000	907.0000	955.0000
AREA (FT**2) =	55.0000	52.0000	45.0000	38.8000	30.0000	5.5000

****
* TABLE AB *   AFT-BODY DRAG COEFFICIENT (CD A/B)   VS   FREE STREAM MACH NUMBER (MNFS)   AND AFT-BODY AREA RATIO (A10/A9)
****

	1.820	2.000	2.500	3.330	5.000	10.000	A10/A9				
A10/A9= 1.820	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.009	0.009	0.014	0.076	0.066	0.059	0.056	0.054	0.052	0.050	CD A/B
A10/A9= 2.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.010	0.010	0.015	0.083	0.070	0.063	0.058	0.056	0.054	0.052	CD A/B
A10/A9= 2.500	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.015	0.015	0.018	0.106	0.093	0.084	0.080	0.076	0.074	0.072	CD A/B
A10/A9= 3.330	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.017	0.017	0.024	0.135	0.116	0.106	0.104	0.100	0.098	0.095	CD A/B
A10/A9= 5.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.025	0.025	0.035	0.180	0.158	0.147	0.144	0.140	0.136	0.132	CD A/B
A10/A9=10.000	0.600	0.800	0.900	1.000	1.100	1.200	1.600	2.000	2.400	3.000	MNFS
	0.035	0.035	0.045	0.240	0.220	0.207	0.202	0.197	0.194	0.190	CD A/B

4.2.2.7 SINGLE 2-D WEDGE NOZZLE INSTALLATION - 'SING2D'



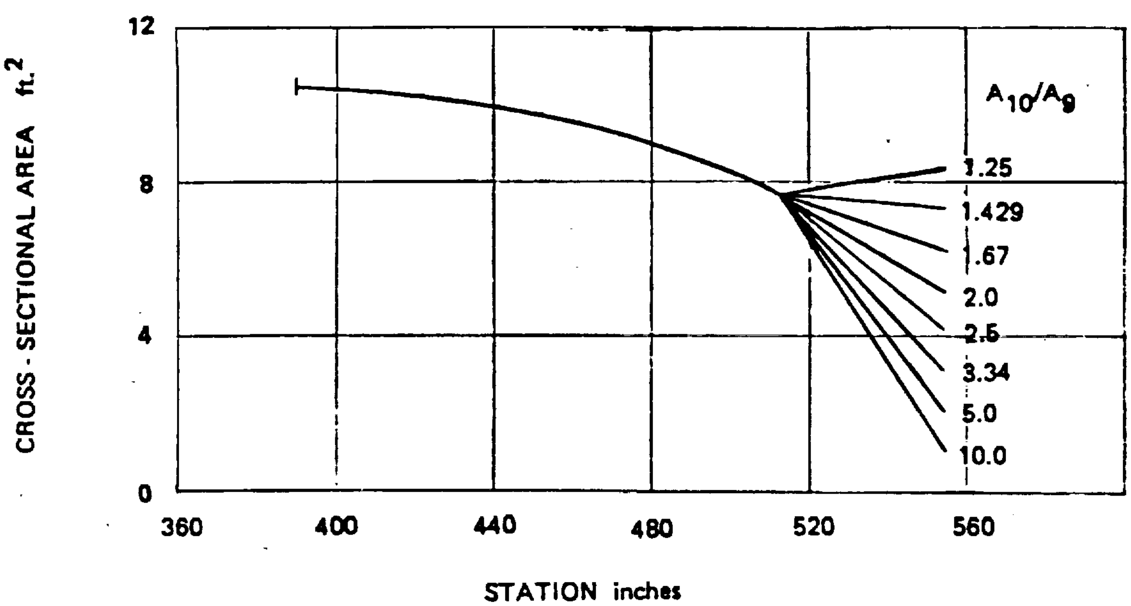


Figure 58 Nozzle Aftbody Area Distributon for a Single 2-D Wedge Nozzle Installation - 'SING2D'

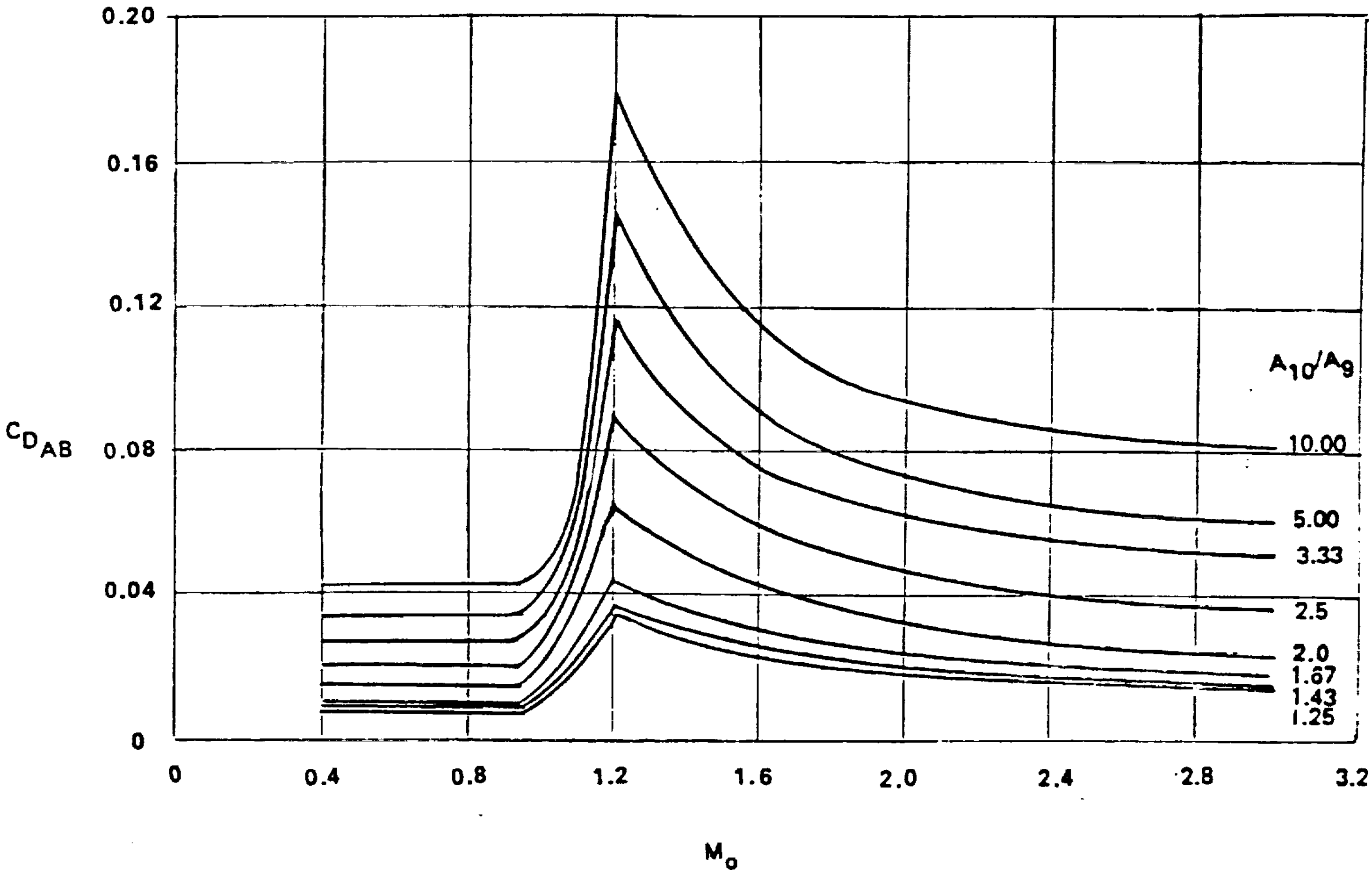


Figure 59 Drag for a Single 2-D Wedge Nozzle/Aftbody Installation - 'SING2D'

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                                   ***********
                                   *         *
                                   * SING2D  *
                                   *         *
                                   ***********

                 SINGLE TWO DIMENSIONAL WEDGE NOZZLE INSTALLATION

                         AFTBODY MAP DERIVATIVE PARAMETERS
                         *********************************

     PARAMETER NUMBER            PARAMETER DEFINITION                 VALUE

            1          NOZZLE STATIC PRESSURE RATIO                   1.0000
            2          TAIL FIN CONFIGURATION                         2.0000
            3          TAIL FIN ANGLE(DEG)                            0.0
            4          TAIL FIN FORE AND AFT LOCATION RATIO           0.6200
            5          BASE AREA RATIO                                0.0

                               FIXED PARAMETERS
                               ****************

     NOZZLE/AFTBODY TYPE                     WEDGE TWO DIMENSIONAL SINGLE NOZZLE

                              AREA VERSUS STATION
                              *******************

                                 A10/A9 =   1.25

STATION (IN) =  390.0000  440.0000  480.0000  513.0000  555.0000
AREA (FT**2) =   10.4000   10.0000    9.0000    7.8000    8.4000
                                 A10/A9 =   1.43

STATION (IN) =  390.0000  440.0000  480.0000  513.0000  555.0000
AREA (FT**2) =   10.4000   10.0000    9.0000    7.8000    7.4000
                                 A10/A9 =   1.67

STATION (IN) =  390.0000  440.0000  480.0000  513.0000  555.0000
AREA (FT**2) =   10.4000   10.0000    9.0000    7.8000    6.4000
                                 A10/A9 =   2.00

STATION (IN) =  390.0000  440.0000  480.0000  513.0000  555.0000
AREA (FT**2) =   10.4000   10.0000    9.0000    7.8000    5.2000
```

A10/A9 = 2.50

STATION (IN) =	390.0000	440.0000	480.0000	513.0000	555.0000
AREA (FT**2) =	10.4000	10.0000	9.0000	7.8000	4.2000

A10/A9 = 3.33

STATION (IN) =	390.0000	440.0000	480.0000	513.0000	555.0000
AREA (FT**2) =	10.4000	10.0000	9.0000	7.8000	3.2000

A10/A9 = 5.00

STATION (IN) =	390.0000	440.0000	480.0000	513.0000	555.0000
AREA (FT**2) =	10.4000	10.0000	9.0000	7.8000	2.0800

A10/A9 = 10.00

STATION (IN) =	390.0000	440.0000	480.0000	513.0000	555.0000
AREA (FT**2) =	10.4000	10.0000	9.0000	7.8000	1.0400

****
* TABLE AB *
****

AFT-BODY DRAG COEFFICIENT (CD A/B) VS FREE STREAM MACH NUMBER (MNFS) AND AFT-BODY AREA RATIO (A10/A9)

	1.250	1.430	1.670	2.000	2.500	3.330	5.000	10.000	A10/A9		
A10/A9= 1.250	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.007	0.007	0.010	0.020	0.034	0.028	0.023	0.018	0.016	0.014	CD A/B
A10/A9= 1.430	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.008	0.008	0.013	0.024	0.036	0.030	0.025	0.020	0.018	0.015	CD A/B
A10/A9= 1.670	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.010	0.010	0.015	0.028	0.043	0.035	0.030	0.024	0.021	0.018	CD A/B
A10/A9= 2.000	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.014	0.014	0.020	0.037	0.063	0.051	0.043	0.033	0.027	0.024	CD A/B
A10/A9= 2.500	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.020	0.020	0.026	0.046	0.088	0.070	0.059	0.046	0.040	0.036	CD A/B

A10/A9= 3.330	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.027	0.027	0.033	0.053	0.115	0.090	0.075	0.062	0.056	0.050	CD A/B
A10/A9= 5.000	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.034	0.034	0.040	0.060	0.144	0.110	0.091	0.073	0.065	0.060	CD A/B
A10/A9=10.000	0.400	0.950	1.000	1.100	1.200	1.400	1.600	2.000	2.400	3.000	MNFS
	0.043	0.043	0.047	0.070	0.178	0.139	0.115	0.094	0.086	0.081	CD A/B

4.2.2.8 TWIN 2-D WEDGE NOZZLE INSTALLATION 'ATS2DM3'

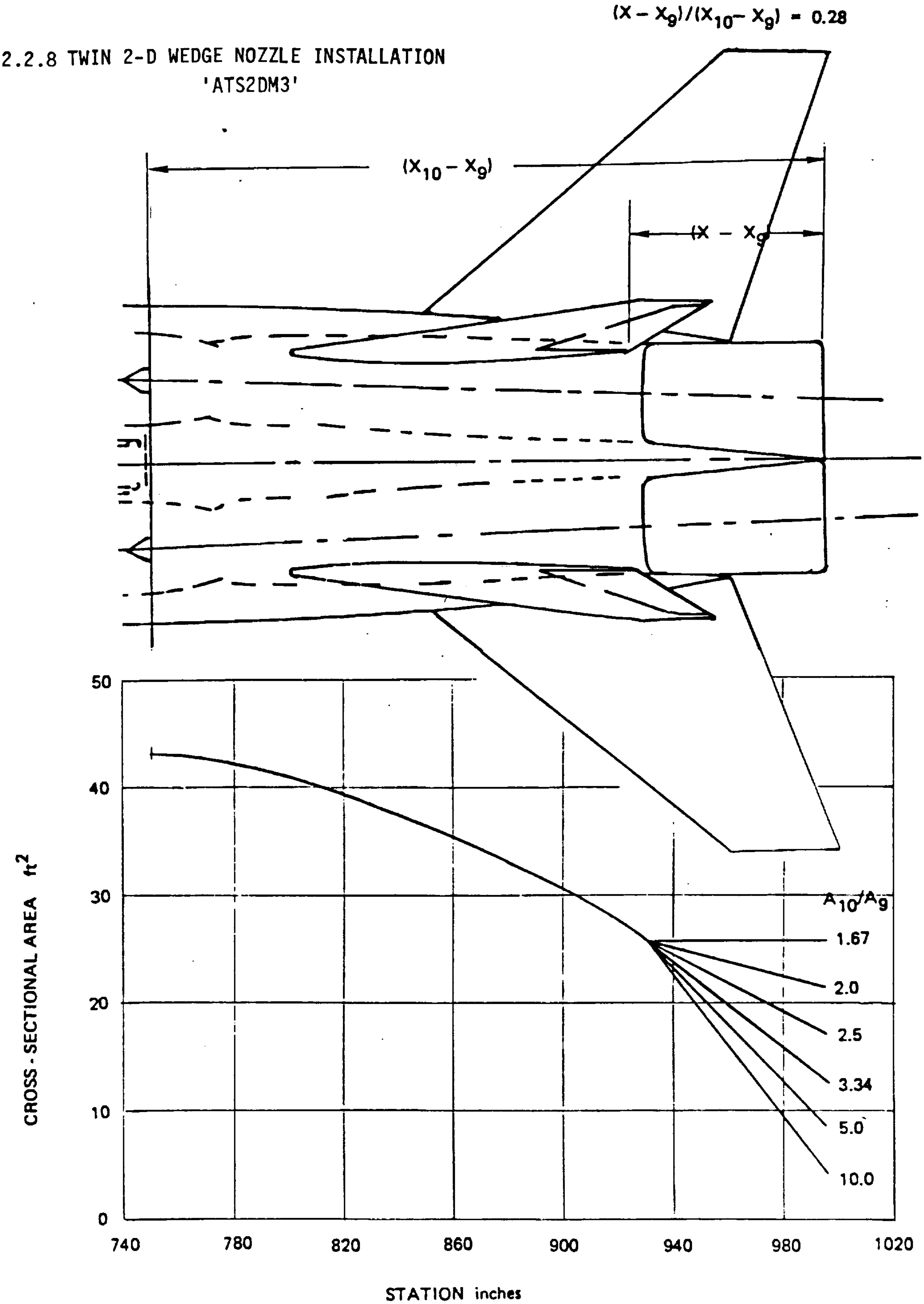

Figure 60 Nozzle/Aftbody Area Distribution for a Twin 2-D Wedge Nozzle Installation 'ATS2DM3'

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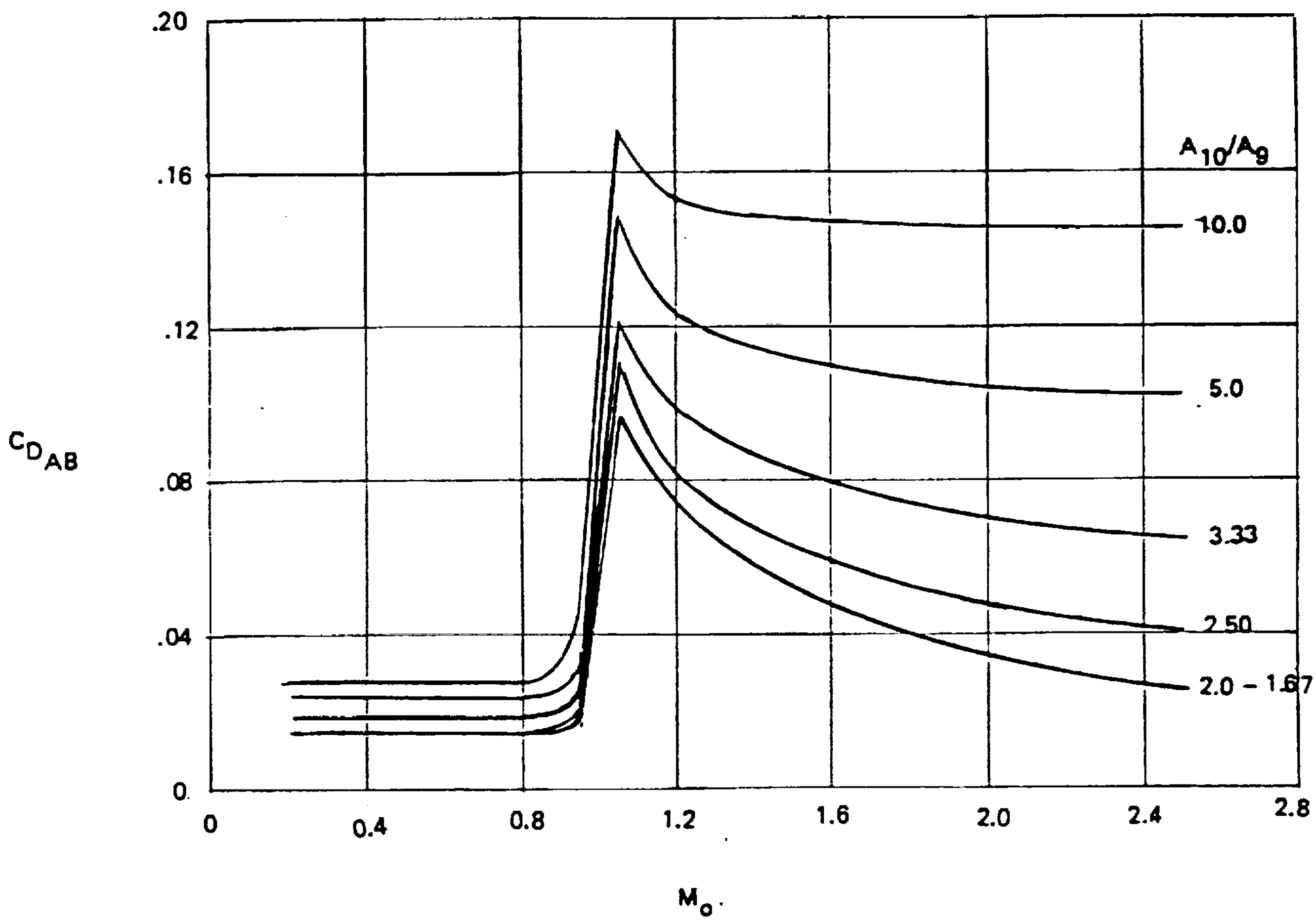

Figure 61 Drag for a Twin 2-D Wedge Nozzle Configuration 'ATS2DM3'

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***********
*         *
* ATS2DM3 *
*         *
***********
```

TWIN TWO-DIMENSIONAL WEDGE NOZZLES, CLOSELY SPACED

AFTBODY MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.2800
5	BASE AREA RATIO	0.0

FIXED PARAMETERS
****

NOZZLE/AFTBODY TYPE   WEDGE TWO DIMENSIONAL DUAL NOZZLE

AREA VERSUS STATION
****

A10/A9 = 1.67

STATION (IN) =	750.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	26.0000

A10/A9 = 2.00

STATION (IN) =	750.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	21.5000

A10/A9 = 2.50

STATION (IN) =	750.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	17.3000

A10/A9 = 3.33

STATION (IN) =	750.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	13.0000

A10/A9 = 5.00

STATION (IN) =	750.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	8.6000

A10/A9 = 10.00

STATION (IN) =	720.0000	800.0000	860.0000	900.0000	932.0000	996.0000
AREA (FT**2) =	43.0000	41.0000	35.5000	30.5000	26.0000	4.3000

****
* TABLE AB *   AFT-BODY DRAG COEFFICIENT (CD A/B)   VS   FREE STREAM MACH NUMBER (MNFS)   AND AFT-BODY AREA RATIO (A10/A9)
****

	1.670	2.000	2.500	3.330	5.000	10.000	A10/A9				
A10/A9= 1.670	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.014	0.014	0.015	0.019	0.097	0.075	0.048	0.035	0.025	0.021	CD A/B
A10/A9= 2.000	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.014	0.014	0.015	0.019	0.097	0.075	0.048	0.035	0.025	0.021	CD A/B
A10/A9= 2.500	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.015	0.015	0.017	0.022	0.111	0.082	0.059	0.048	0.041	0.039	CD A/B
A10/A9= 3.330	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.019	0.019	0.020	0.026	0.121	0.099	0.080	0.070	0.065	0.063	CD A/B
A10/A9= 5.000	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.024	0.024	0.027	0.035	0.149	0.123	0.110	0.104	0.102	0.100	CD A/B
A10/A9=10.000	0.200	0.800	0.900	0.950	1.050	1.200	1.600	2.000	2.400	3.000	MNFS
	0.028	0.028	0.035	0.048	0.170	0.154	0.147	0.146	0.145	0.144	CD A/B

4.2.2.9 ADEN NOZZLE INSTALLATION - 'ADENAB'

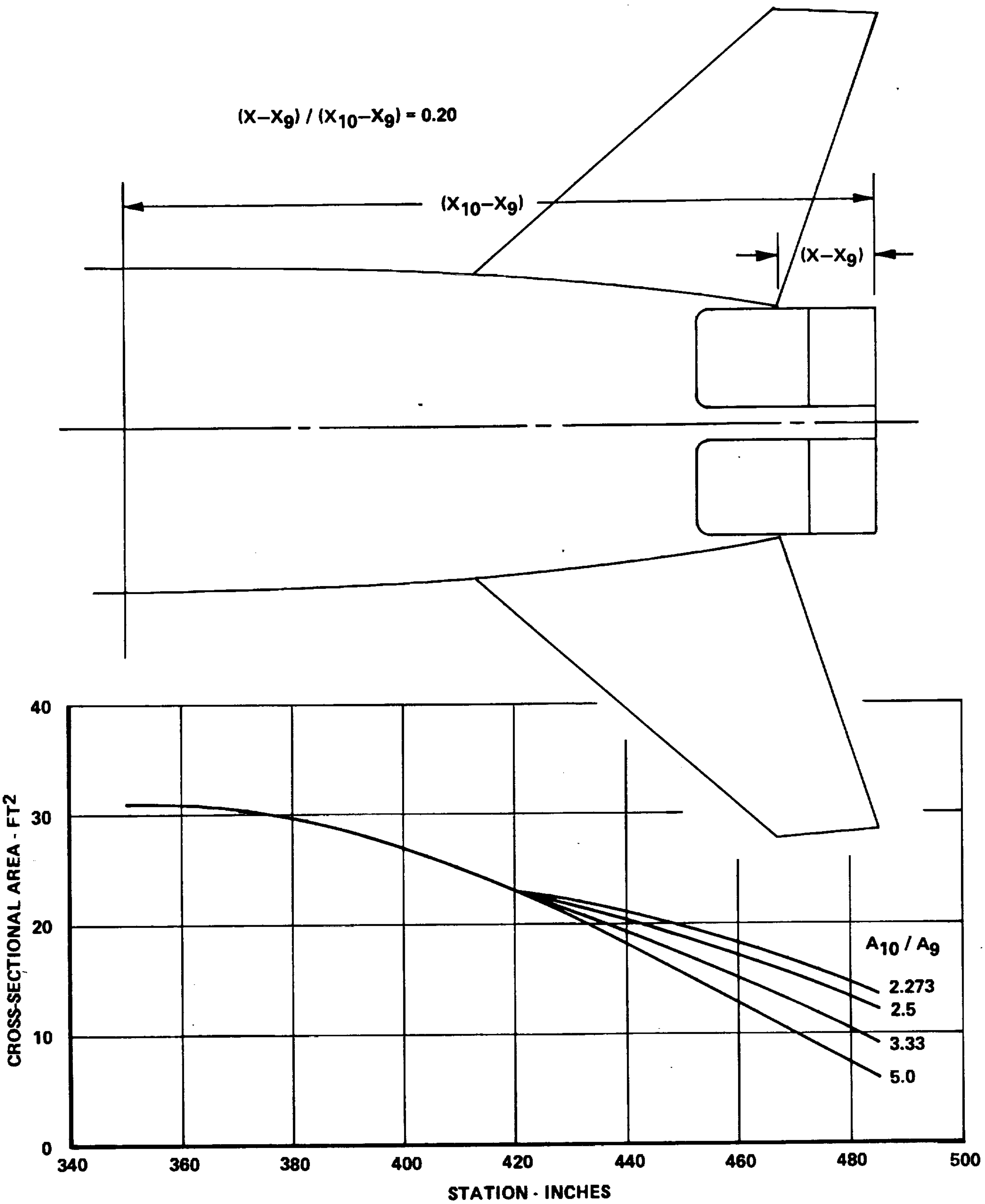

Figure 62 Nozzle/Aftbody Area Distribution for an ADEN Nozzle Installation - 'ADENAB'

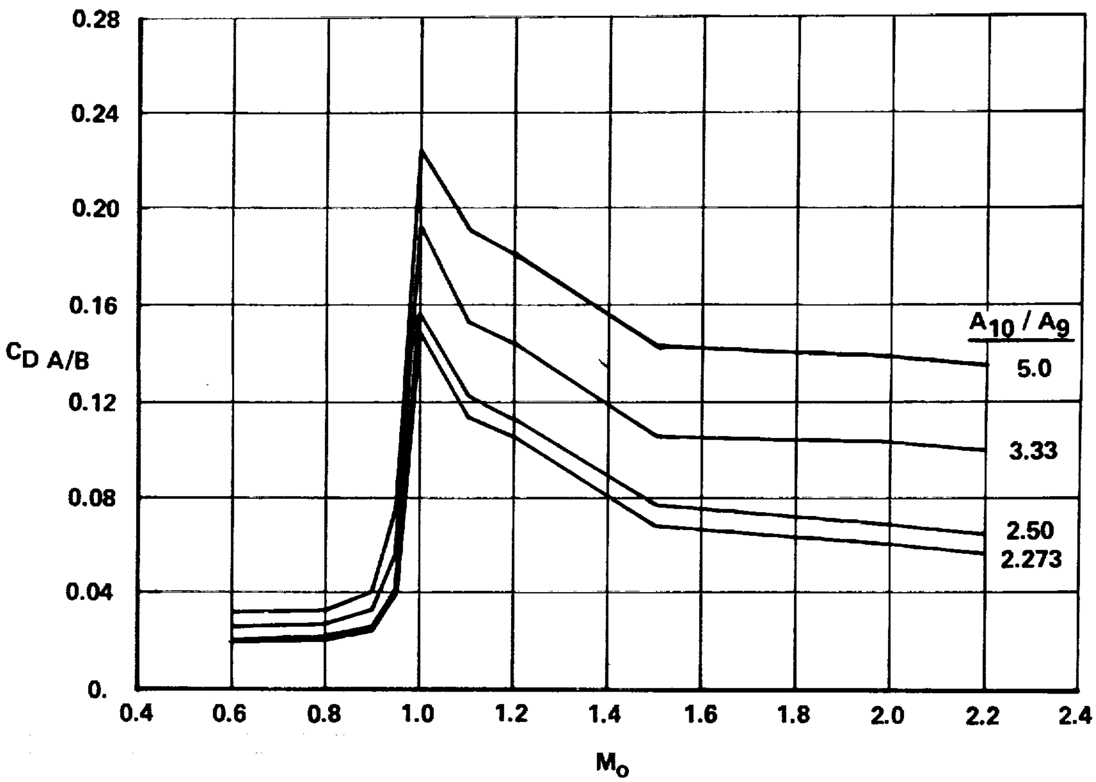

Figure 63 Drag for an ADEN Nozzle Configuration - 'ADENAB'

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***********
*         *
* ADENAB  *
*         *
***********
```

TWIN G.E. ADEN NOZZLE

AFTBODY MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	NOZZLE STATIC PRESSURE RATIO	1.0000
2	TAIL FIN CONFIGURATION	2.0000
3	TAIL FIN ANGLE(DEG)	0.0
4	TAIL FIN FORE AND AFT LOCATION RATIO	0.2000
5	BASE AREA RATIO	0.0

FIXED PARAMETERS

NOZZLE/AFTBODY TYPE   CD-TWO DIMENSIONAL DUAL NOZZLE

AREA VERSUS STATION

A10/A9 = 2.27

STATION (IN) =	350.0000	360.0000	370.0000	390.0000	400.0000	420.0000	430.0000	440.0000	470.0000	485.0000
AREA (FT**2) =	30.9700	30.9000	30.4200	28.2600	26.8800	22.9900	22.2900	21.1100	16.6700	13.6800

A10/A9 = 2.50

STATION (IN) =	350.0000	360.0000	370.0000	390.0000	400.0000	420.0000	430.0000	440.0000	470.0000	485.0000
AREA (FT**2) =	30.9700	30.9000	30.4200	28.2600	26.8800	22.9900	21.7400	20.2100	15.3500	12.4300

A10/A9 = 3.33

STATION (IN) =	350.0000	360.0000	370.0000	390.0000	400.0000	420.0000	430.0000	440.0000	470.0000	485.0000
AREA (FT**2) =	30.9700	30.9000	30.4200	28.2600	26.8800	22.9900	21.1100	19.1000	12.7100	9.3800

A10/A9 = 5.00

STATION (IN) =	350.0000	360.0000	370.0000	390.0000	400.0000	420.0000	430.0000	440.0000	470.0000	485.0000
AREA (FT**2) =	30.9700	30.9000	30.4200	28.2600	26.8800	22.9900	20.3500	17.9200	10.2800	6.2500

****
* TABLE A8 *
****

AFT-BODY DRAG COEFFICIENT (CD A/B) VS FREE STREAM MACH NUMBER (MNFS) AND AFT-BODY AREA RATIO (A10/A9)

	2.273	2.500	3.330	5.000	A10/A9						
A10/A9= 2.273	0.600	0.800	0.900	0.950	1.000	1.100	1.200	1.500	2.000	2.200	MNFS
	0.036	0.036	0.043	0.071	0.264	0.204	0.188	0.121	0.107	0.102	CD A/B
A10/A9= 2.500	0.600	0.800	0.900	0.950	1.000	1.100	1.200	1.500	2.000	2.200	MNFS
	0.035	0.035	0.043	0.068	0.258	0.203	0.188	0.128	0.113	0.108	CD A/B
A10/A9= 3.330	0.600	0.800	0.900	0.950	1.000	1.100	1.200	1.500	2.000	2.200	MNFS
	0.037	0.037	0.046	0.081	0.273	0.219	0.206	0.151	0.147	0.143	CD A/B
A10/A9= 5.000	0.600	0.800	0.900	0.950	1.000	1.100	1.200	1.500	2.000	2.200	MNFS
	0.040	0.040	0.050	0.096	0.279	0.239	0.226	0.180	0.173	0.169	CD A/B

4.2.3 NOZZLE INTERNAL CONFIGURATIONS AND C_{FG} MAPS

Five different nozzle internal configurations were selected and utilized to provide a library of typical nozzle internal performance characteristics. These nozzles included:

1) Axisymmetric convergent-divergent nozzle
2) Axisymmetric plug nozzle
3) Two-dimensional convergent-divergent nozzle
4) Two-dimensional wedge nozzle
5) Two-dimensional ADEN nozzle

Each of the nozzle configurations is described in this section of the report, followed by plotted data showing the variation of nozzle gross thrust coefficient, C_{F_G}, as a function of nozzle total pressure ratio P_{T8}/P_0, power setting PS or jet area A8.

Figure 64 summarizes the derivative parameters for each of the nozzle internal configurations.

		CONFIGURATION NAMELIST				
Derivative Parameters	Definition	CV1	CVRP	CV2DCD	CV2D	ADENCFG
Plug Half Angle	Deg.	N/A	10.0	N/A	N/A	N/A
Wedge Half Angle	Deg.	N/A	N/A	N/A	10.0	12.0
Aspect Ratio	W_g / H_g	N/A	N/A	1.0	1.0	1.0
Divergence Half Angle	Deg	11.45	N/A	22.0	N/A	6.0

Figure 64 Derivative Parameter Summary of Nozzle C_{F_G} Configurations

C-5

4.2.3.1 NOZZLE CONFIGURATION 'CV1' - AXISYMMETRIC, CONVERGENT-DIVERGENT NOZZLE

Axisymmetric convergent-divergent nozzles can vary in complexity from a lightweight fixed geometry to a relatively heavy fully variable exit area and throat area design. The configuration selected for this study is a simple variation of the fixed geometry design utilization mechanically slaved nozzle exit area and throat area to obtain variable internal expansion as a function of powersetting (throat area). This type of design is currently used on the J101/F404 and F100 turbofan engines. The baseline nozzle internal divergence half-angle ($_{DIV}$) for this configuration is 11.45^{o} which occurs at a nozzle area ratio of 1.60. The geometry of the nozzle and the nozzle performance map are shown in Figure 65.

```
************
*          *
* CV1      *
*          *
************
```

AXISYMMETRIC CONVERGENT-DIVERGENT NOZZLE

CFG MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
4	DIVERGENCE HALF ANGLE(DEG)	11.4500

FIXED PARAMETERS
****

NOZZLE TYPE	WEDGE TWO DIMENSIONAL DUAL NOZZLE

```
************
* TABLE CFG*
************
```

GROSS THRUST COEFFICIENT (CFG) VS NOZZLE PRESSURE RATIO (PT9/PAMB) AND NOZZLE AREA RATIO (A9/A8)

	1.000	1.100	1.200	1.300	1.400	1.500	1.600	A9/A8			
A9/A8 1.000	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.992	0.992	0.986	0.976	0.966	0.955	0.936	0.924	0.903	0.886	CFG
A9/A8 1.100	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.932	0.965	0.984	0.986	0.982	0.975	0.960	0.947	0.925	0.908	CFG
A9/A8 1.200	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.888	0.935	0.977	0.986	0.986	0.983	0.970	0.958	0.938	0.920	CFG
A9/A8 1.300	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.862	0.905	0.965	0.982	0.986	0.982	0.972	0.964	0.947	0.932	CFG
A9/A8 1.400	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.840	0.890	0.942	0.976	0.983	0.986	0.976	0.968	0.954	0.942	CFG
A9/A8 1.500	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
	0.822	0.876	0.932	0.962	0.977	0.982	0.978	0.970	0.959	0.948	CFG

A9/A8	1.600	1.500	2.000	3.000	4.000	5.000	6.000	8.000	10.000	14.000	18.000	PT9/PAMB
		0.800	0.867	0.922	0.952	0.970	0.979	0.978	0.972	0.961	0.952	CFG

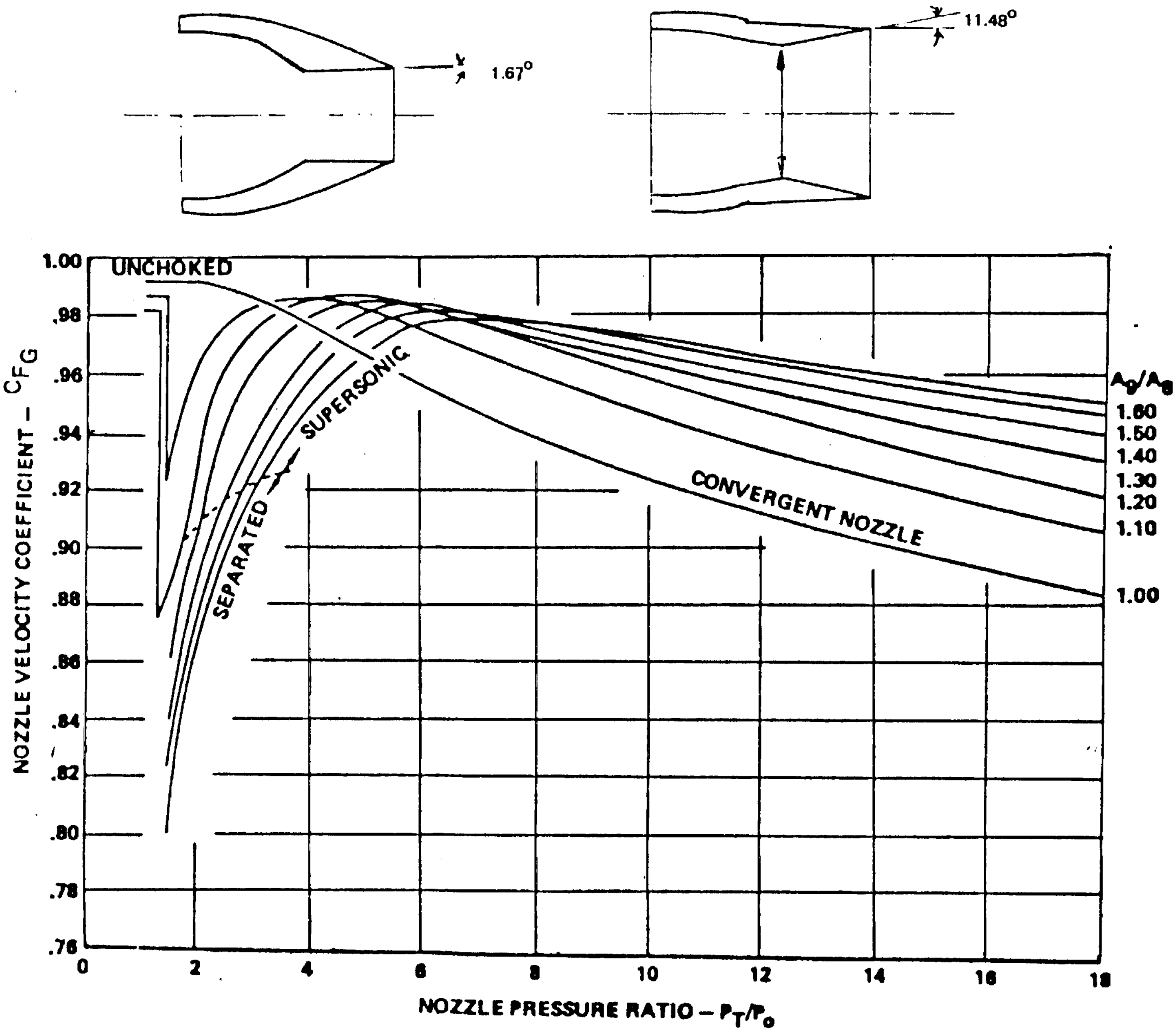

Figure 65 Gross Thrust Coefficient for a Round C-D Nozzle - 'CV1'

4.2.3.2 NOZZLE CONFIGURATION -'CVRP'- AXISYMMETRIC PLUS NOZZLE

Important design variables of axisymmetric plug nozzles include the plug angle, cowl internal angle, cowl exit to throat area ratio, throat inclination angle, and cowl boattail angle. Various methods can be applied to achieve plug nozzle throat area variation. The selected plug configuration shown above utilizes variable plug and cowl geometry to achieve throat area and expansion area ratio control at dry and A/B powersetting. The baseline plug half-angle, $_{p}$, for this configuration is 10^{o}. The nozzle geometry and performance characteristics are shown in Figure 66.

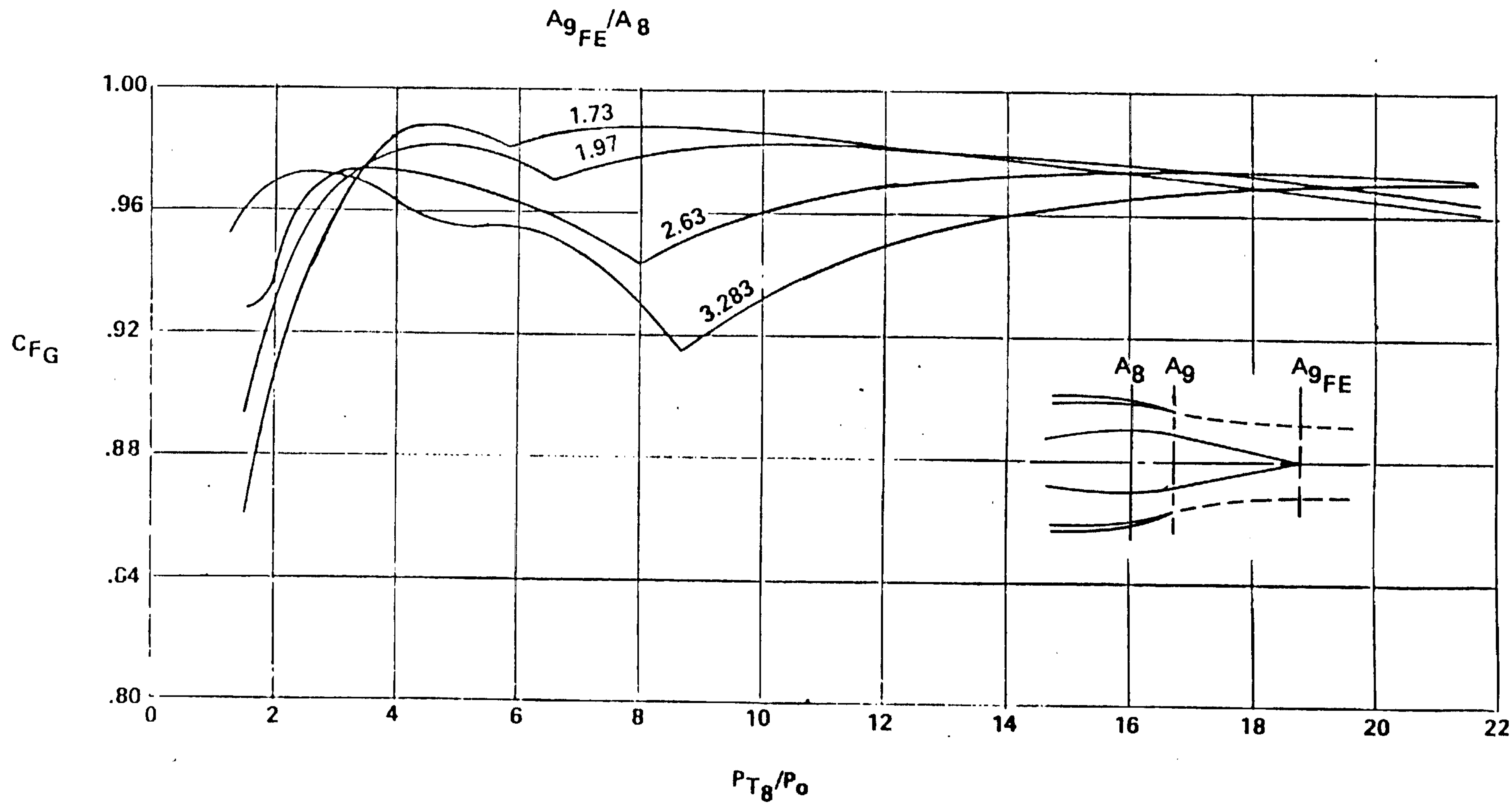

Figure 66 Gross Thrust Coefficient for Axisymmetric Plug Nozzles - 'CVRP'

****
* CVRP *
****

AXISYMMETRIC PLUG NOZZLE

CFG MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
1	PLUG HALF ANGLE(DEG)	10.0000

FIXED PARAMETERS
****

NOZZLE TYPE WEDGE TWO DIMENSIONAL DUAL NOZZLE

****
* TABLE CFG*
****

GROSS THRUST COEFFICIENT (CFG) VS NOZZLE PRESSURE RATIO (PT9/PAMB) AND NOZZLE AREA RATIO (A9/A8)

1.730 1.970 2.630 3.283 A9/A8

A9/A8	1.730	1.500	2.000	3.000	4.000	5.000	6.500	8.500	11.000	16.000	20.000	PT9/PAMB
		0.860	0.910	0.960	0.985	0.987	0.984	0.988	0.984	0.974	0.965	CFG
A9/A8	1.970	1.500	2.000	3.000	4.000	5.000	6.500	8.500	11.000	16.000	20.000	PT9/PAMB
		0.894	0.930	0.968	0.980	0.982	0.971	0.980	0.982	0.976	0.968	CFG
A9/A8	2.630	1.500	2.000	3.000	4.000	5.000	6.500	8.500	11.000	16.000	20.000	PT9/PAMB
		0.928	0.940	0.972	0.973	0.969	0.959	0.948	0.966	0.974	0.973	CFG
A9/A8	3.283	1.500	2.000	3.000	4.000	5.000	6.500	8.500	11.000	16.000	20.000	PT9/PAMB
		0.952	0.969	0.972	0.963	0.955	0.952	0.918	0.942	0.965	0.970	CFG

4.2.3.3 NOZZLE CONFIGURATION -'CV2DCD' - TWO-DIMENSIONAL CONVERGENT-DIVERGENT NOZZLE

The non-axisymmetric C-D nozzle configuration is based on concepts studied under the AFFDL Non-Axisymmetric Nozzle program (ITESC). The concept allows independent actuation to control throat area and exit area. The design employs divergent flaps to achieve a maximum internal area ratio of 1.6. The sidewalls are cut back to reduce weight and cooling requirements. The baseline aspect ratio for this configuration is 1.0. The baseline divergence half-angle, $_{DIV}$, is 22^o at a nozzle area ratio A_9/A_8 of 1.6. The geometry of the nozzle and the performance characteristics are shown in Figure 67.

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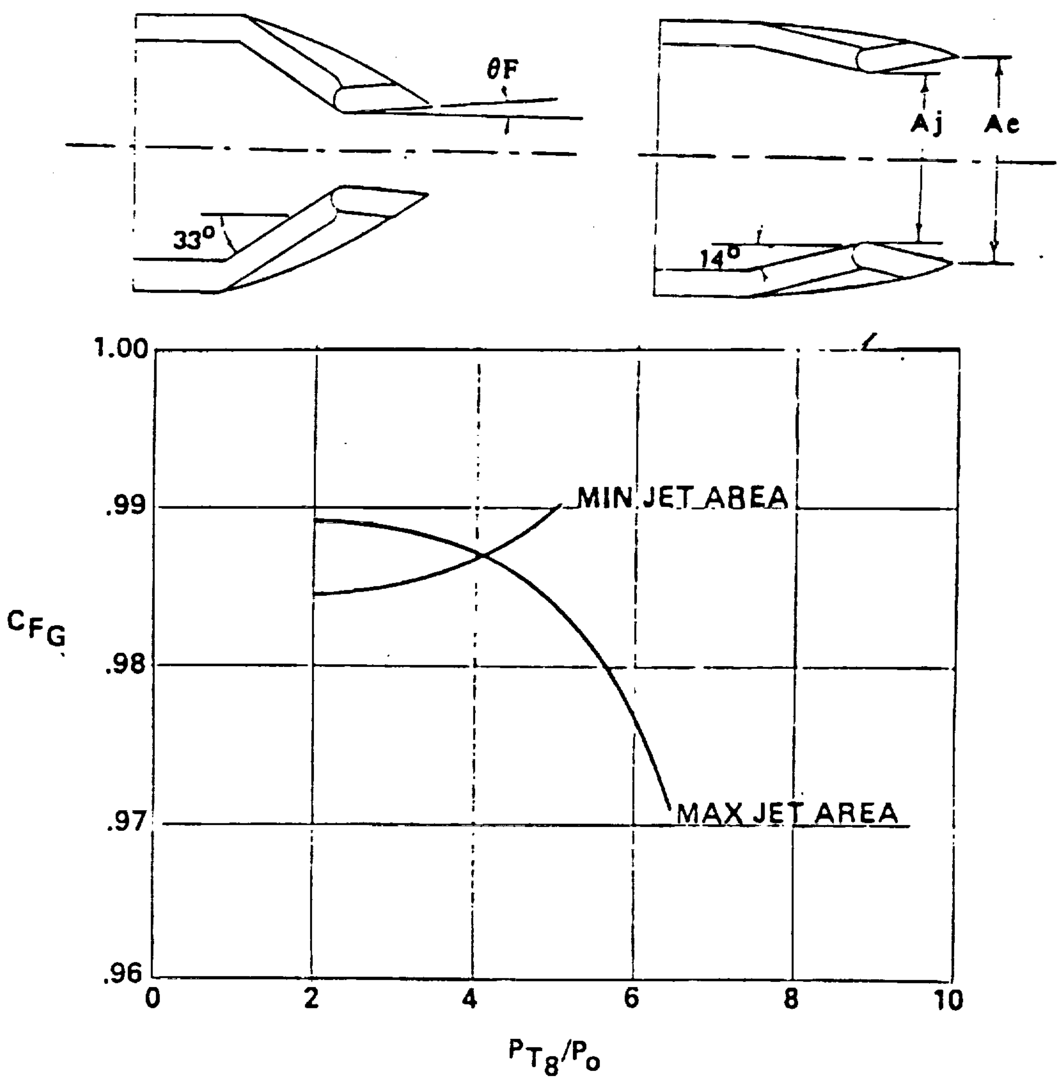

Figure 67 Gross Thrust Coefficient for a 2-D/C-D Nozzle
- 'CV2DCD'

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***********
*         *
* CV2DCD  *
*         *
***********
```

TWO-DIMENSIONAL WEDGE NOZZLE

CFG MAP DERIVATIVE PARAMETERS

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	ASPECT RATIO	1.0000
4	DIVERGENCE HALF ANGLE(DEG)	22.0000

FIXED PARAMETERS

NOZZLE TYPE	WEDGE TWO DIMENSIONAL DUAL NOZZLE

* TABLE CFG*   GROSS THRUST COEFFICIENT (CFG) VS NOZZLE PRESSURE RATIO (PT9/PAMB) AND JET AREA (A8)

100.000 50.000 A8

A8	100.000	2.000	3.000	4.000	5.000	6.000	6.500	PT9/PAMB
		0.989	0.988	0.987	0.984	0.977	0.970	CFG
A8	50.000	2.000	3.000	4.000	5.000	6.000	6.500	PT9/PAMB
		0.934	0.985	0.987	0.990	0.993	0.993	CFG

4.2.3.4 NOZZLE CONFIGURATION -'CV2D'- TWO-DIMENSIONAL WEDGE NOZZLE

The non-axisymmetric wedge nozzle configuration is the Boeing 2-D Airframe Integrated Nozzle concept featuring airframe/nozzle structural and aerodynamic integration. A variable geometry centerbody wedge provides independent throat and exit area control allowing optimization of thrust/drag performance over a wide range of dry and A/B powersetting. The cowl geometry is fixed. The baseline aspect ratio for this configuration is 1.0 and the baseline wedge half-angle, $_{p}$, is 10^{o}. The nozzle geometry and performance characteristics are presented in Figure 68.

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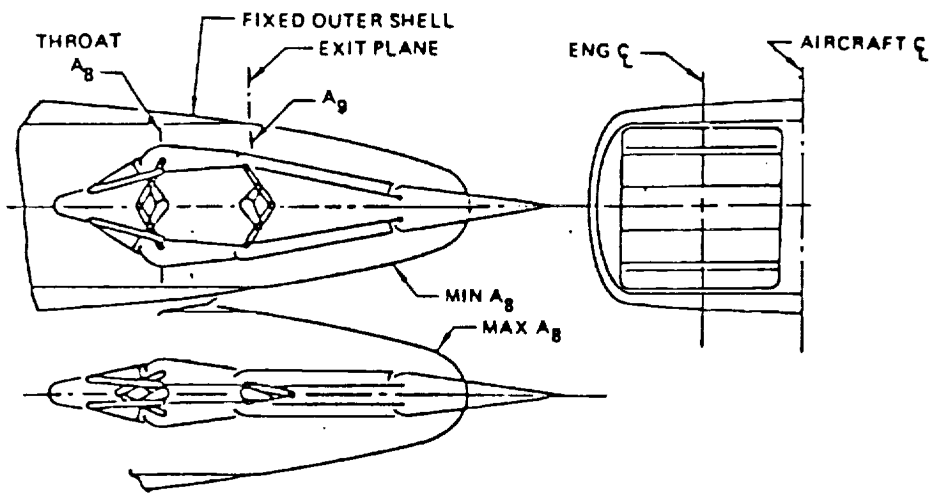

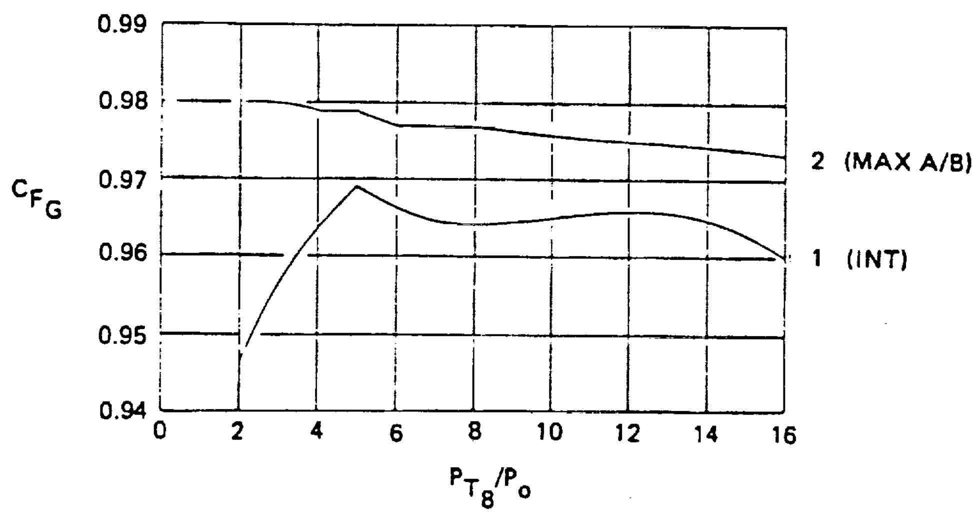

Figure 68 Gross Thrust Coefficient for a 2-D Wedge Nozzle - 'CV2D'

```
***********
*         *
* CV2D    *
*         *
***********
```

TWO-DIMENSIONAL CONVERGENT-DIVERGENT NOZZLE

CFG MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
2	RAMP HALF ANGLE(DEG)	10.0000
3	ASPECT RATIO	1.0000

FIXED PARAMETERS
****

NOZZLE TYPE WEDGE TWO DIMENSIONAL DUAL NOZZLE

```
************
* TABLE CFG*
************
```

GROSS THRUST COEFFICIENT (CFG) VS NOZZLE PRESSURE RATIO (PT9/PAMB) AND POWER SETTING (PS)

2.000 1.000 PS

PS	2.000	2.000	3.000	4.000	5.000	6.000	8.000	10.000	12.000	14.000	16.000	PT9/PAMB
		0.980	0.980	0.979	0.979	0.977	0.977	0.976	0.975	0.974	0.973	CFG
PS	1.000	2.000	3.000	4.000	5.000	6.000	8.000	10.000	12.000	14.000	16.000	PT9/PAMB
		0.946	0.957	0.964	0.969	0.966	0.966	0.965	0.966	0.965	0.960	CFG

4.2.3.5 NOZZLE CONFIGURATION - 'ADENCFG' - TWO DIMENSIONAL SINGLE RAMP NOZZLE

The ADEN nozzle is a 2D variable area external expansion exhaust system. Its basic components consist of:

- o A 2D variable geometry convergent-divergent flap assembly controling throat area
- o A 2D variable ventral flap that controls internal area ratio
- o a 2D variable external expansion ramp
- o a rotating deflector for a full range of thrust vectoring from 0^o tp 110^o

The nozzle/aftbody characteristics given are for the deflector in its towed position (0^o deflection). The nozzle geometry and performance characteristics are presented in Figure 69.

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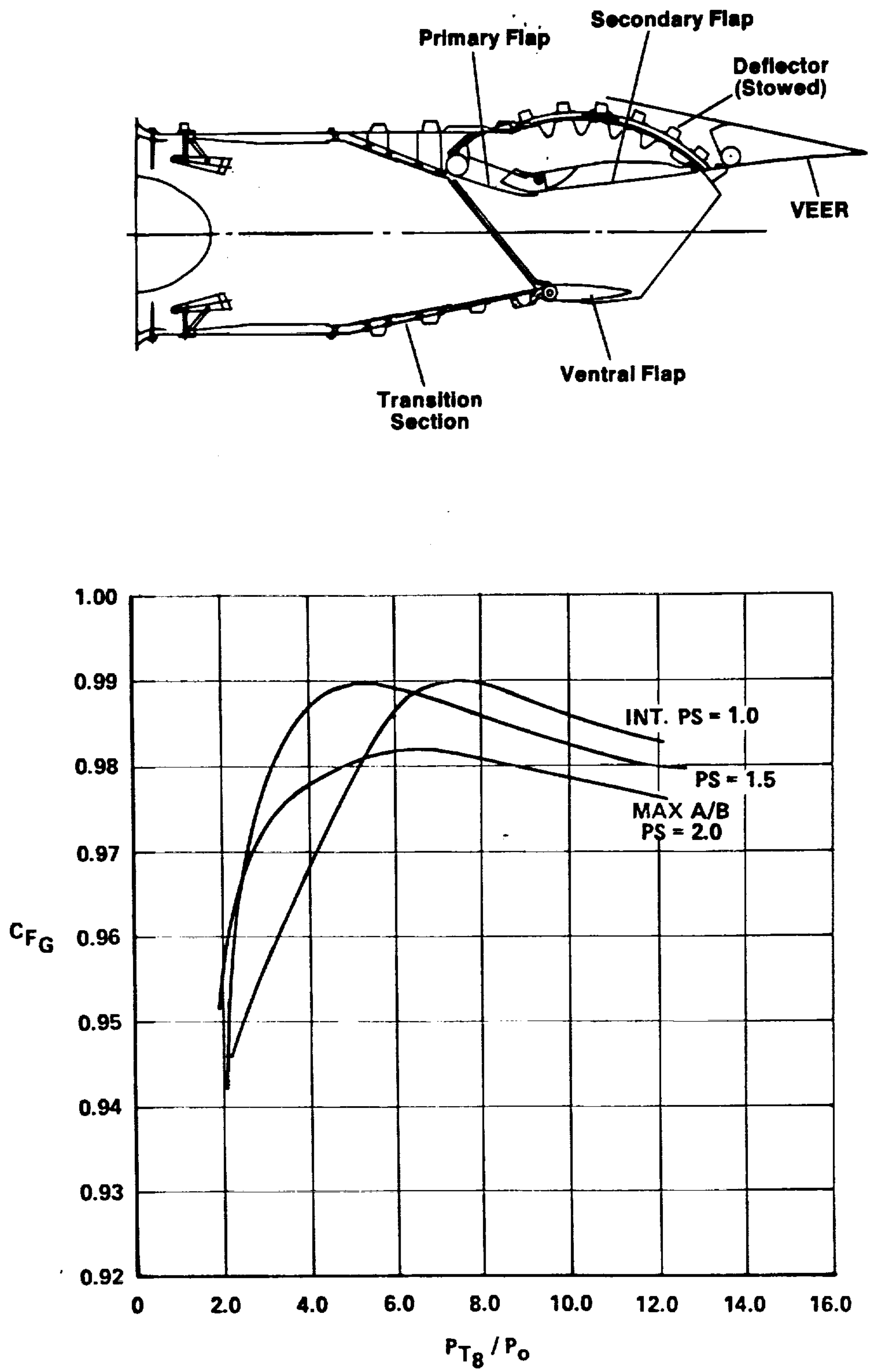


Figure 69. Gross Thrust Coefficient for an ADEN Nozzle - 'ADENCFG'

```
***********
*         *
* ADENCFG *
*         *
***********
```

CFG FOR G.E. ADEN NOZZLE

CFG MAP DERIVATIVE PARAMETERS
****

PARAMETER NUMBER	PARAMETER DEFINITION	VALUE
3	ASPECT RATIO	0.0200
4	DIVERGENCE HALF ANGLE(DEG)	4.0000

FIXED PARAMETERS
****

NOZZLE TYPE — WEDGE TWO DIMENSIONAL DUAL NOZZLE

```
************
* TABLE CFG*
************
```

GROSS THRUST COEFFICIENT (CFG) VS NOZZLE PRESSURE RATIO (PT9/PAMB) AND POWER SETTING (PS)

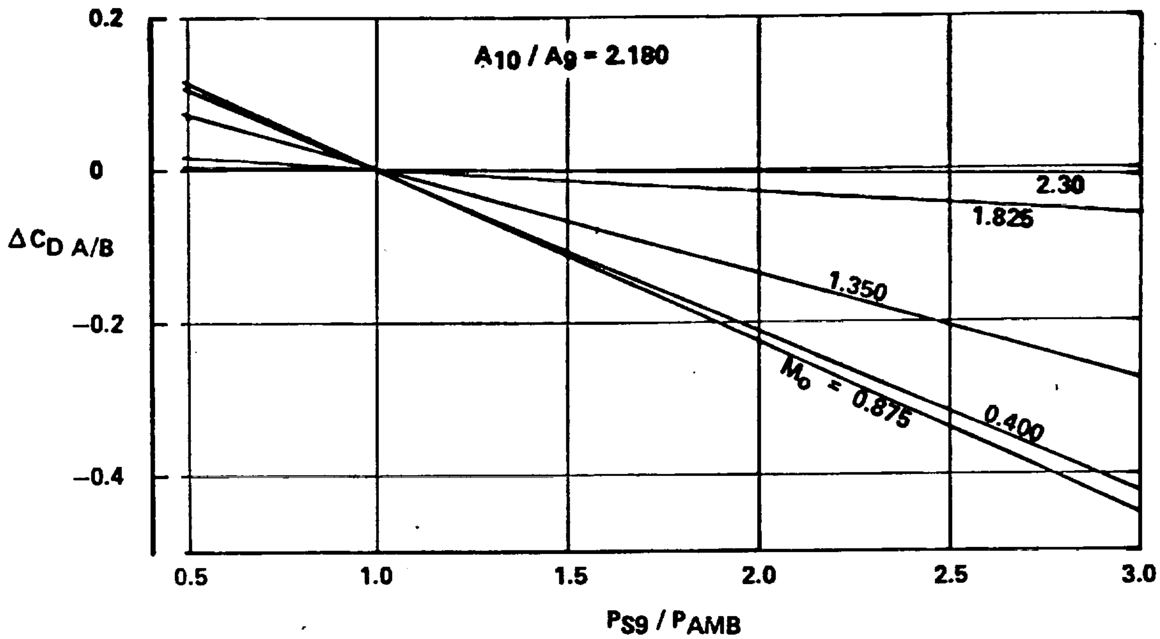
409

		1.000	1.500	2.000	PS			
PS	1.000	2.000	4.000	6.000	8.000	10.000	12.000	PT9/PAMB
		0.945	0.970	0.988	0.990	0.985	0.984	CFG
PS	1.500	2.000	4.000	6.000	8.000	10.000	12.000	PT9/PAMB
		0.925	0.985	0.990	0.985	0.983	0.980	CFG
PS	2.000	2.000	4.000	6.000	8.000	10.000	12.000	PT9/PAMB
		0.950	0.978	0.983	0.982	0.979	0.976	CFG

4.2.4 DELTA CD MAP - ADPRCOR

This section contains a single delta drag correction for the CD2R nozzle. This table was produced by an independent run of the derivative processor and is contained here as an example of this type of table (see Figure 70). This table allows the aftbody drag to include changes due to fluctuations in aftbody pressure ratio.

4.2.4.1 DELTA CD CONFIGURATION #1 - CD2R PRESSURE CORRECTION TABLE



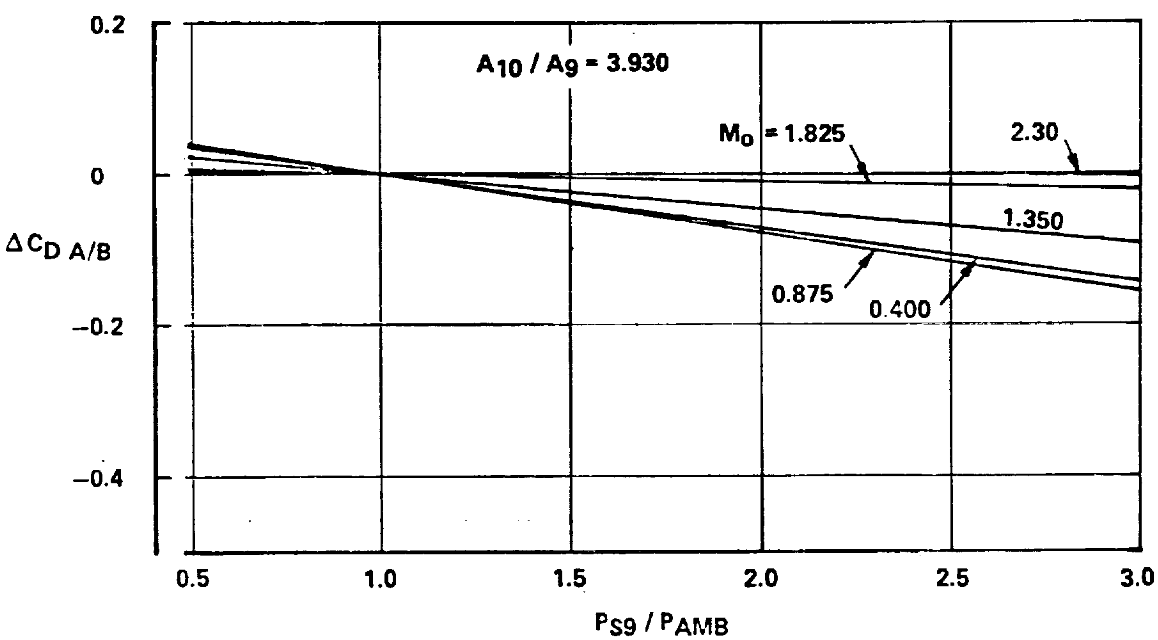
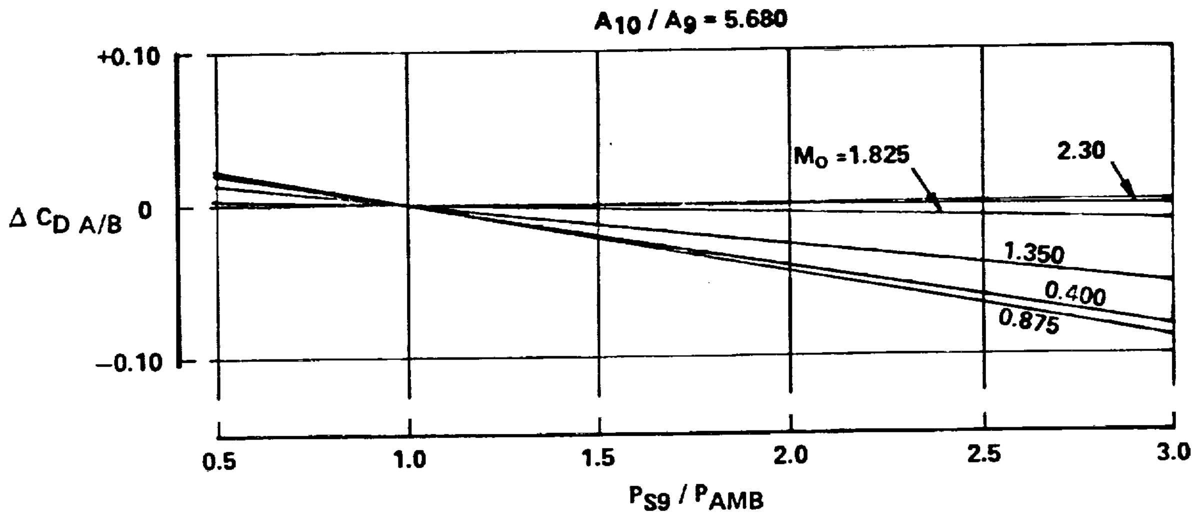


Figure 70 CD2R Pressure Correction Table



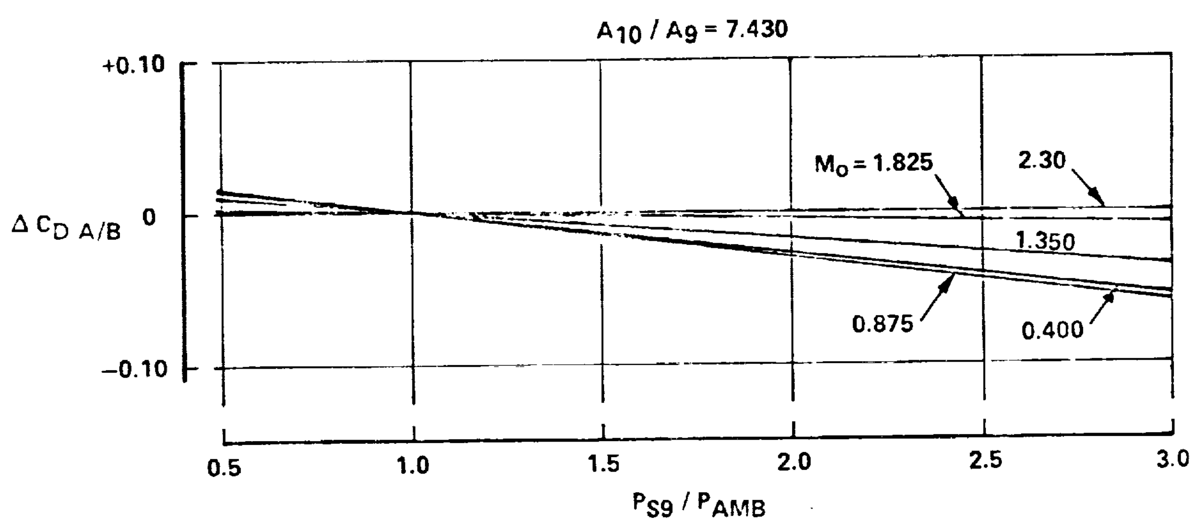


Figure 70 CD2R Pressure Correction Table (Continued)

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***********
*         *
* ADPRCOR *
*         *
***********
```

CD2R PRESSURE CORRECTION TABLE

```
************
* TABLE AD * DEL AFT-BODY DRAG COEFFI(DEL CD A/B)     VS     NOZZLE PRESSURE RATIO (PS9/PAMB)     AND AFT-BODY AREA RATIO (A10/A9
************

               0.400     0.875     1.350     1.825     2.300     MNFS

                         A10/A9 =    2.180
                         ****************

MNFS=0.400     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.105     0.0      -0.105    -0.210    -0.420     DEL CD A/B

MNFS=0.875     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.114     0.0      -0.114    -0.227    -0.450     DEL CD A/B

MNFS=1.350     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.068     0.0      -0.068    -0.137    -0.274     DEL CD A/B

MNFS=1.825     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.015     0.0      -0.015    -0.030    -0.060     DEL CD A/B

MNFS=2.300     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.002     0.0      -0.002    -0.004    -0.009     DEL CD A/B

                         A10/A9 =    3.930
                         ****************

MNFS=0.400     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.036     0.0      -0.036    -0.071    -0.143     DEL CD A/B

MNFS=0.875     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
               0.039     0.0      -0.039    -0.077    -0.155     DEL CD A/B

MNFS=1.350     0.500     1.000     1.500     2.000     3.000     PS9/PAMB
```

	0.023	0.0	-0.023	-0.047	-0.093	DEL CD A/B
MNFS=1.825	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.005	0.0	-0.005	-0.010	-0.021	DEL CD A/B
MNFS=2.300	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.001	0.0	-0.001	-0.001	-0.003	DEL CD A/B

A10/A9 = 5.680
****

MNFS=0.400	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.020	0.0	-0.020	-0.041	-0.081	DEL CD A/B
MNFS=0.875	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.022	0.0	-0.022	-0.044	-0.088	DEL CD A/B
MNFS=1.350	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.013	0.0	-0.013	-0.027	-0.053	DEL CD A/B
MNFS=1.825	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.003	0.0	-0.003	-0.006	-0.012	DEL CD A/B
MNFS=2.300	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.0	0.0	0.0	-0.001	-0.002	DEL CD A/B

A10/A9 = 7.430
****

MNFS=0.400	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.014	0.0	-0.014	-0.027	-0.055	DEL CD A/B
MNFS=0.875	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.015	0.0	-0.015	-0.030	-0.059	DEL CD A/B
MNFS=1.350	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.009	0.0	-0.009	-0.018	-0.036	DEL CD A/B
MNFS=1.825	0.500	1.000	1.500	2.000	3.000	PS9/PAMB
	0.002	0.0	-0.002	-0.004	-0.008	DEL CD A/B
MNFS=2.300	0.500	1.000	1.500	2.000	3.000	PS9/PAMB

0.0	0.0	0.0	-0.001	-0.001	DEL CD A/B

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