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REFERENCE AIRCRAFT FOR ICAO WORKING GROUP E

DOUGLAS AIRCRAFT COMPANY
MCDONNELL DOUGLAS CORPORATION
LONG BEACH, CALIFORNIA

CONTRACT NAS1-14624 (MOD 3)
JULY 1978

National Aeronautics and
Space Administration
Langley Research Center
Hampton, Virginia 23665

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METRIC CONVERSION FACTORS

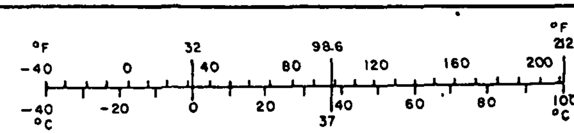
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



1.0 INTRODUCTION

1.1 Task Statement. The objective of this study is to define a reference advanced supersonic transport design as a check point for computer generated designs for use in the ICAO Working Group E (WGE) activity. Definition of the reference configuration includes the technology identified for application in the 1980-1985 time period (assuming no greatly expanded SST research activity). Constraints are as follows:

- Cruise at 2.2 M, standard day.
- Payload of 250 passengers (1/3 first class, 2/3 economy).
- Takeoff field length not to exceed 11,500 ft. on standard + 10°C day.
- Takeoff noise to be minimized as much as possible without penalizing cruise performance, but to be no greater than FAR Part 36 (Stage 2) at any certification measuring station. McDonnell Douglas (MDC) model scale results to be used for mechanical noise suppressors.
- All metal airplane.
- Design range to be at or near 4000 n. miles, zero wind. (MDC baseline with the MDC GE4 cycle results in 4250 n. miles).
- A MDC turbojet engine cycle based on GE4 technology is used for the propulsion data.

1.2 Study Approach. McDonnell Douglas has been actively studying the application of the advanced supersonic technologies to advanced supersonic transports for five years and has used a baseline design for much of this activity. The major elements of potential application of advanced technologies and their timing have been identified. This study for ICAO WGE is to select those technologies which are appropriate for a 1980-1985 program initiation date and incorporate them on the MDC baseline airplane, size and integrate an appropriate GE4 scaled engine, and determine acoustic and range performance. The data for the engine, airplane, and acoustics analysis can be defined in sufficient detail so that independent calculations may be completed for comparison purposes.

2.0 SUMMARY AND AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC. POSITION STATEMENT

This report summarizes the results of an advanced supersonic transport airplane/engine integration study which has been completed to be used as a detail preliminary design case by ICAO Working Group E members to assist in the assessment of noise standards applicable to future supersonic transports.

The design considered in this study reflects the application of the advanced technologies which are projected to be available for program initiation in the 1980-1985 time period. The airframe structure is of all metal construction based on optimized structural parameters (strength, fatigue, fail-safe, aeroelastics, and flutter) consisting of 64% titanium for the major load carrying structural components, and 27% aluminum for the secondary structure and the lightly loaded components, and 9% steel for the landing gear and propulsion system. The design incorporates an arrow-type wing planform with geometry tailored to optimize performance and weight and an area-ruled fuselage in combination with careful placement of engines to minimize wave drag and produce high aerodynamic efficiency for cruise. Single nacelles incorporating axisymmetric mixed compression inlets have been selected for this baseline after careful trade-off studies of options such as dual pods and two-dimensional inlets. An active control system is incorporated consistent with a smaller than normal tail to match relaxed static stability requirements.

The engine for this design is a McDonnell Douglas defined dry turbojet engine based on the GE4 cycle of the 1971 U.S. SST. This engine was designed and tested during the former U.S. SST program. The engine weights and performance are updated to reflect the propulsion technology predicted to be available for a 1980-1985 technology readiness date.

The suppression device incorporated is a mechanical suppressor/ejector type which McDonnell Douglas has successfully designed and tested. Suppression characteristics included in the study are those obtained in simulated forward flight in the Rolls-Royce spin rig using a small scale model. Although improved designs and larger scale models may provide different suppression values the actual test data are used in this study to establish a reference performance level.

The engine size selected by McDonnell Douglas to represent the reference engine will produce a noise no greater than 108 EPNdB at any of the three FAR Part 36 (Stage 2) defined measuring points. The engine finally selected is 700 lb/sec and is sized slightly larger than the optimum cruise size to meet this noise constraint condition. Engines much larger than 700 lb/sec can produce lower noise results, however, the range penalties become relatively severe.

Data are included in this report so that interested parties may check the unsuppressed noise level calculations and calculate takeoff performance for the reference airplane.

When using this report for rule making purposes, the Aerospace Industries Association of America, Inc. position statement to ICAO WGE seems worth noting here to keep the information in perspective. It is summarized as follows:

- The current data base for future SST's consists almost entirely of analytical studies and limited small scale test results.
- Noise criteria are a major constraint on the design of future SST airframes and engines.
- Based on the substantial progress which has been made, present assessment of advanced technology indicates nominal compliance with Annex 16 (1971) may be possible. However, at this time mandatory compliance would constitute an unacceptable risk.
- SST noise standards must be based on technically feasible and economically reasonable demonstrated capability.

- Present allocation of resources will not provide technology demonstration required for rule making as mandated for Working Group E.

3.0 PARAMETRIC STUDIES

The common case Class II technology parameters have been applied to the parametric airplane designs which are used for technology evaluations. The engine performance information used is based upon the technology levels established by General Electric for the GE4 engine as tested in the previous U.S. SST program (1971), but updated to improve the cruise specific fuel consumption one percent and to eliminate the afterburner. The noise levels have been determined based upon use of the very limited small scale test results of the McDonnell Douglas Rolls-Royce spinrig test of a mechanical suppressor. The McDonnell Douglas noise prediction techniques have been used including addition of a shock cell noise contribution for the reference conical nozzle unsuppressed case. (Variations between the MDC noise prediction method and the NASA-ANOP method can be obtained from the ICAO WGE Subgroup Report on SST Noise Prediction Methods.) No considerations have been made for incorporating automated take-off procedures due first to the unresolved question of acceptance by the certification authorities, and secondly, because the degree of benefits during takeoff remain controversial and untested.

The performance for cruise, subsonic and transonic operations, and for low speed climbout, has been predicated on model scale wind tunnel data as demonstrated to date in very limited testing. The airframe structural weight and systems weights have been based upon preliminary design prediction techniques unsubstantiated to date by design and construction experience. The resulting weight estimates may therefore be in error relative to a design that would reflect final airline requirements, government certification requirements, passenger demands, environmental requirements, safety provisions, or other constraints required at the time of certification.

<u>DISCUSSION OF DESIGN CONSIDERATIONS</u>

Consistent with the criteria established at the ICAO WGE initial meeting, the following assumptions were used in defining these parametric designs.

- Co-annular nozzles - not applicable.
- Variable cycle engines - not applicable.
- Unconventional engine positioning - not applicable.
- Composite structures - not applicable.
- 2.20 Mach number - upper limit for cruise.
- Turbine entry temperature limit - 1500° to 1600°K
- Axi-symmetric inlets - possible.
- Active controls - partial.
- Optical, digital, and miniaturized systems - as applicable.
- 4000 n. miles design range.
- Takeoff field length not to exceed 11,500 feet.

A parametric chart comparing variations in thrust, wing area, gross weight, height over the monitor, and noise levels (Figure 3-1) shows a general background of the limits that exist and how changes in engine thrust might impact on overall airplane results. A typical landing speed and fuel capacity constraint are shown.

The parametric chart shows the relationships that exist for the specific design range of 4000 n. miles, from which the "Common Case" airplane parameters have been selected for this analysis for ICAO WGE. The minimum weight airplane design is 712,100 pounds to meet the noise constraints of FAR Part 36 (Stage 2) of 108 EPNdB. This noise constraint has necessitated the addition of wing area and thrust to enable the airplane to be relatively high as it passes over the 3.5 n. mile monitor. Accordingly, take off field distance is relatively short for the minimum weight airplane to meet FAR Part 36 (Stage 2) and the economic penalty is probably rather significant. The general arrangement drawing is shown in Figure 3-2.

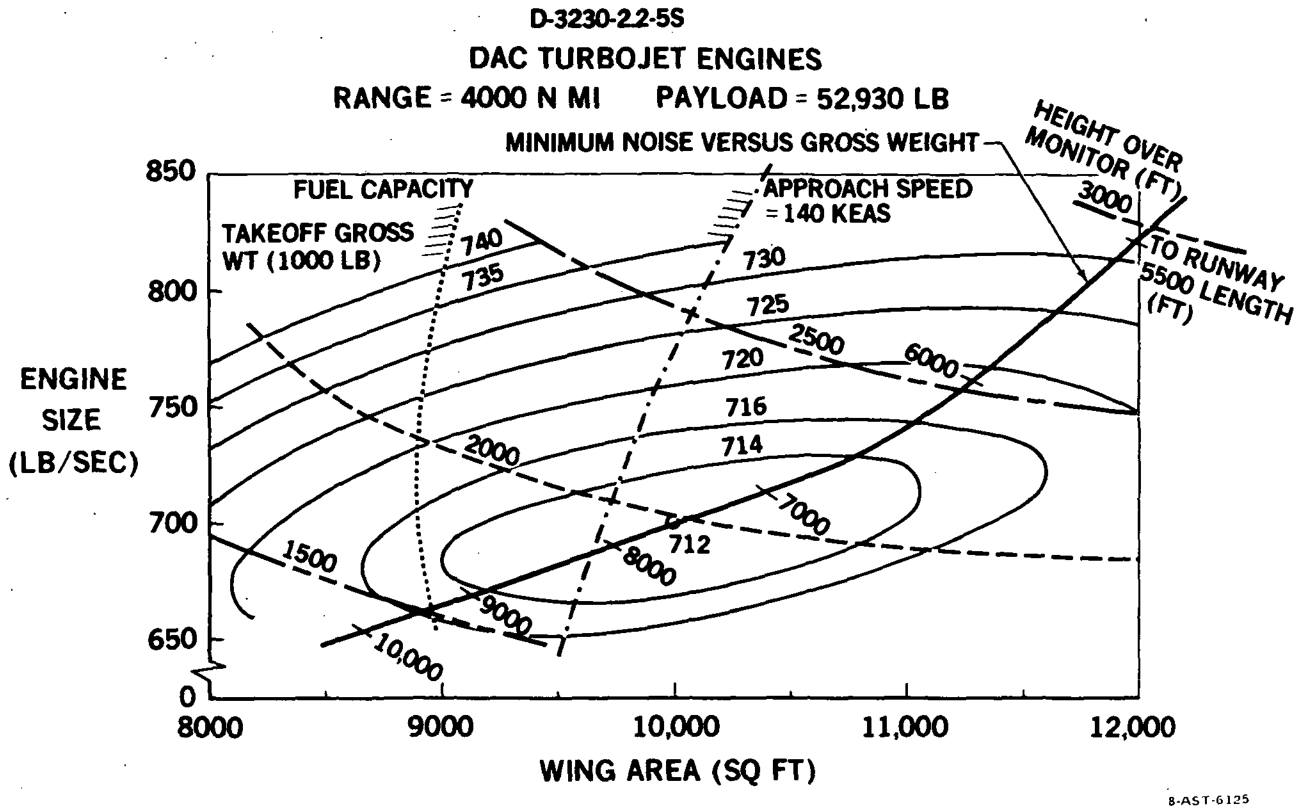


FIGURE 3-1. SIZING STUDY

CHARACTERISTICS			
ITEM	WING	HORIZONTAL STABILIZER	VERTICAL STABILIZER
AREA SQ.FT	10000	1000	700
ASPECT RATIO	1.84	2.0	0.9
TAPER RATIO	.128 (TRAP)	.156	0.25
SWEEP OF L.E.	71° & 57°	50°	50°
DIHEDRAL	0 AT T.E.	0	~
T/C % C	2.25 - 3.0	3.5	3.5
TAIL VOL.COEFF.	~	.15	.044

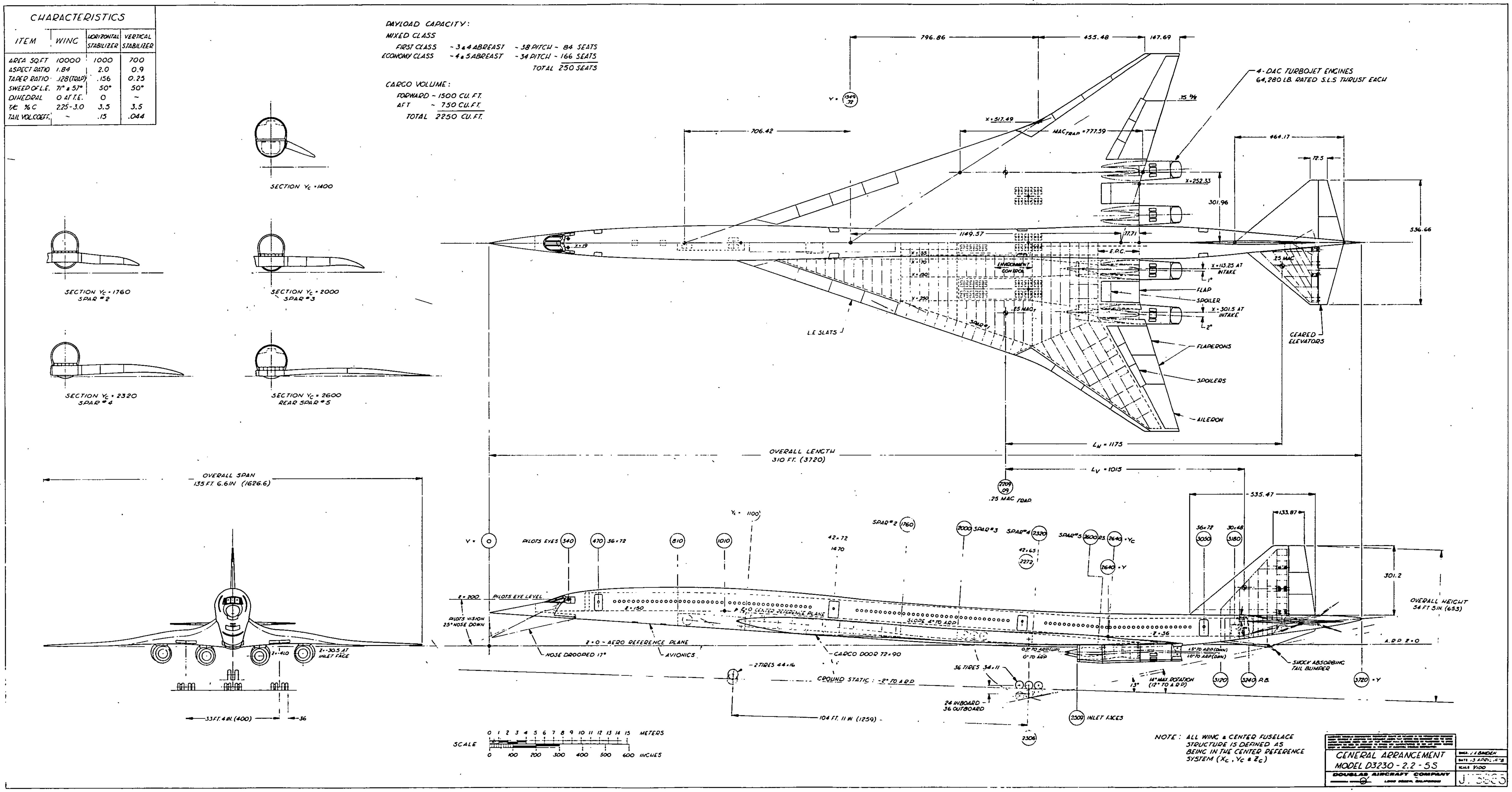


FIGURE 3-2. GENERAL ARRANGEMENT

4.0 "COMMON CASE" AIRPLANE DESIGN CHARACTERISTICS

<u>DESIGN RANGE</u>	4000 N. Miles
<u>DESIGN PAYLOAD</u>	250 Passengers
First Class	84
Business Economy Class	166
<u>DESIGN CRUISE SPEED</u>	2.2 Mach
<u>WEIGHTS</u>	
Takeoff Gross Weight	712,100 lb
Operating Weight Empty	300,304 lb
Materials	
Primary Structure	Titanium 64%
Secondary Structure	Aluminum 27%
Landing Gear, Etc.	Steel 9%
Number of Engines and Type	4 Unaugmented turbojet engines (MDC Modified GE4)
Thrust Per Engine (STD Day Sea Level Static)	64,280 lb
Thrust Loading (at T.O.)	0.34
Airflow per Engine (STD Day Sea Level Static)	700 lb/sec
Mixed Compression Axi-Symmetric Inlet	
Moderate Convergent Divergent Plug Nozzle	
Cruise T_4 (approx.)	2400°F (1588°K)
Noise Suppression Devices	
MDC Mechanical Mixer	
Nozzle with Acoustical Lining	
Ejector Suppressor Plus Elliptical Shaped Nozzle Exit (T.O. and Sideline)	
Acoustically Lined Near - Sonic Inlet (Approach)	
Exhaust Temperature Limit For Operation of Mechanical Suppressor	1700°F
Dry Engine Weight (Per Engine)	14,286 lb
Nacelle Weight (Avg. Per Engine)	2,965 lb
Thrust Loss at 0.3 Mach	4.5%
Thrust Loss at Cruise (Due to acoustic lining in nozzle)	1.5%

ACOUSTICS - Based on FAR Part 36 (Stage 2)

Takeoff (Cutback 3.5 N. Miles)	108 EPNdB
Sideline (0.35 N. Miles)	106 EPNdB
Approach (1 N. Mile)	108 EPNdB
Estimated Area for 90 EPNdB (Incl. T.O. and approach)	21.7 sq. n. mi.

CHARACTERISTICS

WING

Gross Area	10,000 ft^2
Wing Loading (At T.O.)	71.2 lb/ft^2
Type	Modified Arrow
Leading Edge Sweep (Inboard)	71°
Leading Edge Sweep (Outboard)	57°
Span	135.5 ft.
Notch Ratio	0.20
Leading Edge Devices	Full Span
Trailing Edge Devices	42% Span

HORIZONTAL TAIL

Gross Area	1,000 ft^2
Type	Variable Incidence With Geared Elevators
Leading Edge Sweep	50°

VERTICAL TAIL

Gross Area	700 ft^2
Type	Fixed Fin With Hinged Rudder
Leading Edge Sweep	50°

LANDING GEAR — 3 Post Gear

FUSELAGE

Length — 310 ft.

Type - Full Area Ruled

Minimum Cross Section

Affords 21 Inch Per Seat and 18 Inch Aisle

Maximum Cross Section Affords 27 Inch Per Seat and 28 Inch Per Aisle	
Crew	3
Cabin Attendants	7
Galleys	4
Lavatories	7

PERFORMANCE

The takeoff profile is shown in Figure 4-1. Also included as Appendix A-1 is the computer printout of the takeoff data.

The mission profile is shown in Figure 4-2 and weights and corresponding altitudes are shown in Table 4-1. The computer printout of the mission performance data is included as Appendix A-2.

ADDITIONAL ENGINE DETAILS

The details and characteristics of the baseline turbojet engine are described in Table 4-2, the engine dimensions and schematic in Figure 4-3, and the nacelle inlet and exhaust dimensions in Figure 4-4.

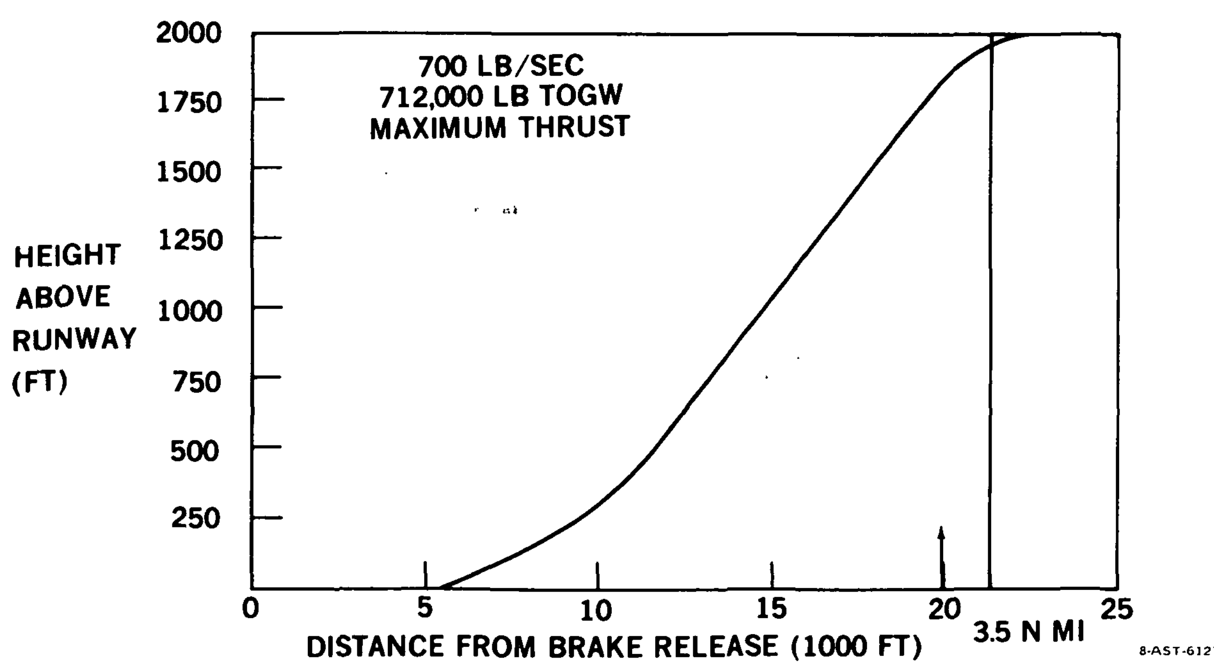


FIGURE 4-1. TAKEOFF PROFILE – SUPPRESSED MDC TURBOJET

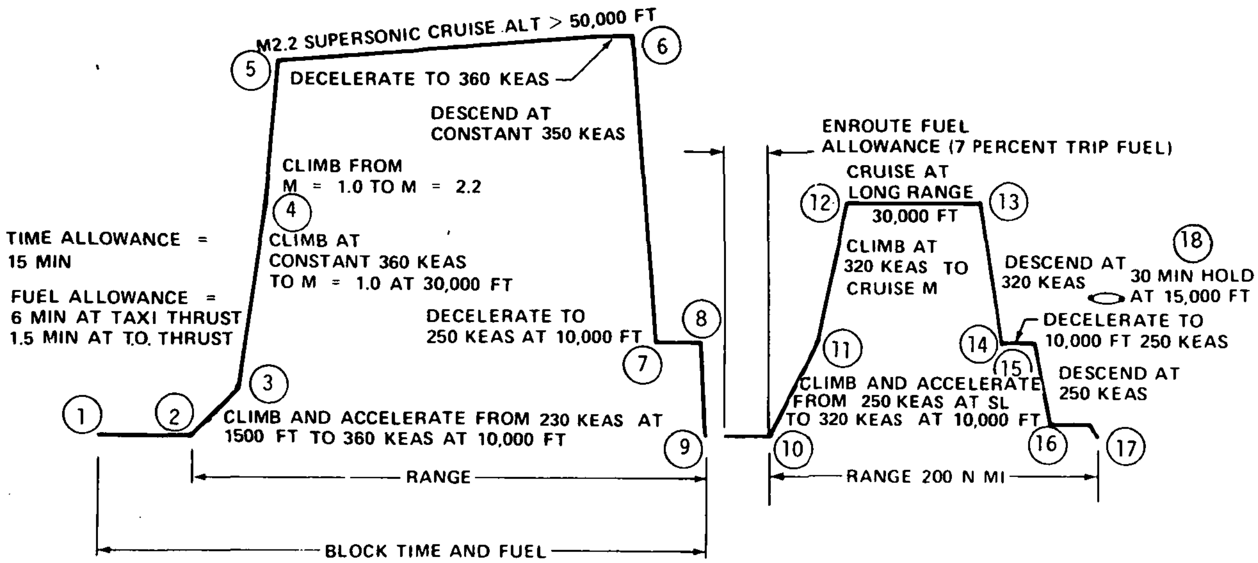


FIGURE 4-2. MISSION PROFILE

TABLE 4-1
MISSION PROFILE – WEIGHTS

	REFERENCE POINT			WEIGHT	
	ALTITUDE	MACH	DISTANCE		
1)			0	711,986	pounds
2)			0	705,986	"
3)			14	695,444	"
4)	30,000'	1.0	60	681,462	"
5)	53,000'	2.2	458	624,881	"
6)	65,000'	2.2	3793	424,181	"
7)	10,000'	.64	3968	420,200	"
8)	10,000'	.46	3976	419,601	"
9)	S.L.	0	4000	416,863	"
10)	(7%)			396,204	"
11)	10,000'	.55		392,142	"
12)	30,000'	.91		386,005	"
13)	30,000'	.91		378,764	"
14)	10,000'	.58		376,391	"
15)	10,000'	.46		375,960	"
16)	S.L.	.38		372,982	"
17)	S.L.	0		372,982	"
18)	(1/2 hour at 15,000')			353,233	"

(TOTAL FUEL 358,867 LB) 4000 N. MILES RANGE MISSION

TABLE 4-2

BASELINE TURBOJET — ENGINE CHARACTERISTIC SUMMARY
700 LB/SEC RATED AIRFLOW

DESIGN CYCLE CHARACTERISTICS

CYCLE PRESSURE RATIO 18:0

COMBUSTOR EXIT TEMP (T.O.) 2600°F
(MAX CLIMB) 2500°F
(MAX CRUISE) 2400°F

TAKEOFF RATINGS [STD DAY + 18°F (10°C)]

MAXIMUM THRUST (SLS - LB) 64,280

MAXIMUM THRUST (SL, 0.3M, UNINSTALLED) (LB) 59,710

THRUST AT T.O. (SL, 0.3M UNINSTALLED) (LB) 52,153

WEIGHT

ENGINE (LB) 10,120

ENGINE + NOZZLE/REVERSER/SUPPRESSOR (LB) 13,756

DIMENSIONS

ENGINE INLET GAS

FLOW PATH DIAMETER (IN) 63.2

ENGINE MAX DIAMETER (IN) 92.3

HUB-TO-TIP RATIO
(AT PLANE OF ATTACH FLANGEs) 0.42

LENGTH - INLET
FLANGE TO EXHAUST PLANE - IN 343.4

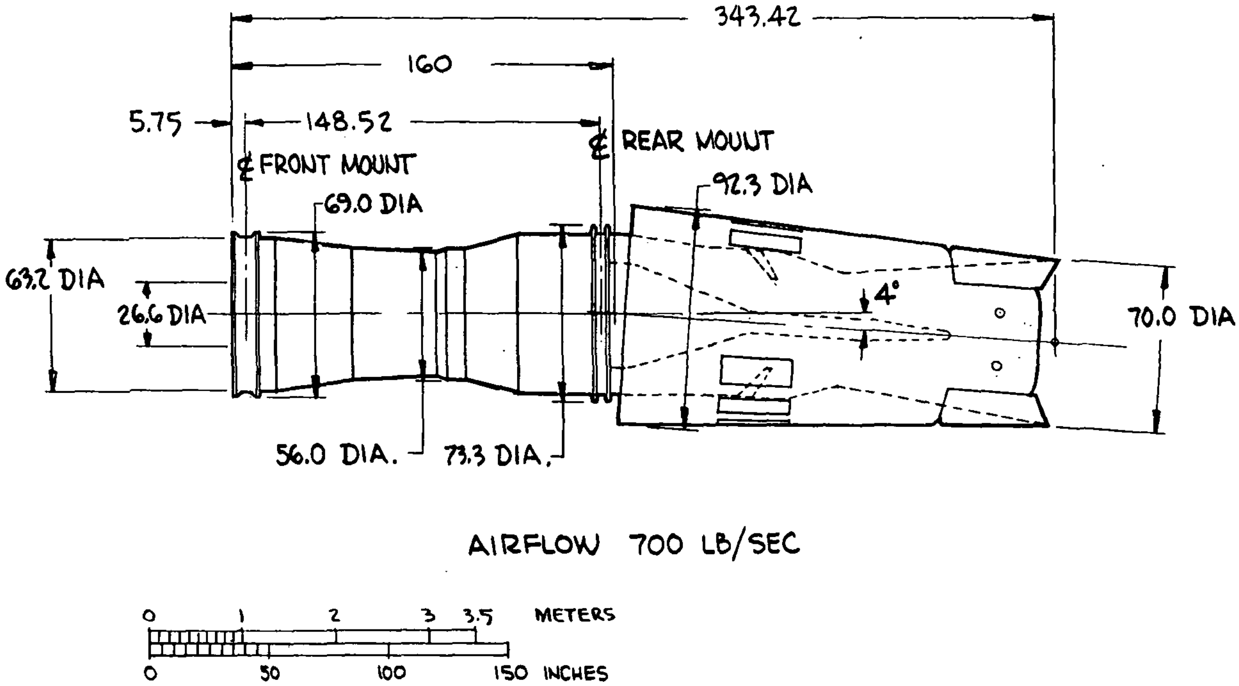


FIGURE 4-3. DAC TURBOJET ENGINE SCHEMATIC

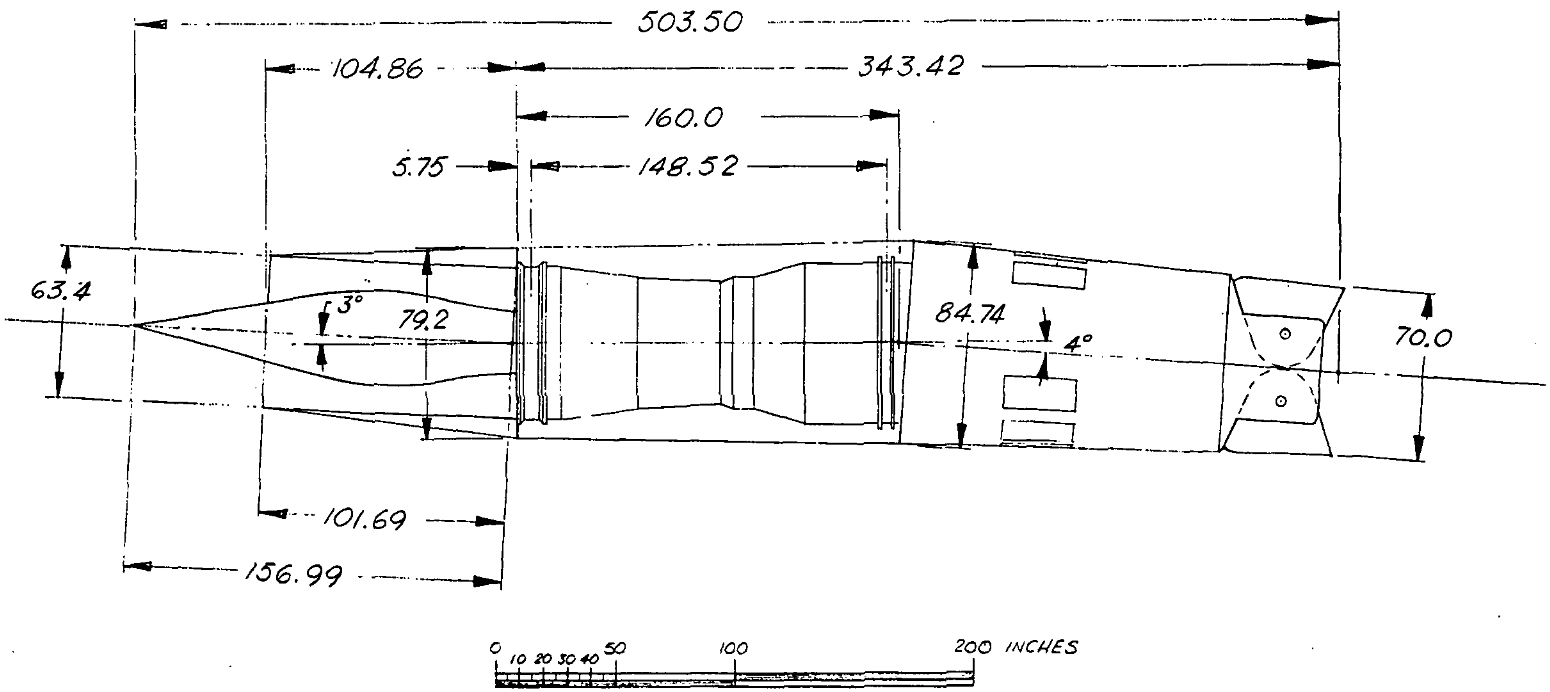


FIGURE 4-4. DAC TURBOJET ENGINE MIXED COMPRESSION INLET – AIRFLOW: 700 LB/SEC

5.0 "MDC BASELINE" AIRPLANE DESIGN DEFINITION

To validate the computer generated parametric studies, the "MDC Baseline" was used as a point design. It utilizes the extensive detail evaluation studies conducted over the past five years of NASA Systems Studies on a 750,000 lb, 250 passenger, 2.2 Mach number baseline design. This reference point airplane is a design for which both low speed and high speed wind tunnel tests have been run; a design for which Pratt and Whitney, General Electric, and Rolls-Royce, have optimized engine cycles, inlets and nozzles, and for which sophisticated structural modeling has been completed to cover strength, aeroelastics, fatigue, fail safety, and flutter, as well as weight estimations. Also, detailed values of noise predictions are available matching the detailed airplane performance estimates for the baseline design.

It is believed that the use of this MDC generated baseline as a hard-point design for the computer generated parametric designs offers a degree of validity not otherwise available in using parametric trade studies.

A parametric chart at the range and passenger payload of the MDC conceptual baseline design is shown in Figure 5-1. The design gross weight of 750,000 lb with an engine sized at 743 lb per second to meet the requirements of FAR Part 36 (Stage 2) as used for this design point assessment is slightly off the minimum weight point on the "knothole" plot. This is readily understandable as the GE4 derivative engine is not the engine for which the MDC baseline design was configured. The range of these designs, in Figure 5-1, is 4250 n. miles, slightly greater than the 4000 n. miles desired for the "Common Case" airplane design of ICAO WGE.

Section 4.0 describes the "Common Case" parametrics at 4000 n. miles, and the "Common Case" airplane design resulting from use of those parametrics, a 712,000 lb airplane design that best meets FAR Part 36 (Stage 2).

This section defines design details that are pertinent to both configurations and typical of configurations that would be represented by the parametric studies.

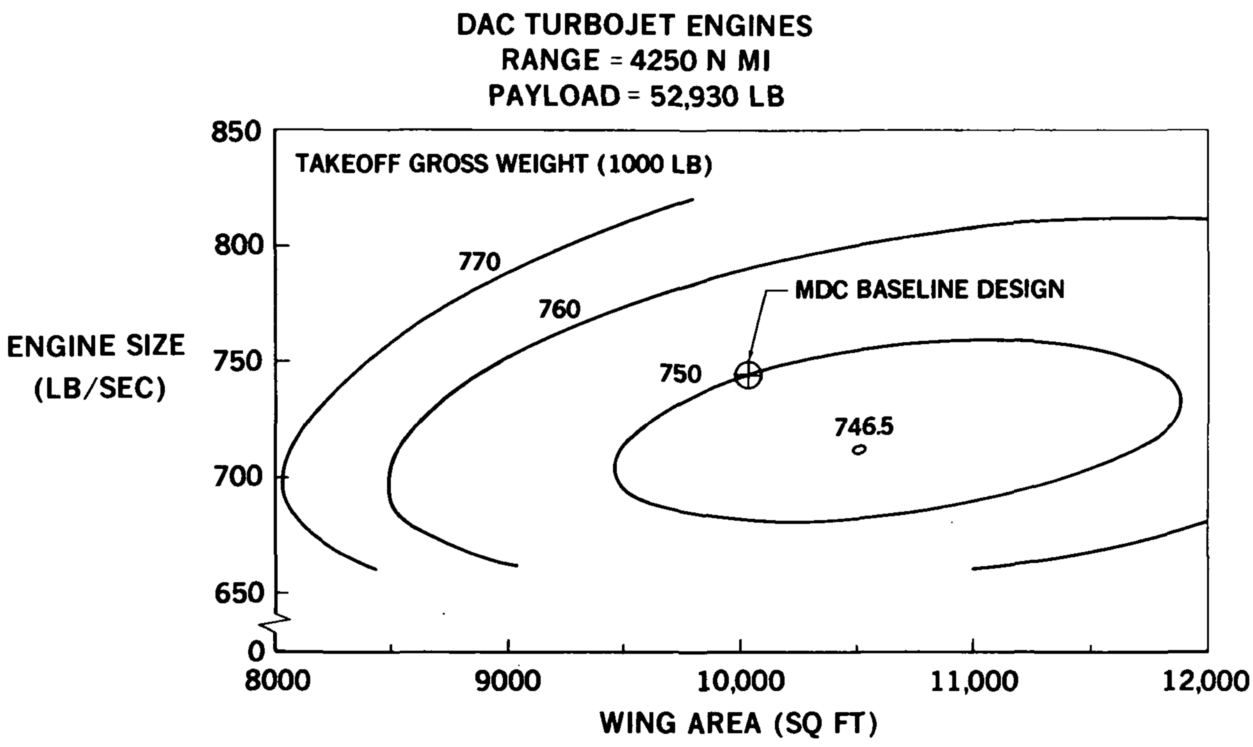


FIGURE 5-1. MODEL D-3230-2.2-5S SIZING STUDY

5.1 Configuration Integration

5.1.1 Configuration, Payload and Interior Arrangement. The configuration described is a 250 passenger aircraft developed from the McDonnell Douglas baseline supersonic cruise vehicle from five years of refinement analysis. The interior requirement is for a 34% first class and 66% economy class mix accommodation. The resulting forward fuselage compartment is configured for 84 first class seats at 38-inch pitch, and the center and aft fuselage compartments for 166 economy class seats at 34-inch pitch.

Double and single seats are used in the first class compartment giving a maximum of four abreast. Double and triple seats in the economy class compartment are arranged to give a maximum of five abreast and a minimum of four abreast. Both compartments have a single aisle of not less than 18-inch width.

Galleys, lavatories, and coat closets are installed forward and aft of each passenger compartment. Enclosed compartments are provided above the passenger seats for personal carry-on baggage. All door sizes and number, and aisle widths and clearances comply with FAA airworthiness standards. The interior arrangement is shown in Figure 5-2.

5.1.2 Wing Sizing, Geometry and Structure. The aerodynamic analysis defines a modified arrow wing planform of 10,000 ft^2, which is based on the geometry and aerodynamic characteristics of the pitch constrained wing as used for the wind tunnel tests of the NASA/Douglas SCAR high speed model.

Leading edge sweep is 71° for the inboard panel and 57° for the outboard panel. Thickness/chord ratio is 2.25% at the plane of symmetry tapering to 3% at the

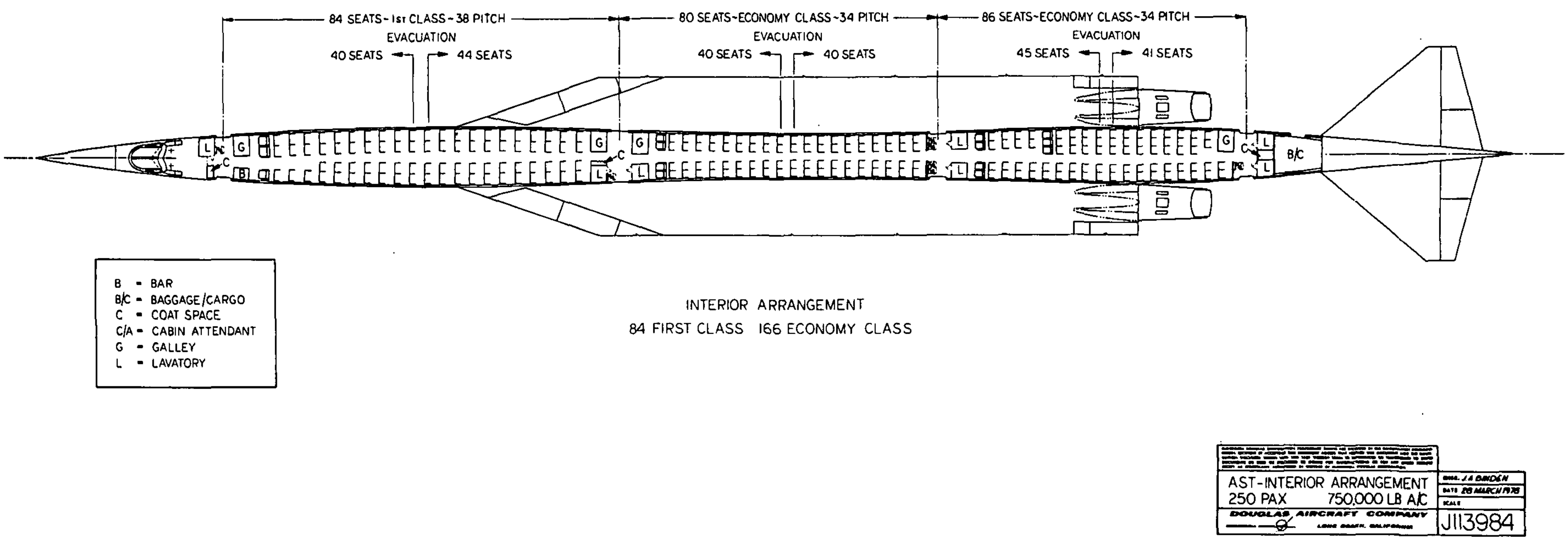


FIGURE 5-2. INTERIOR ARRANGEMENT

trailing edge break, and maintained at 3% to the wing tip. The resultant wing thicknesses provide sufficient spar depth for structural integrity, main landing gear stowage and sufficient volume for mission fuel requirements in the inner wing.

The wing structure is a multi-spar construction and consists of two structural boxes. The main torque box and the forward box are separated by the main landing gear bays. Wing skins are of titanium sandwich construction, providing high structural efficiency and fuel tank insulation properties. The triangular wing structure ahead of the carry-through structural boxes is pin jointed to the fuselage sides to avoid wing carry-through structure and provides cargo/baggage stowage in the fuselage between the nose gear bay aft bulkhead and the forward carry-through wing box structure.

5.1.3 Lateral Control and High-Lift Devices. - Low speed roll control is obtained by the combination of conventional ailerons on the outer wing panel and a four-segment spoiler/slot deflector system per side on the upper and lower wing surfaces. At supersonic cruise, the ailerons are locked out and roll control is obtained by use of the spoiler/slot deflector system only. Single slotted flaps, between the engine nacelles, and outboard of the engine nacelles, in conjunction with leading edge devices, provide a high-lift system for takeoff and landing.

5.1.4 Fuselage Definition. - Fuselage definition is based on the idealized aerodynamic wing/body area distribution and camber inputs, derived from layouts of the cabin interior and minimum fuselage length requirements. The aerodynamic optimization of the wing/body area distribution observes the following constraints in the fuselage cross sectional areas:

1. Minimum area requirements for a 3-man flight crew station.
2. Minimum cross section for 4-abreast first class seating plus nose landing gear stowage.
3. Minimum cross section for 4-abreast economy seating plus center main landing gear stowage.
4. Minimum circular cross section for 5-abreast economy class seating aft of the wing.

Wing carry-through structure, fuselage cabin requirements and preferred commonality of the three post main landing gear struts integrate carefully with the low wing configuration.

Due to the fuselage and wing camber, systems space and structural requirements above the center main landing gear bay, at cruise the center cabin floor is at 4° to the aerodynamic reference plane (ARP). The forward cabin area floor and the rear portion of the economy class cabin, aft of the wing, are at 0° to the ARP. The static attitude of the ARP on the ground is 2° nose down. This provides improved pilot's visibility, reduces nose gear length, and results in passenger and cargo floors being not more than 2° from horizontal during loading and unloading operations. Cargo/baggage compartments are provided in the lower fuselage segment between the aft bulkhead of the nose landing gear bay and the forward carry-through wing box spar, and in the rear fuselage aft of the main cabin area and up to the fuselage rear pressure bulkhead.

5.1.5 <u>Vertical and Horizontal Tail</u>. - Vertical and horizontal tail sizes are commensurate with the proposed usage of a stability augmentation system for a reduced static stability design.

The vertical stabilizer is of multi-spar construction, mounted in line with fuselage frames to achieve a simple rigid structure. A three segment rudder is mounted aft of the vertical rear spar for yaw control.

The horizontal stabilizer is of multi-spar construction with a carry-through main torque box. Pivot points are provided on the torque box and hinged to a truss from the aft fuselage structure. A four segment elevator is mounted to the aft rear spar of the horizontal main torque box. Aircraft pitch attitude is controlled primarily by varying the incidence of the horizontal tail surface. The control effectiveness is enhanced by the four segment elevator geared to the main horizontal surface rotation.

Vertical and horizontal tail surfaces are staggered with respect to each others location on the fuselage to improve supersonic area distribution.

5.1.6 Engine Integration. - The four engines are installed under the wing in axisymmetric structural nacelles utilizing mixed compression inlets.

Inboard nacelles spanwise location at the inlet face is 113.25 inches from the centerline of the aircraft.

Outboard nacelles spanwise location at the inlet face is 301.5 inches from the centerline of the aircraft.

Principal criteria for determining the spanwise locations for the nacelles are:

- Minimum wave drag.
- Adequate nacelle separation for minimum airflow interference.
- Compatibility with wing box structure.
- Location of control surfaces.
- Minimum interference of airflow with spray/slush ingestion from landing gear.

The forward and aft locations of the inlets are determined analytically from inputs from aerodynamics, structural mechanics, acoustics and propulsion technologies. The engine location selected provides the best solution to the established criteria.

5.1.7 Engine/ Nacelle Attachment to the Wing. - Engine/airframe integration is achieved by the use of a structural nacelle concept. The upper segment of the nacelle is composed of semi-hoop frames skinned with titanium/honeycomb panels. This structure is integral with a pylon/box beam cantilevered aft of the wing rear spar. The lower closing longeron of the structural nacelle segment carries hinged non-structural access panels forming the lower segment of the engine nacelle. The engine is mounted by means of links to the pylon/nacelle structure. The forward mounting links carry thrust, side and vertical loads. The aft mount carries vertical, side and torque loads and translates for engine growth under operating temperatures.

The axisymmetric intakes are mounted to a full hoop frame on the front of the nacelle structure. Flexible seals are provided to allow for relative movement between intake and engine faces.

The boundary layer diverter is integrated into the engine nacelle/wing fairing.

5.1.8 Landing Gear. - Airport criteria, such as pavement thickness, turning radius and tire wear, and the desirability for achieving gear retraction within the wing profile, determined selection of a three-post main landing gear. Each main gear bogie consists of a 12 tire/6 wheel and 6 carbon brake assembly. Tire characteristics, including an aspect ratio of approximately

0.60 and pressures of 240 p.s.i. are within the projected technology capability of industry in the time scale for construction of the supersonic cruise transport as defined in this study.

Nose gear requirements and stowage availability defines a twin wheel unit, two wheels each 44 x 16 - 18 inches.

All four gear assemblies are designed to free fall and lock down in the event of a gear extension power failure.

5.1.9 Fuel Tank Arrangement. - The inner wing panel structure and skins are designed to provide seven integral fuel tanks and one ballast tank per side. For arrangement see Figure 5-3. The tanks are numbered in relation to the engine fed by the system; i.e., tank system 1 feeds engine 1, etc. Engine feed is from each main tank. The main tanks are kept full by transfer from the associated alternate, auxiliary and/or center tanks.

The fuel management system maintains the required center of gravity location of the aircraft by sequencing the transfer of fuel to the main tanks and obviates the need for a balance tank system.

For payloads less than 50 percent of capacity, fuel will be used as ballast to maintain allowable c.g. locations.

5.1.10 Configuration and Characteristics.- The resultant configuration and geometry of the described aircraft model are shown on the general arrangement drawing Figure 5-4.

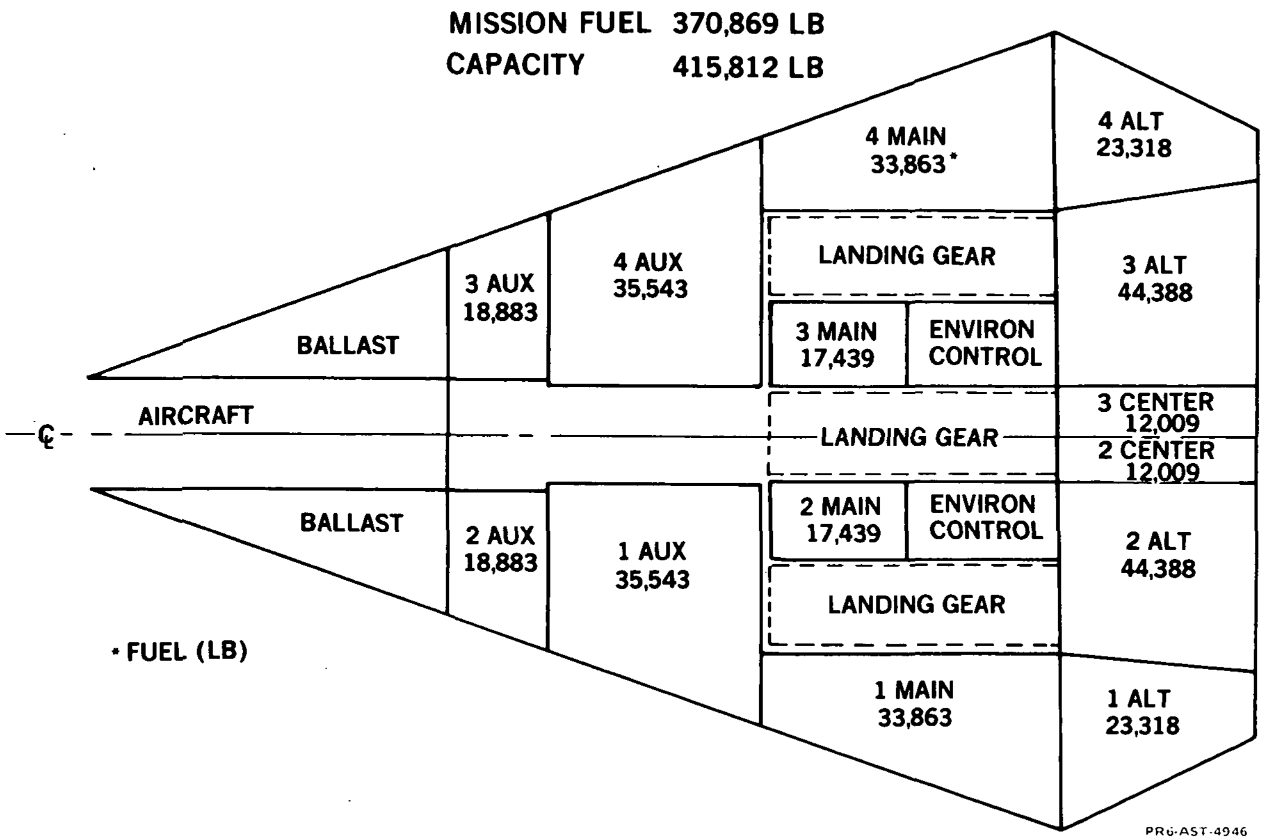
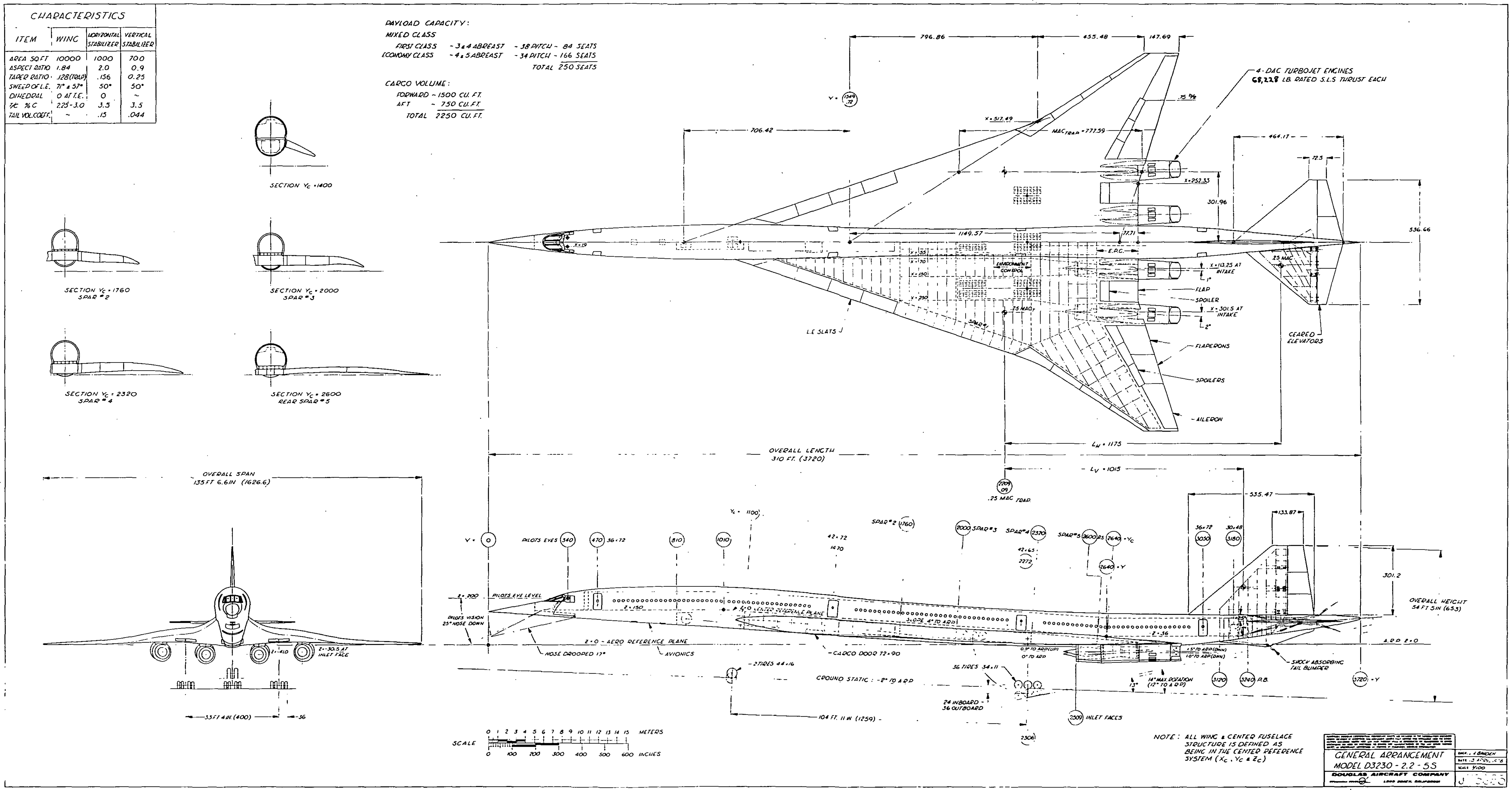


FIGURE 5-3. BASELINE TANK ARRANGEMENT

5.2 Propulsion System Definition and Performance

5.2.1 Engine Description. The engine defined for the "MDC baseline" airplane design is a MDC defined dry turbojet based on the GE 4 engine cycle of the 1971 U.S. SST. This conceptual turbojet engine performance data has subsequently been updated to incorporate 1980-1985 technology. This engine is used in sizing to meet FAR Part 36 noise constraints and in the determination of airplane performance.

The engine size resulting from integration into the airplane is 743 lb/sec inlet corrected airflow at maximum combustor exit temperature at sea level,std. +18°F (10°C) day,static takeoff operation. The engine exhaust system is a convergent-



CHARACTERISTICS

ITEM	WING	HORIZONTAL STABILIZER	VERTICAL STABILIZER
AREA SQ.FT	10000	1000	700
ASPECT RATIO	1.84	2.0	0.9
TAPER RATIO	.128 (TRAP)	.156	0.25
SWEEP OF L.E.	71° & 57°	50°	50°
DIHEDRAL	0 AT T.E.	0	~
T/C % C	2.25-3.0	3.5	3.5
TAIL VOL. COEFF.	~	.15	.044

FIGURE 5-4. GENERAL ARRANGEMENT

divergent ejector nozzle, incorporating a suppressor stowed in the nozzle within the ejector shroud and utilizing trailing buckets as the exit area control and reverser. The jet noise suppressor is a DAC design utilizing 12 lobes and 24 tubes. The maximum jet noise suppression is 10.5 PNdB at 2700 ft. per sec. ideal jet velocity. The suppression is based on use of the suppressor and an acoustically lined ejector. In addition, the reverser buckets are deflected to shape the nozzle resulting in an additional 2.5 PNdB jet noise reduction for the sideline measuring point. The exhaust system in the suppressed mode and in the cruise mode is shown schematically in Figure 5-5.

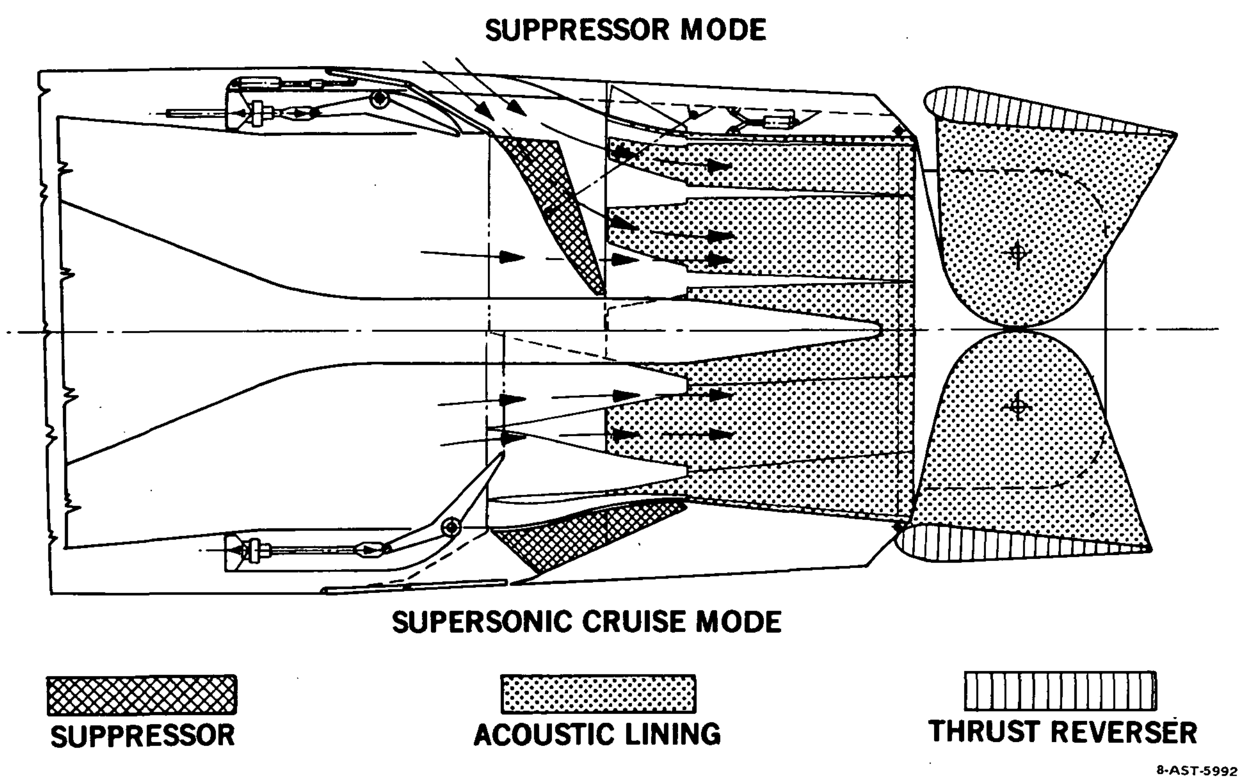


FIGURE 5-5. DAC MECHANICAL SUPPRESSOR/EJECTER NOZZLE

A takeoff data pack listing is provided in Appendix A-3. These data are also available in card format which can be made available.

The following matrix is incorporated in the takeoff data pack:

Altitudes	-	0, 2000, 4000 feet
Mach Numbers	-	0, 0.1, 0.2, 0.3, 0.4, 0.5
Rating Codes	-	50 (Max takeoff, dry)
		40 (Max climb)
		35 (Max Cruise)
		34, 32, 30, 28, 26 (Partial Powers)

The performance includes effects of the following installation factors:

- Inlet recovery per Figure 8 of Reference 1.
- 0.28% w_{bleed} per engine
- 200 horsepower extraction per engine
- Drags (inlet bleed, bypass, spillage, boattail, nacelle skin friction).
- Standard +18°F day.

The data used are for fixed nozzle throat area, simulating the suppressor deployed mode. The nozzle is defined at rating code 44.5. The referred airflow $\left(W_a\sqrt{\theta_{T2}}/\delta_{T2}\right)$ is 722 lb/sec in the data pack, although not so listed in the data pack. At rating codes above 44.5, the engine airflow and RPM increase above realistic limits. However, the performance data are valid for analytical studies. Once the noise characteristics of the study vehicle are established, the engine operating constraints can be redefined. The rating code of 44.5 is the maximum power based on an exhaust gas temperature of 1700°F. This exhaust gas temperature limit is based on an uncooled jet noise suppressor.

Engine-related configuration constraints are defined as follows:

• LP compressor (not fan design Mach no.)	1320 ft/sec
• LP Compressor area (less centerbody)	15.27 ft^2
• LP Compressor diameter (at first stage rotor)	4.96 ft
• Jet nozzle Mach number	2.2

Other items (number of vanes, number of blades, number of inlet guide vanes, rotor/stator spacing - percent blade chord, inlet flow distortion factor) are not defined, but are assumed consistent with the GE4 engine. The compressor noise estimates are based on the results of GE4 compressor tests and the method published in Reference 2. The ratio of the compressor tip diameter to the GE4 compressor tip diameter is 1.09375, and the ratio of the blade number to the GE4 blade number is 1.05882.

5.2.2 Engine Sizing. Sizing criteria for the engine are to provide sufficient thrust to meet a takeoff field length not to exceed 11,500 ft., to meet the requirements of FAR Part 36 (Stage 2) (without trading) and to maintain the exhaust gas temperature through the suppressor at or below 1700°F.

The procedure used in meeting the above constraints is to select the maximum allowable thrust (limited by the temperature through the suppressor) and vary design engine size. As the engine size is increased, the takeoff field length decreases which results in an increase in altitude at the monitor. Figure 5-6 shows the results of the study. The sideline noise level remains relatively constant at 106 EPNdB with increasing engine size. The flyover noise variation is significant and continues to decrease as engine size is increased. For the 108 EPNdB requirement, a minimum engine size of 743 lb/sec is selected for the baseline configuration.

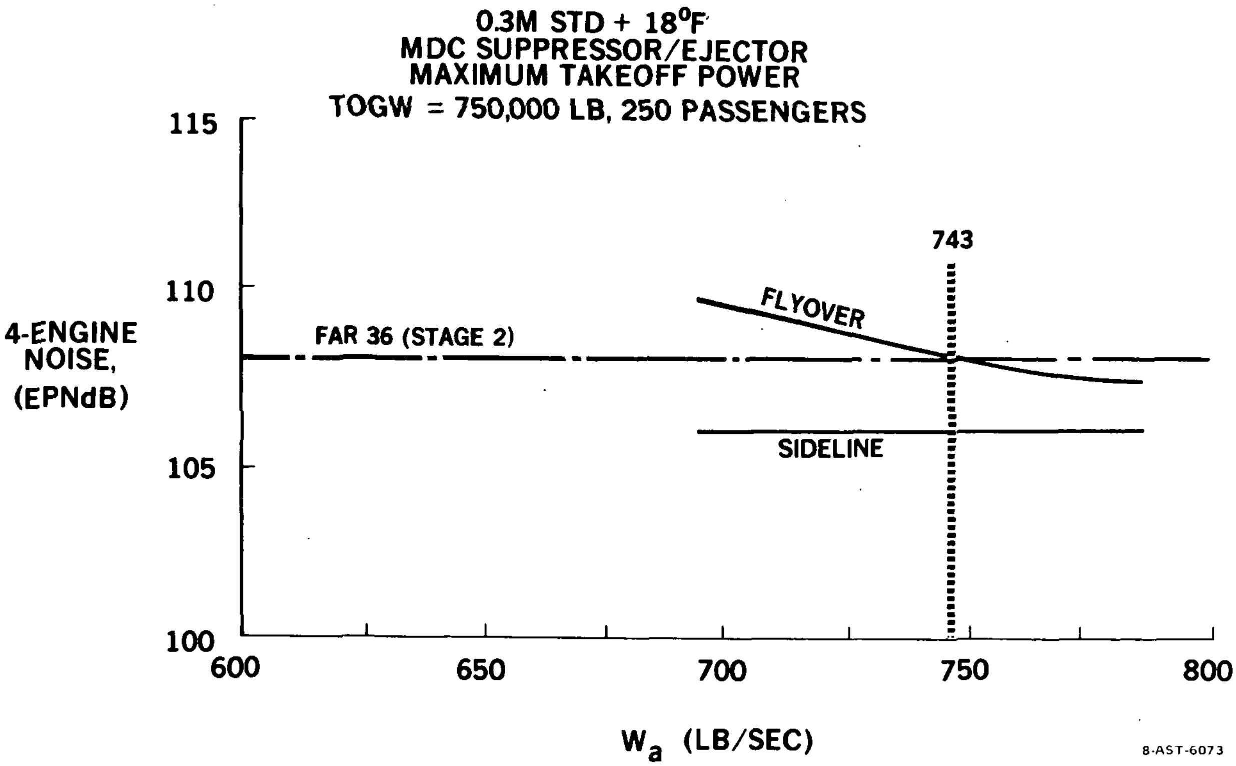


FIGURE 5-6. BASELINE TURBOJET ENGINE SIZING

5.3 Structural Definition. The structural definition is for an airplane whose design is to be initiated in the 1980-1985 time period. The reference airplane will be designed for cruise at 2.2 Mach and have a total flight lifetime of 50,000 hours. The McDonnell Douglas design life requirement including strength, fatigue, fail-safe, aeroelastic and flutter considerations is two lifetimes (100,000 hours) of which 70,000 hours is at elevated temperatures (maximum of 250°F) for cruise.

No composite materials are included for this 1980-1985 time period. Therefore, an all metal airplane is defined to satisfy the technology readiness requirement.

Aluminums and titaniums have been studied extensively in the MDC AST activity to establish the best structural applications and continuing studies are underway to establish the fabrication concepts which are the most cost effective. For materials selection,the following summarizes the findings for the major structural components for the 2.2 Mach cruise condition.

1. Aluminums are subject to creep, thermal stress, and reduced fatigue resistance and,at moderate loadings and stress allowables,must be limited to values approximately 40% less than for subsonic application.

2. Titanium does not appreciably deteriorate in allowables due to thermal effects.

3. The resulting structural efficiency of an aluminum structure (stress/density) is approximately 60% of an annealed Ti 6Al-4V titanium structure.

The baseline materials, distribution of materials and preferred construction methods are summarized in Figure 5-7. The major wing structure is assumed to be aluminum brazed titanium honeycomb panels over titanium spars and ribs. Lightly loaded

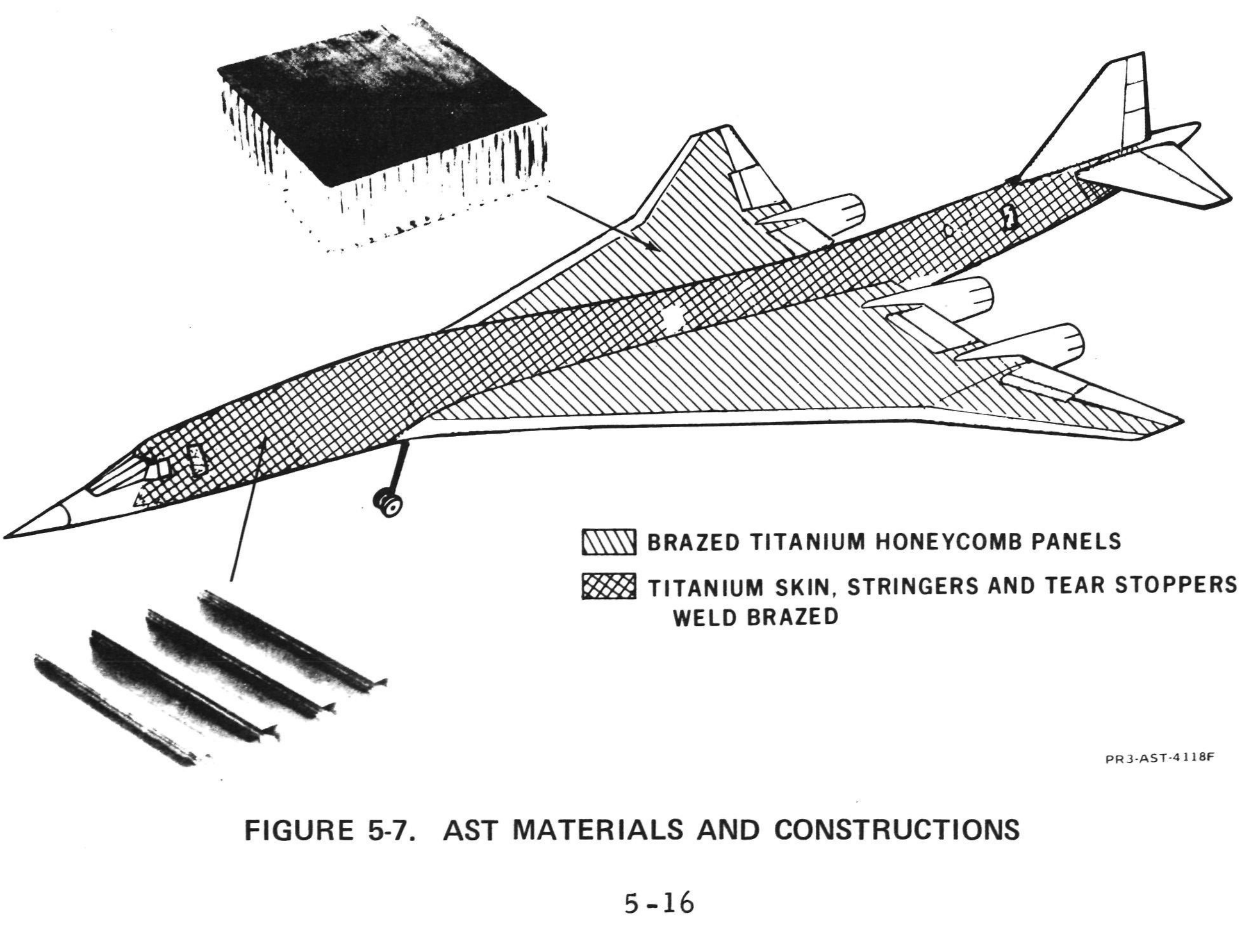


FIGURE 5-7. AST MATERIALS AND CONSTRUCTIONS

minimum gage leading edges are most cost effective if made of aluminum. The lower temperature trailing edge wing surfaces are also of aluminum. The fuselage is assumed to be titanium and of conventional skin and stringer construction. It also contains aluminum for the low temperature lightly loaded inner frames and/or other secondary structure such as floor beams. The resulting airframe structure is 64% titanium, 27% aluminum and 9% steel (landing gear and propulsion system).

5.4 ACOUSTIC ANALYSIS

5.4.1 Noise Sources. The noise sources for the reference aircraft are related to the turbojet gas-turbine engine propulsion system, and the airframe-generated noise from such sources as the extended landing gear, the deployed flaps and the large wing surface vortices. Engine noise includes the compressor generated turbo-machinery noise radiating forward from the inlet, the turbine generated turbo-machinery noise radiating aft from the exit, and the externally generated jet noise.

Methods of suppression of jet engine noise include inlet throat choking, inlet duct-lining treatment, and jet noise suppressors. Turbo-machinery generated noise can be reduced by aerodynamic design features that reduce the noise generation at the source. A jet noise suppressor-mixer is constructed of lobes and tubes to accelerate mixing followed by an acoustically lined ejector which induces secondary air into the exhaust to reduce the mixed velocity at the exit.

5.4.2 Jet-Engine Noise. The noise produced by jet engines can be classed in two broad categories: (1) external jet noise generated within the jet efflux and (2) internally generated turbo-machinery noise resulting from the combustion process and the fluctuating forces associated with the rotor, stator, and fan components of the engine. MDC developed engine-noise-prediction computer programs are used to estimate the far-field noise produced by these external and internal sources. The prediction method represents an amalgam of theoretical analyses and empirical data that relate far-field noise levels produced by the various engine noise sources to appropriate geometric, aerodynamic, and thermodynamic variables. In developing the prediction method, MDC used information obtained from the engine manufacturers, as well as the results of various static engine tests and aircraft flyover-noise tests conducted by MDC.

The predicted noise levels of a jet engine include estimates of the broadband and discrete-frequency components of the noise radiated from the engine inlet duct and the turbine-discharge duct. Estimates of inlet noise include multiple pure tone (buzz saw) components when the compressor stages are operating at sonic or supersonic gas velocities relative to the rotor. Estimates of internal engine noise include combustion noise and low-frequency broadband noise resulting from aerodynamic disturbances upstream of the primary nozzle. Estimates of turbine generated noise include discrete tones of the harmonic frequency and multiples thereof and broadband noise due to haystacking. Estimates of jet noise include contributions due to the mixing processes occurring between the hot primary jet and the atmosphere. Spectra that represent the noise contributions from the sources described above are calculated, in terms of 1/3-octave-band sound pressure levels (SPL), for various angles along a 100-foot circular arc about an engine. A computer program, Gas Turbine Engine Noise (GTEN), has been developed to carry out certain of the calculations.

The strength and the directivity of far-field noise levels are related to appropriate aerodynamic and geometric parameters for various components of a propulsion system. A stage-stacking or component building-block approach is used to estimate the noise produced by separate engine components. For a gas turbine engine, the six components considered are:

1. Inlet guide vanes
2. Compressor rotor
3. Compressor stator
4. Turbine rotor
5. Turbine stator
6. Primary exhaust nozzle

In making noise estimates for the reference engine, Douglas uses compressor, core (internal engine) and primary jet as the engine noise sources and airframe generated noise to predict the total airplane noise. The compressor noise subroutine in the MDC GTEN computer program uses data from the test results of the GE4 engine compressor as the data base. The semi-empirical method is defined in Reference 2. The jet noise and core noise prediction subroutines are empirically based on both flight and static full scale engine data taken from many different engines. The nonpropulsive noise prediction procedure is based on the early work of other investigators and modified by MDC to include recent data for wide-body transports.

Prediction of the noise produced by each source results in a matrix of 1/3-octave-band SPL spectra for angles between 0° and 180° from the inlet, for various power settings. Attenuation spectra from the acoustic linings, near sonic inlets, and jet suppressor are subtracted from appropriate untreated SPL spectra to obtain treated SPL spectra. The treated SPL spectra for each component are extrapolated to the desired distance, accounting for spherical divergence, atmospheric attenuation, Doppler shift and forward velocity effects. Estimates of the noise from each source are then combined to calculate the total engine-noise component of the aircraft flyover noise signature.

The flyover time histories and SPL frequency spectra of the engine unsuppressed noise sources at the FAR Part 36 sideline and approach measuring stations are calculated by the Douglas procedure. At the sideline measuring condition, jet noise is the dominant noise source and it requires substantial noise reduction. During approach, compressor noise has a greater impact on total engine noise. Both acoustical treatment and a high throat Mach number inlet are added to reduce compressor noise.

5.4.3 Suppression. The levels of jet noise suppression applied for the sideline and takeoff/cutback conditions are based on measured test results at model scale, presented in Figure 5-8.

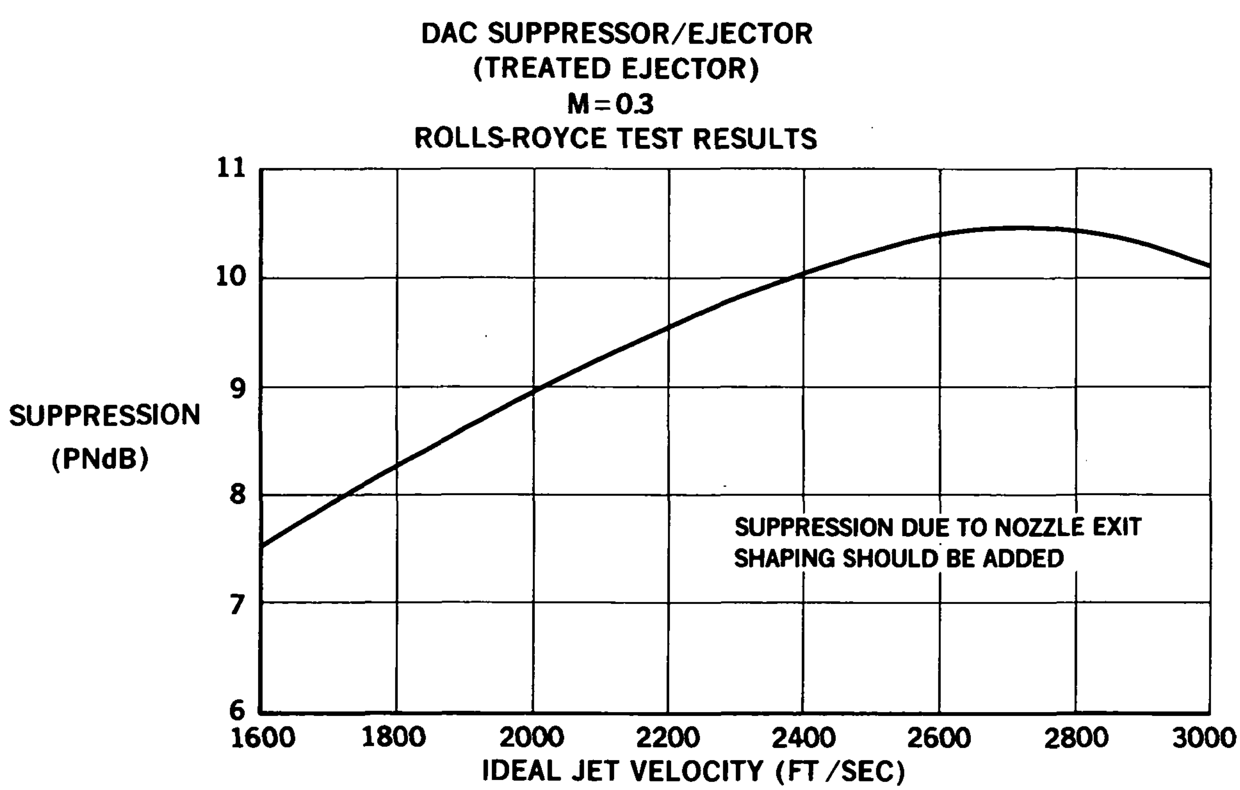


FIGURE 5-8. NOISE SUPPRESSION LEVELS

At the sideline condition, the effects of extra ground attenuation and fuselage shielding are included by an allowance for lateral noise attenuation. In addition, an exhaust shaping factor of 2.5 EPNdB reduction is included (but not shown) in the final estimate, based on the information published in Reference 3.

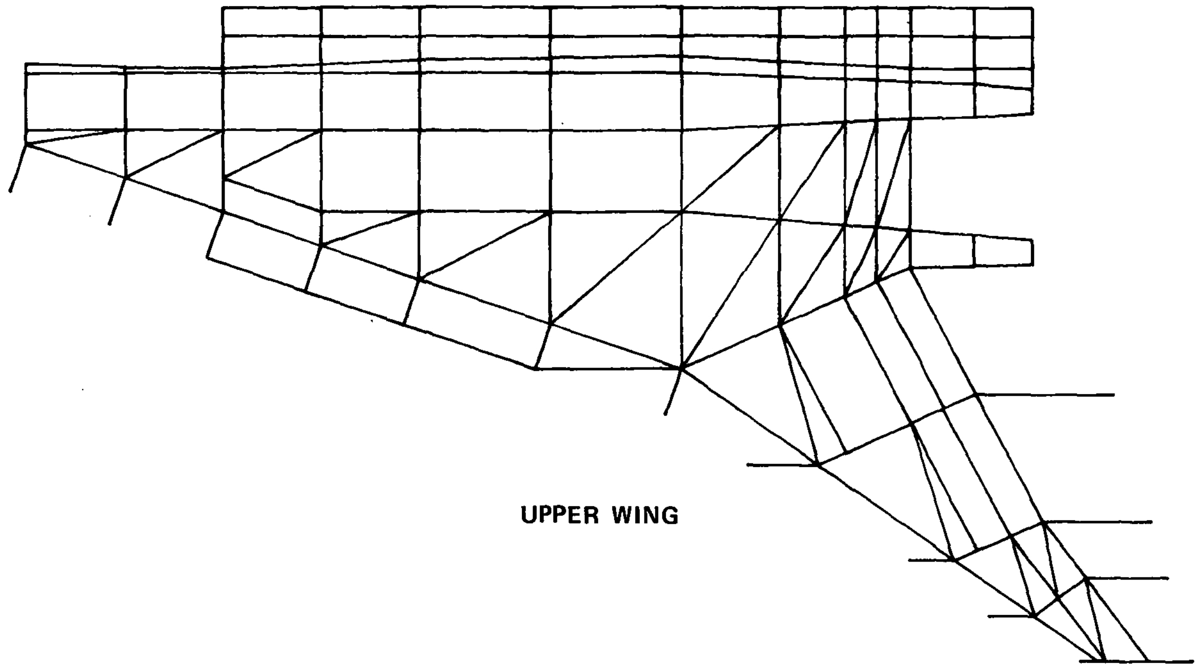
The reference turbojet design includes a treated inlet, based on conventional sound absorbing material design procedures. A choked inlet has not been found necessary for the MDC configuration. The estimated approach noise level is 108 EPNdB with the treated inlet.

5.4.4 Summary. An acoustic study has been conducted for the dry turbojet engine to determine the noise reduction needed to meet the current FAR Part 36 noise level requirements and to specify a preliminary design to accomplish the noise reduction required. Because a balanced acoustic design is desired,hardwall and treated PNLT-time histories are predicted for the three FAR Part 36 conditions of approach, sideline and takeoff. The noise sources include compressor, core and jet noise, and airframe generated noise for approach only. The predicted aircraft noise levels are listed below.

FAR Part 36 Conditions	Hardwall EPNL	Treated EPNL
Approach	114 EPNdB	108 EPNdB
Sideline	116 EPNdB	106 EPNdB
Takeoff/Cutback	114 EPNdB	108 EPNdB

5.5 Structural Analysis

5.5.1 Strength Analysis. Structural analysis is aided by computing programs. The primary structure is represented by a model for the analysis. Figure 5-9 shows the models which represent the wing and Figure 5-10 shows the combined wing and fuselage model for the configuration.



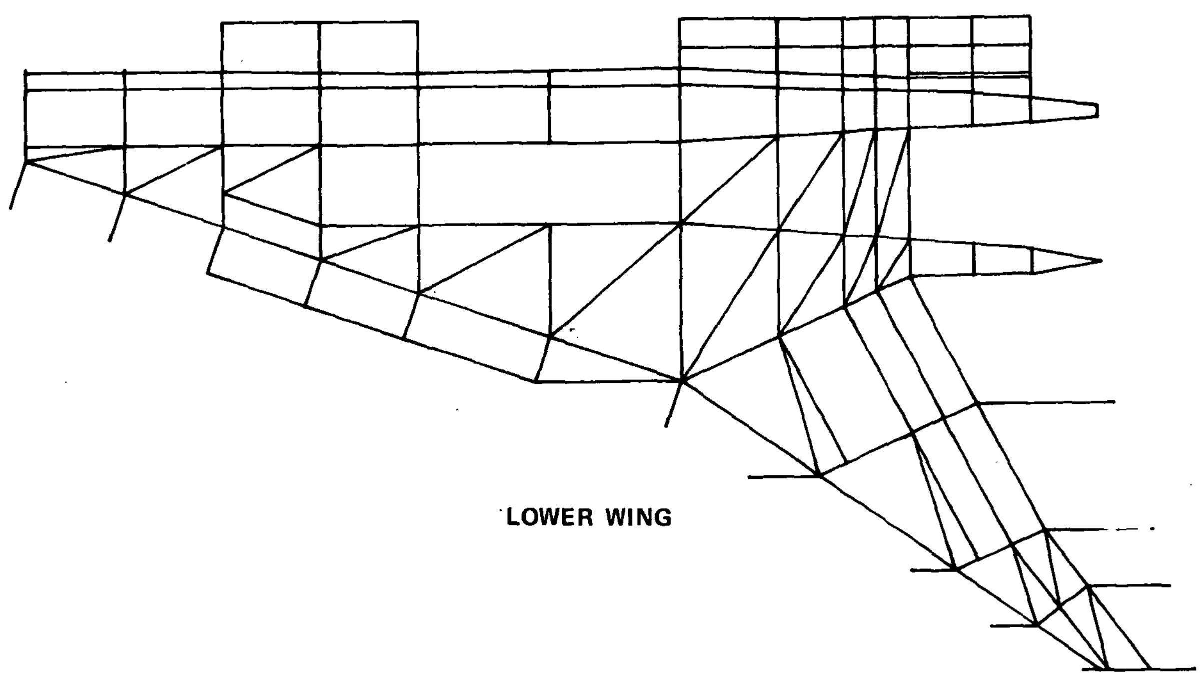


FIGURE 5-9. STRUCTURAL MODEL – MACH 2.2 PLAN VIEW

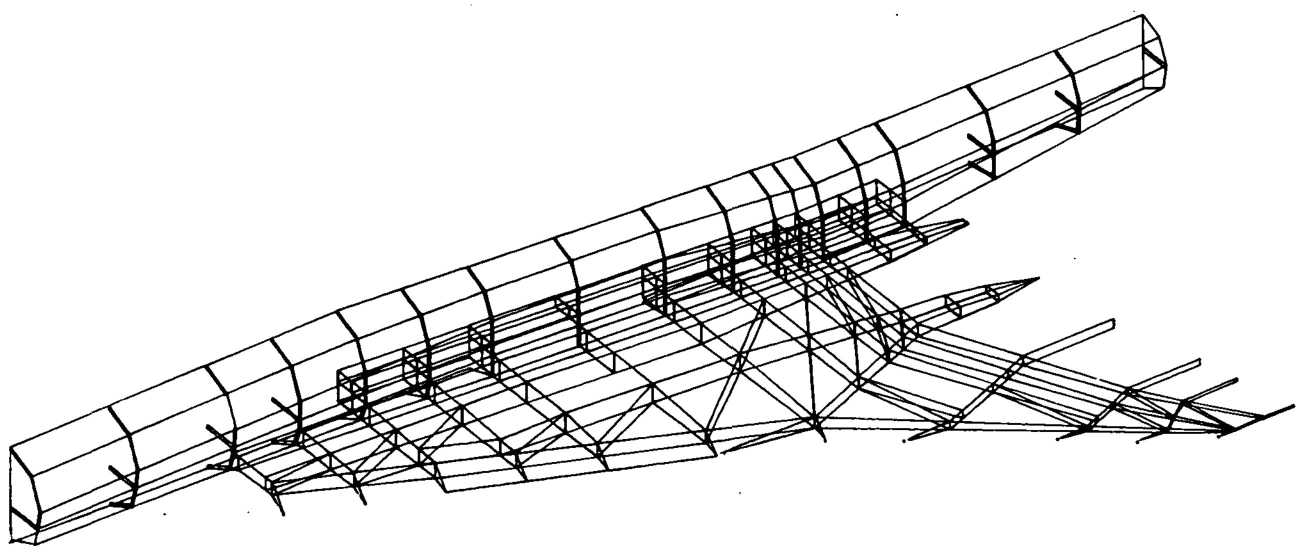


FIGURE 5-10. -5A BASELINE MEMBRANE MODEL

Accountability is made in the analysis for the effect of engine size and c.g. location on wing and fuselage carrythrough structural weight. The moment of the engine overhang from the rear spar is a function of the engine c.g. location. The engine size is accounted for by the weight change at the engine c.g.. Considerable work has been devoted to isolating these effects. For this study, these structural effects are included in the optimization analysis as both the engine weight and c.g. location are specific inputs.

Critical wing and fuselage load conditions for the Mach 2.2 case are summarized in Figures 5-11, 5-12, and 5-13.

1. SUBSONIC 2-1/2 g SYMM MANEUVER
2. SUPERSONIC 2-1/2 g SYMM MANEUVER

* = MINIMUM GAGE

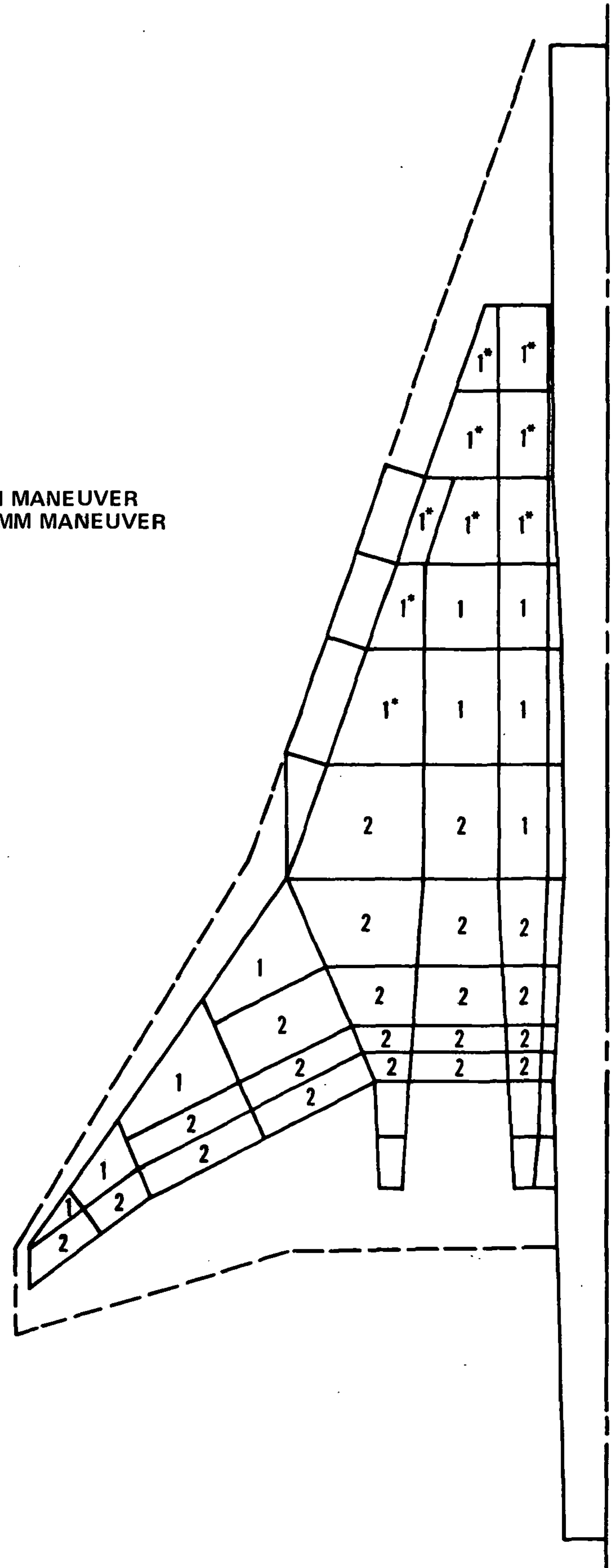


FIGURE 5-11. UPPER WING CRITICAL LOAD CONDITIONS M = 2.2 CRUISE

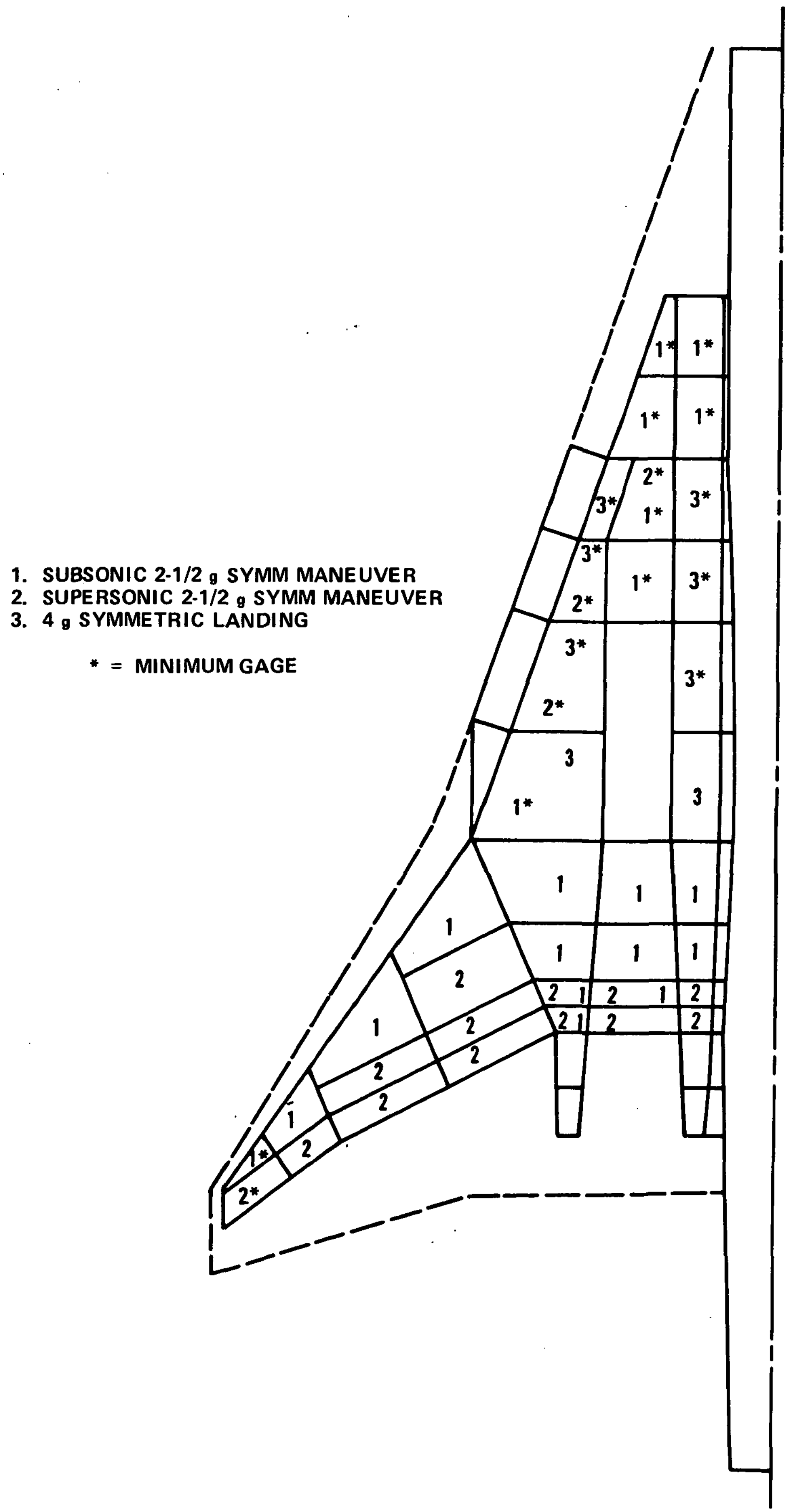


FIGURE 5-12. LOWER WING CRITICAL LOAD CONDITIONS M = 2.2 CRUISE

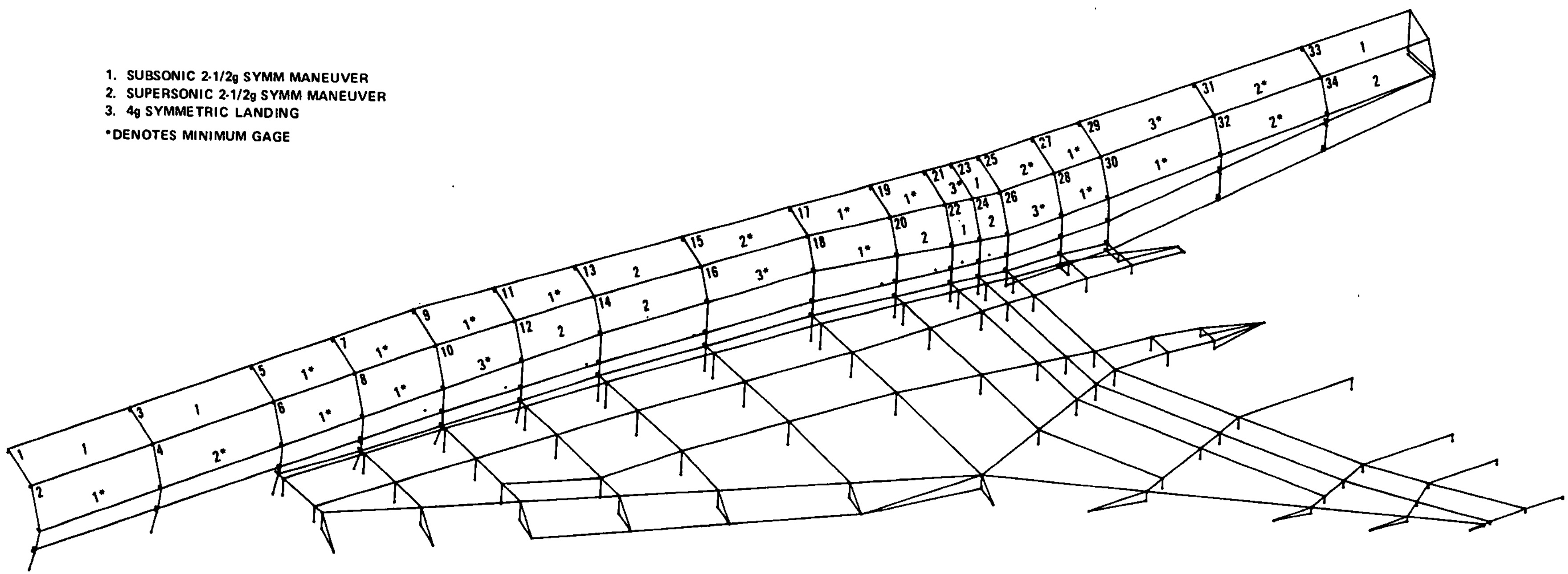


FIGURE 5-13. FUSELAGE MEMBRANES SHOWING CRITICAL LOAD CONDITION NUMBERS FOR MACH 2.2

5.5.2 Structural Analysis Models. - The finite element idealization used for the static analysis and fail-safe studies is based on drawing J113984 for the baseline 2.2 M configuration.

The complete structural model (Figure 5-6) consists of 2140 inches length of half-fuselage from the nose gear attachment bulkhead at y = 1100 inches to the rear pressure bulkhead at y = 3240 inches, and the half-wing primary structure from y = 1520 inches to the rear spar at y = 2600 inches.

The fuselage consists of 18 lumped frames and 6 lumped longerons. The top and second rows of skin panels are modeled with membrane elements. The remaining fuselage panels carry pure shear. A keel member extends from y = 1760 inches to the rear spar. The inner wing has 11 spars. The front two spars are not continuous through the fuselage. The rear five spars, to which the outer wing is attached, form the main torque box. The upper and lower wing skins are modeled as membrane elements. The spar and rib webs are modeled as shear panels. The main gear is attached to spar 4 at y = 2320 inches between ribs at x = 150 inches and x = 250 inches. The gear retracts forward into a housing between spars 3 (y = 2000 inches) and 4. The lower skin in this area is omitted. The intermediate spar at y = 2160 inches contains a cut-out to accomodate the oleo.

The engine pods are mounted on box beams extending aft of the rear spar. The four main wing ribs are modeled as extensions of these beams. Truss members extend from the leading and trailing edges of the model to the true leading and trailing edges. These trusses transmit aerodynamic loads only and are not primary structure.

The model consists of 478 joints, 993 bars, 399 shear panels and 186 membrane panel elements, giving 3163 element stresses and design variables.

5.6 WEIGHT ANALYSIS

The weights for the AST are developed from multi-component semi-analytical/empirical methods which utilize criteria and geometry inputs. These methods have evolved from post design analyses of several subsonic production transport aircraft and from previous and current study aircraft programs. Weights for the wing box, flutter and aeroelasticity increment, center fuselage, and nacelle inlet also include the results of detailed AST structural/weight optimization analyses. The weights for the engine, nozzle, reverser, and suppressor are provided by the engine manufacturer.

Table 5-1 presents a summary of the operational empty weight. The operational items include the cockpit and cabin crew, food and passenger service items, potable water, lavatory reflux, life rafts and life vests, baggage and cargo containers, unusable fuel, and engine oil. Galley structure, inserts, and carts are included with the furnishings group. Table 5-2 summarizes the design weights and airplane geometry.

5.7 Airplane Performance

5.7.1 Aerodynamic Analysis. The high-speed characteristics of the aircraft for use in the mission performance analysis are based on the results of wind tunnel tests of the configuration adjusted for differences between the wind tunnel model and the aircraft and aerodynamic improvements adopted since the design of the wind tunnel model.

The low-speed characteristics are based on adjustments of SCAT 15F wind tunnel data for the differences between the configurations.

TABLE 5-1
WEIGHT SUMMARY

	WEIGHT, LB
Wing	74,825
Horizontal Tail	3,960
Vertical Tail	3,807
Fuselage	47,713
Landing Gear	36,792
Flight Controls	9,115
Nacelle/Inlet	11,860
Propulsion	57,144
Fuel System	3,820
Emergency Power Unit	950
Instruments	1,227
Hydraulics	5,684
Pneumatics	1,332
Electrical	4,850
Navigation & Comm.	2,756
Furnishings	23,477
Air Conditioning	4,854
Ice Protection	489
Handling Provisions	90
Flutter & Aeroelasticity	2,860
MANUFACTURER'S EMPTY WEIGHT	297,605
OPERATIONAL ITEMS	7,829
OPERATIONAL EMPTY WEIGHT	305,434

TABLE 5-2

DESIGN WEIGHTS AND GEOMETRY SUMMARY

Design Weights	
Maximum Takeoff (lb)	750,000
Maximum Landing (lb)	433,000
Maximum Zero Fuel (lb)	383,610
Wing Geometry	
Area - Gross (ft^2)	10,000
Aspect Ratio	1.84
Taper Ratio	.128
Sweep of L.E. (deg) - Inbd./Outbd.	71/57
t/c (%) - Root/Tip	2.25/3.0
Flap Area (ft^2)	645
Slat Area (ft^2)	710
Aileron Area (ft^2)	213
Spoiler Area (ft^2)	200
Tail Geometry	
Horizontal Tail Area (ft^2)	1000
Elevator Area (ft^2)	274
Horizontal Tail Length (In.)	1175
Horizontal Tail Volume	.15
Vertical Tail Area (ft^2)	700
Rudder Area (ft^2)	191
Vertical Tail Length (In.)	1015
Vertical Tail Volume	.044
Fuselage Geometry	
Length (In.)	3720
Maximum Height (In.)	178
Maximum Width (In.)	150
Wetted Area - Gross (ft^2)	9235
No. of Passengers	250
First Class	84
Tourist	166

The low-speed lift curves as a function of flap deflection are shown in Figure 5-14.

The low-speed drag polars are shown in Figure 5-15.

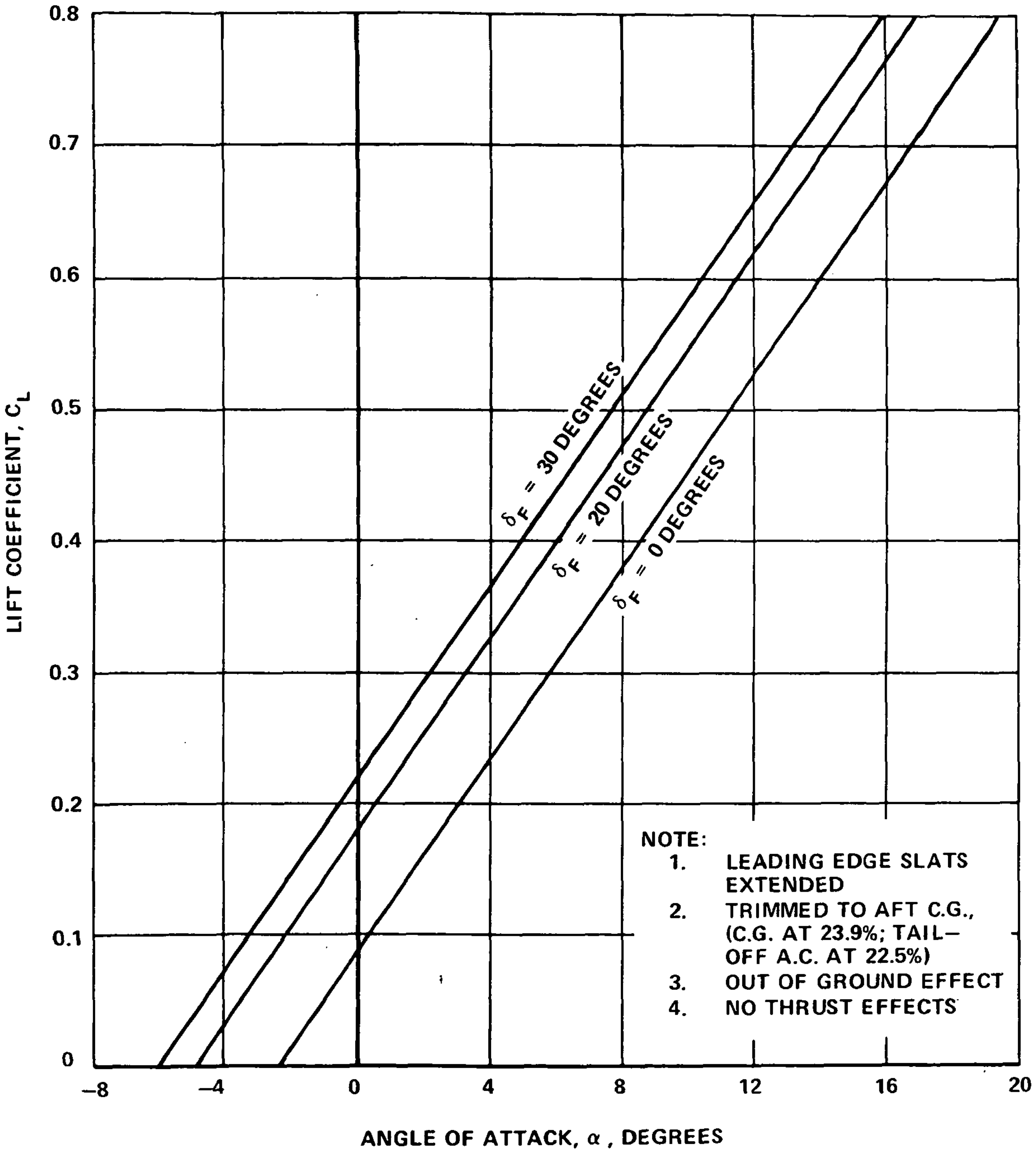


FIGURE 5-14. MODEL D3230-2.2-5A: TRIMMED LOW SPEED LIFT CHARACTERISTICS

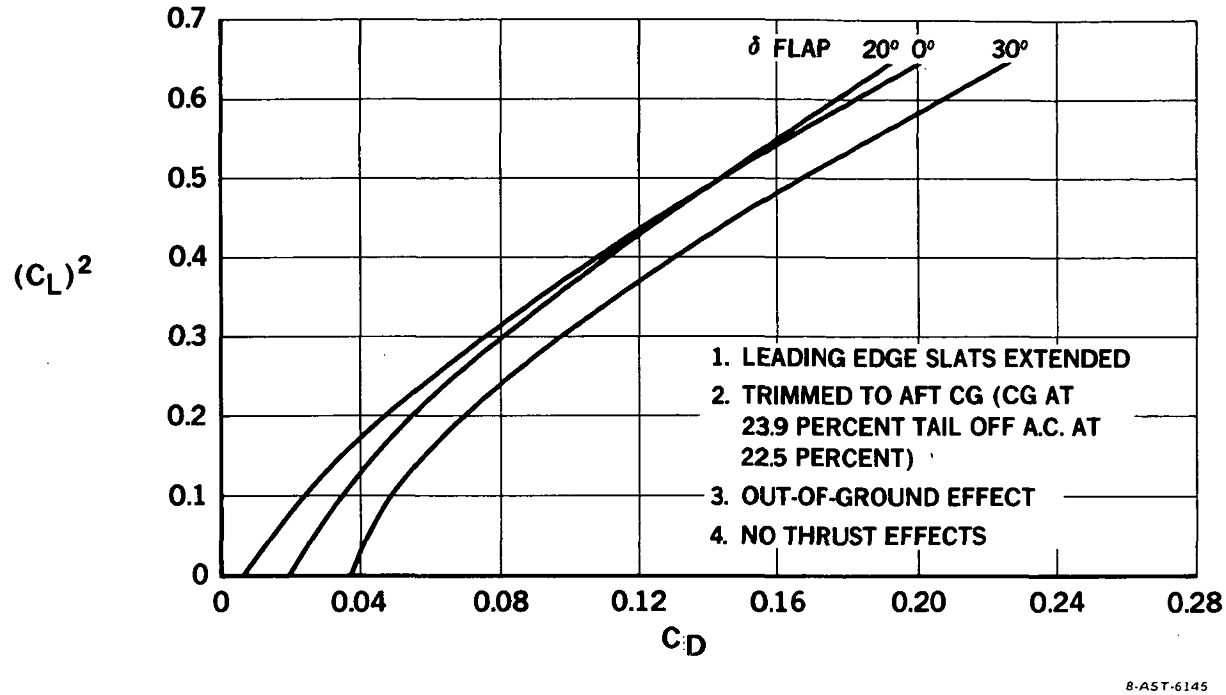


FIGURE 5-15. TRIMMED LOW SPEED POLARS

5.7.2 Performance Results. The takeoff performance and takeoff flight path are determined by the following procedure:

1. Accelerate on ground to rotation speed determined as the speed which, with one engine out, will result in reaching V_2 speed at the obstacle (35 foot height).
2. Rotate at 3°/second until lift-off.
3. Continue rotating at 3°/second until reaching zero acceleration.
4. Maintain zero acceleration until reaching a height above the runway of 35 feet.
5. Push over at 3°/sec until reaching an acceleration of 2 foot/second^2.
6. Hold 2 foot/second^2 acceleration until reaching desired climb-out speed (nominally 10 KEAS above the equivalent airspeed at the obstacle).
7. Gear retraction 13 seconds from lift-off.

8. Maintain equivalent airspeed to monitor.
9. At a point three seconds before passing over monitor, reduce throttle to thrust level corresponding to an equilibrium all engine gradient of four percent (engine out gradient $\geqslant 0$) at the existing equivalent airspeed.
10. Thrust is reduced exponentially to reach the four percent gradient value directly over the monitor.

V_2 is calculated as the minimum speed meeting the following requirements:

a) $\geq$ 1.125 times the speed for zero rate of climb (V_{ZRC}) one engine out, gear up, out of ground effect.

b) 3% climb gradient with one engine out, gear up, out of ground effect, zero bank angle.

c) 2% climb gradient with one engine out, gear up, out of ground effect, 18° bank angle.

Lift off speed must meet the following requirements:

a) $\geq$ 1.05 times the minimum unstick speed (V_{MU}) one engine out.

b) $\geq$ 1.10 times the minimum unstick speed (V_{MU}) all engines.

Mission performance is calculated using the mission rules illustrated in Figure 5-16.

Details of the climb path are illustrated in Figure 5-17.

The effect of engine size on mission performance is obtained by holding takeoff gross weight and wing area constant and varying engine size. The effects of changes in engine size on weight empty and aerodynamic cruise efficiency (L/D) are carefully evaluated as shown in Figure 5-18. The resulting range potential is shown in Figure 5-19. It is desired to select an engine size corresponding to maximum range, however, in this case the engine size of 743 lb/sec is the smallest engine which meets the noise constraints established for the study. Therefore, the range penalty incurred is 1 percent for the engine matched to the noise requirements.

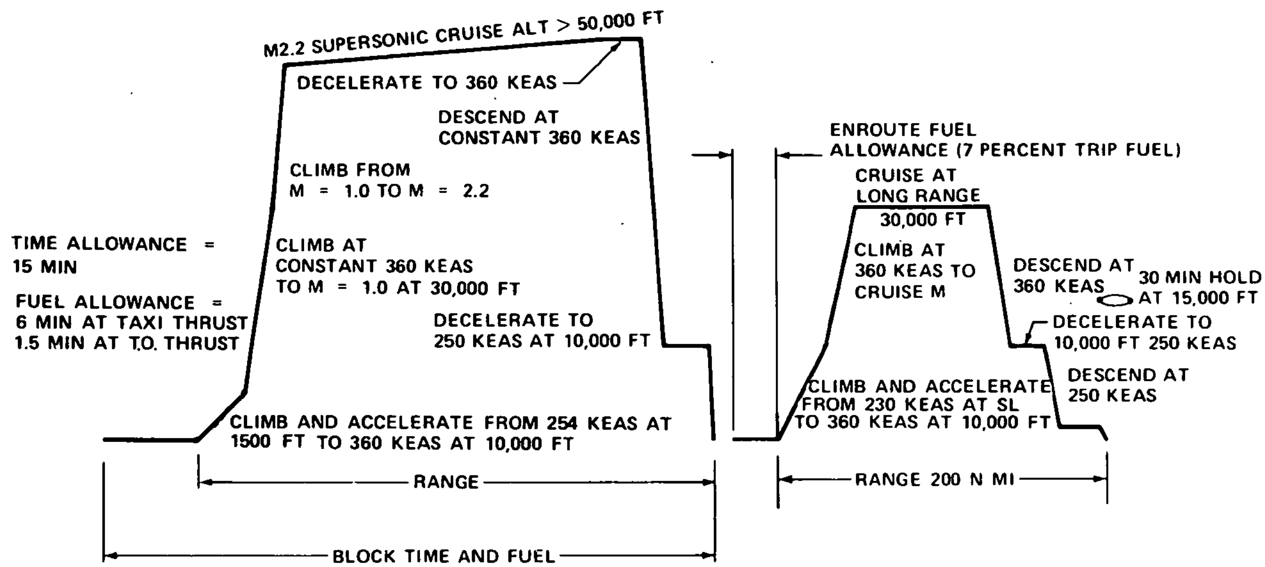


FIGURE 5-16. MISSION PROFILE

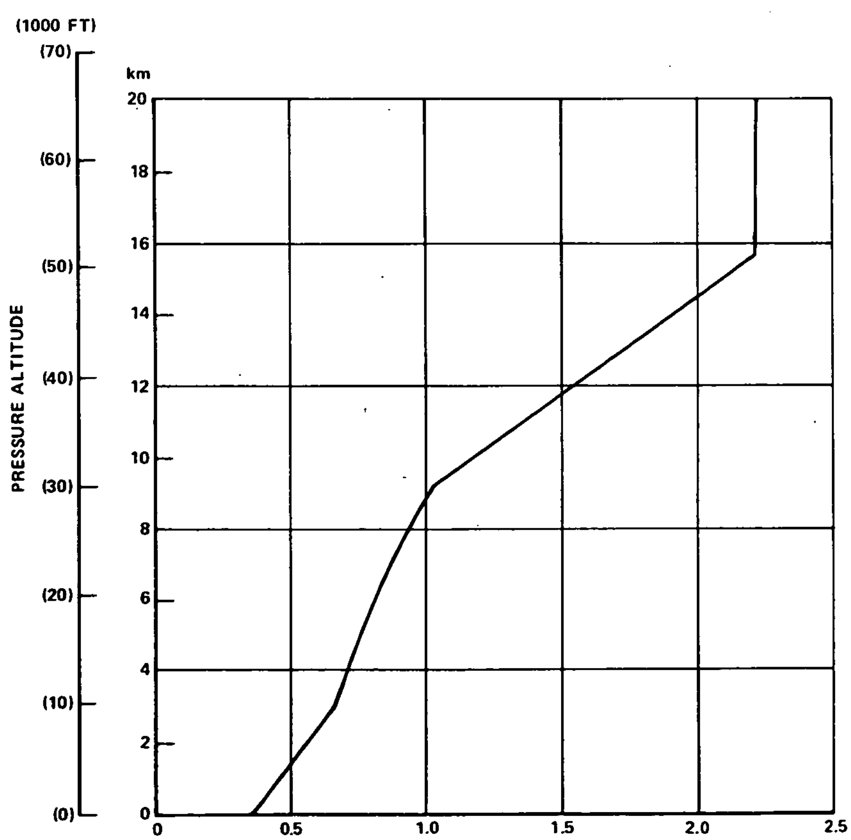


FIGURE 5-17. CLIMB FLIGHTPATH

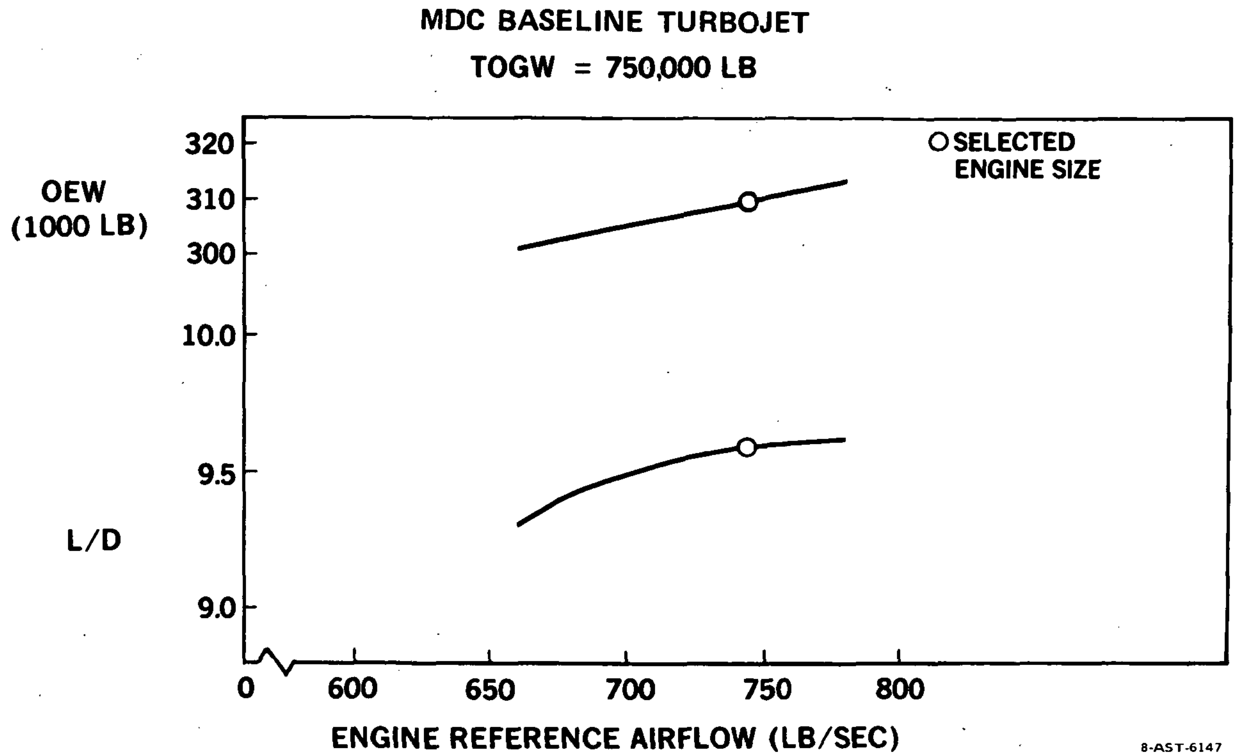


FIGURE 5-18. OPERATING WEIGHT AND L/D VARIATION WITH ENGINE SIZE

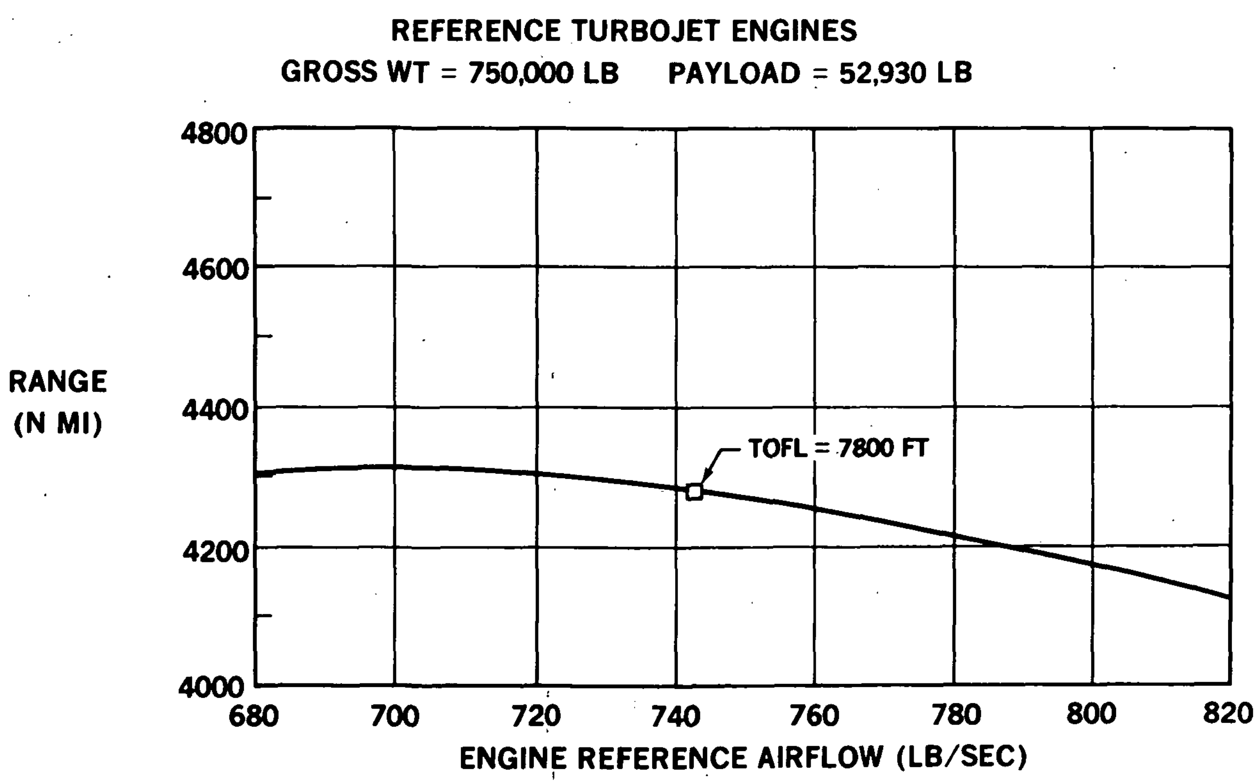


FIGURE 5-19. RANGE SUMMARY

The range characteristics shown were obtained with the engine data as available in the MDC basic deck, except that the results were reduced by 1.5 percent as an allowance for anticipated losses due to the acoustic treatment on the exhaust nozzle.

6.0 CERTIFICATION ANALYSIS

6.1 Acoustics. Many factors must be considered in estimating the probability that an AST aircraft design can meet the three point FAR Part 36 noise certification criteria. Some of the major factors include the accuracy of the flyover noise prediction procedures, the jet noise suppression actually attainable in flight compared to the predicted, the aerodynamic and engine performance achieved inflight compared to the predictions, and the flyover noise measurement repeatability. Two factors which have a major impact or conflict are those associated with jet noise suppression levels and the accuracy of predicting the measured noise levels. These subjects are discussed in the following paragraphs.

6.1.1 Jet Noise Suppression Levels. At the present time, McDonnell Douglas, Rolls-Royce and the British Aerospace Corporation are conducting a cooperative flight test program on unique mechanical suppressor designs, with flight support from the Royal Aircraft Establishment at Bedford, England. The flight test program utilizes a Hawker Siddely HS-125 twin engined aircraft with an uprated Viper Mk. 601 engine on the port side and a standard Viper Mk. 520 on the starboard side. The suppressors are to be mounted on the uprated 601 engine and nacelle.

The suppressor design concepts have been tested at model scale on the Rolls-Royce spinning rig and in the NASA-Ames 40-foot x 80-foot wind tunnel. Flight data at a reasonable scale is needed to confirm favorable test results.

6.1.2 Estimation Tolerances Needed for Flight Certification Confidence. The widespread differences in noise estimates noted in Reference 4 illustrate the difficulties in predicting noise levels of new aircraft/engine combinations prior to flight. No one can be certain what the correct levels are or, in fact, that the correct levels are within the spread of the levels listed. Thus, the prediction accuracy between the estimate and the actual value is unknown at this time. Large scale flight demonstrations of similar hardware are required to estimate the prediction tolerances. Some prediction tolerances will be required to estimate the probability of certification in any new aircraft configuration prior to authorization of production. For example, a certification confidence chart, Figure 6-1, published in Reference 5 illustrates the situation in terms of one standard deviation, σ, for a measurement accuracy ($\sigma \approx 0.5$ EPNdB) and several levels of prediction accuracy. For example, with a prediction accuracy ($\sigma = 2$ EPNdB) and the given measurement accuracy, a tolerance of 3 EPNdB/measuring point is required to achieve an 80 percent probability of certification. With the same tolerance of 3 EPNdB/point, a prediction accuracy of 1 EPNdB is needed to achieve a 100 percent probability of certification, according to Figure 6-1.

The above discussion highlights the risk involved in relying on noise level predictions made prior to flight.

6.1.3 Comparison of Noise Prediction Estimates. In Reference 4, a table of noise estimates from an SST reference engine is shown with values listed from various organizations throughout the world. The reference, or "strawman", prediction procedure, suggested by the subcommittee chairman gives levels slightly different from those of the various organizations. The McDonnell Douglas procedures, for example, produce estimates of unsuppressed EPNL values 1 EPNdB lower than the "strawman" procedure at full takeoff power, four EPNdB higher at cutback power and

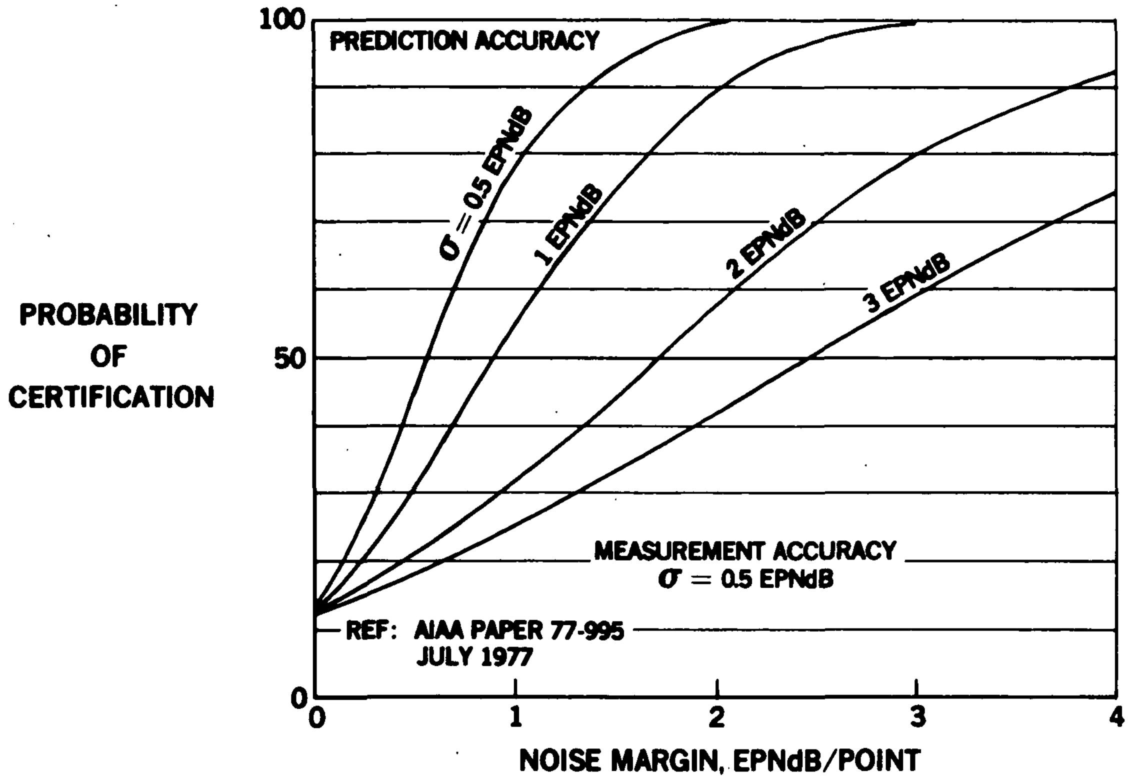


FIGURE 6-1. CERTIFICATION CONFIDENCE

equivalent at approach power. In Reference 4, several additions and/or revisions are suggested to permit the "strawman" procedure to predict noise levels more closely in agreement with the measured test cases. However, the net effect of these proposed changes to the "strawman" procedure cannot be evaluated a priori on what changes would occur to the predicted noise levels for the SST reference engine.

In addition, the level of jet noise suppression provided by a mechanical suppressor is the subject of controversy. Not only is the level of jet noise suppression under discussion, but also controversial is the correct reference, or baseline, nozzle for an advanced supersonic engine. Thus, both the noise level for the proper reference nozzle and the resultant noise level with jet noise suppression are the subjects of much discussion. An exhaust system for an advanced design turbojet engine intended to propel a transport at supersonic cruise conditions would probably feature a form of a convergent-divergent nozzle. If the nozzle were designed without noise constraint, it would be fully hardwall. Noise predictions for such a reference nozzle are relatively straight forward. However, when one considers the advanced coannular nozzle designs which feature inverted velocity profiles, the question of what is a true reference nozzle is raised.

6.2 Performance. The effects of degraded performance on the noise levels predicted for the aircraft have been investigated and three cases are shown in Figure 6-2. For the case where the cruise L/D or SFC is degraded by 2% and the gross weight is increased to maintain the same range, there are small penalties in both field length and flyover noise. For the case of a 20,000 lb increase in operating weight and, assuming the engine thrust (at the same engine

FAA REFERENCE AIRPLANE
RANGE = CONSTANT

	TOGW (LB)	FIELD LENGTH (FT)	SIDELINE NOISE (EPNdB)	FLYOVER NOISE (EPNdB)
BASELINE	750,000	7800	106	108
CRUISE SFC OR L/D DEGRADED 2%	757,500	8040	106	108.5
+20,000 LB OEW AND THRUST INCREASED	792,500	7800	106	109
+20,000 LB, OEW AND NO THRUST INCREASE	792,500	9130	106	110

8-AST-6112A

FIGURE 6-2. RISK ASSESSMENT SUMMARY

size) is increased to maintain the same field length, there is a significant penalty in flyover noise. For the same case where no thrust increase is possible, the flyover noise increases again due to the lower altitude at the monitor. Consideration must be given to tolerances on certified noise values in guaranteed airplane performance.

7.0 REFERENCES

1. Anon.: Advanced Technology Engine Integration/Acoustic Study, Douglas Aircraft Company, Douglas Report MDC J4601, April 1978.

2. Benzakein, M. J., et al: Fan/Compressor Noise Research, Volume II - Detailed Discussion (11), Report No. FAA-RD-71-85, 11 March 1972.

3. Anon.: Concorde Noise - A Submission to the Environmental Protection Agency and Federal Aviation Administration, May 1974.

4. Anon.: ICAO Working Group E, Interim Report of Subcommittee on SST Noise Prediction Methods, 21 March 1972.

5. Foster, C. R.: Noise Regulations of the Federal Government; AIAA Paper No. 77-995, July 1977.

APPENDIX A

TERMINAL AREA PERFORMANCE PROGRAM

D 3230 - 2.2 - 5S

WEIGHT	= 711986.	WAT2	= 700.	THRUST/ENG (LIFT)	= 0
WING AREA	=10000.00	NUMBER OF ENGINES	= 4.0000	NUMBER OF ENGINES	= 0.0
WING LOADING	= 71.199	SCALE FACTOR	= 0.9695	SCALE FACTOR	= 0.0
THRUST-TO-WEIGHT	=	INCLINATION	= 0.0	INCLINATION	= 0.0
FLAP ANGLE	= 20.00	TAU	= 44.5000	TAU	= 0.0
AIRPORT ALTITUDE	= 0.	AIRPORT OTEMP (F)	= 18.00		

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
711986. 0.	0.0 0.0 0.0	0.10 0.10 0.0001	0.0 0.0 0.00	0.0 0.0 0.0	20.000 0.0 0.0000	0.0 0.2406 9.7214	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225807. 0. 225807.	4.0000 44.5000	536.6 2116.2 672.8
711861. 125.	2.00 19.8 0.0	11.61 11.42 0.0172	0.0 0.0 0.44	0.0 0.0 0.0	20.000 0.0 0.0013	0.0 0.2406 9.7108	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225695. 0. 225695.	4.0000 44.5000	536.6 2116.2 672.8
711735. 251.	4.00 78.4 0.0	23.10 22.71 0.0343	0.0 0.0 1.75	0.0 0.0 0.0	20.000 0.0 0.0053	0.0 0.2406 9.6847	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225563. 0. 225563.	4.0000 44.5000	536.6 2116.2 672.8
711610. 376.	6.00 175.7 0.0	34.56 33.97 0.0514	0.0 0.0 3.91	0.0 0.0 0.0	20.000 0.0 0.0119	0.0 0.2406 9.6423	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225409. 0. 225409.	4.0000 44.5000	536.6 2116.2 672.8
711485. 501.	8.00 311.6 0.0	45.95 45.17 0.0683	0.0 0.0 6.92	0.0 0.0 0.0	20.000 0.0 0.0211	0.0 0.2406 9.5870	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225235. 0. 225235.	4.0000 44.5000	536.6 2116.2 672.8
711360. 626.	10.00 485.8 0.0	57.27 56.30 0.0851	0.0 0.0 10.75	0.0 0.0 0.0	20.000 0.0 0.0327	0.0 0.2406 9.5159	0.2165 0.0402 0.9000	0.0 0.0170 0.0	225042. 0. 225042.	4.0000 44.5000	536.6 2116.2 672.8
711235. 751.	12.00 698.0 0.0	68.49 67.34 0.1018	0.0 0.0 15.37	0.0 0.0 0.0	20.000 0.0 0.0468	0.0 0.2406 9.4307	0.2165 0.0402 0.9000	0.0 0.0170 0.0	224829. 0. 224829.	4.0000 44.5000	536.6 2116.2 672.8
711110. 876.	14.00 948.0 0.0	79.61 78.26 0.1183	0.0 0.0 20.77	0.0 0.0 0.0	20.000 0.0 0.0632	0.0 0.2406 9.3317	0.2165 0.0402 0.9000	0.0 0.0170 0.0	224599. 0. 224599.	4.0000 44.5000	536.6 2116.2 672.8
710985. 1001.	16.00 1235.3 0.0	90.60 89.07 0.1347	0.0 0.0 26.90	0.0 0.0 0.0	20.000 0.0 0.0819	0.0 0.2406 9.2196	0.2165 0.0402 0.9000	0.0 0.0170 0.0	224352. 0. 224352.	4.0000 44.5000	536.6 2116.2 672.8
710860. 1126.	18.00 1559.4 0.0	101.45 99.74 0.1509	0.0 0.0 33.73	0.0 0.0 0.0	20.000 0.0 0.1027	0.0 0.2406 9.0950	0.2165 0.0402 0.9000	0.0 0.0170 0.0	224089. 0. 224089.	4.0000 44.5000	536.6 2116.2 672.8
710736. 1250.	20.00 1920.0 0.0	112.15 110.25 0.1667	0.0 0.0 41.21	0.0 0.0 0.0	20.000 0.0 0.1256	0.0 0.2406 8.9587	0.2165 0.0402 0.9000	0.0 0.0170 0.0	223811. 0. 223811.	4.0000 44.5000	536.6 2116.2 672.8
710612. 1374.	22.00 2316.3 0.0	122.68 120.60 0.1823	0.0 0.0 49.21	0.0 0.0 0.0	20.000 0.0 0.1503	0.0 0.2406 8.8115	0.2165 0.0402 0.9000	0.0 0.0170 0.0	223519. 0. 223519.	4.0000 44.5000	536.6 2116.2 672.8

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
710487. 1499.	24.00 2747.9 0.0	133.03 130.78 0.1977	0.0 0.0 57.98	0.0 0.0 0.0	20.000 0.0 0.1767	0.0 0.2406 8.6541	0.2165 0.0402 0.9000	0.0 0.0170 0.0	223215. 0. 223215.	4.0000 44.5000	536.6 2116.2 672.8
710363. 1623.	26.00 3214.1 0.0	143.18 140.76 0.2128	0.0 0.0 67.17	0.0 0.0 0.0	20.000 0.0 0.2048	0.0 0.2406 8.4928	0.2165 0.0402 0.9000	0.0 0.0170 0.0	223018. 0. 223018.	4.0000 44.5000	536.6 2116.2 672.8
710240. 1746.	28.00 3714.2 0.0	153.15 150.56 0.2276	0.0 0.0 76.84	0.0 0.0 0.0	20.000 0.0 0.2343	0.0 0.2406 8.3251	0.2165 0.0402 0.9000	0.0 0.0170 0.0	222861. 0. 222861.	4.0000 44.5000	536.6 2116.2 672.8
710116. 1870.	30.00 4247.7 0.0	162.91 160.16 0.2421	0.0 0.0 86.95	0.0 0.0 0.0	20.000 0.0 0.2651	0.0 0.2406 8.1511	0.2165 0.0402 0.9000	0.0 0.0170 0.0	222726. 0. 222726.	4.0000 44.5000	536.6 2116.2 672.8
710048. 1938.	31.10 4554.2 0.0	168.18 165.33 0.2499	0.0 0.0 92.58	0.0 0.0 0.0	20.000 0.0 0.2823	0.0 0.2406 8.0547	0.2165 0.0402 0.9000	0.0 0.0170 0.0	222661. 0. 222661.	4.0000 44.5000	536.6 2116.2 672.8

710048. 1938.	31.10 4554.2 0.0	168.18 165.33 0.2499	0.0 0.0 92.54	0.0 0.0 0.0	20.000 0.0 0.2822	0.0 0.2406 8.0553	0.2165 0.0402 0.9000	0.0 0.0170 0.0	222662. 0. 222662.	4.0000 44.5000	536.6 2116.2 672.8
709986. 2000.	32.10 4842.0 0.0	172.87 169.94 0.2569	0.0 0.0 97.87	3.000 0.0 3.000	20.000 0.0 0.4971	0.0 0.3875 7.7731	0.3487 0.0464 0.9000	0.0 0.0170 0.0	222607. 0. 222607.	4.0000 44.5000	536.6 2116.2 672.8
709924. 2062.	33.10 5137.5 0.0	177.29 174.29 0.2635	0.0 0.0 103.05	6.000 0.0 6.000	20.000 0.0 0.7309	0.0 0.5344 7.1572	0.4809 0.0598 0.9000	0.0 0.0170 0.0	222560. 0. 222560.	4.0000 44.5000	536.6 2116.2 672.8
709862. 2124.	34.10 5440.0 0.0	181.23 178.16 0.2693	0.0 0.0 107.46	9.000 0.0 9.000	20.000 0.0 0.9771	0.0 0.6812 6.1377	0.6131 0.0783 0.9000	0.0 0.0170 0.0	222523. 0. 222523.	4.0000 44.5000	536.6 2116.2 672.8
709855. 2131.	34.22 5476.9 0.0	181.66 178.59 0.2700	0.0 0.02 107.98	9.362 0.003 9.359	20.000 0.0474 1.0079	0.0 0.6989 5.9757	0.6290 0.0813 0.9000	0.0 0.0170 0.0	222519. 0. 222519.	4.0000 44.5000	536.6 2116.2 672.8

LIFTOFF

X(383)=F(2)= 47.217
X(372)=F(2)= 47.217

709855. 2131.	34.22 5476.9 0.0	181.66 178.59 0.2700	0.0 0.02 107.98	9.362 0.003 9.359	20.000 0.0457 1.0076	0.0 0.6988 5.9718	0.6289 0.0813 0.9000	0.0 0.0170 0.0	222519. 0. 222519.	4.0000 44.5000	536.6 2116.2 672.8
709793. 2193.	35.22 5786.0 1.6	184.66 181.53 0.2744	0.0 3.15 111.54	12.362 0.579 11.782	20.000 1.1072 1.1871	0.0 0.7948 4.1555	0.7153 0.1049 0.9000	0.0 0.0170 0.0	222481. 0. 222481.	4.0000 44.5000	536.6 2116.0 672.8

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
709731. 2255.	36.22 6099.2 8.5	186.48 183.30 0.2771	0.0 10.62 113.70	15.362 1.933 13.428	20.000 1.6008 1.2726	0.0 0.8325 1.9743	0.7493 0.1300 0.9000	0.0 0.0170 0.0	222419. 0. 222419.	4.0000 44.5000	536.6 2115.5 672.8
709669. 2317.	37.22 6414.0 23.6	187.06 183.84 0.2780	0.0 19.63 114.39	17.870 3.564 14.306	20.000 1.6604 1.2824	0.0 0.8307 0.0119	0.7477 0.1492 0.9000	0.0 0.0170 0.0	222318. 0. 222318.	4.0000 44.5000	536.5 2114.4 672.8
709637. 2349.	37.75 6580.3 35.1	187.07 183.81 0.2781	0.0 23.86 114.38	18.015 4.334 13.681	20.000 1.2567 1.2122	0.0 0.7850 0.0072	0.7065 0.1407 0.9000	0.0 0.0170 0.0	222242. 0. 222242.	4.0000 44.5000	536.5 2113.5 672.7

X(323)=F(6)= 192.808

709637. 2349.	37.75 6580.3 35.1	187.07 183.81 0.2781	0.0 23.86 114.38	18.015 4.334 13.681	20.000 1.2975 1.2194	0.0 0.7895 -0.0231	0.7106 0.1423 0.9000	0.0 0.0170 0.0	222242. 0. 222242.	4.0000 44.5000	536.5 2113.5 672.7
709575. 2411.	38.75 6895.5 60.7	187.56 184.32 0.2789	0.0 27.32 115.04	15.144 4.948 10.196	20.000 -0.0700 0.9945	0.0 0.6361 2.0084	0.5725 0.1001 0.9000	0.0 0.0170 0.0	222070. 0. 222070.	4.0000 44.5000	536.4 2111.5 672.7
709513. 2473.	39.75 7212.1 87.8	188.84 185.41 0.2807	0.0 26.86 116.39	14.987 4.835 10.152	20.000 -0.1559 0.9694	0.0 0.6195 1.9990	0.5575 0.0980 0.9000	0.0 0.0170 0.0	221883. 0. 221883.	4.0000 44.5000	536.3 2109.5 672.6
709452. 2534.	40.75 7530.7 114.3	190.03 186.50 0.2825	0.0 26.30 117.75	14.820 4.704 10.116	20.000 -0.1055 0.9783	0.0 0.6181 1.9993	0.5563 0.0987 0.9000	0.0 0.0170 0.0	221700. 0. 221700.	4.0000 44.5000	536.2 2107.4 672.6
709390. 2596.	41.75 7851.4 140.4	191.21 187.59 0.2843	0.0 25.64 119.14	14.663 4.592 10.071	20.000 -0.1192 0.9759	0.0 0.6096 1.9995	0.5486 0.0982 0.9000	0.0 0.0170 0.0	221521. 0. 221521.	4.0000 44.5000	536.1 2105.5 672.5
709329. 2658.	42.75 8174.1 166.1	192.40 188.68 0.2861	0.0 25.50 120.52	14.539 4.503 10.035	20.000 -0.0576 0.9868	0.0 0.6096 1.9995	0.5487 0.0984 0.9000	0.0 0.0170 0.0	221345. 0. 221345.	4.0000 44.5000	536.0 2103.5 672.4
709267. 2719.	43.75 8498.8 191.5	193.58 189.77 0.2879	0.0 25.41 121.92	14.428 4.460 9.968	20.000 -0.0285 0.9919	0.0 0.6062 1.9995	0.5454 0.0974 0.9000	0.0 0.0170 0.0	221171. 0. 221171.	4.0000 44.5000	535.9 2101.6 672.4
709206. 2780.	44.75 8825.5 217.0	194.77 190.86 0.2897	0.0 25.47 123.33	14.320 4.444 9.876	20.000 -0.0042 0.9963	0.0 0.6024 1.9995	0.5421 0.0964 0.9000	0.0 0.0170 0.0	220997. 0. 220997.	4.0000 44.5000	535.9 2099.6 672.3
709144. 2842.	45.75 9154.3 242.5	195.95 191.95 0.2915	0.0 25.65 124.74	14.215 4.448 9.767	20.000 0.0123 0.9992	0.0 0.5978 1.9994	0.5380 0.0951 0.9000	0.0 0.0170 0.0	220823. 0. 220823.	4.0000 44.5000	535.8 2097.7 672.3

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FP WF	NE TAU	TEM PRES C
709083. 2903.	46.75 9485.0 268.3	197.14 193.03 0.2932	0.0 25.91 126.15	14.112 4.466 9.646	20.000 0.0239 1.0013	0.0 0.5928 1.9994	0.5335 0.0938 0.9000	0.0 0.0170 0.0	220648. 0. 220648.	4.0000 44.5000	535.7 2095.7 672.2
709039. 2947.	47.46 9721.9 286.9	197.98 193.81 0.2945	0.0 26.13 127.17	14.039 4.485 9.554	20.000 0.0286 1.0021	0.0 0.5889 1.9998	0.5300 0.0928 0.9000	0.0 0.0170 0.0	220523. 0. 220523.	4.0000 44.5000	535.6 2094.3 672.2

X(463)=E(6)= 193.809
X(493)=E(6)= 193.809

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FP WF	NE TAU	TEM PRES C
709039. 2947.	47.46 9721.9 286.9	197.98 193.81 0.2945	0.0 26.13 127.17	14.039 4.485 9.554	20.000 0.0280 1.0020	0.0 0.5888 2.9809	0.5299 0.0757 0.9000	0.0 0.0 0.0	220523. 0. 220523.	4.0000 44.5000	535.6 2094.3 672.2
708978. 3008.	48.46 10055.9 314.6	199.10 194.83 0.2962	0.0 29.30 128.42	17.039 5.002 12.037	20.000 1.0054 1.1792	0.0 0.6841 0.8077	0.6157 0.1045 0.9000	0.0 0.0 0.0	220337. 0. 220337.	4.0000 44.5000	535.5 2092.2 672.1
708917. 3069.	49.46 10390.5 347.0	199.34 194.97 0.2966	0.0 35.62 128.67	18.300 6.077 12.223	20.000 1.1443 1.2032	0.0 0.6964 -0.0062	0.6267 0.1088 0.9000	0.0 0.0 0.0	220124. 0. 220124.	4.0000 44.5000	535.4 2089.8 672.0
708856. 3130.	50.46 10724.7 385.5	199.34 194.85 0.2966	0.0 41.43 128.54	18.655 7.074 11.581	20.000 0.8503 1.1473	0.0 0.6653 0.0001	0.5988 0.0983 0.9000	0.0 0.0 0.0	219874. 0. 219874.	4.0000 44.5000	535.2 2086.9 672.0
708795. 3191.	51.46 11058.3 429.2	199.34 194.73 0.2967	0.0 45.82 128.38	18.863 7.828 11.035	20.000 0.6573 1.1104	0.0 0.6451 -0.0003	0.5806 0.0918 0.9000	0.0 0.0 0.0	219591. 0. 219591.	4.0000 44.5000	535.1 2083.6 671.9
708734. 3252.	52.46 11391.4 476.7	199.34 194.59 0.2967	0.0 49.16 128.20	19.002 8.402 10.600	20.000 0.4915 1.0788	0.0 0.6280 -0.0004	0.5652 0.0866 0.9000	0.0 0.0 0.0	219283. 0. 219283.	4.0000 44.5000	534.9 2080.0 671.7
708673. 3313.	53.46 11724.0 527.1	199.34 194.45 0.2968	0.0 51.64 128.00	19.084 8.828 10.256	20.000 0.3614 1.0539	0.0 0.6147 -0.0005	0.5532 0.0928 0.9000	0.0 0.0 0.0	218957. 0. 218957.	4.0000 44.5000	534.7 2076.2 671.6
708612. 3374.	54.46 12056.3 579.6	199.34 194.29 0.2968	0.0 53.44 127.80	19.131 9.139 9.992	20.000 0.2598 1.0346	0.0 0.6045 -0.0006	0.5441 0.0799 0.9000	0.0 0.0 0.0	218617. 0. 218617.	4.0000 44.5000	534.6 2072.2 671.5
708551. 3435.	55.46 12388.4 633.7	199.34 194.14 0.2969	0.0 54.72 127.60	19.155 9.360 9.795	20.000 0.1820 1.0198	0.0 0.5970 -0.0006	0.5373 0.0779 0.9000	0.0 0.0 0.0	218268. 0. 218268.	4.0000 44.5000	534.4 2068.2 671.4
708491. 3495.	56.46 12720.3 688.8	199.34 193.98 0.2969	0.0 55.60 127.39	19.164 9.513 9.651	20.000 0.1233 1.0087	0.0 0.5915 -0.0006	0.5324 0.0765 0.9000	0.0 0.0 0.0	217912. 0. 217912.	4.0000 44.5000	534.2 2064.0 671.3

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
708430. 3556.	57.46 13052.1 744.7	199.34 193.82 0.2970	0.0 56.19 127.18	19.163 9.614 9.549	20.000 0.0794 1.0004	0.0 0.5877 -0.0007	0.5289 0.0755 0.9000	0.0 0.0 0.0	217552. 0. 217552.	4.0000 44.5000	534.0 2059.8 671.1
708370. 3616.	58.46 13384.0 800.6	199.49 193.81 0.2973	0.0 55.61 126.97	18.278 9.506 8.771	20.000 -0.2948 0.9319	0.0 0.5493 0.5202	0.4944 0.0662 0.9000	0.0 0.0 0.0	217192. 0. 217192.	4.0000 44.5000	533.8 2055.7 671.0
708309. 3677.	59.46 13716.2 856.0	199.65 193.81 0.2976	0.0 55.08 127.15	19.038 9.407 9.631	20.000 0.0963 1.0040	0.0 0.5899 0.0340	0.5309 0.0760 0.9000	0.0 0.0 0.0	216835. 0. 216835.	4.0000 44.5000	533.6 2051.5 670.9
708249. 3737.	60.46 14048.8 910.9	199.82 193.81 0.2979	0.0 54.70 126.98	18.225 9.334 8.891	20.000 -0.2434 0.9418	0.0 0.5549 0.5174	0.4994 0.0675 0.9000	0.0 0.0 0.0	216482. 0. 216482.	4.0000 44.5000	533.4 2047.4 670.8
708189. 3797.	61.46 14381.8 965.4	199.98 193.81 0.2982	0.0 54.39 127.16	18.976 9.273 9.703	20.000 0.1231 1.0093	0.0 0.5929 0.0307	0.5336 0.0768 0.9000	0.0 0.0 0.0	216131. 0. 216131.	4.0000 44.5000	533.2 2043.4 670.7
708129. 3857.	62.46 14715.0 1019.7	200.14 193.81 0.2985	0.0 54.15 126.98	18.177 9.224 8.953	20.000 -0.2216 0.9460	0.0 0.5573 0.5123	0.5016 0.0680 0.9000	0.0 0.0 0.0	215783. 0. 215783.	4.0000 44.5000	533.0 2039.3 670.5
708069. 3917.	63.46 15048.6 1073.7	200.30 193.81 0.2988	0.0 53.94 127.16	18.913 9.180 9.733	20.000 0.1338 1.0116	0.0 0.5942 0.0324	0.5348 0.0772 0.9000	0.0 0.0 0.0	215436. 0. 215436.	4.0000 44.5000	532.8 2035.3 670.4
708009. 3977.	64.46 15382.5 1127.6	200.46 193.81 0.2990	0.0 53.76 126.99	18.130 9.143 8.987	20.000 -0.2087 0.9485	0.0 0.5588 0.5075	0.5029 0.0683 0.9000	0.0 0.0 0.0	215091. 0. 215091.	4.0000 44.5000	532.6 2031.4 670.3
707950. 4037.	65.46 15716.7 1181.2	200.62 193.81 0.2993	0.0 53.60 127.16	18.853 9.107 9.745	20.000 0.1378 1.0126	0.0 0.5948 0.0346	0.5353 0.0773 0.9000	0.0 0.0 0.0	214747. 0. 214747.	4.0000 44.5000	532.4 2027.4 670.2
707890. 4096.	66.46 16051.2 1234.8	200.78 193.81 0.2996	0.0 53.46 126.99	18.083 9.076 9.007	20.000 -0.2008 0.9501	0.0 0.5597 0.5032	0.5037 0.0686 0.9000	0.0 0.0 0.0	214406. 0. 214406.	4.0000 44.5000	532.2 2023.4 670.0
707830. 4156.	67.46 16386.0 1288.2	200.94 193.81 0.2999	0.0 53.32 127.16	18.794 9.045 9.750	20.000 0.1387 1.0130	0.0 0.5950 0.0367	0.5355 0.0774 0.9000	0.0 0.0 0.0	214065. 0. 214065.	4.0000 44.5000	532.0 2019.5 669.9
707771. 4215.	68.46 16721.1 1341.4	201.10 193.81 0.3002	0.0 53.19 126.99	18.034 9.016 9.018	20.000 -0.1963 0.9511	0.0 0.5602 0.5003	0.5042 0.0687 0.9000	0.0 0.0 0.0	213725. 0. 213725.	4.0000 44.5000	531.8 2015.6 669.8

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
707712. 4275.	69.46 17056.4 1394.5	201.26 193.81 0.3005	0.0 53.06 127.16	18.738 8.987 9.751	20.000 0.1385 1.0131	0.0 0.5951 0.0380	0.5356 0.0774 0.9000	0.0 0.0 0.0	213385. 0. 213385.	4.0000 44.5000	531.7 2011.7 669.7
707652. 4334.	70.46 17392.1 1447.5	201.42 193.81 0.3008	0.0 52.94 127.00	17.986 8.960 9.026	20.000 -0.1932 0.9517	0.0 0.5606 0.4975	0.5045 0.0688 0.9000	0.0 0.0 0.0	213048. 0. 213048.	4.0000 44.5000	531.5 2007.8 669.6
707593. 4393.	71.46 17728.0 1500.4	201.58 193.81 0.3011	0.0 52.82 127.16	18.682 8.932 9.750	20.000 0.1372 1.0131	0.0 0.5951 0.0401	0.5355 0.0774 0.9000	0.0 0.0 0.0	212711. 0. 212711.	4.0000 44.5000	531.3 2003.9 669.5
707534. 4452.	72.46 18064.3 1553.2	201.74 193.81 0.3014	0.0 52.71 127.00	17.939 8.905 9.033	20.000 -0.1898 0.9525	0.0 0.5610 0.4939	0.5049 0.0689 0.9000	0.0 0.0 0.0	212376. 0. 212376.	4.0000 44.5000	531.1 2000.1 669.3
707475. 4511.	73.46 18400.8 1605.8	201.89 193.81 0.3017	0.0 52.59 127.16	18.625 8.878 9.747	20.000 0.1354 1.0129	0.0 0.5950 0.0424	0.5355 0.0774 0.9000	0.0 0.0 0.0	212040. 0. 212040.	4.0000 44.5000	530.9 1996.2 669.2
707416. 4570.	74.46 18737.6 1658.4	202.05 193.81 0.3020	0.0 52.48 127.00	17.892 8.853 9.039	20.000 -0.1870 0.9531	0.0 0.5613 0.4905	0.5052 0.0689 0.9000	0.0 0.0 0.0	211708. 0. 211708.	4.0000 44.5000	530.7 1992.4 669.1
707357. 4629.	75.46 19074.7 1710.8	202.21 193.81 0.3022	0.0 52.37 127.16	18.570 8.826 9.744	20.000 0.1336 1.0128	0.0 0.5949 0.0445	0.5354 0.0773 0.9000	0.0 0.0 0.0	211375. 0. 211375.	4.0000 44.5000	530.5 1988.6 669.0
707299. 4687.	76.46 19412.1 1763.1	202.37 193.81 0.3025	0.0 52.26 127.00	17.844 8.800 9.044	20.000 -0.1847 0.9536	0.0 0.5616 0.4878	0.5054 0.0690 0.9000	0.0 0.0 0.0	211044. 0. 211044.	4.0000 44.5000	530.3 1984.8 668.9
707270. 4716.	76.95 19576.9 1788.6	202.45 193.81 0.3027	0.0 52.25 127.25	18.507 8.797 9.710	20.000 0.1707 1.0201	0.0 0.5987 0.0452	0.5388 0.0784 0.9000	0.0 0.0 0.0	210882. 0. 210882.	4.0000 44.5000	530.2 1982.9 668.8
)7270. 4716.	76 5 195[illegible].9 [illegible].d.6	202.45 193.81 0.3027	0.0 52.25 127.17	18.507 8.797 9.710	20.000 0.1354 1.0133	0.0 0.5951 0.0569	0.5356 0.0774 0.9000	0.0 0.0 0.0	210882. 0. 210882.	4.0000 44.5000	530.2 1982.9 668.8
Cutback	132975. 132717.	131410. 131208.		127427. 131410.	0.5390 0.5385	0.07843 0.07827					
707215. 4771.	77.95 19914.9 1839.8	202.58 193.79 0.3029	0.0 50.14 127.12	15.507 8.432 7.075	20.000 -0.8652 0.8290	0.0 0.4925 0.4090	0.4433 0.0546 0.9000	0.0 0.0 0.0	182094. 0. 182094.	4.0000 33.3529	530.1 1979.2 668.7
	132912. 132747.	131362. 131233.		128813. 131362.	0.5390 0.5387	0.07842 0.07832					
707171. 4815.	78.95 20253.6 1886.3	202.60 193.67 0.3030	0.0 42.84 126.94	12.507 7.198 5.309	20.000 -1.6033 0.6949	0.0 0.4191 -0.3479	0.3772 0.0426 0.9000	0.0 0.0 0.0	134722. 0. 134722.	4.0000 29.5003	529.9 1975.7 668.6
	132910.	131364.		131296.	C 394	0.07853					

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
707134. 4852.	79.95 20593.6 1923.7	202.76 193.72 0.3033	0.0 32.00 127.02	9.507 5.366 4.141	20.000 -2.0605 0.6133	0.0 0.3709 0.8777	0.3338 0.0364 0.9000	0.0 0.0 0.0	131291. 0. 131291.	4.0000 29.2713	529.8 1973.1 668.5
X(533)=E(6)= 193.718											
707134. 4852.	79.95 20593.6 1923.7	202.76 193.72 0.3033	0.0 32.00 127.05	9.507 5.366 4.141	20.000 -2.0811 0.6093	0.0 0.3685 0.8606	0.3317 0.0361 0.9000	0.0 0.0 0.0	131290. 0. 131290.	4.0000 29.2713	529.8 1973.1 668.5
707098. 4888.	80.95 20934.9 1951.7	203.01 193.88 0.3037	0.0 23.98 127.26	12.243 4.013 8.230	20.000 -0.6247 0.8812	0.0 0.5280 0.0004	0.4752 0.0615 0.9000	0.0 0.0 0.0	131211. 0. 131211.	4.0000 29.2713	529.7 1971.1 668.4
707063. 4923.	81.91 21266.0 1973.6	203.01 193.82 0.3037	0.0 21.22 127.18	12.278 3.550 8.728	20.000 -0.3311 0.9367	0.0 0.5610 -0.0007	0.5049 0.0689 0.9000	0.0 0.0 0.0	131159. 0. 131159.	4.0000 29.2713	529.6 1969.5 668.4
3.5 mi.											
X(573)=E(6)= 193.816											
707063. 4923.	81.91 21266.0 1973.6	203.01 193.82 0.3037	0.0 21.22 127.18	12.278 3.550 8.728	20.000 -0.3832 0.9269	0.0 0.5552 0.0000	0.4997 0.0675 0.9000	0.0 0.0 0.0	131159. 0. 131159.	4.0000 29.2713	529.6 1969.5 668.4
707026. 4960.	82.91 21608.1 1993.7	203.08 193.82 0.3038	0.0 18.89 127.10	11.865 3.159 8.706	20.000 -0.3988 0.9243	0.0 0.5540 0.2313	0.4986 0.0672 0.9000	0.0 0.0 0.0	131112. 0. 131112.	4.0000 29.2713	529.5 1968.1 668.3
706990. 4996.	83.91 21950.5 2011.8	203.15 193.84 0.3040	0.0 17.38 127.29	12.225 2.906 9.320	20.000 -0.1082 0.9787	0.0 0.5852 -0.0005	0.5267 0.0748 0.9000	0.0 0.0 0.0	131059. 0. 131059.	4.0000 29.2713	529.5 1966.8 668.3
706953. 5033.	84.91 22292.9 2028.7	203.19 193.82 0.3040	0.0 16.45 127.14	12.021 2.750 9.271	20.000 -0.2036 0.9609	0.0 0.5753 0.1298	0.5178 0.0723 0.9000	0.0 0.0 0.0	131022. 0. 131022.	4.0000 29.2713	529.4 1965.6 668.3
706917. 5069.	85.91 22635.6 2044.8	203.24 193.82 0.3041	0.0 15.67 127.22	12.154 2.619 9.535	20.000 -0.0585 0.9881	0.0 0.5910 0.0293	0.5319 0.0763 0.9000	0.0 0.0 0.0	130979. 0. 130979.	4.0000 29.2713	529.3 1964.4 668.2
706880. 5106.	86.91 22978.3 2060.2	203.28 193.82 0.3042	0.0 15.12 127.15	11.989 2.526 9.463	20.000 -0.1275 0.9753	0.0 0.5837 0.1342	0.5253 0.0744 0.9000	0.0 0.0 0.0	130944. 0. 130944.	4.0000 29.2713	529.3 1963.3 668.2
706844. 5142.	87.91 23321.1 2075.1	203.33 193.82 0.3043	0.0 14.73 127.23	12.156 2.461 9.696	20.000 -0.0024 0.9987	0.0 0.5971 0.0124	0.5374 0.0779 0.9000	0.0 0.0 0.0	130903. 0. 130903.	4.0000 29.2713	529.2 1962.2 668.2
706808. 5178.	88.91 23664.0 2089.7	203.37 193.82 0.3044	0.0 14.43 127.14	11.958 2.409 9.549	20.000 -0.1017 0.9801	0.0 0.5866 0.1449	0.5279 0.0752 0.9000	0.0 0.0 0.0	130871. 0. 130871.	4.0000 29.2713	529.2 1961.2 668.1

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
706771. 5215.	89.91 24007.0 2104.0	203.42 193.82 0.3045	0.0 14.23 127.24	12.167 2.376 9.791	20.000 0.0359 1.0059	0.0 0.6012 -0.0061	0.5411 0.0791 0.9000	0.0 0.0 0.0	130831. 0. 130831.	4.0000 29.2713	529.1 1960.1 668.1
706735. 5251.	90.91 24350.1 2118.1	203.46 193.82 0.3045	0.0 14.05 127.13	11.923 2.345 9.578	20.000 -0.0973 0.9810	0.0 0.5871 0.1608	0.5284 0.0753 0.9000	0.0 0.0 0.0	130801. 0. 130801.	4.0000 29.2713	529.1 1959.1 668.1
706699. 5287.	91.91 24693.2 2132.1	203.51 193.83 0.3046	0.0 13.91 127.25	12.144 2.321 9.823	20.000 0.0502 1.0086	0.0 0.6027 -0.0004	0.5425 0.0795 0.9000	0.0 0.0 0.0	130761. 0. 130761.	4.0000 29.2713	529.0 1958.1 668.0
706662. 5324.	92.91 25036.4 2146.0	203.55 193.82 0.3047	0.0 13.87 127.14	11.969 2.314 9.655	20.000 -0.0647 0.9871	0.0 0.5905 0.1260	0.5315 0.0762 0.9000	0.0 0.0 0.0	130732. 0. 130732.	4.0000 29.2713	529.0 1957.1 668.0
706626. 5360.	93.91 25379.7 2159.8	203.59 193.82 0.3048	0.0 13.81 127.23	12.127 2.303 9.824	20.000 0.0426 1.0072	0.0 0.6020 0.0090	0.5418 0.0792 0.9000	0.0 0.0 0.0	130694. 0. 130694.	4.0000 29.2713	528.9 1956.1 668.0
706590. 5396.	94.91 25723.1 2173.6	203.63 193.82 0.3048	0.0 13.74 127.14	11.940 2.292 9.648	20.000 -0.0656 0.9869	0.0 0.5904 0.1398	0.5314 0.0762 0.9000	0.0 0.0 0.0	130664. 0. 130664.	4.0000 29.2713	528.9 1955.1 667.9
706553. 5433.	95.91 26066.6 2187.4	203.67 193.82 0.3049	0.0 13.72 127.24	12.142 2.288 9.855	20.000 0.0578 1.0100	0.0 0.6035 -0.0066	0.5432 0.0797 0.9000	0.0 0.0 0.0	130626. 0. 130626.	4.0000 29.2713	528.8 1954.2 667.9
706517. 5469.	96.91 26410.1 2201.0	203.71 193.82 0.3050	0.0 13.67 127.13	11.909 2.278 9.631	20.000 -0.0768 0.9848	0.0 0.5892 0.1566	0.5303 0.0759 0.9000	0.0 0.0 0.0	130597. 0. 130597.	4.0000 29.2713	528.8 1953.2 667.9
706481. 5505.	97.91 26753.7 2214.7	203.76 193.83 0.3051	0.0 13.62 127.25	12.124 2.270 9.854	20.000 0.0610 1.0107	0.0 0.6038 -0.0004	0.5434 0.0797 0.9000	0.0 0.0 0.0	130559. 0. 130559.	4.0000 29.2713	528.7 1952.2 667.8
706444. 5542.	98.91 27097.4 2228.3	203.80 193.82 0.3052	0.0 13.65 127.14	11.953 2.274 9.679	20.000 -0.0543 0.9890	0.0 0.5915 0.1245	0.5324 0.0765 0.9000	0.0 0.0 0.0	130530. 0. 130530.	4.0000 29.2713	528.7 1951.2 667.8
706408. 5578.	99.91 27441.1 2242.0	203.84 193.82 0.3052	0.0 13.63 127.23	12.110 2.271 9.839	20.000 0.0487 1.0083	0.0 0.6025 0.0087	0.5422 0.0794 0.9000	0.0 0.0 0.0	130493. 0. 130493.	4.0000 29.2713	528.6 1950.2 667.8
706372. 5614.	100.91 27784.9 2255.6	203.88 193.82 0.3053	0.0 13.60 127.14	11.924 2.265 9.659	20.000 -0.0602 0.9879	0.0 0.5909 0.1390	0.5318 0.0763 0.9000	0.0 0.0 0.0	130464. 0. 130464.	4.0000 29.2713	528.6 1949.3 667.8

TERMINAL AREA PERFORMANCE PROGRAM

WEIGHT FUEL	TIME DIST HEIGHT	V(KTAS) V(KEAS) MACH	V/VS R/C Q	THETA GAMMA ALPHA	FLAP GAMDOT N	CMU CL/CLM A	CL CD CLMAX	DCL DCD DCLM	FG FR WF	NE TAU	TEM PRES C
706336. 5650.	101.91 28128.8 2269.2	203.92 193.82 0.3054	0.0 13.60 127.24	12.126 2.265 9.860	20.000 0.0606 1.0106	0.0 0.6037 -0.0062	0.5433 0.0797 0.9000	0.0 0.0 0.0	130427. 0. 130427.	4.0000 29.2713	528.5 1948.3 667.7

APPENDIX B

MODEL D 3230 - 2.2 - 5S
DAC Turbojet Engines

Wing Area - 10,000 Sq.Ft.
Engine Size - 700 lb/sec

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

TOGW - 711986 lb

CEILING ALTITUDE	WT= 711986.	HP= 54117.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 676387.	HP= 55183.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 640788.	HP= 56308.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 605188.	HP= 57498.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 569589.	HP= 58759.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 533990.	HP= 60102.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 498390.	HP= 61537.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 462791.	HP= 63079.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 427192.	HP= 64745.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 391593.	HP= 66556.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 355993.	HP= 68544.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 320394.	HP= 70749.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 284795.	HP= 73222.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 249195.	HP= 76036.	MACH= 2.200	TAU= 1.000	R/C= 52.
CEILING ALTITUDE	WT= 213596.	HP= 79298.	MACH= 2.200	TAU= 1.000	R/C= 52.

	WEIGHT FUEL	TIME DIST	HP HZ	MACH VGND	VKEAS VKTAS	WF FN	TAU DRAG	SR R/C	CL CDO	CDI CDC	Q CS	PRESS TEMP
ALLOWANCE	705986. 6000.	0.250 0.0										
CLIMB	705986. 6000.	0.250 0.0	0. 0.	0.3477 230.00	230.00 230.00	243115. 242472.	1.000 104894.	0.0009 4539.	0.3942 0.0061	0.0525 0.0	179.1 661.5	2116. 518.7
CLIMB	703534. 8452.	0.261 2.4	2500. 2500.	0.3639 238.64	230.00 238.64	223088. 219384.	1.000 104181.	0.0011 3957.	0.3928 0.0060	0.0521 0.0	179.1 655.8	1932. 509.8
CLIMB	700918. 11068.	0.273 5.4	5000. 5001.	0.3812 247.78	230.00 247.78	204566. 198325.	1.000 103430.	0.0012 3397.	0.3914 0.0060	0.0517 0.0	179.1 650.0	1761. 500.8
ACCELERATION	700918. 11068.	0.273 5.4	5000. 5001.	0.3812 247.78	230.00 247.78	204566. 198325.	1.000 103431.	0.0012 9291.	0.3914 0.0060	0.0517 0.0	179.1 650.0	1761. 500.8
ACCELERATION	700253. 11733.	0.276 6.2	5000. 5001.	0.4312 280.28	260.17 280.28	208989. 195260.	1.000 83823.	0.0013 10921.	0.3056 0.0060	0.0306 0.0	229.2 650.0	1761. 500.8
ACCELERATION	699654. 12332.	0.279 7.1	5000. 5001.	0.4812 312.78	290.34 312.78	214917. 194646.	1.000 71260.	0.0015 12102.	0.2452 0.0060	0.0190 0.0	285.4 650.0	1761. 500.8
ACCELERATION	699090. 12897.	0.281 7.9	5000. 5001.	0.5312 345.28	320.51 345.28	222607. 196481.	1.000 63319.	0.0016 13072.	0.2010 0.0059	0.0123 0.0	347.8 650.0	1761. 500.8
ACCELERATION	698543. 13443.	0.284 8.8	5000. 5001.	0.5812 377.78	350.68 377.78	232243. 200768.	1.000 58589.	0.0016 13968.	0.1678 0.0059	0.0082 0.0	416.3 650.0	1761. 500.8
ACCELERATION	698377. 13609.	0.285 9.1	5000. 5001.	0.5966 387.79	359.97 387.79	235624. 202583.	1.000 57631.	0.0016 14244.	0.1592 0.0059	0.0073 0.0	438.7 650.0	1761. 500.8
CLIMB	698377. 13609.	0.285 9.1	5000. 5001.	0.5966 387.79	359.97 387.79	235624. 202583.	1.000 57631.	0.0016 8151.	0.1592 0.0059	0.0073 0.0	438.7 650.0	1761. 500.8

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT FUEL	TIME DIST	HP HZ	MACH VGND	VKEAS VKTAS	WF FN	TAU DRAG	SR R/C	CL CDO	CDI CDC	Q CS	PRESS TEMP
CLIMB	696926. 15060.	0.291 11.5	7500. 7503.	0.6246 402.37	359.49 402.37	220450. 187876.	1.000 57428.	0.0018 7627.	0.1593 0.0059	0.0073 0.0	437.5 644.2	1602. 491.9
CLIMB	695444. 16543.	0.298 14.4	10000. 10005.	0.6552 418.27	359.44 418.27	206885. 174907.	1.000 57182.	0.0020 7170.	0.1590 0.0058	0.0072 0.0	437.4 638.3	1455. 483.0
CLIMB	693931. 18055.	0.305 17.5	12500. 12507.	0.6885 435.45	359.66 435.45	194795. 163562.	1.000 56897.	0.0022 6778.	0.1585 0.0058	0.0072 0.0	437.9 632.4	1320. 474.1
CLIMB	692390. 19596.	0.313 21.1	15000. 15011.	0.7245 453.86	360.02 453.86	184030. 153712.	1.000 56589.	0.0025 6447.	0.1578 0.0058	0.0071 0.0	438.8 626.4	1194. 465.2
CLIMB	690824. 21162.	0.322 25.2	17500. 17515.	0.7631 473.43	360.40 473.43	174427. 145223.	1.000 56271.	0.0027 6173.	0.1571 0.0057	0.0070 0.0	439.7 620.4	1079. 456.3
CLIMB	689493. 22493.	0.330 28.9	19600. 19618.	0.7976 490.74	360.64 490.74	167126. 139037.	1.000 55999.	0.0029 5985.	0.1566 0.0057	0.0070 0.0	440.3 615.3	989. 448.8
CLIMB	689493. 22493.	0.330 28.9	19600. 19618.	0.7976 490.74	360.64 490.74	157213. 128182.	1.000 55999.	0.0031 5203.	0.1566 0.0057	0.0070 0.0	440.3 615.3	989. 448.8
CLIMB	687729. 24257.	0.342 34.7	22100. 22123.	0.8410 512.33	360.77 512.33	148326. 119229.	1.000 55641.	0.0035 4797.	0.1561 0.0057	0.0069 0.0	440.6 609.2	890. 439.9
CLIMB	685864. 26122.	0.355 41.5	24600. 24629.	0.8872 534.92	360.62 534.92	139835. 110434.	1.000 55279.	0.0038 4356.	0.1558 0.0056	0.0069 0.0	440.3 602.9	799. 430.9
CLIMB	683862. 28125.	0.369 49.5	27100. 27135.	0.9359 558.46	360.11 558.46	131574. 102017.	1.000 55080.	0.0042 3882.	0.1558 0.0056	0.0069 0.0	439.0 596.7	716. 422.0
CLIMB	681462. 30524.	0.388 60.3	29600. 29642.	0.9897 584.26	360.01 584.26	123765. 94125.	1.000 60540.	0.0047 2916.	0.1553 0.0069	0.0069 -0.0000	438.8 590.3	640. 413.1
CLIMB	676061. 35925.	0.432 87.2	32100. 32149.	1.1106 648.50	381.46 648.50	123690. 91802.	1.000 73577.	0.0052 1770.	0.1372 0.0100	0.0050 -0.0001	492.6 583.9	571. 404.2
CLIMB	668316. 43671.	0.494 129.9	34600. 34657.	1.2576 726.21	407.37 726.21	125661. 92519.	1.000 73233.	0.0058 2122.	0.1190 0.0096	0.0035 -0.0001	561.8 577.5	507. 395.3
CLIMB	660789. 51197.	0.554 175.6	37100. 37166.	1.4007 803.37	427.36 803.37	126391. 92149.	1.000 74326.	0.0064 2194.	0.1069 0.0093	0.0028 -0.0001	618.3 573.6	450. 390.0
CLIMB	652477. 59509.	0.620 231.8	39600. 39675.	1.5432 885.14	443.40 885.14	123318. 89210.	1.000 73763.	0.0072 2122.	0.0980 0.0090	0.0022 -0.0001	665.6 573.6	399. 390.0
CLIMB	649275. 62711.	0.646 255.3	40500. 40579.	1.5944 914.49	448.31 914.49	121606. 87775.	1.000 73666.	0.0075 2012.	0.0954 0.0089	0.0020 -0.0001	680.4 573.6	382. 390.0

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT	TIME	HP	MACH	VKEAS	WF	TAU	SR	CL	CDI	Q	PRESS
	FUEL	DIST	HZ	VGND	VKTAS	FN	DRAG	R/C	CDO	CDC	CS	TEMP
CLIMB	649275.	0.646	40500.	1.5944	448.31	127739.	1.000	0.0072	0.0954	0.0020	680.4	382.
	62711.	255.3	40579.	914.49	914.49	94042.	73665.	2907.	0.0089	-0.0001	573.6	390.0
CLIMB	643247.	0.693	43000.	1.7365	459.78	131709.	1.000	0.0076	0.0899	0.0017	715.7	339.
	68740.	299.7	43089.	995.98	995.98	98270.	73535.	3878.	0.0087	-0.0001	573.6	390.0
CLIMB	638007.	0.732	45500.	1.8778	468.21	133821.	1.000	0.0080	0.0860	0.0015	742.2	301.
	73979.	340.6	45599.	1077.05	1077.05	100085.	73521.	4541.	0.0085	-0.0001	573.6	390.0
CLIMB	633076.	0.769	48000.	2.0156	473.28	134290.	1.000	0.0086	0.0835	0.0014	758.3	267.
	78911.	381.7	48111.	1156.11	1156.11	99594.	73531.	4820.	0.0084	-0.0001	573.6	390.0
CLIMB	627920.	0.808	50500.	2.1515	475.73	131162.	1.000	0.0094	0.0820	0.0013	766.2	236.
	84066.	428.1	50622.	1234.06	1234.06	95270.	73072.	4418.	0.0083	-0.0001	573.6	390.0
CLIMB	624881.	0.832	53000.	2.2000	458.08	119953.	1.000	0.0105	0.0880	0.0017	710.4	210.
	87105.	458.4	53135.	1261.85	1261.85	86246.	70073.	3307.	0.0083	-0.0001	573.6	390.0
CLIMB	623059.	0.848	55500.	2.2000	431.37	106372.	1.000	0.0119	0.0989	0.0024	630.0	186.
	88927.	478.8	55648.	1261.85	1261.85	76481.	66818.	1982.	0.0083	-0.0001	573.6	390.0
CLIMB	621472.	0.864	56945.	2.2000	416.65	99236.	1.000	0.0127	0.1057	0.0030	587.7	173.
	90514.	498.3	57100.	1261.85	1261.85	71350.	65465.	1210.	0.0083	-0.0001	573.6	390.0
CRUISE	621473.	0.864	56945.	2.2000	416.65	90905.	1.000	0.0139	0.1057	0.0030	587.7	173.
	90514.	498.3	57100.	1261.85	1261.85	65717.	65467.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	607233.	1.022	57427.	2.2000	411.84	88821.	1.000	0.0142	0.1057	0.0030	574.2	169.
	104753.	698.3	57586.	1261.85	1261.85	64210.	63966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	592993.	1.185	57921.	2.2000	406.99	86739.	1.000	0.0145	0.1057	0.0030	560.8	166.
	118993.	903.0	58082.	1261.85	1261.85	62705.	62467.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	578753.	1.351	58427.	2.2000	402.07	84656.	1.000	0.0149	0.1057	0.0030	547.3	162.
	133233.	1112.7	58590.	1261.85	1261.85	61199.	60966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	564514.	1.521	58945.	2.2000	397.10	82573.	1.000	0.0153	0.1057	0.0030	533.8	158.
	147472.	1327.6	59112.	1261.85	1261.85	59693.	59466.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	550274.	1.696	59476.	2.2000	392.06	80491.	1.000	0.0157	0.1057	0.0030	520.4	154.
	161712.	1547.9	59646.	1261.85	1261.85	58188.	57966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	536034.	1.875	60022.	2.2000	386.95	78437.	1.000	0.0161	0.1057	0.0030	506.9	150.
	175952.	1774.1	60195.	1261.85	1261.85	56681.	56466.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	521794.	2.059	60582.	2.2000	381.78	76325.	1.000	0.0165	0.1057	0.0030	493.5	146.
	190192.	2006.4	60758.	1261.85	1261.85	55176.	54966.	51.	0.0083	-0.0001	573.6	390.0

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT	TIME	HP	MACH	VKEAS	WF	TAU	SR	CL	CDI	Q	PRESS
	FUEL	DIST	HZ	VGND	VKTAS	FN	DRAG	R/C	CDO	CDC	CS	TEMP
CRUISE	507555.	2.248	61158.	2.2000	376.53	74242.	1.000	0.0170	0.1057	0.0030	480.0	142.
	204431.	2245.0	61337.	1261.85	1261.85	53670.	53466.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	493315.	2.443	61750.	2.2000	371.21	72159.	1.000	0.0175	0.1057	0.0030	466.5	138.
	218671.	2490.5	61933.	1261.85	1261.85	52164.	51966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	479075.	2.643	62359.	2.2000	365.82	70077.	1.000	0.0180	0.1057	0.0030	453.1	134.
	232911.	2743.2	62545.	1261.85	1261.85	50659.	50466.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	464835.	2.849	62988.	2.2000	360.33	67992.	1.000	0.0186	0.1057	0.0030	439.6	130.
	247150.	3003.4	63178.	1261.85	1261.85	49152.	48966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	450596.	3.062	63633.	2.2000	354.78	65911.	1.000	0.0191	0.1057	0.0030	426.1	126.
	261390.	3271.8	63828.	1261.85	1261.85	47648.	47467.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	436356.	3.281	64302.	2.2000	349.13	63828.	1.000	0.0198	0.1057	0.0030	412.7	122.
	275630.	3548.8	64501.	1261.85	1261.85	46142.	45966.	51.	0.0083	-0.0001	573.6	390.0
CRUISE	424181.	3.475	64891.	2.2000	344.22	62046.	1.000	0.0203	0.1057	0.0030	401.1	118.
	287805.	3792.9	65093.	1261.85	1261.85	44854.	44684.	51.	0.0083	-0.0001	573.6	390.0
ACCELERATION	424181.	3.475	64891.	2.2000	344.22	13092.	1.000	0.0964	0.1057	0.0030	401.1	118.
	287805.	3792.9	65093.	1261.85	1261.85	-3245.	44684.	200.	0.0083	-0.0001	573.6	390.0
DESCENT	424181.	3.475	64891.	2.2000	344.22	13092.	1.000	0.0964	0.1057	0.0030	401.1	118.
	287805.	3792.9	65093.	1261.85	1261.85	-3245.	44684.	-14439.	0.0083	-0.0001	573.6	390.0
DESCENT	424051.	3.485	62391.	2.1065	350.00	13285.	1.000	0.0909	0.1022	0.0026	414.7	134.
	287935.	3805.1	62578.	1208.23	1208.23	-2558.	45115.	-13756.	0.0083	-0.0001	573.6	390.0
DESCENT	423888.	3.497	59891.	1.9837	350.00	12985.	1.000	0.0876	0.1022	0.0026	414.7	151.
	288098.	3819.6	60063.	1137.77	1137.77	-1716.	45232.	-12760.	0.0084	-0.0001	573.6	390.0
DESCENT	423732.	3.509	57391.	1.8680	350.00	12751.	1.000	0.0840	0.1022	0.0025	414.7	170.
	288254.	3833.1	57549.	1071.43	1071.43	-1235.	45365.	-11933.	0.0085	-0.0001	573.6	390.0
DESCENT	423583.	3.521	54891.	1.7591	350.00	12535.	1.000	0.0805	0.1021	0.0025	414.7	191.
	288404.	3845.3	55036.	1008.95	1008.95	-1474.	45732.	-11387.	0.0087	-0.0001	573.6	390.0
DESCENT	423442.	3.532	52391.	1.6565	350.00	12345.	1.000	0.0770	0.1021	0.0025	414.7	216.
	288544.	3856.4	52523.	950.12	950.12	-2286.	46277.	-11035.	0.0088	-0.0001	573.6	390.0
DESCENT	423310.	3.543	49891.	1.5599	350.00	12155.	1.000	0.0736	0.1021	0.0024	414.7	243.
	288676.	3866.3	50010.	894.72	894.72	-3425.	46928.	-10778.	0.0090	-0.0001	573.6	390.0
DESCENT	423187.	3.553	47391.	1.4690	350.00	12016.	1.000	0.0701	0.1020	0.0025	414.7	275.
	288799.	3875.2	47499.	842.55	842.55	-4739.	47807.	-10595.	0.0092	-0.0001	573.6	390.0

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	WEIGHT FUEL	TIME DIST	HP HZ	MACH VGND	VKEAS VKTAS	WF FN	TAU DRAG	SR R/C	CL CDO	CDI CDC	Q CS	PRESS TEMP
DESCENT	423071. 288915.	3.563 3883.1	44891. 44988.	1.3833 793.42	350.00 793.42	12028. -5944.	1.000 48493.	0.0660 -10339.	0.1020 0.0093	0.0025 -0.0001	414.7 573.6	310. 390.0
DESCENT	422958. 289028.	3.572 3890.2	42391. 42477.	1.3026 747.15	350.00 747.15	12233. -7007.	1.000 48858.	0.0611 -9994.	0.1020 0.0095	0.0024 -0.0001	414.7 573.6	349. 390.0
DESCENT	422847. 289139.	3.581 3896.7	39891. 39967.	1.2267 703.59	350.00 703.59	12537. -7893.	1.000 49586.	0.0561 -9686.	0.1020 0.0097	0.0024 -0.0001	414.7 573.6	394. 390.0
DESCENT	422736. 289250.	3.590 3902.6	37391. 37458.	1.1552 662.56	350.00 662.56	12963. -8597.	1.000 50581.	0.0511 -9393.	0.1019 0.0099	0.0024 -0.0001	414.7 573.6	444. 390.0
DESCENT	422628. 289358.	3.598 3907.9	34891. 34949.	1.0880 627.43	350.00 627.43	13520. -9017.	1.000 51461.	0.0464 -9093.	0.1019 0.0101	0.0024 -0.0001	414.7 576.7	501. 394.2
DESCENT	422522. 289464.	3.606 3912.5	32391. 32441.	1.0259 598.27	350.00 598.27	14209. -9066.	1.000 52496.	0.0421 -8828.	0.1019 0.0102	0.0025 -0.0000	414.7 583.2	563. 403.2
DESCENT	422392. 289594.	3.615 3917.7	29891. 29934.	0.9686 571.07	350.00 571.07	15079. -8187.	1.000 34792.	0.0379 -5884.	0.1019 0.0059	0.0025 0.0	414.7 589.6	632. 412.1
DESCENT	422217. 289769.	3.626 3923.9	27391. 27427.	0.9156 545.64	350.00 545.64	16108. -6815.	1.000 33727.	0.0339 -5305.	0.1018 0.0056	0.0025 0.0	414.7 595.9	707. 421.0
DESCENT	422020. 289966.	3.638 3930.2	24891. 24921.	0.8665 521.84	350.00 521.84	17265. -5463.	1.000 33874.	0.0302 -4926.	0.1018 0.0057	0.0025 0.0	414.7 602.2	789. 429.9
DESCENT	421799. 290187.	3.650 3936.5	22391. 22415.	0.8210 499.54	350.00 499.54	18561. -4136.	1.000 34030.	0.0269 -4577.	0.1017 0.0057	0.0025 0.0	414.7 608.4	879. 438.8
DESCENT	421551. 290435.	3.663 3942.8	19891. 19910.	0.7788 478.61	350.00 478.61	20041. -2929.	1.000 34156.	0.0239 -4264.	0.1017 0.0057	0.0025 0.0	414.7 614.6	977. 447.7
DESCENT	421271. 290715.	3.676 3949.1	17391. 17405.	0.7394 458.94	350.00 458.94	21698. -1803.	1.000 34260.	0.0212 -3978.	0.1016 0.0058	0.0025 0.0	414.7 620.7	1084. 456.7
DESCENT	420953. 291033.	3.690 3955.4	14891. 14902.	0.7028 440.44	350.00 440.44	23504. -662.	1.000 34354.	0.0187 -3710.	0.1015 0.0058	0.0025 0.0	414.7 626.7	1200. 465.6
DESCENT	420592. 291394.	3.705 3961.7	12391. 12398.	0.6686 423.02	350.00 423.02	25466. 491.	1.000 34438.	0.0166 -3457.	0.1014 0.0058	0.0025 0.0	414.7 632.7	1325. 474.5
DESCENT	420200. 291786.	3.720 3967.9	10000. 10005.	0.6380 407.29	350.00 407.29	27500. 1605.	1.000 34504.	0.0148 -3229.	0.1013 0.0058	0.0025 0.0	414.7 638.3	1455. 483.0
DECELERATION	420200. 291786.	3.720 3967.9	10000. 10005.	0.6380 407.29	350.00 407.29	27500. 1605.	1.000 34506.	0.0148 -5373.	0.1013 0.0058	0.0025 0.0	414.7 638.3	1455. 483.0

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT FUEL	TIME DIST	HP HZ	MACH VGND	VKEAS VKTAS	WF FN	TAU DRAG	SR R/C	CL CDO	CDI CDC	Q CS	PRESS TEMP
DECELERATION	420034. 291953.	3.726 3970.3	10000. 10005.	0.5880 375.37	322.57 375.37	26779. 2954.	1.000 33715.	0.0140 -5026.	0.1192 0.0059	0.0037 0.0	352.3 638.3	1455. 483.0
DECELERATION	419864. 292122.	3.732 3972.6	10000. 10005.	0.5380 343.45	295.14 343.45	26099. 3750.	1.000 34006.	0.0132 -4945.	0.1424 0.0059	0.0056 0.0	294.9 638.3	1455. 483.0
DECELERATION	419700. 292286.	3.739 3974.7	10000. 10005.	0.4880 311.54	267.72 311.54	25522. 4460.	1.000 35736.	0.0122 -5114.	0.1730 0.0060	0.0088 0.0	242.7 638.3	1455. 483.0
DECELERATION	419601. 292385.	3.743 3975.8	10000. 10005.	0.4557 290.92	250.00 290.92	25204. 4873.	1.000 37875.	0.0115 -5397.	0.1983 0.0060	0.0119 0.0	211.6 638.3	1455. 483.0
DESCENT	419601. 292385.	3.743 3975.8	10000. 10005.	0.4557 290.92	250.00 290.92	25204. 4873.	1.000 37875.	0.0115 -2317.	0.1983 0.0060	0.0119 0.0	211.6 638.3	1455. 483.0
DESCENT	419057. 292929.	3.763 3981.7	7500. 7503.	0.4344 279.81	250.00 279.81	27541. 5644.	1.000 37836.	0.0102 -2177.	0.1980 0.0060	0.0119 0.0	211.6 644.2	1602. 491.9
DESCENT	418429. 293557.	3.785 3987.7	5000. 5001.	0.4143 269.32	250.00 269.32	30077. 6473.	1.000 37785.	0.0090 -2041.	0.1977 0.0060	0.0118 0.0	211.6 650.0	1761. 500.8
DESCENT	417704. 294282.	3.808 3993.8	2500. 2500.	0.3956 259.40	250.00 259.40	32823. 7363.	1.000 37719.	0.0079 -1909.	0.1974 0.0060	0.0118 0.0	211.6 655.8	1932. 509.8
DESCENT	416863. 295123.	3.833 4000.0	0. 0.	0.3779 250.00	250.00 250.00	35793. 8318.	1.000 37635.	0.0070 -1780.	0.1970 0.0060	0.0117 0.0	211.6 661.5	2116. 518.7
LANDING												
BLOCK POINT												
RESERVES	396204. 315782.	3.833 4000.0										
STAGE POINT												
CLIMB	396204. 315782.	3.833 4000.0	0. 0.	0.3779 250.00	250.00 250.00	245568. 238700.	1.000 34968.	0.0010 13018.	0.1872 0.0060	0.0105 0.0	211.6 661.5	2116. 518.7
CLIMB	395355. 316631.	3.836 4000.8	2500. 2500.	0.3956 259.40	250.00 259.40	225690. 216355.	1.000 34833.	0.0011 12061.	0.1868 0.0060	0.0104 0.0	211.6 655.8	1932. 509.8
CLIMB	394505. 317481.	3.840 4001.8	5000. 5001.	0.4143 269.32	250.00 269.32	207345. 196019.	1.000 34697.	0.0013 11153.	0.1864 0.0060	0.0104 0.0	211.6 650.0	1761. 500.8
CLIMB	393653. 318333.	3.844 4002.9	7500. 7503.	0.4344 279.81	250.00 279.81	190462. 177569.	1.000 34559.	0.0015 10294.	0.1860 0.0060	0.0103 0.0	211.6 644.2	1602. 491.9

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT	TIME	HP	MACH	VKEAS	WF	TAU	SR	CL	CDI	Q	PRESS
	FUEL	DIST	HZ	VGND	VKTAS	FN	DRAG	R/C	CDO	CDC	CS	TEMP
CLIMB	392796.	3.849	10000.	0.4557	250.00	174970.	1.000	0.0017	0.1856	0.0103	211.6	1455.
	319190.	4004.1	10005.	290.92	290.92	160883.	34418.	9485.	0.0060	0.0	638.3	483.0
ACCELERATION	392796.	3.849	10000.	0.4557	250.00	174970.	1.000	0.0017	0.1856	0.0103	211.6	1455.
	319190.	4004.1	10005.	290.92	290.92	160883.	34418.	22095.	0.0060	0.0	638.3	483.0
ACCELERATION	392542.	3.851	10000.	0.5057	277.43	180562.	1.000	0.0018	0.1506	0.0064	260.6	1455.
	319444.	4004.6	10005.	322.84	322.84	161370.	32156.	22590.	0.0059	0.0	638.3	483.0
ACCELERATION	392285.	3.852	10000.	0.5557	304.85	187692.	1.000	0.0019	0.1247	0.0041	314.6	1455.
	319701.	4005.1	10005.	354.75	354.75	163882.	31499.	23159.	0.0059	0.0	638.3	483.0
ACCELERATION	392142.	3.853	10000.	0.5834	320.00	192336.	1.000	0.0019	0.1131	0.0033	346.7	1455.
	319844.	4005.3	10005.	372.38	372.38	166138.	31661.	23534.	0.0059	0.0	638.3	483.0
CLIMB	392142.	3.853	10000.	0.5834	320.00	192336.	1.000	0.0019	0.1131	0.0033	346.7	1455.
	319844.	4005.3	10005.	372.38	372.38	166138.	31661.	12932.	0.0059	0.0	638.3	483.0
CLIMB	391401.	3.857	12500.	0.6126	320.00	179375.	1.000	0.0022	0.1129	0.0032	346.7	1320.
	320585.	4006.8	12507.	387.44	387.44	153420.	31533.	12218.	0.0059	0.0	632.4	474.1
CLIMB	390656.	3.861	15000.	0.6440	320.00	167705.	1.000	0.0024	0.1127	0.0032	346.7	1194.
	321329.	4008.4	15011.	403.41	403.41	142175.	31400.	11584.	0.0058	0.0	626.4	465.2
CLIMB	389909.	3.866	17500.	0.6776	320.00	157241.	1.008	0.0027	0.1125	0.0032	346.7	1079.
	322077.	4010.3	17515.	420.37	420.37	132300.	31261.	11031.	0.0058	0.0	620.4	456.3
CLIMB	389157.	3.871	20000.	0.7136	320.00	147891.	1.000	0.0030	0.1123	0.0032	346.7	972.
	322828.	4012.4	20019.	438.39	438.39	123695.	31116.	10551.	0.0058	0.0	614.3	447.3
CLIMB	388403.	3.876	22500.	0.7524	320.00	139556.	1.000	0.0033	0.1120	0.0032	346.7	875.
	323583.	4014.7	22524.	457.58	457.58	116265.	30964.	10177.	0.0058	0.0	608.2	438.4
CLIMB	387646.	3.881	25000.	0.7941	320.00	132130.	1.000	0.0036	0.1118	0.0032	346.7	785.
	324340.	4017.2	25030.	478.03	478.03	109922.	30805.	9880.	0.0057	0.0	601.9	429.5
CLIMB	387494.	3.882	25500.	0.8029	320.00	130743.	1.000	0.0037	0.1118	0.0032	346.7	768.
	324491.	4017.8	25531.	482.28	482.28	108776.	30771.	9832.	0.0057	0.0	600.7	427.7
CLIMB	387495.	3.882	25500.	0.8029	320.00	122861.	1.000	0.0039	0.1118	0.0032	346.7	768.
	324491.	4017.8	25531.	482.28	482.28	100014.	30771.	8727.	0.0057	0.0	600.7	427.7
CLIMB	386679.	3.889	28000.	0.8486	320.00	115563.	1.000	0.0044	0.1115	0.0031	346.7	688.
	325306.	4021.1	28038.	504.39	504.39	92643.	30574.	8199.	0.0057	0.0	594.4	418.8
CLIMB	386005.	3.895	30000.	0.8877	320.00	110033.	1.000	0.0048	0.1113	0.0031	346.7	628.
	325980.	4024.2	30043.	523.17	523.17	86877.	30405.	7751.	0.0056	0.0	589.3	411.7

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT	TIME	HP	MACH	VKEAS	WF	TAU	SR	CL	CDI	Q	PRESS
	FUEL	DIST	HZ	VGND	VKTAS	FN	DRAG	R/C	CDO	CDC	CS	TEMP
CRUISE	386005.	3.895	30000.	0.9094	327.80	42294.	0.418	0.0127	0.1061	0.0028	363.8	628.
	325980.	4024.2	30043.	535.92	535.92	30578.	30578.	0.	0.0056	0.0	589.3	411.7
CRUISE	378764.	4.068	30000.	0.9049	326.17	41653.	0.411	0.0128	0.1052	0.0027	360.2	628.
	333222.	4116.4	30043.	533.26	533.26	30064.	30064.	0.	0.0056	0.0	589.3	411.7
DESCENT	378764.	4.068	30000.	0.8877	320.00	13991.	1.000	0.0374	0.1093	0.0030	346.7	628.
	333222.	4116.4	30043.	523.17	523.17	-5064.	29914.	-4893.	0.0056	0.0	589.3	411.7
DESCENT	378581.	4.080	27500.	0.8391	320.00	15060.	1.000	0.0332	0.1092	0.0030	346.7	703.
	333405.	4122.9	27536.	499.85	499.85	-3906.	30055.	-4541.	0.0057	0.0	595.7	420.6
DESCENT	378375.	4.094	25000.	0.7941	320.00	16267.	1.000	0.0294	0.1091	0.0030	346.7	785.
	333610.	4129.3	25030.	478.03	478.03	-2796.	30177.	-4218.	0.0057	0.0	601.9	429.5
DESCENT	378143.	4.107	22500.	0.7524	320.00	17657.	1.000	0.0259	0.1091	0.0030	346.7	875.
	333843.	4135.7	22524.	457.58	457.58	-1827.	30269.	-3933.	0.0058	0.0	608.2	438.4
DESCENT	377879.	4.122	20000.	0.7136	320.00	19176.	1.000	0.0229	0.1090	0.0030	346.7	972.
	334107.	4142.1	20019.	438.39	438.39	-844.	30351.	-3665.	0.0058	0.0	614.3	447.3
DESCENT	377578.	4.137	17500.	0.6776	320.00	20834.	1.000	0.0202	0.1089	0.0030	346.7	1079.
	334407.	4148.5	17515.	420.37	420.37	151.	30425.	-3413.	0.0058	0.0	620.4	456.3
DESCENT	377235.	4.152	15000.	0.6440	320.00	22639.	1.000	0.0178	0.1088	0.0030	346.7	1194.
	334751.	4155.0	15011.	403.41	403.41	1156.	30489.	-3176.	0.0058	0.0	626.4	465.2
DESCENT	376841.	4.169	12500.	0.6126	320.00	24602.	1.000	0.0157	0.1087	0.0030	346.7	1320.
	335144.	4161.6	12507.	387.44	387.44	2169.	30541.	-2954.	0.0059	0.0	632.4	474.1
DESCENT	376391.	4.187	10000.	0.5834	320.00	26711.	1.000	0.0139	0.1086	0.0029	346.7	1455.
	335595.	4168.2	10005.	372.38	372.38	3032.	30587.	-2761.	0.0059	0.0	638.3	483.0
DECELERATION	376391.	4.187	10000.	0.5834	320.00	26711.	1.000	0.0139	0.1086	0.0029	346.7	1455.
	335595.	4168.2	10005.	372.38	372.38	3032.	30588.	-5024.	0.0059	0.0	638.3	483.0
DECELERATION	376220.	4.193	10000.	0.5334	292.57	26040.	1.000	0.0131	0.1298	0.0045	289.8	1455.
	335765.	4170.5	10005.	340.46	340.46	3820.	30260.	-4823.	0.0059	0.0	638.3	483.0
DECELERATION	376050.	4.200	10000.	0.4834	265.14	25473.	1.000	0.0121	0.1580	0.0071	238.0	1455.
	335935.	4172.7	10005.	308.54	308.54	4522.	31174.	-4864.	0.0060	0.0	638.3	483.0
DECELERATION	375960.	4.203	10000.	0.4557	250.00	25204.	1.000	0.0115	0.1777	0.0093	211.6	1455.
	336026.	4173.7	10005.	290.92	290.92	4873.	32376.	-5020.	0.0060	0.0	638.3	483.0
DESCENT	375960.	4.203	10000.	0.4557	250.00	25204.	1.000	0.0115	0.1777	0.0093	211.6	1455.
	336026.	4173.7	10005.	290.92	290.92	4873.	32376.	-2155.	0.0060	0.0	638.3	483.0

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

	WEIGHT / FUEL	TIME / DIST	HP / HZ	MACH / VGND	VKEAS / VKTAS	WF / FN	TAU / DRAG	SR / R/C	CL / CDO	CDI / CDC	Q / CS	PRESS / TEMP
DESCENT	375373.	4.226	7500.	0.4344	250.00	27541.	1.000	0.0102	0.1774	0.0093	211.6	1602.
	336612.	4180.1	7503.	279.81	279.81	5644.	32341.	-2015.	0.0060	0.0	644.2	491.9
DESCENT	374694.	4.249	5000.	0.4143	250.00	30077.	1.000	0.0090	0.1771	0.0093	211.6	1761.
	337292.	4186.5	5001.	269.32	269.32	6473.	32293.	-1879.	0.0060	0.0	650.0	500.8
DESCENT	373904.	4.274	2500.	0.3956	250.00	32823.	1.000	0.0079	0.1767	0.0092	211.6	1932.
	338082.	4193.2	2500.	259.40	259.40	7363.	32231.	-1747.	0.0060	0.0	655.8	509.8
DESCENT	372982.	4.301	0.	0.3779	250.00	35793.	1.000	0.0070	0.1763	0.0092	211.6	2116.
	339004.	4200.0	0.	250.00	250.00	8318.	32151.	-1618.	0.0060	0.0	661.5	518.7
STAGE POINT												
HOLD	372982.	4.301	15000.	0.5414	269.01	40607.	0.253	0.0084	0.1522	0.0066	245.0	1194.
	339004.	4200.0	15011.	339.13	339.13	30552.	30552.	0.	0.0059	0.0	626.4	465.2
HOLD	358742.	4.659	15000.	0.5263	261.51	39017.	0.245	0.0084	0.1549	0.0068	231.5	1194.
	353243.	4200.0	15011.	329.67	329.67	29527.	29527.	0.	0.0059	0.0	626.4	465.2
HOLD	353233.	4.801	15000.	0.5204	258.61	38386.	0.242	0.0085	0.1560	0.0069	226.4	1194.
	358752.	4200.0	15011.	326.02	326.02	29130.	29130.	0.	0.0059	0.0	626.4	465.2

K5JA MISSION ANALYSIS CASE 1 MCDONNELL DOUGLAS CORPORATION JUNE 21, 1978

T.O.G.W. =	711986.	~~[illegible]~~ WAT2 =	700.	TOTAL TIME=	4.801	BLOCK TIME =	3.833	(T-MP) TIME=	0.0
WING AREA=	10000.0	NE =	4.0000	TOTAL FUEL=	358752.	BLOCK FUEL =	295123.	(T-MP) FUEL=	0.
PAYLOAD =	52931.	ENG SIZE =	1.0000	TOTAL DIST=	4200.	BLOCK DIST =	4000.	(T-MP) DIST=	0.
O.E.W. =	300304.	WF MULT =	1.0000	F =	0.0	(T-B) TIME =	0.968	MP WT/SW =	0.0
WT/SW =	71.20	FN MULT =	1.0000	AR =	0.0	(T-B) FUEL =	63629.	MP FN/WT =	0.0
~~FN/WT~~ =	~~[illegible]~~	FUEL/WT =	0.5039	E =	0.0	(T-B) DIST =	200.	MP FUEL/WT =	0.0

MISSION SEGMENT	FINAL WEIGHT	SEGMENT TIME	SEGMENT FUEL	SEGMENT DIST	ACCUM DIST	INITIAL HP	FINAL HP	INITIAL MACH	FINAL MACH
ALLOWANCE	705986.	0.250	6000.	0.0	0.0				
CLIMB	700918.	0.023	5068.	5.4	5.4	0.	5000.	0.348	0.381
ACCELERATION	698377.	0.012	2541.	3.7	9.1	5000.	5000.	0.381	0.597
CLIMB	689493.	0.046	8884.	19.9	28.9	5000.	19600.	0.597	0.798
CLIMB	649275.	0.316	40218.	226.4	255.3	19600.	40500.	0.798	1.594
CLIMB	621473.	0.218	27803.	243.0	498.3	40500.	56945.	1.594	2.200
CRUISE /	424181.	2.611	197291.	3294.6	3792.9	56945.	64891.	2.200	2.200
ACCELERATION	424181.	0.0	0.	0.0	3792.9	64891.	64891.	2.200	2.200
DESCENT	420200.	0.245	3981.	175.0	3967.9	64891.	10000.	2.200	0.638
DECELERATION	419601.	0.023	599.	8.0	3975.8	10000.	10000.	0.638	0.456
DESCENT	416863.	0.090	2738.	24.2	4000.0	10000.	0.	0.456	0.378
LANDING									
BLOCK POINT									
RESERVES	396204.	0.0	20659.	0.0	0.0				
STAGE POINT									
CLIMB	392796.	0.017	3408.	4.2	4.2	0.	10000.	0.378	0.456
ACCELERATION	392142.	0.004	654.	1.2	5.3	10000.	10000.	0.456	0.583
CLIMB	387495.	0.030	4647.	12.5	17.8	10000.	25500.	0.583	0.803
CLIMB	386005.	0.013	1489.	6.4	24.2	25500.	30000.	0.803	0.888
CRUISE	378764.	0.173	7242.	92.2	116.4	30000.	30000.	0.909	0.905
DESCENT	376391.	0.119	2373.	51.8	168.2	30000.	10000.	0.888	0.583
DECELERATION	375960.	0.017	431.	5.5	173.8	10000.	10000.	0.583	0.456
DESCENT	372982.	0.098	2978.	26.3	200.0	10000.	0.	0.456	0.378
STAGE POINT									
HOLD	353233.	0.500	19748.	0.0	0.0	15000.	15000.	0.541	0.520

V APP= 138.043

X LOCATION
470. MACH
470. ACCE

NUMBER OF ITERATIONS = 6

APPENDIX C

FINAL FORMAT FOR PROPULSION INPUT FOR TAKEOFF

CARD 1

M	ALT	SN	PS	INSTALLED NET THRUST	WPI	VPI	API	TTPI	NPRI
MACH	ALTITUDE	CARD NO. 1	ENG POWER SETTING	NET THRUST	PRIMARY AIRFLOW	PRI JET VEL	PRI JET FULLY EXP AREA	PRI JET TOT TEM	PRI NOZ PRESS RTO
-	FEET	-	-	#F	#m/sec	ft/sec	in^2	^oR	-
F5.2	F10.1	I5	F5.1	F10.2	F10.2	F10.2	F10.2	F10.2	F5.1

CARD 2

M	ALT	SN	PS	WF	WP2	VP2	AP2	TTP2	NPR2
MACH	ALTITUDE	CARD NO. 2	ENG POWER SETTING	TOTAL FUEL FLOW	SEC AIRFLOW	SEC JET VEL	SEC JET FULLY EXP AREA	SEC JET TOT TEM	SEC NPR
	FEET	—	—	#m/hr	#m/sec	ft/sec	in^2	^oR	-
F5.2	F10.1	I5	F5.1	F10.2	F10.2	F10.2	F10.2	F10.2	F5.1

CARD 3

M	ALT	SN	PS	TFAN	RD	CIP	CET	FRM	CIT
MACH	ALTITUDE	CARD NO. 3	ENG POWER SETTING	FAN TEMP RISE	RAM DRAG	COMB INLET PRESS	COMB EXIT TEMP	FAN RPM	COMB INLET TEMP
	FEET	-	-	^oR	#F	PSF	^oR	RPM	^oR
F5.2	F10.1	I5	F5.1	F10.2	F10.2	F10.2	F10.2	F10.2	F5.0

LISTING

Engine data for takeoff program

DAC Turbojet
SPEC DK PG
SPEC DK 63

13 July 1978

0.0	0.0	1	50.0	60150.93	663.40	2471.25	1314.27	2201.35 3.92
0.0	0.0	2	50.0	60195.64	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	50.0	0.0	0.0	247.64	3060.14	5291.591337.
0.0	2000.0	1	50.0	56962.24	625.19	2982.66	1321.96	2200.51 3.98
0.0	2000.0	2	50.0	57565.55	0.0	0.0	0.0	0.0 0.0
0.0	2000.0	3	50.0	0.0	0.0	232.74	3059.55	5305.971330.
0.0	4000.0	1	50.0	53794.24	568.70	2994.62	1329.77	2199.68 4.05
0.0	4000.0	2	50.0	54402.54	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	50.0	0.0	0.0	219.08	3058.94	5321.581323.
0.1	0.0	1	50.0	59926.90	664.55	2996.35	1333.64	2200.87 4.04
0.1	0.0	2	50.0	62799.80	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	50.0	0.0	2414.07	254.95	3060.14	5294.641338.
0.1	2000.0	1	50.0	56667.40	644.73	3010.60	1340.46	2200.64 4.10
0.1	2000.0	2	50.0	59356.44	0.0	0.0	0.0	0.0 0.0
0.1	2000.0	3	50.0	0.0	2256.57	240.01	3059.55	5304.141331.
0.1	4000.0	1	50.0	53384.60	606.64	3022.42	1346.00	2199.99 4.16
0.1	4000.0	2	50.0	56005.64	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	50.0	0.0	2111.55	225.84	3058.94	5315.991324.
0.2	0.0	1	50.0	59359.10	705.18	3031.00	1348.36	2205.43 4.18
0.2	0.0	2	50.0	64632.61	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	50.0	0.0	4973.62	262.42	3060.14	5264.551340.
0.2	2000.0	1	50.0	56239.20	664.73	3037.37	1359.60	2200.49 4.23
0.2	2000.0	2	50.0	61100.24	0.0	0.0	0.0	0.0 0.0
0.2	2000.0	3	50.0	0.0	4657.27	247.47	3059.55	5296.201334.
0.2	4000.0	1	50.0	53194.10	626.62	3048.63	1368.30	2199.72 4.28
0.2	4000.0	2	50.0	57722.22	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	50.0	0.0	4356.57	233.60	3058.94	5313.441327.
0.3	0.0	1	50.0	59124.30	730.17	3053.06	1376.36	2198.13 4.31
0.3	0.0	2	50.0	66704.00	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	50.0	0.0	7724.81	272.04	3060.14	5278.021346.
0.3	2000.0	1	50.0	56036.00	689.12	3069.10	1382.95	2200.86 4.38
0.3	2000.0	2	50.0	63175.39	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	50.0	0.0	7242.20	256.65	3059.55	5280.701339.
0.3	4000.0	1	50.0	53019.10	646.78	3080.26	1391.41	2200.16 4.44
0.3	4000.0	2	50.0	59677.40	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	50.0	0.0	6772.43	241.49	3058.94	5300.231332.
0.4	0.0	1	50.0	58808.40	761.35	3091.72	1401.77	2202.35 4.49
0.4	0.0	2	50.0	69277.03	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	50.0	0.0	10739.50	283.61	3060.14	5253.211354.
0.4	2000.0	1	50.0	55736.10	716.34	3096.74	1411.69	2197.86 4.55
0.4	2000.0	2	50.0	65415.62	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	50.0	0.0	10057.69	266.85	3059.55	5276.341346.
0.4	4000.0	1	50.0	52796.10	675.39	3114.30	1416.76	2200.35 4.62
0.4	4000.0	2	50.0	61697.41	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	50.0	0.0	9400.31	251.50	3058.94	5265.491339.
0.5	0.0	1	50.0	58212.10	790.09	3123.63	1428.51	2201.31 4.67
0.5	0.0	2	50.0	71636.25	0.0	0.0	0.0	0.0 0.0
0.5	0.0	3	50.0	0.0	13941.61	294.67	3060.14	5190.141362.
0.5	2000.0	1	50.0	55469.10	748.53	3140.23	1439.16	2202.32 4.76
0.5	2000.0	2	50.0	68059.09	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	50.0	0.0	13110.84	278.84	3059.55	5255.011354.
0.5	4000.0	1	50.0	52742.00	706.32	3150.38	1451.01	2199.44 4.83
0.5	4000.0	2	50.0	64430.47	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	50.0	0.0	12288.44	263.08	3058.94	5263.131347.
0.0	0.0	1	26.0	17354.50	386.49	1564.34	1064.00	1382.02 1.77
0.0	0.0	2	26.0	16537.50	0.0	0.0	0.0	0.0 0.0

0.0	0.0	3	26.0	0.0	0.0	115.27	1954.94	4243.891050.
0.0	0.0	1	28.0	24237.70	441.03	1901.65	1072.94	1530.72 2.15
0.0	0.0	2	28.0	23007.20	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	28.0	0.0	0.0	137.88	2159.81	4344.331103.
0.0	0.0	1	30.0	32065.66	497.22	2192.19	1111.06	2.54
0.0	0.0	2	30.0	30322.41	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	30.0	0.0	0.0	162.37	2364.67	1154.
0.0	0.0	1	32.0	40611.69	553.96	2452.54	1167.96	2.96
0.0	0.0	2	32.0	38366.44	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	32.0	0.0	0.0	188.39	2569.53	4586.211206.
0.0	0.0	1	34.0	49462.16	607.98	2687.01	1234.47	1987.23 3.39
0.0	0.0	2	34.0	47714.32	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	34.0	0.0	0.0	215.12	2774.40	4742.611260.
0.0	0.0	1	35.0	53713.59	631.55	2795.50	1265.49	2062.28 3.60
0.0	0.0	2	35.0	52238.55	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	35.0	0.0	0.0	227.88	2876.83	4953.891287.
0.0	0.0	1	40.0	57701.58	653.04	2898.70	1294.53	2139.59 3.80
0.0	0.0	2	40.0	57362.41	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	40.0	0.0	0.0	239.72	2977.36	5171.131315.
0.0	0.0	1	50.0	60156.95	663.40	2971.25	1314.27	2201.35 3.92
0.0	0.0	2	50.0	60195.64	0.0	0.0	0.0	0.0 0.0
0.0	0.0	3	50.0	0.0	0.0	247.04	3060.14	5291.591337.
0.1	0.0	1	26.0	16980.90	398.04	1621.72	1062.45	1382.08 1.82
0.1	0.0	2	26.0	17444.09	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	26.0	0.0	1403.70	118.73	1954.94	4246.591051.
0.1	0.0	1	28.0	23664.90	453.73	1935.14	1076.66	1531.21 2.19
0.1	0.0	2	28.0	23717.08	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	28.0	0.0	1600.08	141.85	2159.81	4345.851104.
0.1	0.0	1	30.0	31643.70	513.46	2222.55	1122.41	1683.64 2.61
0.1	0.0	2	30.0	31209.55	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	30.0	0.0	1810.70	167.66	2364.67	4455.031156.
0.1	0.0	1	32.0	40166.20	570.62	2480.95	1160.36	1637.51 3.05
0.1	0.0	2	32.0	39510.29	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	32.0	0.0	2012.30	194.07	2569.53	4587.891207.
0.1	0.0	1	34.0	48968.40	625.13	2715.43	1247.05	1988.95 3.49
0.1	0.0	2	34.0	49050.42	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	34.0	0.0	2204.53	221.12	2774.40	4738.951260.
0.1	0.0	1	35.0	55363.90	651.13	2822.92	1281.83	2062.28 3.71
0.1	0.0	2	35.0	54101.65	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	35.0	0.0	2296.20	234.81	2876.83	4947.291289.
0.1	0.0	1	40.0	57438.70	674.08	2925.32	1313.95	2138.93 3.92
0.1	0.0	2	40.0	59167.20	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	40.0	0.0	2377.15	247.45	2977.36	5176.721317.
0.1	0.0	1	50.0	59928.90	684.55	2998.35	1333.64	2200.87 4.04
0.1	0.0	2	50.0	62799.88	0.0	0.0	0.0	0.0 0.0
0.1	0.0	3	50.0	0.0	2414.07	254.95	3060.14	5294.641338.
0.2	0.0	1	26.0	16114.40	468.52	1654.64	1061.47	1382.64 1.87
0.2	0.0	2	26.0	17645.75	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	26.0	0.0	2881.28	121.87	1954.94	4253.651055.
0.2	0.0	1	28.0	22642.10	465.82	1963.66	1081.96	1531.10 2.25
0.2	0.0	2	28.0	24279.07	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	28.0	0.0	3265.45	145.70	2159.81	4352.921107.
0.2	0.0	1	30.0	30752.50	526.03	2248.84	1129.35	1684.25 2.68
0.2	0.0	2	30.0	31977.09	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	30.0	0.0	3710.07	171.62	2364.67	4459.501158.
0.2	0.0	1	32.0	35385.50	586.26	2506.66	1192.13	1837.59 3.13

0.2	0.0	2	32.0	40521.74	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	32.0	0.0	4134.84	199.41	2569.53	4591.351210.
0.2	0.0	1	34.0	46169.20	642.08	2739.80	1261.27	1988.73 3.59
0.2	0.0	2	34.0	50262.59	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	34.0	0.0	4528.56	227.22	2774.40	4741.641263.
0.2	0.0	1	35.0	52674.40	669.36	2847.78	1297.74	2062.22 3.82
0.2	0.0	2	35.0	55527.09	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	35.0	0.0	4720.99	241.40	2876.83	4924.971291.
0.2	0.0	1	40.0	56662.30	692.12	2950.75	1329.02	2139.09 4.03
0.2	0.0	2	40.0	60682.95	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	40.0	0.0	4881.47	254.11	2977.36	5145.461319.
0.2	0.0	1	50.0	59359.10	705.18	3031.00	1348.36	2205.43 4.18
0.2	0.0	2	50.0	64052.01	0.0	0.0	0.0	0.0 0.0
0.2	0.0	3	50.0	0.0	4975.02	262.42	3060.14	5264.551340.
0.3	0.0	1	26.0	15224.60	420.61	1689.32	1062.71	1382.99 1.92
0.3	0.0	2	26.0	18268.81	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	26.0	0.0	4449.79	125.55	1954.94	4266.771060.
0.3	0.0	1	28.0	21967.60	480.29	1996.94	1087.57	1533.54 2.32
0.3	0.0	2	28.0	24904.02	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	28.0	0.0	5061.19	150.24	2159.81	4363.491113.
0.3	0.0	1	30.0	29671.30	541.30	2277.44	1139.14	1684.80 2.76
0.3	0.0	2	30.0	32785.94	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	30.0	0.0	5726.64	176.85	2364.67	4469.821164.
0.3	0.0	1	32.0	38607.20	603.21	2533.66	1205.21	1837.03 3.23
0.3	0.0	2	32.0	41574.97	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	32.0	0.0	6381.60	205.22	2569.53	4596.331214.
0.3	0.0	1	34.0	47370.2	661.27	2767.29	1276.86	1989.56 3.70
0.3	0.0	2	34.0	51633.73	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	34.0	0.0	6995.93	234.03	2774.40	4745.001268.
0.3	0.0	1	35.0	51906.00	689.77	2876.71	1314.22	2064.25 3.94
0.3	0.0	2	35.0	57065.65	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	35.0	0.0	7297.38	248.76	2876.83	4873.641295.
0.3	0.0	1	40.0	56121.30	714.66	2977.67	1349.67	2137.87 4.16
0.3	0.0	2	40.0	62488.91	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	40.0	0.0	7560.88	262.45	2977.36	5117.511324.
0.3	0.0	1	50.0	59124.30	730.17	3053.06	1376.38	2198.13 4.31
0.3	0.0	2	50.0	66704.06	0.0	0.0	0.0	0.0 0.0
0.3	0.0	3	50.0	0.0	7724.81	272.64	3060.14	5276.021346.
0.4	0.0	1	26.0	14120.70	432.07	1724.53	1063.38	1383.95 1.98
0.4	0.0	2	26.0	16636.25	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	26.0	0.0	6103.20	129.23	1954.94	4283.281067.
0.4	0.0	1	28.0	20976.40	495.33	2029.47	1095.57	1533.34 2.39
0.4	0.0	2	28.0	25518.60	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	28.0	0.0	6967.06	155.05	2159.80	4380.621120.
0.4	0.0	1	30.0	28875.20	559.14	2306.86	1152.23	1664.75 2.84
0.4	0.0	2	30.0	33070.58	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	30.0	0.0	7667.25	182.77	2364.67	4486.691172.
0.4	0.0	1	32.0	37297.60	624.55	2566.41	1219.67	1841.27 3.33
0.4	0.0	2	32.0	42014.26	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	32.0	0.0	8809.92	212.53	2569.53	4601.971223.
0.4	0.0	1	34.0	46465.30	682.93	2796.15	1294.75	1990.02 3.82
0.4	0.0	2	34.0	55094.00	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	34.0	0.0	9633.38	241.74	2774.40	4752.471275.
0.4	0.0	1	35.0	50766.40	710.55	2907.88	1329.41	2068.25 4.06
0.4	0.0	2	35.0	58629.42	0.0	0.0	0.0	0.0 0.0
0.4	0.0	3	35.0	0.0	10022.99	256.17	2876.83	4819.201301.

0.4	0.0	1	40.0	55442.20	740.50	3004.94	1375.01	2135.21	4.30
0.4	0.0	2	40.0	64400.52	0.0	0.0	0.0	0.0	0.0
0.4	0.0	3	40.0	0.0	10442.64	271.97	2977.36	5085.23	1331.
0.4	0.0	1	50.0	52800.40	761.35	3091.72	1401.77	2202.35	4.49
0.4	0.0	2	50.0	69277.63	0.0	0.0	0.0	0.0	0.0
0.4	0.0	3	50.0	0.0	10759.50	283.61	3060.14	5253.21	1354.
0.5	0.0	1	26.0	12959.00	446.75	1701.17	1066.16	1365.38	2.04
0.5	0.0	2	26.0	19063.30	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	26.0	0.0	7677.22	135.55	1954.94	4304.48	1077.
0.5	0.0	1	28.0	19911.50	511.53	2063.55	1104.70	1532.88	2.47
0.5	0.0	2	28.0	20145.04	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	28.0	0.0	9019.40	160.26	2159.81	4401.46	1128.
0.5	0.0	1	30.0	27742.90	576.75	2338.44	1163.38	1685.73	2.94
0.5	0.0	2	30.0	34515.55	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	30.0	0.0	10169.59	188.06	2364.67	4505.62	1180.
0.5	0.0	1	32.0	43042.50	645.57	2594.95	1237.84	1836.61	3.45
0.5	0.0	2	32.0	44010.55	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	32.0	0.0	11362.90	219.82	2569.53	4613.25	1232.
0.5	0.0	1	34.0	45540.7	704.65	2824.33	1313.46	1969.03	3.95
0.5	0.0	2	34.0	54579.25	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	34.0	0.0	12424.72	249.30	2774.40	4757.04	1283.
0.5	0.0	1	35.0	49920.90	757.36	2936.34	1353.69	2067.69	4.21
0.5	0.0	2	35.0	60511.98	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	35.0	0.0	13005.24	260.66	2876.83	4631.35	1310.
0.5	0.0	1	40.0	54645.90	769.20	3042.43	1397.42	2140.81	4.47
0.5	0.0	2	40.0	60691.60	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	40.0	0.0	13563.96	282.57	2977.36	5000.30	1339.
0.5	0.0	1	50.0	58212.10	750.09	3123.83	1428.51	2201.31	4.67
0.5	0.0	2	50.0	71656.25	0.0	0.0	0.0	0.0	0.0
0.5	0.0	3	50.0	0.0	13541.61	294.07	3060.14	5190.14	1362.
0.0	2000.0	1	26.0	17015.06	367.66	1613.16	1062.66	1381.01	1.81
0.0	2000.0	2	26.0	16252.66	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	26.0	0.0	0.0	109.03	1954.56	4227.07	1043.
0.0	2000.0	1	28.0	23405.77	426.34	1927.36	1077.75	1529.89	2.16
0.0	2000.0	2	28.0	22113.75	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	28.0	0.0	0.0	131.36	2159.39	4330.35	1097.
0.0	2000.0	1	30.0	30966.32	474.39	2217.66	1116.20	1685.05	2.60
0.0	2000.0	2	30.0	29047.33	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	30.0	0.0	0.0	154.81	2364.21	4436.48	1147.
0.0	2000.0	1	32.0	38999.04	520.40	2471.44	1177.76	1835.42	3.03
0.0	2000.0	2	32.0	30018.12	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	32.0	0.0	0.0	179.03	2569.03	4581.18	1199.
0.0	2000.0	1	34.0	47513.08	576.79	2704.02	1244.68	1985.42	3.46
0.0	2000.0	2	34.0	45433.13	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	34.0	0.0	0.0	204.06	2773.86	4700.24	1253.
0.0	2000.0	1	35.0	51261.15	598.56	2609.01	1277.16	2058.01	3.67
0.0	2000.0	2	35.0	49922.59	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	35.0	0.0	0.0	215.64	2876.27	5011.99	1281.
0.0	2000.0	1	40.0	54018.16	614.99	2904.07	1305.55	2133.30	3.84
0.0	2000.0	2	40.0	54196.62	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	40.0	0.0	0.0	225.79	2976.76	5206.25	1309.
0.0	2000.0	1	50.0	56902.24	625.19	2962.66	1321.96	2200.51	3.98
0.0	2000.0	2	50.0	57565.55	0.0	0.0	0.0	0.0	0.0
0.0	2000.0	3	50.0	0.0	0.0	232.74	3059.55	5305.97	1330.
0.1	2000.0	1	26.0	16470.16	378.79	1649.65	1062.04	1380.99	1.86
0.1	2000.0	2	26.0	16717.40	0.0	0.0	0.0	0.0	0.0

0.1	2000.0	3	26.0	0.0	1326.94	112.90	1954.56	4229.71	1044.
0.1	2000.0	1	28.0	22957.60	433.52	1960.01	1083.64	1529.91	2.24
0.1	2000.0	2	28.0	22700.60	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	28.0	0.0	1517.98	135.35	2159.39	4333.04	1098.
0.1	2000.0	1	30.0	30490.80	467.62	2245.64	1128.23	1683.06	2.67
0.1	2000.0	2	30.0	29057.47	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	30.0	0.0	1708.88	159.23	2364.21	4439.52	1148.
0.1	2000.0	1	32.0	36541.30	541.90	2501.27	1188.40	1637.21	3.12
0.1	2000.0	2	32.0	37074.96	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	32.0	0.0	1890.32	184.24	2569.03	4579.20	1200.
0.1	2000.0	1	34.0	40967.70	594.26	2732.16	1260.14	1965.59	3.57
0.1	2000.0	2	34.0	40700.70	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	34.0	0.0	2061.76	210.25	2773.86	4752.87	1254.
0.1	2000.0	1	35.0	50990.70	616.96	2636.54	1293.94	2058.18	3.78
0.1	2000.0	2	35.0	51420.21	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	35.0	0.0	2161.34	222.49	2876.27	5006.81	1283.
0.1	2000.0	1	40.0	54300.90	634.28	2932.64	1322.94	2134.24	3.96
0.1	2000.0	2	40.0	55869.93	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	40.0	0.0	2221.94	222.86	2976.78	5200.86	1310.
0.1	2000.0	1	50.0	56667.40	644.75	3010.60	1340.48	2200.64	4.10
0.1	2000.0	2	50.0	59336.44	0.0	0.0	0.0	0.0	0.0
0.1	2000.0	3	50.0	0.0	2236.57	240.01	3059.55	5304.14	1331.
0.2	2000.0	1	26.0	15667.20	368.66	1661.53	1062.39	1381.40	1.91
0.2	2000.0	2	26.0	17105.67	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	26.0	0.0	2724.42	115.93	1954.56	4237.08	1047.
0.2	2000.0	1	28.0	22137.90	443.79	1968.12	1067.56	1530.23	2.30
0.2	2000.0	2	28.0	23260.81	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	28.0	0.0	3109.26	138.69	2159.39	4336.28	1101.
0.2	2000.0	1	30.0	29712.40	500.56	2271.69	1136.64	1683.38	2.74
0.2	2000.0	2	30.0	30572.85	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	30.0	0.0	3507.01	163.42	2364.21	4445.27	1151.
0.2	2000.0	1	32.0	37686.60	557.39	2525.01	1202.41	1835.82	3.20
0.2	2000.0	2	32.0	38670.40	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	32.0	0.0	3905.16	169.55	2569.03	4586.06	1205.
0.2	2000.0	1	34.0	40014.10	606.05	2756.54	1269.39	1989.22	3.66
0.2	2000.0	2	34.0	47030.20	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	34.0	0.0	4260.16	214.99	2773.80	4728.73	1255.
0.2	2000.0	1	35.0	50332.90	634.23	2659.45	1311.41	2056.34	3.88
0.2	2000.0	2	35.0	52774.83	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	35.0	0.0	4443.50	228.74	2876.27	4991.40	1285.
0.2	2000.0	1	40.0	55765.70	652.57	2960.98	1333.03	2140.86	4.11
0.2	2000.0	2	40.0	57489.83	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	40.0	0.0	4572.64	239.30	2976.76	5157.10	1309.
0.2	2000.0	1	50.0	56259.20	664.75	3037.57	1359.86	2200.49	4.23
0.2	2000.0	2	50.0	61100.24	0.0	0.0	0.0	0.0	0.0
0.2	2000.0	3	50.0	0.0	4657.27	247.47	3059.55	5298.20	1354.
0.3	2000.0	1	26.0	14616.50	400.14	1715.64	1063.67	1382.07	1.97
0.3	2000.0	2	26.0	17506.88	0.0	0.0	0.0	0.0	0.0
0.3	2000.0	3	26.0	0.0	4205.18	119.34	1954.56	4249.33	1053.
0.3	2000.0	1	28.0	21390.10	456.70	2016.12	1097.22	1527.24	2.37
0.3	2000.0	2	28.0	25626.79	0.0	0.0	0.0	0.0	0.0
0.3	2000.0	3	28.0	0.0	4600.23	142.93	2159.39	4352.36	1106.
0.3	2000.0	1	30.0	26669.40	515.17	2295.39	1147.41	1663.73	2.82
0.3	2000.0	2	30.0	31549.21	0.0	0.0	0.0	0.0	0.0
0.3	2000.0	3	30.0	0.0	5414.14	166.24	2364.21	4455.64	1156.
0.3	2000.0	1	32.0	37045.00	573.62	2554.66	1214.02	1837.87	3.30

0.3	2000.0	2	32.0	39666.40	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	32.0	0.0	6028.41	195.07	2569.03	4587.531206.
0.3	2000.0	1	34.0	45636.80	629.86	2783.86	1292.44	1985.56 3.78
0.3	2000.0	2	34.0	49535.86	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	34.0	0.0	6619.42	222.97	2773.86	4745.911262.
0.3	2000.0	1	35.0	45623.10	655.04	2692.64	1327.23	2061.63 4.02
0.3	2000.0	2	35.0	54372.62	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	35.0	0.0	6684.00	236.20	2876.27	4937.221290.
0.3	2000.0	1	40.0	53660.20	679.88	2993.83	1364.66	2137.61 4.24
0.3	2000.0	2	40.0	59574.73	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	40.0	0.0	7145.04	249.56	2976.76	5182.821319.
0.3	2000.0	1	50.0	56052.00	689.12	3029.10	1362.95	2200.86 4.36
0.3	2000.0	2	50.0	63173.39	0.0	0.0	0.0	0.0 0.0
0.3	2000.0	3	50.0	0.0	7242.20	256.63	3059.55	5286.761339.
0.4	2000.0	1	26.0	13634.80	412.29	1750.43	1066.20	1382.77 2.03
0.4	2000.0	2	26.0	17901.86	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	26.0	0.0	5777.23	123.05	1954.56	4266.611060.
0.4	2000.0	1	28.0	20340.20	470.64	2051.40	1101.02	1532.59 2.44
0.4	2000.0	2	28.0	24405.54	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	28.0	0.0	6597.57	147.28	2159.39	4363.901113.
0.4	2000.0	1	30.0	27924.60	531.32	2328.03	1160.34	1683.66 2.91
0.4	2000.0	2	30.0	32170.98	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	30.0	0.0	7447.91	173.59	2364.21	4471.391164.
0.4	2000.0	1	32.0	36171.10	591.15	2582.10	1229.43	1836.73 3.40
0.4	2000.0	2	32.0	40733.09	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	32.0	0.0	8283.40	201.09	2569.03	4595.161214.
0.4	2000.0	1	34.0	44525.10	648.33	2814.04	1305.86	1989.24 3.90
0.4	2000.0	2	34.0	50667.93	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	34.0	0.0	9064.72	279.42	2773.86	4744.231266.
0.4	2000.0	1	35.0	48902.96	677.08	2921.39	1349.05	2061.91 4.15
0.4	2000.0	2	35.0	56033.15	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	35.0	0.0	9495.96	244.41	2876.27	4889.091296.
0.4	2000.0	1	40.0	52847.30	701.26	3023.41	1384.23	2137.44 4.39
0.4	2000.0	2	40.0	61265.91	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	40.0	0.0	9820.39	257.49	2976.76	5117.561324.
0.4	2000.0	1	50.0	55730.10	716.34	3098.74	1411.69	2197.60 4.55
0.4	2000.0	2	50.0	65415.62	0.0	0.0	0.0	0.0 0.0
0.4	2000.0	3	50.0	0.0	10037.69	266.85	3059.55	5276.541346.
0.5	2000.0	1	26.0	12791.70	425.54	1787.15	1069.43	1383.84 2.09
0.5	2000.0	2	26.0	16299.63	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	26.0	0.0	7453.65	127.11	1954.56	4287.911069.
0.5	2000.0	1	28.0	19499.20	489.00	2084.57	1116.16	1529.78 2.53
0.5	2000.0	2	28.0	25112.16	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	28.0	0.0	8505.18	153.16	2159.39	4389.921123.
0.5	2000.0	1	30.0	26949.40	549.76	2359.60	1173.70	1684.68 3.01
0.5	2000.0	2	30.0	33050.73	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	30.0	0.0	9629.39	179.72	2364.21	4490.051173.
0.5	2000.0	1	32.0	35364.10	613.38	2613.94	1248.13	1837.76 3.52
0.5	2000.0	2	32.0	41999.89	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	32.0	0.0	10743.66	268.78	2569.03	4605.581224.
0.5	2000.0	1	34.0	43704.60	672.33	2843.42	1328.75	1987.68 4.04
0.5	2000.0	2	34.0	52182.21	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	34.0	0.0	11776.23	238.04	2773.86	4756.581277.
0.5	2000.0	1	35.0	47991.40	701.30	2953.08	1370.20	2063.73 4.30
0.5	2000.0	2	35.0	57740.63	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	35.0	0.0	12263.66	252.88	2870.27	4829.571304.

0.5	2000.0	1	40.0	52224.00	729.21	3056.75	1409.16	2140.31 4.56
0.5	2000.0	2	40.0	63439.45	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	40.0	0.0	12772.52	267.77	2976.76	5047.111332.
0.5	2000.0	1	50.0	55489.10	748.53	3140.23	1439.16	2202.32 4.76
0.5	2000.0	2	50.0	66059.69	0.0	0.0	0.0	0.0 0.0
0.5	2000.0	3	50.0	0.0	13110.64	278.64	3059.55	5255.611354.
0.0	4000.0	1	26.0	16477.79	349.93	1641.88	1062.22	1379.93 1.65
0.0	4000.0	2	26.0	15566.73	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	26.0	0.0	0.0	104.19	1954.17	4210.401036.
0.0	4000.0	1	28.0	22060.75	399.91	1952.41	1082.33	1528.46 2.23
0.0	4000.0	2	28.0	21151.69	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	28.0	0.0	0.0	124.68	2158.96	4315.761090.
0.0	4000.0	1	30.0	29861.50	450.79	2239.69	1126.30	1682.11 2.66
0.0	4000.0	2	30.0	27737.07	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	30.0	0.0	0.0	147.05	2363.74	4423.871140.
0.0	4000.0	1	32.0	37415.70	500.11	2491.66	1167.15	1834.21 3.09
0.0	4000.0	2	32.0	34912.60	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	32.0	0.0	0.0	170.02	2566.52	4575.231193.
0.0	4000.0	1	34.0	45267.91	547.71	2721.88	1256.80	1982.64 3.55
0.0	4000.0	2	34.0	43270.30	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	34.0	0.0	0.0	193.75	2773.30	4827.231248.
0.0	4000.0	1	35.0	48607.56	566.72	2828.10	1285.47	2059.66 3.74
0.0	4000.0	2	35.0	47435.15	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	35.0	0.0	0.0	204.26	2875.70	5047.981275.
0.0	4000.0	1	40.0	51009.59	579.93	2921.79	1310.54	2136.89 3.91
0.0	4000.0	2	40.0	51295.12	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	40.0	0.0	0.0	212.80	2976.18	5210.771301.
0.0	4000.0	1	50.0	53794.24	586.70	2994.62	1329.77	2199.68 4.03
0.0	4000.0	2	50.0	54462.54	0.0	0.0	0.0	0.0 0.0
0.0	4000.0	3	50.0	0.0	0.0	219.08	3058.94	5321.581323.
0.1	4000.0	1	26.0	15972.00	360.34	1677.53	1062.37	1379.95 1.91
0.1	4000.0	2	26.0	16013.28	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	26.0	0.0	1253.84	107.33	1954.17	4212.991037.
0.1	4000.0	1	28.0	22199.30	412.16	1984.35	1088.94	1528.42 2.30
0.1	4000.0	2	28.0	21774.42	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	28.0	0.0	1434.13	128.71	2158.96	4318.661091.
0.1	4000.0	1	30.0	29425.10	464.20	2269.02	1136.25	1682.14 2.74
0.1	4000.0	2	30.0	28540.66	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	30.0	0.0	1615.21	151.43	2363.74	4425.961141.
0.1	4000.0	1	32.0	37044.60	515.23	2519.69	1200.15	1834.27 3.19
0.1	4000.0	2	32.0	35943.93	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	32.0	0.0	1792.78	175.16	2566.52	4576.611194.
0.1	4000.0	1	34.0	44558.90	564.11	2748.14	1273.06	1982.17 3.64
0.1	4000.0	2	34.0	44540.27	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	34.0	0.0	1962.85	199.56	2773.30	4821.541249.
0.1	4000.0	1	35.0	46520.70	583.84	2854.54	1302.65	2059.21 3.85
0.1	4000.0	2	35.0	46841.55	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	35.0	0.0	2031.51	210.44	2875.70	5042.491276.
0.1	4000.0	1	40.0	51446.10	598.11	2949.11	1329.02	2136.83 4.03
0.1	4000.0	2	40.0	52670.21	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	40.0	0.0	2061.16	219.47	2976.18	5209.761302.
0.1	4000.0	1	50.0	55564.00	606.04	3022.42	1348.00	2199.99 4.16
0.1	4000.0	2	50.0	56605.84	0.0	0.0	0.0	0.0 0.0
0.1	4000.0	3	50.0	0.0	2111.55	225.84	3056.94	5315.991324.
0.2	4000.0	1	26.0	15210.10	369.86	1708.53	1063.51	1380.28 1.96
0.2	4000.0	2	26.0	16383.95	0.0	0.0	0.0	0.0 0.0

0.2	4000.0	3	26.0	0.0	2573.90	110.19	1954.17	4220.211040.
0.2	4000.0	1	26.0	21502.90	423.71	2012.50	1095.93	1528.65 2.36
0.2	4000.0	2	26.0	22515.56	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	28.0	0.0	2948.63	132.51	2156.96	4326.031095.
0.2	4000.0	1	30.0	28762.00	476.37	2294.48	1145.46	1682.38 2.81
0.2	4000.0	2	30.0	29227.21	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	30.0	0.0	3315.12	155.44	2363.74	4431.751144.
0.2	4000.0	1	32.0	36316.00	526.69	2545.16	1211.21	1835.00 3.27
0.2	4000.0	2	32.0	36626.50	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	32.0	0.0	3679.24	179.73	2568.52	4577.621196.
0.2	4000.0	1	34.0	44246.96	579.12	2774.66	1265.69	1984.59 3.74
0.2	4000.0	2	34.0	45671.19	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	34.0	0.0	4030.17	204.65	2773.30	4781.901251.
0.2	4000.0	1	35.0	47938.60	600.73	2878.79	1320.16	2058.43 3.96
0.2	4000.0	2	35.0	50165.71	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	35.0	0.0	4180.57	216.56	2875.70	5027.441279.
0.2	4000.0	1	40.0	50965.30	616.56	2979.93	1345.15	2140.15 4.16
0.2	4000.0	2	40.0	54445.14	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	40.0	0.0	4290.75	226.13	2976.18	5188.921304.
0.2	4000.0	1	50.0	55194.10	626.02	3046.63	1366.30	2199.72 4.28
0.2	4000.0	2	50.0	57722.22	0.0	0.0	0.0	0.0 0.0
0.2	4000.0	3	50.0	0.0	4336.57	233.00	3058.94	5313.441327.
0.3	4000.0	1	26.0	14423.50	360.56	1741.70	1065.70	1380.84 2.01
0.3	4000.0	2	26.0	16766.71	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	26.0	0.0	3972.56	113.43	1954.17	4232.311045.
0.3	4000.0	1	28.0	20673.70	434.39	2042.31	1100.12	1529.84 2.43
0.3	4000.0	2	28.0	22796.74	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	28.0	0.0	4534.46	135.71	2158.96	4335.961099.
0.3	4000.0	1	30.0	27909.70	469.65	2321.69	1155.66	1662.94 2.89
0.3	4000.0	2	30.0	29950.57	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	30.0	0.0	5113.40	159.69	2363.74	4441.101149.
0.3	4000.0	1	32.0	35664.50	545.22	2572.79	1226.10	1835.25 3.37
0.3	4000.0	2	32.0	37657.56	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	32.0	0.0	5691.37	185.39	2568.52	4583.821201.
0.3	4000.0	1	34.0	45672.90	597.41	2801.97	1303.43	1964.86 3.86
0.3	4000.0	2	34.0	46960.71	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	34.0	0.0	6236.23	211.36	2773.30	4745.401255.
0.3	4000.0	1	35.0	47457.60	620.18	2904.79	1341.10	2056.63 4.09
0.3	4000.0	2	35.0	51645.32	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	35.0	0.0	6473.88	223.64	2875.70	5001.931283.
0.3	4000.0	1	40.0	50749.30	638.36	3004.46	1371.15	2135.27 4.30
0.3	4000.0	2	40.0	56167.06	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	40.0	0.0	6665.65	234.31	2976.18	5191.461310.
0.3	4000.0	1	50.0	53019.10	646.78	3060.26	1391.41	2200.16 4.44
0.3	4000.0	2	50.0	59677.40	0.0	0.0	0.0	0.0 0.0
0.3	4000.0	3	50.0	0.0	6772.43	241.49	3058.94	5300.231332.
0.4	4000.0	1	26.0	13526.90	392.09	1775.82	1066.80	1381.75 2.07
0.4	4000.0	2	26.0	17146.54	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	26.0	0.0	5457.25	116.93	1954.17	4249.181053.
0.4	4000.0	1	28.0	19767.30	447.92	2076.19	1105.43	1534.05 2.50
0.4	4000.0	2	28.0	23355.03	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	28.0	0.0	6234.28	139.99	2158.96	4346.311106.
0.4	4000.0	1	30.0	27001.30	505.51	2349.96	1169.11	1683.01 2.98
0.4	4000.0	2	30.0	30742.28	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	30.0	0.0	7035.90	165.05	2363.74	4456.661157.
0.4	4000.0	1	32.0	34770.30	562.05	2602.92	1239.39	1837.64 3.48

0.4	4000.0	2	32.0	36674.91	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	32.0	0.0	7622.62	191.11	2568.52	4586.771207.
0.4	4000.0	1	34.0	42709.20	615.96	2831.62	1319.04	1987.69 3.98
0.4	4000.0	2	34.0	46259.23	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	34.0	0.0	8573.14	217.93	2773.30	4739.411261.
0.4	4000.0	1	35.0	46691.20	641.81	2937.89	1360.21	2061.02 4.24
0.4	4000.0	2	35.0	53250.69	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	35.0	0.0	8932.60	231.40	2875.70	4936.001289.
0.4	4000.0	1	40.0	50510.20	666.46	3039.02	1399.96	2137.06 4.47
0.4	4000.0	2	40.0	58377.55	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	40.0	0.0	9276.30	244.62	2976.16	5182.821319.
0.4	4000.0	1	50.0	52756.10	673.39	3114.58	1418.70	2200.35 4.62
0.4	4000.0	2	50.0	61897.41	0.0	0.0	0.0	0.0 0.0
0.4	4000.0	3	50.0	0.0	9400.31	251.50	3058.94	5285.491339.
0.5	4000.0	1	26.0	12564.30	405.25	1612.57	1073.39	1382.69 2.14
0.5	4000.0	2	26.0	17553.26	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	26.0	0.0	7650.07	120.95	1954.17	4270.981062.
0.5	4000.0	1	28.0	18827.50	462.68	2107.68	1117.63	1531.92 2.59
0.5	4000.0	2	28.0	23944.94	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	28.0	0.0	8653.06	144.81	2158.96	4368.371114.
0.5	4000.0	1	30.0	26150.60	523.69	2381.03	1164.76	1663.37 3.08
0.5	4000.0	2	30.0	31026.10	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	30.0	0.0	9111.00	171.69	2363.74	4476.731167.
0.5	4000.0	1	32.0	34019.70	583.03	2634.68	1258.37	1838.74 3.61
0.5	4000.0	2	32.0	40086.21	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	32.0	0.0	10143.56	198.32	2568.52	4596.731217.
0.5	4000.0	1	34.0	41626.80	637.74	2862.62	1339.14	1989.06 4.13
0.5	4000.0	2	34.0	49767.52	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	34.0	0.0	11095.39	225.66	2773.30	4745.451270.
0.5	4000.0	1	35.0	45948.60	665.69	2971.11	1363.09	2063.59 4.40
0.5	4000.0	2	35.0	54997.66	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	35.0	0.0	11581.57	240.05	2875.70	4855.391297.
0.5	4000.0	1	40.0	49865.10	690.17	3071.04	1423.47	2136.38 4.65
0.5	4000.0	2	40.0	60235.03	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	40.0	0.0	12007.50	253.43	2976.18	5105.051325.
0.5	4000.0	1	50.0	52742.60	706.32	3150.38	1451.61	2199.44 4.83
0.5	4000.0	2	50.0	64430.47	0.0	0.0	0.0	0.0 0.0
0.5	4000.0	3	50.0	0.0	12288.44	263.08	3058.94	5263.131347.