DOT/FAA/AR-96/125

Office of Aviation Research
Washington, D.C. 20591

Video Landing Parameter Survey—John F. Kennedy International Airport

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July 1997

Final Report

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1. Report No.

DOT/FAA/AR-96/125

4. Title and Subtitle

VIDEO LANDING PARAI
INTERNATIONAL AIRPO

7. Author(s)

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9. Performing Organization Name and

*Naval Air Warfare Center
Aircraft Division
Patuxant River, MD

12. Sponsoring Agency Name and Add

U.S. Department of Transpo
Federal Aviation Administra
Office of Aviation Research
Washington, DC 20591

15. Supplementary Notes

This video landing paramete
Naval Air Warfare Center, A
AAR-432.

16. Abstract

The Federal Aviation Adm
surveys at high-capacity cor
aircraft and airports as they

The initial parameter landin
cameras were temporarily in
narrow-body, and 108 com
presented include sink rate,
distance from the runway to
for most landings. Since th
and are presented without re

Subsequent surveys have be
these results will be reporte

17. Key Words

Landing parameters, Sink ra
Roll, and Yaw angles and ra

19. Security Classif. (of this report)

Unclassified

Form DOT F1700.7 (8-72)

EXECUTIVE SUM

1 INTRODUC

2 SYSTEM DE

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5 REFERENCE

APPENDICES

A—Statistica

B—Listing of

C—Landing F

D—Accuracy
Aircraft

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AA Landing

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Probability Di

Survey Parame

The Federal Aviation
video landing paramete
typical landing contac
aircraft design criteria

The initial landing par
June 1994. Four videc
images of 614 transpo
analyzed, and the resu
speed; touchdown pitc
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for most landings. Si
data were processed a

Subsequent surveys
International runway 8

1. INTRODUCTIO

In an effort to better
jet transport aircraft
Hughes Technical C
activity commercial
wide variety of aircr
gear and support str
valuable resource in

The use of image da
aircraft were introdu
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safer. The Navy de
tracking and analysis
developed in 1947 [1
developed a similar
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systems was that the
NASA's camera was
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In 1967, the Navy er
This provided cons
Using these systems,
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thereafter, the Federa
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Preliminary results fr
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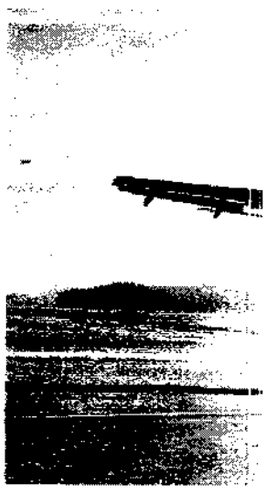

FIGURE 1. VIDE
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The video cameras are
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3. DISCUSSION.

A total of 621 landin
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primarily for takeof
landing runway used
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survey, runway 13L v
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indicate, resulted in s
right turn onto final a
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The analysis of image
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summaries were used

Landing parameters
commuter aircraft la
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FIGURE 3. AVERA(
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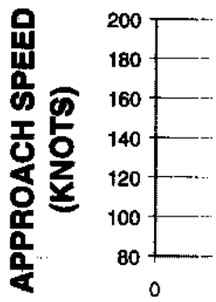

FIGURE 4. APPROA

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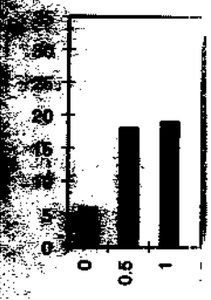

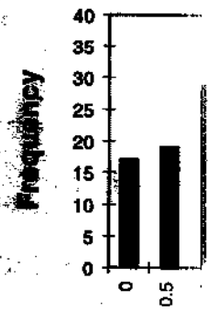

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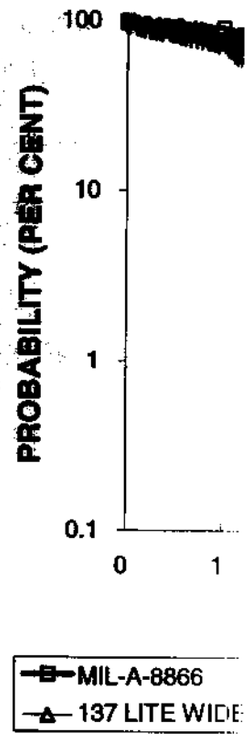

FIGURE 6. PROBA
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REFERENCES.

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NASA TN D-5
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NASA TN-D-8
Turbojet Trans
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LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
91	135	127	1.7	2.1	2.3	263900	2050	-3	0.6	5.8	3.6	0.0	-4.8	-6.2	8	3

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING RATE AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	[illegible] ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	[illegible]
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
290	151	146	2.8	1.1	2.0	244490	1571	-9	0.5	8.0	-1.1	0.1	10.0	-2.9	5	13
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	PORT FT/SEC	STBD FT/SEC	AVG FT/SEC	WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	PITCH ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	PITCH ANGLE TD DEGREE	TOUCHDOWN	
13	146	137	3.7	3.6	3.7	115206	1671	-16	0.9	6.4	-1.5	0.0	-3.1	-2.0	9	3
17	132	123	2.4	2.3	2.3	130244	1858	-3	0.6	5.7	-1.5	-1.7	0.8	-3.0	9	3
23	125	116	4.0	2.3	3.1		2240	-2	0.9	6.0	1.1	-1.1	0.1	-2.7	9	3

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	[illegible] TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	[illegible] ANGLE TD DEGREE	[illegible] ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	[illegible] ANGLE TD DEGREE	[illegible] RATE TD DEG/SEC	[illegible] ANGLE TD DEGREE	[illegible] AT TOUCHDOWN	
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC											
514	145	136	2.2	1.1	1.4	141102	1905	1	0.3	6.4	-2.0	2.4	11.8	-4.3	9	16
522	132	130	0.2	1.7	0.9	142192	1723	19	0.2	5.5	-0.9	3.9	-5.4	-4.4	2	12
524	140	138	2.6	2.3	2.1	142021	2126	13	0.5	6.2	0.1	3.2	-3.6	-4.9	2	12

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WINDS AT TOUCHDOWN	
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC											
860	145	142	0.6	0.9	0.8	143321	2341	-3	0.2	2.1	1.1	-2.0	-2.2	-3.4	3	8
887	134	132	0.8	1.0	0.9		2352	-7	0.2	3.9	-1.1	1.2	-1.8	-1.0	1	7
897	125	123	5.4	5.1	5.3	142211	910	1	1.5	6.6	-2.1	0.8	0.9	-3.3	1	7

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LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS AT TOUCHDOWN	WIND KNOTS AT TOUCHDOWN
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC											
2	133	124	0.7	1.6	1.1	102300	2391	-10	0.3	6.5	0.1	1.0	0.8	2.9	9	3
69	138	128	1.7	1.5	1.7	103000	946	3	0.4	4.4	-1.6	1.3	8.8	-3.8	10	4

LANDING DATA MODEL BOEING 747 AIRCRAFT
FAA SURVEY JOHN F. KENNEDY INTERNATIONAL AIRPORT

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS-WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
27	141	132	1.7	4.9	4.5	503124	1524	-7	1.2	4.7	-1.0	-1.0	-6.9	2.0	9	3

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
875	150	149	3.9	3.0	3.5		900	2	0.8	4.0	-0.6	1.0	0.8	-0.4	1	7
879	143	142	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
10	116	107	1.9	3.4	2.8	[illegible]	828	-5	0.9	6.9	-1.2	1.5	-8.4	1.7	9	3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	[illegible] AT TOUCHDOWN	
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC											
513	139	130	4.1	4.6	4.3	179900	719	7	1.1	4.5	3.1	4.9	-1.7	-0.1	9	16
523	137	135	1.7	0.8	1.1	182600	1758	3	0.3	4.6	0.0	0.7	3.5	-3.6	2	12

LANDING DATA

FAA SURVEY [illegible] AIRPORT

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	[illegible] SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	[illegible] WIND KNOTS	[illegible] WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
14	131	122	3.8	1.8	2.2	287300	1498	5	0.6	8.7	8.9	3.8	-2.0	-4.7	9	3
18	142	132	3.1	2.7	2.9	242778	670	3	0.7	4.9	0.9	-0.6	1.9	2.3	9	3

FAA

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
390	141	133	0.0	0.7	0.2		1588	7	0.1	6.2	2.7	-0.9	2.3	-1.3	8	-7
412	132	123	1.4	1.7	1.9		2101	-13	0.5	6.3	1.0	0.7	-0.9	3.8	10	-5

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
817	161	156	0.3	-0.2	0.1	260000	1849	8	0.0	5.6	0.7	0.2	2.5	-4.2	5	9
822	131	120	0.7	0.5	0.5	254800	1853	0	0.2	7.3	2.0	0.7	0.4	1.0	11	0

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
62	168	157	4.2	5.8	5.9	Not	831	-5	1.3	11.0	-2.1	-1.1	0.2	-0.9	10	4
186	170	166	4.6	5.6	5.1	Recorded	4110	-6	1.0	10.1	-2.6	1.4	-14.2	-2.6	3	9

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FAA SURVEY JOHN F. KENNEDY INTERNATIONAL AIRPORT

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
38	138	129	3.2	3.1	3.0	307840	2212	1	0.8	8.3	0.3	-0.1	1.4	-1.4	9	3

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LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	[illegible] WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
4	133	123	0.9	0.6	0.8	95300	811	-4	0.2	7.2	-1.2	-0.3	-0.6	-4.7	9	3

[redacted]

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LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
126	132	126	3.6	3.0	3.3	310000	883	3	0.9	6.5	-2.0	1.5	0.2	1.9	6	10

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	RUNWAY SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	[illegible] KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
39	150	141	0.3	0.0	0.2	360700	2412	-3	0.0	5.3	0.7	3.0	-2.5	0.7	9	3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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FAA SURVEY JOHN F. KENNEDY INTERNATIONAL AIRPORT

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	HEAD WIND KNOTS	CROSS WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
53	131	120	0.9	1.0	0.9	101467	2430	2	0.3	4.6	0.6	1.8	-4.2	2.0	11	2
88	150	142	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GLIDE SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
730	138	138	1.9	2.0	2.1	116099	818	3	0.5	3.6	0.0	0.6	5.9	-1.9	0	10
734	131	131	1.8	2.0	2.1	116579	2069	5	0.6	3.9	1.1	-0.3	3.4	-1.7	0	10

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
28	101	92	2.1	1.6	1.9	32771	2397	-2	0.7	3.9	0.9	0.4	2.6	3.0	9	3
73	107	97	1.3	2.9	2.1		2459	-4	0.7	2.9	5.7	3.7	3.8	-2.2	10	4

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS	WIND DEGS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
9	77	67	0.3	0.9	0.6		1759	-6	0.3	6.3	-6.1	2.3	1.2	1.3	9	3
25	76	67	1.4	1.6	1.5		2150	1	0.7	3.8	1.9	-0.7	17	10	9	3

LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	RUNWAY SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND WIND KNOTS	WIND WIND KNOTS
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC										AT TOUCHDOWN	
3	74	65	0.0	0.6	0.3		1788	-1	0.2	6.7	-0.7	2.7	-4.0	-1.0	9	3
171	122	117	2.9	4.5	4.0		688	-21	1.2	6.1	3.0	0.9	3.8	2.5	6	10

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LNDG NO.	POWER APPROACH AIRSPEED KNOTS	CLOSURE SPEED KN	SINKING SPEED AT TOUCHDOWN			WEIGHT LBS	RAMP TO TD DIST FT	RUNWAY OFF-CENTER FEET	GD SLOPE ANGLE TD DEGREE	PITCH ANGLE TD DEGREE	PITCH RATE TD DEG/SEC	ROLL ANGLE TD DEGREE	ROLL RATE TD DEG/SEC	YAW ANGLE TD DEGREE	WIND KNOTS AT TOUCHDOWN	WIND KNOTS AT TOUCHDOWN
			PORT FT/SEC	STBD FT/SEC	AVG FT/SEC											
8	116	106	1.6	2.6	2.3	22750	1735	-4	0.7	3.6	-4.2	5.0	-5.8	2.4	9	3
65	122	112	1.1	1.3	1.2	23000	1979	0	0.4	5.0	-2.4	-0.7	1.4	-4.8	10	4

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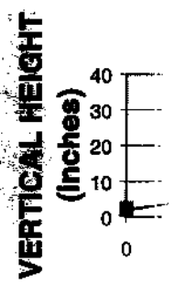

FIGURE D-2. N

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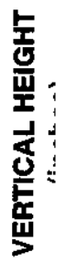

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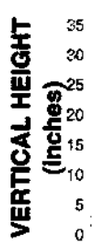

FIGURE D-4. N

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