

AEEM 3042 – Aircraft Performance & Design

Block 3

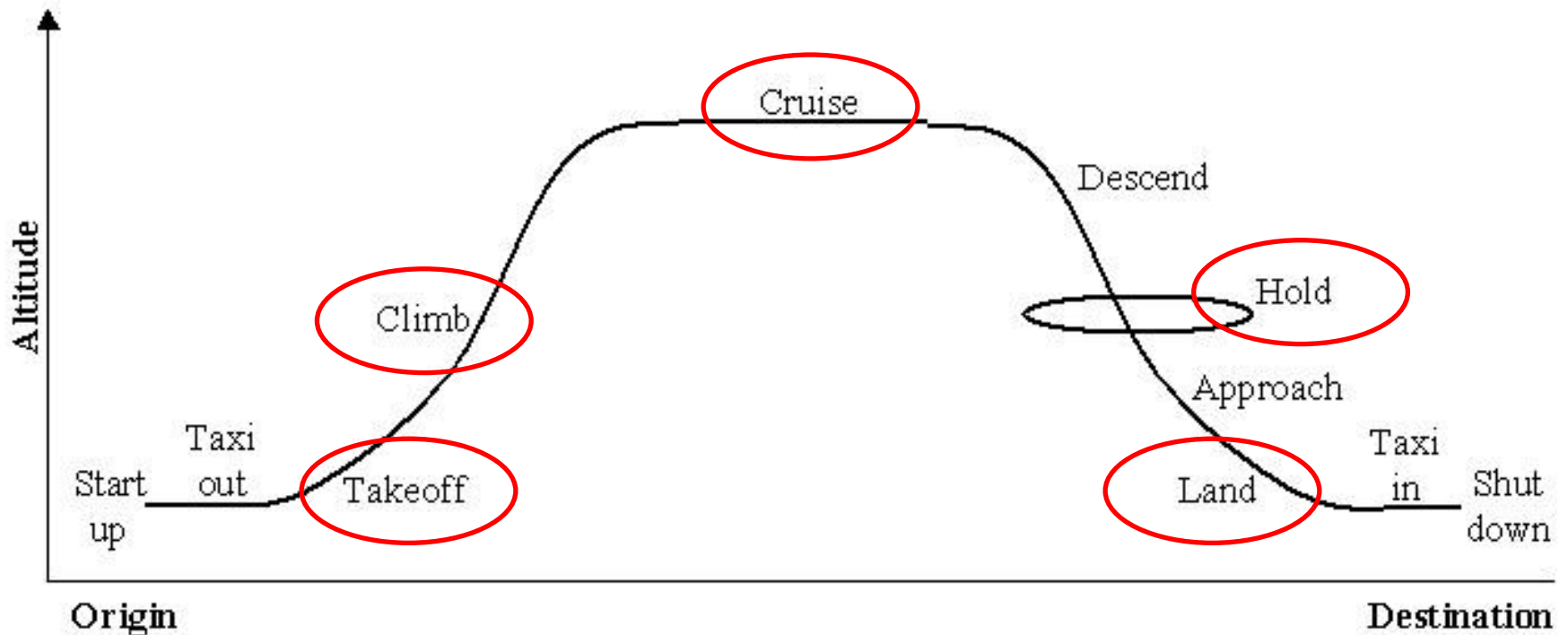
Aircraft Design

Block 3 Schedule – Aircraft Design

Block 3 – Aircraft Design		
Tuesday, March 21		Intro to Design; Airliner Research
Thursday, March 23		Case Studies
Tuesday, March 28		Aircraft Design; Weights
Thursday, March 30		Sensitivities; Wing Loading
Tuesday, April 4	Project #1	Wing Design; Fuselage Design
Thursday, April 6		Tail Design
Tuesday, April 11		Second Iteration; Design Project
Thursday, April 13		No class
Tuesday, April 18		
Thursday, April 20	Project #2	
Exam Week		

Aircraft Performance Equations of Motion Mission Analysis

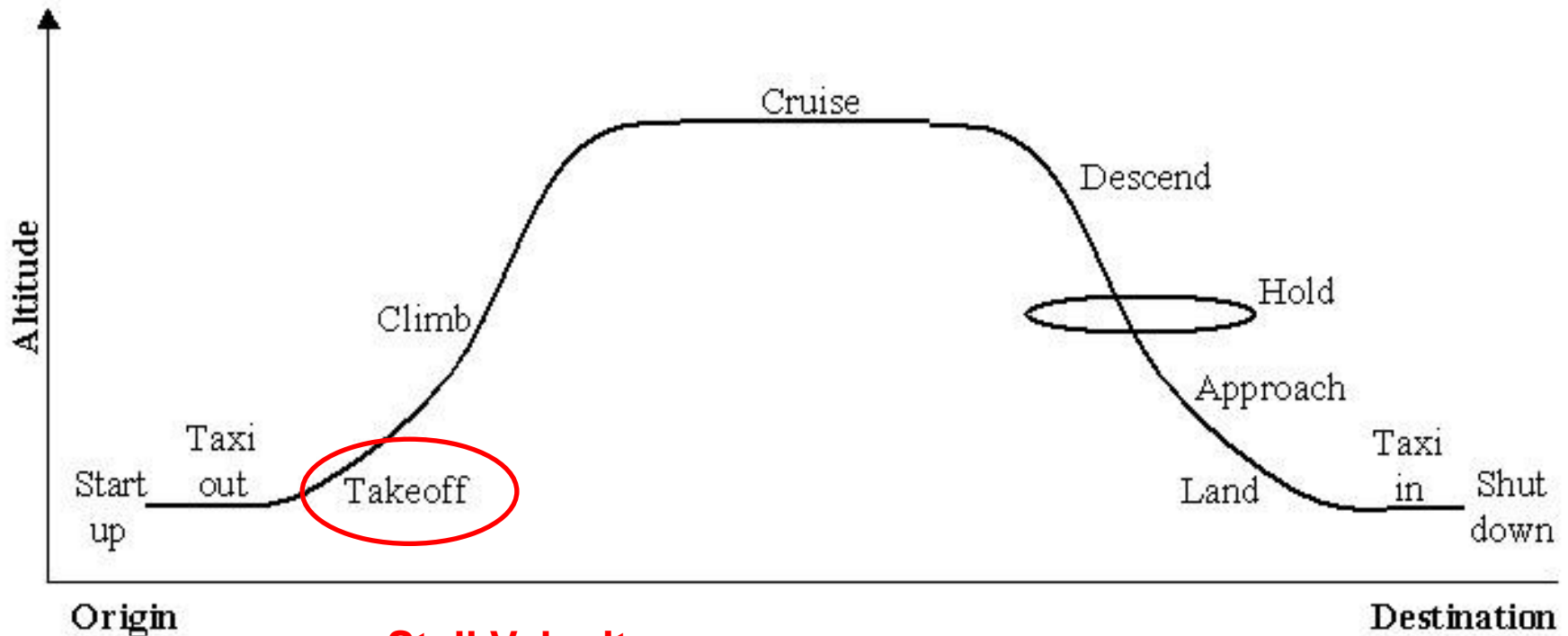
Mission Analysis



**New York
(LGA)**

**Los Angeles
(LAX)**

Mission Analysis

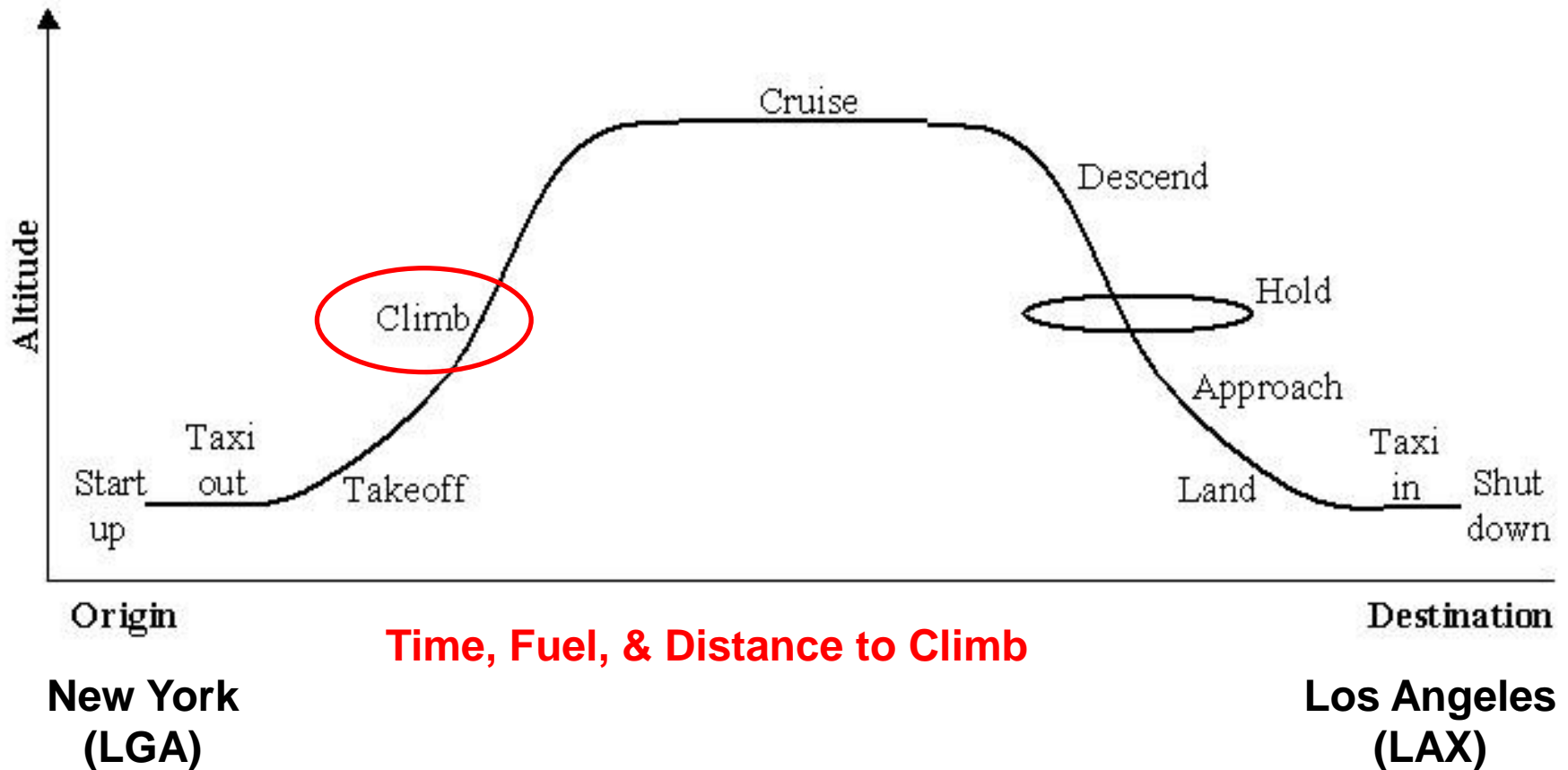


New York
(LGA)

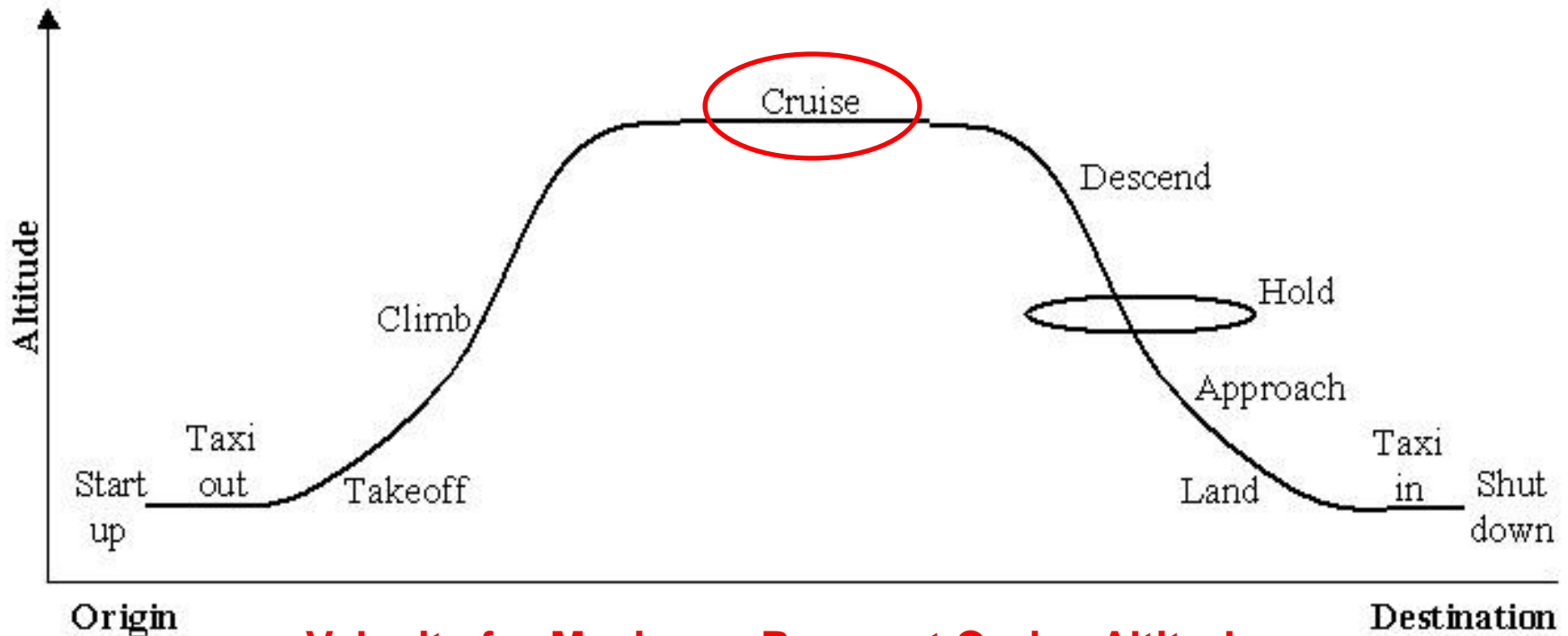
Stall Velocity
Rotation Velocity
Liftoff Velocity
Obstacle Velocity
Takeoff Ground Roll Distance

Los Angeles
(LAX)

Mission Analysis



Mission Analysis

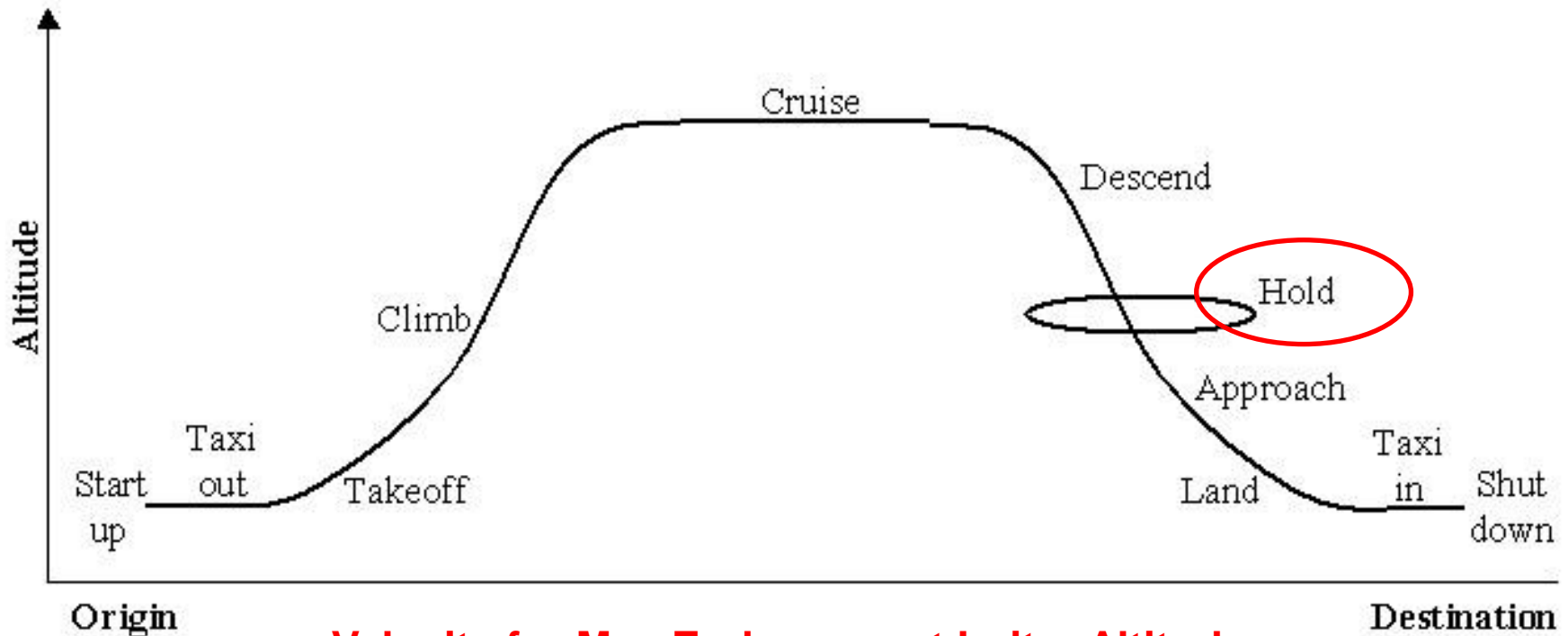


Origin
New York
(LGA)

Velocity for Maximum Range at Cruise Altitude
Check for Cruise Ceiling
Cruise Time, Fuel, & Distance using X lb of fuel

Destination
Los Angeles
(LAX)

Mission Analysis

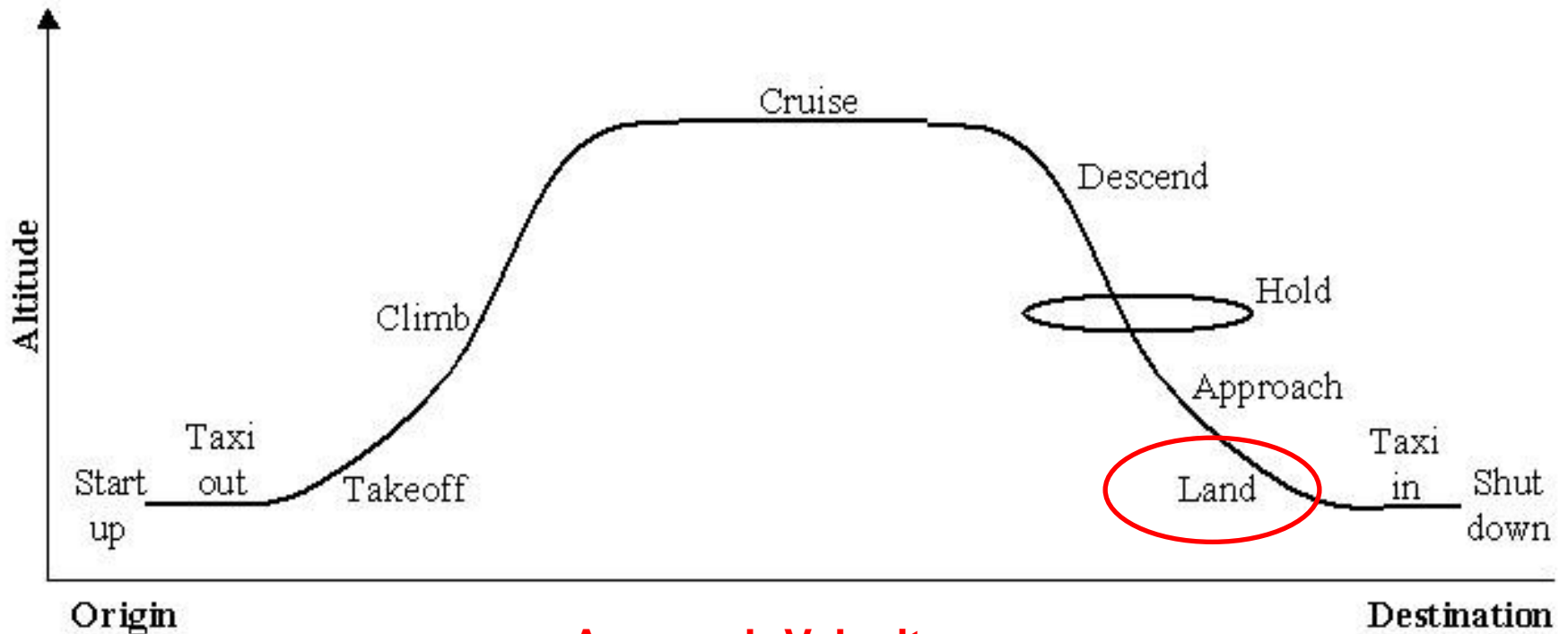


Origin
New York
(LGA)

Velocity for Max Endurance at Loiter Altitude
Endurance Time using remaining fuel
Glide Range if it runs out of fuel

Destination
Los Angeles
(LAX)

Mission Analysis



New York
(LGA)

Approach Velocity
Touchdown Velocity
Landing Ground Roll Distance

Los Angeles
(LAX)

Mission Analysis

Mission Leg	Initial Weight	Altitude	Speed	Time	Fuel	Distance
Takeoff	68,000 lb	Sea Level	Start to Obstacle Speed	0	0	0
Climb	68,000 lb	Sea Level to 30,000 ft	Max Rate of Climb	3.2 min	2,000 lb	65 NM
Cruise	66,000 lb	30,000 ft	Max Range	4.78 hr	14,000 lb	2,238 NM
Hold	52,000 lb	5,000 ft	Max Endurance	20 min	1,000 lb	0
Land	49,000 lb	Sea Level	Approach Speed to Stop	0	0	0

Aircraft Flight Manual

Each aircraft built and flown has a Flight Manual

- information required to safely operate the aircraft

A Flight Manual usually contains:

- Operating limitations
- Normal procedures
- Emergency procedures
- Performance data
- Subsystems descriptions and usage

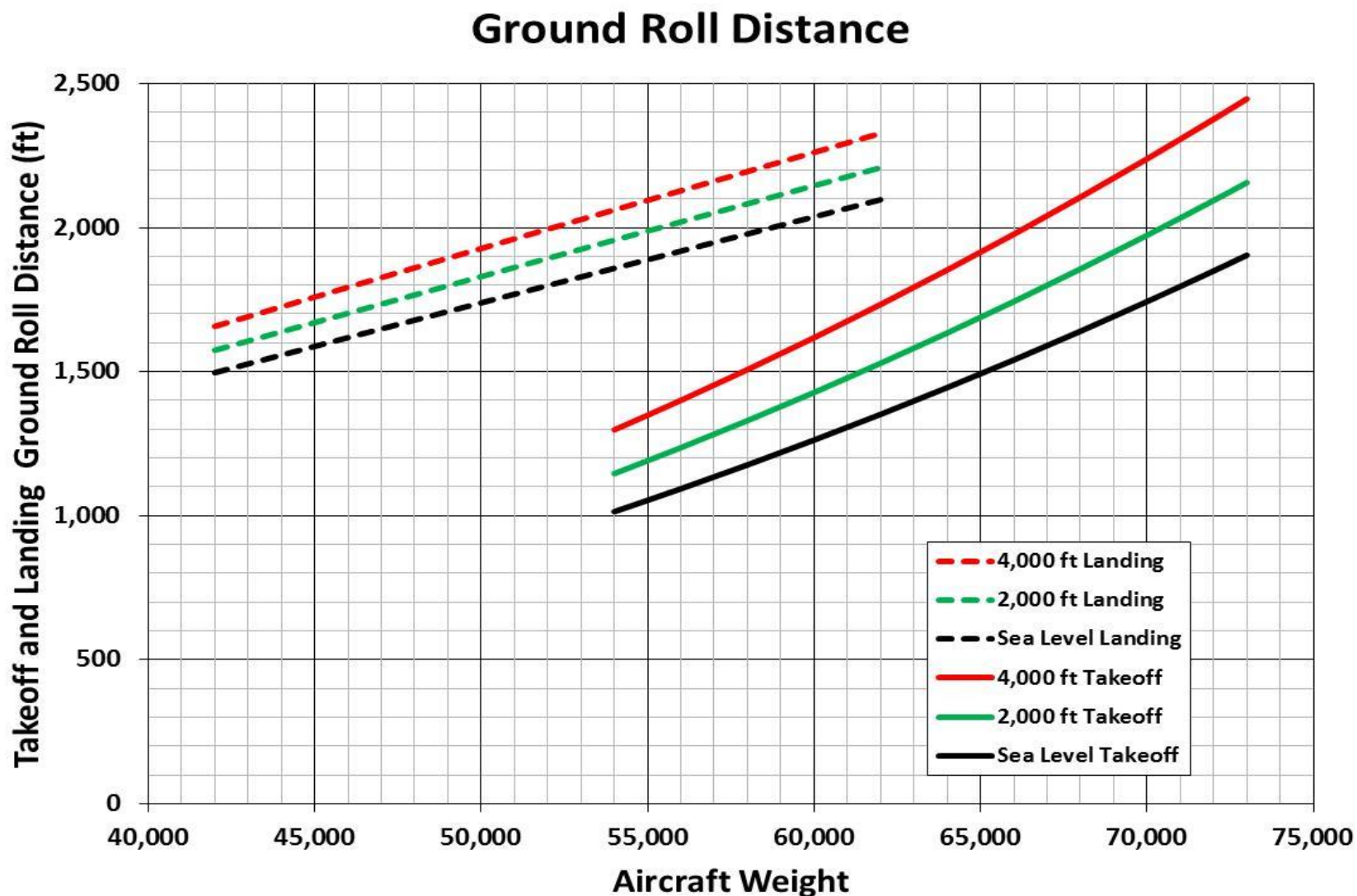
Aircraft Flight Manual

A1-C2AHA-NFM-000	
	
NATOPS FLIGHT MANUAL NAVY MODEL C-2A AIRCRAFT	
THIS PUBLICATION SUPERSEDES A1-C2AHA-NFM-000 DATED 15 SEPTEMBER 2005 AND CHANGED 1 SEPTEMBER 2007.	
	
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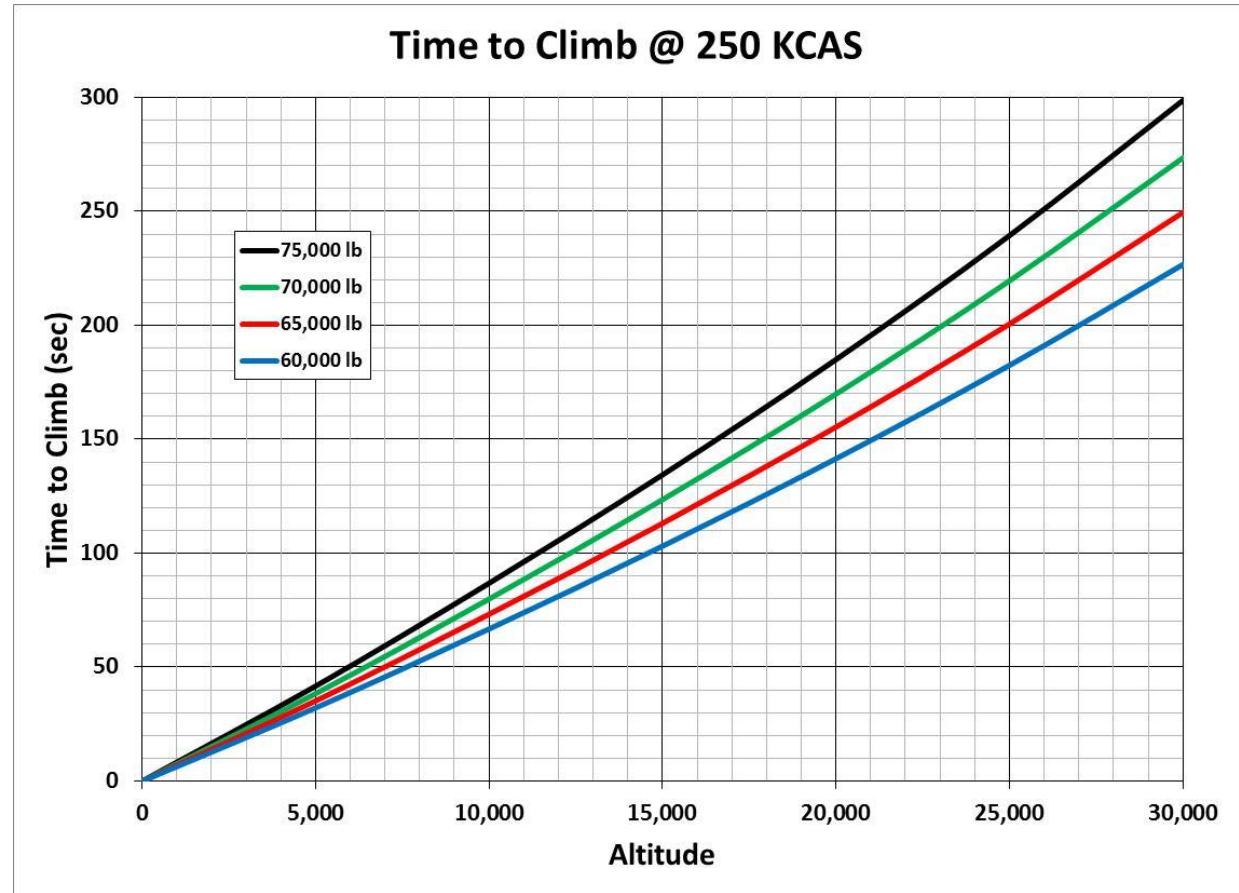
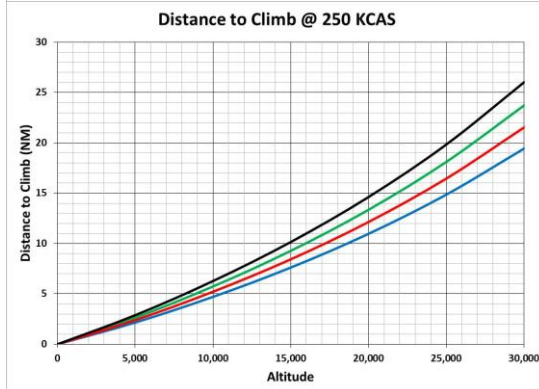
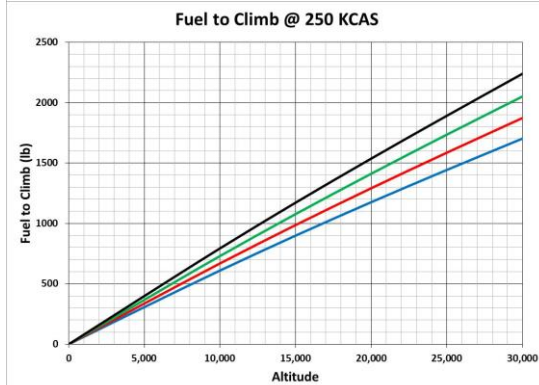
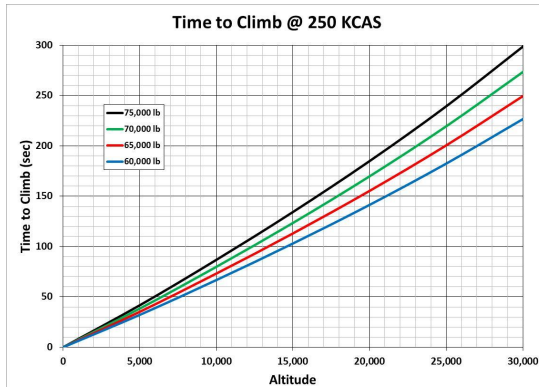


Flight Manual Info



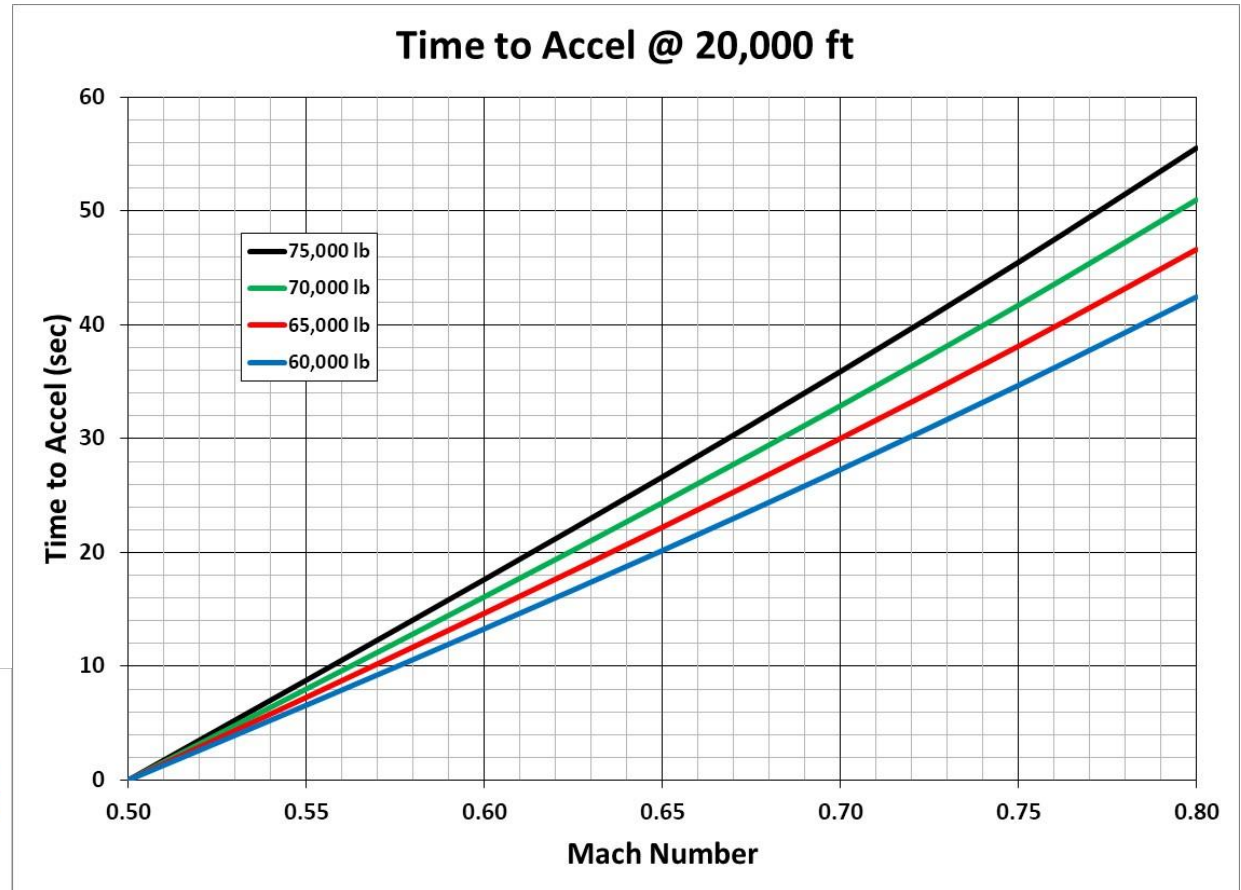
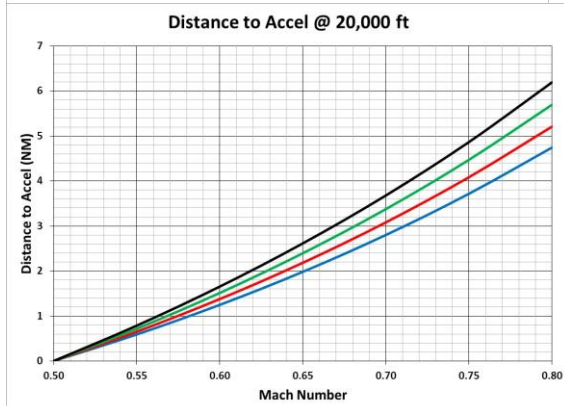
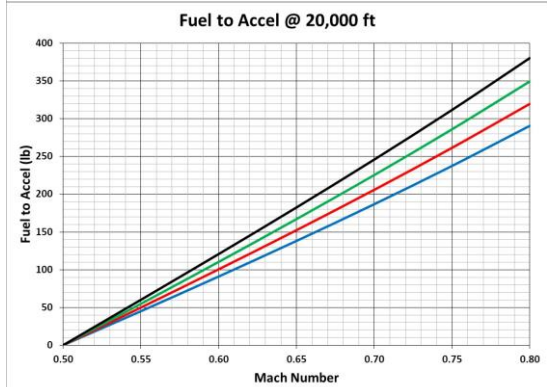
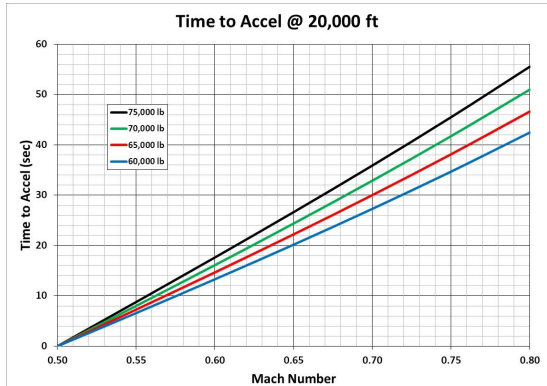
Flight Manual Info

G-IV Data



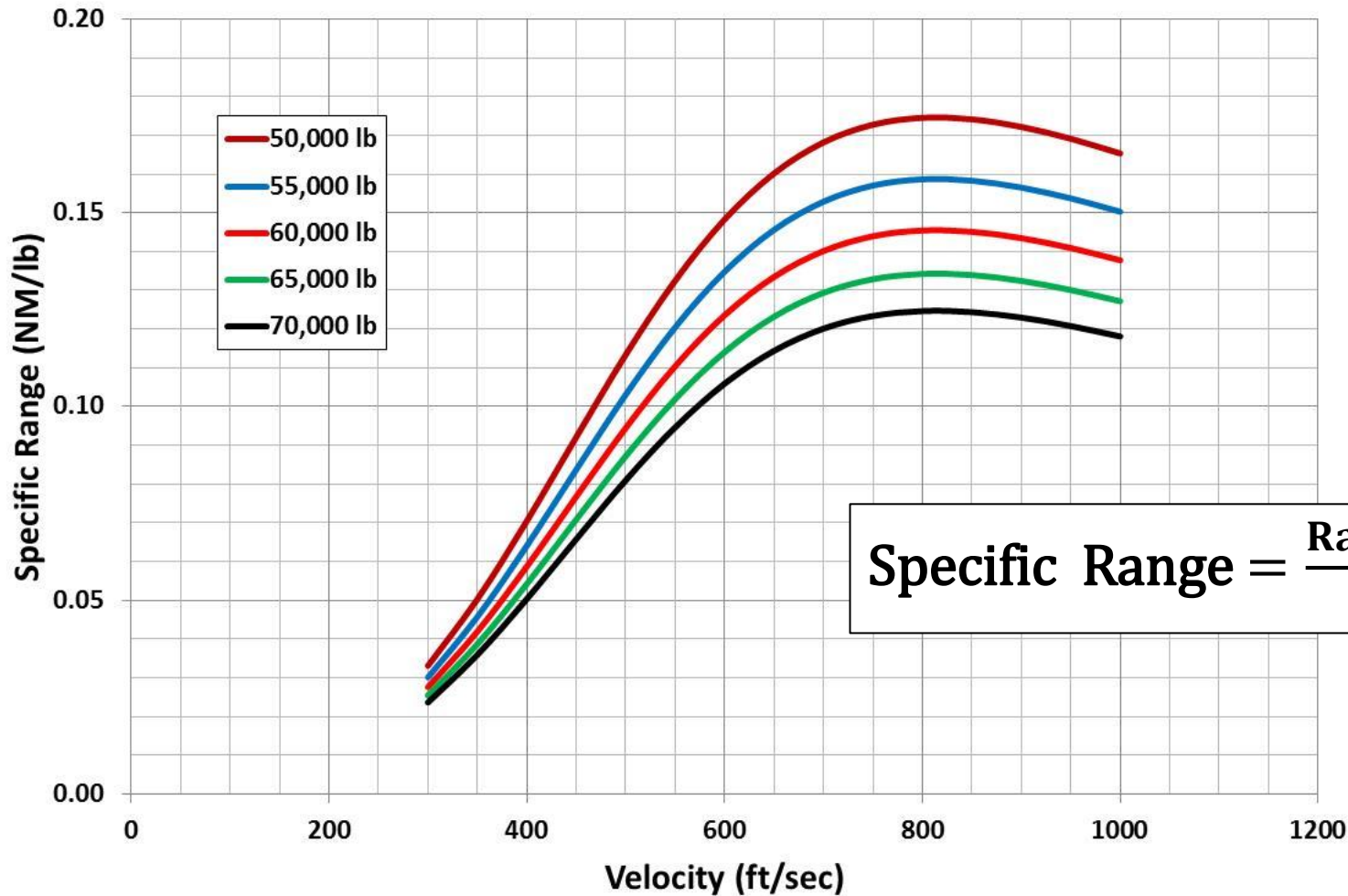
Flight Manual Info

G-IV Data



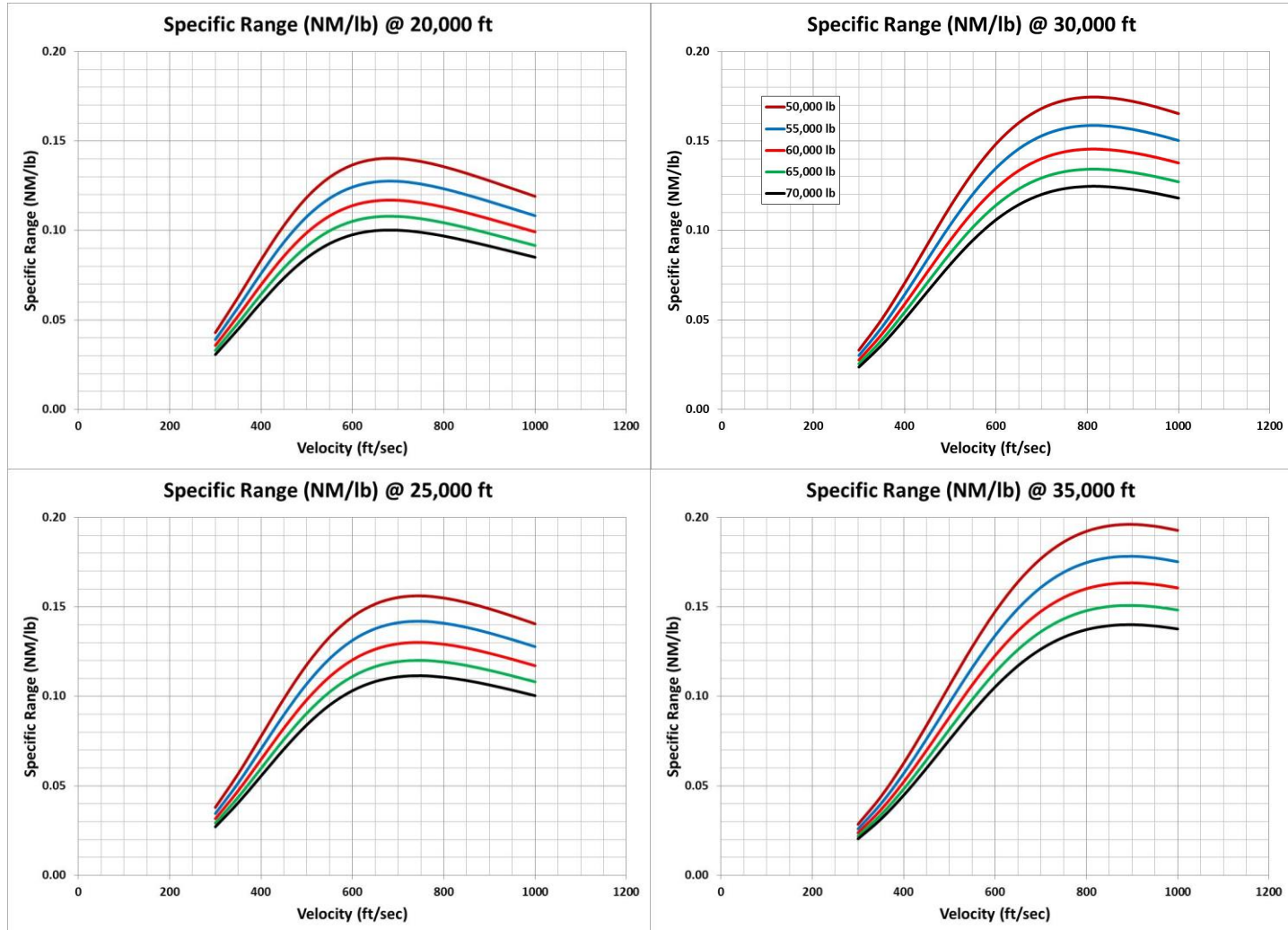
Flight Manual Info

Specific Range (NM/lb) @ 30,000 ft



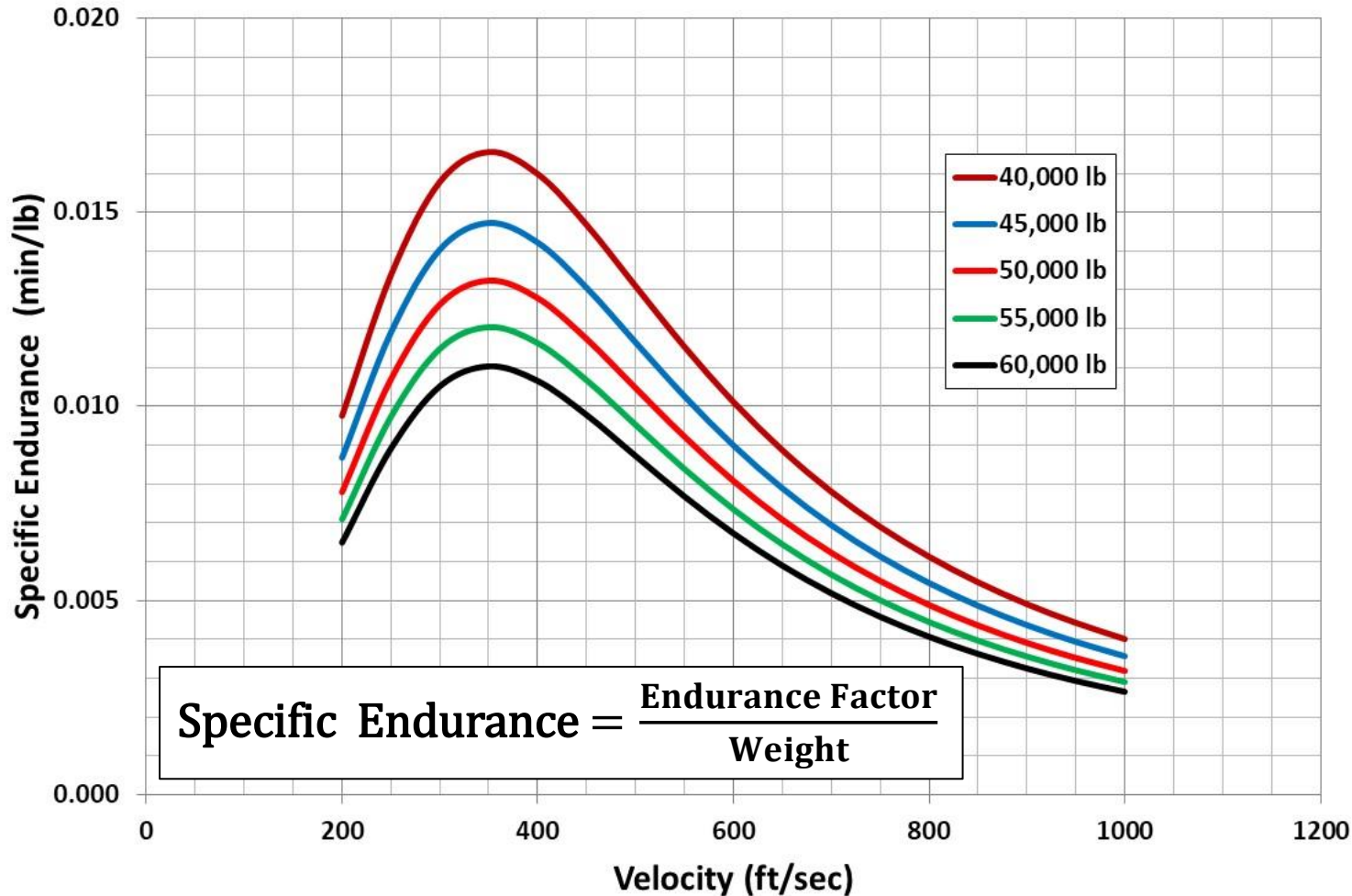
$$\text{Specific Range} = \frac{\text{Range Factor}}{\text{Weight}}$$

Flight Manual Info



Flight Manual Info

Specific Endurance (min/lb) @ Sea Level



Flight Manual Project

**These project assignments are due by
midnight on Monday, April 3rd**

Instructor help is available via e-mail anytime

E-mailed to student teams:

- BD-5J Mission Planning Microsoft Excel file**
- Instructor Tips – Using the Flight Manual**

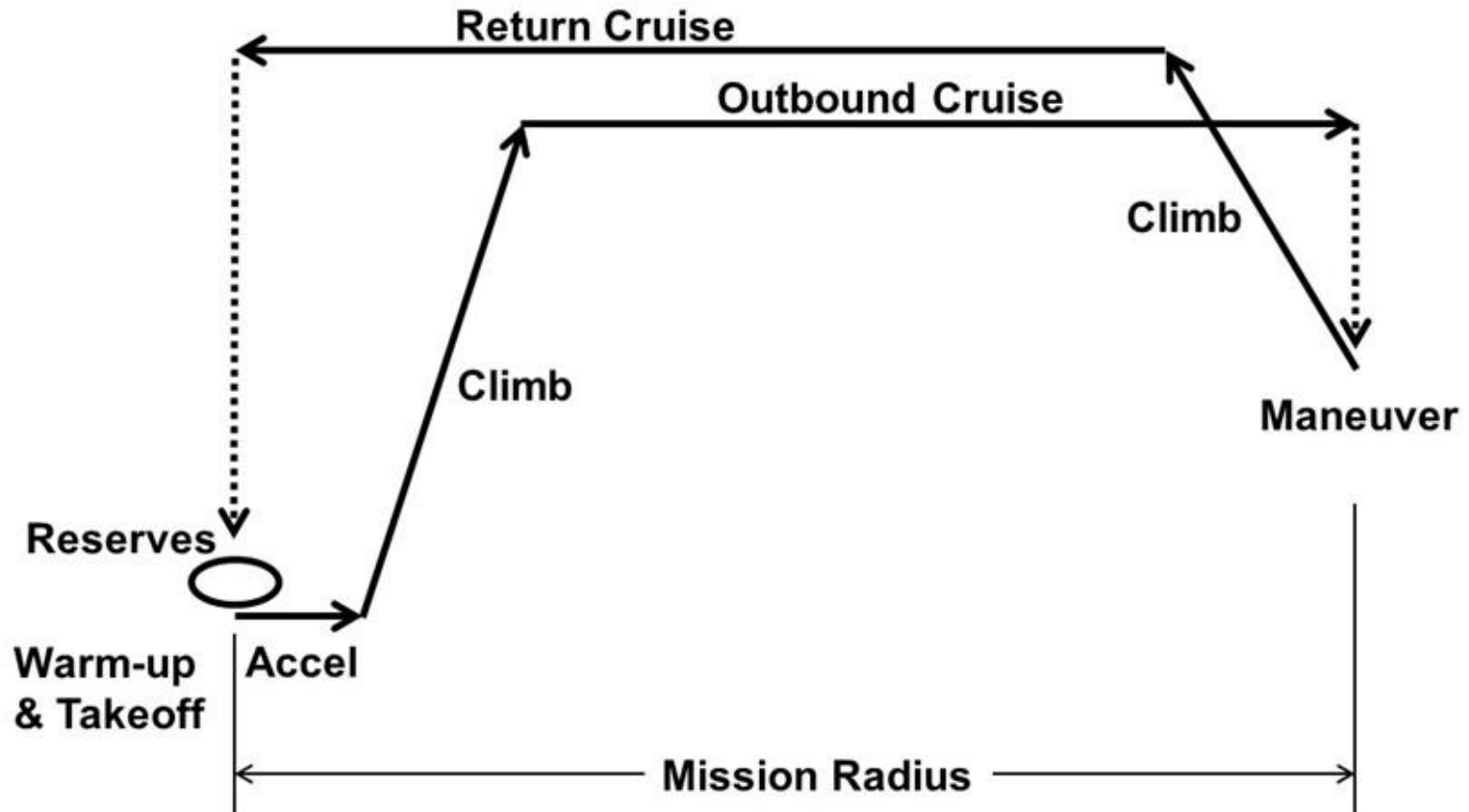
Posted on Canvas:

- BD-5J Flight Manual**
- Instructor Tips – Using the Flight Manual**

Flight Manual Project

AEEM 3042 Aircraft Performance and Design			Project #1 - Flight Manual		
Name(s):			Flight Profile #	60	
The pilot of the BD-5J will be performing a flight soon and needs to plan it out. He plans each segment of the flight by using the BD-5J Flight Manual (posted on Canvas). Below are the details for each segment of his flight.					
Your assignment is to use the Flight Manual to calculate the time, fuel, and distance of each flight segment and determine how much total time the entire flight will take, how much fuel he will use during the flight, and what the total range of the flight will be. Also calculate how much fuel he will have left onboard when he lands the aircraft.					
This assignment is due on Monday, March 29 at midnight					
Your submittal should include the Mission Worksheet, the Mission Time History, and any Excel/hand calculations done					
Instructor help is available via e-mail anytime					

Flight Manual Project



Outbound Cruise Distance may not be equal to Return Cruise Distance

Flight Segment	Segment Details			
Warm-up & Taxi	Fuel allowance is the fuel burned for 20 minutes at 10% power. No range credit.			
	Departure Airport Altitude:	2,000	ft	
	Takeoff Gross Weight:	920	lb	
	Total Fuel Onboard:	330	lb	
Takeoff	Take off at Max Power. No range credit.			
	Takeoff Speed: 1.1 x Stall Speed			
Climb to Altitude	Climb at Max Rate of Climb Speed from Takeoff Altitude to Cruise Altitude.			
	Cruise Altitude:	20,000	ft	
Initial Cruise	Cruise at Max Range Speed at the Cruise Altitude.			
	Cruise Distance:	250	NM	
Descent	Descend at Max Range Glide Speed to the Maneuver Altitude.			
	Maneuver Altitude:	5,000	ft	
Maneuver	Turn at Max Sustained g Speed and Load Factor, accelerate from 0.2M to 0.4M. No range credit.			
	Number of 360 degree Turns:	8	turns	
Climb to Altitude	Climb at Max Rate of Climb Speed from Maneuver Altitude to Cruise Altitude.			
	Cruise Altitude:	20,000	ft	
Final Cruise	Cruise at Max Range Speed at the Cruise Altitude.			
	Cruise Distance:	250	NM	
Initial Descent	Descend at Max Range Glide Speed to the Holding Pattern Altitude.			
	Holding Pattern Altitude:	4,000	ft	
Hold	Cruise at Max Endurance Speed at the Holding Pattern Altitude. No range credit.			
	Hold Time:	10	min	
Final Descent	Descend at Min Sink Speed to the Destination Airport Altitude.			
	Destination Airport Altitude:	2,000	ft	
Landing	Land at the Destination Airport.			

Flight Profile # 60			MISSION WORKSHEET			Name:		
Warm-up and Taxi						Climb to Altitude		
Initial Weight	lb					Initial Weight	lb	
Airfield Altitude	ft					Initial Altitude	ft	
Time of Warm-up	min					Initial Speed	ft/sec	
Fuel for Warm-up and Taxi	lb					Time to Climb	min	
Final Weight	lb					Fuel to Climb	lb	
Takeoff						Distance to Climb	NM	
Initial Weight	lb					Final Weight	lb	
Airfield Altitude	ft					Final Altitude	ft	
Stall Speed	ft/sec					Final Speed	ft/sec	
Rotation Speed	ft/sec					Final Cruise		
Takeoff Speed	ft/sec					Initial Weight	lb	
Obstacle Speed	ft/sec					Initial Altitude	ft	
Ground Roll Distance	ft					Initial Speed	ft/sec	
Time for Takeoff	min					Time to Cruise	min	
Fuel for Takeoff	lb					Fuel to Cruise	lb	
Distance for Takeoff	NM					Distance to Cruise	NM	
Final Weight	lb					Final Weight	lb	
Final Altitude	ft					Final Altitude	ft	
Final Speed	ft/sec					Final Speed	ft/sec	
Climb to Altitude						Initial Descent		
Initial Weight	lb					Initial Weight	lb	
Initial Altitude	ft					Initial Altitude	ft	
Initial Speed	ft/sec					Initial Speed	ft/sec	
Time to Climb	min					Time to Descend	min	
Fuel to Climb	lb					Fuel to Descend	lb	
Distance to Climb	NM					Distance to Descend	NM	
Final Weight	lb					Final Weight	lb	
Final Altitude	ft					Final Altitude	ft	
Final Speed	ft/sec					Final Speed	ft/sec	
Initial Cruise						Hold		
Initial Weight	lb					Initial Weight	lb	
Initial Altitude	ft					Initial Altitude	ft	
Initial Speed	ft/sec					Initial Speed	ft/sec	
Time to Cruise	min					Time to Hold	min	
Fuel to Cruise	lb					Fuel to Hold	lb	
Distance to Cruise	NM					Distance to Hold	NM	
Final Weight	lb					Final Weight	lb	
Final Altitude	ft					Final Altitude	ft	
Final Speed	ft/sec					Final Speed	ft/sec	
Descent to Maneuver						Final Descent		
Initial Weight	lb					Initial Weight	lb	
Initial Altitude	ft					Initial Altitude	ft	
Initial Speed	ft/sec					Initial Speed	ft/sec	
Time to Descend	min					Time to Descend	min	
Fuel to Descend	lb					Fuel to Descend	lb	
Distance to Descend	NM					Distance to Descend	NM	
Final Weight	lb					Final Weight	lb	
Final Altitude	ft					Final Altitude	ft	
Final Speed	ft/sec					Final Speed	ft/sec	
Maneuver						Landing		
Initial Weight	lb					Initial Weight	lb	
Initial Altitude	ft					Airfield Altitude	ft	
Initial Speed	ft/sec					Stall Speed	ft/sec	
Corner Velocity	ft/sec					Approach Speed	ft/sec	
Max Inst Turn Rate	deg/sec					Landing Speed	ft/sec	
Sustained g Velocity	ft/sec					Ground Roll Distance	ft	
Max Sustained Turn Rate	deg/sec					Remaining fuel onboard		
X degrees in Turn	deg					Remaining fuel onboard	lb	
Time to turn X degrees	min							
Fuel to turn X degrees	lb							
Interim Weight	lb							
Time to Accel 0.2M to 0.4M	min							
Fuel to Accel 0.2M to 0.4M	lb							
Time to Maneuver	min							
Fuel to Maneuver	lb							
Distance to Maneuver	NM							
Final Weight	lb							
Final Altitude	ft							
Final Speed	ft/sec							

Flight Profile # 60		MISSION TIME HISTORY SUMMARY			Name:					
					Incremental			Total		
Mission Segment		Aircraft Weight (lb)	Altitude (ft)	Speed (ft/sec)	Time (min)	Fuel (lb)	Distance (NM)	Time (min)	Fuel (lb)	Distance (NM)
Warm-up & Taxi	Initial Conditions									
	Final Conditions									
Takeoff	Initial Conditions									
	Final Conditions									
Climb to Altitude	Initial Conditions									
	Final Conditions									
Initial Cruise	Initial Conditions									
	Final Conditions									
Descent	Initial Conditions									
	Final Conditions									
Maneuver	Initial Conditions									
	Final Conditions									
Climb to Altitude	Initial Conditions									
	Final Conditions									
Final Cruise	Initial Conditions									
	Final Conditions									
Initial Descent	Initial Conditions									
	Final Conditions									
Hold	Initial Conditions									
	Final Conditions									
Final Descent	Initial Conditions									
	Final Conditions									
Landing	Initial Conditions									
	Final Conditions									
							Remaining fuel onboard:			lb

Questions?