DOCKET NO. **SA - 510**

EXHIBIT NO. **13 I**

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

Excerpted Data From Various Studies

KINEMATIC MODEL

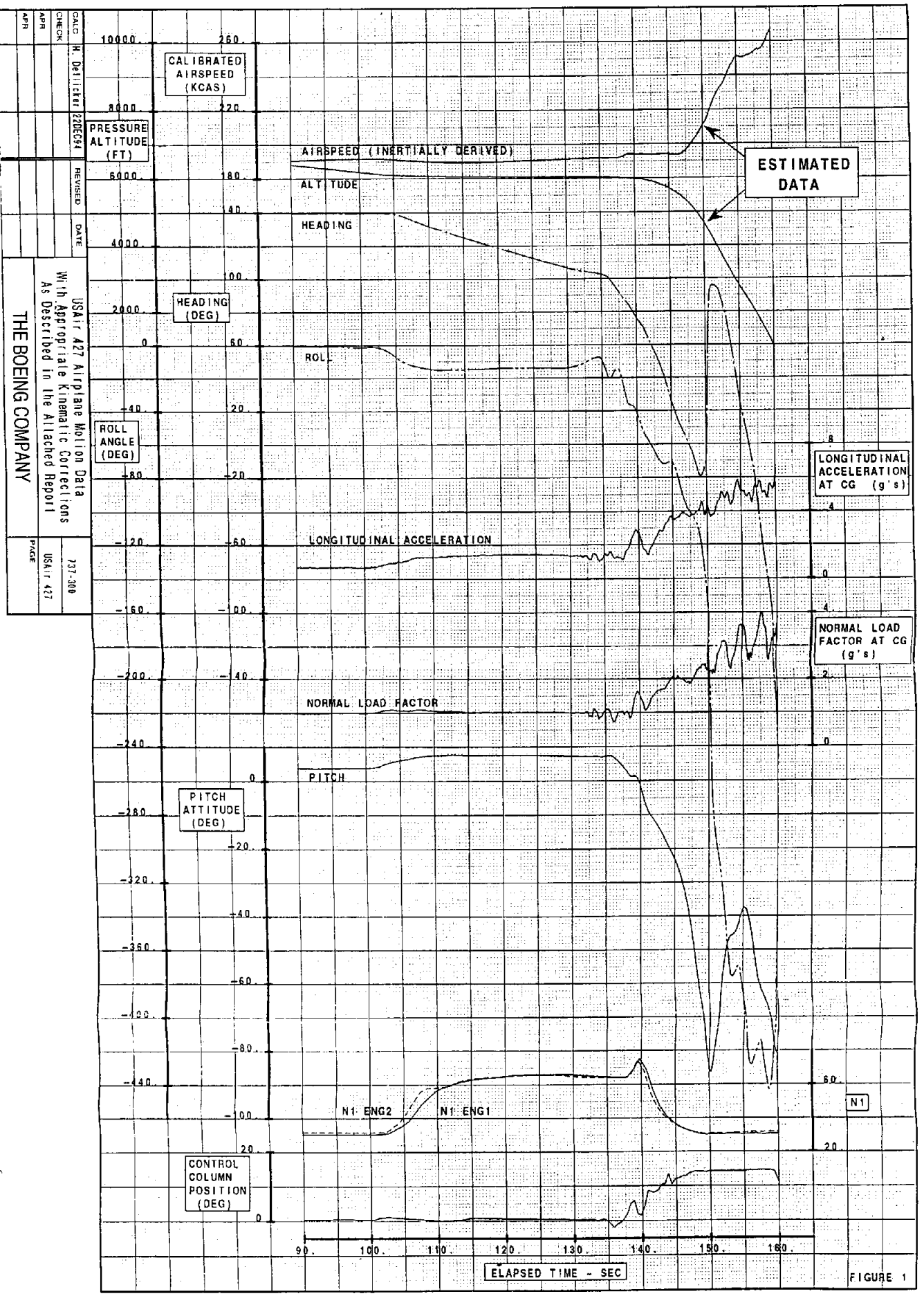


FIGURE 1

THE BOEING COMPANY

USAir 427 Airplane Motion Data
With Appropriate Kinematic Corrections
As Described in the Attached Report

737-300
USAir 427
PAGE

	CALC	CHECK	APR	APR
H. Dellicker				
22DEC94				
REVISED				
DATE				

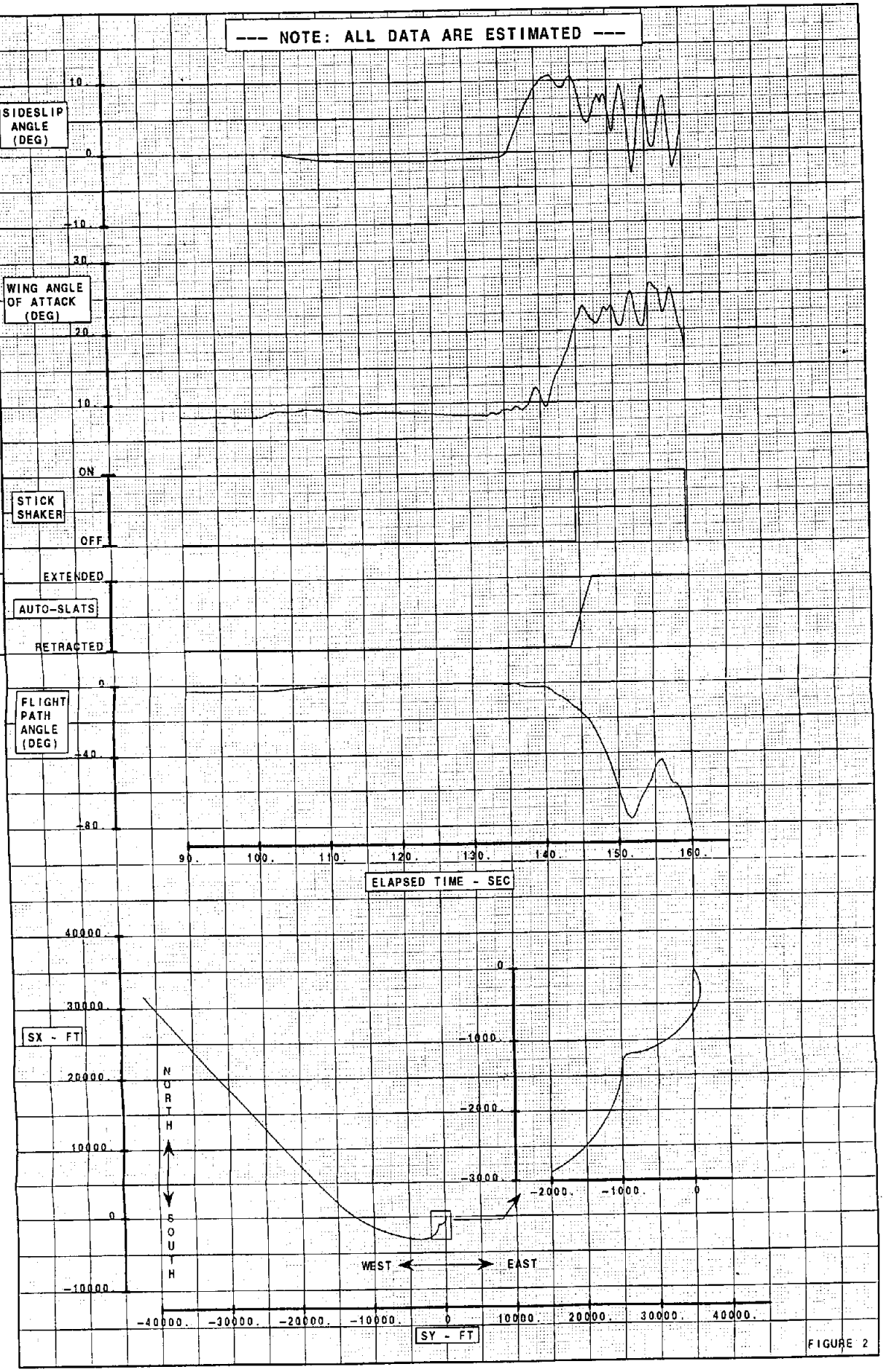


FIGURE 2

--- NOTE: ALL DATA ARE ESTIMATED ---

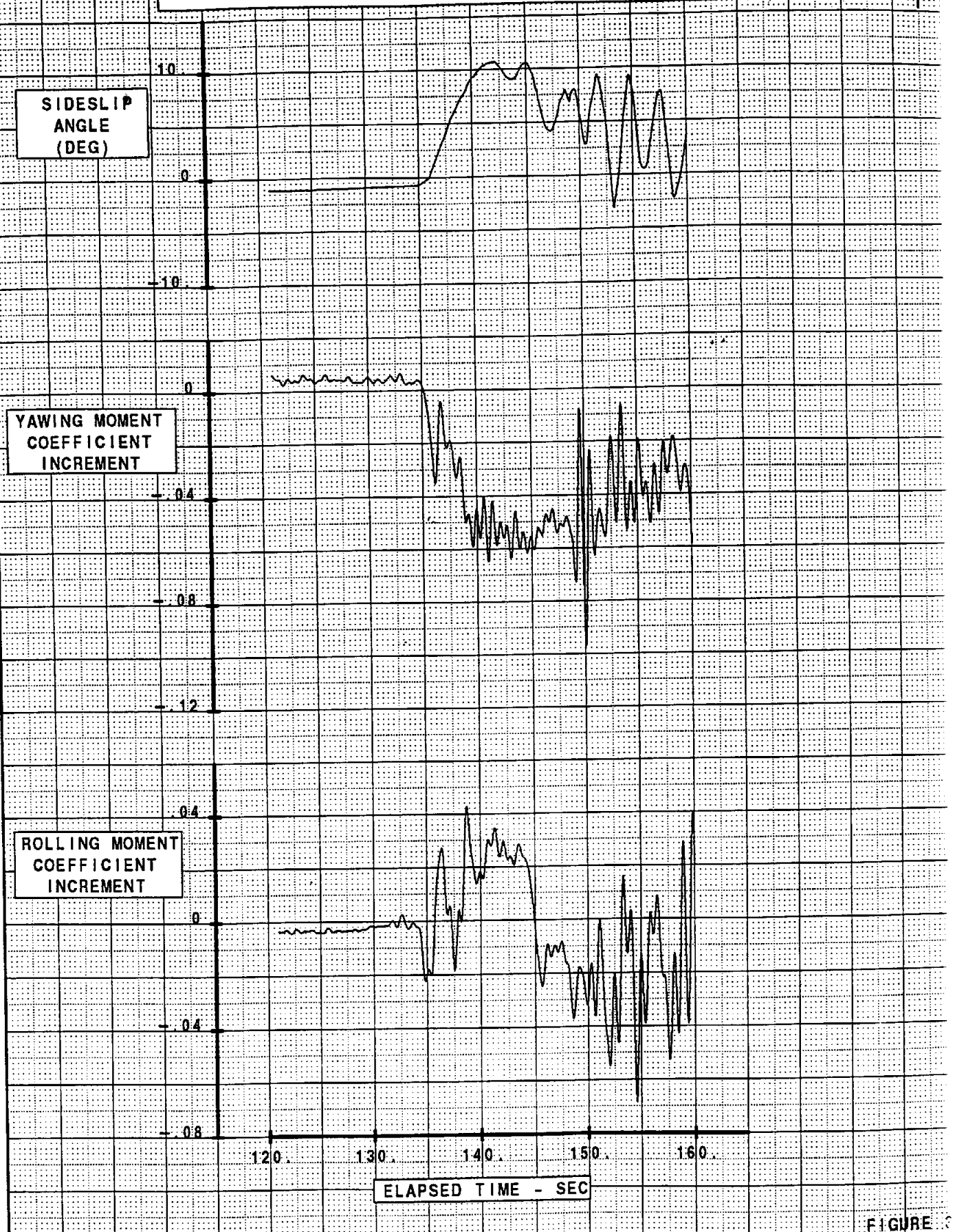


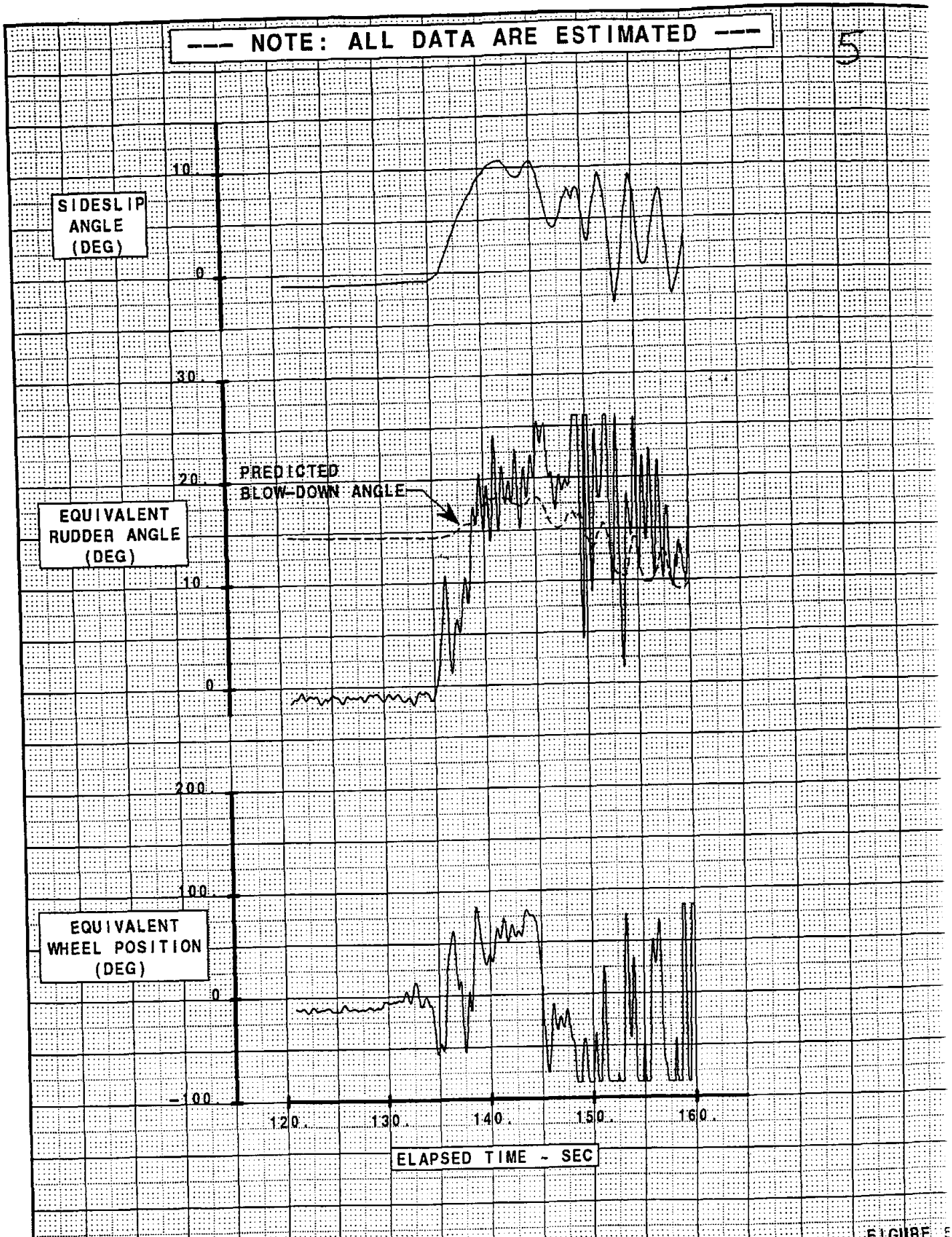
FIGURE 3

CALC	H. Dellicker	21DEC94	REVISED	DATE	USAir 427 Aerodynamic Coefficient Data -- Lateral/Directional -- (Rudder, Wheel and Stab set to Zero)
CHECK					
APR					
APR					
					THE BOEING COMPANY

737-300

USAir 427

PAGE



FIGURE

CALC	H. Dellicker	21DEC94	REVISED	DATE	USAir 427 Aerodynamic Coefficient Data -- Lateral/Directional -- (Yaw & Roll Trimmed with Rudder & Wheel	737-300
CHECK						USAir 427
APR					THE BOEING COMPANY	PAGE
APR						

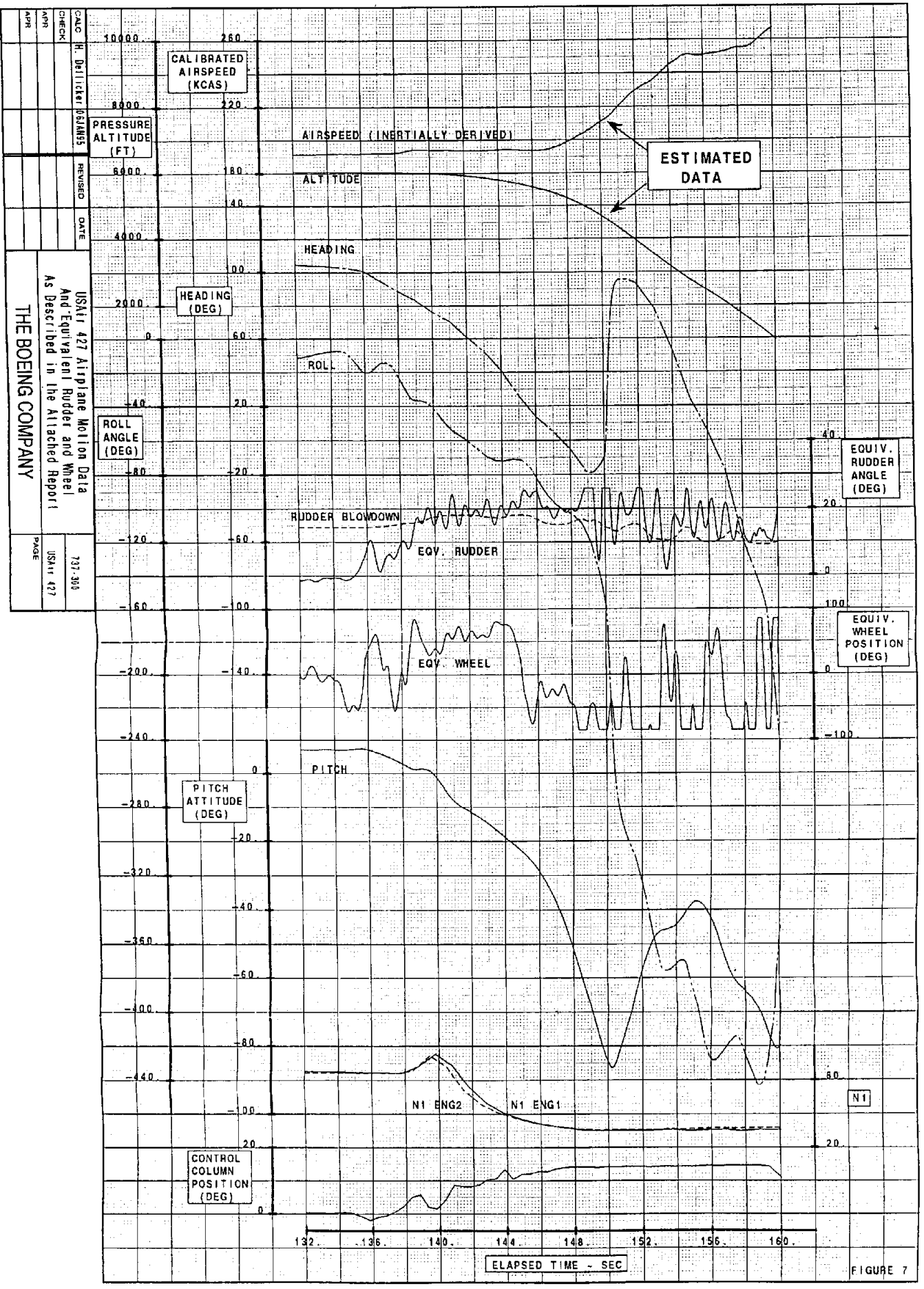

CALC H. Dellicker 06/AUG/85
CHECK
APR
APR
REVISED
DATE
THE BOEING COMPANY
USAir 427 Airplane Motion Data
And Equivalent Rudder and Wheel
As Described in the Attached Report
737-300
USAir 427
PAGE
CALIBRATED AIRSPEED (KCAS)
PRESSURE ALTITUDE (FT)
HEADING (DEG)
ROLL ANGLE (DEG)
PITCH ATTITUDE (DEG)
CONTROL COLUMN POSITION (DEG)
EQUIV. RUDDER ANGLE (DEG)
EQUIV. WHEEL POSITION (DEG)
N1
AIRSPEED (INERTIALLY DERIVED)
ALTITUDE
HEADING
ROLL
RUDDER BLOWDOWN
EQV. RUDDER
EQV. WHEEL
PITCH
N1 ENG2
N1 ENG1
ESTIMATED DATA
ELAPSED TIME - SEC
132.
136.
140.
144.
148.
152.
156.
160.

FIGURE 7

--- NOTE: ALL DATA ARE ESTIMATED ---

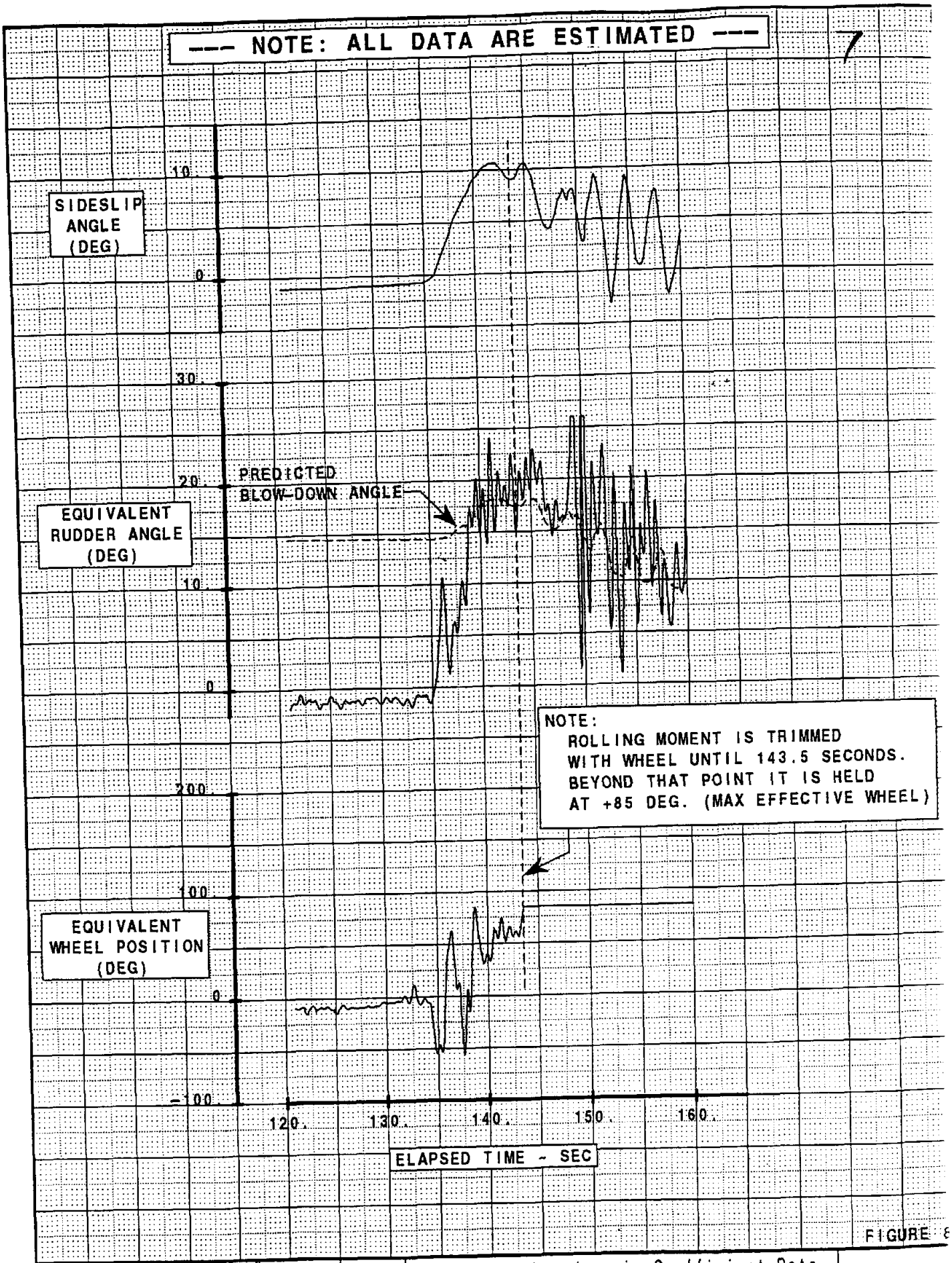


FIGURE 8

CALC	H. Dellicker	06JAN95	REVISED	DATE
CHECK				
APR				
APR				

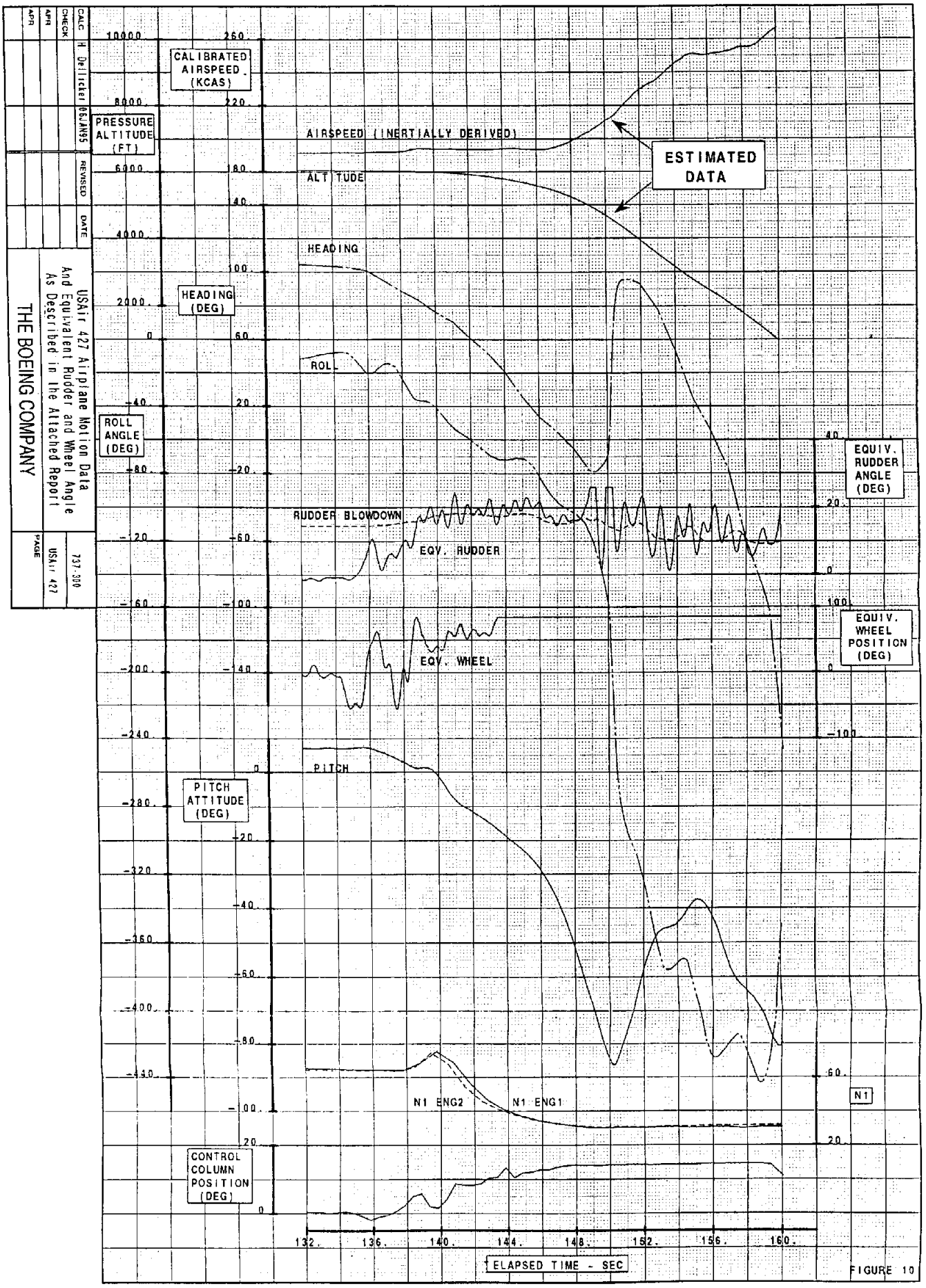
USAir 427 Aerodynamic Coefficient Data
-- Lateral/Directional --
(Yaw Trimmed w/Rudder: Roll, see Note)

737-300

USAir 427

PAGE

THE BOEING COMPANY


CALIBRATED AIRSPEED (KCAS)
PRESSURE ALTITUDE (FT)
AIRSPEED (INERTIALLY DERIVED)
ESTIMATED DATA
ALTITUDE
HEADING
HEADING (DEG)
ROLL
ROLL ANGLE (DEG)
EQUIV. RUDDER ANGLE (DEG)
RUDDER BLOWDOWN
EQV. RUDDER
EQUIV. WHEEL POSITION (DEG)
EQV. WHEEL
PITCH
PITCH ATTITUDE (DEG)
N1 ENG2
N1 ENG1
N1
CONTROL COLUMN POSITION (DEG)
ELAPSED TIME - SEC
THE BOEING COMPANY
USAir 427 Airplane Motion Data
And Equivalent Rudder and Wheel Angle
As Described in the Attached Report
737-300
USAir 427
FIGURE 10

BACKDRIVE MODEL

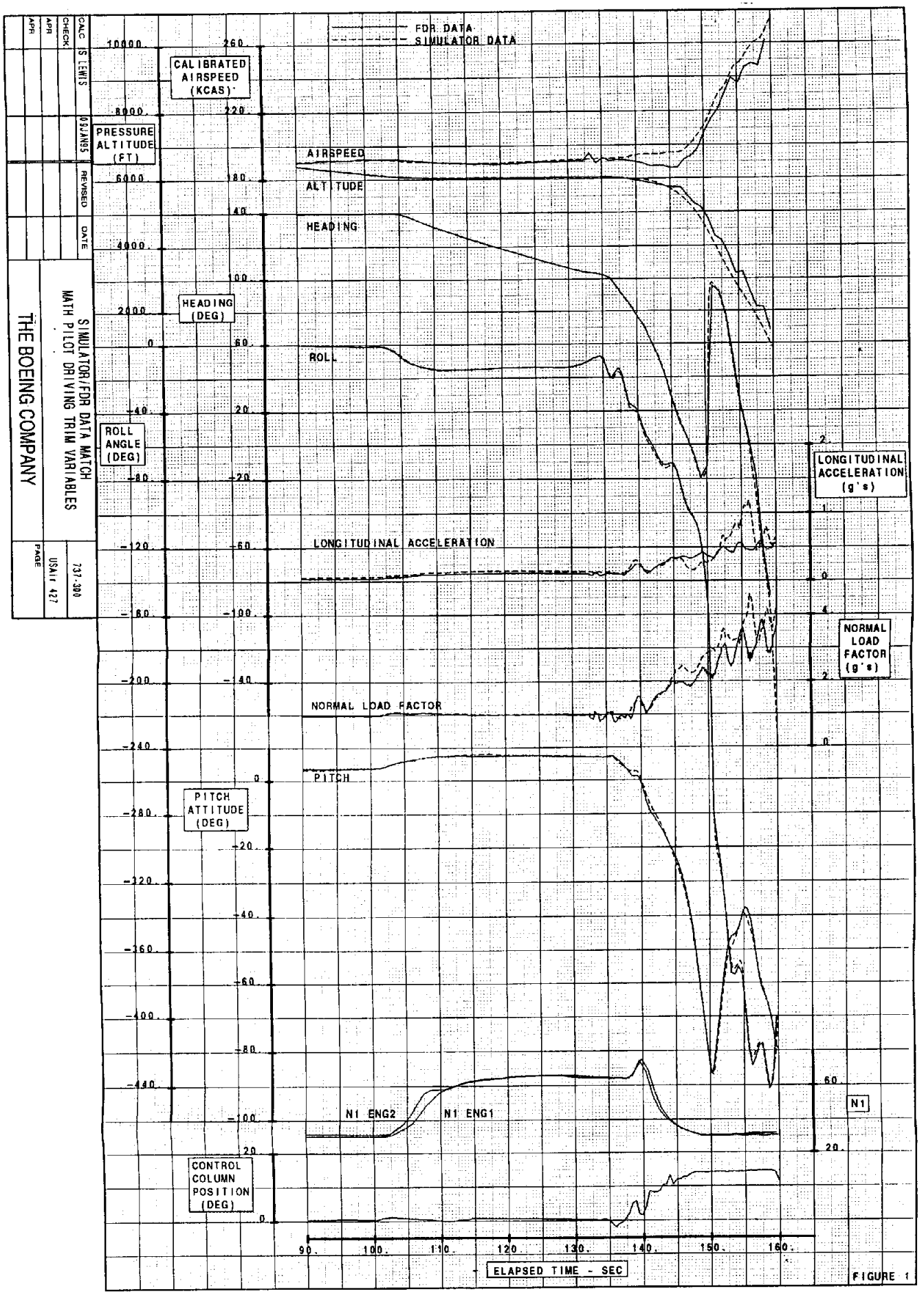

FDR DATA
SIMULATOR DATA
CALIBRATED AIRSPEED (KCAS)
PRESSURE ALTITUDE (FT)
HEADING (DEG)
ROLL ANGLE (DEG)
PITCH ATTITUDE (DEG)
CONTROL COLUMN POSITION (DEG)
AIRSPEED
ALTITUDE
HEADING
ROLL
LONGITUDINAL ACCELERATION
NORMAL LOAD FACTOR
PITCH
N1 ENG2
N1 ENG1
LONGITUDINAL ACCELERATION (g's)
NORMAL LOAD FACTOR (g's)
N1
ELAPSED TIME - SEC
CALC S LEWIS
CHECK
APR
APR
DATE
REVISED
09JAN95
THE BOEING COMPANY
SIMULATOR/FDR DATA MATCH
MATH PILOT DRIVING TRIM VARIABLES
737-300
USAir 427
PAGE

FIGURE 1

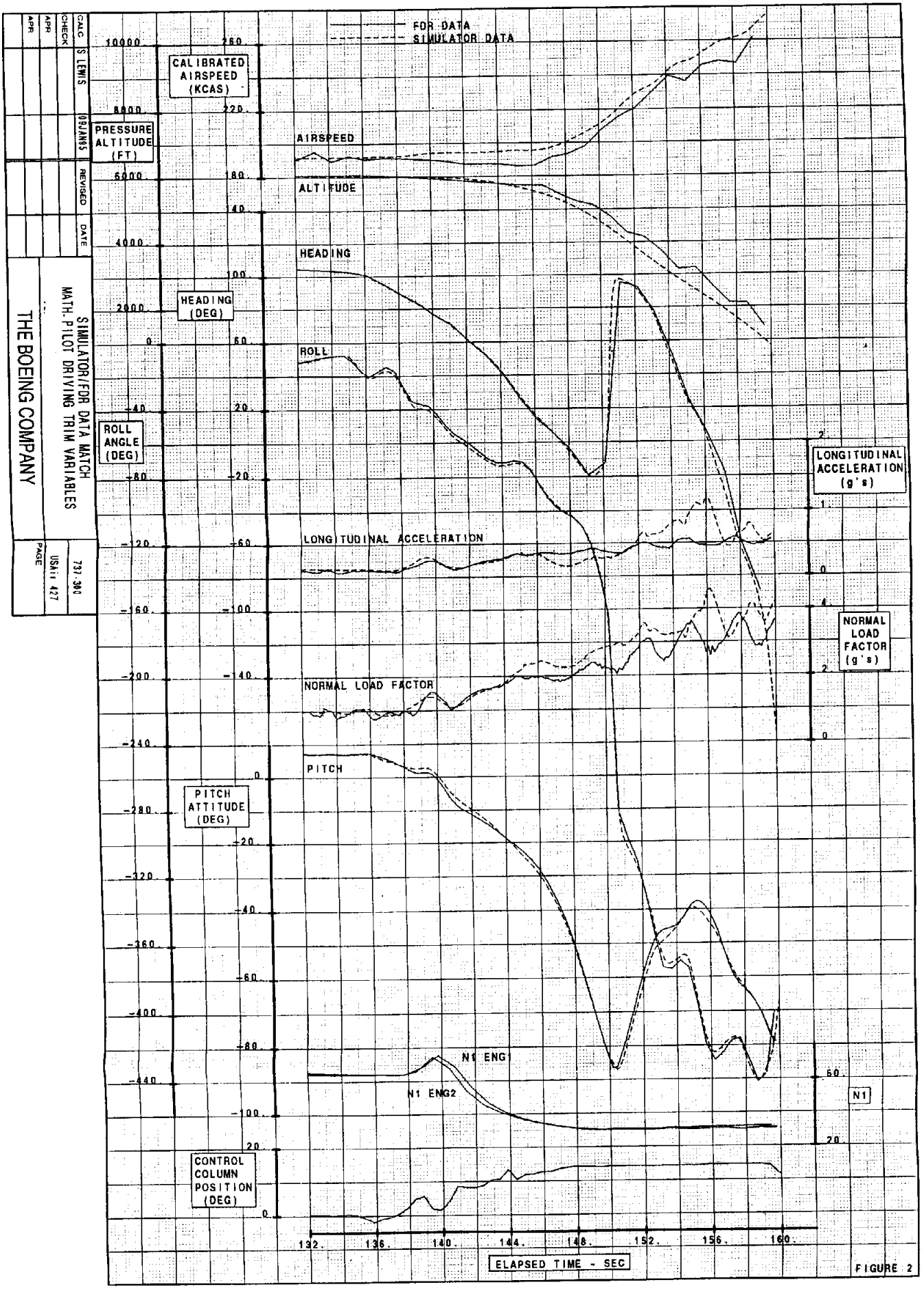

FOR DATA
SIMULATOR DATA
CALIBRATED AIRSPEED (KCAS)
PRESSURE ALTITUDE (FT)
HEADING (DEG)
ROLL ANGLE (DEG)
PITCH ATTITUDE (DEG)
CONTROL COLUMN POSITION (DEG)
LONGITUDINAL ACCELERATION (g's)
NORMAL LOAD FACTOR (g's)
N1
AIRSPEED
ALTITUDE
HEADING
ROLL
LONGITUDINAL ACCELERATION
NORMAL LOAD FACTOR
PITCH
N1 ENG1
N1 ENG2
ELAPSED TIME - SEC
CALC S LEWIS
CHECK BRJANES
APR REVISED
APR DATE
THE BOEING COMPANY
SIMULATOR/FDR DATA MATCH
MATH-PILOT DRIVING TRIM VARIABLES
737-300
USAir 427
PAGE

FIGURE 2

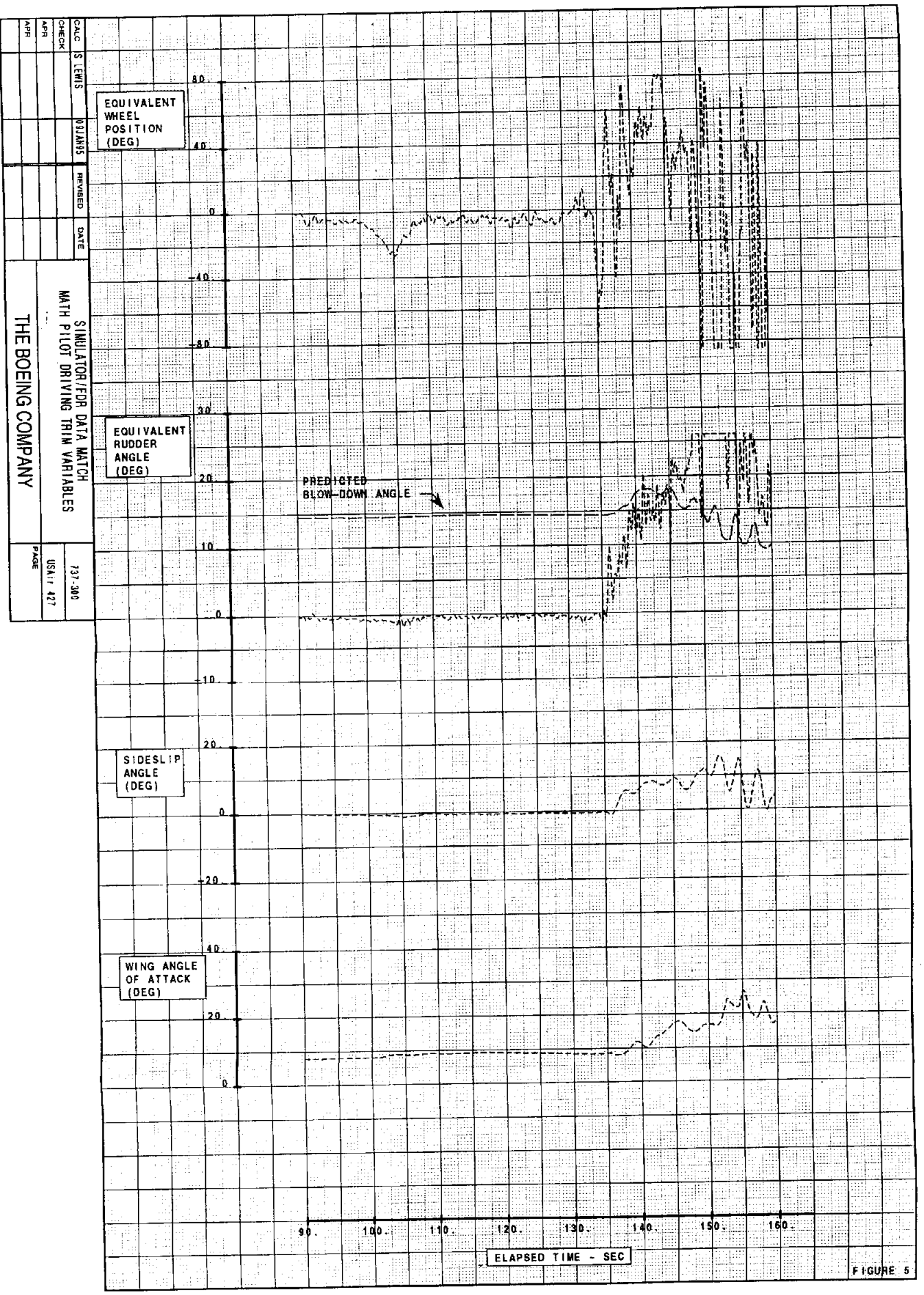


FIGURE 5

CALC JS LEWIS 03/JAN/95
CHECK
APR
APR
REVISED
DATE

THE BOEING COMPANY

SIMULATOR/FDR DATA MATCH
MATH PILOT DRIVING TRIM VARIABLES

737-300
USAir 427

PAGE

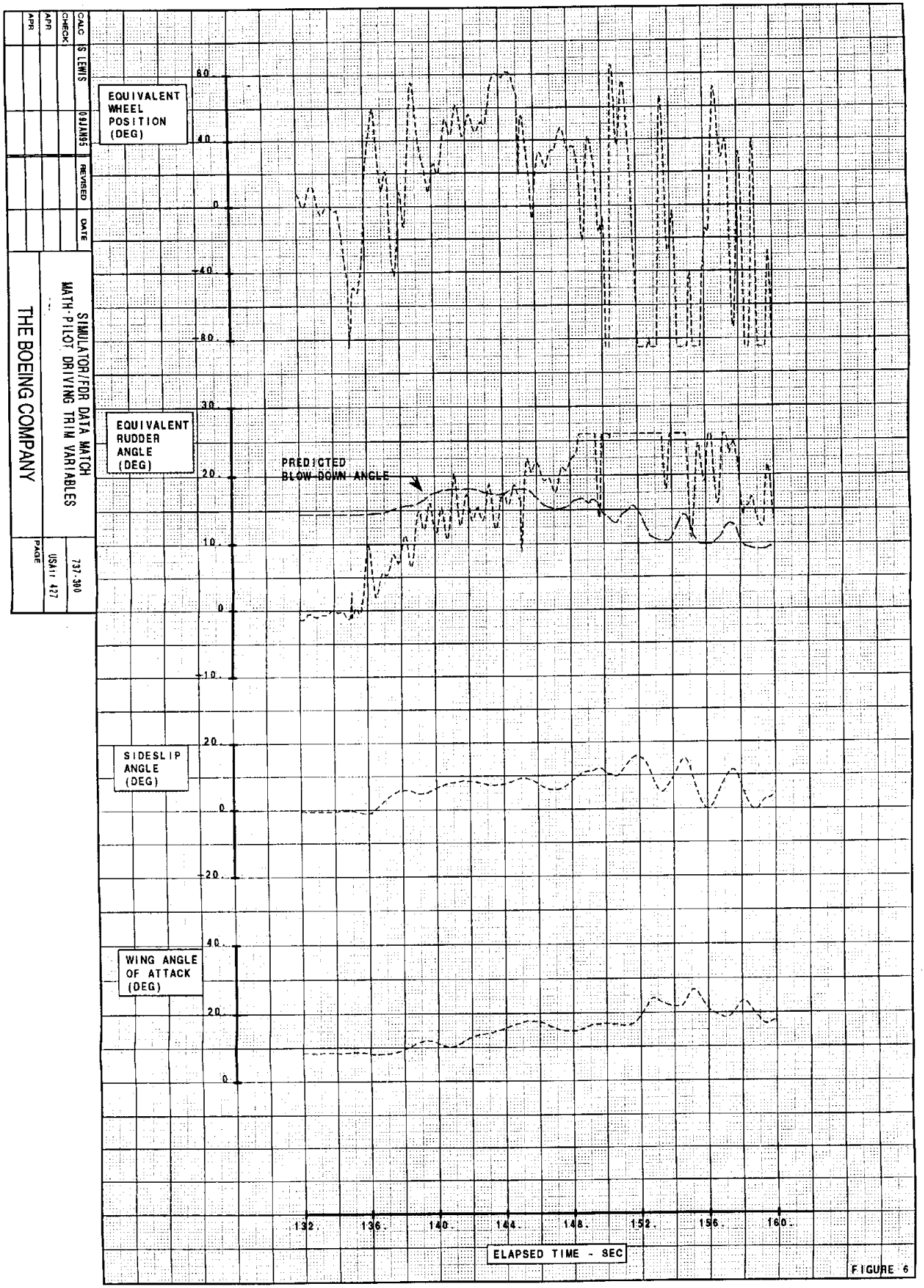


FIGURE 6

CALC IS LEWIS
CHECK
APR
APR

DATE	REVISED	08JAN85

THE BOEING COMPANY

SIMULATOR/FDR DATA MATCH
MATH-PILOT DRIVING TRIM VARIABLES

737-300
USA11 427
PAGE

Tom,

Attached are 2 sets of plots for the B-727 at the conditions as I know them. The weather data which you sent suggests that there would be little turbulence at the flight altitude so I ran cases for no turbulence and light turbulence to give you some bounds on the problem.

The "DESCENT" and "DECAY" charts labeled No turbulence represent the strongest possible vortices. The two lines on each chart correspond to different wing span loadings or more precisely the ratio of vortex spacing to wing span caused by different span loadings. Vortex spacing/wing span (or b/s) for elliptic loading is pi/4 theoretically or about 0.78 and I believe the value of 0.7 was used by Boeing in their calculations. At any rate, this range should bound the spacing/span. For no turbulence, b/s of 0.7 descends more than 300 ft in 70 sec and b/s elliptic goes about 250 ft. The MAXIMUM strength at 70 seconds is about 2000 ft2/sec for b/s of 0.7 and this is probably higher than the actual value since at this strength and spacing they would descend more than 300 ft.

The charts labeled "Light Turbulence" are my best guess at actual conditions. The vortices descend about 250-300 ft depending on b/s and are at about 1300-1400 ft2/sec at 70 seconds. Since the vortices must move down about 300 ft, this bounds the strength between about 1300 and 2000 ft2/sec. This is about the range that was tested in the Boeing simulator. Our calculations in the past have indicated that this strength is sufficient to cause some rolling motion but not sufficient to flip a B-737 upside down.

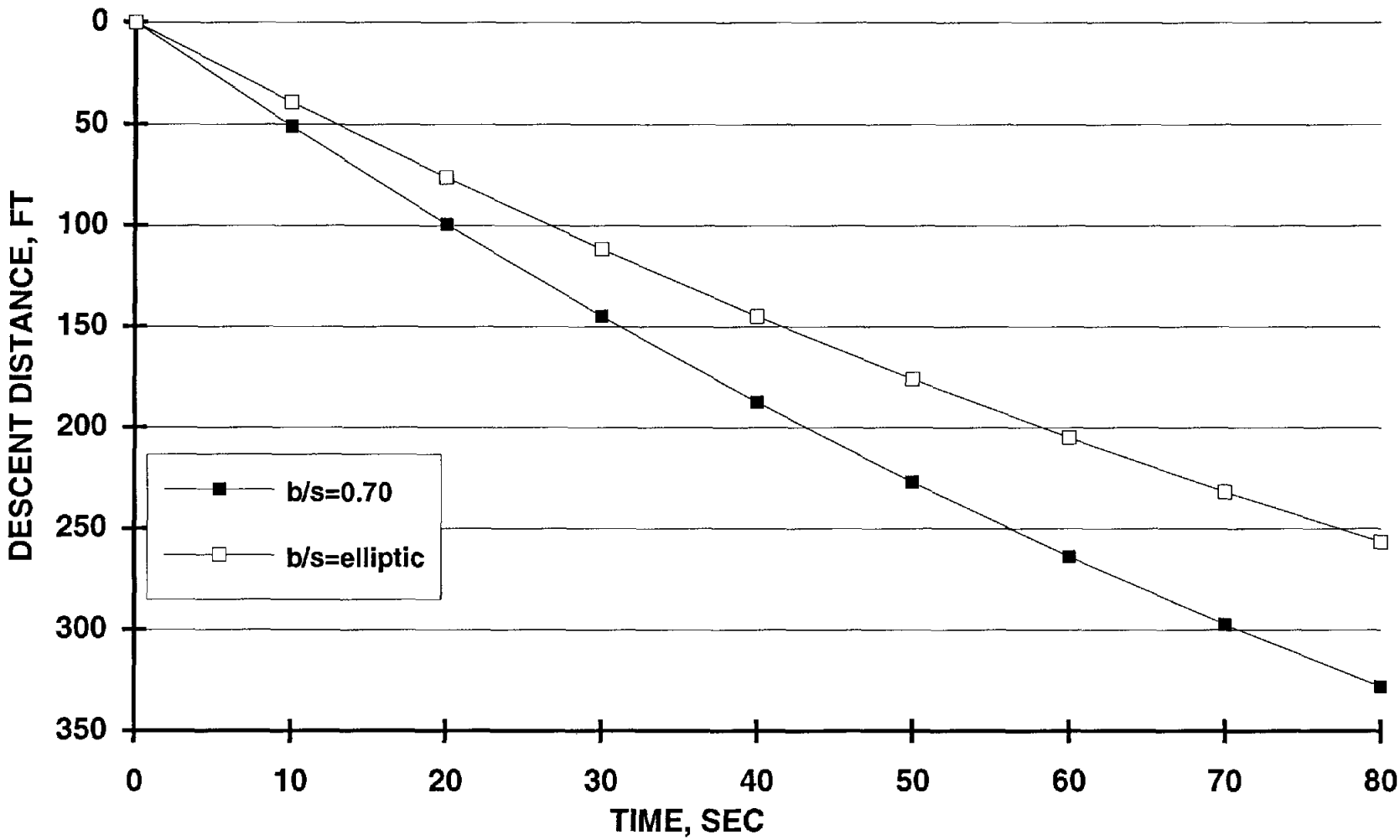
The sky is very big and a vortex is small so it is impossible to say for sure that there was a vortex encounter. However, there was a vortex in about the right location to be hit and the simulated encounters seem to be consistent with the predicted vortex strength.

Please let me know as soon as you are sure that my testimony is required and the topics which I should be prepared to cover.

George Greene

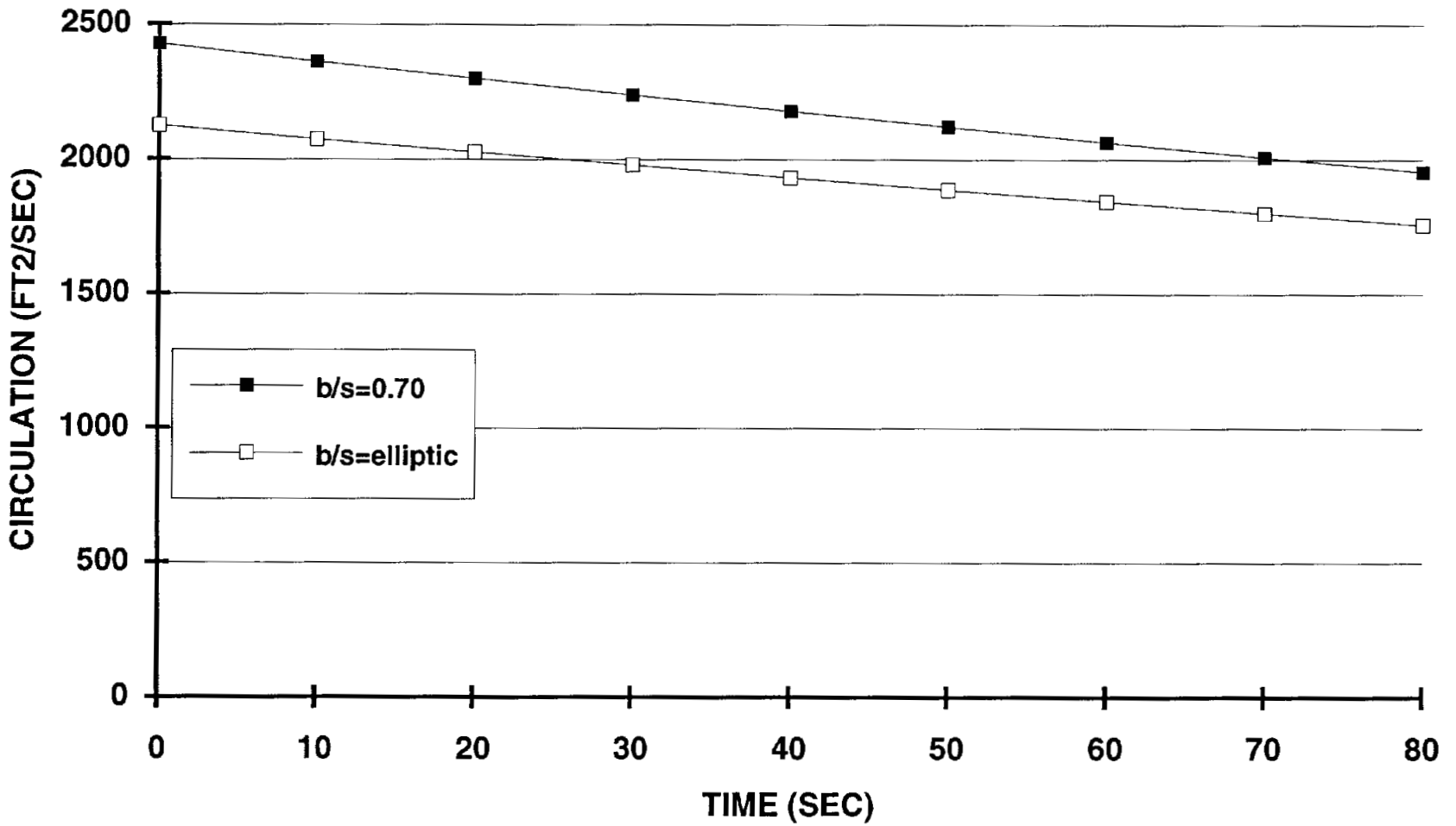
B-727 WAKE DESCENT

Light Turbulence and Stratification, 205 kts TAS, 126.4k lbs, Density=0.001988 slugs/ft3



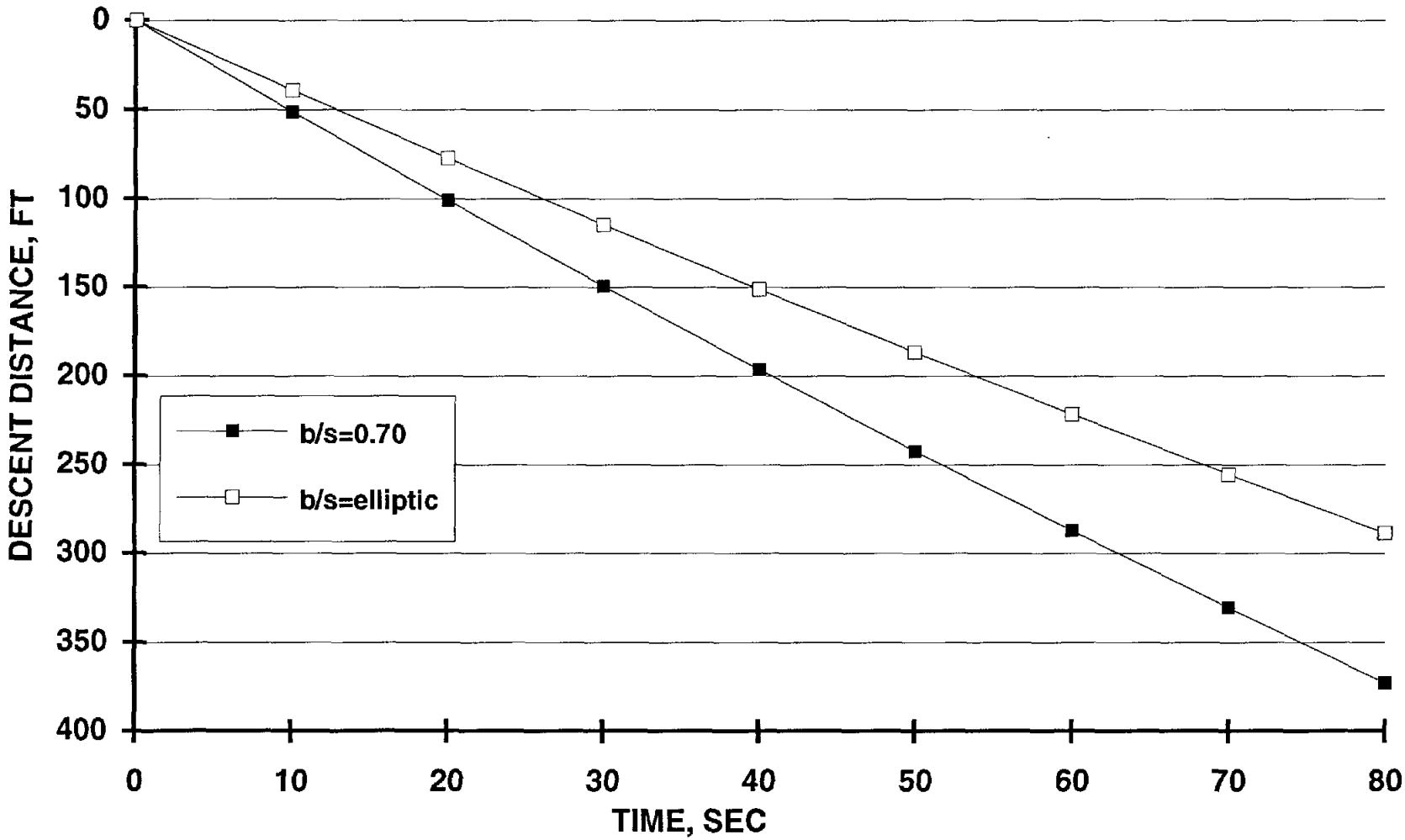
B-727 WAKE DECAY

No Turbulence or Stratification, 205 kts TAS, 126.4k lbs, Density=0.001988 slugs/ft3



B-727 WAKE DESCENT

No Turbulence or Stratification, 205 kts TAS, 126.4k lbs, Density=0.001988 slugs/ft3



B-727 WAKE DECAY

Light Turbulence and Stratification, 205 kts TAS, 126.4k lbs, Density=0.001988 slugs/ft3