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ANALYSIS OF PREDICTED AIRCRAFT WAKE VORTEX TRANSPORT AND COMPARISON WITH EXPERIMENT

Volume II -- Appendixes

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16. Abstract

A unifying wake vortex transport model is developed and applied to a wake vortex predictive system concept. The fundamentals of vortex motion underlying the predictive model are discussed including vortex decay, bursting and instability phenomena. A parametric and sensitivity analysis is presented to establish baseline uncertainties in the algorithm to allow meaningful comparison of predicted and measured vortex tracks. A detailed comparison of predicted vortex tracks with photographic and groundwind vortex data is presented. Excellent agreement between prediction and measurement is shown to exist when sufficient wind data are available. Application of the Pasquill class criteria is shown to be an effective technique to describe the wind profile in the absence of detailed wind data. The effects of wind shear and the Ekman spiral on vortex transport are discussed. It is shown that the combination of wind shear and ground plane may be possible mechanisms underlying vortex tilting and a theoretical explanation is advanced that is somewhat supported by comparison with the experimental data. Finally, recommendations for further vortex data collection in the vicinity of an airport are presented.

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PREFACE

This document represents the final report of Contract DOT-TSC-593 and covers the period 2 April to 2 December 1973.

This study was performed by personnel at the Lockheed Missles & Space Company, Inc., Huntsville Research & Engineering Center, Huntsville, Alabama. The project engineer and principal investigator for this study was Dr. M.R. Brashears of the Fluid Mechanics Applications Group.

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CONTENTS

VOLUME I

CONTENTS (CONTINUED)

CONTENTS (CONTINUED)

Appendix A

SUMMARY OF AIRCRAFT FLYBYS

This appendix summarizes aircraft information for the test days of interest. The first priority flybys are those recorded on 17 and 18 October 1972 and 1 November 1972. However, predictive vortex tracks have been generated for most of the runs shown in this appendix. The wind speed and direction are the unaveraged values recorded at the 140-foot level on the tower corresponding to the time of aircraft passage.

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (^oC)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power ↓	DC6 78	250 ↓	170 ↓	75 ↓	125	22	8	0 ↓	8	330	126	8-19 ↓	10:49
	DC6 79				122	23 ↓	6		6	0	130		10:53
	DC6 80				123		4		6	350	128		10:55
	DC6 81				120		8		8	0	126		10:58
	DC6 82		175		120		7	340 ↓	7	340	126		11:01
	DC6 83		170 ↓		118				8	340	126		11:05
	DC6 84				120	24			8	0	128		11:08
	DC6 85				121	24	4	0			127		11:12

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power	B727 37	150	100	119	120	28	10	140	—	—	216	8-22	13:03
	B727 38		130	118	123			160	10	160	215		13:07
	B727 39		140	118	115			150	10	150	210		13:12
	B727 40		140	116	116			170	12		212		13:15
	B727 41		140	116	114			150	10		215		13:18
	B727 42		180	115	115				15		210		13:22
	B727 43		130	115	112		12		12		215		13:26
	B727 44		130	114	114						212		13:30
	B727 45		90	115	120						214		13:33
	B727 46		120	113	119						214		13:36
	B727 47		160	112	118						218		13:40
Holding, level flight, all engines same power	B727 48	200	120	111	330		—	—	—	—	212		13:42

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power	B727 124	-150	150	127	127	26	8	180	7	180	127	9-13	11:52
↓	B727 125	↓	140	126	125	↓	6	180	5	180	126	9-13	11:55
	B727 126		170	126	122		6	190	—	—	125	9-13	11:59
	B727 127		130	137	128		9	250	8	255	130	9-14	06:56
	B727 128		160	136	135		9	255	—	—	128	↓	07:01
	B727 129		130	135	128		9	260	8	250	127		07:04
	B727 130		130	134	132		11	255	—	—	127		07:08
	B727 131		150	133	130		10	260	10	260	127		07:13
	B727 132		150	132	132		6	250	7	250	125		07:17
	B727 133		140	132	128		8	255	—	—	125		07:21
	B727 134		140	131	128		10	260	—	—	↓		07:26
	B727 135		130	131	130		6	260	10	250			07:30
	B727 136		155	130	130		10	255	—	—			07:34
	B727 137		135	130	130		8	250	—	—	124		07:38

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (^{o}C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power	B727 138	-150	130	128	126	26	10	250	8	255	125	9-14	07:43
	B727 139		135	127	125	26		250	—	—	124		07:47
	B727 140		130	126	126	26		250	—	—	126		07:52
	B727 141		120	122	115	29		265	—	—	128		08:44
	B727 142		120	122	112	29		260	—	—	126		08:48
	B727 143 or 144		140	121	115	29	9	260	—	—	128		08:56
	B727 162		150	126	122	31	12	250	14	260	125		11:25
	B727 178	153	147	115	120	21	10	20	8	10	127	9-15	09:07
	B727 179	141	162	113	120		10	20	10	30	126		09:11
	B727 180	159	162	112	117		11	30	—	—	125		09:15
	B727 181	157	150	111	115		8	20	8	30			09:18
	B727 182	152	147	110	116		—	—	11	10			09:22
	B727 183	160	137	110	116		10	30	5	20			09:25
	B727 184	159	158	109	113	22	—	—	10	20			09:30

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power ↓	B727 185	163	160	108	114	22 ↓	9	20	8	20	125 ↓	9-15 ↓	09:34
	B727 186	171	155	107	114		9	20	9	25			09:37
	B727 187	152	143	107	117		8	30	5 ↓	20			09:42
	B727 188	145	151	106	115		6	20					09:45
	B727 189	225	131	139	128	25 ↓	11	30	13	45	126		11:04
	B727 190	263	148	138	128		13	45	5	50	124		11:07
	B727 198	213	169	132	128		15	55	8	80	122		11:35
	B727 199	219	183	131	126		9	60	12	70	120		11:39

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power →	B747 1	-390	175	538	150	17 →	8	250	6	240	105	9-16 →	08:54
	B747 2	-267	178	536	152		—	—	—	—	125		08:58
	B747 3	-448	191	534	152		5	250 →	8	240	125		09:02
	B747 4	-291	197	532	144		5		8	250	130		09:06
	B747 5	-296	163	530	146		8		5	260	132		09:10
	B747 6	-261	179	528	150		9		10	255	130 →		09:14
	B747 7	-176	168	526	158		10		8	250			09:18
	B747 8	-235	187	522	155		6		8	260			09:22
	B747 9	-140	184	520	145		3	200	7	250			09:26
	B747 10	-207	168	518	145		10	250	8	250			09:31
	B747 11	-208	206	516	135		4	240	—	—	132		09:35
	B747 12	-136	225	514	140		3	240	—	—	130 →		09:39
	B747 13	-441	234	486	138	23	8	265	—	—			10:35
	B747 14	-438	224	484	138	23	8	265	—	—			10:39
	B747 15	-266	189	482	142	23	8	265	—	—			10:44

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Landing, level flight, all engines same power	B747 16	-222	178	480	136	24	9	270	5	275	130	9-16	10:47
	B747 17	-229	187	478	135		9	280	5	275	132		10:52
	B747 18	-610	338	460	140		10	270	3	270	225		11:31
	B747 19	-404	321	458	136		11	275	6	250	226		11:36
	B747 20	-357	334	456	138		7	280	12	290	230		11:42
Takeoff, level flight, all engines same power	B747 21	-286	397	454	152		12	295	12	290	228		11:47
Takeoff, level flight, all engines same power	B747 22	-237	322	452	150		8	290	5	295	225		11:51
Holding, level flight, all engines same power	B747 23	-279	275	450	190		7	280			222		11:56
Holding, level flight, all engines same power	B747 24	-439	320	448	192		7	280			220		12:01
Landing, level flight, all engines same power	B747 26	-205	185	556	160	25	12	250	7	230	120	9-17	09:56
Landing, level flight, all engines same power	B747 27	-272	186	554	154		9	220	4	270	125		10:00
Takeoff, level flight, all engines same power	B747 28	-305	172	552	160		10	220	10	210	125		10:04
Takeoff, level flight, all engines same power	B747 29	-200	175	549	163		9	240	10	210	130		10:08
Holding, level flight, all engines same power	B747 30	-248	177	546	205		10	230	11	230	128		10:11

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Alt. Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Holding, level flight, all engines same power	B747 31	-268	186	544	205	25	10	220	10	230	130	9-17	10:15
Landing, level flight, all engines same power	B747 32	-185	183	542	142			245	12	240	130		10:20
	B747 33	-223	172	540	152			230	12	250	128		10:24
	B747 34	-162	164	538	148			240	14	240	130		10:27
	B747 35	-276	128	536	145	26	13	220	9	220			10:32
	B747 36	-240	176	534	152		10	230	10	250			10:35
	B747 37	-236	179	532	152			210	10	210			10:39
	B747 38	-243	184	530	150			220	—	—			10:43
	B747 39	-227	194	528	152			220	12	220			10:47
	B747 40	-279	183	507	145	28	13	220	10	230			11:38
	B747 41	-240	206	504	145	29	12	230	14	210			11:42
Takeoff, level flight, all engines same power	B747 42	-293	144	502	165		12	220	13	240			11:46
	B747 43	-292	158	500	162		12	270	14	230			11:50
Holding, level flight, all engines same power	B747 44	-330	160	498	190		—	—	12	240			11:56

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Holding, level flight, all engines same power	B747 45	-249	161	496	195	29	15	230	14	225	130	9-17	12:00
Landing, level flight, all engines same power	B747 46	-231	143	494	148	↓	10	230	14	230	↓	↓	12:04
↓	B747 47	-216	153	492	140		↓	245	12	240			12:08
	B747 48	-229	147	490	140			240	11	245			12:12
	B747 49	-224	169	487	140			235	—	—			12:16
	B747 50	-243	143	484	140		8	240	10	240			12:21
	B747 51	-227	145	482	145		—	—	14	240			12:25

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Altitude Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (^oC)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Holding, level flight, all engines same power	B747 53	-198	152	597	220	14	16	220	18	220	132	10-17	08:28
Holding, level flight, all engines same power	B747 54	-171	151	595	210	14	13	220	12	220	132	10-17	08:32
Holding, level flight, all engines same power	B747 55	-171	177	593	200	14	13	220	10	220	132	10-17	08:36
Landing, outboard engine toward tower at idle (Vortex 1)	B747 56	-185	184	591	160	140	13	220	13	220	132	10-17	08:40
Landing, outboard engine toward tower at idel (Vortex 1)	B747 57	-170	170	589	156	14	10	230	11	235	130	10-17	08:45
Landing, outboard engine toward tower at idle (Vortex 1)	B747 58	-183	184	587	155	15	17	220	13	235	130	10-17	08:51
Landing, outboard engine away from tower at idle (Vortex 2)	B747 59	-215	166	585	160	15	15	240	13	240	128	10-17	08:56
Landing, outboard engine away from tower at idle (Vortex 2)	B747 60	-207	158	581	160	15			8	260	128	10-17	09:01
Landing, outboard engine away from tower at idle (Vortex 2)	B747 61	-221	154	578	158	15	14	250	16	250	130	10-17	09:06
Take off, swoop, full power	B747 62	-210	103	575	160	15			15	250	130	10-17	09:12
Take off, swoop, full power	B747 63	-208	121	569	170	16	20	255	23	260	125	10-17	09:22
Take off, swoop, full power	B747 64	-197	119	566	175	16			20	270	128	10-17	09:26

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Holding, level flight, all engines same power	B747 65	-440	172	563	310	16					305	10-17	09:31
Holding, level flight, all engines same power	B747 66	-334	220	532	250	17	24	260	20	280	220	10-17	10:34
Holding, level flight, all engines same power	B747 67	-449	259	530	250	17	20	280			220	10-17	10:38
Holding, level flight, all engines same power	B747 68	-439	213	528	250	17	21	270	17	280	220	10-17	10:42
Landing, outboard engine away from tower at idle (Vortex 1	B747 69	-404	229	525	150	17	20	270	20	260	222	10-17	10:49
Landing, outboard engine away from tower at idle (Vortex 2)	B747 70	-428	204	523	155	18	22	270	18	270	222	10-17	10:54
Landing, outboard engine toward tower at idle (Vortex 1)	B747 71	-416	216	521	145	18	20	280	24	270	223	10-17	10:59
Landing, outboard engine away from tower at idle (Vortex 2)	B747 72	-482	206	519	155	18	23	270	27	270	226	10-17	11:04
Landing, outboard engine away from tower at idle (Vortex 2)	B747 73	-440	238	517	150	18	26	260	24	270	230	10-17	11:09
Landing, outboard engine toward tower at idle (Vortex 1)	B747 74	-402	216	513	150	18	18	280	19	270	225	10-17	11:14
Holding, level flight, all engines same power	B747 75	-394	224	510	205	18	20	270	25	280	225	10-17	11:19
Holding, level flight, all engines same power	B747 76	-354	136	507	300	18					352	10-17	11:24

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Holding, level flight, all engines same power	B707 1	232	197	263	215	4	6	10	6	10	135	10-18	07:49
Holding, level flight all engines same power	B707 2	286	211	262	215	4	6	10	6	10	135	10-18	07:52
Holding, level flight, all engines same power	B707 3	245	208	261	215	4	6	10	6	10	130	10-18	07:56
Landing, outboard engine away from tower at idle (Vortex 2)	B707 4	273	204	261	145	5	7		5	10	130	10-18	07:59
Landing, outboard engine away from tower at idel (Vortex 2)	B707 5	261	208	259	147	5	8		8		130	10-18	08:03
Landing, outboard engine away from tower at idle (Vortex 2)	B707 6	269	215	258	145	5	6	5	7	5	130	10-18	08:07
Landing, outboard engine toward tower at idle (Vortex 1)	B707 7	243	219	257	145	5	3	10			130	10-18	08:12
Landing, outboard engine toward tower at idle (Vortex 1)	B707 8	229	204	255	146	5	8		7		123	10-18	08:16
Landing, outboard engine toward tower at idle (Vortex 1)	B707 9	234	213	253	145	5	7		9		126	10-18	08:21
Take off, swoop, full power	B707 10	292	225	252	170	5			6		130	10-18	08:25
Take off, swoop, full power	B707 11	271	211	251	165	5	6	355	4	10	130	10-18	08:29
Take off, swoop, full power	B707 12	277	192	250	160	5	6	15			130	10-18	08:32

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Holding, level flight, all engines same power	B707 13	257	215	237	220	6	5	20	6	350	130	10-18	09:33
Holding, level flight, all engines same power	B707 14	288	231	236	225	6	6	20	9		130	10-18	09:37
Holding, level flight, all engines same power	B707 15	248	195	235	220	6	8		8	10	130	10-18	09:41
Landing, outboard engine away from tower at idle (Vortex 2)	B707 16	275	221	234	145	6	10		7	10	130	10-18	09:45
Landing, outboard engine away from tower at idle (Vortex 2)	B707 17	271	191	233	145	6	10		8		130	10-18	09:50
Landing, outboard engine away from tower at idle (Vortex 2)	B707 18	275	209	231	209	6	8		9		130	10-18	09:54
Landing, outboard engine toward tower at idle (Vortex 1)	B707 19	249	196	230	145	6	9		8		128	10-18	09:57
Landing, outboard engine toward tower at idle (Vortex 1)	B707 20	252	156	229	145	6	8		8		130	10-18	10:02
Landing, outboard engine toward tower at idle (Vortex 1)	B707 21	278	150	227	145	6	8				127	10-18	10:06
Take off, swoop, full power	B707 22	277	182	226	170	7	4		6	350	130	10-18	10:10
Take off, swoop, full power	B707 23	269	161	225	170	7	8	10	6		130	10-18	10:15
Take off, swoop, full power	B707 24	270	158	223	172	7	6	20			130	10-18	10:22

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Altitude Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (^{o}C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EDT)
Holding, level flight, all engines same power	B707 25	267	181	210	205	11	6		4		130	10-18	11:16
Holding, level flight, all engines same power	B707 26	269	198	209	205	11	6	2	8	10	130	10-18	11:21
Holding, level flight, all engines same power	B707 27	286	206	207	202	11	4		5		130	10-18	11:24
Holding, level flight, all engines same power	B707 28	273	210	207	200	11	4		6	20	130	10-18	11:28
Holding, level flight, all engines same power	B707 29	283	194	206	202	11	6	15	8	40	130	10-18	11:32
Holding, level flight, all engines same power	B707 30	272	192	206	202	11	3	40	4	60	130	10-18	11:36
Take off, level flight, all engines same power	B707 31	269	187	205	138	9	2	60	5		125	10-18	11:41
Take off, level flight, all engines same power	B707 32	275	199	204	145	9	5				120	10-18	11:45
Holding, level flight, all engines same power	B707 33	-412	100	203	320	9					310	10-18	11:50

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Altitude Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EST)
Holding, level flight, all engines same power	B707 34	257	191	264	225	6	7				130	11-1	07:36
Holding, level flight, all engines same power	B707 35	303	205	263	218	6	6		6	350	130	11-1	07:40
Landing, level flight, all engines same power	B707 36	276	212	262	150	6	7		7		126	11-1	07:44
Landing, level flight, all engines same power	B707 37	294	197	261	148	5	5	350			128	11-1	07:49
Landing, outboard engine away from tower at idle (Vortex 2)	B707 38	276	204	258	148	5	5	310			130	11-1	07:58
Landing, outboard engine away from tower at idle (Vortex 2)	B707 39	278	229	256	146	6			7		130	11-1	08:08
Landing, outboard engine toward tower at idle (Vortex 1)	B707 40	298	218	254	148	5	9	330	8		126	11-1	08:07
Landing, outboard engine toward tower at idle (Vortex 1)	B707 41	276	216	250	143	5			7	350	128	11-1	08:12
Takeoff, level flight, all engines same power	B707 42	241	200	250	145	5	7		5		130	11-1	08:18
Take off, level flight, all engines same power	B707 43	269	219	249	148	5	6		6		130	11-1	08:23
Take off, swoop, full power	B707 44	263	145	248	158	6					130	11-1	08:27
Take off, swoop, full power	B707 45	250	180	246	158	5	7		5		130	11-1	08:32
Holding, level flight, all engines same power	B707 46	251	240	230	218	6	2		4		128	11-1	09:31
Holding, level flight, all engines same power	B707 47	250	190	229	210	5	2		2		126	11-1	09:36

Configuration	Run Label	Aircraft Displacement from Tower (ft)	Aircraft Altitude Abreast of Tower (ft)	Aircraft Weight (1000 lb)	Aircraft Speed (knots)	Temp. (°C)	Initial Wind Speed (mph)	Initial Wind Angle (deg from true N)	Final Wind Speed (mph)	Final Wind Angle (deg from true N)	Aircraft Heading (deg from mag. N)	Month-Day (1972)	Time (EST)
Landing, level flight, all engines same power	B707 48	277	215	228	137	5	2		4	350	128	11-1	09:40
Landing, level flight, all engines same power	B707 49	272	206	227	134	6	4				126	11-1	09:44
Landing, outboard engine away from tower at idle (Vortex 2)	B707 50	240	201	226	133	7	2				128	11-1	09:48
Landing, outboard engine away from tower at idle (Vortex 2)	B707 51	278	219	223	135	6	3		4		130	11-1	09:58
Landing, outboard engine toward tower at idle (Vortex 1)	B707 52	256	219	221	134	6			4		127	11-1	10:03
Landing, outboard engine toward tower at idle (Vortex 1)	B707 53	239	212	219	131	6	2		3		126	11-1	10:07
Take off, level flight, all engines same power	B707 54	285	184	218	135	7	5				127	11-1	10:12
Take off, level flight, all engines same power	B707 55	270	213	216	134	6	4	340			127	11-1	10:17
Take off, swoop, full power	B707 56	285	164	215	132	7					126ψ	11-1	10:23
Take off, swoop, full power	B707 57	281	162	213	135	6	5		12		128	11-1	10:27
Holding, level flight, all engines same power	B707 58	271	177	202	198	6	4	340	3		128	11-1	11:12
Holding, level flight, all engines same power	B707 59	293	206	201	185	6					130	11-1	11:16
Landing, level flight, all engines same power	B707 60	340	206	200	131	6			4		128	11-1	11:20
Landing, level flight, all engines same power	B707 61	273	220	199	124	7					130	11-1	11:25
Holding, level flight, all engines same power	B707 63	250	150	192	290	6					130	11-1	11:33

Appendix B

PROBABLE STABILITY CONDITIONS PREVALENT DURING SELECTED NAFEC FLYBYS AT ATLANTIC CITY, N.J.

Near neutral atmospheric buoyancy or stability conditions are likely to prevail 80% of the time at any given station. At night, during and very shortly after sunrise, an inversion layer usually exists in the surface boundary layer (region of shear stress almost constant with height). Thus, the near neutral conditions would tend toward the stable state during this period. This effect is due to a massive heat exchange by horizontal convection in the upper atmosphere as opposed to a negative to very small positive temperature rise in the surface boundary region. In its relatively non-dynamic state, the surface boundary layer will only experience a large temperature rise when the surface itself is well exposed to an appreciable solar radiation flux. Shortly after sunrise the neutral conditions will tend more toward the unstable state due to the surface heating and the resultant vertical convective processes. Heat exchange at higher altitudes is mostly a function of mass exchange due to horizontal pressure gradients and the earth's rotation and are relatively independent of the surface characteristics when the region of interest is confined to such a small scale as an airport. Radiosonde data taken at these higher altitudes will exhibit lapse rates which somewhat arbitrarily reverse signs and cover a somewhat larger variation in magnitudes.

In Lissaman, et al.(Ref. 5), the Pasquill classes were categorized in terms of various lapse rates. In addition, a qualitative description of meteorological conditions likely to be present during the various Pasquill defined degrees of stability are given.

The tables presented in this appendix define the classes which would exist under the Pasquill criteria during the periods of interest (if the necessary data are available). The classes are suggested for: (1) the general meteorological conditions (from NOAA surface weather tables); (2) the lapse rate from 23 to 140 feet (from NAFEC tower data); (3) the lapse rate from approximately 200 to approximately 4000 feet (from radiosonde data); and (4) the lapse rate from 140 to approximately 200 feet (from NAFEC tower data in conjunction with the radiosonde data).

General meteorological conditions indicate that the expected stabilities for a given time of day were present in each case with the possible exception of the unusual trend of 17 October 1972. The tendency of the buoyancy conditions to remain more nearly neutral throughout the morning than normal may be explained by the air mass modification created by the impending frontal passage. The sharp temperature contrasts of 17 October and 18 October support this argument.

The lapse rates from 23 to 140 feet appear to be anomalous in magnitude and, in some cases, sign for all periods of interest. This phenomenon is possibly due to instrument error or high degree of inaccuracy.

As discussed previously, the lapse rates from approximately 200 to approximately 4000 feet do not give a true picture of stability. Even if linear trends of temperature change with height were exhibited these trends would most probably be inapplicable to the vertical region of interest.

Although the lapse rates between 140 feet and approximately 200 feet would be of value in establishing the conditions applicable to the vortex problem, the values computed are unrealistic due to the possible inaccuracy of the tower data and the fact that the lowest level radiosonde measurement is unreliable most of the time.

Date (1973)	Time (EDT)	General Meteorological Conditions	Lapse Rate (23 to 140 ft)	Lapse Rate (~200 to ~4000 ft)	Lapse Rate (140 to ~200 ft)
8-19	~11:00	Moderate insolation during this daytime period. Surface winds were approximately 5.0 m/s at 340 deg from true North. This implies Pasquill class C or slightly unstable.	$-0.7^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable		
8-22	~13:00	Strong insolation during this daytime period. Surface winds were approximately 4.5 m/s at 120 deg from true North. This implies Pasquill class B or moderately unstable	$-0.6^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable		
	~14:00	Strong insolation during this daytime period. Surface winds were approximately 5.0 m/s at 160 deg from true North. This implies Pasquill class B to C or moderately to slightly unstable.	$-1.2^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable		
9-12	~12:00	Slight insolation during this daytime period. Surface winds were approximately 2.5 m/s at 250 deg from true North. This implies Pasquill class C or slightly unstable.	$-0.3^{o}C/100$ ft ⇒ Pasquill class D or neutral		
9-14	~07:00	Moderate insolation during this daytime period. Surface winds were approximately $5.0\ m/s^{-1}$ at 250 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions suggest ground fog dissipation in progress.	$0.2^{o}C/100$ ft ⇒ Pasquill class E or slightly stable		
	~08:00	Moderate insolation during this daytime period. Surface winds were approximately 5.0 m/s at 250 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions suggest ground fog dissipation remains in progress.	$-0.6^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable		
	~09:00	Moderate insolation during this daytime period. Surface winds were approximately 5.0 m/s at 250 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions still exist suggesting slow ground fog dissipation thus neutral conditions are likely.	$-0.3^{o}C/100$ ft ⇒ Pasquill class D or neutral		

Date (1972)	Time (EDT)	General Meteorological Conditions	Lapse Rate (23 to 140 ft)	Lapse Rate (~200 to ~4000 ft)	Lapse Rate (140 to ~200 ft)
9-14	~11:30	Slight insolation during this daytime period. Surface winds were approximately 7.0 m/s at 260 deg from true North. This implies Pasquill class D or neutral conditions. Hazy conditions are prevalent and this being the case at this time of day, the neutral argument is strongly supported.	$-8.3^{\circ}C/100$ ft ⇒ Pasquill class A or extremely unstable		
9-16	~09:00	Slight insolation during this daytime period. Surface winds were approximately 4.0 m/s at 250 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions suggest ground fog dissipation is in progress.	$0.2^{\circ}C/100$ ft ⇒ Pasquill class E or slightly stable		
	~11:00	Moderate insolation during this daytime period. Surface winds were approximately 3.0 m/s at 290 deg from true North. This implies Pasquill class B or moderately unstable conditions.	$-1.2^{\circ}C/100$ ft ⇒ Pasquill class A or extremely unstable		
	~12:00	Strong insolation during this daytime period. Surface winds were approximately 4.0 m/s at 310 deg from true North. This implies Pasquill class B or moderately unstable conditions.	$-0.5^{\circ}C/100$ ft ⇒ Pasquill class B or moderately unstable		
9-17	~10:00	Strong insolation during this daytime period. Surface winds were approximately 5.0 m/s at 240 deg from true North. This implies Pasquill class B to C or moderately to slightly unstable. Hazy conditions suggest ground fog dissipation is in progress.	$0.1^{\circ}C/100$ ft ⇒ Pasquill class E or slightly stable		
	~12:00	Strong insolation during this daytime period. Surface winds were approximately 6.0 m/s at 230 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions present at this time may be indicative of recent frontal passage in conjunction with increased sea level pressure and temperature thus holding particulate condensates toward the surface with the increased evaporation.	$-1.4^{\circ}C/100$ ft ⇒ Pasquill class A or extremely unstable		

Date (1972)	Time (EDT)	General Meteorological Conditions	Lapse Rate (23 to 140 ft)	Lapse Rate (~200 to ~4000 ft)	Lapse Rate (140 to ~200 ft)
10-17	~04:00	Less than 3/8 cloud cover during this nighttime period. Surface winds were approximately 5.5 m/s at 240 deg from true North. This implies Pasquill class D to E or neutral to slightly stable. Moderate ground fog present supports slightly stable argument.		$-0.2^{o}C/100$ ft ⇒ Pasquill class D or neutral conditions	
	~07:00	Strong insolation during this daytime period. Surface winds were approximately 5.0 m/s at 240 deg from true North. This implies Pasquill class B to C or moderately to slightly unstable. Moderate ground fog present. Shortly after sunrise possible neutral conditions exist.		$-0.1^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	
	~08:00	Moderate insolation during this daytime period. Surface winds were approximately 6 m/s at 240 deg from true North. This implies Pasquill class D to C or neutral to slightly unstable. Moderate ground fog still present.		$-0.1^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	
	~09:00	Moderate insolation during this daytime period. Surface winds were approximately 5.5 m/s at 240 deg from true North. This implies Pasquill class D to C or neutral to slightly unstable. Hazy conditions indicate ground fog is breaking up and therefore bouyancy tends toward unstable.	$-0.7^{o}C/100$ ft => Pasquill class A or extremely unstable	$-0.2^{o}C/100$ ft ⇒ Pasquill class D or neutral conditions	
	~10:00	Moderate isolation during this daytime period. Surface winds were approximately 6 m/s at 260 deg from true North. This implies Pasquill class C to D or slightly unstable to neutral. Fog has completely dissipated.		$-0.2^{o}C/100$ ft ⇒ Pasquill class D or neutral conditions	
	~11:00	Moderate insolation during this daytime period. Surface winds were approximately 8 m/s at 270 deg from true North. This implies Pasquill class D or neutral.			

Date (1972)	Time (EDT)	General Meteorological Conditions	Lapse Rate (23 to 140 ft)	Lapse Rate (~200 to ~4000 ft)	Lapse Rate (140 to ~200 ft)
10-18	~04:00	Less than 3/8 cloud cover during this nighttime period. Surface winds were approximately 2.5 m/s from true North. This implies Pasquill class F or moderately stable.			
	~07:00	Slight insolation during this daytime period. Surface winds were approximately 3 m/s from true North. This implies Pasquill class B or moderately unstable. Shortly after sunrise possible neutral conditions exist.		-0.2°C/100 ft ⇒ Pasquill class D or neutral conditions	
	~08:00	Slight insolation during this daytime period. Surface winds were approximately 2 m/s at 10 deg from true North. This implies Pasquill class B or moderately unstable.	-0.2°C/100 ft ⇒ Pasquill class D or neutral		
	~09:00	Slight insolation during this daytime period. Surface winds were approximately 4 m/s from true North. This implies Pasquill class C or slightly unstable.		-0.1°C/100 ft ⇒ Pasquill class E or slightly stable	
	~10:00	Slight insolation during this daytime period. Surface winds were approximately 3 m/s from true North. This implies Pasquill class C or slightly unstable.	-0.5°C/100 ft ⇒ Pasquill class B or moderately unstable	-0.2°C/100 ft ⇒ Pasquill class D or neutral	-0.6°C/100 ft ⇒ Pasquill class A or extremely unstable
	~14:00	Slight insolation during this daytime period. Surface winds were approximately 2.5 m/s at 310 deg from true North. This implies Pasquill class C or slightly unstable.	-0.6°C/100 ft ⇒ Pasquill class A or extremely unstable	-0.3°C/100 ft ⇒ Pasquill class D or neutral	-1.5°C/100 ft ⇒ Pasquill class A or extremely unstable
	~15:00	Slight insolation during this daytime period. No surface winds. This implies Pasquill class B or moderately unstable.	-0.5°C/100 ft ⇒ Pasquill class B or moderately unstable	0.9°C/100 ft ⇒ Pasquill class F or moderately stable	-3.2°C/100 ft ⇒ Pasquill class A or extremely unstable
	~16:00	Slight insolation during this daytime period. No surface winds. This implies Pasquill class B or moderately unstable.	-1.0°C/100 ft ⇒ Pasquill class A or extremely unstable	-0.3°C/100 ft ⇒ Pasquill class D or neutral	-2.5°C/100 ft ⇒ Pasquill class A or extremely unstable

Date (1972)	Time (EST)	General Meteorological Conditions	Lapse Rate (23 to 140 ft)	Lapse Rate (200 to 4000 ft)	Lapse Rate (140 to 200 ft)
11-1	~07:30	Slight insolation during this nighttime/daytime transition period. Surface winds were approximately 2.5 m/s at 330 deg from true North. This implies Pasquill class C or slightly unstable. Hazy conditions support instability as ground fog is being dissipated.	$-0.8^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable	$-0.1^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	$-2.6^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable
	~08:30	Slight insolation during this daytime period. Surface winds were approximately 2.5 m/s at 320 deg from true North. This implies Pasquill class C or slightly unstable.	$0.9^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable	$-0.1^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	$-4.0^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable
	~09:30	Slight insolation during this daytime period. Surface winds were approximately 2 m/s from true north. This implies Pasquill class C or slightly unstable.	$0.3^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	$-0.1^{o}C/100$ ft ⇒ Pasquill class E or slightly stable	$-2.5^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable
	~10:30	Slight insolation during this daytime period. Surface winds were approximately 2 m/s at 320 deg from true North. This implies Pasquill class C or slightly unstable.	$0.2^{o}C/100$ ft ⇒ Pasquill class D or neutral	$-0.2^{o}C/100$ ft ⇒ Pasquill class D or neutral	$-0.7^{o}C/100$ ft ⇒ Pasquill class A or extremely unstable

Appendix C

DESCRIPTION OF OUTPUT PLOTS OF WAKE VORTEX TRANSPORT COMPUTER PROGRAM

Following is a brief description of the output plots (SC-4020) for the wake vortex transport computer program. The output consists of 14 pages of plots shown on pages C-3 through C-16. The first page represents a summary of input flags as used for analysis of Run 4 on 18 October 1972, and also the first portion of the wind field input description. All input flags are defined via comment cards in the computer program and are given in Appendix D for easy reference. The wind field is defined by specifying the number of altitudes to be used in the curve fitting algorithm followed by a table defining the wind speed for both the horizontal and vertical versus altitude. This table is concluded on the second page. Next is the specified reference speed and altitude along with the exponent defining the power law curve fit required to represent the wind field over a continuous height. Following this is a temperature-altitude table for stability and density calculations. Page C-5 defines the variables for the temperature-altitude curve fit, the wind shear model parameters, the buoyancy model parameters, and a description of the ground wind array and sensor type. Page C-6 lists aircraft information required for the transport calculations and some of the basic quantities calculated in the program.

The display of the vortex tracks is initiated in the plot on page C-7. This plot is a cross sectional vortex track of altitude versus lateral distance referenced to the centerline of the aircraft flight path. Each plotting symbol indicates a time as defined by the user specified time increment. Page C-8 represents a cross sectional vortex track corresponding to the desired experimental condition. The current setup represents the NAFEC conditions with the lateral distance coordinate referenced to the NAFEC tower. The plotting characters initiating at the simulated aircraft are predicted values with the asterisks and Xs representing the starboard and port vortices, respectively. The measured vortex position as determined from the photographs are shown superimposed on the predicted tracks with the S and P corresponding to the starboard and port vortices, respectively. The solid line represents constant time lines and can be calibrated by the caption at the top of the plot.

Page C-9 is a time versus altitude track comparing predicted and photographic measurement. In the case for no wind shear, equal circulation and level flight, the starboard and port predictive tracks are identical as indicated by the double plotting character. Here again the S and P represent starboard and port vortex position obtained by measurement. Next is the reduced ground wind track comparing predicted and measured vortex positions. The lines represent predicted vortex position versus time with the S and P referring to photographic measurement and R and L referring to ground wind measurement of the right and left vortex, respectively. Page C-11 is the induced velocity (predicted) as a function of time for each ground wind sensor including a specified sensor response. The peaks are the predictive points shown in the previous plot. The remaining plots relate to either the wind field or the atmospheric characterization.

The plot on page C-12 is the measured (symbols) wind velocity for the five tower levels and the line through the data is the least square power law representation of the wind profile. Page C-13 shows the variation of wind direction with altitude for both the measured (symbols) and the least square quadratic representation (solid line) of the data. Pages C-14 and C-15 show the component wind profile for the lateral and longitudinal directions, respectively, for both the measured data and that calculated from the least square information of the previous two plots. The final plot (page C-16) represents temperature, pressure and density profiles for the altitude range of interest computed from the temperature data measured on the tower and the recorded surface pressure measured by NOAA,

RUN 4 B707 WIND PROFILE

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STIME    =   .00000000E+00
FTIME    =   .16000000E+03
DTIME    =   .20000000E+01
JPRINT   =                +1
SPEED    =  -.21250000E+03
WEIGHT   =   .24700000E+06
WSPAN    =   .14580000E+03
IPLOT1   =                +1
IPLOT2   =                +3
IPUNCH   =                +1
LINE     =                +1
DTLINE   =   .60000000E+01
ISCALE   =                +1
YR       =   .40000000E+03
YL       =  -.60000000E+03
ZT       =   .25000000E+03
PMIN     =  -.30000000E+02
PMAX     =   .30000000E+02

$END
$VORT
VOR      =   .00000000E+00
ISIGHT   =                +0

$END
$WINDS
JWIND    =                +3
SWINDT   =   .00000000E+00
WINDD    =   .00000000E+00
NW       =                +5
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CPOWER   =       .27000000E+00
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NA       =                  +5
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                 .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                 .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                 .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                 .20000000E+04,   .20000000E+04
TEMP     =       .29000000E+01,   .28000000E+01,   .29000000E+01,   .28000000E+01,
                 .27000000E+01,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                 .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                 .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                 .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
```

```
              .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
              .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
              .20000000E+02,   .20000000E+02
NPOLYT   =               +1
COEFT    =    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
              .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
              .00000000E+00
JFOTEN   =               +1

$END
$SHEAR
NROWS    =               +0
NCOLS    =               +1
HEIGHT   =    .00000000E+00
WIDTH    =    .00000000E+00
F        =    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00

$END
$BUOY
SMIX     =    .00000000E+00
ZCHECK   =    .50000000E+03

$END
$SENSOR
KSEN     =               +0
NSEN     =              +12
YSEN     =    .55000000E+03,   .45000000E+03,   .35000000E+03,   .25000000E+03,
              .15000000E+03,   .50000000E+02,  -.50000000E+02,  -.15000000E+03,
             -.25000000E+03,  -.35000000E+03,  -.45000000E+03,  -.55000000E+03,
              .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00
ZSEN     =    .60000000E+01,   .60000000E+01,   .60000000E+01,   .60000000E+01,
              .60000000E+01,   .60000000E+01,   .60000000E+01,   .60000000E+01,
              .60000000E+01,   .60000000E+01,   .60000000E+01,   .60000000E+01,
              .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00
PHI      =    .27000000E+03,   .27000000E+03,   .27000000E+03,   .27000000E+03,
              .27000000E+03,   .27000000E+03,   .27000000E+03,   .27000000E+03,
              .27000000E+03,   .27000000E+03,   .27000000E+03,   .27000000E+03,
              .27000000E+03,   .27000000E+03,   .27000000E+03,   .27000000E+03
THETA    =    .90000000E+02,   .90000000E+02,   .90000000E+02,   .90000000E+02,
              .90000000E+02,   .90000000E+02,   .90000000E+02,   .90000000E+02,
              .90000000E+02,   .90000000E+02,   .90000000E+02,   .90000000E+02,
              .90000000E+02,   .90000000E+02,   .90000000E+02,   .90000000E+02
ISENS    =               +0,              +0,              +0,              +0,
                         +3,              +3,              +3,              +3,
                         +3,              +3,              +3,              +3,
                         +3,              +3,              +3,              +3

$END
```

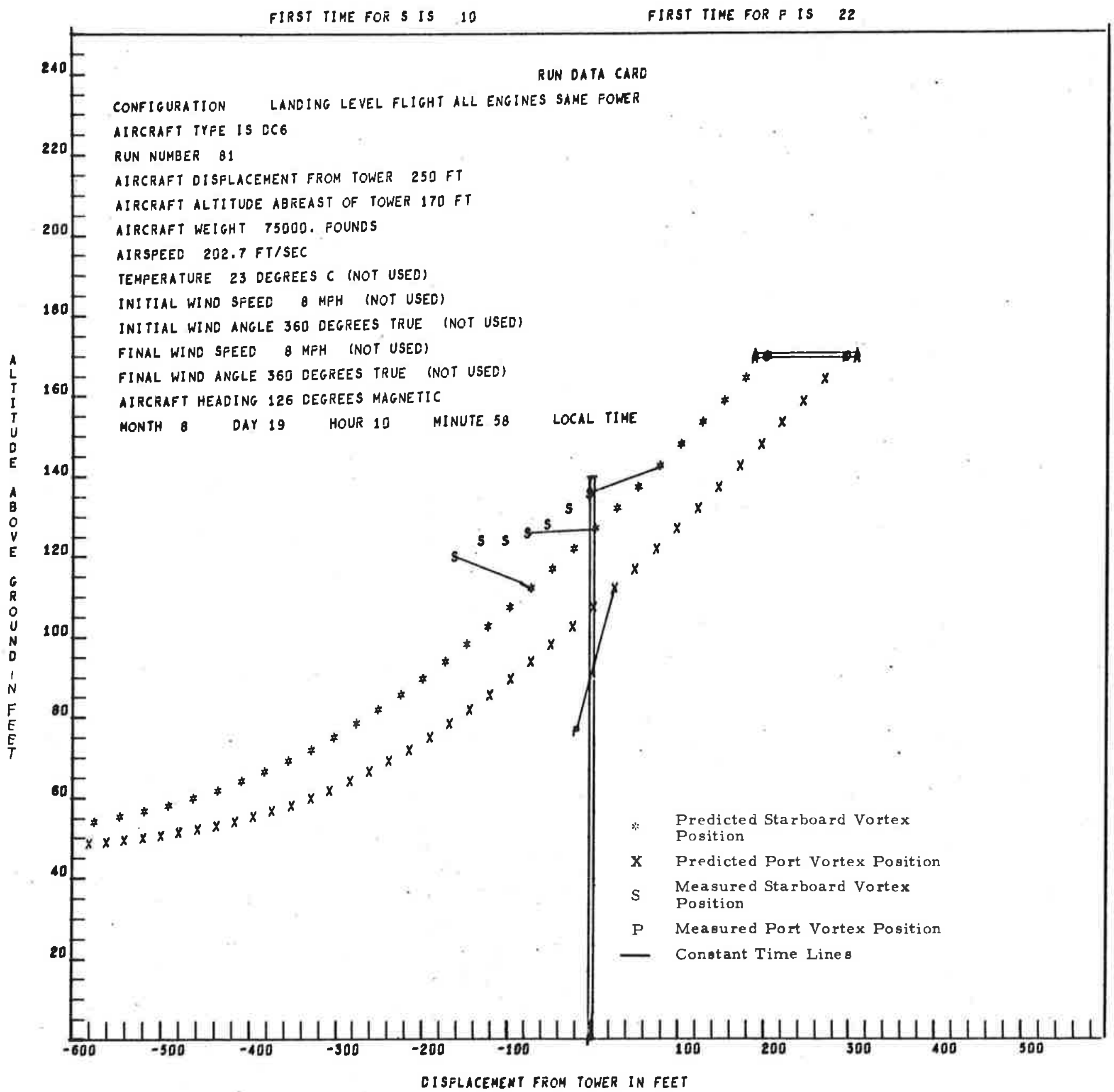
RUN DATA CARD

CONFIGURATION LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 4
AIRCRAFT DISPLACEMENT FROM TOWER 273 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 294 FT
AIRCRAFT WEIGHT 261000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 7 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 5 MPH (NOT USED)
FINAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 7 MINUTE 59 LOCAL TIME

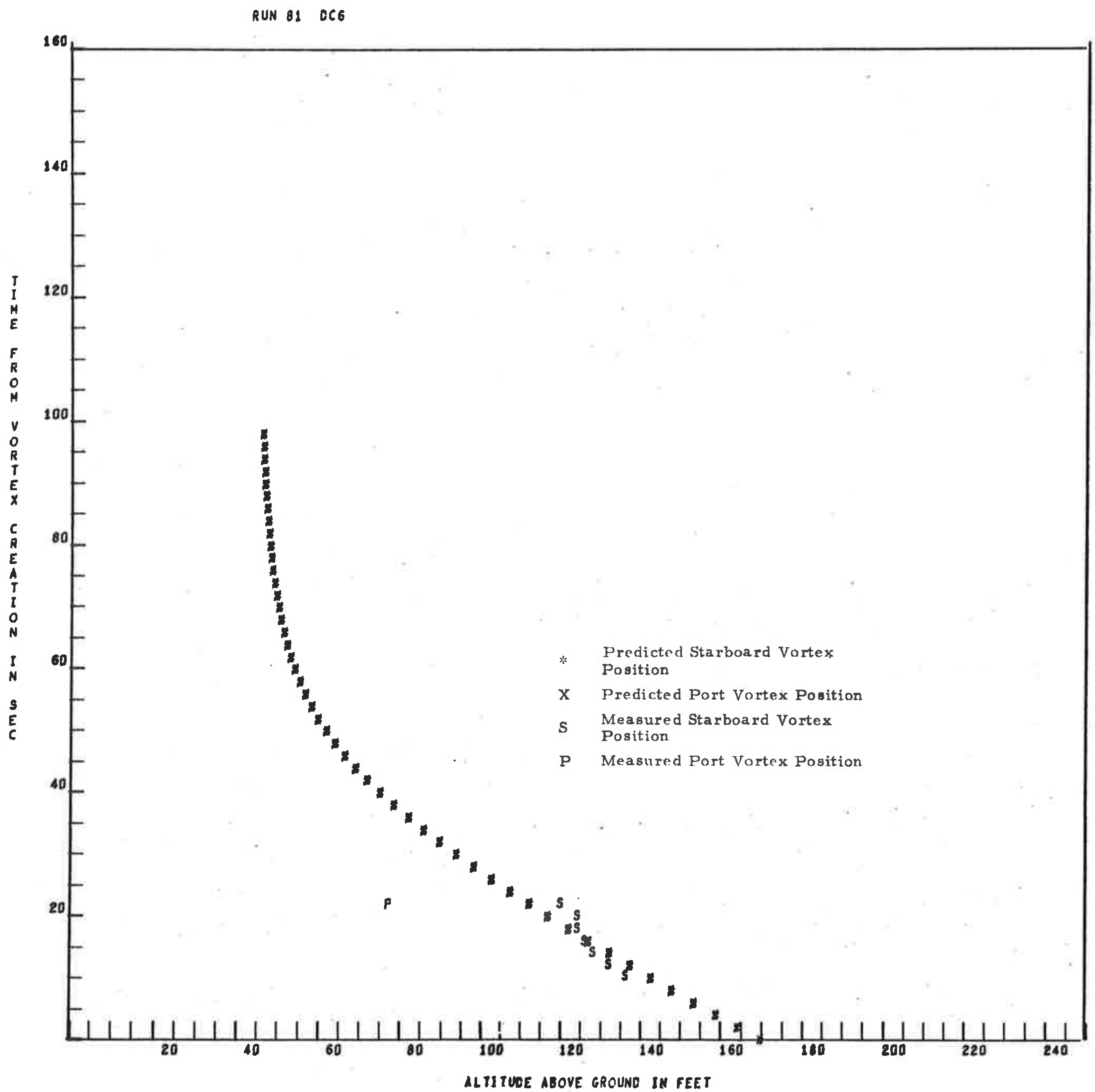
```
$OUTPUT
SPEED   =    -.24490500E+03
WEIGHT  =     .26100000E+06
WSPAN   =     .14200000E+03

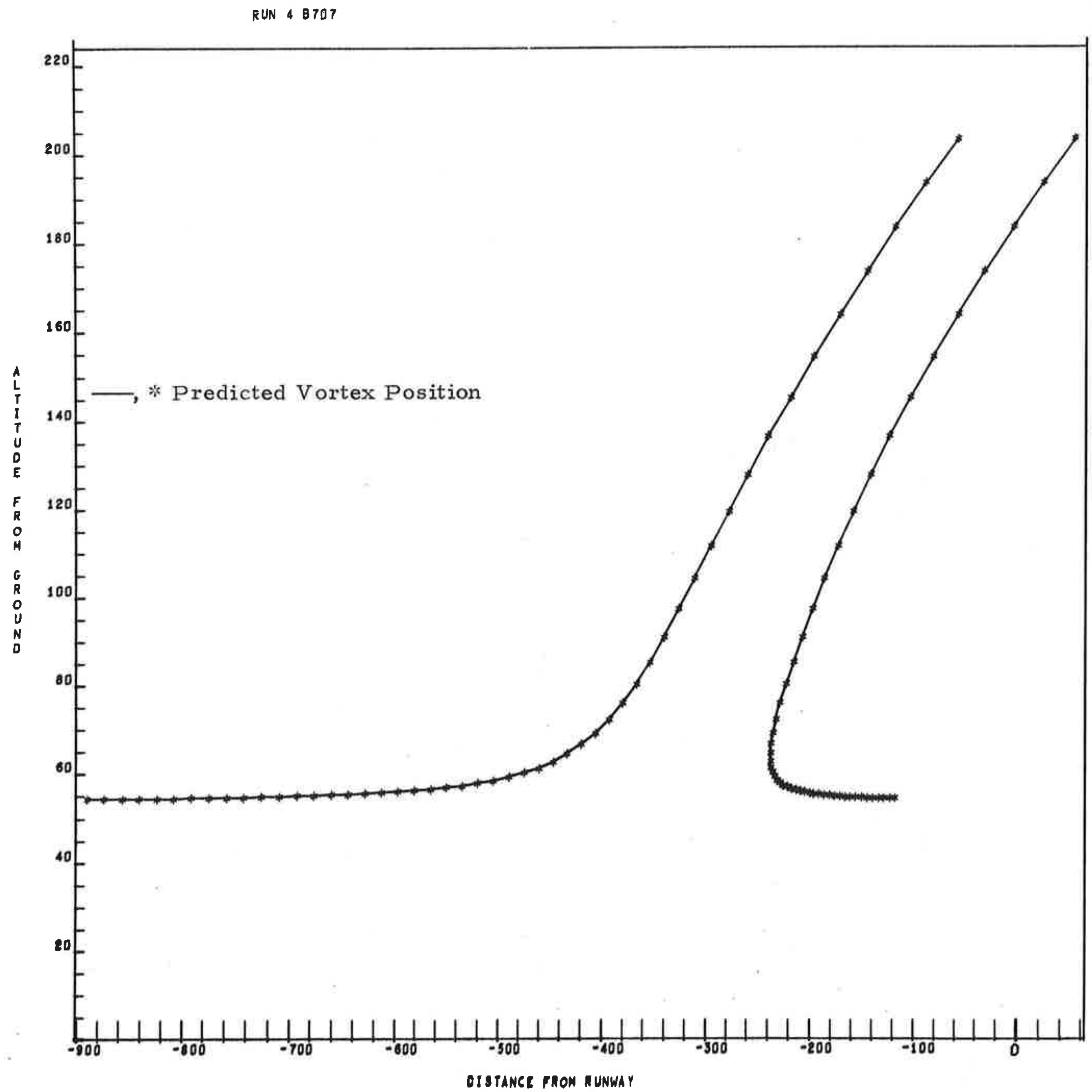
$END
$WLOG
WSPR    =     .40058082E+01
CPOWER  =     .62449599E+00
COEF    =    -.44856098E+02,   .32959656E+00,   .25889222E-03,   .12560241E+02,
              .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
              .00000000E+00

$END
GAMMA IN FT**2/SEC =   3.84819925+03
EDDY VISCOSITY IN FT**2/SEC =   5.06608792-01
TEMPERATURE IN RANKINE =   4.96429741+02
DENSITY IN SLUGS/FT**3 =   2.48317368-03
ACOUSTIC VELOCITY IN FT/SEC =   1.09220007+03
STABILITY IN 1/SEC**2 =   0.00000000
INITIAL PARAMETER (DIMENSIONLESS) =   0.00000000
```

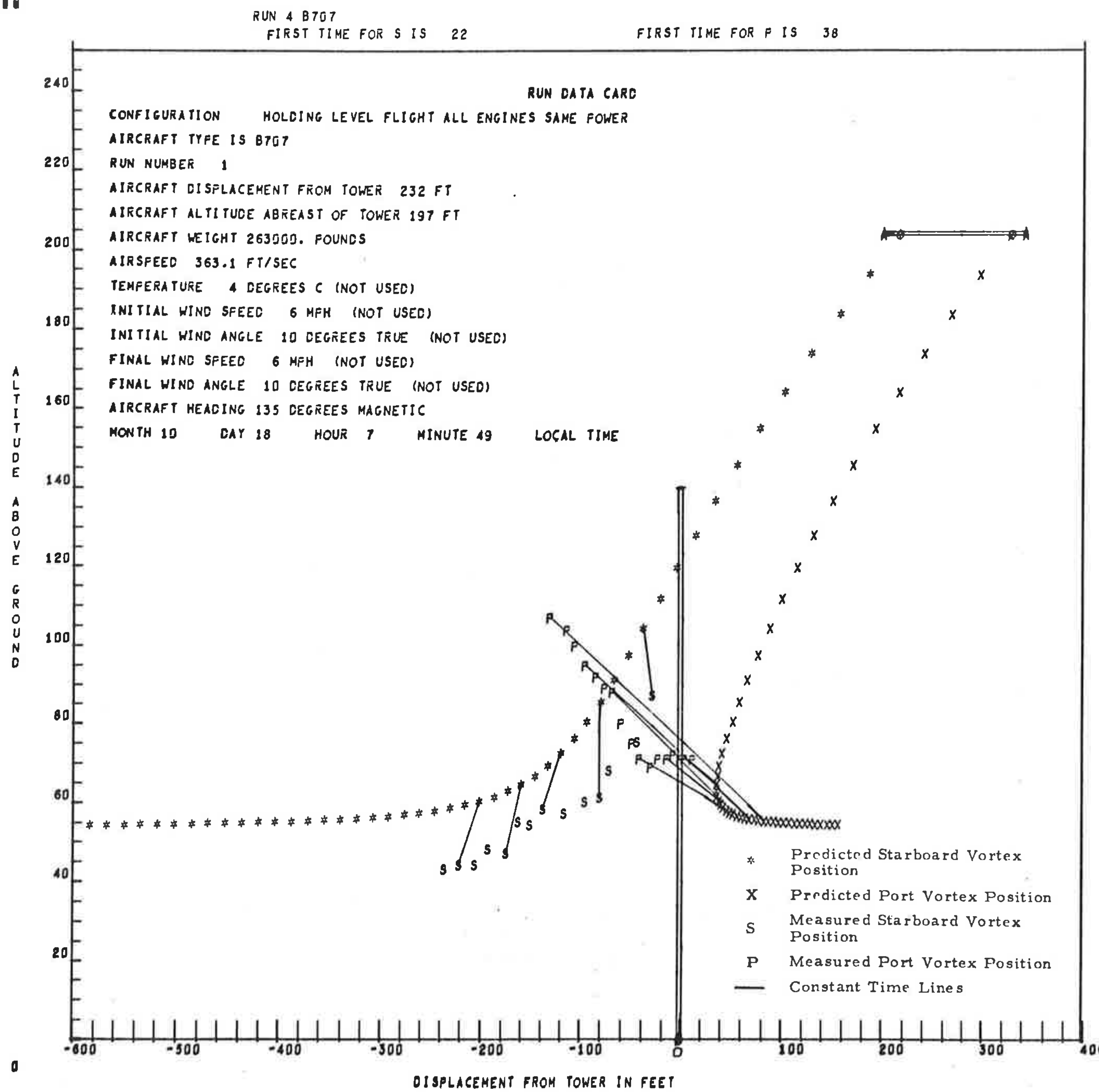


FIRST TIME FOR S IS 10
FIRST TIME FOR P IS 22
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS DC6
RUN NUMBER 81
AIRCRAFT DISPLACEMENT FROM TOWER 250 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 170 FT
AIRCRAFT WEIGHT 75000. POUNDS
AIRSPEED 202.7 FT/SEC
TEMPERATURE 23 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 126 DEGREES MAGNETIC
MONTH 8 DAY 19 HOUR 10 MINUTE 58 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines


RUN 81 DC6
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20 40 60 80 100 120 140 160 180 200 220 240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

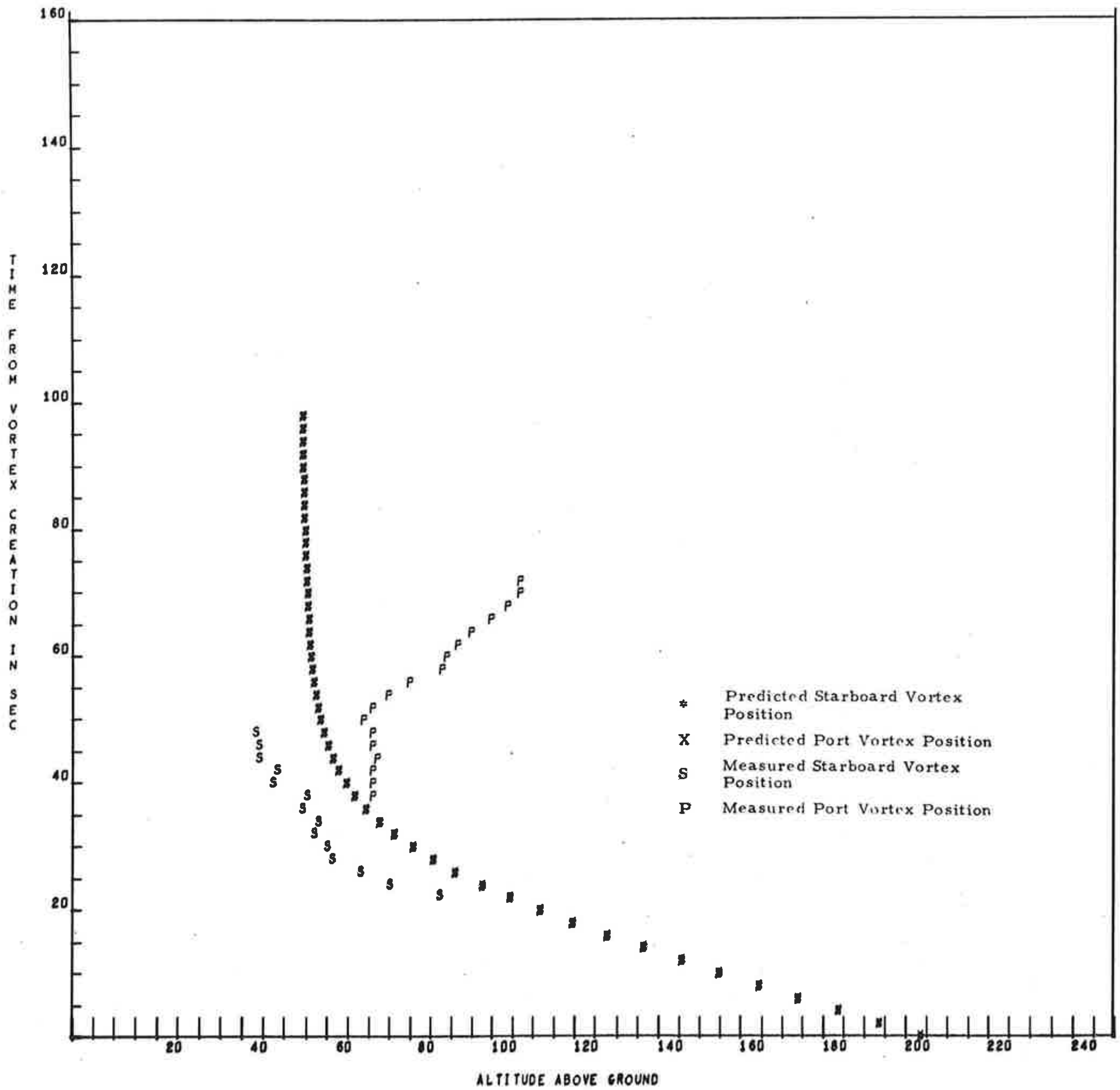


RUN 4 B707
220
200
180
160
140
120
100
80
60
40
20
ALTITUDE FROM GROUND
—, * Predicted Vortex Position
-900
-800
-700
-600
-500
-400
-300
-200
-100
0
DISTANCE FROM RUNWAY

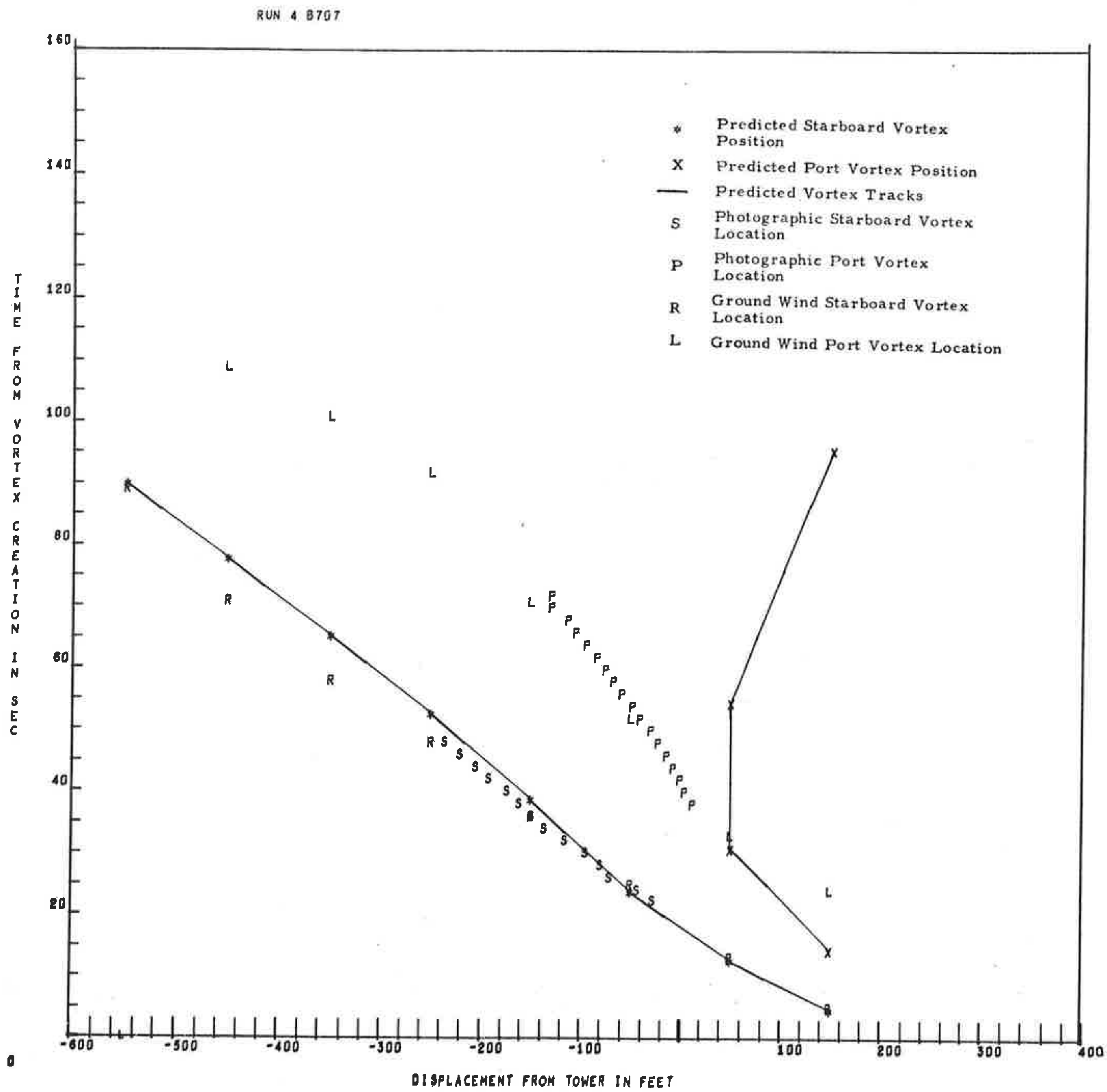


RUN 4 B707
FIRST TIME FOR S IS 22
FIRST TIME FOR P IS 38
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 1
AIRCRAFT DISPLACEMENT FROM TOWER 232 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 197 FT
AIRCRAFT WEIGHT 263000. POUNDS
AIRSPEED 363.1 FT/SEC
TEMPERATURE 4 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 135 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 7 MINUTE 49 LOCAL TIME
ALTITUDE ABOVE GROUND
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

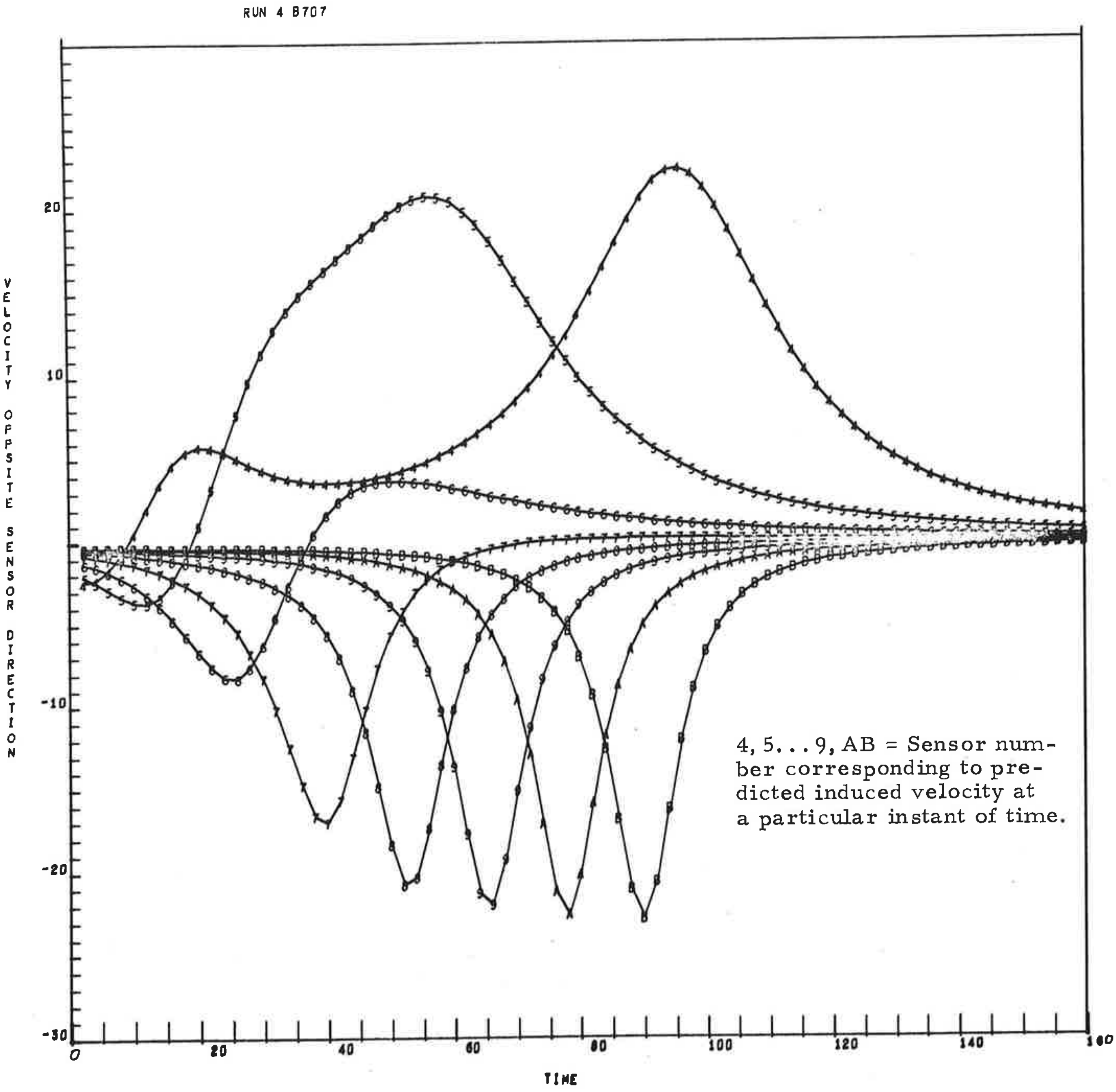
RUN 4 B707

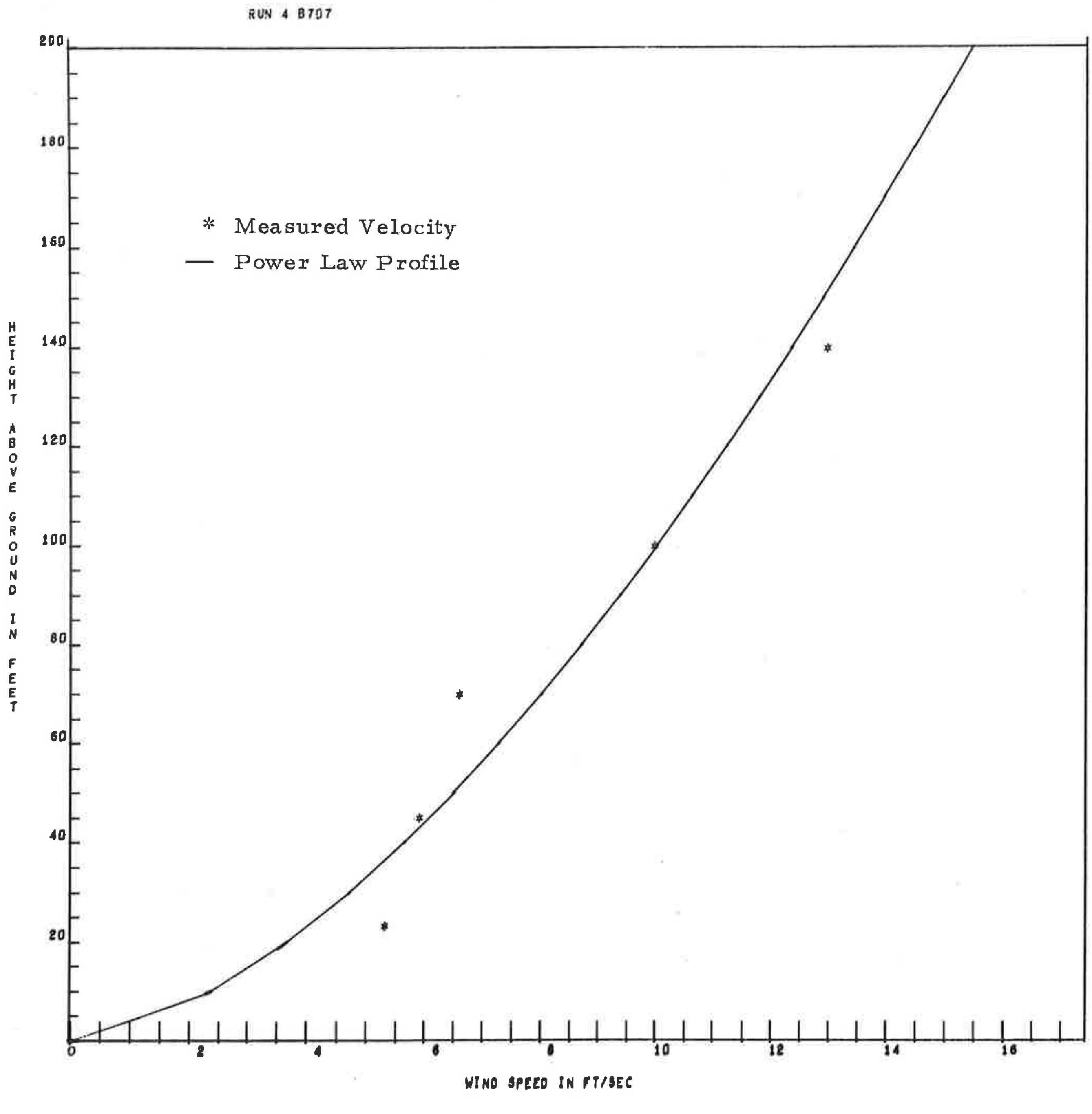


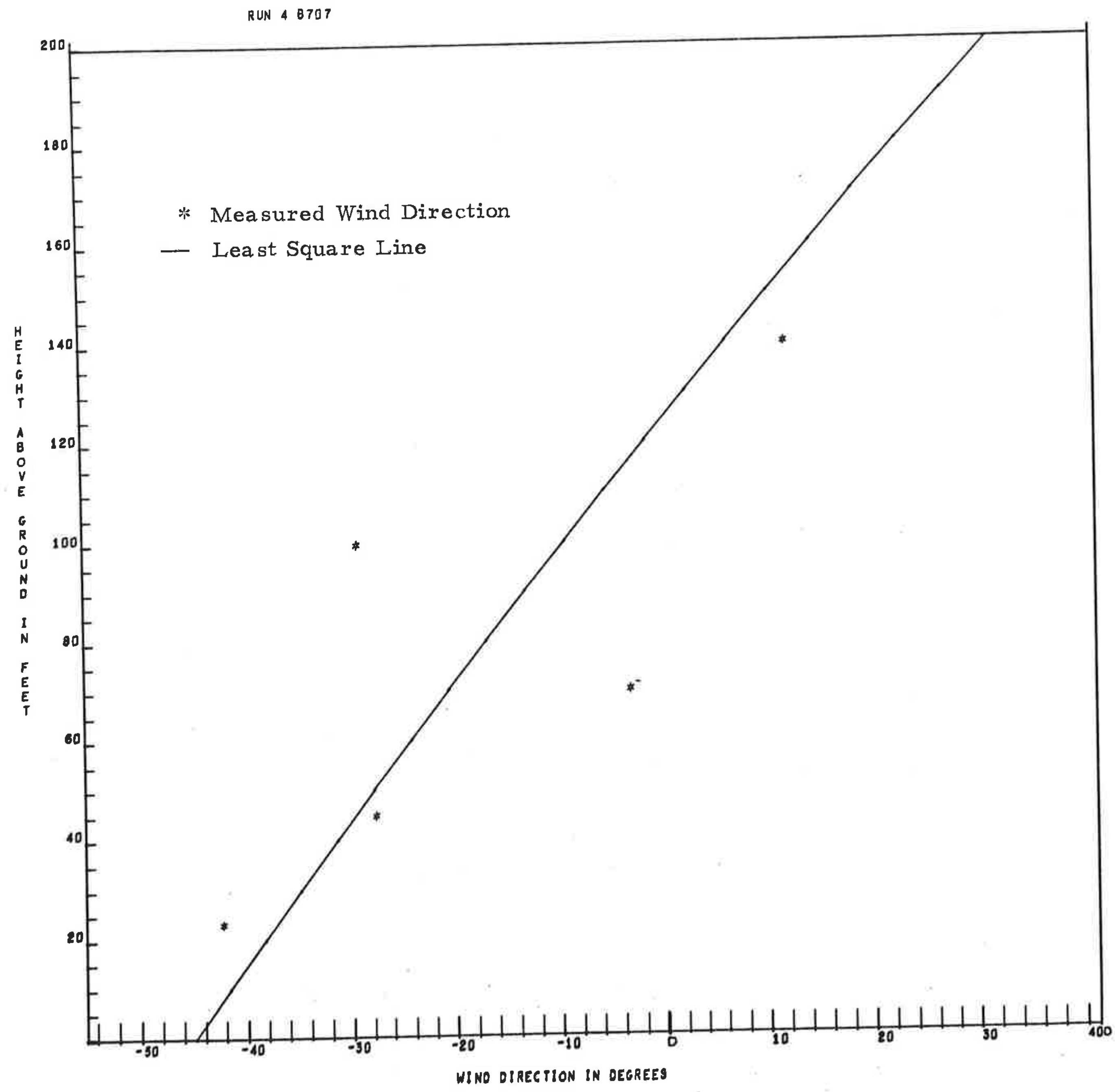
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

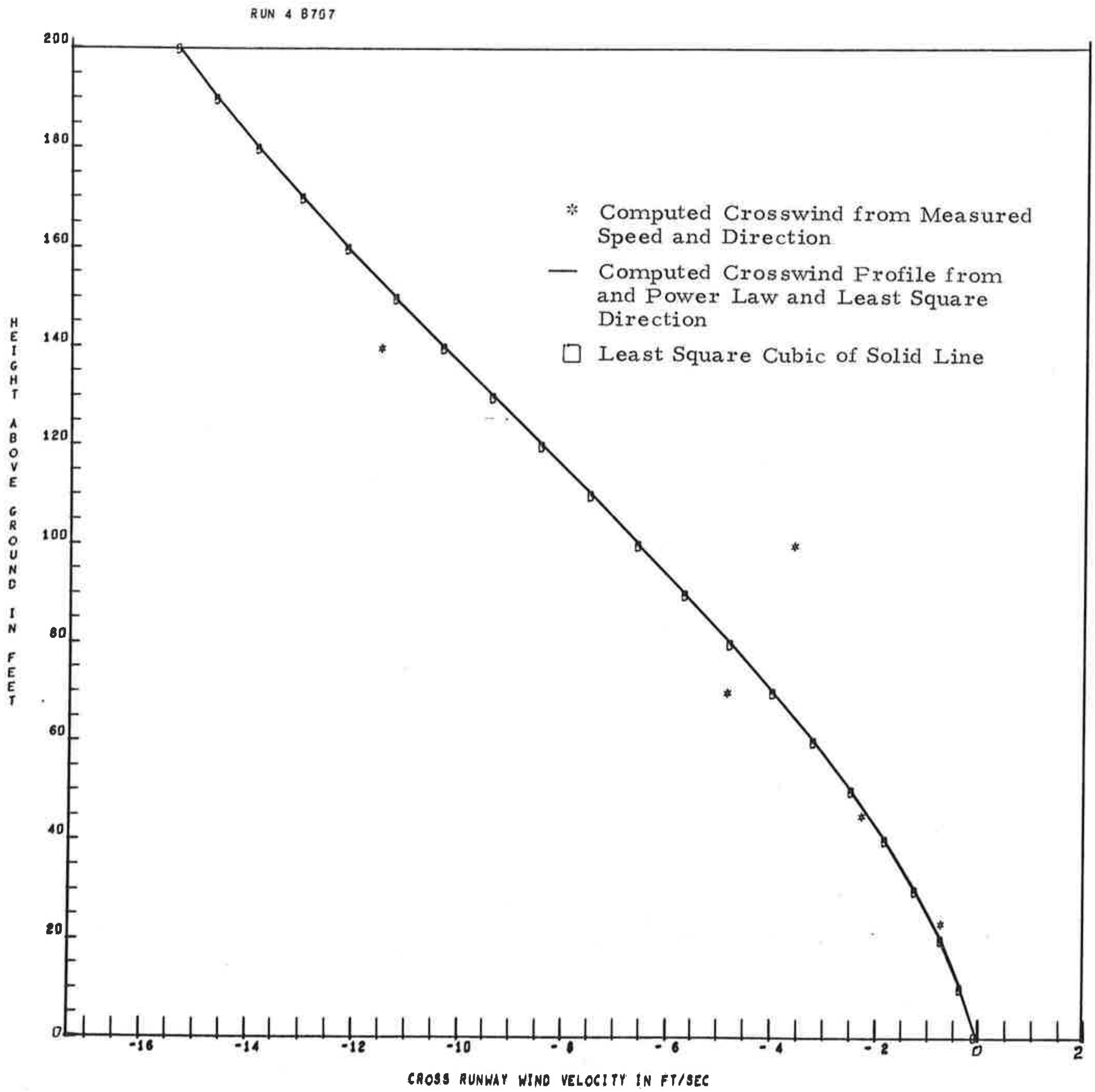


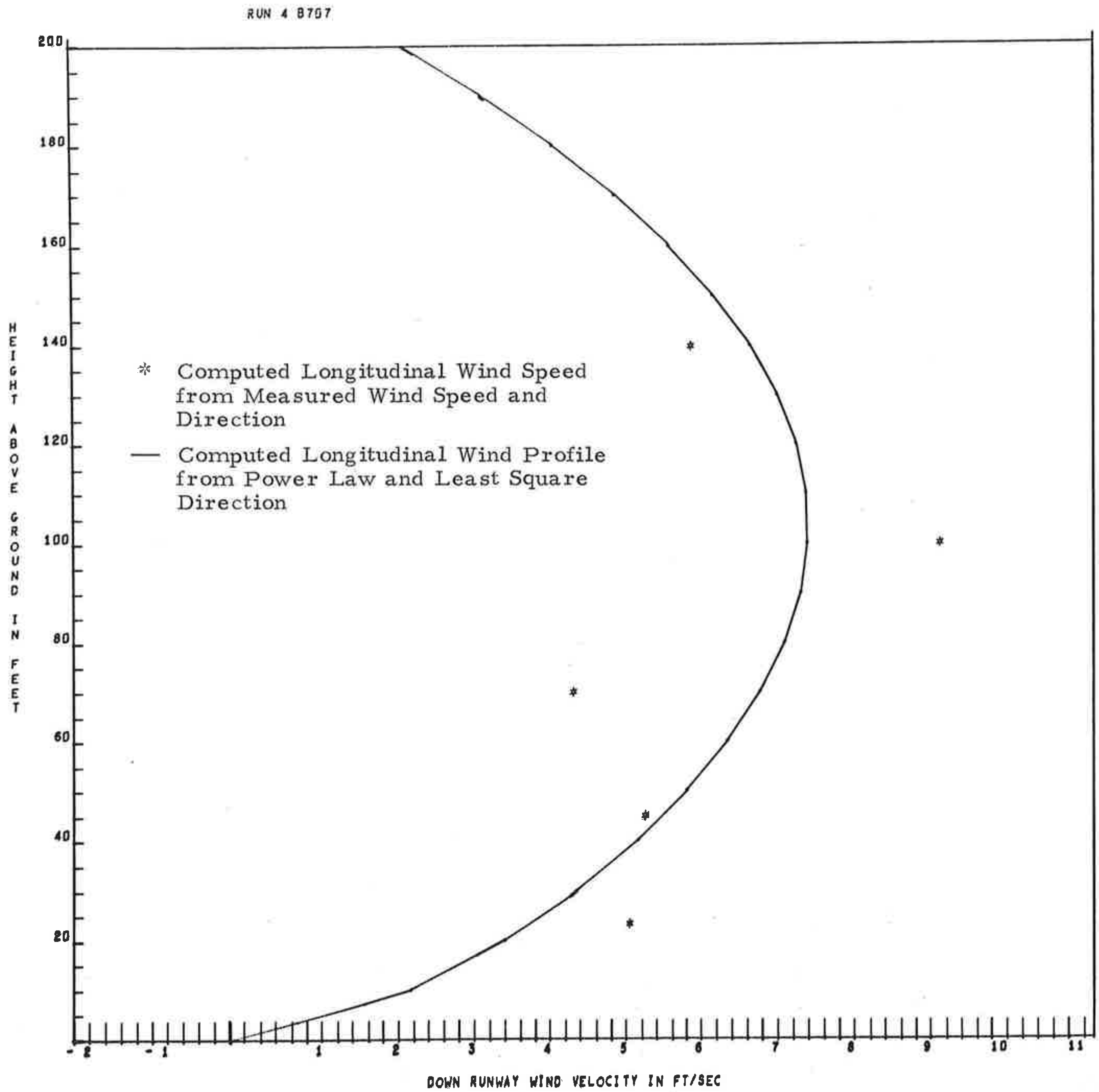
RUN 4 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
0
20
40
60
80
100
120
140
160
-600
-500
-400
-300
-200
-100
100
200
300
400
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location


RUN 4 B707
VELOCITY OFFSITE SENSOR DIRECTION
20
10
-10
-20
-30
0
20
40
60
80
100
120
140
160
TIME
4, 5. . . 9, AB = Sensor number corresponding to predicted induced velocity at a particular instant of time.

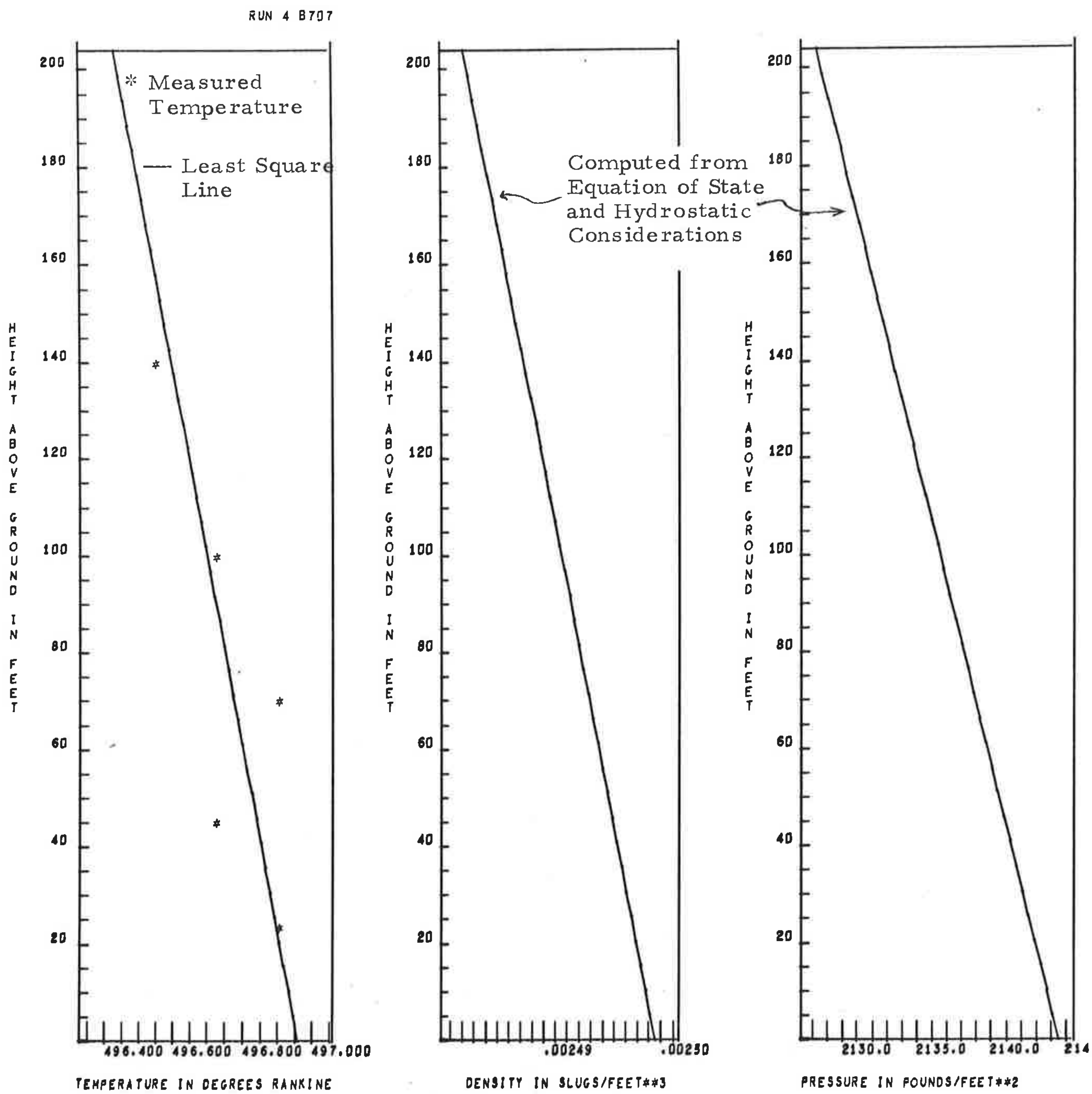

RUN 4 B707
200
180
160
140
120
100
80
60
40
20
HEIGHT ABOVE GROUND IN FEET
* Measured Velocity
— Power Law Profile
0
2
4
6
8
10
12
14
16
WIND SPEED IN FT/SEC


RUN 4 8707
* Measured Wind Direction
— Least Square Line
HEIGHT ABOVE GROUND IN FEET
200
180
160
140
120
100
80
60
40
20
-50
-40
-30
-20
-10
0
10
20
30
40
WIND DIRECTION IN DEGREES


RUN 4 B707
200
180
160
140
120
100
80
60
40
20
0
HEIGHT ABOVE GROUND IN FEET
-16
-14
-12
-10
-8
-6
-4
-2
0
2
CROSS RUNWAY WIND VELOCITY IN FT/SEC
* Computed Crosswind from Measured Speed and Direction
— Computed Crosswind Profile from and Power Law and Least Square Direction
☐ Least Square Cubic of Solid Line



RUN 4 B707
200
180
160
140
120
100
80
60
40
20
HEIGHT ABOVE GROUND IN FEET
* Computed Longitudinal Wind Speed from Measured Wind Speed and Direction
— Computed Longitudinal Wind Profile from Power Law and Least Square Direction
-2
-1
1
2
3
4
5
6
7
8
9
10
11
DOWN RUNWAY WIND VELOCITY IN FT/SEC


RUN 4 B707
* Measured Temperature
— Least Square Line
Computed from Equation of State and Hydrostatic Considerations
HEIGHT ABOVE GROUND IN FEET
200
180
160
140
120
100
80
60
40
20
496.400 496.600 496.800 497.000
TEMPERATURE IN DEGREES RANKINE
.00249 .00250
DENSITY IN SLUGS/FEET**3
2130.0 2135.0 2140.0 2145
PRESSURE IN POUNDS/FEET**2

Appendix D

DESCRIPTION OF INPUT REQUIREMENTS FOR LOCKHEED WAKE VORTEX TRANSPORT COMPUTER PROGRAM

This Appendix presents a summary of input namelist and input flag requirements for using the Lockheed Wake Vortex transport computer program.

```
C
C                              THE ONE ELEMENT PROGRAM
C

C
C     TITLE CARD     72 COLUMNS OF COMMENT
C                    (IF FIRST 6 COLUMNS ARE BLANK, PROGRAM TERMINATES)
C
C     AIRCRAFT CARD    CHOOSE STANDARD AIRCRAFT WITH FIRST 6 COLUMNS
C                    (LEFT JUSTIFIED)
C                      THE CHOICES ARE B747 B707 B727 DC10 DC9 DC8 CV880
C                    L1011 CSA
C                      ALL BLANKS INDICATES AIRCRAFT FROM PREVIOUS CASE
C                    WILL BE USED
C
```

```
C
C                       NAMELIST (INPUT)
C
C      STIME          START TIME FOR SIMULATION
C      FTIME          CUTOFF TIME FOR VORTEX CONSIDERATION
C      DTIME          STEP SIZE IN TIME
C      JPRINT         NUMBER OF TIME STEPS FOR EACH PRINT
C      SPEED          SPEED OF AIRCRAFT RELATIVE TO GROUND
C                     IF NEGATIVE, (SPEED) IS TAKEN AS AIR SPEED
C      WEIGHT         WEIGHT OF AIRCRAFT
C      WSPAN          WING SPAN OF AIRCRAFT
C      IPLOT1         FLAG
C                       IPLOT1 = 0  INDICATES NO CROSS SECTION PLOT
C                       IPLOT1 = 1  INDICATES CROSS SECTION PLOT
C                       IPLOT1 = 2  INDICATES CROSS SECTION PLOTS
C                                     WITH SHEAR
C      IPLOT2         FLAG
C                       IPLOT2 = 0 NO COMPARISON PLOTS
C                       IPLOT2 = 1  PHOTOGRAPHIC COMPARISON PLOT
C                                    (REQUIRES PHOTOGRAPHIC INPUT PACKAGE)
C                       IPLOT2 = 2  GROUND WIND SENSOR COMPARISON PLOT
C                                    (REQUIRES GROUND WIND SENSOR
C                                    COMPARISON INPUT PACKAGE)
C                       IPLOT2 = 3  BOTH PHOTOGRAPHIC AND GROUND WIND
C                                    SENSOR COMPARISON PLOTS
C      LINE           FLAG
C                       LINE = 0  NO LINES BETWEEN EQUAL TIME POINTS ON
C                                  PHOTOGRAPHIC COMPARISON PLOT
C                       LINE = 1  LINES BETWEEN EQUAL TIME POINTS ON
C                                  PHOTOGRAPHIC COMPARISON PLOT
C      DTLINE         TIME INTERVAL BETWEEN TIME LINES ON PHOTOGRAPHIC
C                      COMPARISON PLOT
C      ISCALE         FLAG
C                       ISCALE = 0  ALL PLOTS COMPUTE OWN SCALE FACTORS
C                       ISCALE = 1  INPUTED SCALE FACTORS FOR
C                                     PHOTOGRAPHIC COMPARISON PLOT,
C                                     GROUND WIND SENSOR COMPARISON PLOT
C                                     AND GROUND WIND SENSOR PLOT
C      YR             RIGHT EXTREME OF PHOTOGRAPHIC PLOT AND GROUND WIND
C                      SENSOR COMPARISON PLOT
C      YL             LEFT EXTREME OF PHOTOGRAPHIC PLOT AND GROUND WIND
C                      SENSOR COMPARISON PLOT
C      ZT             TOP EXTREME OF PHOTOGRAPHIC PLOT
C      PMIN           BOTTOM EXTREME OF GROUND WIND SENSOR PLOT
C      PMAX           TOP EXTREME OF GROUND WIND SENSOR PLOT
C
```

```
C
C                        NAMELIST (VORT)
C
C       VOR                  VORTEX ALTITUDE ABOVE GROUND
C       ISIGHT               FLAG
C                              ISIGHT = 0  PHOTOGRAPHIC INPUT IS NOT USED TO
C                                           DETERMINE VORTEX STARTING POSITION
C                              ISIGHT = 1  THE FIRST PHOTOGRAPHIC INPUT CARD IS
C                                           USED TO DETERMINE VORTEX STARTING
C                                           POSITION
C
```

```
C
C              NAMFLIST (WINDS)
C
C      JWIND            FLAG
C                         JWIND = 1  WIND IS PROVIDED BY TAPE 10 AS A
C                                    FUNCTION OF TIME
C                         JWIND = 2  WIND IS PROVIDED BY TABLE WITH LINEAR
C                                    INTERPOLATION AND LINEAR EXTRAPOLATION
C                                    AS A FUNCTION OF ALTITUDE
C                         JWIND = 3  WIND IS PROVIDED BY LEAST SQUARE CURVES
C                                    OF TABLE VALUES
C      SWINDT            TIME ON WIND TAPE WHICH CORRESPONDS TO ZERO TIME OF
C                         SIMULATION
C      WINDD            DIRECTION OF WIND REFERENCE ON TAPE IN DEGREES
C                         CLOCK-WISE FROM (-Y)
C      NW               NUMBER OF ALTITUDES
C      ALT(30)          ALTITUDES AT WHICH THE WINDS ARE SPECIFIED
C      WSPEED(30)       WIND SPEED (FT/SEC)
C      WDIREC(30)       DIRECTION FROM WHICH WIND IS COMING.
C                           DEGREES MEASURED COUNTER-CLOCKWISE FROM THE
C                           NEGATIVE X-AXIS
C                           IF COMPARISON PLOTS ARE BEING MADE
C                           DEGREES ARE MEASURED CLOCKWISE FROM MAGNETIC
C                           NORTH
C      WSV(30)          VERTICAL WIND SPEED (FT/SEC)
C      ALTR             REFERENCE ALTITUDE FOR LEAST SQUARS CURVE OF WIND
C                       SPEED
C      WSPR             WIND SPEED AT REFERENCE ALTITUDE
C                           (COMPUTED WHEN NW IS GREATER THAN 0)
C      CPOWER           IS VARIABLE IN LEAST SQUARES CURVE
C                           ALT/ALTR = (WSPEED/WSPR)**CPOWER
C                           (COMPUTED WHEN NW IS GREATER THAN 4)
C      NPOLY            ORDER OF POLYNOMIAL TO BE FITTED TO WIND DIRECTION.
C                           MAXIMUM VALUE FOR NPOLY IS 7
C      COEF(9)          COEFFICIENTS OF POLYNOMIAL FOR WIND DIRECTION
C                           (COMPUTED WHEN NW IS GREATER THAN NPOLY)
C      PRESSG           PRESSURE AT GROUND LEVEL IN MILLIBARS
C      NA               NUMBER OF ALTITUDES AT WHICH THE TEMPERATURE IS
C                           SPECIFIED.
C      ALTIT(30)        ALTITUDES AT WHICH THE TEMPRATURE IS SPECIFIED.
C      TEMP(30)         TEMPERATURE IN DEGREES C
C
```

```
      C
      C                          NAMELIST (SHEAR)
      C
      C      NROWS                  NUMBER OF ROWS OF VORTICES FOR SHEAR
      C                               IF NROWS = 0 NO SHEAR IS ASSUMED
      C      NCOLS                  NUMBER OF COLUMNS OF VORTICES FOR SHEAR
      C                                 (SHOULD BE ODD)
      C      HEIGHT                 HEIGHT OF UPPER MOST ROW OF SHEAR VORTICES
      C      WIDTH                  SEPARATION BETWEEN COLUMNS OF SHEAR VORTICES
      C      F(4)                   FRACTION OF VORTICITY IN EACH ROW OF VORTICES
      C
```

```
C
C                   NAMELIST (BUOY)
C
C     SMIX               MIXING PARAMETER
C                          SMIX POSITIVE INDICATES TOMBACH'S BUOYANCY MODEL
C                          SMIX = -1. INDICATES SCORER AND DAVENPORT'S
C                                     BUOYANCY MODEL
C                          SMIX = -2. INDICATES ADIABATIC COMPRESSION
C                                     (WITH NO MIXING) AS THE
C                                     BUOYANCY MODEL
C     ZCHECK             ELEVATION CUTOFF POINT FOR BUOYANCY
C
```

```
C
C                    NAMELIST (SENSOR)
C
C    KSEN              FLAG
C                        KSEN = 0  INDICATES SENSOR ORIENTED VELOCITY
C                                    COMPONENT COMPUTED
C                        KSEN = 1  INDICATES PRESSURE DIFFERENCE COMPUTED
C    NSEN              NUMBER OF SENSORS MAXIMUM IS 16
C    YSEN(16)          Y POSITION OF SENSOR IN FEET
C    ZSEN(16)          Z POSITION OF SENSOR IN FEET
C    PHI(16)           ORIENTATION OF SENSOR ANGLE IN DEGREES (POSITIVE)
C                         FROM X AXIS COUNTER-CLOCK-WISE IN XY PLANE
C    THETA(16)         ORIENTATION OF SENSOR ANGLE IN DEGREES FROM Z AXIS
C    ISENS(16)         FLAG FOR SENSOR TYPE
C                        ISENS = 0  SENSOR NOT USED
C                        ISENS = 1  SENSOR WITH UNIT RESPONSE
C                         ISENS = 2  DUAL TOTAL HEAD PROBE
C                         ISENS = 3  SENSOR WITH COSINE RESPONSE
C
```

Appendix E

SUMMARY OF LINE PRINTER OUTPUT OF LOCKHEED WAKE VORTEX TRANSPORT COMPUTER PROGRAM

LINE PRINTER OUTPUT

Print out on Page E-7

(1) Title from title card

(2) Standard aircraft chosen; not printed if standard aircraft not chosen

(3) Namelist INPUT

The printing of variable STIME does not reflect the effect of the selection of first Photographic Input Card used to determine the vortex starting position.

The printing of variables SPEED, WEIGHT and WSPAN reflects the effect of (2) but does not reflect the overriding of the Run Data Card, if selected.

(4) Namelist VORT

(5) Namelist WINDS

Print out on Page E-8

(5) Continuation of Namelist WINDS

The printing of variables ALTR, WSPR, CPOWER, COEF and COEFT does not reflect the least squares computations.

(6) Namelist SHEAR

(7) Namelist BUOY

Print out on Page E-9

(8) Namelist SENSOR

(49) Altitude in feet of port vortex

(50) Horizontal position in feet of starboard vortex relative to tower

(51) Same as (47)

(52) Horizontal position in feet of port vortex relative to tower

(53) Same as (49)

(54) Rate of change in feet per second of the horizontal position of the starboard vortex

(55) Rate of change in feet per second of the altitude of the starboard vortex

(56) Rate of change in feet per second of the horizontal position of the port vortex

(57) Rate of change in feet per second of the altitude of the port vortex

(58) Distance between vortex centers in feet

(59) Horizontal separation between vortex centers in feet

(60) Altitude difference between vortex centers in feet

(61) Tilt angle in degrees from horizontal of line through vortex centers. Positive is in the counterclockwise direction.

(62) Same as (61) but in radians

(63) Rate of change of angle described in (61). Units are degrees per second.

(64) Same as (63) but units are radians per second

(65) Difference in circulation between the two vortices in square feet per second

(66) Cross flight path windspeed in feet per second

(67) Wind velocity component in direction ground wind sensor is pointed at sensor location in feet per second.

(68) Orthogonal wind velocity components in feet per second at sensor location

(69) The magnitude of the wind velocity in feet per second

Print out on Page E-13

Information from photographic data cards.

(70) Time in seconds from vortex creation for the following observed positions.

(71) Same as (50) except this is observed

(72) Same as (51) except this is observed

(73) Same as (52) except this is observed

(74) Same as (53) except this is observed

(75) Same as (58) except computed from observed position

(76) Same as (59) except computed from observed position

(77) Same as (60) except computed from observed position

(78) Same as (61) except computed from observed position

(79) Same as (62) except computed from observed position

(80) Same as (54) except computed from observed positions before and after

(81) Same as (55) except computed from observed positions before and after

(82) Same as (56) except computed from observed positions before and after

(83) Same as (57) except computed from observed positions before and after

(84) Same as (63) except computed from observed positions before and after

(85) Same as (64) except computed from observed positions before and after

(86) Difference in circulation between the two vortices necessary to cause the angular rate (84).

(87) Same as (66) except computed from observed positions before and after

Print out on Page E-14

Information from Ground Wind Data Cards

(88) Position from tower of ground sensor (in feet)

(89) Time in seconds from vortex creation when starboard vortex passes over ground sensor

(90) Time in seconds from vortex creation when port vortex passes over ground sensor

(91) Same as (80) except computed from positions observed by the ground sensor

(92) Same as (82) except computed from positions observed by the ground sensor

(93) Cubic curve fit coefficients of cross flight path wind profile. Program does not use this curve fit.

$$V_{wind} = -2.13 - 0.236H + 1.731 * 10^{-3} H^2 - 4.644 * 10^{-6} H^3$$

0.511 is the standard deviation of the points from the cubic curve.

```
                    (1) RUN 17 B707  WIND PROFILE
(2) THE B707   AIRCRAFT WAS CHOSEN
(3) $INPUT
    ISIM     =             +1
    STIME    =   .00000000E+00
    FTIME    =   .16000000E+03
    DTIME    =   .20000000E+01
    JPRINT   =             +1
    SPEED    =  -.21250000E+03
    WEIGHT   =   .24700000E+06
    WSPAN    =   .14580000E+03
    IPLOT1   =             +1
    IPLOT2   =             +3
    IPUNCH   =             +1
    LINE     =             +1
    DTLINE   =   .60000000E+01
    ISCALE   =             +1
    YR       =   .40000000E+03
    YL       =  -.60000000E+03
    ZT       =   .25000000E+03
    PMIN     =  -.30000000E+02
    PMAX     =   .30000000E+02

    $END
(4) $VORT
    VOR      =   .00000000E+00
    ISIGHT   =             +0

    $END
(5) $WINDS
    JWIND    =             +3
    SWINDT   =   .00000000E+00
    WINDD    =   .00000000E+00
    NW       =             +5
    ALT      =   .23000000E+02,  .45000000E+02,  .70000000E+02,  .10000000E+03,
                 .14000000E+03,  .20000000E+03,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00
    WSPEED   =   .92000000E+01,  .11100000E+02,  .11400000E+02,  .13500000E+02,
                 .15700000E+02,  .15700000E+02,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00
    WDIREC   =   .83000000E+01,  .12900000E+02,  .23800000E+02,  .15300000E+02,
                 .19200000E+02,  .19200000E+02,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
                 .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00,
```

```
(5)                 .00000000E+00,   .00000000E+00
     WSV      =     .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00
     ALTP     =     .23000000E+02
     WSPR     =     .00000000E+00
     CPOWER   =     .27000000E+00
     NPOLY    =                +2
     COEF     =     .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00
     PRESSG   =     .10278000E+04
     JTEMP    =                +2
     NA       =                +5
     ALTIT    =     .23000000E+02,   .45000000E+02,   .70000000E+02,   .10000000E+03,
                    .19000000E+03,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04,   .20000000E+04,   .20000000E+04,
                    .20000000E+04,   .20000000E+04
     TEMP     =     .51000000E+01,   .48000000E+01,   .47000000E+01,   .47000000E+01,
                    .45000000E+01,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02,   .20000000E+02,   .20000000E+02,
                    .20000000E+02,   .20000000E+02
     NPOLYT   =                +1
     COEFT    =     .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00,
                    .00000000E+00
     JPOTEN   =                +1
     $END
(6)  $SHEAR
     NROWS    =                +0
     NCOLS    =                +1
     HEIGHT   =     .00000000E+00
     WIDTH    =     .00000000E+00
     F        =     .00000000E+00,   .00000000E+00,   .00000000E+00,   .00000000E+00
     $END
(7)  $BUOY
     SMIX     =     .00000000E+00
     ZCHECK   =     .52000000E+03
     $END
```

(8)

```
$SENSOR
KSEN   =          +0

NSEN   =         +12
YSEN   =  .55000000E+03,  .45000000E+03,  .35000000E+03,  .25000000E+03,
          .15000000E+03,  .50000000E+02, -.50000000E+02, -.15000000E+03,
         -.25000000E+03, -.35000000E+03, -.45000000E+03, -.55000000E+03,
          .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00
ZSEN   =  .60000000E+01,  .60000000E+01,  .60000000E+01,  .60000000E+01,
          .60000000E+01,  .60000000E+01,  .60000000E+01,  .60000000E+01,
          .60000000E+01,  .60000000E+01,  .60000000E+01,  .60000000E+01,
          .00000000E+00,  .00000000E+00,  .00000000E+00,  .00000000E+00
PHI    =  .27000000E+03,  .27000000E+03,  .27000000E+03,  .27000000E+03,
          .27000000E+03,  .27000000E+03,  .27000000E+03,  .27000000E+03,
          .27000000E+03,  .27000000E+03,  .27000000E+03,  .27000000E+03,
          .27000000E+03,  .27000000E+03,  .27000000E+03,  .27000000E+03
THETA  =  .90000000E+02,  .90000000E+02,  .90000000E+02,  .90000000E+02,
          .90000000E+02,  .90000000E+02,  .90000000E+02,  .90000000E+02,
          .90000000E+02,  .90000000E+02,  .90000000E+02,  .90000000E+02,
          .90000000E+02,  .90000000E+02,  .90000000E+02,  .90000000E+02
ISENS  =             +0,             +0,             +0,             +0,
                     +3,             +3,             +3,             +3,
                     +3,             +3,             +3,             +3,
                     +3,             +3,             +3,             +3

$END
```

```
                                                RUN DATA CARD
(9) CONFIGURATION      LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
    AIRCRAFT TYPE IS B707
    RUN NUMBER  17
    AIRCRAFT DISPLACEMENT FROM TOWER  271 FT
    AIRCRAFT ALTITUDE ABREAST OF TOWER 191 FT
    AIRCRAFT WEIGHT 233000. POUNDS
    AIRSPEED  244.9 FT/SEC
    TEMPERATURE   8 DEGREES C (NOT USED)
    INITIAL WIND SPEED  10 MPH  (NOT USED)
    INITIAL WIND ANGLE   0 DEGREES TRUE  (NOT USED)
    FINAL WIND SPEED   8 MPH  (NOT USED)
    FINAL WIND ANGLE   0 DEGREES TRUE  (NOT USED)
    AIRCRAFT HEADING 130 DEGREES MAGNETIC
    MONTH 10      DAY 18      HOUR  9      MINUTE 50      LOCAL TIME

(10) $OUTPUT
    SPEED    =    -.24490500E+03
    WEIGHT   =     .23300000E+06
    WSPAN    =     .14200000E+03

    $END
(11) $WLOG
    WSPR     =     .88597282E+01
    CPOWER   =     .29712910E+00
    COEF     =     .68822373E+01,   .16470542E+00,   -.42616861E-03,   .36999969E+01,
                   .00000000E+00,   .00000000E+00,   .00000000E+00,    .00000000E+00,
                   .00000000E+00

    $END
(12) COEFT =   5.09    -4.362-03    8.919-02    0.000    0.000    0.000    0.000    0.000    0.000
```

RUN 17 B707 WIND PROFILE

(13) USES RECORDED WIND AND TEMPERATURE

(14) ALTITUDE	(15) POTENTIAL T	(16) TEMPERATURE K	(17) PRESSURE MB	(18) WIND SPEED
2.3000000+01	2.7615602+02	2.7826000+02	1.0269206+03	9.1999999+00
4.5000000+01	2.7592286+02	2.7796000+02	1.0260799+03	1.1100000+01
7.0000000+01	2.7589697+02	2.7786000+02	1.0251250+03	1.1400000+01
1.0000000+02	2.7598509+02	2.7786000+02	1.0239798+03	1.3500000+01
1.4000000+02	2.7590396+02	2.7766000+02	1.0229581+03	1.5700000+01

(19) ALTITUDE	(20) ALTITUDE 1	(21) ALTITUDE 2	(22) DTH/DZ	(23) DU/DZ	(24) RICHARDSON	(25) POTENTIAL T	(26) TEMPERATURE K	(27) PRESSURE MB	(28) WIND SPEED	(29) Z ZERO
3.4000+01	2.3000+01	4.5000+01	-1.0599-02	8.6344-02	-1.6542-01	2.7604+02	2.7811+02	1.0265+03	1.0142+01	8.9193-01
4.6500+01	2.3000+01	7.0000+01	-5.5118-03	4.6809-02	-2.9334-01	2.7592+02	2.7795+02	1.0260+03	1.1106+01	2.1696-01
6.1500+01	2.3000+01	1.0000+02	-2.2199-03	5.5844-02	-8.3009-02	2.7591+02	2.7789+02	1.0254+03	1.1253+01	9.9111-01
8.1500+01	2.3000+01	1.4000+02	-2.1544-03	5.5556-02	-8.1389-02	2.7593+02	2.7786+02	1.0247+03	1.2172+01	1.7844+00
5.7500+01	4.5000+01	7.0000+01	-1.0355-03	1.2000-02	-8.3851-01	2.7591+02	2.7791+02	1.0256+03	1.1199+01	1.5764-06
7.2500+01	4.5000+01	1.0000+02	1.1316-03	4.3636-02	6.9300-02	2.7590+02	2.7786+02	1.0250+03	1.1564+01	1.1203+00
9.2500+01	4.5000+01	1.4000+02	-1.9885-04	4.8421-02	-9.8879-03	2.7596+02	2.7786+02	1.0243+03	1.2951+01	2.9093+00
8.5000+01	7.0000+01	1.0000+02	2.9374-03	7.0000-02	6.9898-02	2.7594+02	2.7786+02	1.0246+03	1.2416+01	1.0097+01
1.0500+02	7.0000+01	1.4000+02	9.9945-05	6.1429-02	3.0878-03	2.7597+02	2.7783+02	1.0238+03	1.3771+01	1.1143+01
1.2000+02	1.0000+02	1.4000+02	-2.0282-03	5.5000-02	-7.8174-02	2.7594+02	2.7776+02	1.0232+03	1.4592+01	1.2485+01

(19) ALTITUDE	(20) ALTITUDE 1	(21) ALTITUDE 2	(30) DUC/DZ	(31) DUD/DZ	(32) DVC/DZ	(33) DVD/DZ
3.4000+01	2.3000+01	4.5000+01	9.3359-02	1.0100-02	-9.3359-02	1.0100-02
4.6500+01	2.3000+01	7.0000+01	6.6381-02	-3.5188-02	-6.6381-02	-3.5188-02
6.1500+01	2.3000+01	1.0000+02	5.7629-02	1.0479-02	-5.7629-02	1.0479-02
8.1500+01	2.3000+01	1.4000+02	5.8541-02	6.3320-03	-5.8541-02	6.3320-03
5.7500+01	4.5000+01	7.0000+01	4.2639-02	-7.5042-02	-4.2639-02	-7.5042-02
7.2500+01	4.5000+01	1.0000+02	4.3336-02	1.0630-02	-4.3336-02	1.0630-02
9.2500+01	4.5000+01	1.4000+02	5.0478-02	5.4593-03	-5.0478-02	5.4593-03
8.5000+01	7.0000+01	1.0000+02	4.3917-02	8.2024-02	-4.3917-02	8.2024-02
1.0500+02	7.0000+01	1.4000+02	5.3277-02	3.4210-02	-5.3277-02	3.4210-02
1.2000+02	1.0000+02	1.4000+02	6.0298-02	-1.6506-03	-6.0298-02	-1.6506-03

(34) RANGE-MEAN RICHARDSON NUMBER -2.5310300-01
(35) SMALL GAMMA = .9544549
(36) Z ZERO TOLTAL = 2.346841
(37) BT = .2704781

(38) GAMMA IN FT**2/SEC = 3.44867923+03
(39) EDDY VISCOSITY IN FT**2/SEC = 4.74849720-01
(40) TEMPERATURE IN RANKINE = 4.99349861+02
(41) DENSITY IN SLUGS/FT**3 = 2.47358737-03
(42) ACOUSTIC VELOCITY IN FT/SEC = 1.09540765+03
(43) STABILITY IN 1/SEC**2 = 0.00000000
(44) INITIAL PARAMETER (DIMENSIONLESS) = 0.00000000

Z VELOCITY	1.532-01	4.595+02	1.666-02	7.254-03
AIR SPEED	8.020+00	6.695+00	6.282+00	6.122+00

(45) 24.000000 SEC. BEHIND GENERATING AIRCRAFT

(46) Y1 = -4.07955132+02 (47) Z1 = 9.65372152+01 (48) Y2 = -2.79310440+02 (49) Z2 = 9.65372152+01

(50) Y1 = -1.36955132+02 (51) Z1 = 9.65372152+01 (52) Y2 = -8.31044006+00 (53) Z2 = 9.65372152+01 WITH RESPECT TO TOWER

(54) DY1= -1.35248765+01 (55) DZ1= -2.95506108+00 (56) DY2= -1.17770160+01 (57) DZ2= -2.95506108+00

(58) SEPARATION BETWEEN VORTICES 129. (59) Y SEPARATION 129. (60) Z SEPARATION 0.000 ANGLE FROM HORIZONTAL (61) 0.000 (62) 0.000

W = 0.000 (63) 0.000 (64) DELTA GAMMA = 0.000 (65) CROSS RUNWAY WIND VELOCITY -12.7 (66)

SENSORS

	ZERO	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
(67) SENSOR ORIENTED V	0.000	0.000	0.000	0.000	-3.111+00	9.082-01	-1.704+00	-1.264+01
(68) X VELOCITY	0.000	0.000	0.000	0.000	3.162+00	3.162+00	3.162+00	3.162+00
Y VELOCITY	0.000	0.000	0.000	0.000	-3.111+00	9.082-01	-1.704+00	-1.264+01
Z VELOCITY	0.000	0.000	0.000	0.000	1.267-01	3.384-01	-8.238-01	-2.277-02
(69) AIR SPEED	0.000	0.000	0.000	0.000	4.438+00	3.307+00	3.685+00	1.303+01
	EIGHT	NINE	TEN	ELEVEN	TWELVE	THIRTEEN	FOURTEEN	FIFTEEN
SENSOR ORIENTED V	-8.255+00	-6.126+00	-5.501+00	-5.271+00				
X VELOCITY	3.162+00	3.162+00	3.162+00	3.162+00				
Y VELOCITY	-8.255+00	-6.126+00	-5.501+00	-5.271+00				
Z VELOCITY	2.273-01	6.312-02	2.111-02	8.705-03				
AIR SPEED	8.843+00	6.895+00	6.345+00	6.147+00				

26.000000 SEC. BEHIND GENERATING AIRCRAFT

Y1 = -4.34906227+02 Z1 = 9.08741903+01 Y2 = -3.02426704+02 Z2 = 9.08741903+01

Y1 = -1.63906227+02 Z1 = 9.08741903+01 Y2 = -3.14267044+01 Z2 = 9.08741903+01 WITH RESPECT TO TOWER

DY1= -1.34326487+01 DZ1= -2.70585191+00 DY2= -1.13372509+01 DZ2= -2.70585191+00

SEPARATION BETWEEN VORTICES 132. Y SEPARATION 132. Z SEPARATION 0.000 ANGLE FROM HORIZONTAL 0.000 0.000

W = 0.000 0.000 DELTA GAMMA = 0.000 CROSS RUNWAY WIND VELOCITY -12.4

SENSORS

	ZERO	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
SENSOR ORIENTED V	0.000	0.000	0.000	0.000	-3.547+00	-1.885-01	1.917+00	-1.242+01
X VELOCITY	0.000	0.000	0.000	0.000	3.162+00	3.162+00	3.162+00	3.162+00
Y VELOCITY	0.000	0.000	0.000	0.000	-3.547+00	-1.885-01	1.917+00	-1.242+01
Z VELOCITY	0.000	0.000	0.000	0.000	9.505-02	3.523-01	-6.050-01	-5.197-01
AIR SPEED	0.000	0.000	0.000	0.000	4.753+00	3.187+00	3.747+00	1.283+01
	EIGHT	NINE	TEN	ELEVEN	TWELVE	THIRTEEN	FOURTEEN	FIFTEEN
SENSOR ORIENTED V	-9.608+00	-6.446+00	-5.595+00	-5.306+00				
X VELOCITY	3.162+00	3.162+00	3.162+00	3.162+00				
Y VELOCITY	-9.608+00	-6.446+00	-5.595+00	-5.306+00				
Z VELOCITY	3.365-01	8.934-02	2.727-02	1.059-02				
AIR SPEED	1.012+01	7.180+00	6.427+00	6.177+00				

28.000000 SEC. BEHIND GENERATING AIRCRAFT

Y1 = -4.61712 72+02 Z1 = 8.57238035+01 Y2 = -3.24649918+02 Z2 = 8.57238035+01

```
PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    14
      STARBOARD DISPLACEMENT  -33 AND HEIGHT  111                  PORT DISPLACEMENT     0 AND HEIGHT     0
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -15.0        Z COMPONENT =  -1.50

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    16
      STARBOARD DISPLACEMENT  -63 AND HEIGHT  108                  PORT DISPLACEMENT     0 AND HEIGHT     0
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.5        Z COMPONENT =  -4.00

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    18
      STARBOARD DISPLACEMENT  -92 AND HEIGHT  100                  PORT DISPLACEMENT     0 AND HEIGHT     0
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.0        Z COMPONENT =  -3.50

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    20
      STARBOARD DISPLACEMENT -120 AND HEIGHT   93                  PORT DISPLACEMENT     0 AND HEIGHT     0
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.5        Z COMPONENT =  -7.00

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    22
      STARBOARD DISPLACEMENT -149 AND HEIGHT   79                  PORT DISPLACEMENT  -12 AND HEIGHT   84
SEPARATION BETWEEN VORTICES    137.      Y SEPARATION    137.      Z SEPARATION    5.00      ANGLE FROM HORIZONTAL    2.09      3.448-02
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -8.00        Z COMPONENT =  -2.00
      PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -11.5        Z COMPONENT =  -5.00
W =  -1.27     -2.209-02      DELTA GAMMA =  -394.          CROSS RUNWAY WIND VELOCITY  -9.75

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS (70) 24
      STARBOARD DISPLACEMENT (71) -165 AND HEIGHT (72) 75 (76)      PORT DISPLACEMENT (73) -35 AND HEIGHT (74) 74   (78)   (79)
SEPARATION BETWEEN VORTICES (75) 130.      Y SEPARATION    130.      Z SEPARATION (77) -1.00      ANGLE FROM HORIZONTAL  -.441   -7.492-03
  STARBOARD VORTEX TRANSPORT VELOCITY (80) Y COMPONENT =  -14.0  (81) Z COMPONENT =  -2.50
      PORT VORTEX TRANSPORT VELOCITY (82) Y COMPONENT =  -16.5  (83) Z COMPONENT =  -.500
W = (84) .908  (85) 1.584-02      DELTA GAMMA = (86) 258.          CROSS RUNWAY WIND VELOCITY (87) -15.2

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    26
      STARBOARD DISPLACEMENT -193 AND HEIGHT   70                  PORT DISPLACEMENT  -68 AND HEIGHT   73
SEPARATION BETWEEN VORTICES    125.      Y SEPARATION    125.      Z SEPARATION    3.00      ANGLE FROM HORIZONTAL    1.37      2.400-02
      PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.0        Z COMPONENT =  -1.00

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    28
      STARBOARD DISPLACEMENT     0 AND HEIGHT    0                  PORT DISPLACEMENT  -96 AND HEIGHT   71
      PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -11.0        Z COMPONENT =  0.000

PHOTOGRAPHIC DATA    TIME FROM VORTEX GENERATION IS    30
      STARBOARD DISPLACEMENT     0 AND HEIGHT    0                  PORT DISPLACEMENT -118 AND HEIGHT   71
```

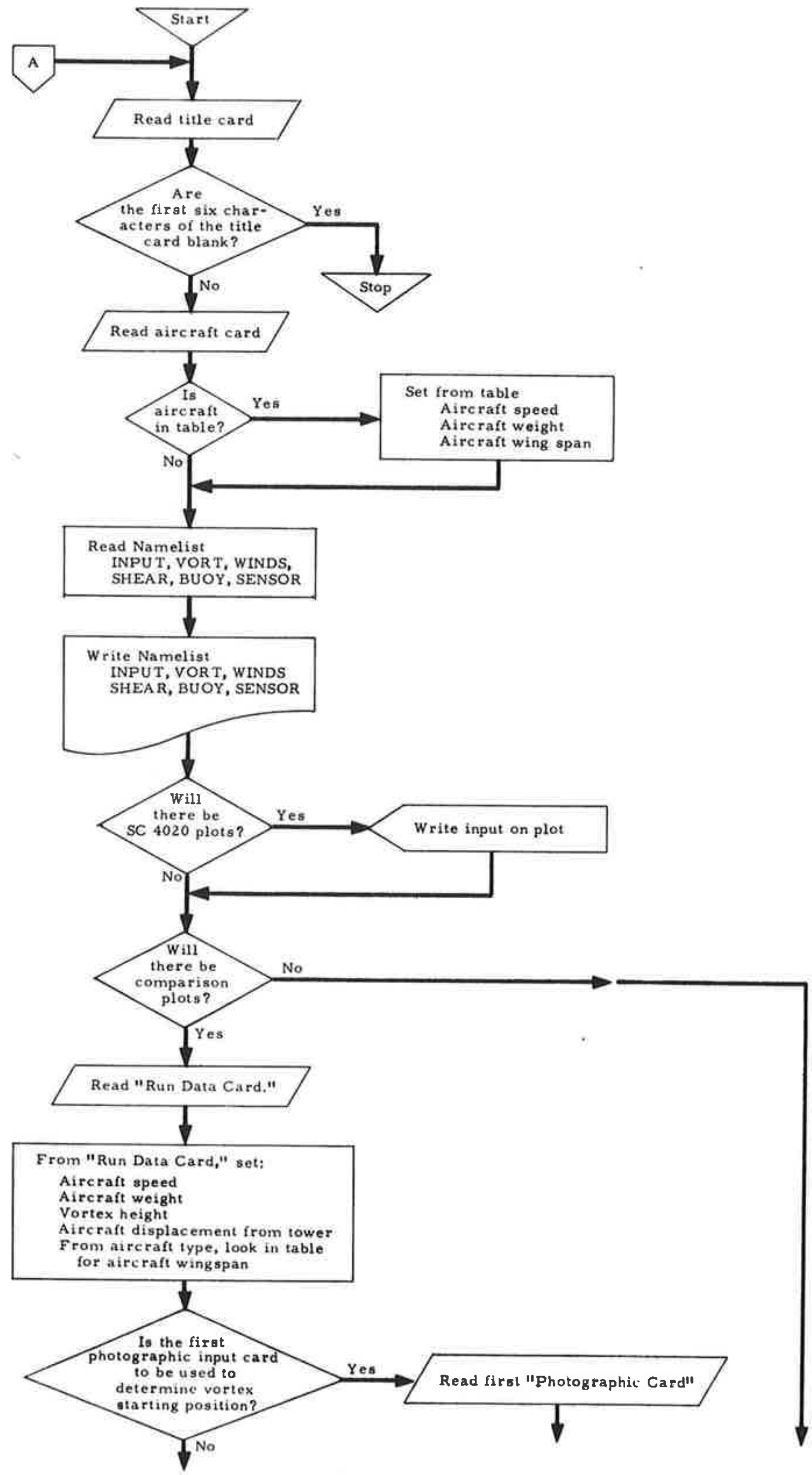
```
GROUND SENSOR DATA    POSTION FROM TOWER (88) 50          (91) STARBOARD VORTEX AT TIME (89) 10          PORT VORTEX AT TIME (90) 22
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -16.7
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT = (92) -14.3
GROUND SENSOR DATA    POSTION FROM TOWER  -50          STARBOARD VORTEX AT TIME   16          PORT VORTEX AT TIME   29
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.3
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -14.3
GROUND SENSOR DATA    POSTION FROM TOWER -150          STARBOARD VORTEX AT TIME   23          PORT VORTEX AT TIME   36
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -16.7
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -11.1
GROUND SENSOR DATA    POSTION FROM TOWER -250          STARBOARD VORTEX AT TIME   29          PORT VORTEX AT TIME   45
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -16.7
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -5.88
GROUND SENSOR DATA    POSTION FROM TOWER -350          STARBOARD VORTEX AT TIME   35          PORT VORTEX AT TIME   62
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -12.5
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -4.74
GROUND SENSOR DATA    POSTION FROM TOWER -450          STARBOARD VORTEX AT TIME   43          PORT VORTEX AT TIME   83
  STARBOARD VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -7.69
       PORT VORTEX TRANSPORT VELOCITY      Y COMPONENT =  -5.00
GROUND SENSOR DATA    POSTION FROM TOWER -550          STARBOARD VORTEX AT TIME   56          PORT VORTEX AT TIME  103

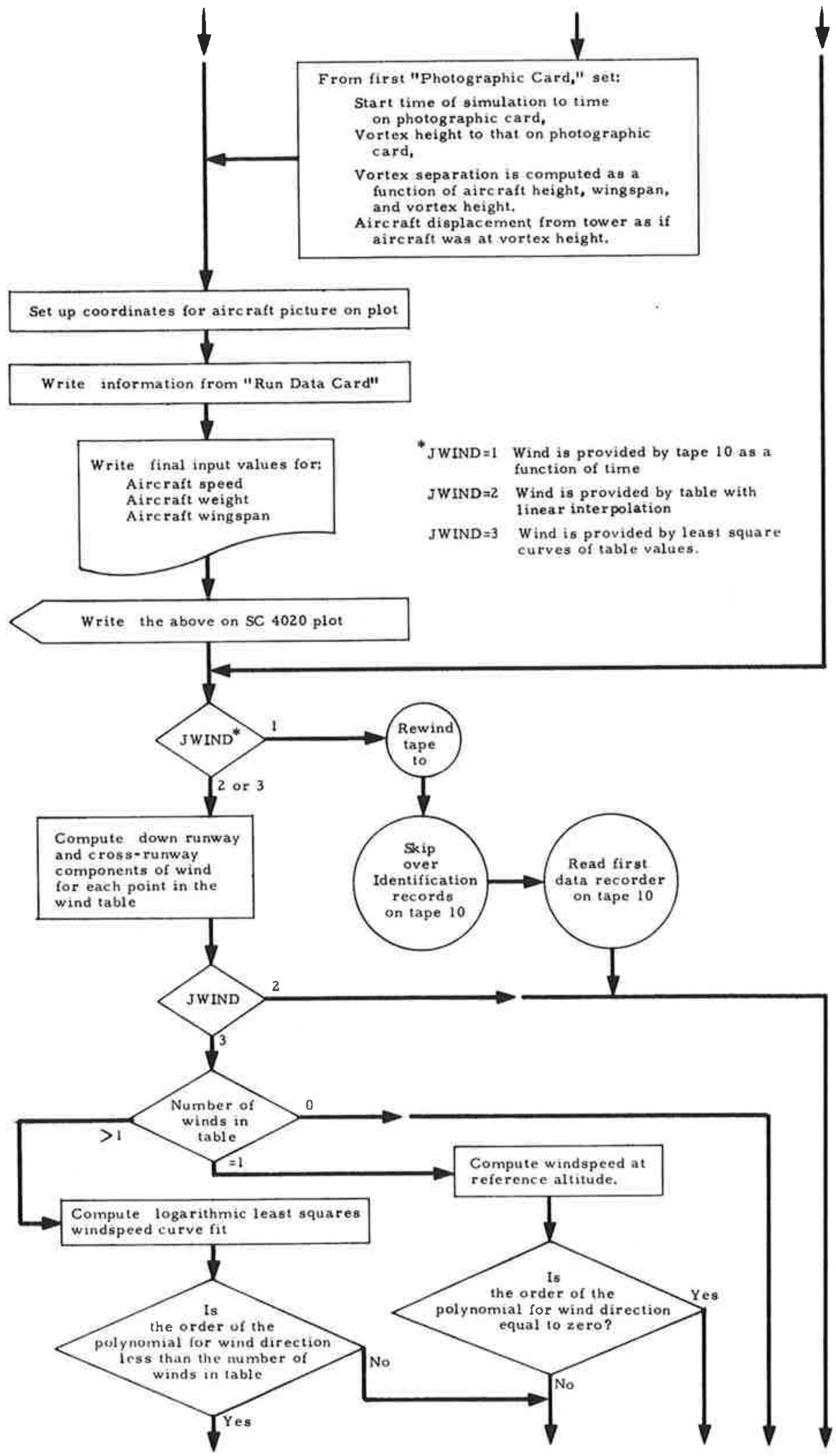
(93) COEFX =   -2.13     -.236     1.731-03  -4.444-06    .511     0.000     0.000     0.000     0.000
```

Appendix F

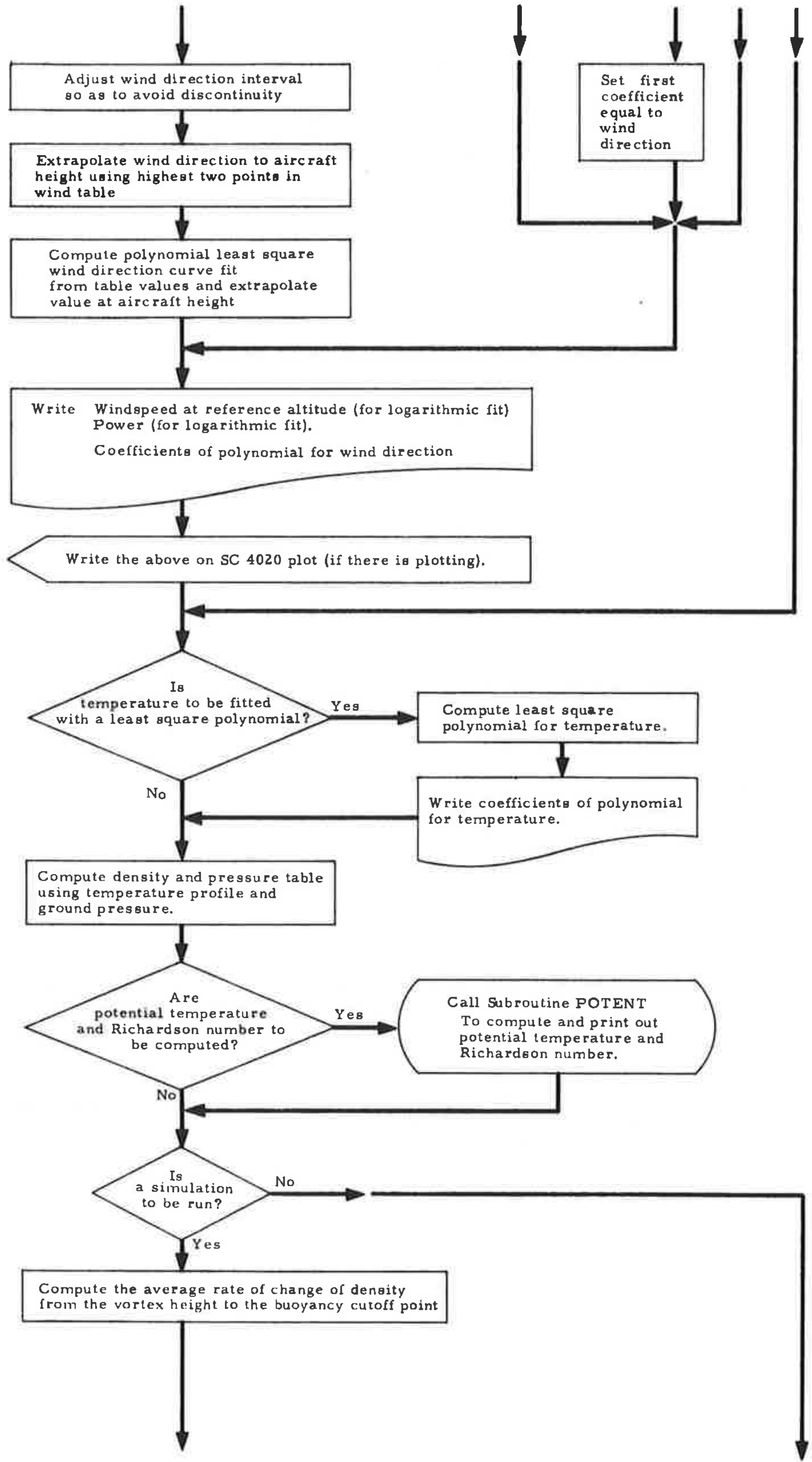
FLOW CHARTS FOR LOCKHEED WAKE VORTEX TRANSPORT COMPUTER PROGRAM

Following is a detailed flow chart of the Lockheed Wake Vortex Transport Computer Program. A simple block flow chart is presented at the conclusion of this Appendix to aid the user in establishing the general calling sequences.

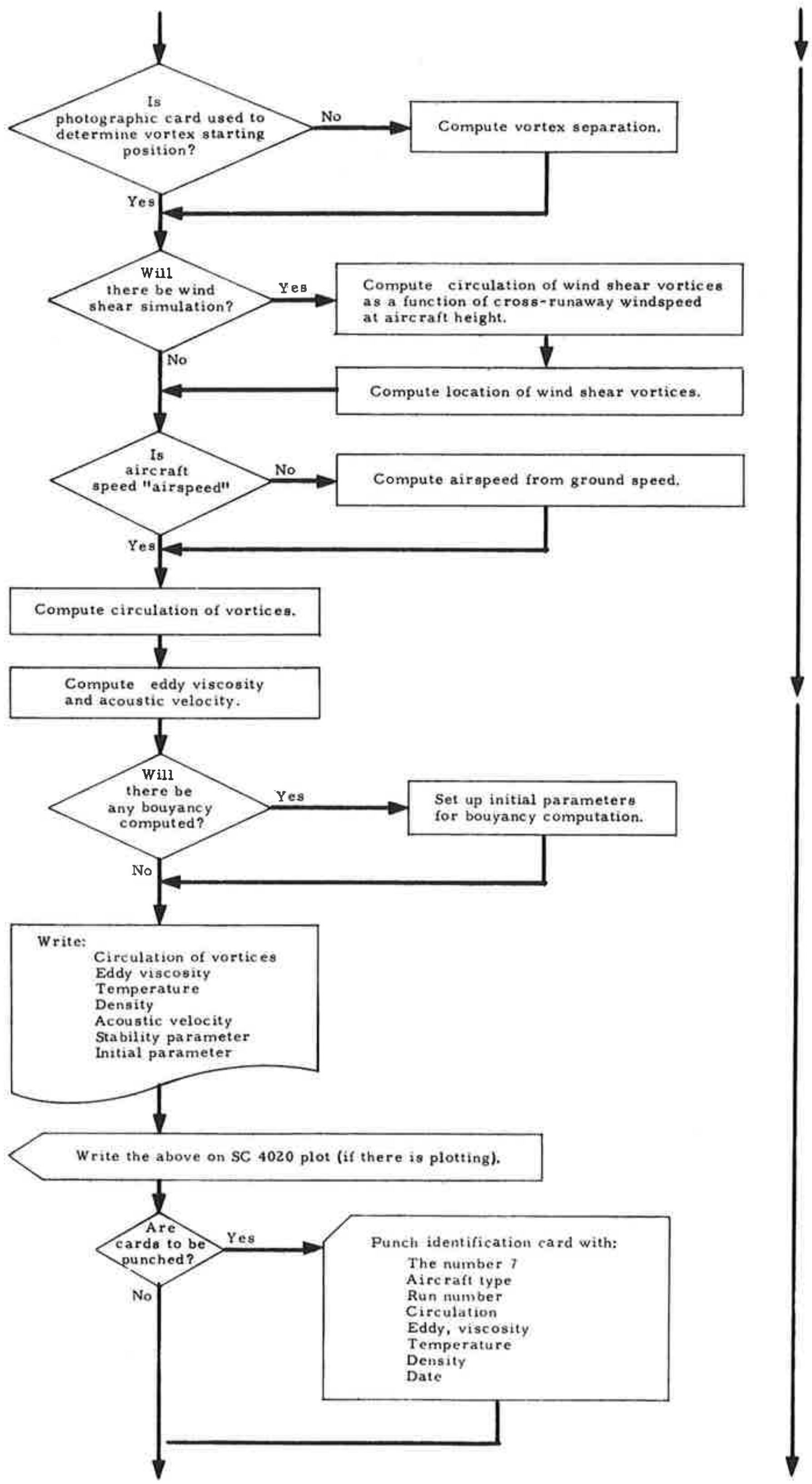

Start
A
Read title card
Are the first six characters of the title card blank?
Yes
Stop
No
Read aircraft card
Is aircraft in table?
Yes
Set from table
Aircraft speed
Aircraft weight
Aircraft wing span
No
Read Namelist
INPUT, VORT, WINDS,
SHEAR, BUOY, SENSOR
Write Namelist
INPUT, VORT, WINDS
SHEAR, BUOY, SENSOR
Will there be SC 4020 plots?
Yes
Write input on plot
No
Will there be comparison plots?
No
Yes
Read "Run Data Card."
From "Run Data Card," set:
Aircraft speed
Aircraft weight
Vortex height
Aircraft displacement from tower
From aircraft type, look in table
for aircraft wingspan
Is the first photographic input card to be used to determine vortex starting position?
Yes
Read first "Photographic Card"
No

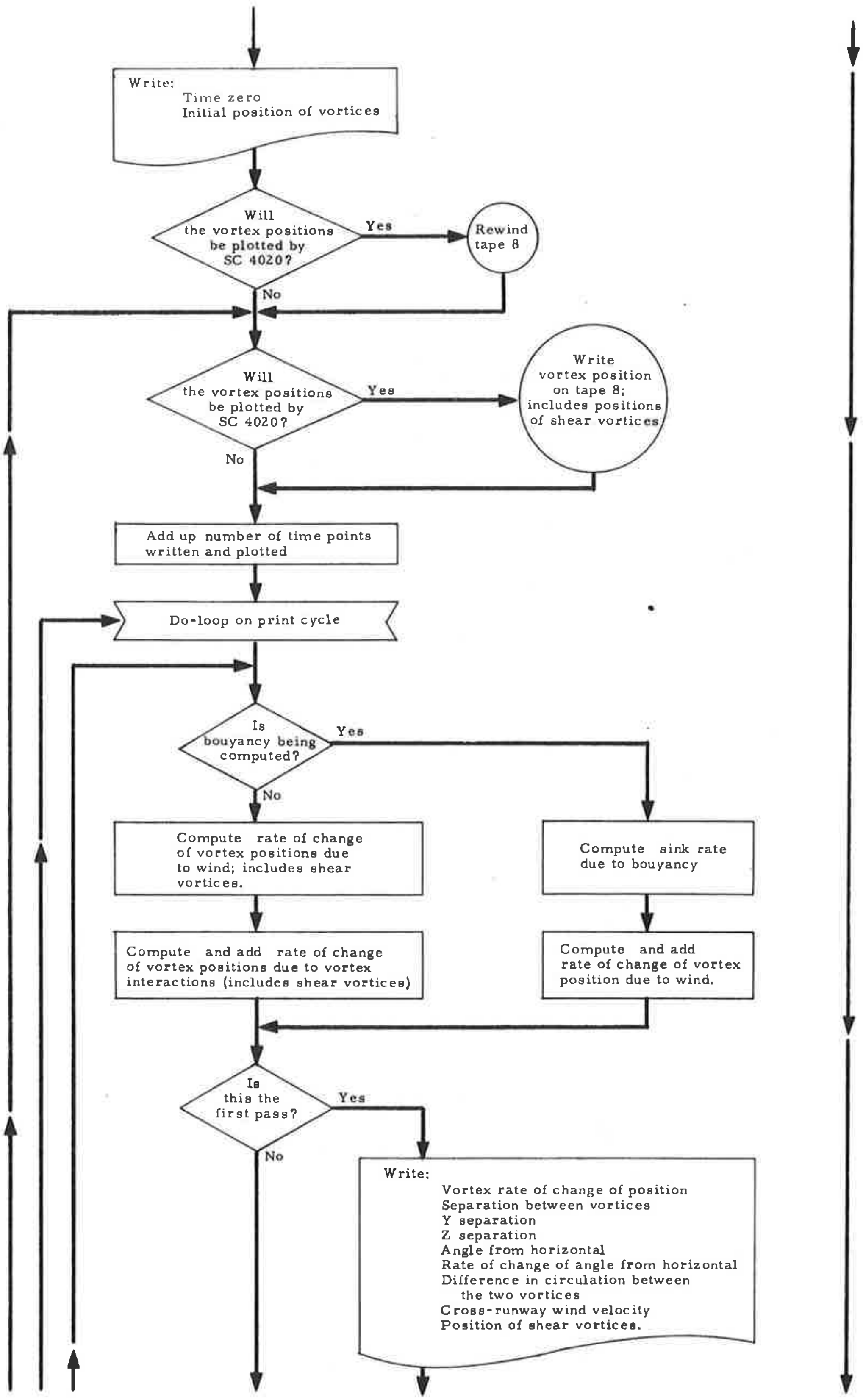


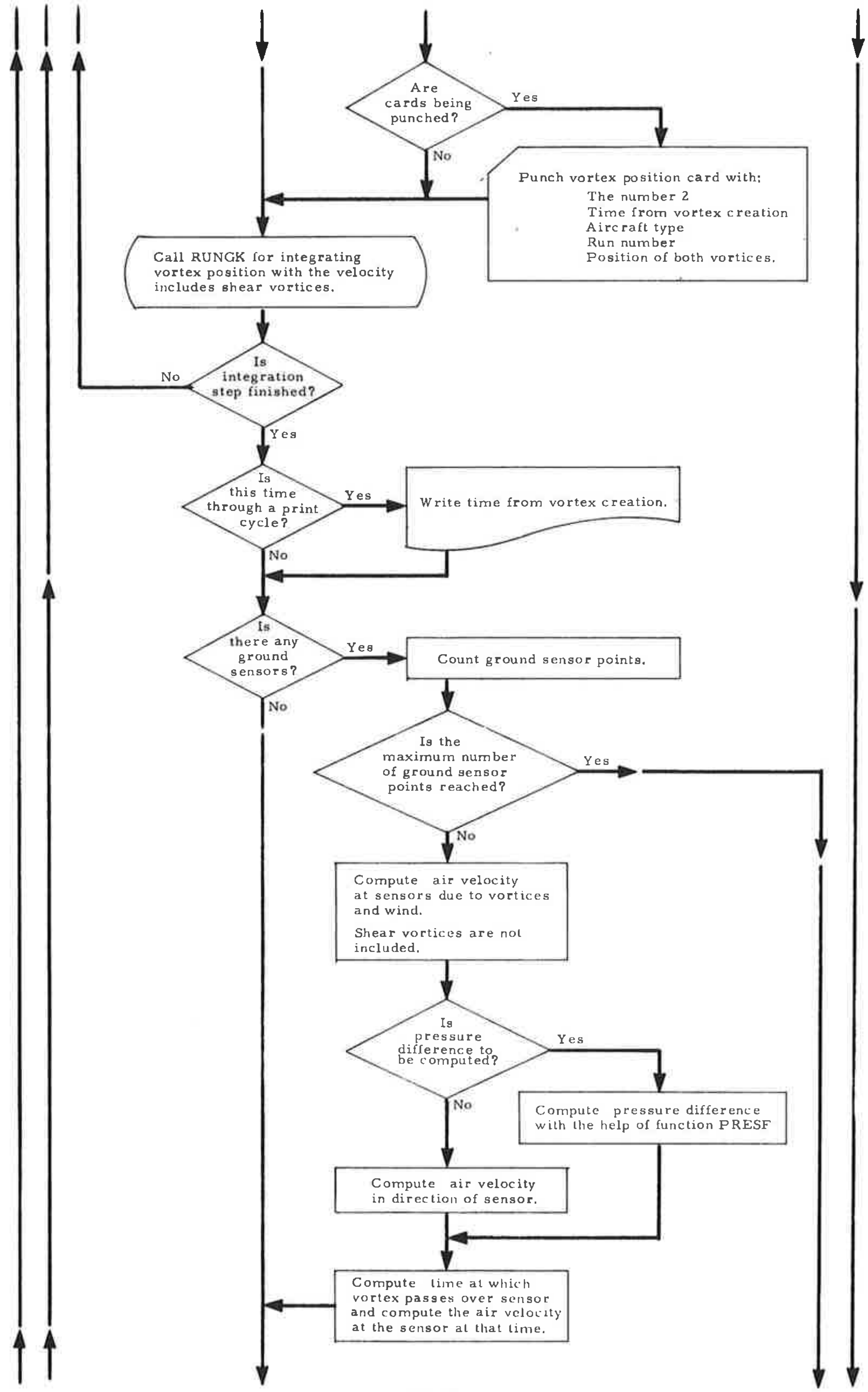
From first "Photographic Card," set:
Start time of simulation to time on photographic card,
Vortex height to that on photographic card,
Vortex separation is computed as a function of aircraft height, wingspan, and vortex height.
Aircraft displacement from tower as if aircraft was at vortex height.
Set up coordinates for aircraft picture on plot
Write information from "Run Data Card"
Write final input values for:
Aircraft speed
Aircraft weight
Aircraft wingspan
*JWIND=1 Wind is provided by tape 10 as a function of time
JWIND=2 Wind is provided by table with linear interpolation
JWIND=3 Wind is provided by least square curves of table values.
Write the above on SC 4020 plot
JWIND*
1
Rewind tape to
2 or 3
Compute down runway and cross-runway components of wind for each point in the wind table
Skip over Identification records on tape 10
Read first data recorder on tape 10
JWIND
2
3
Number of winds in table
0
>1
=1
Compute windspeed at reference altitude.
Compute logarithmic least squares windspeed curve fit
Is the order of the polynomial for wind direction equal to zero?
Yes
No
Is the order of the polynomial for wind direction less than the number of winds in table
No
Yes

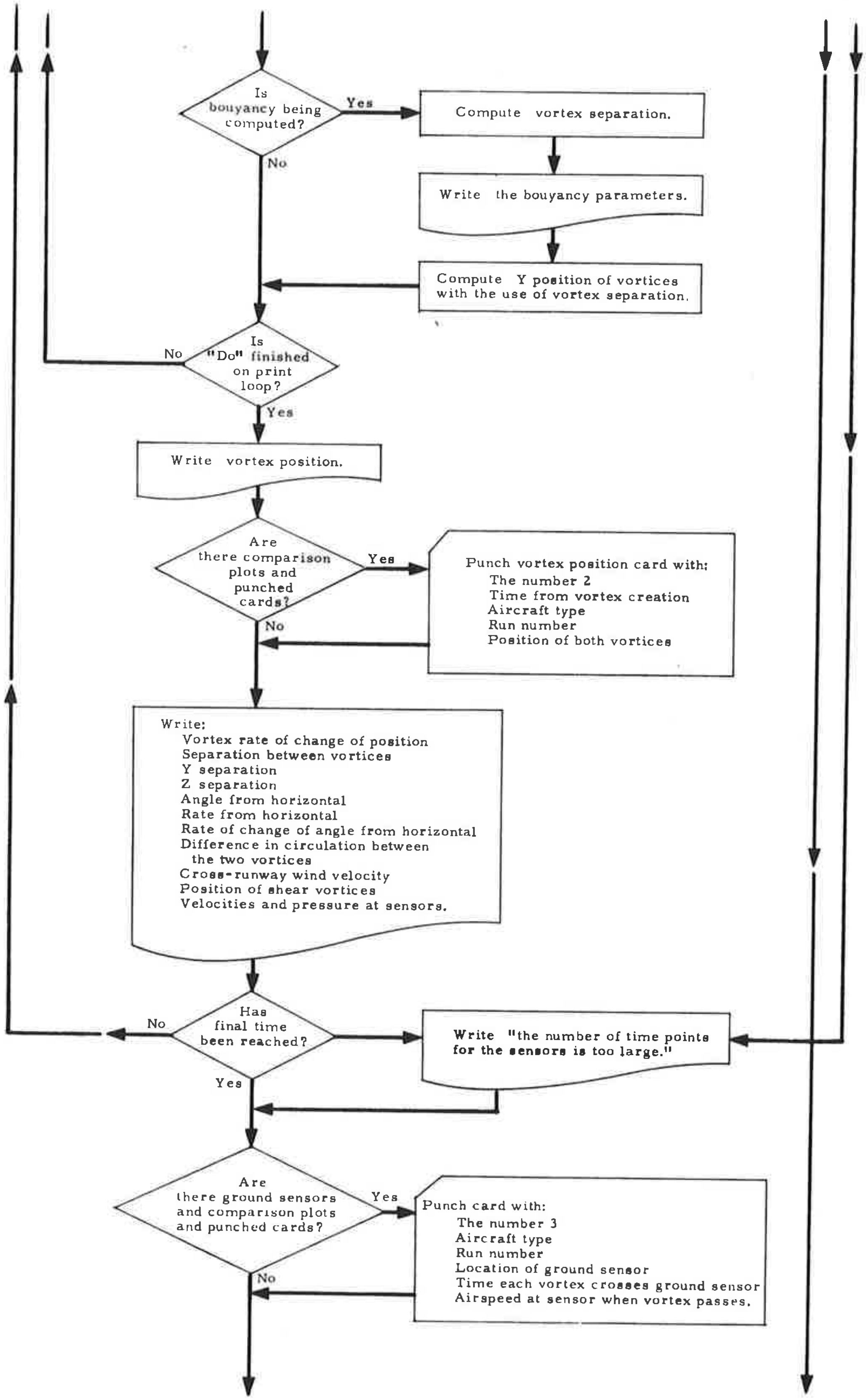


Adjust wind direction interval so as to avoid discontinuity
Extrapolate wind direction to aircraft height using highest two points in wind table
Compute polynomial least square wind direction curve fit from table values and extrapolate value at aircraft height
Set first coefficient equal to wind direction
Write Windspeed at reference altitude (for logarithmic fit) Power (for logarithmic fit). Coefficients of polynomial for wind direction
Write the above on SC 4020 plot (if there is plotting).
Is temperature to be fitted with a least square polynomial?
Yes
No
Compute least square polynomial for temperature.
Write coefficients of polynomial for temperature.
Compute density and pressure table using temperature profile and ground pressure.
Are potential temperature and Richardson number to be computed?
Yes
No
Call Subroutine POTENT To compute and print out potential temperature and Richardson number.
Is a simulation to be run?
No
Yes
Compute the average rate of change of density from the vortex height to the buoyancy cutoff point

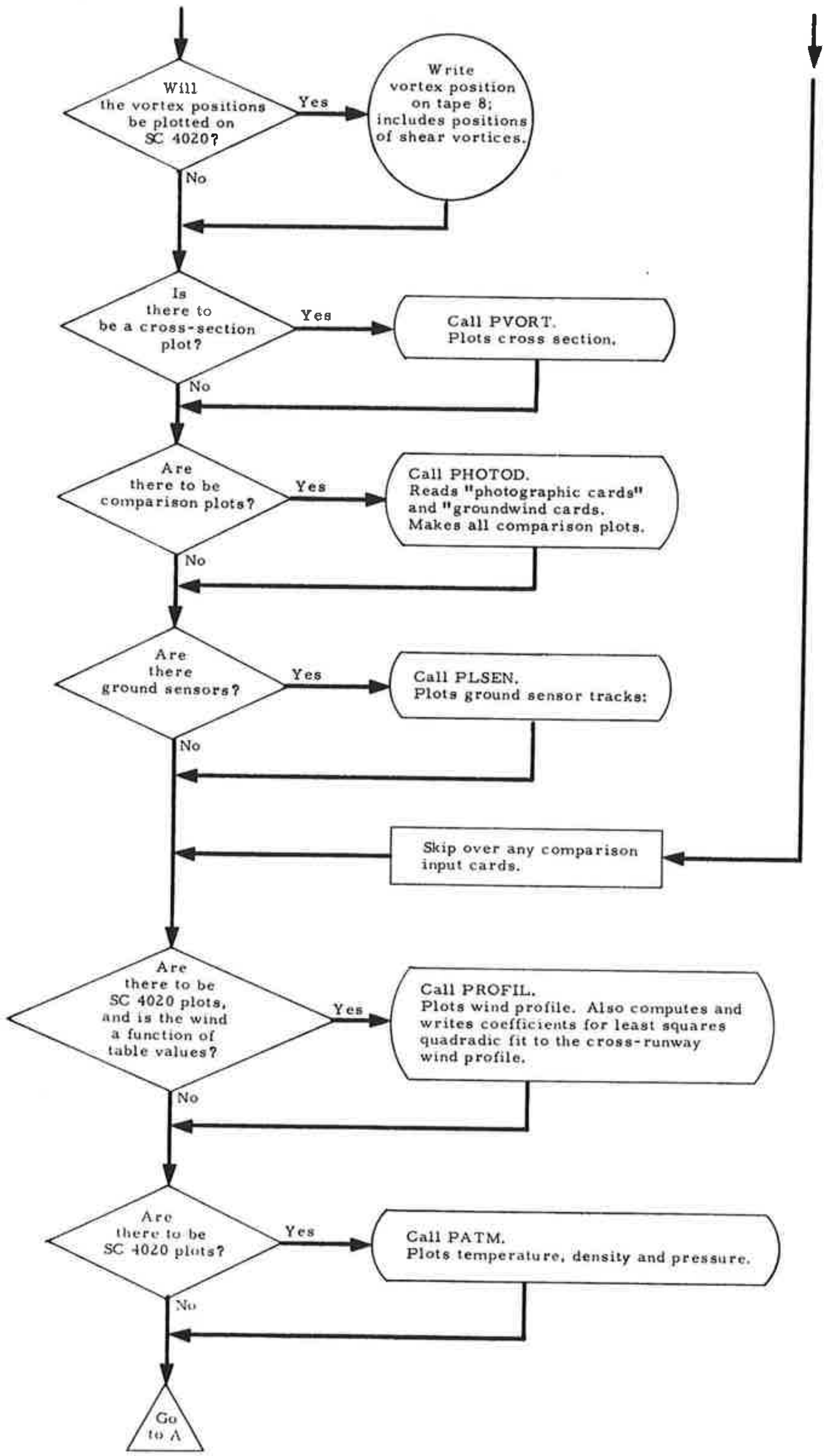

Is photographic card used to determine vortex starting position?
No
Compute vortex separation.
Yes
Will there be wind shear simulation?
Yes
Compute circulation of wind shear vortices as a function of cross-runaway windspeed at aircraft height.
No
Compute location of wind shear vortices.
Is aircraft speed "airspeed"
No
Compute airspeed from ground speed.
Yes
Compute circulation of vortices.
Compute eddy viscosity and acoustic velocity.
Will there be any bouyancy computed?
Yes
Set up initial parameters for bouyancy computation.
No
Write:
Circulation of vortices
Eddy viscosity
Temperature
Density
Acoustic velocity
Stability parameter
Initial parameter
Write the above on SC 4020 plot (if there is plotting).
Are cards to be punched?
Yes
Punch identification card with:
The number 7
Aircraft type
Run number
Circulation
Eddy, viscosity
Temperature
Density
Date
No

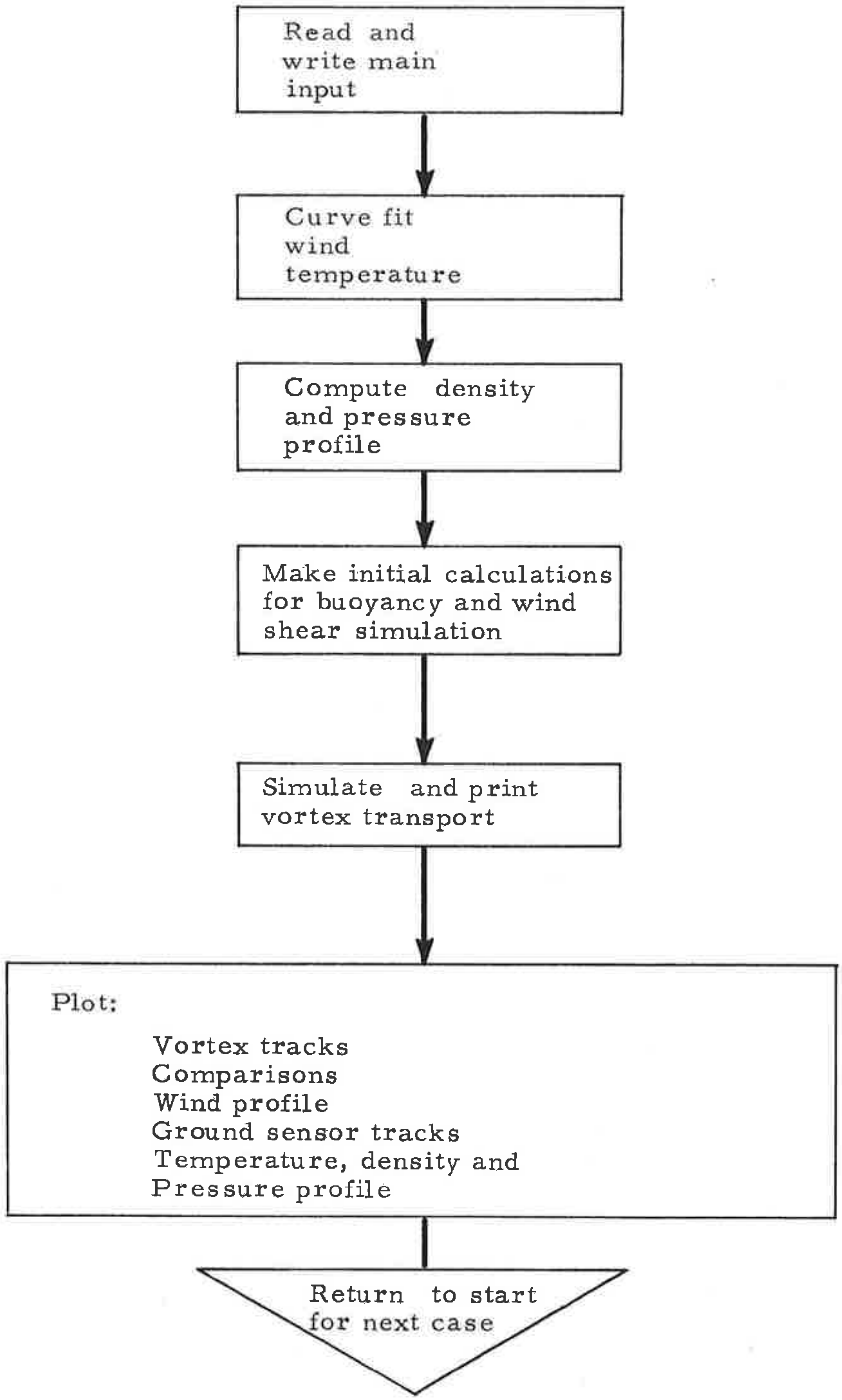

Write:
Time zero
Initial position of vortices
Will the vortex positions be plotted by SC 4020?
Yes
Rewind tape 8
No
Will the vortex positions be plotted by SC 4020?
Yes
Write vortex position on tape 8; includes positions of shear vortices
No
Add up number of time points written and plotted
Do-loop on print cycle
Is bouyancy being computed?
Yes
No
Compute rate of change of vortex positions due to wind; includes shear vortices.
Compute sink rate due to bouyancy
Compute and add rate of change of vortex positions due to vortex interactions (includes shear vortices)
Compute and add rate of change of vortex position due to wind.
Is this the first pass?
Yes
No
Write:
Vortex rate of change of position
Separation between vortices
Y separation
Z separation
Angle from horizontal
Rate of change of angle from horizontal
Difference in circulation between the two vortices
Cross-runway wind velocity
Position of shear vortices.


Are cards being punched?
Yes
No
Punch vortex position card with:
The number 2
Time from vortex creation
Aircraft type
Run number
Position of both vortices.
Call RUNGK for integrating vortex position with the velocity includes shear vortices.
Is integration step finished?
No
Yes
Is this time through a print cycle?
Yes
Write time from vortex creation.
No
Is there any ground sensors?
Yes
Count ground sensor points.
No
Is the maximum number of ground sensor points reached?
Yes
No
Compute air velocity at sensors due to vortices and wind.
Shear vortices are not included.
Is pressure difference to be computed?
Yes
Compute pressure difference with the help of function PRESF
No
Compute air velocity in direction of sensor.
Compute time at which vortex passes over sensor and compute the air velocity at the sensor at that time.



Is bouyancy being computed?
Yes
No
Compute vortex separation.
Write the bouyancy parameters.
Compute Y position of vortices with the use of vortex separation.
Is "Do" finished on print loop?
No
Yes
Write vortex position.
Are there comparison plots and punched cards?
Yes
No
Punch vortex position card with:
The number 2
Time from vortex creation
Aircraft type
Run number
Position of both vortices
Write:
Vortex rate of change of position
Separation between vortices
Y separation
Z separation
Angle from horizontal
Rate from horizontal
Rate of change of angle from horizontal
Difference in circulation between the two vortices
Cross-runway wind velocity
Position of shear vortices
Velocities and pressure at sensors.
Has final time been reached?
No
Yes
Write "the number of time points for the sensors is too large."
Are there ground sensors and comparison plots and punched cards?
Yes
No
Punch card with:
The number 3
Aircraft type
Run number
Location of ground sensor
Time each vortex crosses ground sensor
Airspeed at sensor when vortex passes.


Will the vortex positions be plotted on SC 4020?
Yes
No
Write vortex position on tape 8; includes positions of shear vortices.
Is there to be a cross-section plot?
Yes
No
Call PVORT. Plots cross section.
Are there to be comparison plots?
Yes
No
Call PHOTOD. Reads "photographic cards" and "groundwind cards. Makes all comparison plots.
Are there ground sensors?
Yes
No
Call PLSEN. Plots ground sensor tracks:
Skip over any comparison input cards.
Are there to be SC 4020 plots, and is the wind a function of table values?
Yes
No
Call PROFIL. Plots wind profile. Also computes and writes coefficients for least squares quadradic fit to the cross-runway wind profile.
Are there to be SC 4020 plots?
Yes
No
Call PATM. Plots temperature, density and pressure.
Go to A


Read and write main input
Curve fit wind temperature
Compute density and pressure profile
Make initial calculations for buoyancy and wind shear simulation
Simulate and print vortex transport
Plot:
Vortex tracks
Comparisons
Wind profile
Ground sensor tracks
Temperature, density and
Pressure profile
Return to start for next case

Appendix G

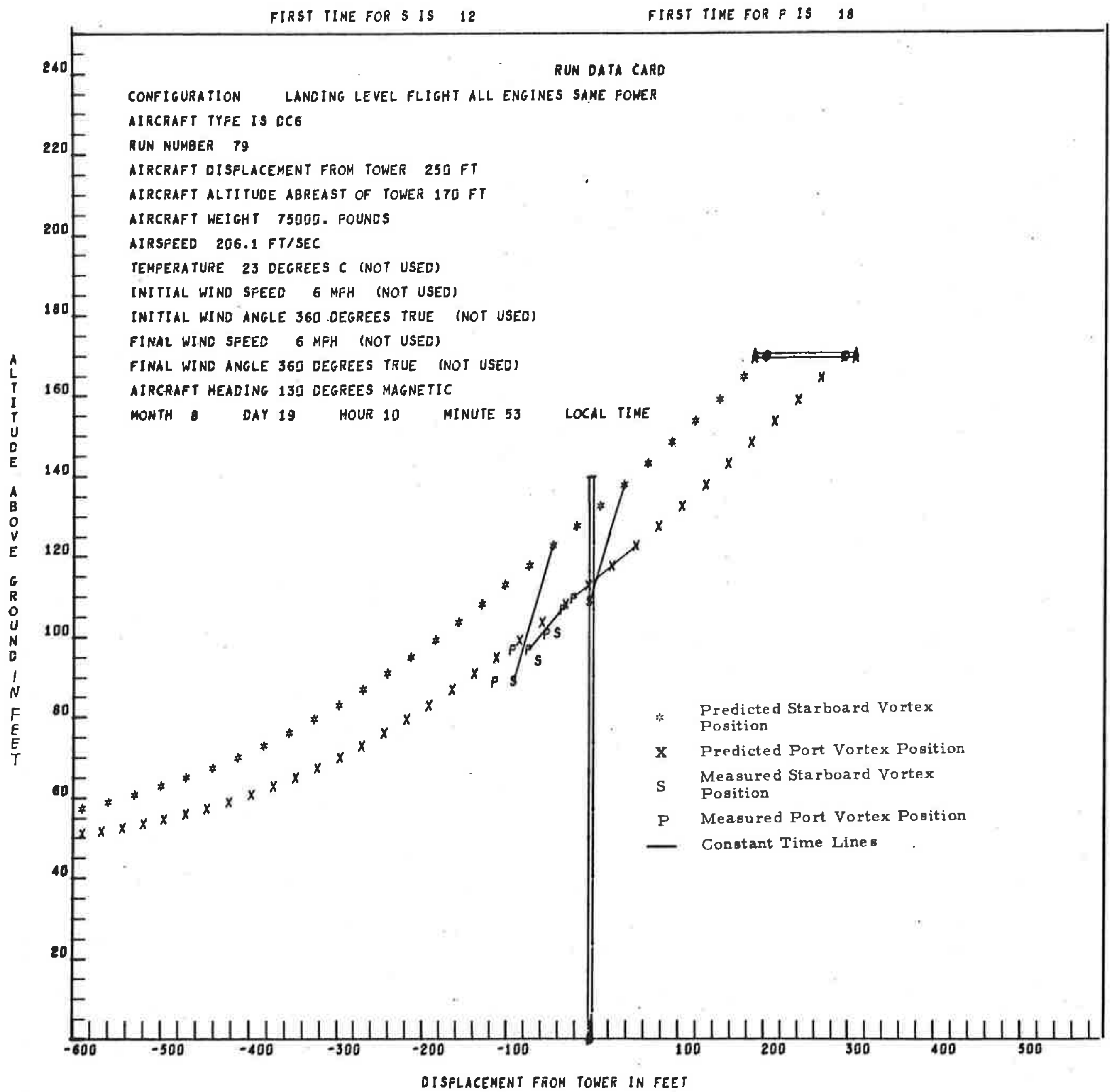
SUMMARY OF PREDICTED WAKE VORTEX TRACKS AND COMPARISON WITH EXPERIMENT

LIST OF RUNS PROVIDED IN THIS APPENDIX

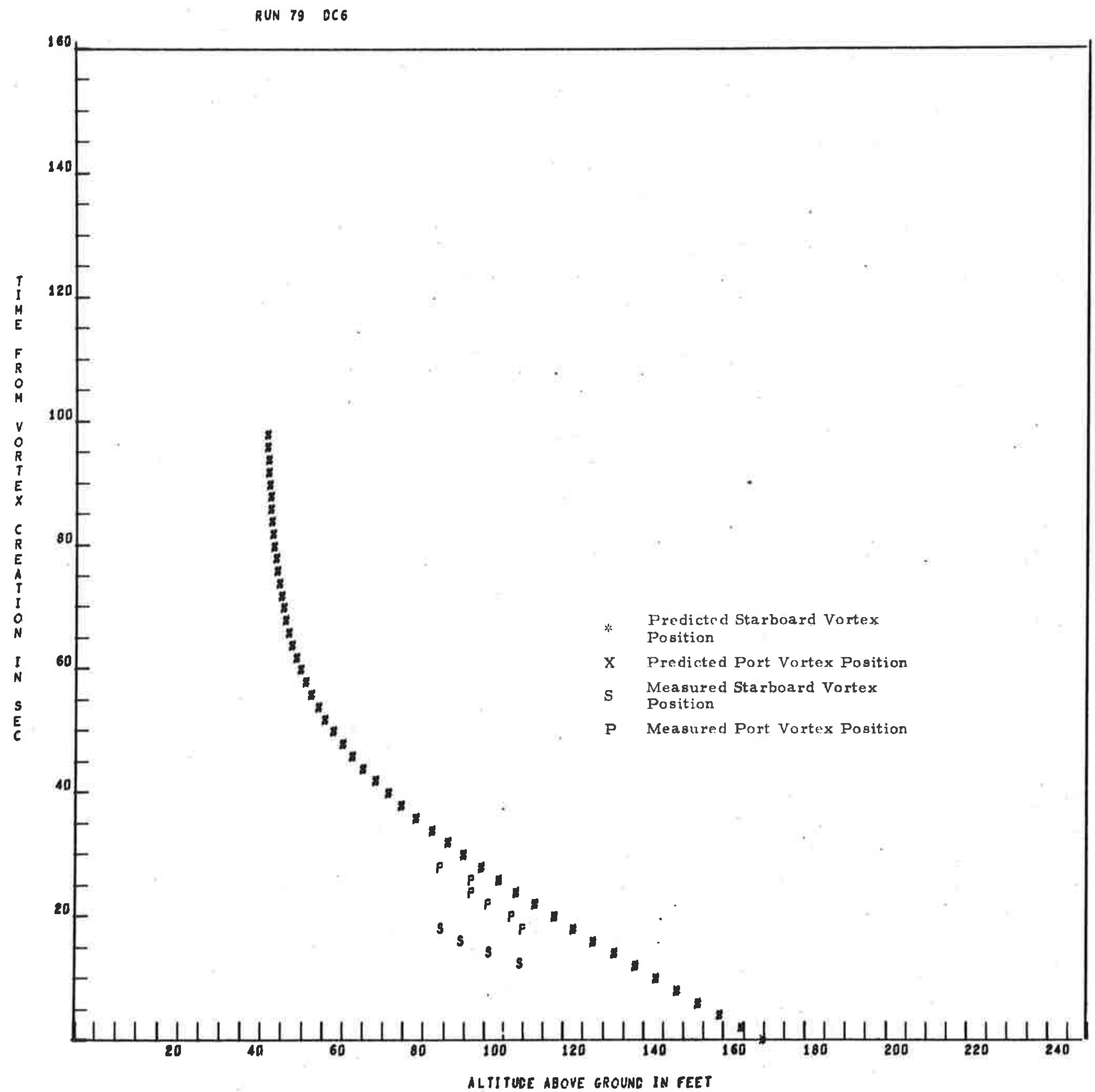
Aircraft Type	Run Number	Date (1972)	Page
DC6	79	19 August	
	81		
	83		
	84		
	85		
B747	1	16 September	
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	15		
	16		
	17		
	27	17 September	
	30		
	31		
	33		
	55	17 October	
	56		
	57		
	58		
	59		
	60		
	63		
B707	6	18 October	
	7		
	8		
	9		
	10		
	13		
	15		
	18		
	20		
	21		

LIST OF RUNS (Concluded)

Aircraft Type	Run Number	Date (1972)	Page
B707	26	18 October	
↓	29	↓	
	31		
	32		
	34	1 November	
	35	↓	
	37		
	40		
	41		
	42		
	43		
	46		

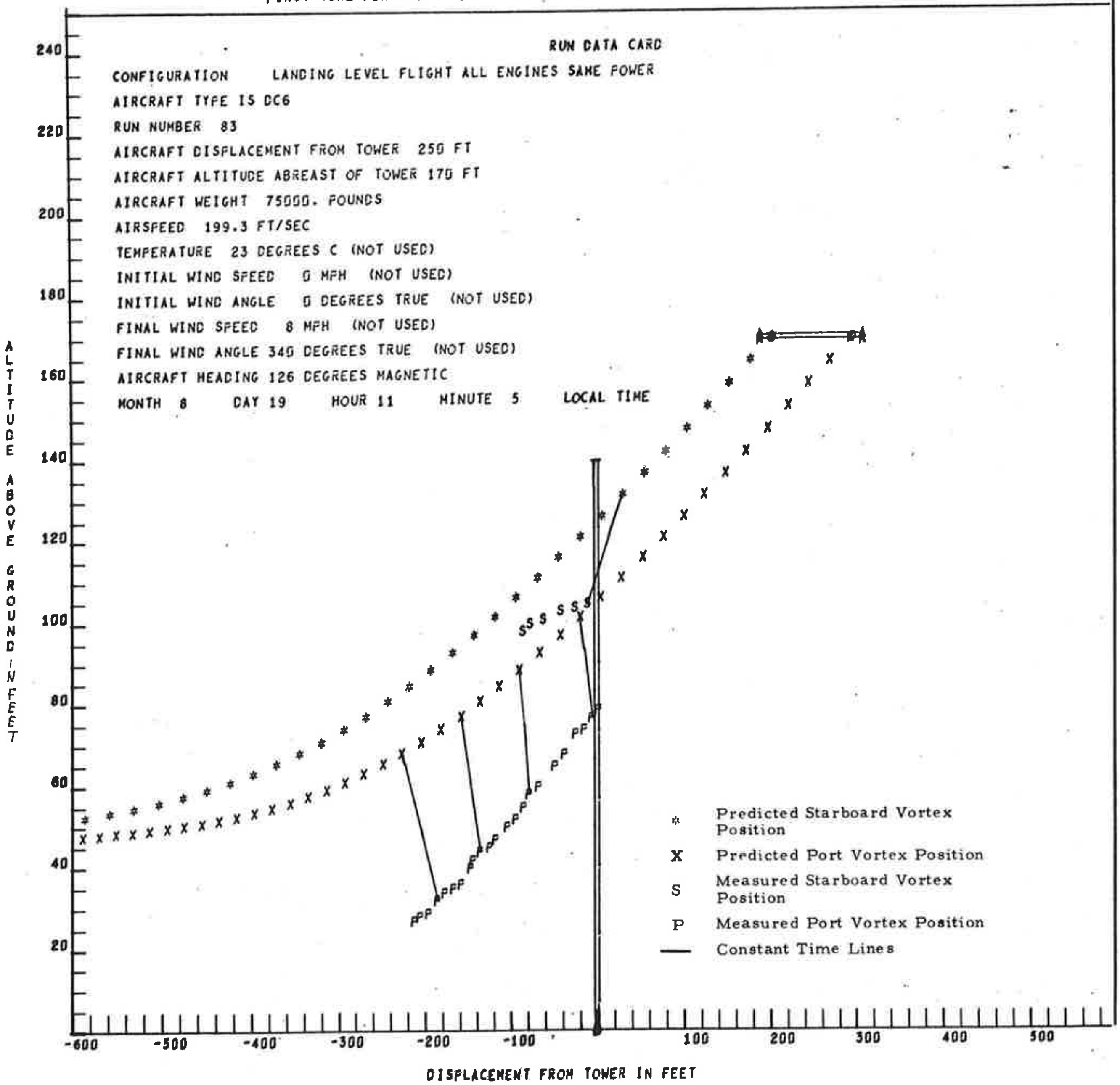


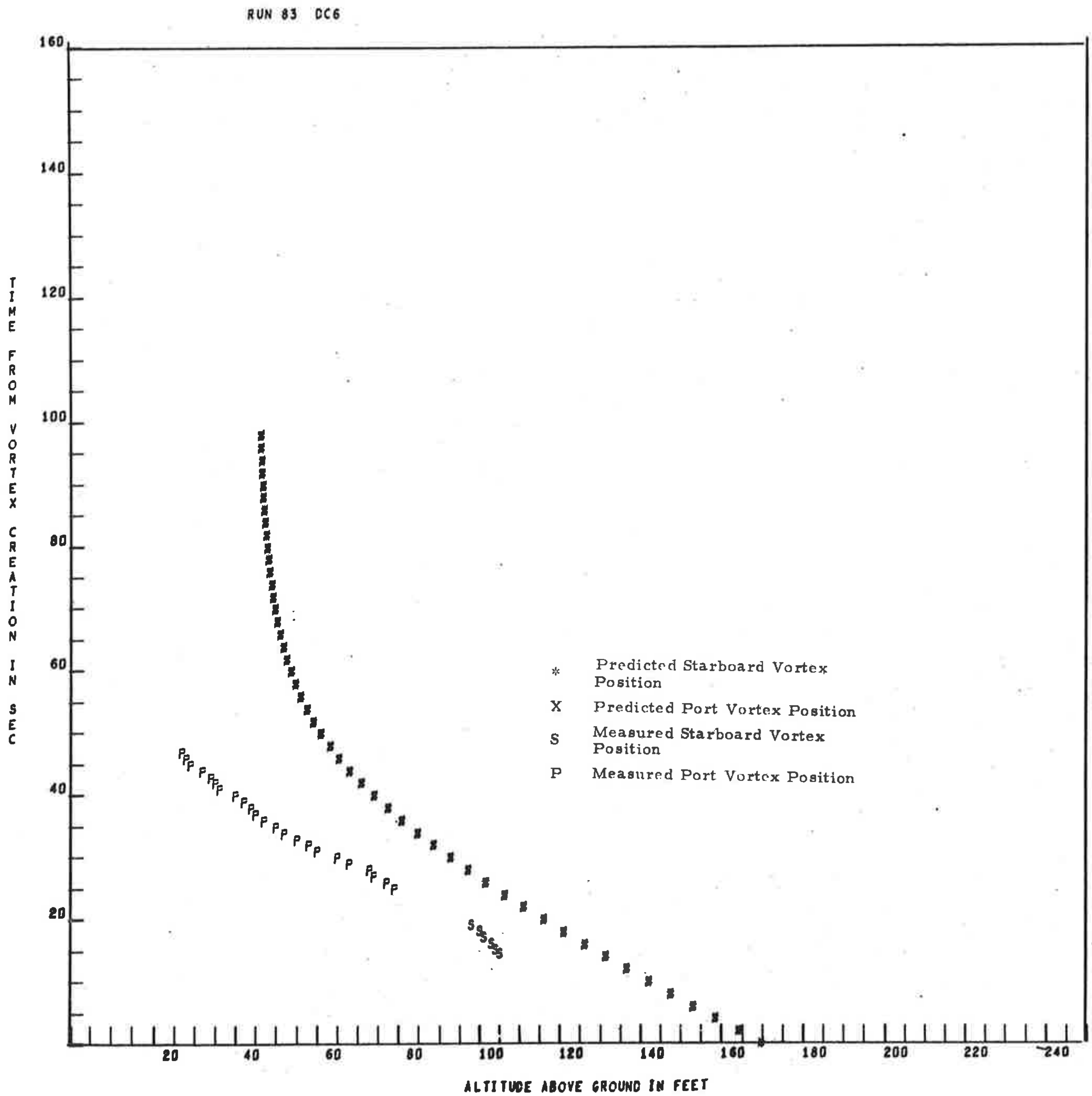
FIRST TIME FOR S IS 12
FIRST TIME FOR P IS 18
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS DC6
RUN NUMBER 79
AIRCRAFT DISPLACEMENT FROM TOWER 250 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 170 FT
AIRCRAFT WEIGHT 75000. POUNDS
AIRSPEED 206.1 FT/SEC
TEMPERATURE 23 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 8 DAY 19 HOUR 10 MINUTE 53 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines



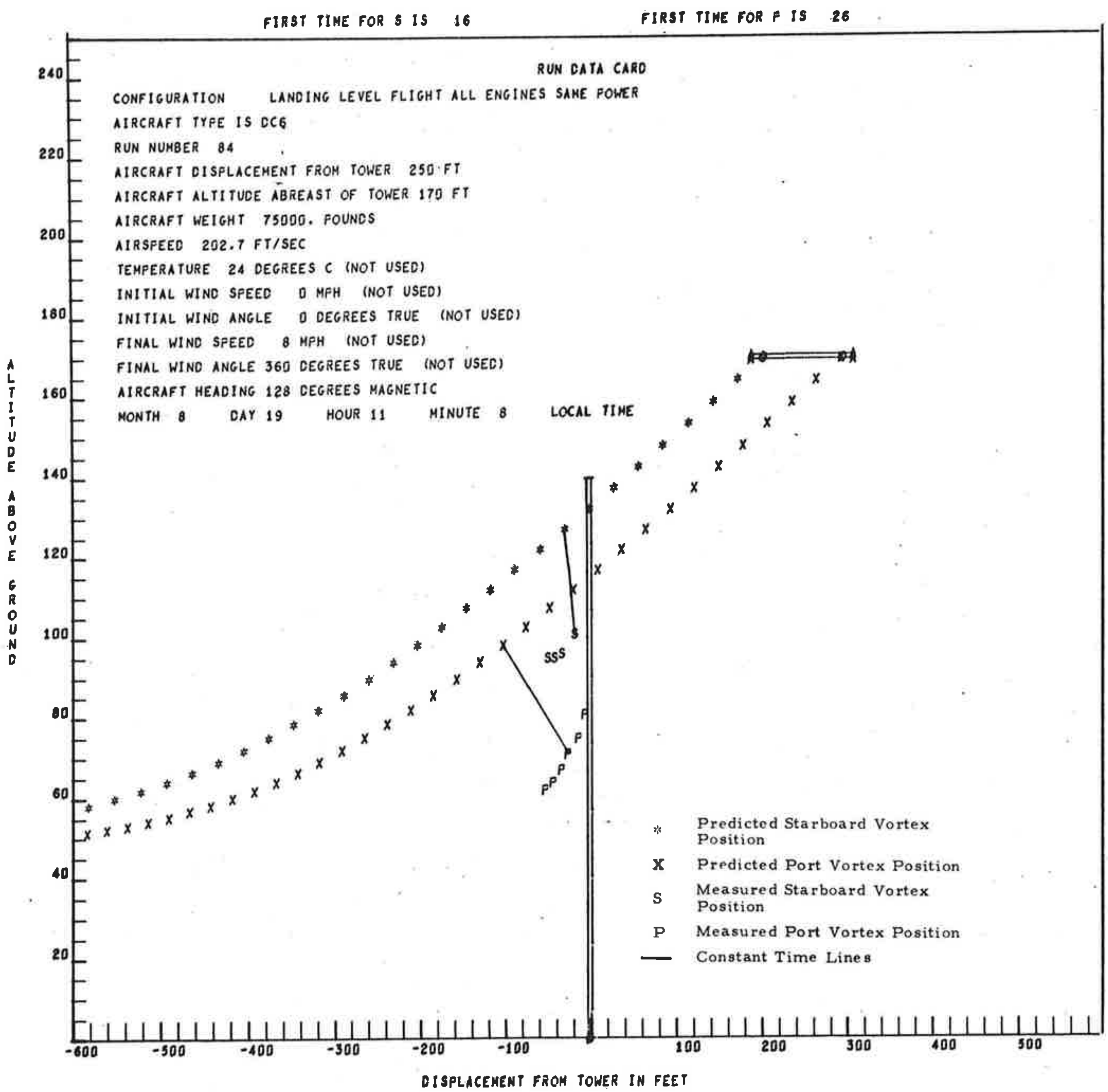
RUN 79 DC6
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

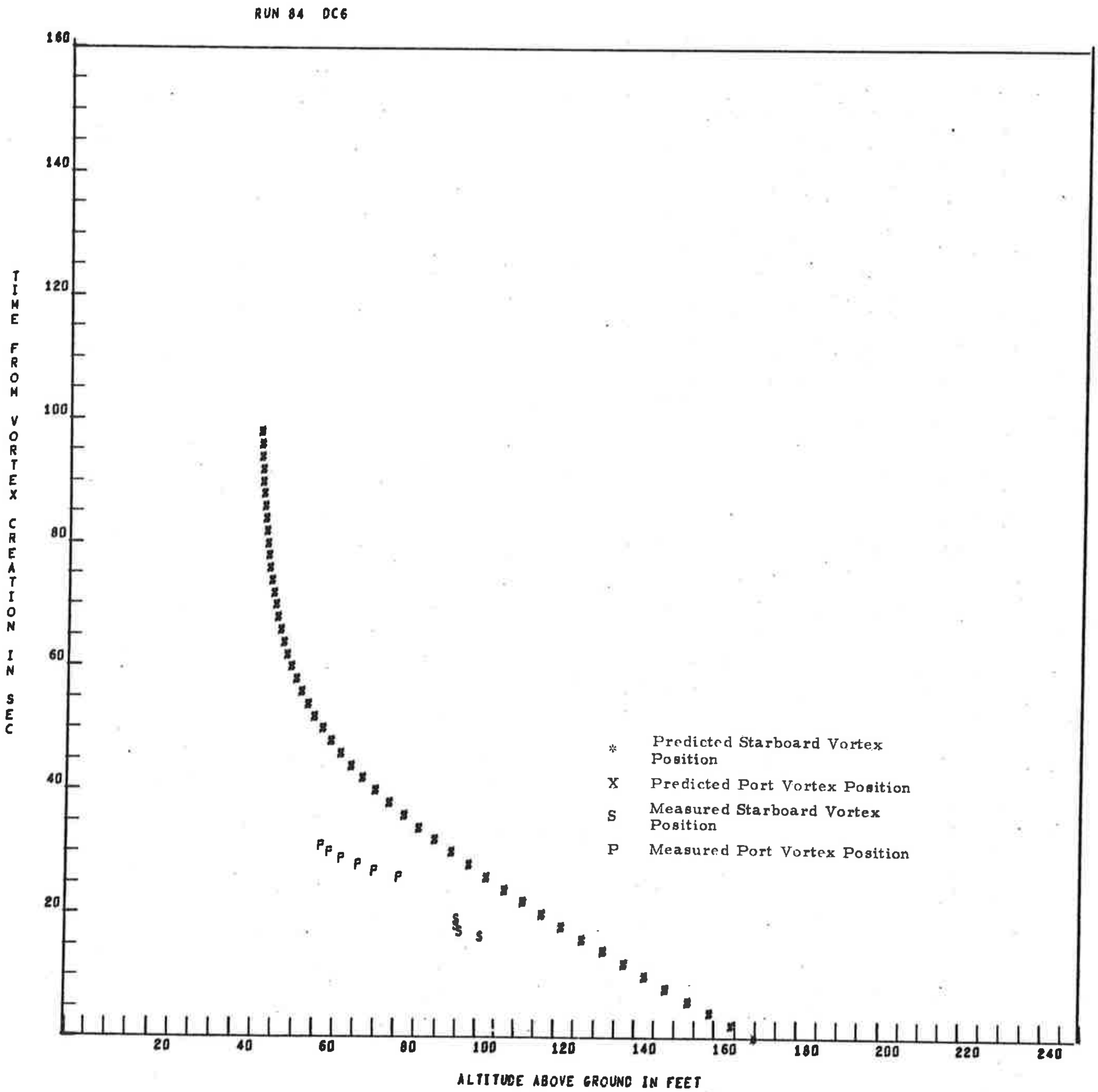
FIRST TIME FOR S IS 14 FIRST TIME FOR P IS 25

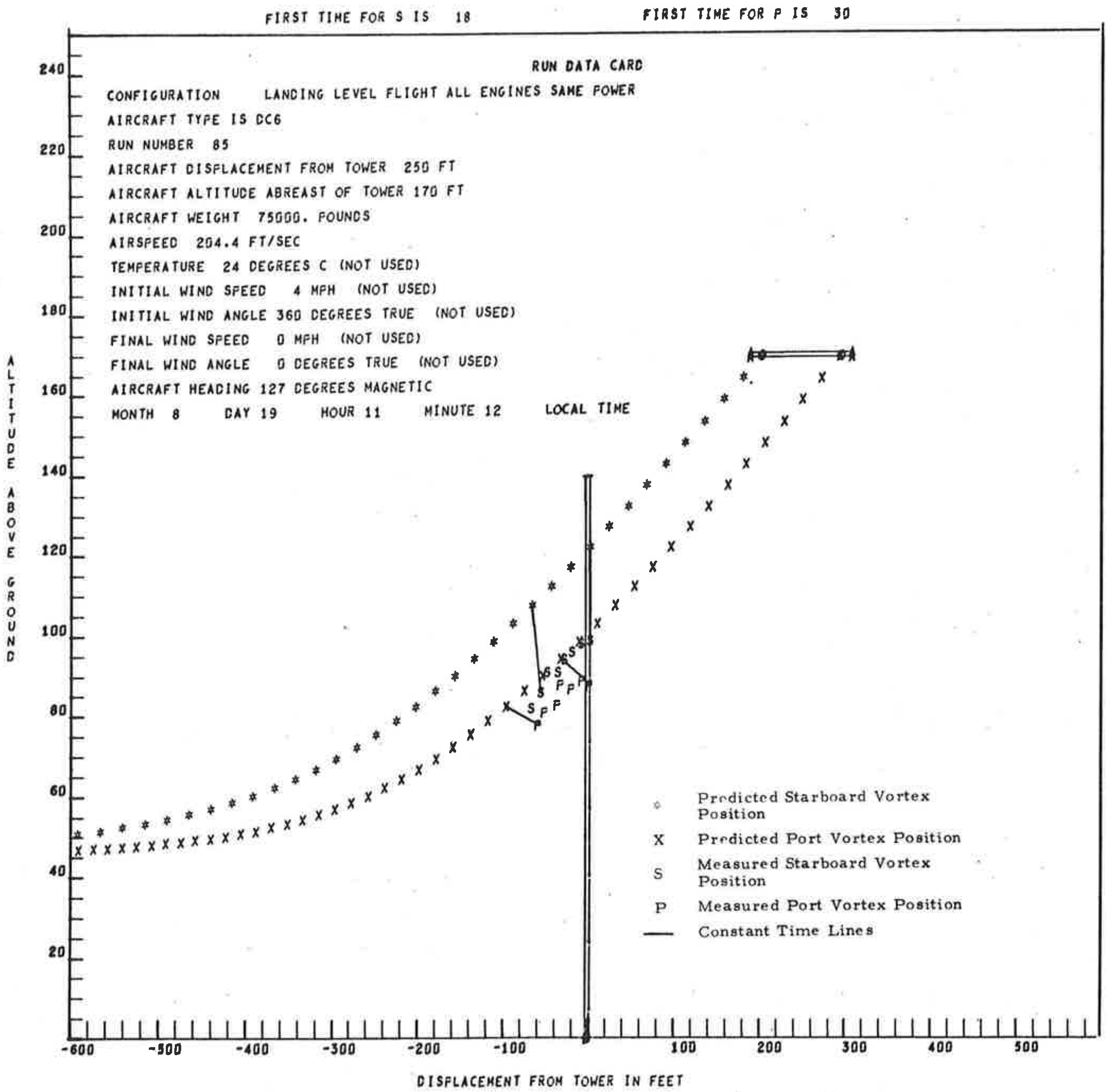


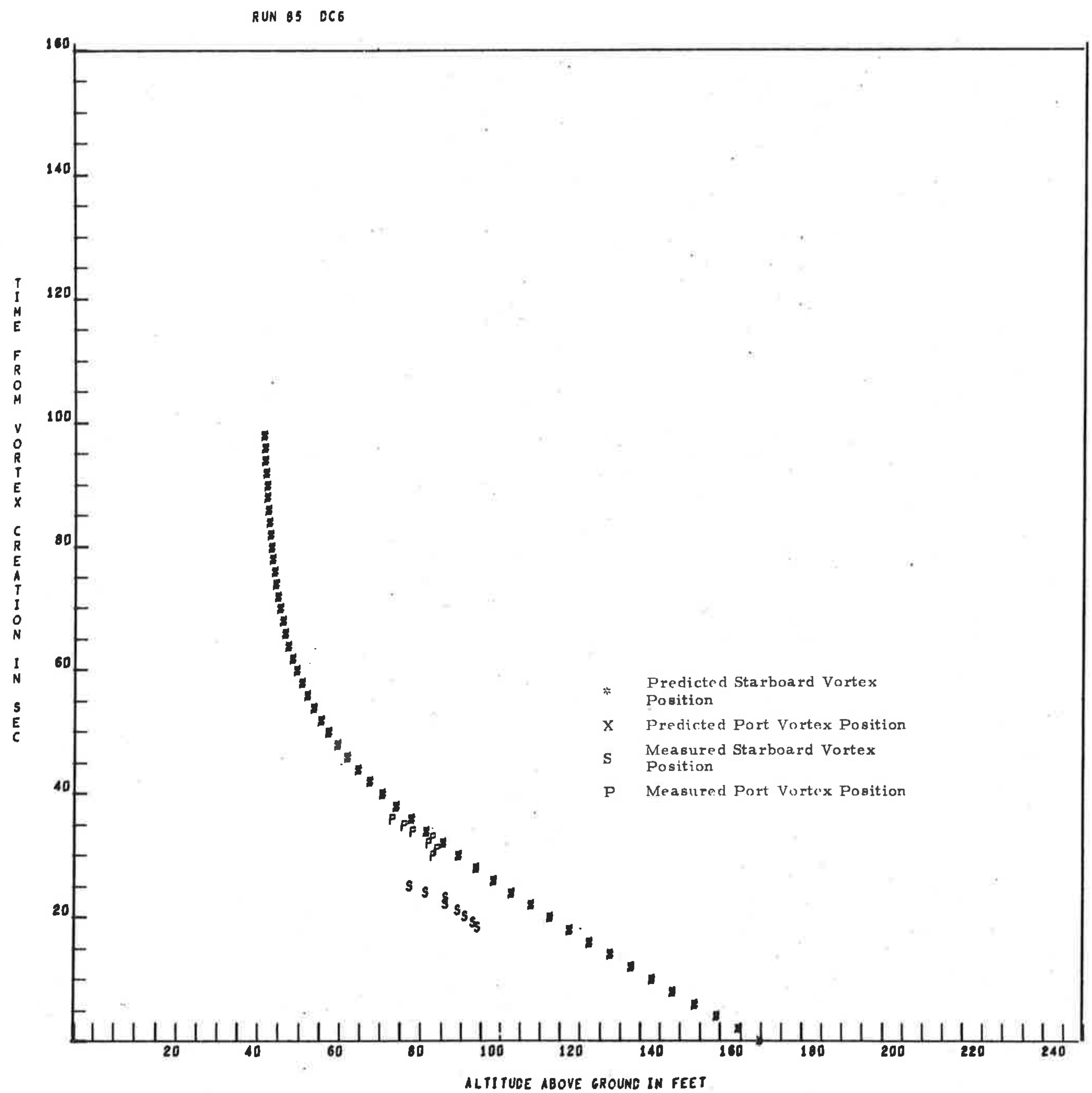


RUN 83 DC6
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

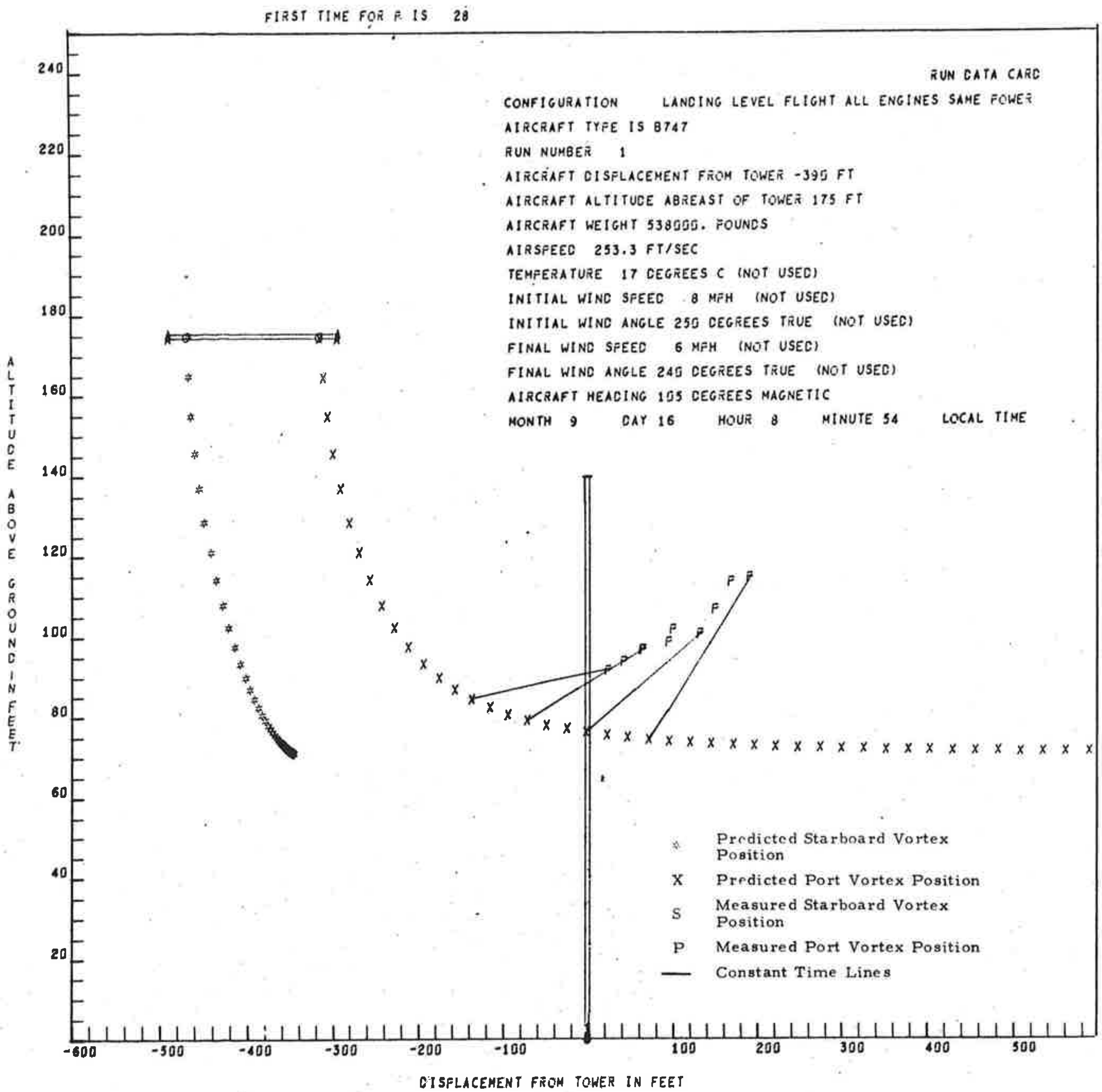

FIRST TIME FOR S IS 16
FIRST TIME FOR P IS 26
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS DC6
RUN NUMBER 84
AIRCRAFT DISPLACEMENT FROM TOWER 250 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 170 FT
AIRCRAFT WEIGHT 75000. POUNDS
AIRSPEED 202.7 FT/SEC
TEMPERATURE 24 DEGREES C (NOT USED)
INITIAL WIND SPEED 0 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 8 DAY 19 HOUR 11 MINUTE 8 LOCAL TIME
ALTITUDE ABOVE GROUND
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines


RUN 84 DC6
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


FIRST TIME FOR S IS 18
FIRST TIME FOR P IS 30
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS DC6
RUN NUMBER 85
AIRCRAFT DISPLACEMENT FROM TOWER 250 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 170 FT
AIRCRAFT WEIGHT 75000. POUNDS
AIRSPEED 204.4 FT/SEC
TEMPERATURE 24 DEGREES C (NOT USED)
INITIAL WIND SPEED 4 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 127 DEGREES MAGNETIC
MONTH 8 DAY 19 HOUR 11 MINUTE 12 LOCAL TIME
ALTITUDE ABOVE GROUND
240
220
200
180
160
140
120
100
80
60
40
20
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET

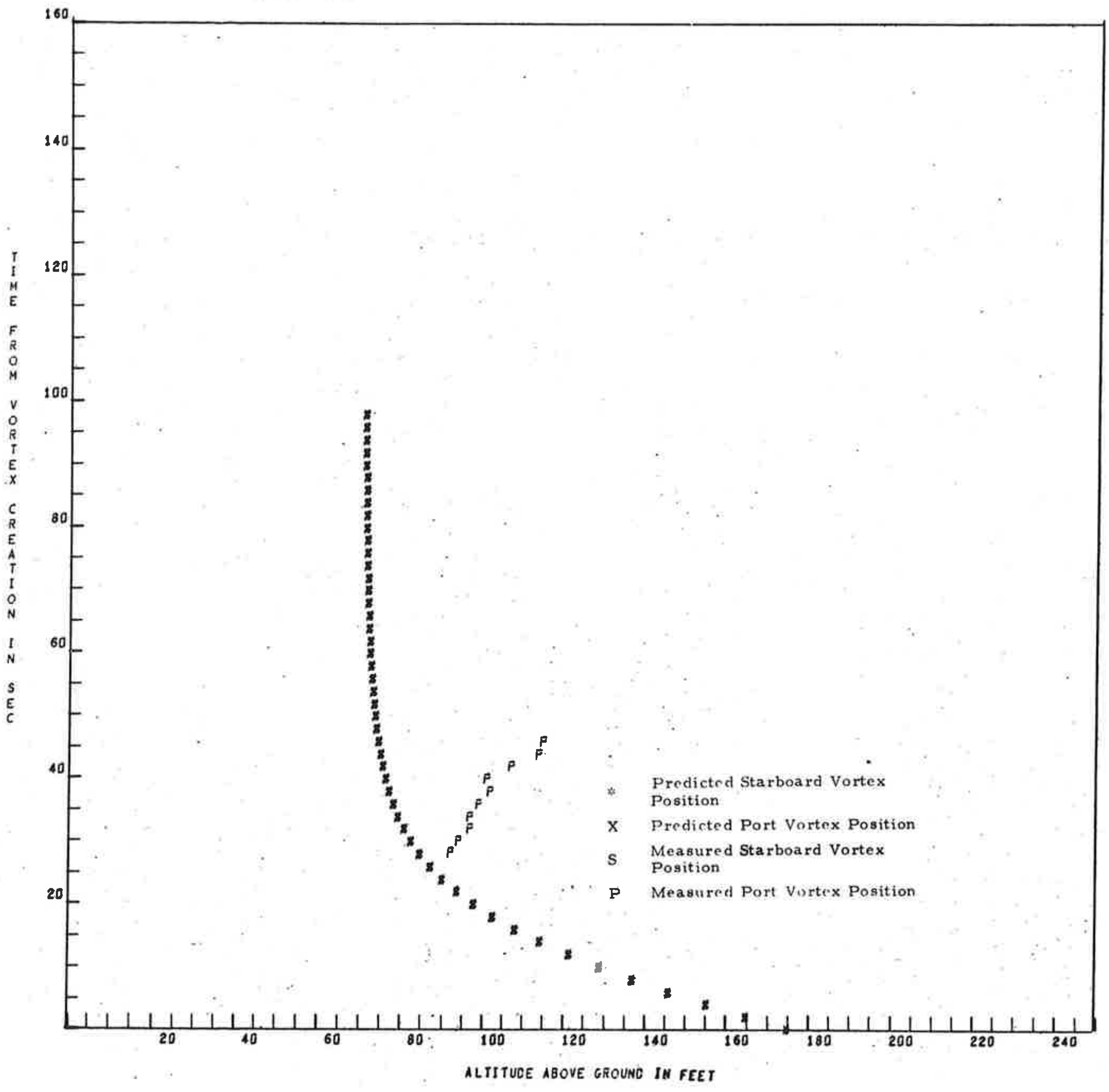


RUN 85 DC6
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

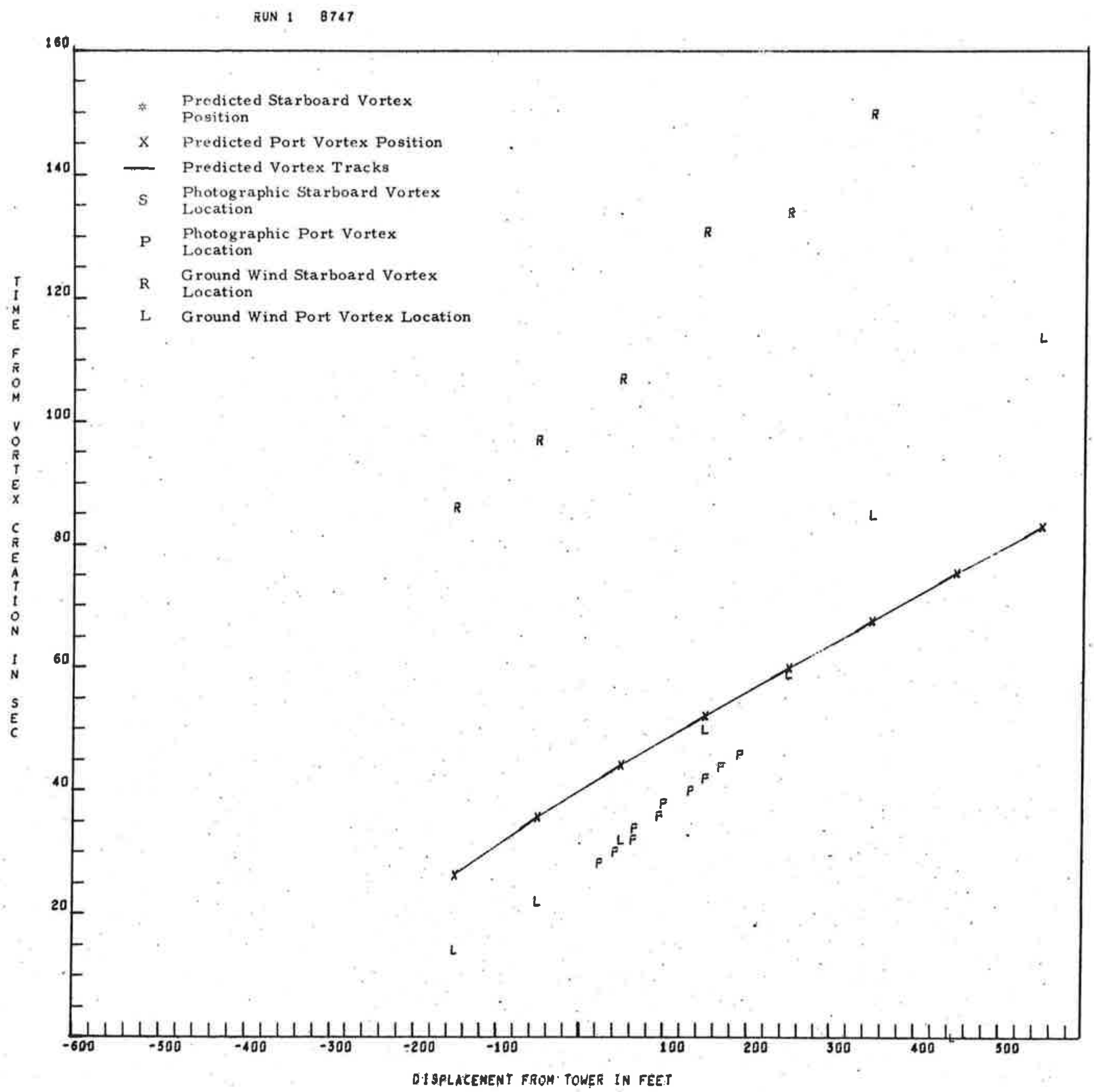


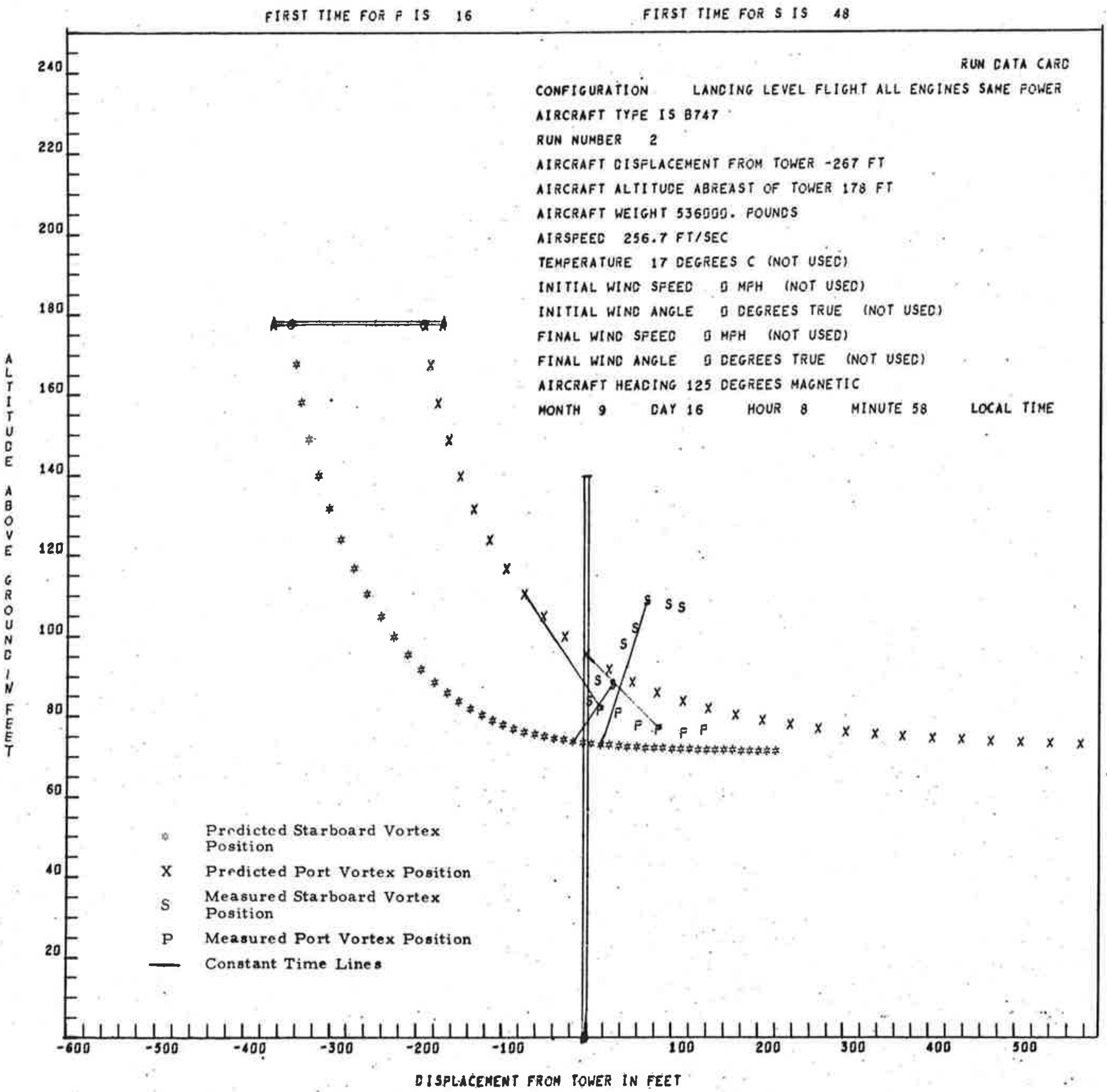
FIRST TIME FOR P IS 28
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 1
AIRCRAFT DISPLACEMENT FROM TOWER -395 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 175 FT
AIRCRAFT WEIGHT 538000. POUNDS
AIRSPEED 253.3 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 105 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 8 MINUTE 54 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

RUN 1 B747

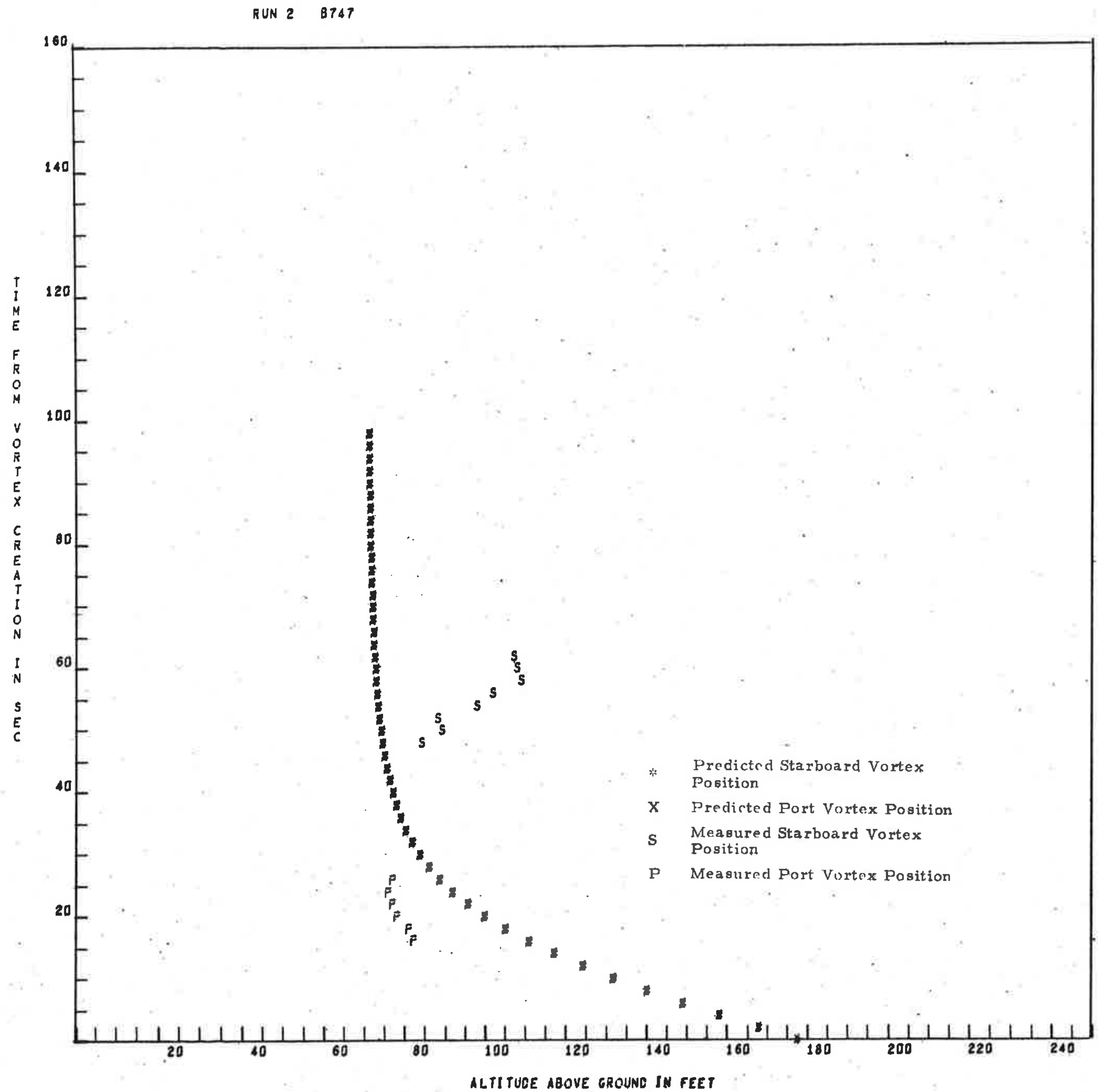


160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

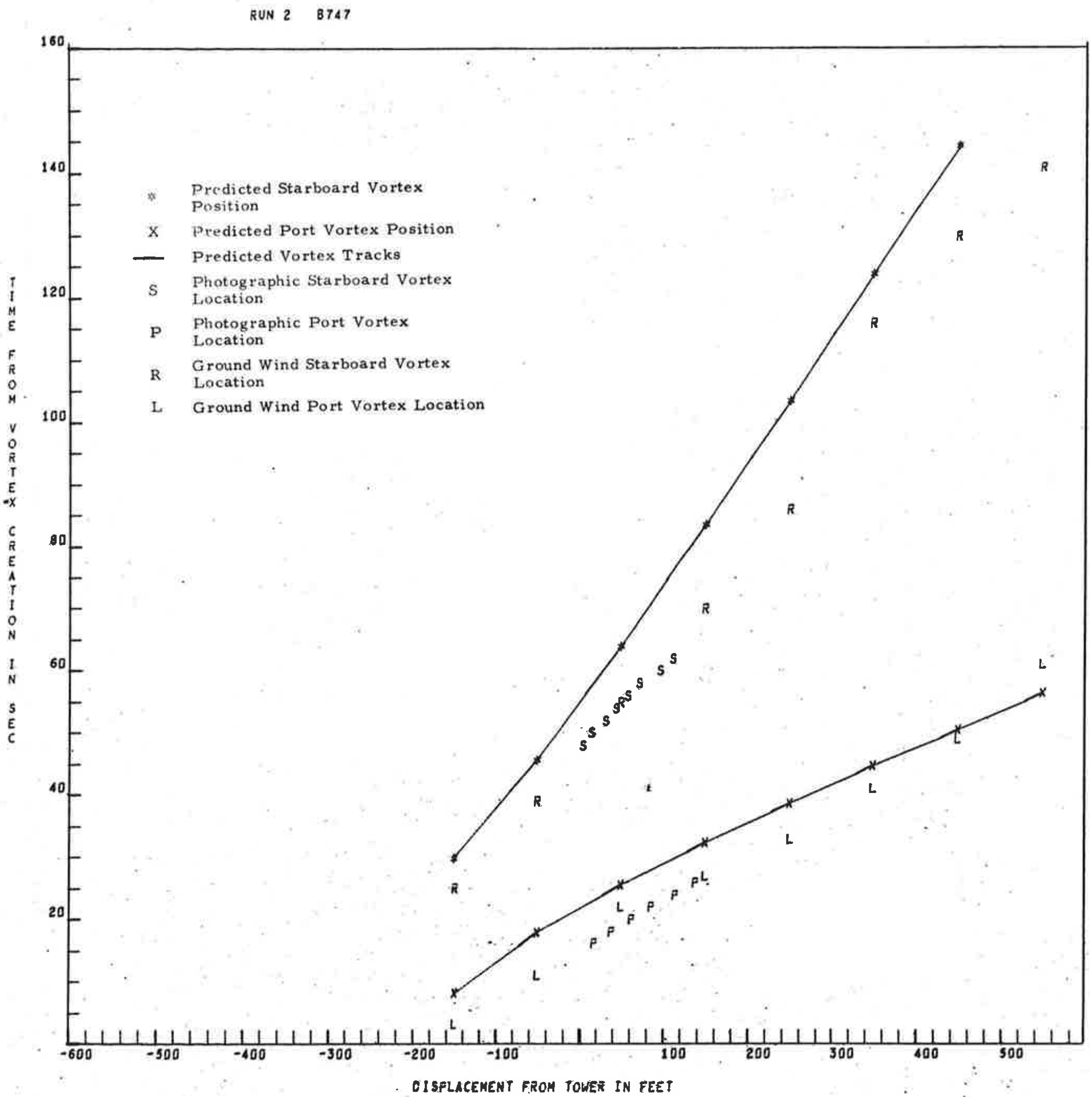

RUN 1 B747
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET



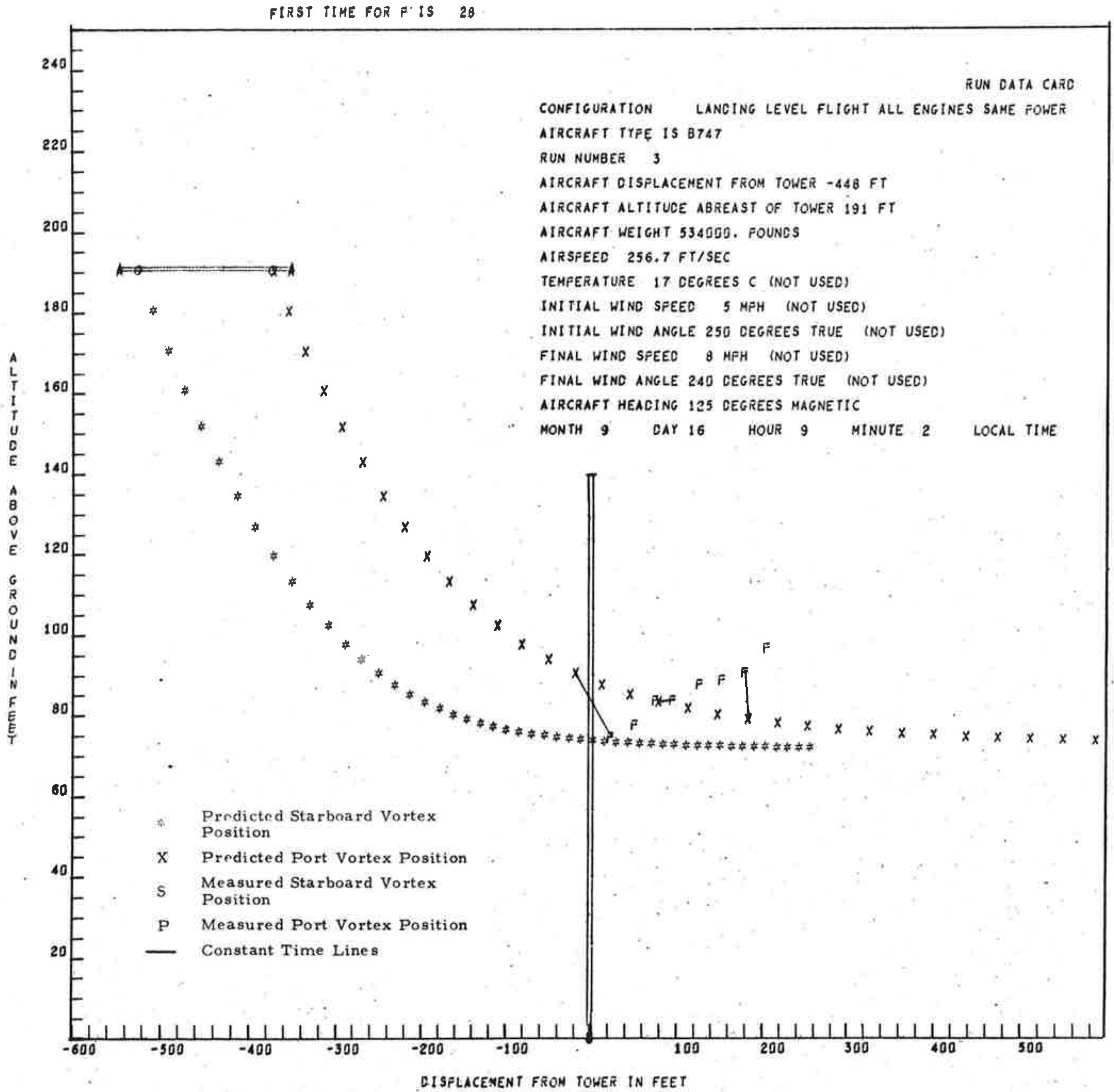
FIRST TIME FOR P IS 16
FIRST TIME FOR S IS 48
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 2
AIRCRAFT DISPLACEMENT FROM TOWER -267 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 178 FT
AIRCRAFT WEIGHT 536000. POUNDS
AIRSPEED 256.7 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 0 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 125 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 8 MINUTE 58 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines



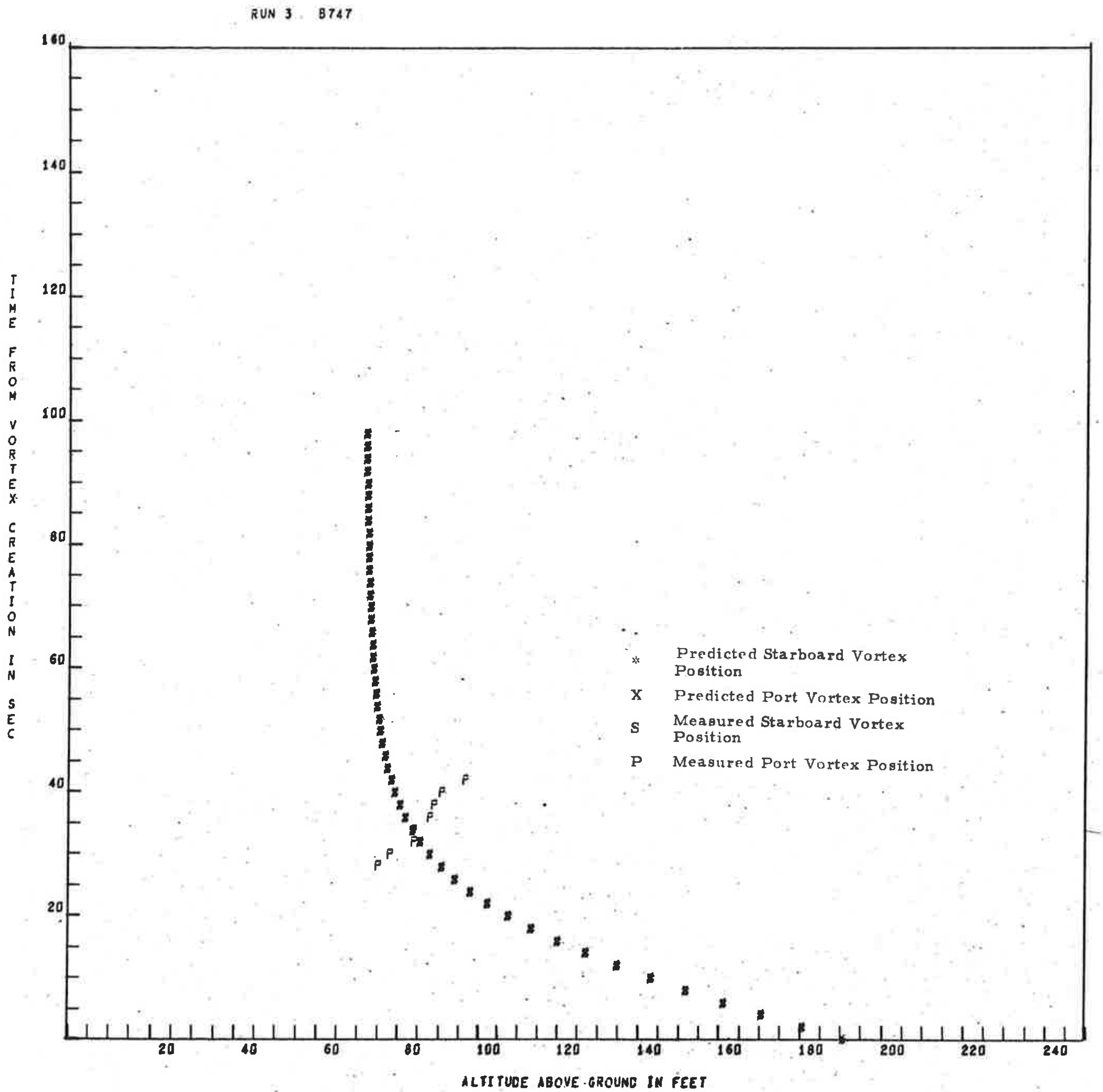
RUN 2 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



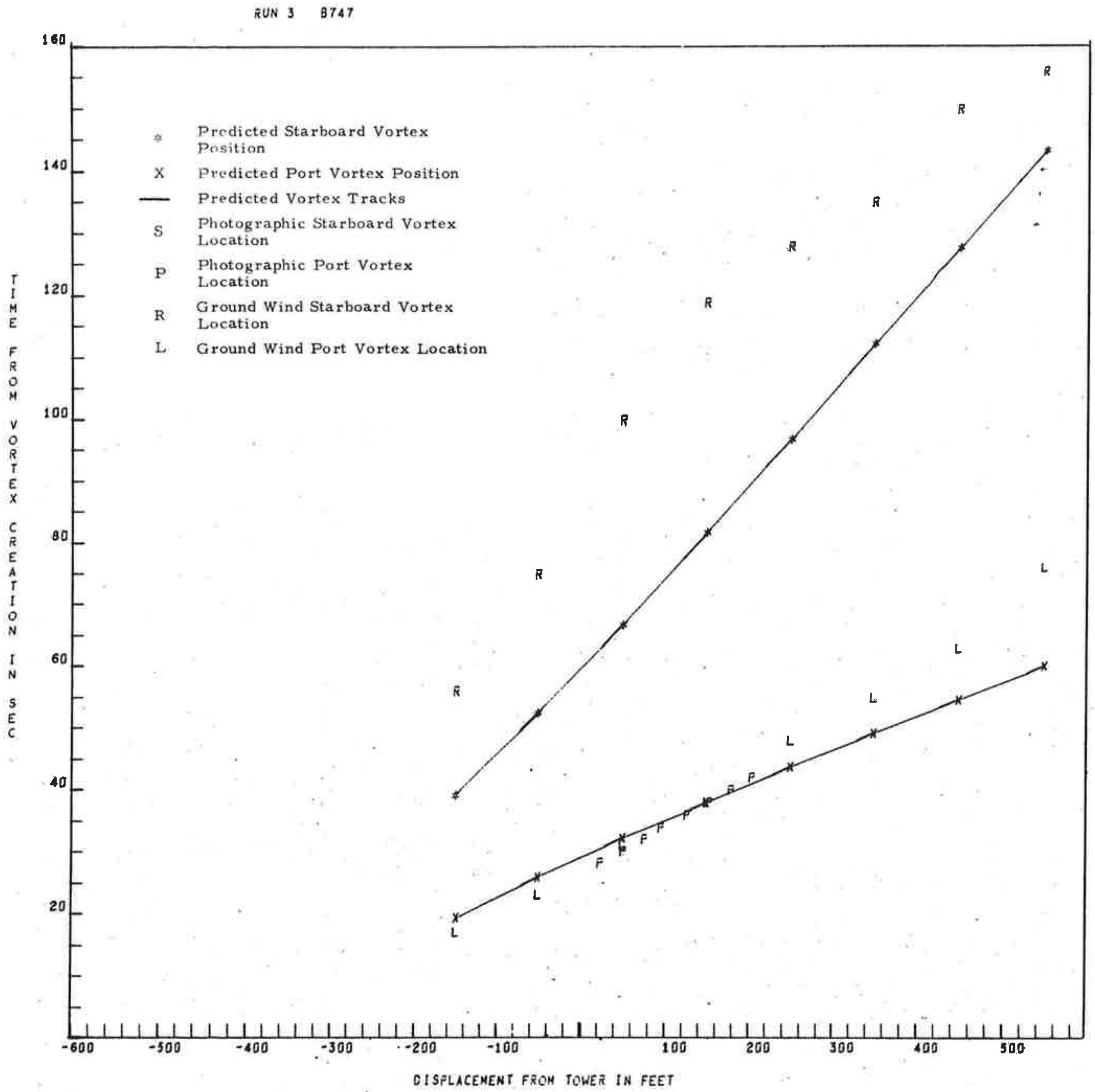
RUN 2 B747
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500

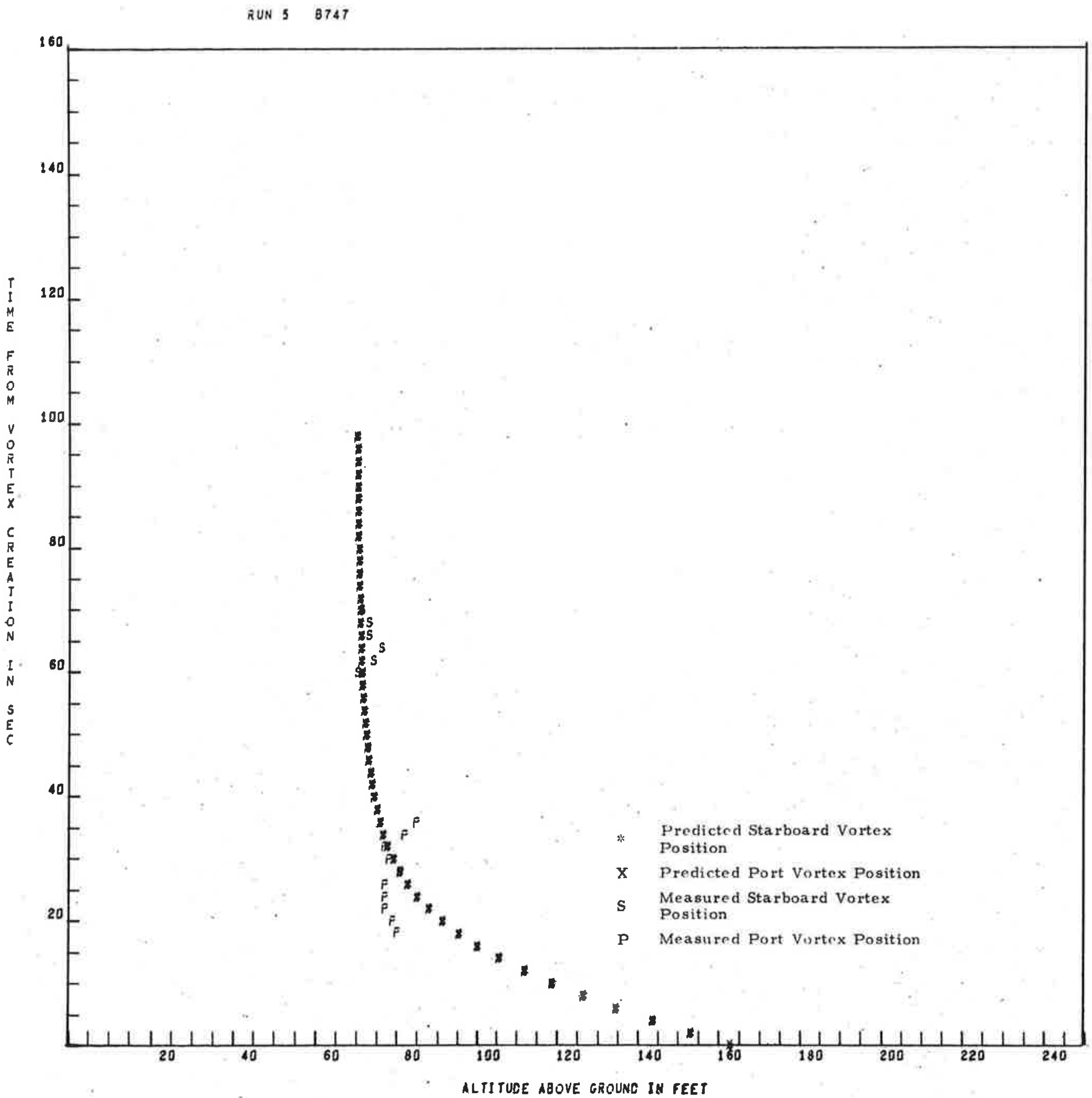


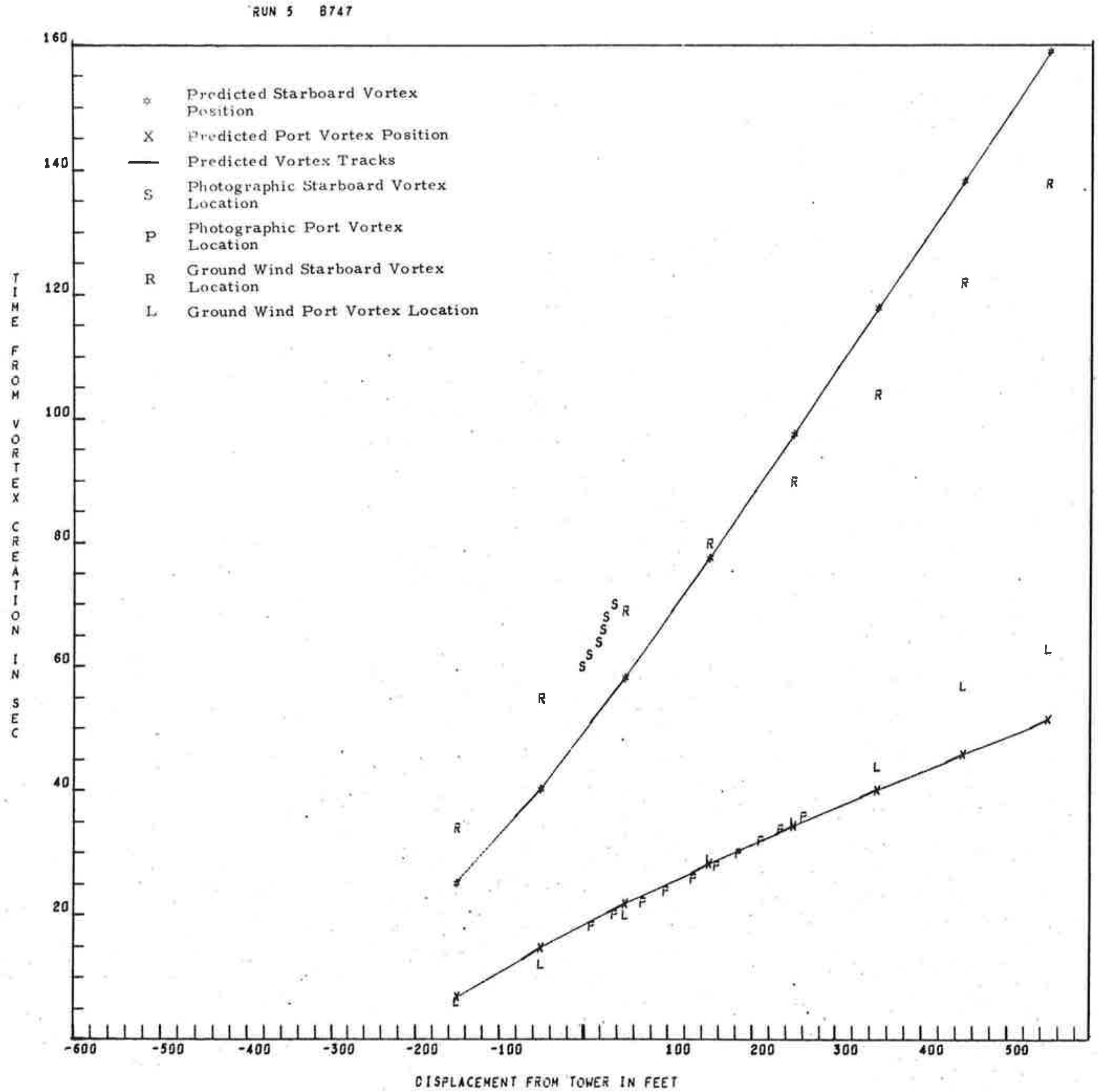
FIRST TIME FOR P IS 28
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 3
AIRCRAFT DISPLACEMENT FROM TOWER -448 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 191 FT
AIRCRAFT WEIGHT 534000. POUNDS
AIRSPEED 256.7 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 5 MPH (NOT USED)
INITIAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 125 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 2 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

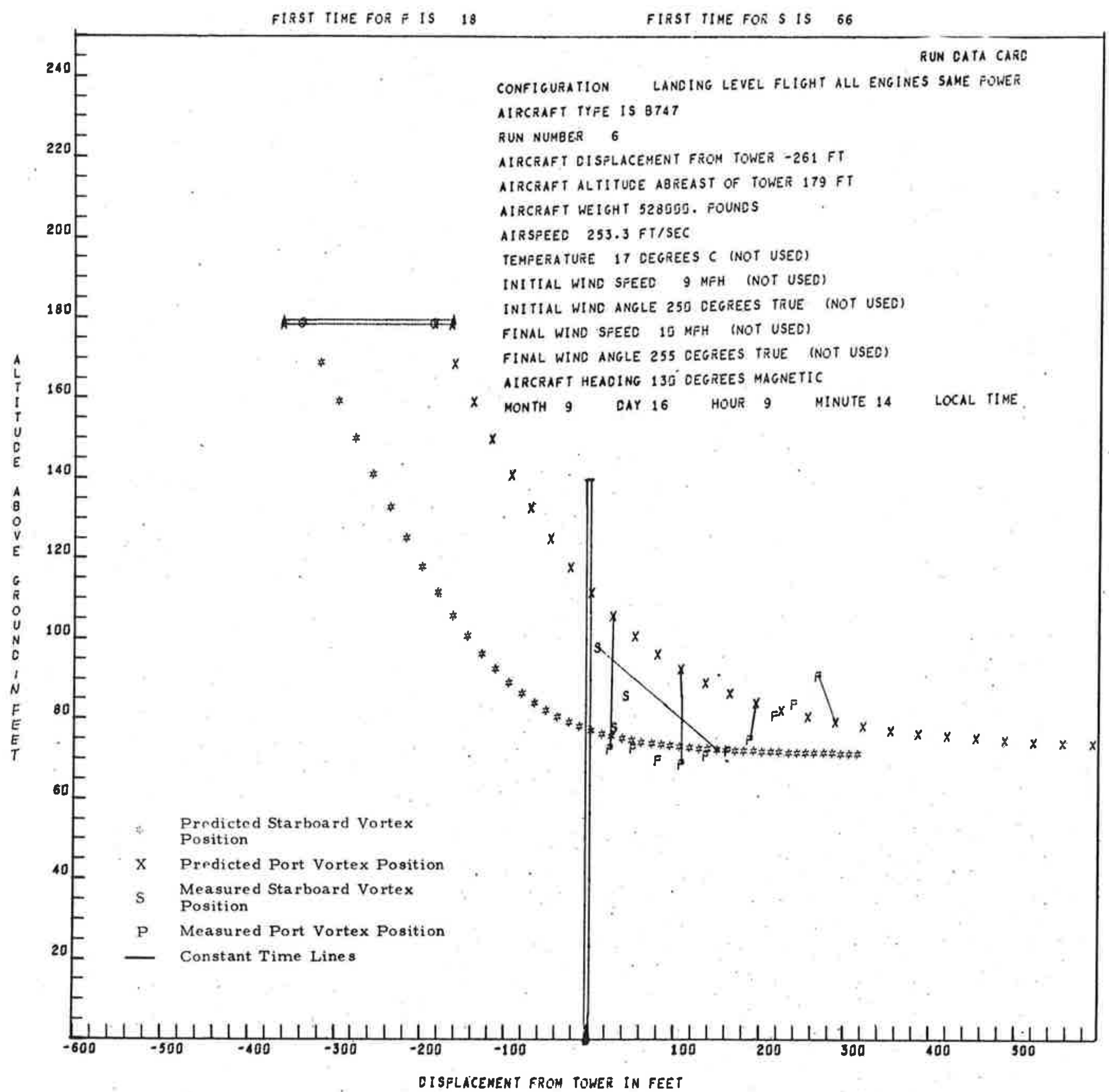


RUN 3 . B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

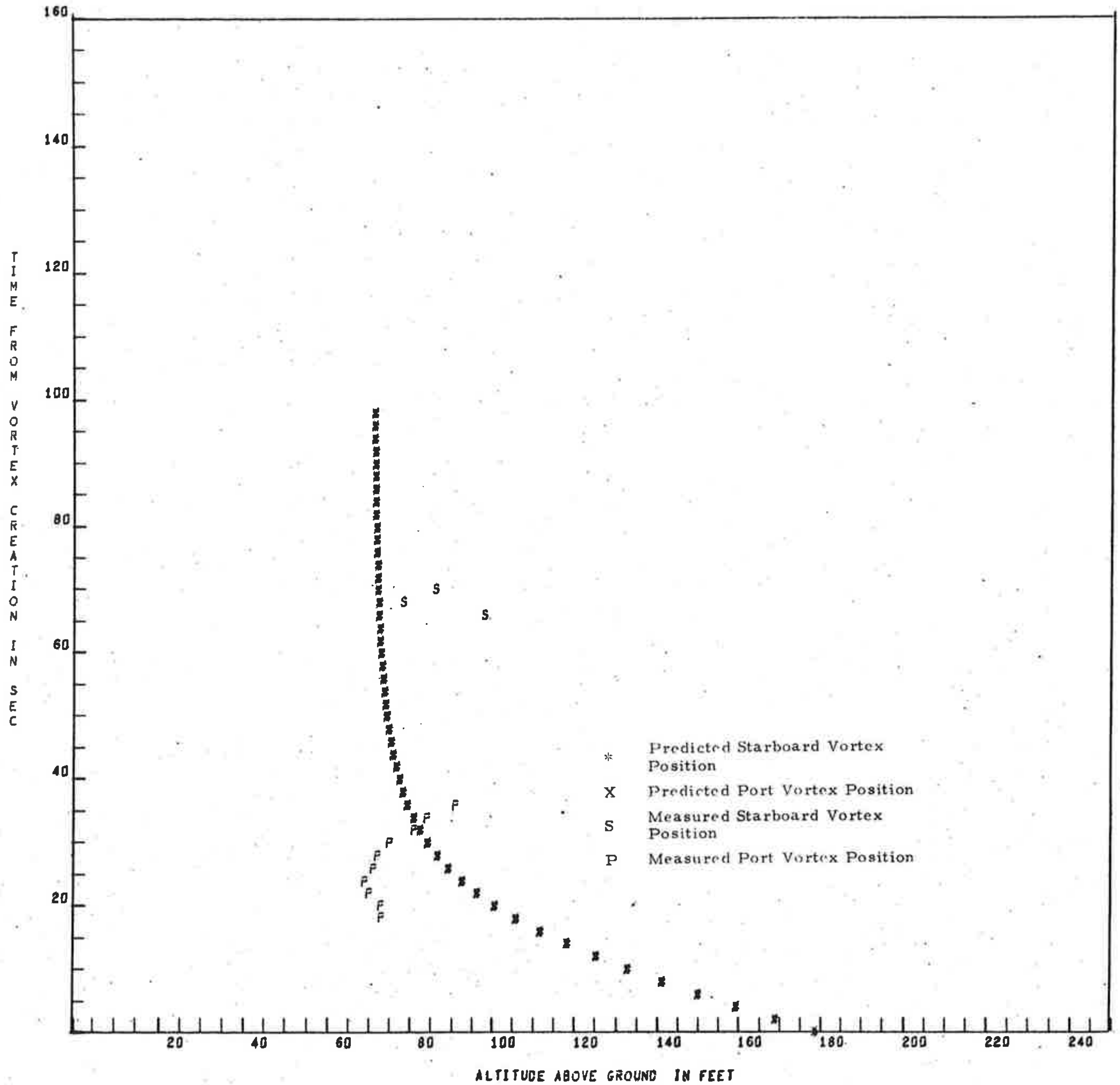

RUN 3 B747
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500


RUN 5 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position

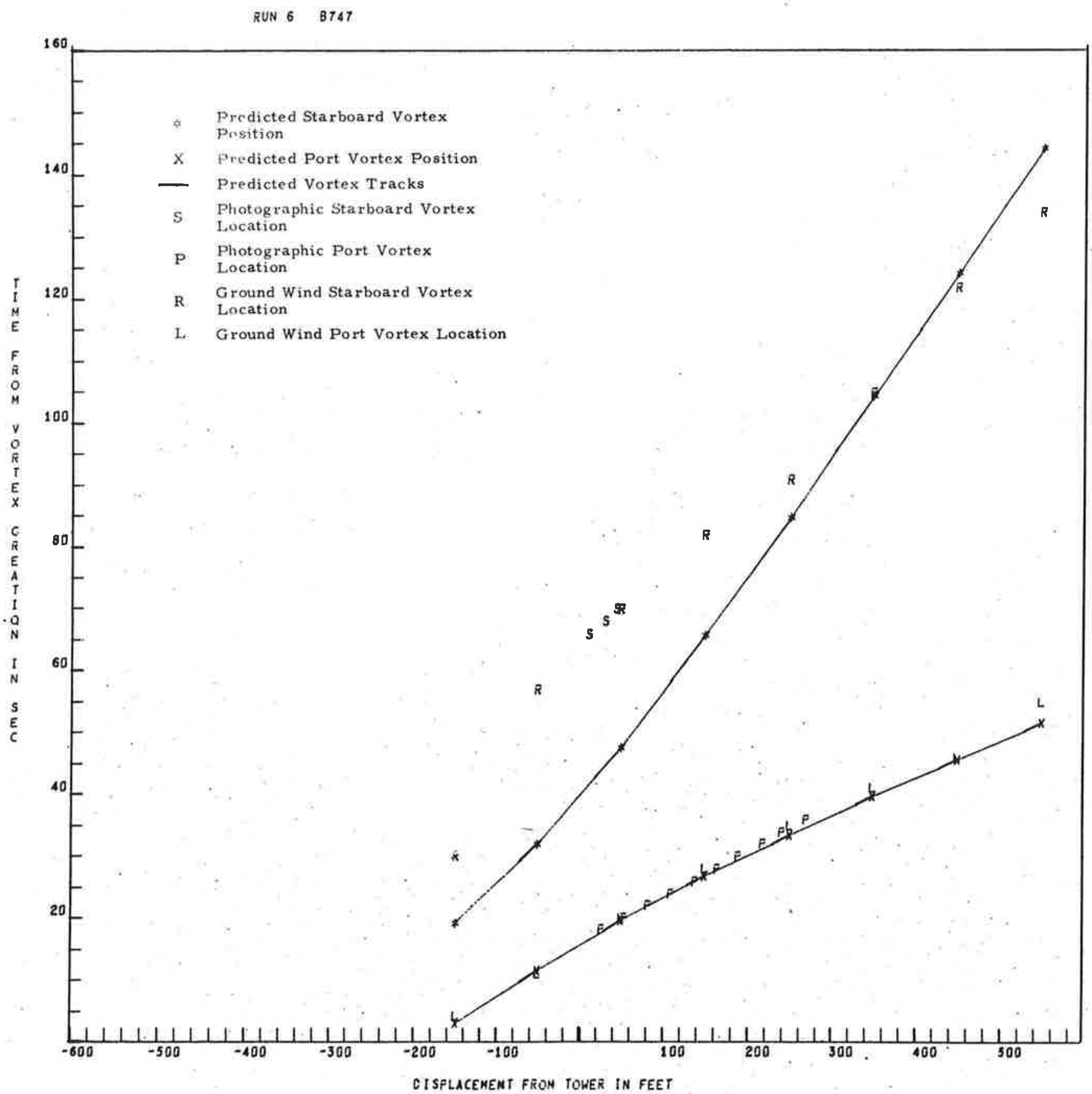

RUN 5 B747
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET


FIRST TIME FOR P IS 18
FIRST TIME FOR S IS 66
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 6
AIRCRAFT DISPLACEMENT FROM TOWER -261 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 179 FT
AIRCRAFT WEIGHT 528000. POUNDS
AIRSPEED 253.3 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 9 MPH (NOT USED)
INITIAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 10 MPH (NOT USED)
FINAL WIND ANGLE 255 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 14 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

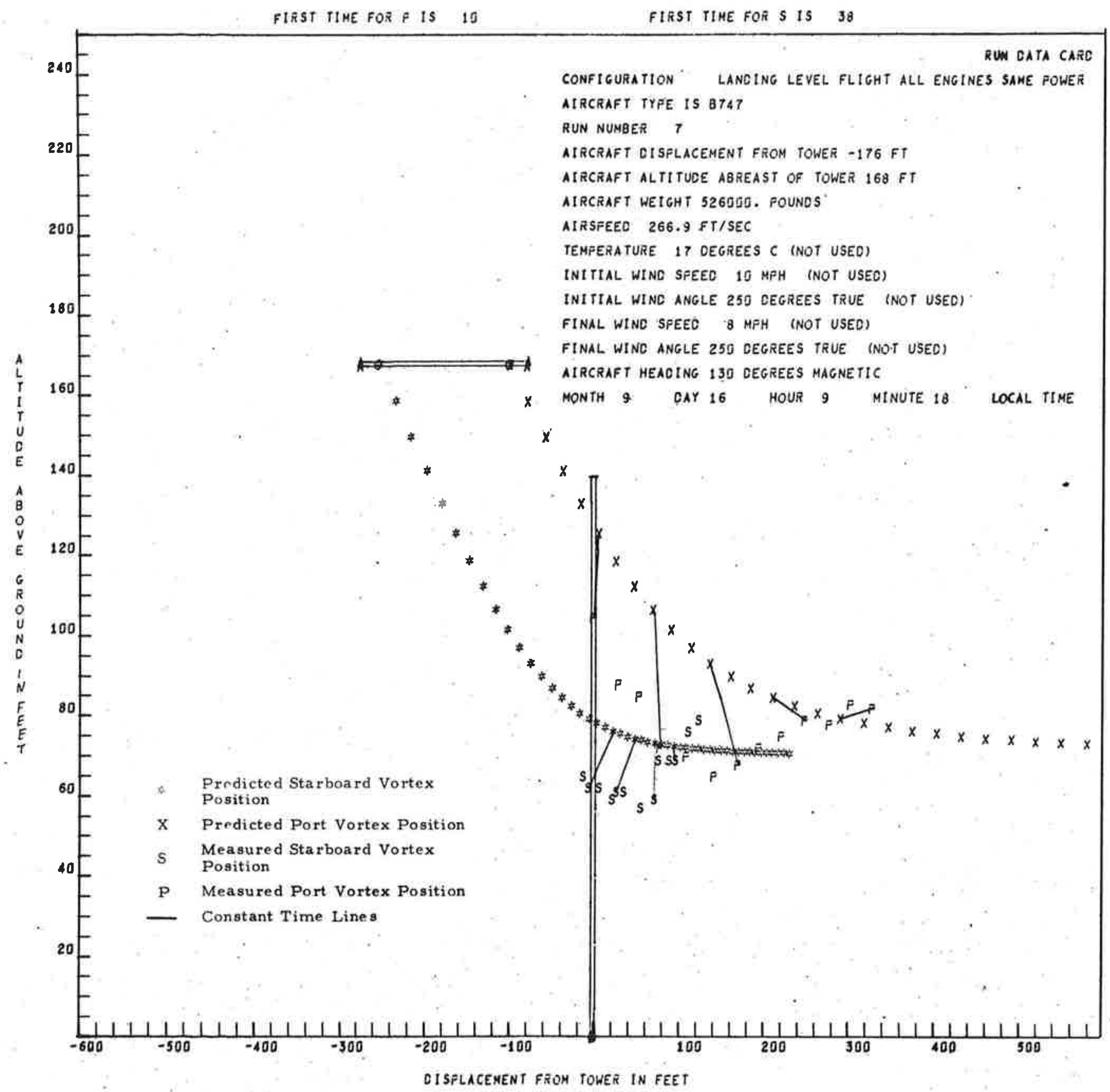
RUN 6   B747

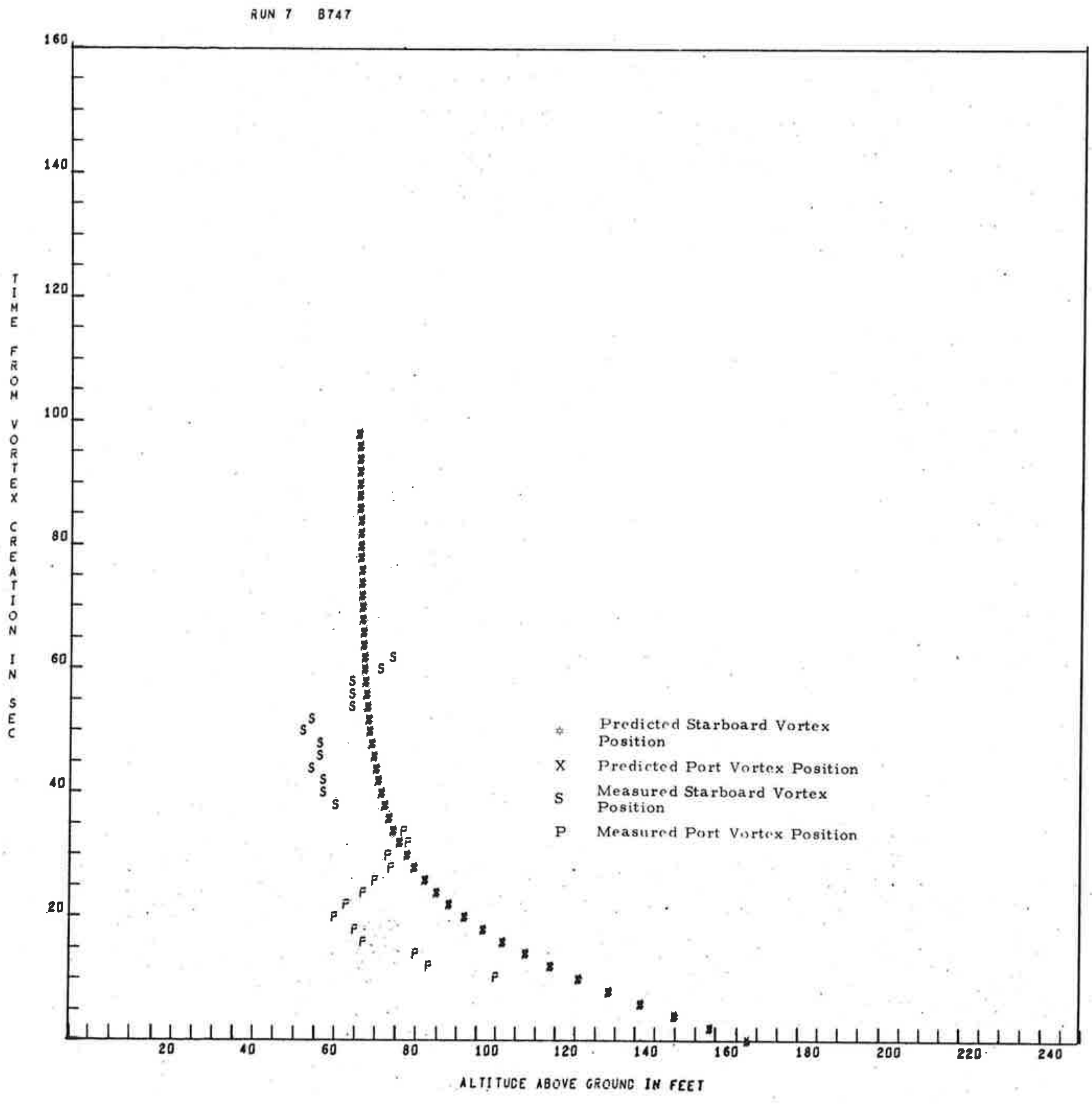


160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

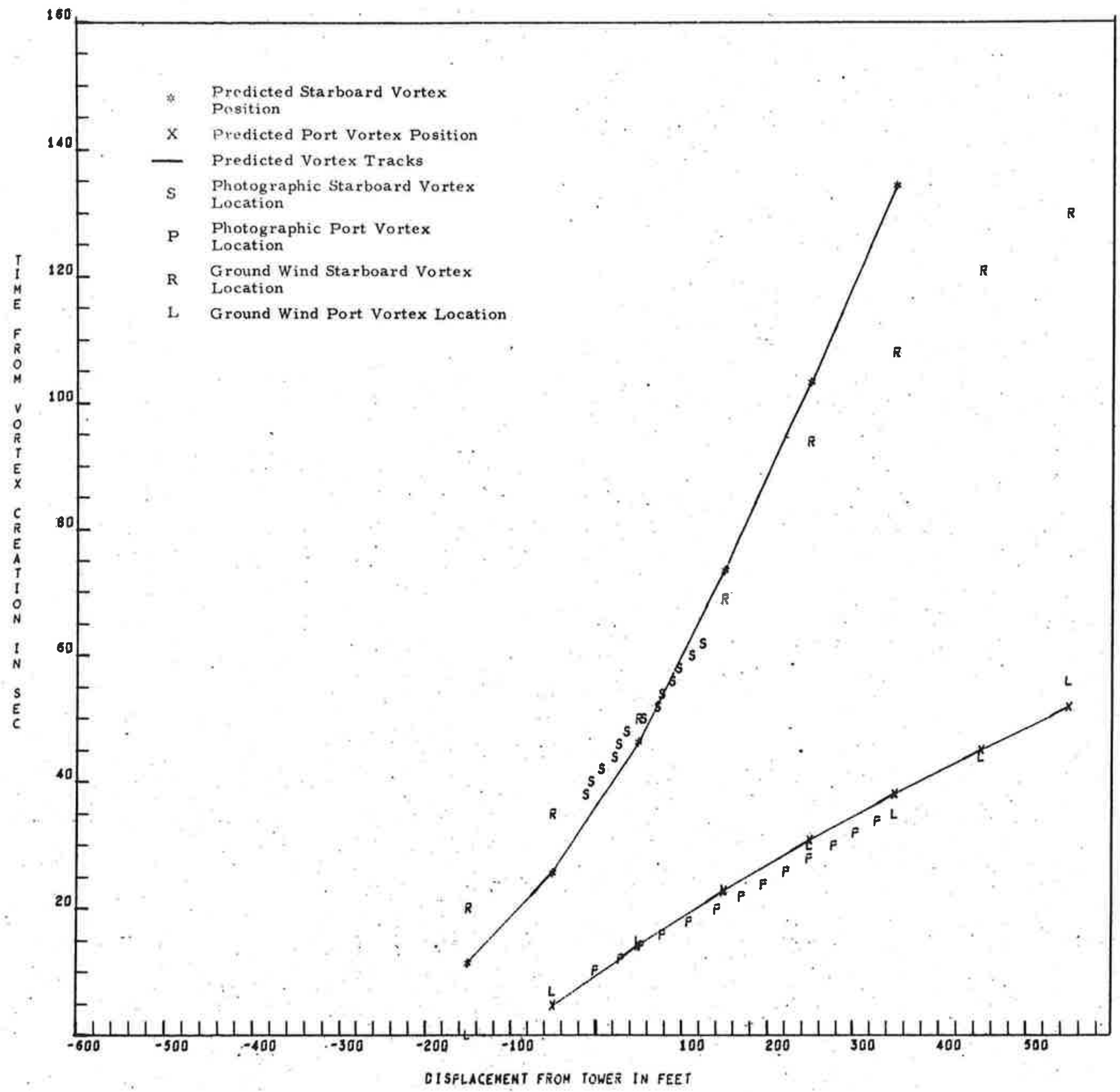


RUN 6 B747
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
-600
-500
-400
-300
-200
-100
100
200
300
400
500
20
40
60
80
100
120
140
160

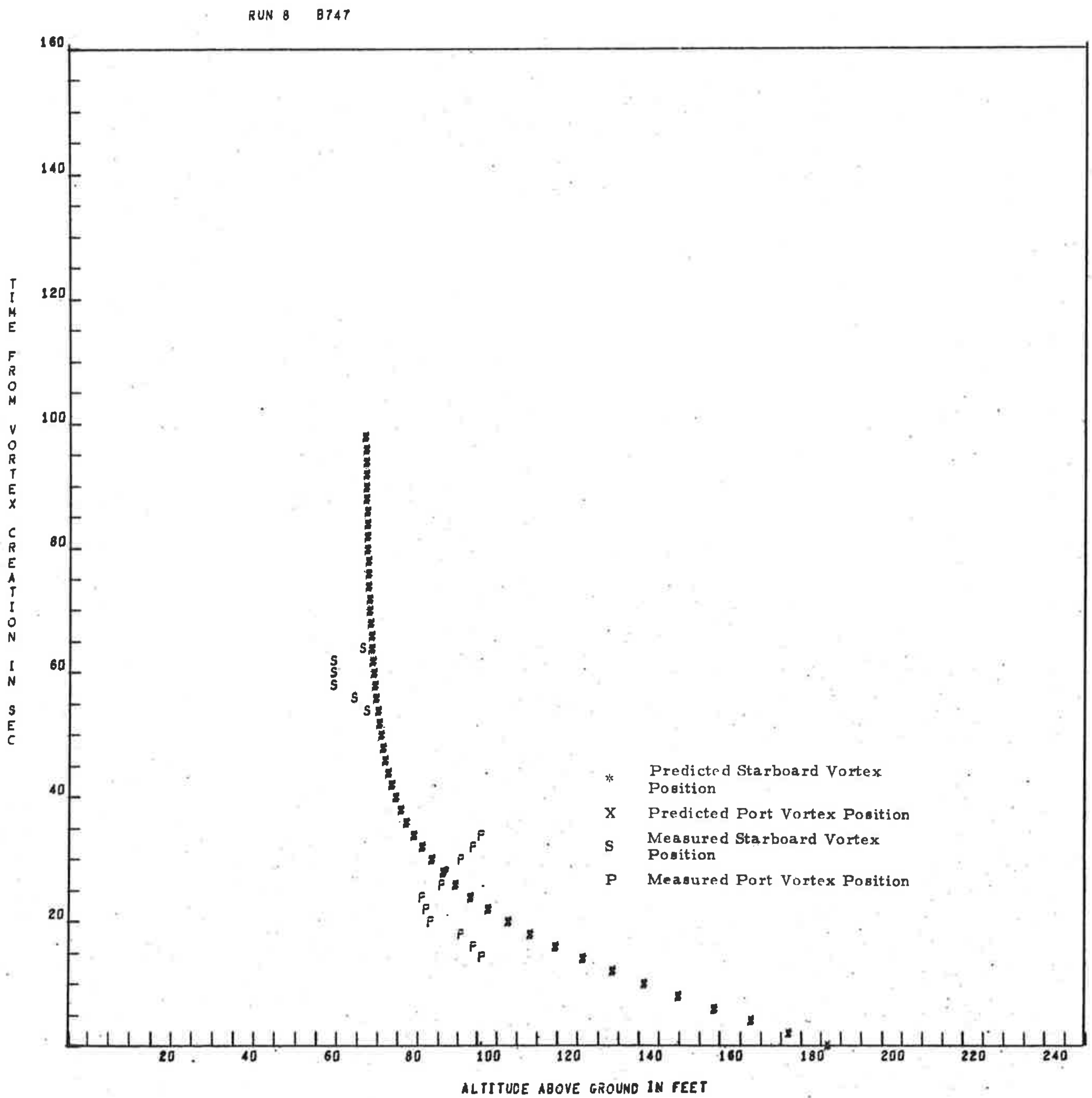

FIRST TIME FOR P IS 10
FIRST TIME FOR S IS 38
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 7
AIRCRAFT DISPLACEMENT FROM TOWER -176 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 168 FT
AIRCRAFT WEIGHT 526000. POUNDS
AIRSPEED 266.9 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH (NOT USED)
INITIAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 18 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

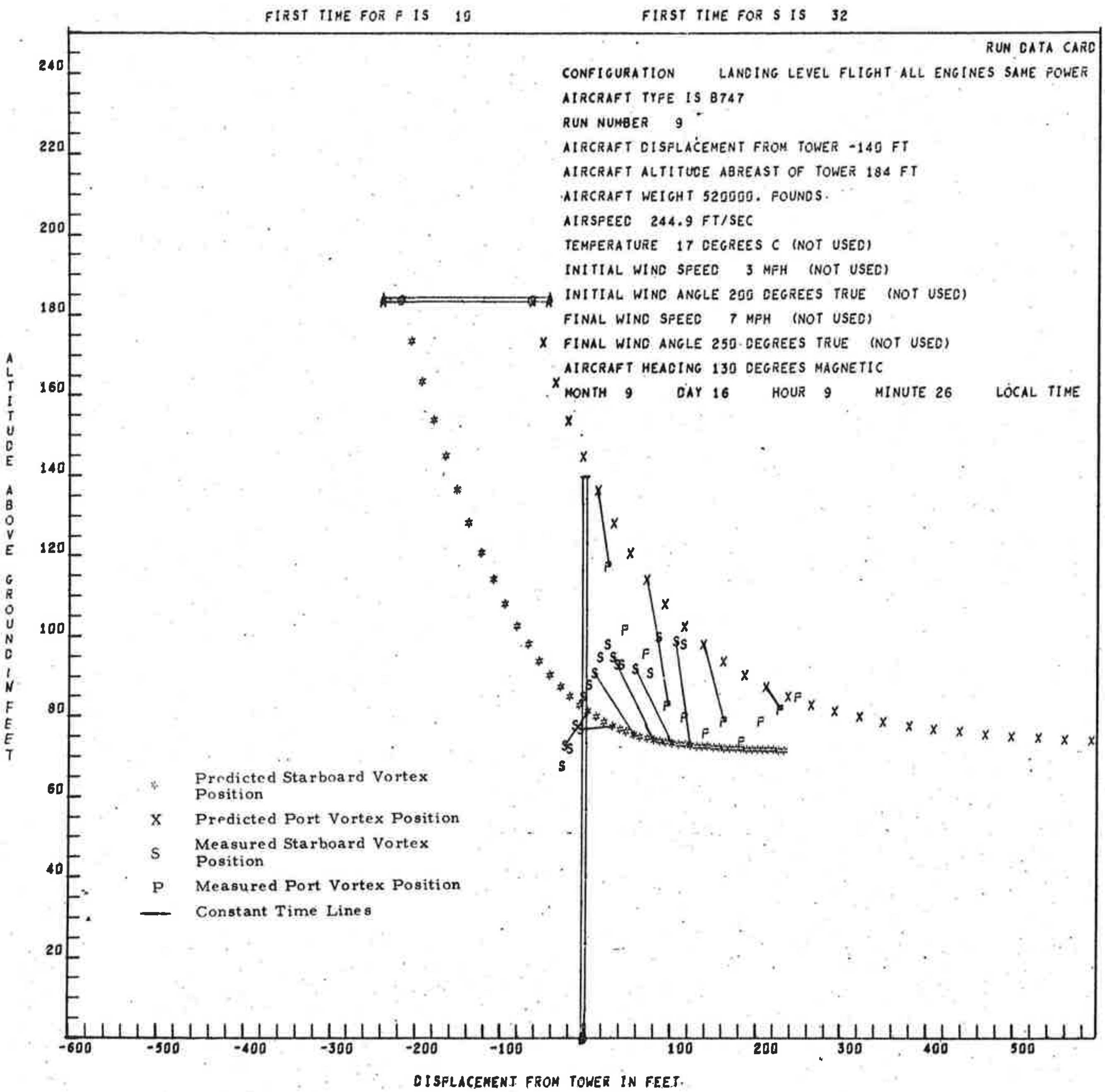

RUN 7 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

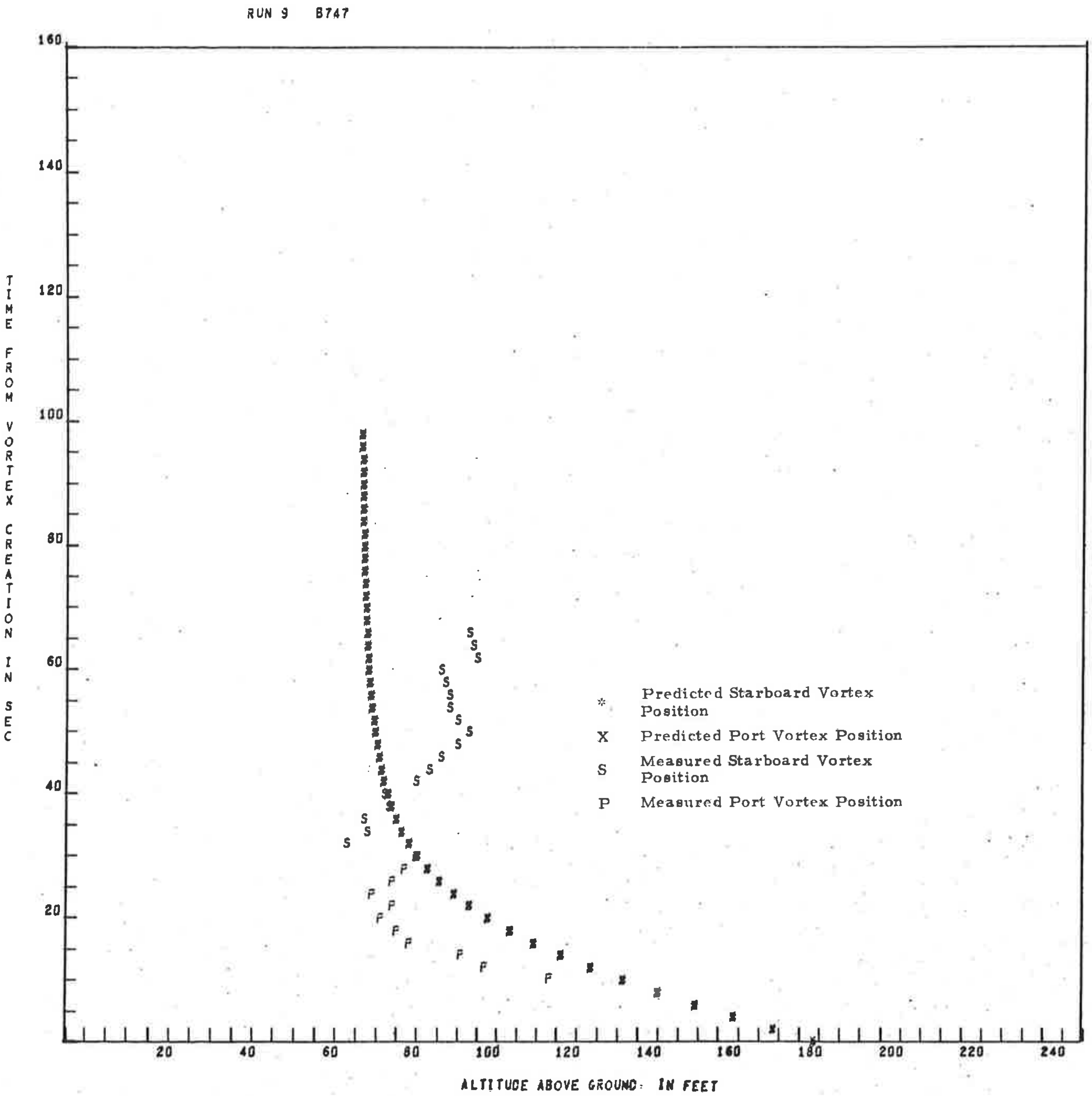
RUN 7 B747



Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET

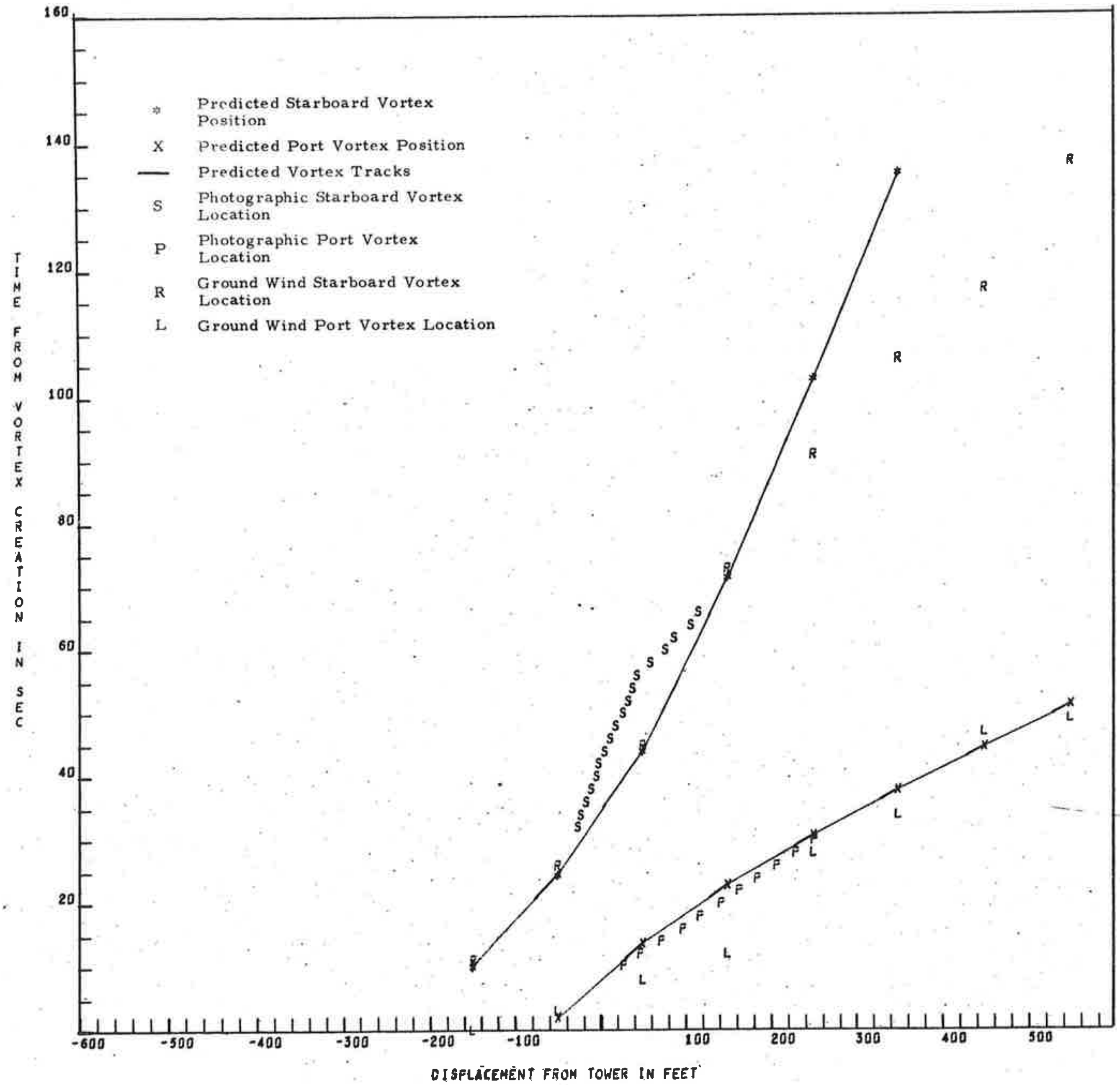

RUN 8 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


FIRST TIME FOR P IS 19
FIRST TIME FOR S IS 32
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 9
AIRCRAFT DISPLACEMENT FROM TOWER -140 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 184 FT
AIRCRAFT WEIGHT 520000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 3 MPH (NOT USED)
INITIAL WIND ANGLE 200 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 7 MPH (NOT USED)
FINAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 26 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

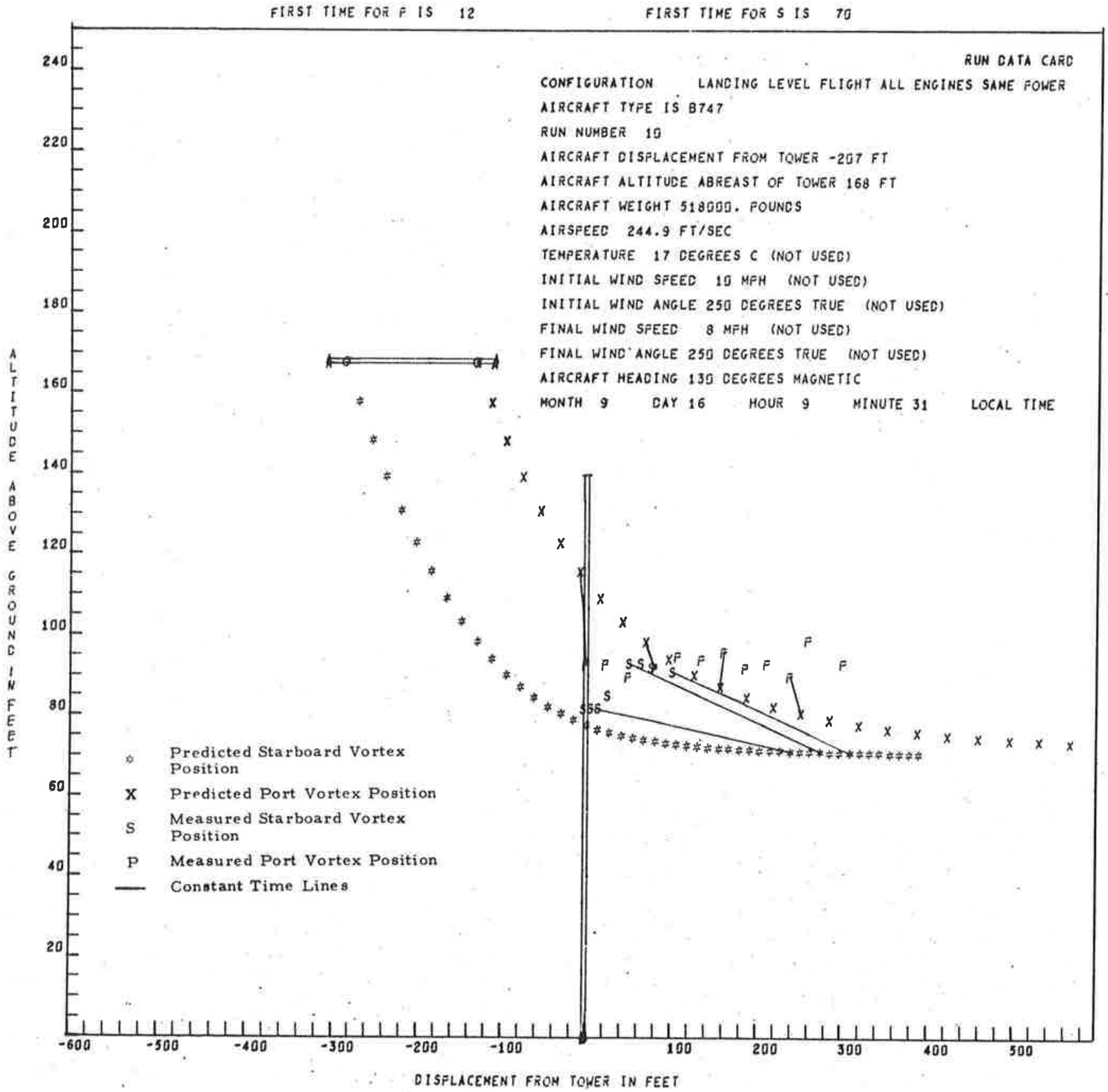


RUN 9 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND: IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

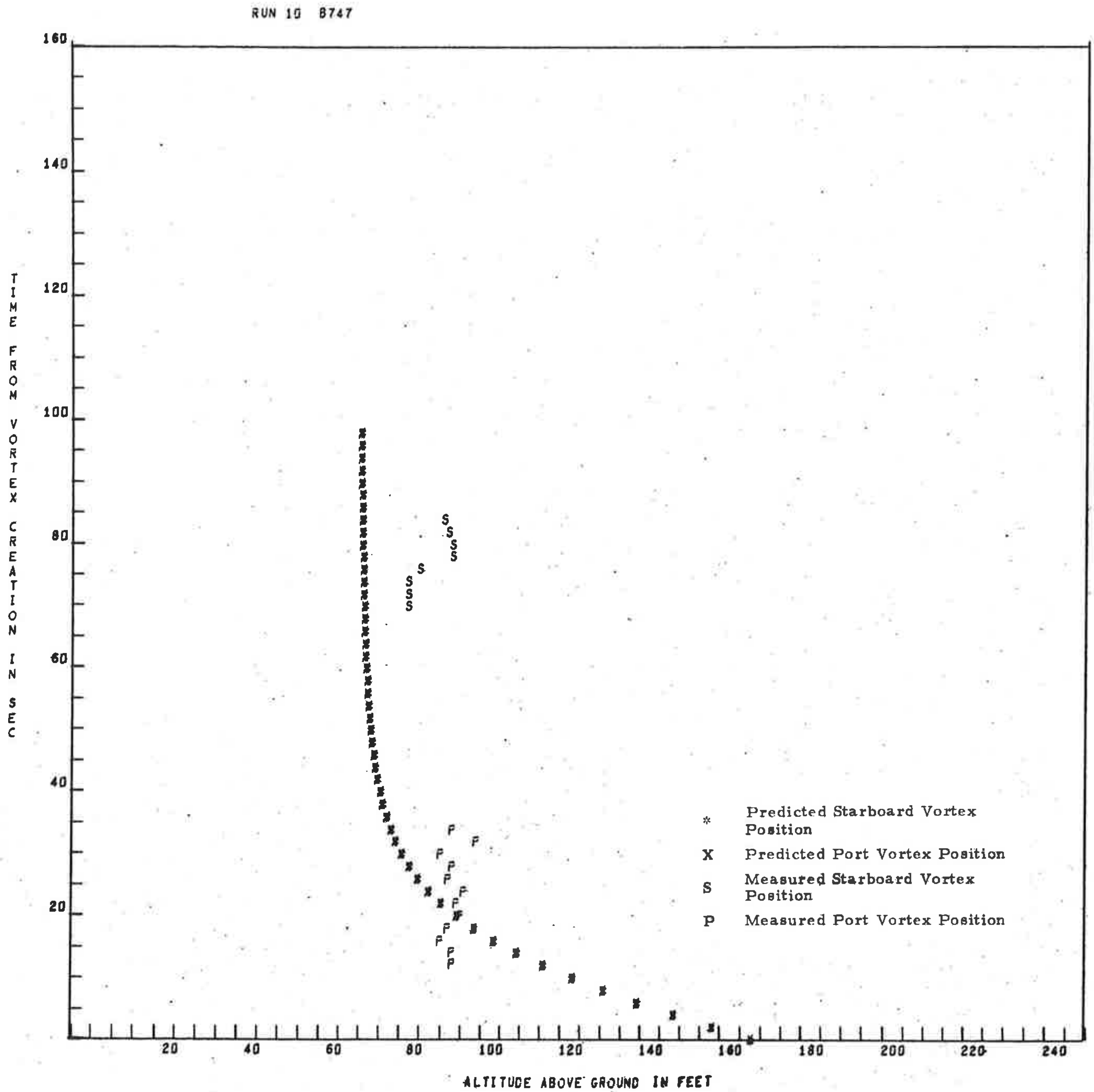
RUN 9 B747



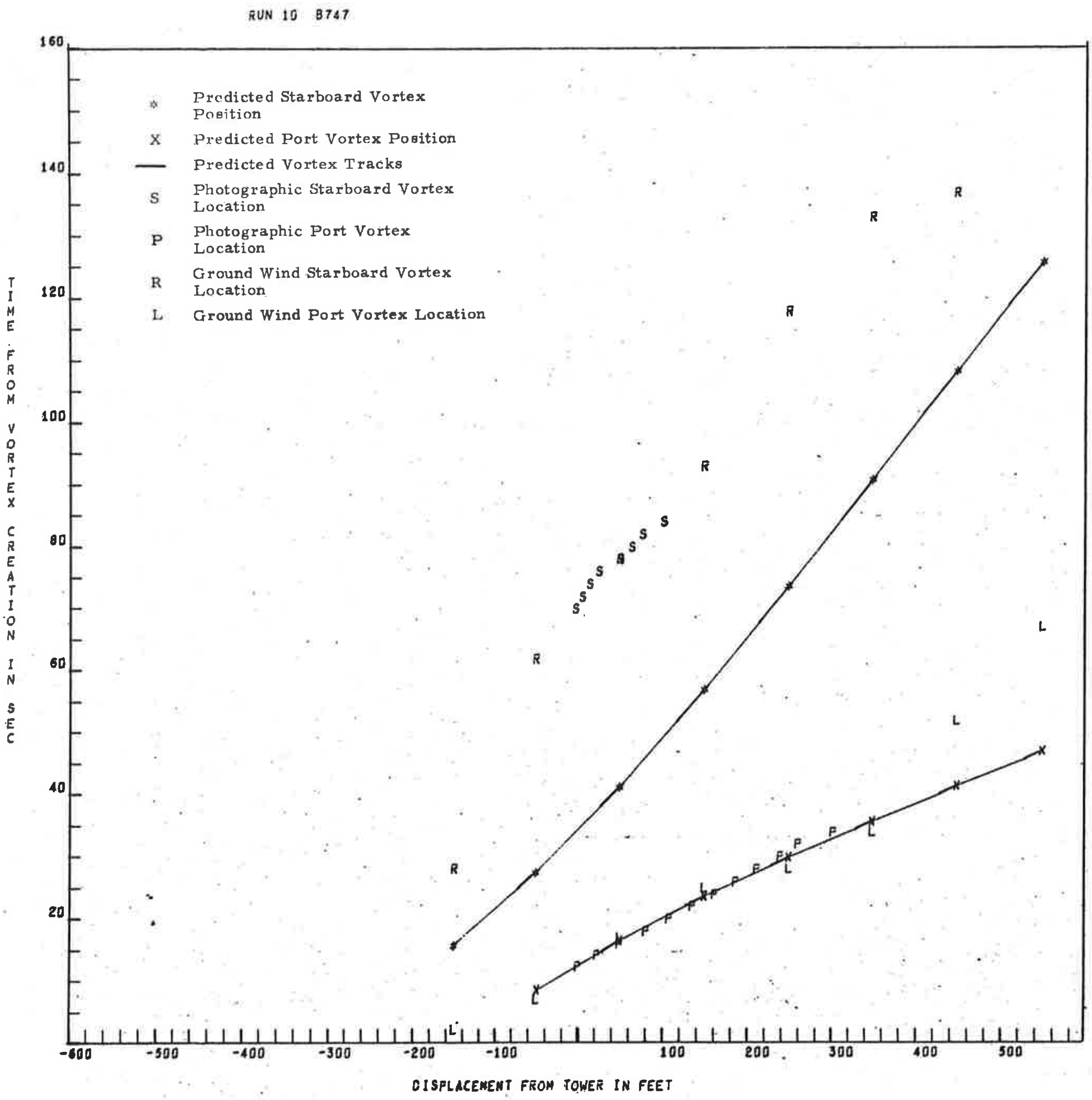
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500

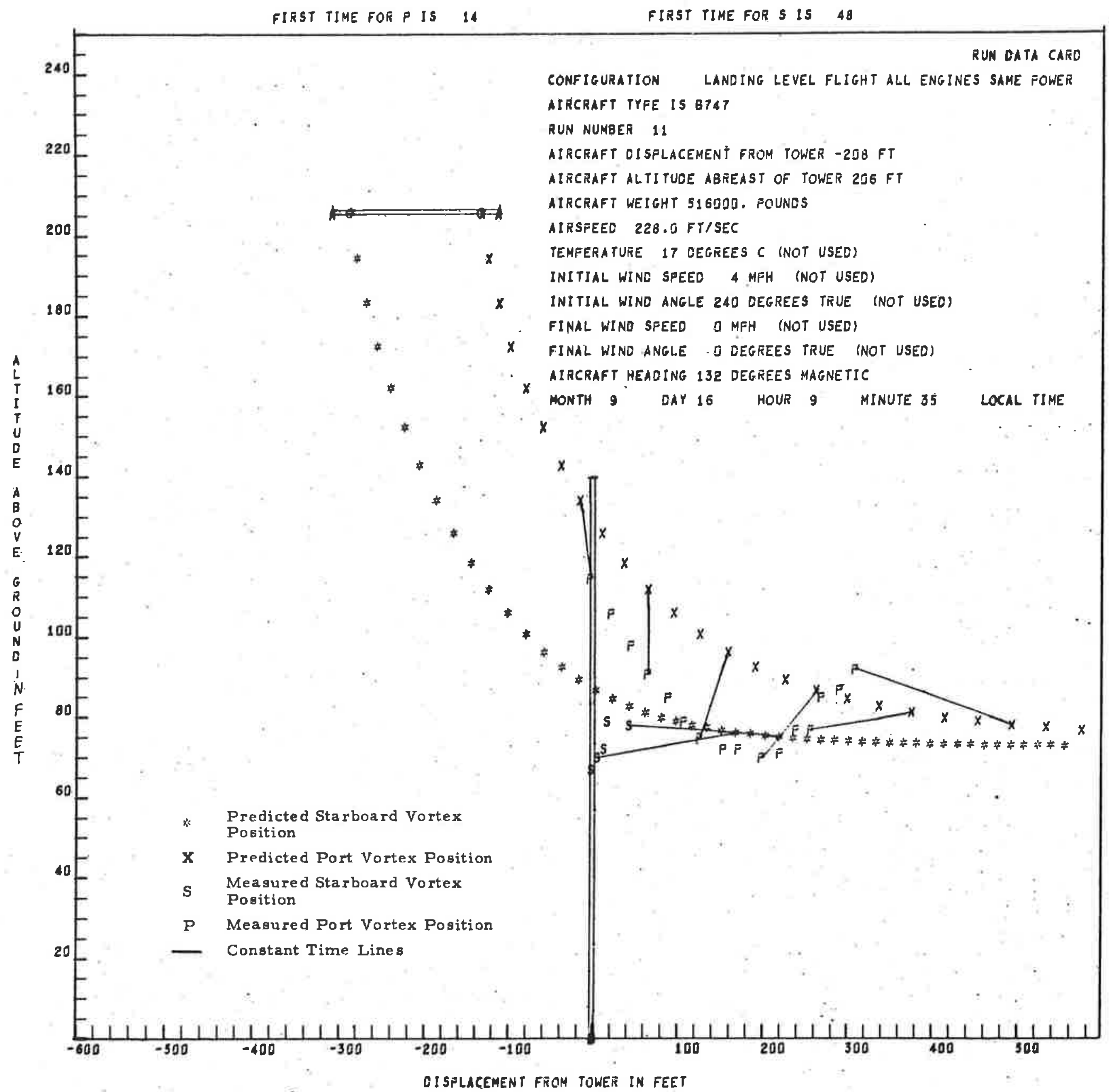


FIRST TIME FOR P IS 12
FIRST TIME FOR S IS 70
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 10
AIRCRAFT DISPLACEMENT FROM TOWER -207 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 168 FT
AIRCRAFT WEIGHT 518000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH (NOT USED)
INITIAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 31 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

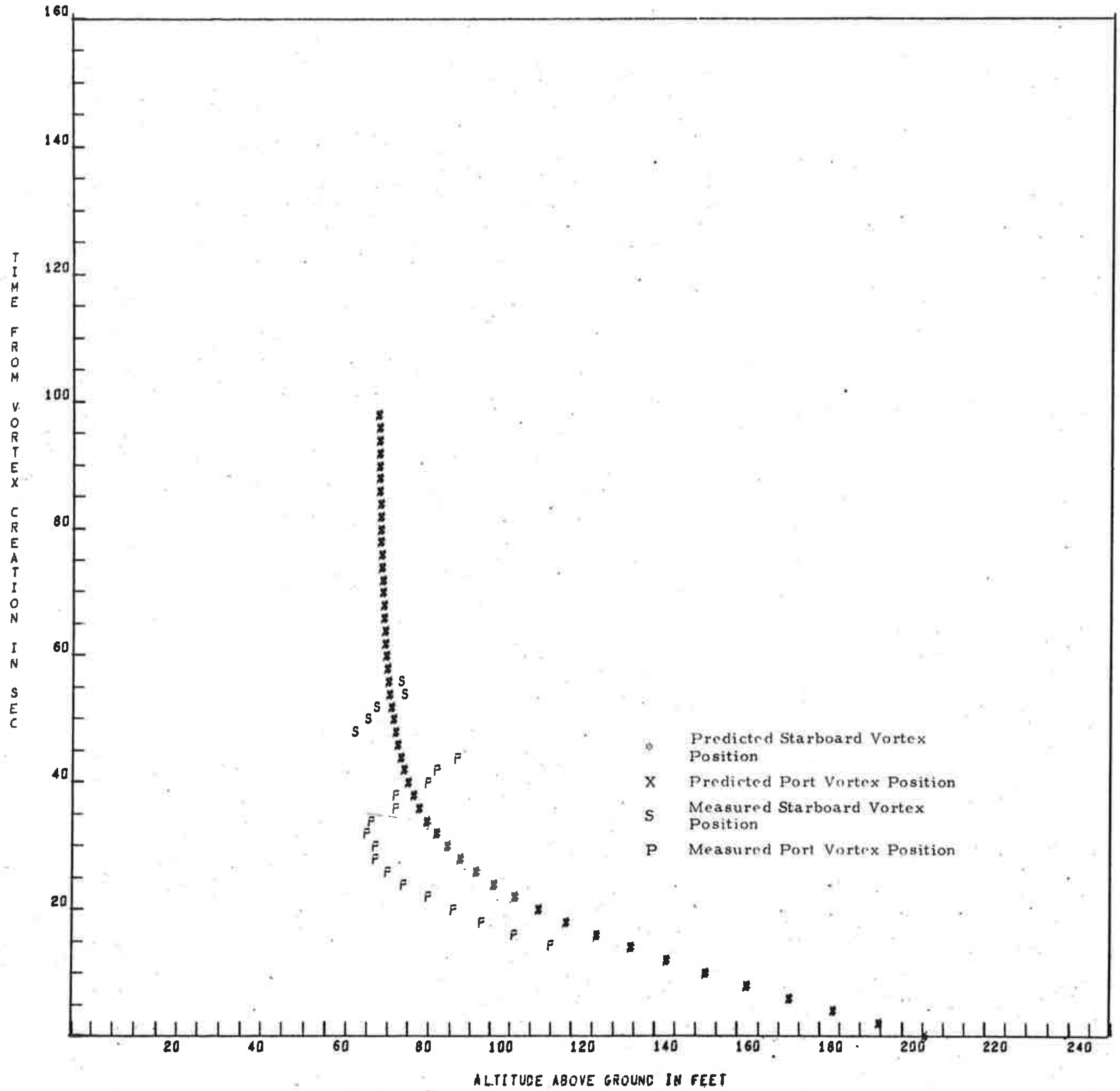


RUN 10 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

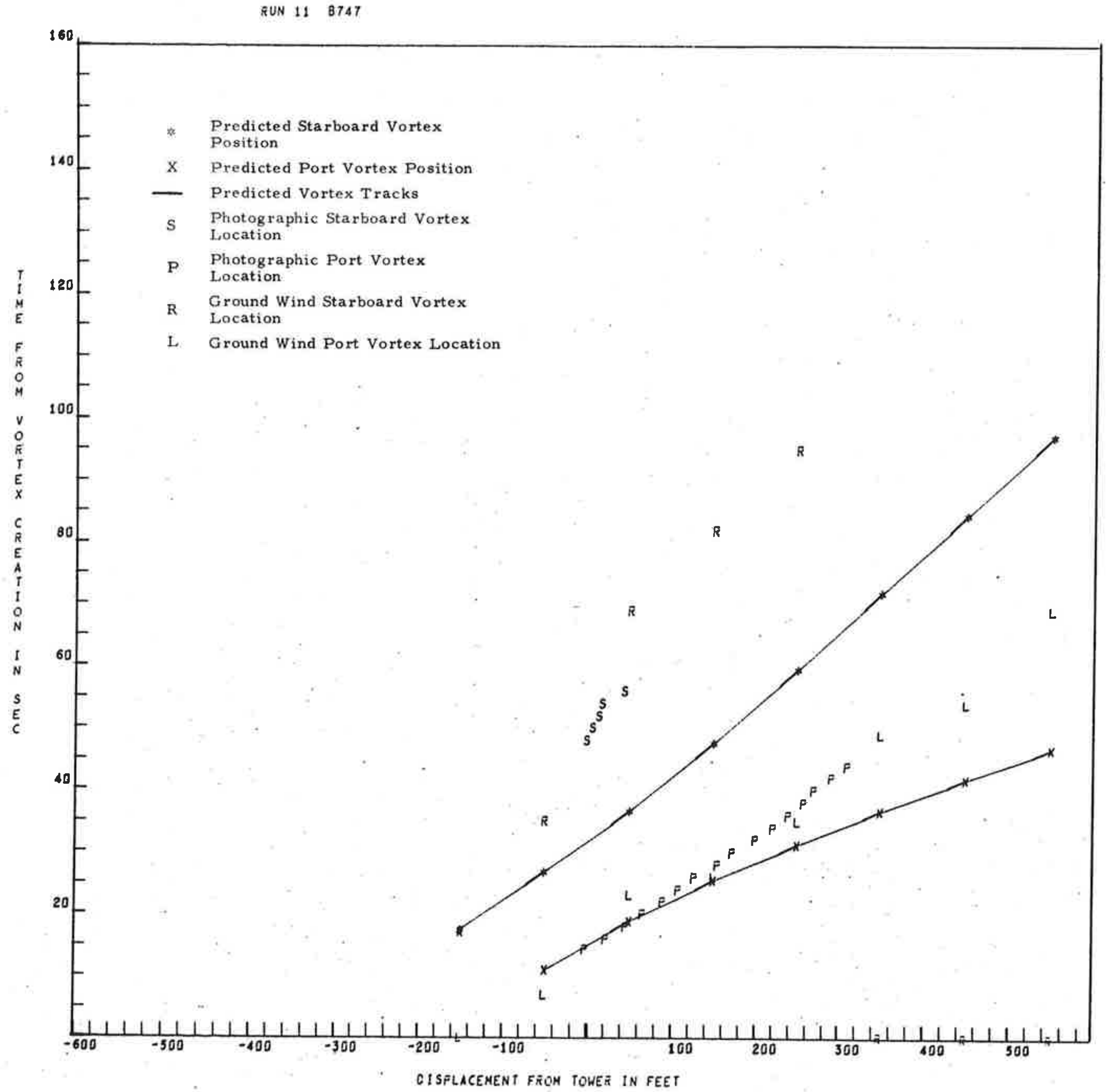

RUN 10 B747
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET

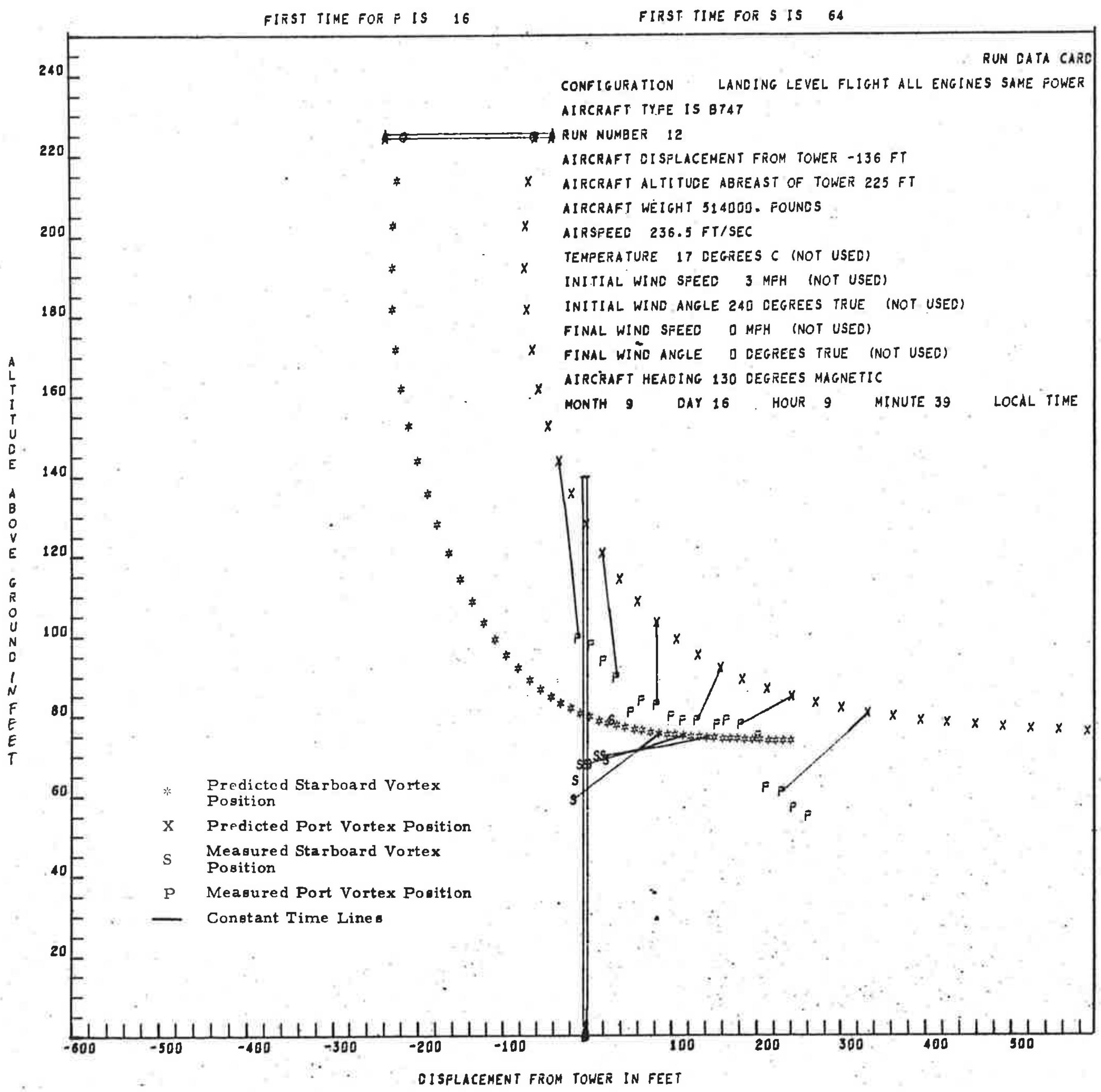

FIRST TIME FOR P IS 14
FIRST TIME FOR S IS 48
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 11
AIRCRAFT DISPLACEMENT FROM TOWER -208 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 206 FT
AIRCRAFT WEIGHT 516000. POUNDS
AIRSPEED 228.0 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 4 MPH (NOT USED)
INITIAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 132 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 35 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

RUN 11 B747



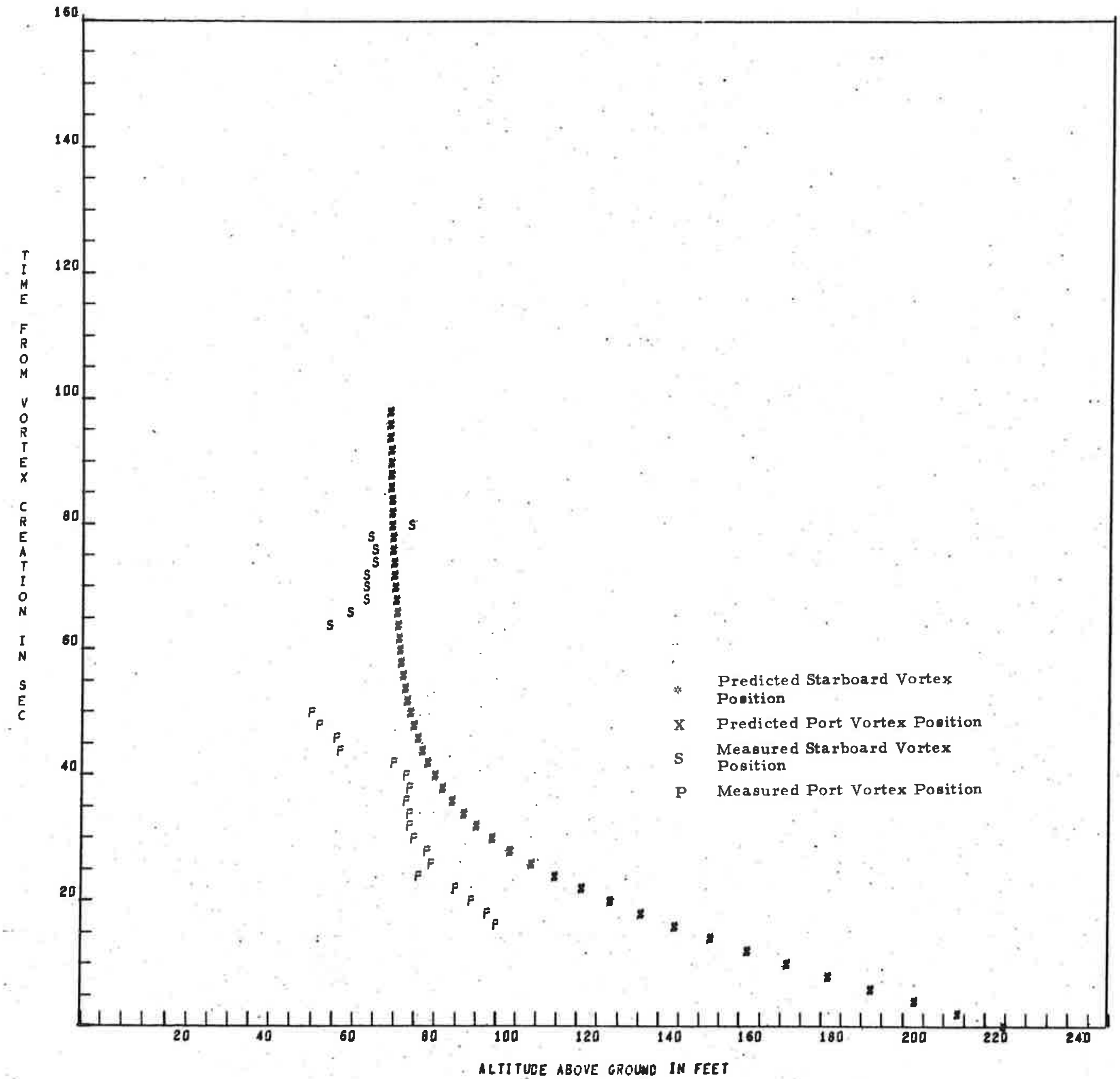
160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 11 B747
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500

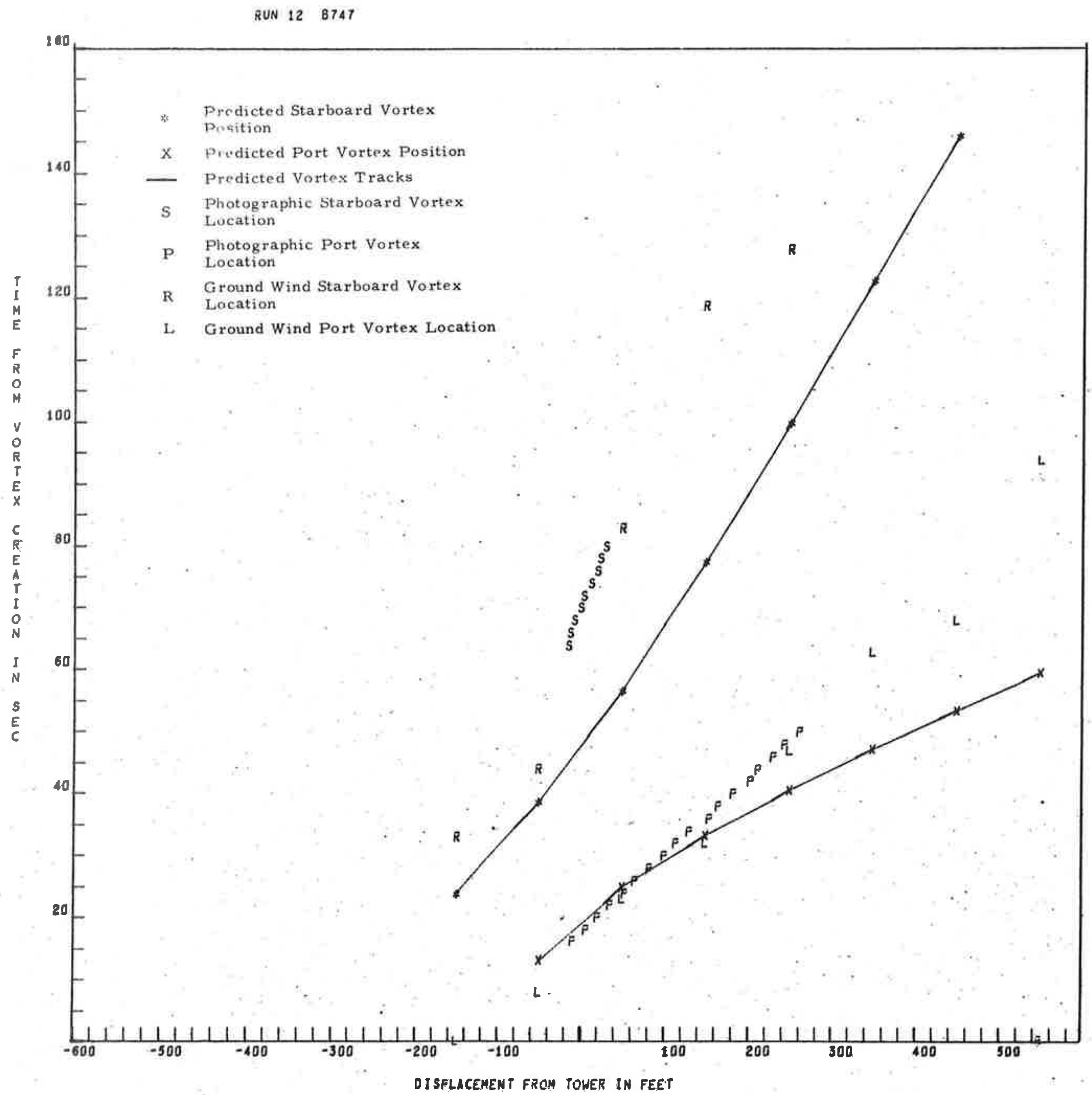


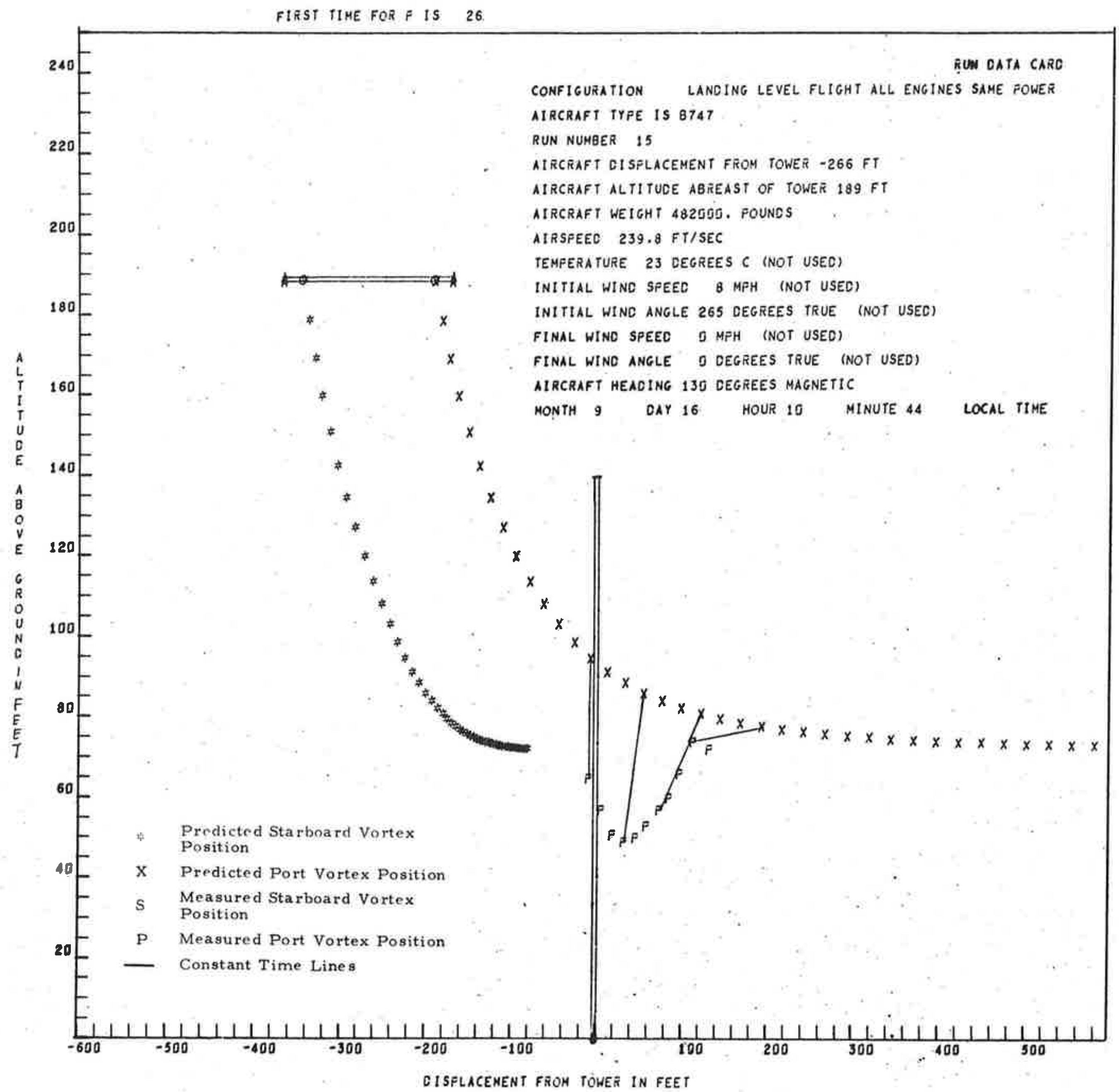
FIRST TIME FOR P IS 16
FIRST TIME FOR S IS 64
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 12
AIRCRAFT DISPLACEMENT FROM TOWER -136 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 225 FT
AIRCRAFT WEIGHT 514000. POUNDS
AIRSPEED 236.5 FT/SEC
TEMPERATURE 17 DEGREES C (NOT USED)
INITIAL WIND SPEED 3 MPH (NOT USED)
INITIAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 9 MINUTE 39 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

RUN 12 B747

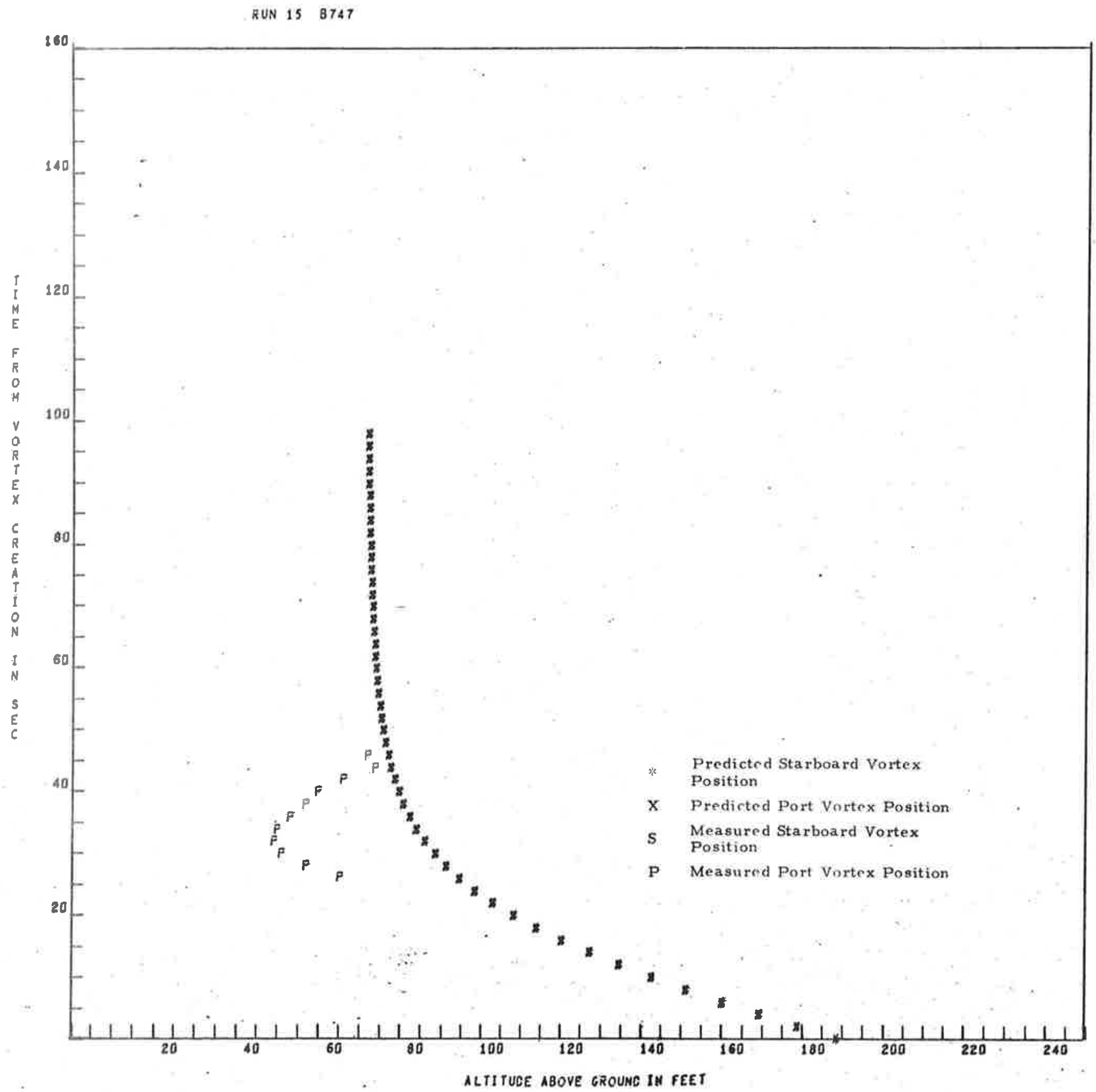


TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

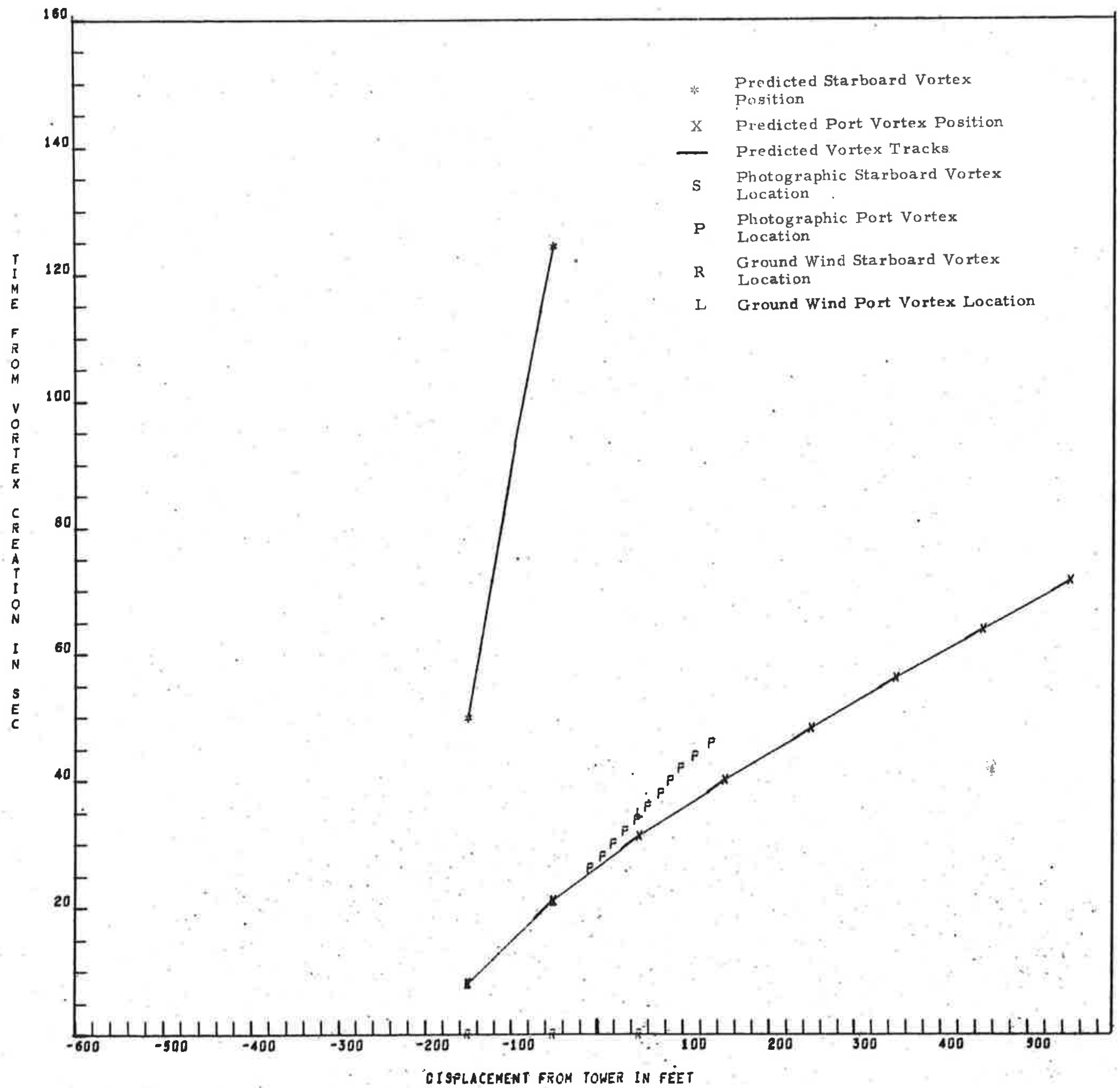

RUN 12 B747
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500

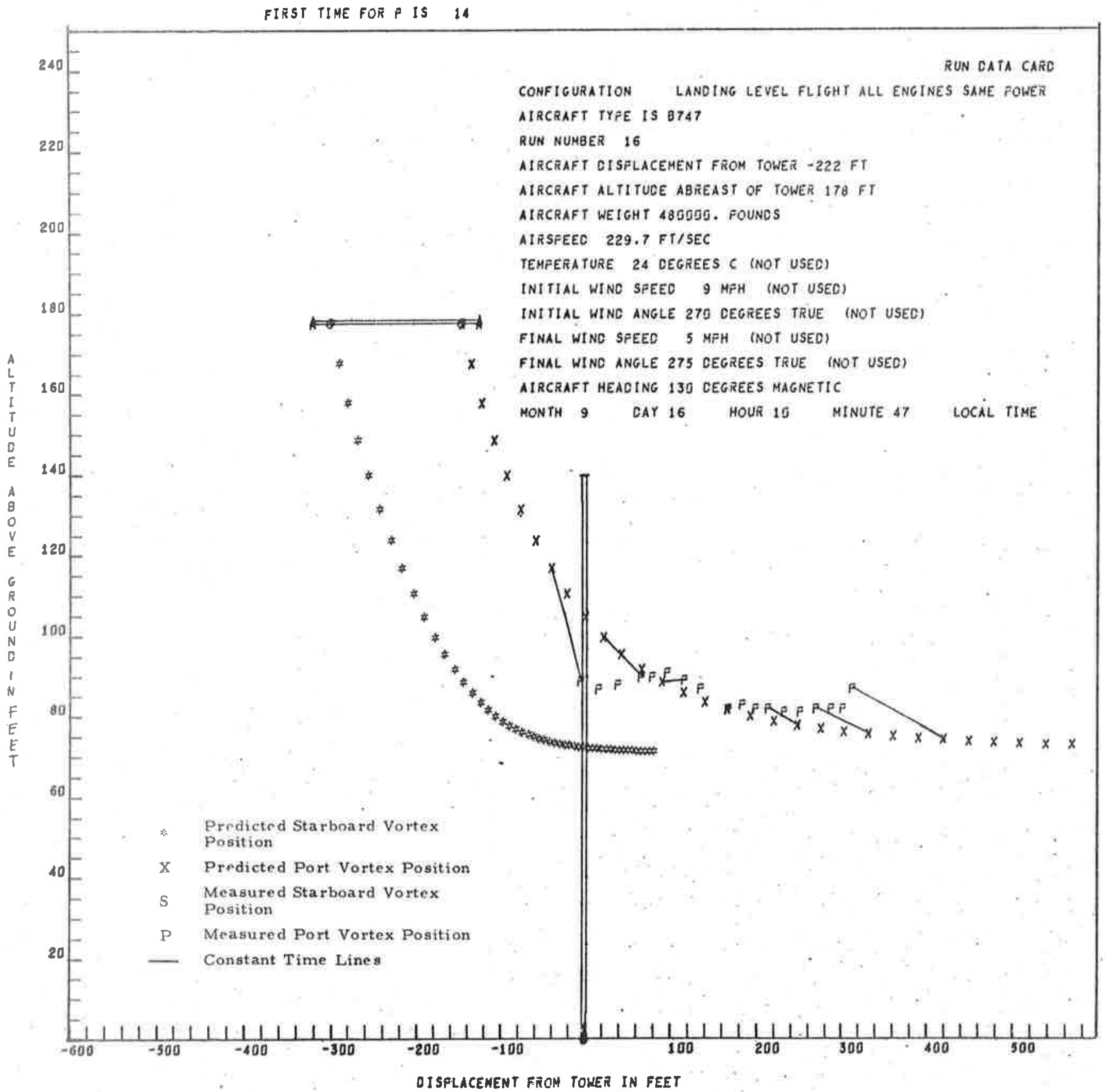


FIRST TIME FOR P IS 26.
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 15
AIRCRAFT DISPLACEMENT FROM TOWER -266 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 189 FT
AIRCRAFT WEIGHT 482000. POUNDS
AIRSPEED 239.8 FT/SEC
TEMPERATURE 23 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 265 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 10 MINUTE 44 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

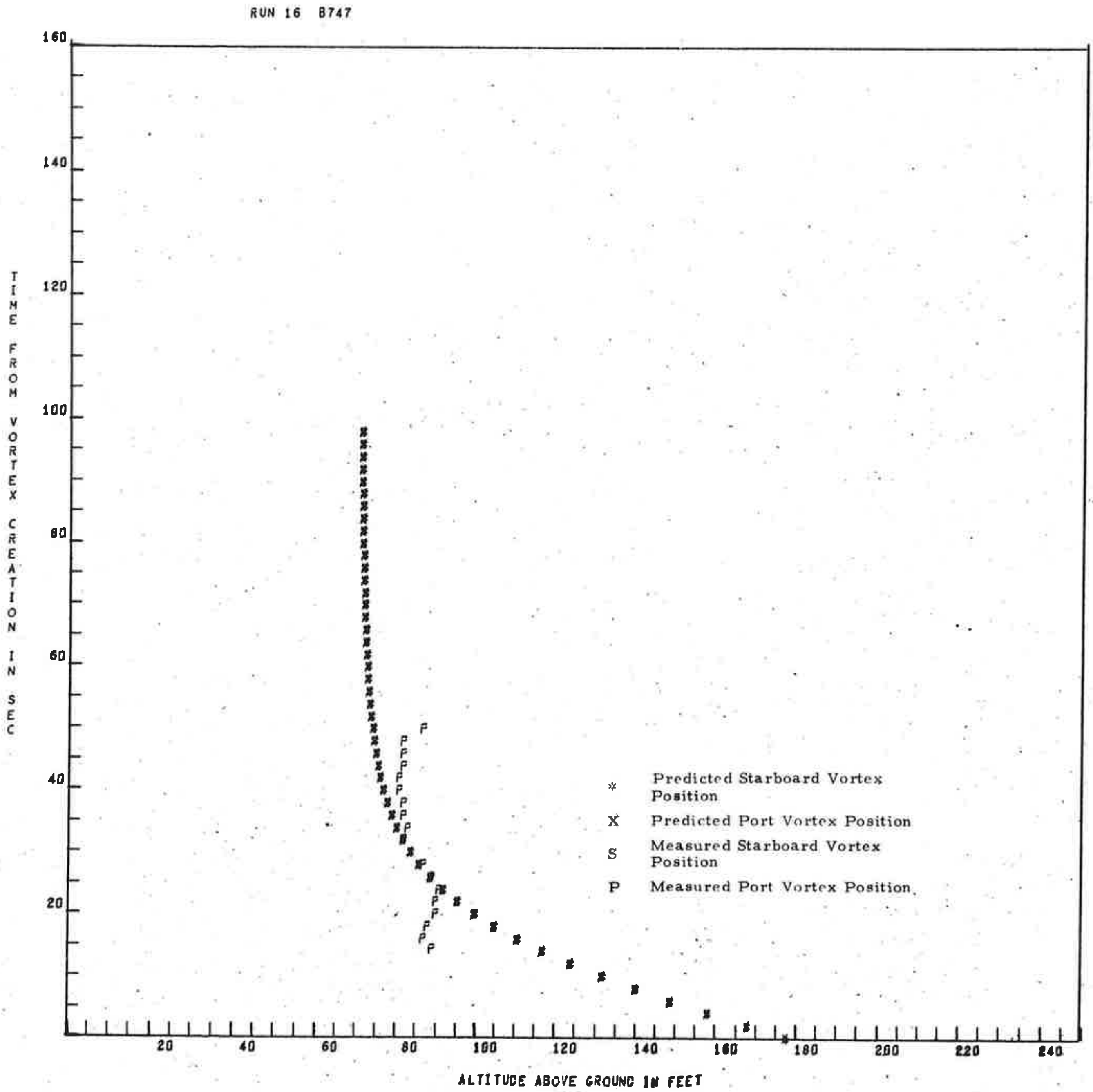

RUN 15 B747
160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

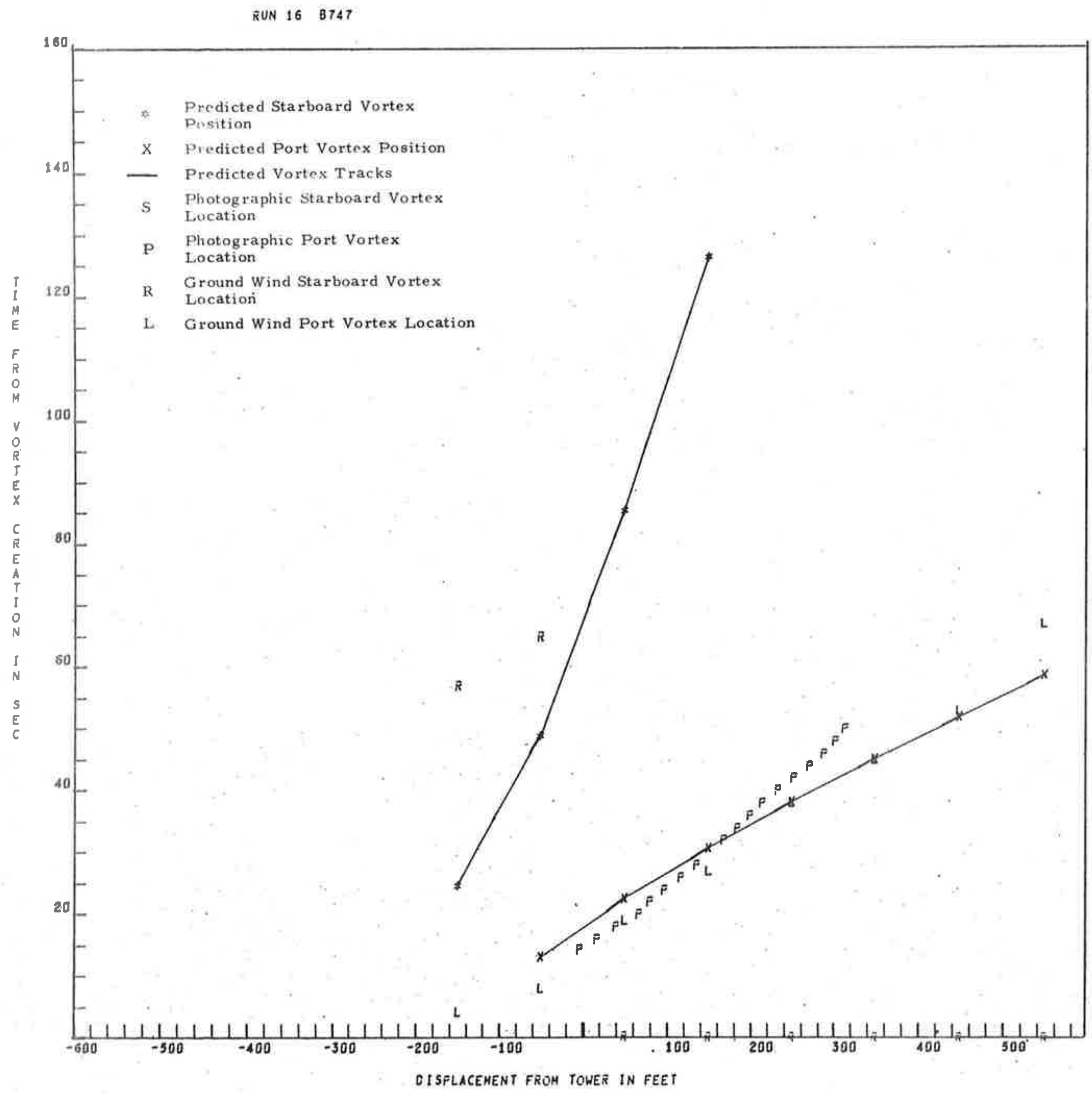
RUN 15 B747

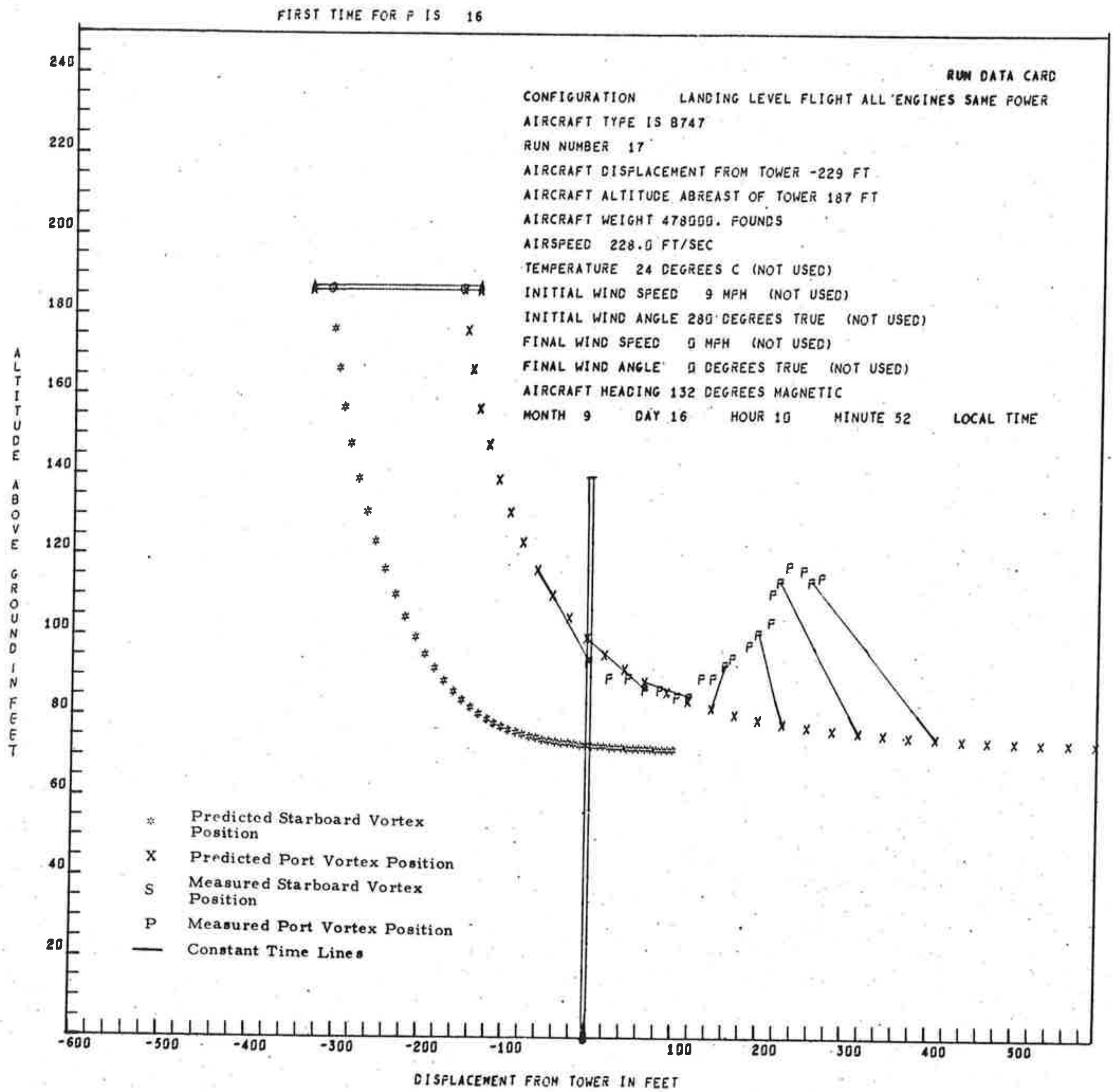

160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

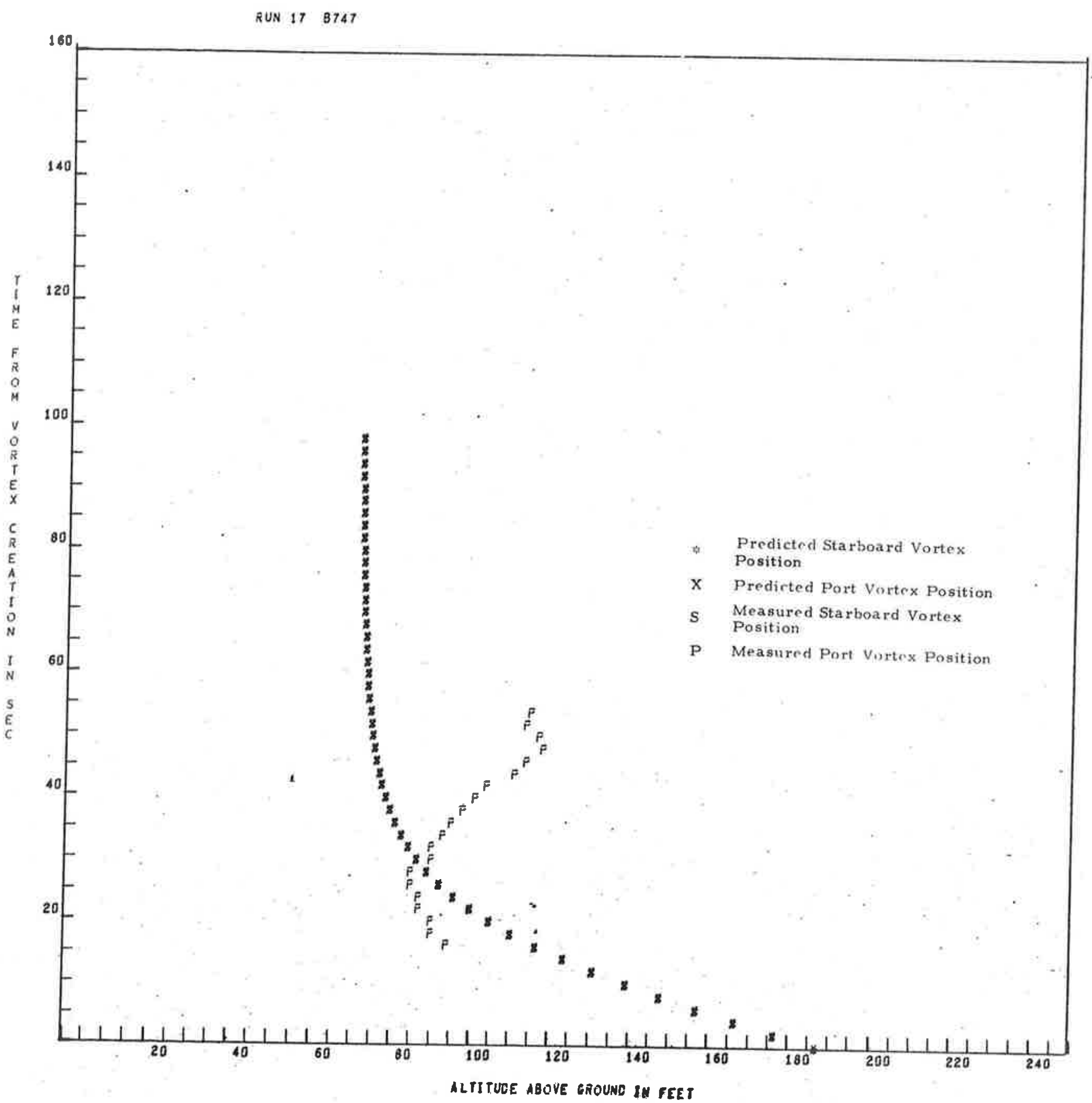


FIRST TIME FOR P IS 14
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 16
AIRCRAFT DISPLACEMENT FROM TOWER -222 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 178 FT
AIRCRAFT WEIGHT 480000. POUNDS
AIRSPEED 229.7 FT/SEC
TEMPERATURE 24 DEGREES C (NOT USED)
INITIAL WIND SPEED 9 MPH (NOT USED)
INITIAL WIND ANGLE 270 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 5 MPH (NOT USED)
FINAL WIND ANGLE 275 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 10 MINUTE 47 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

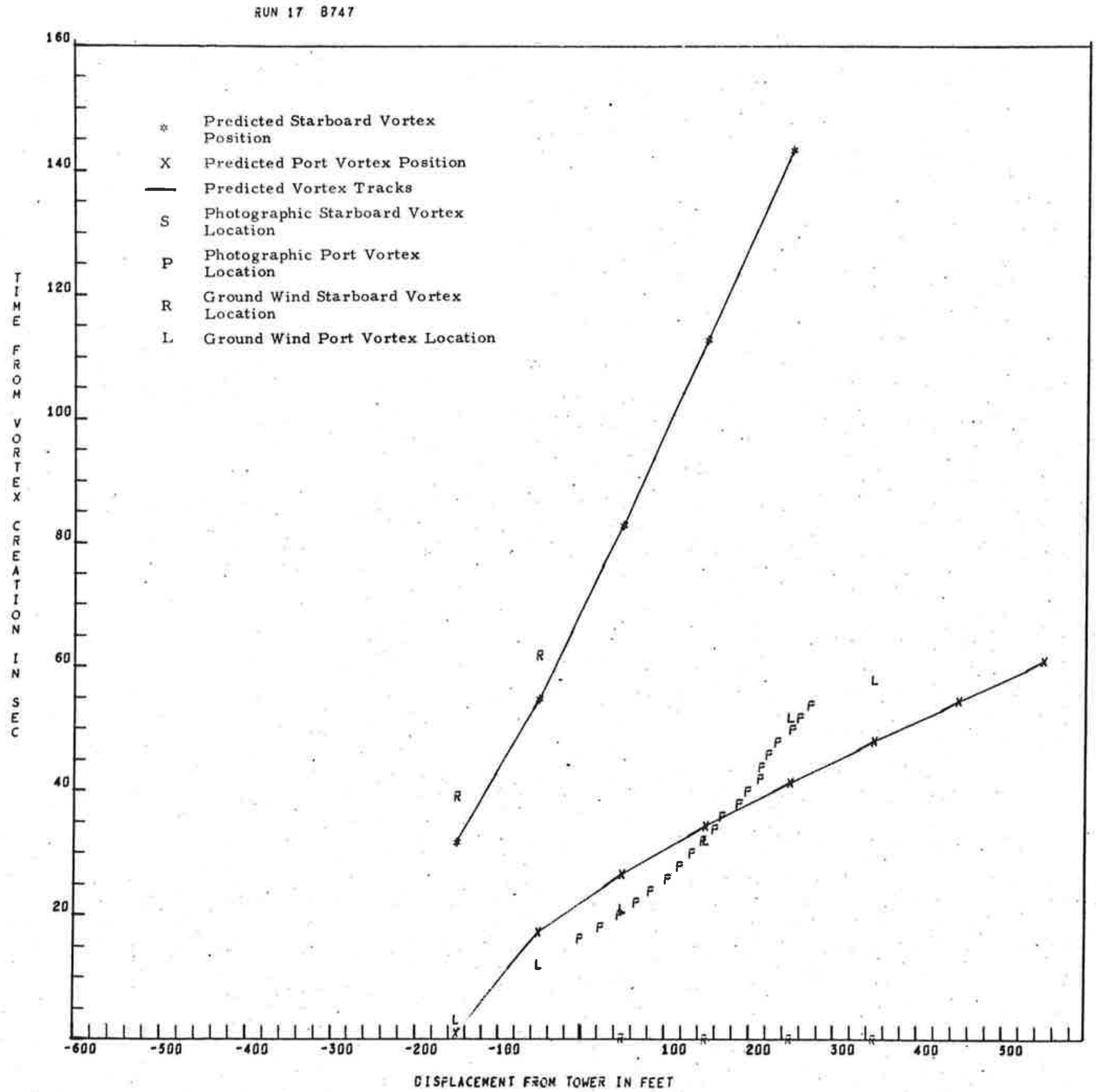

RUN 16 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

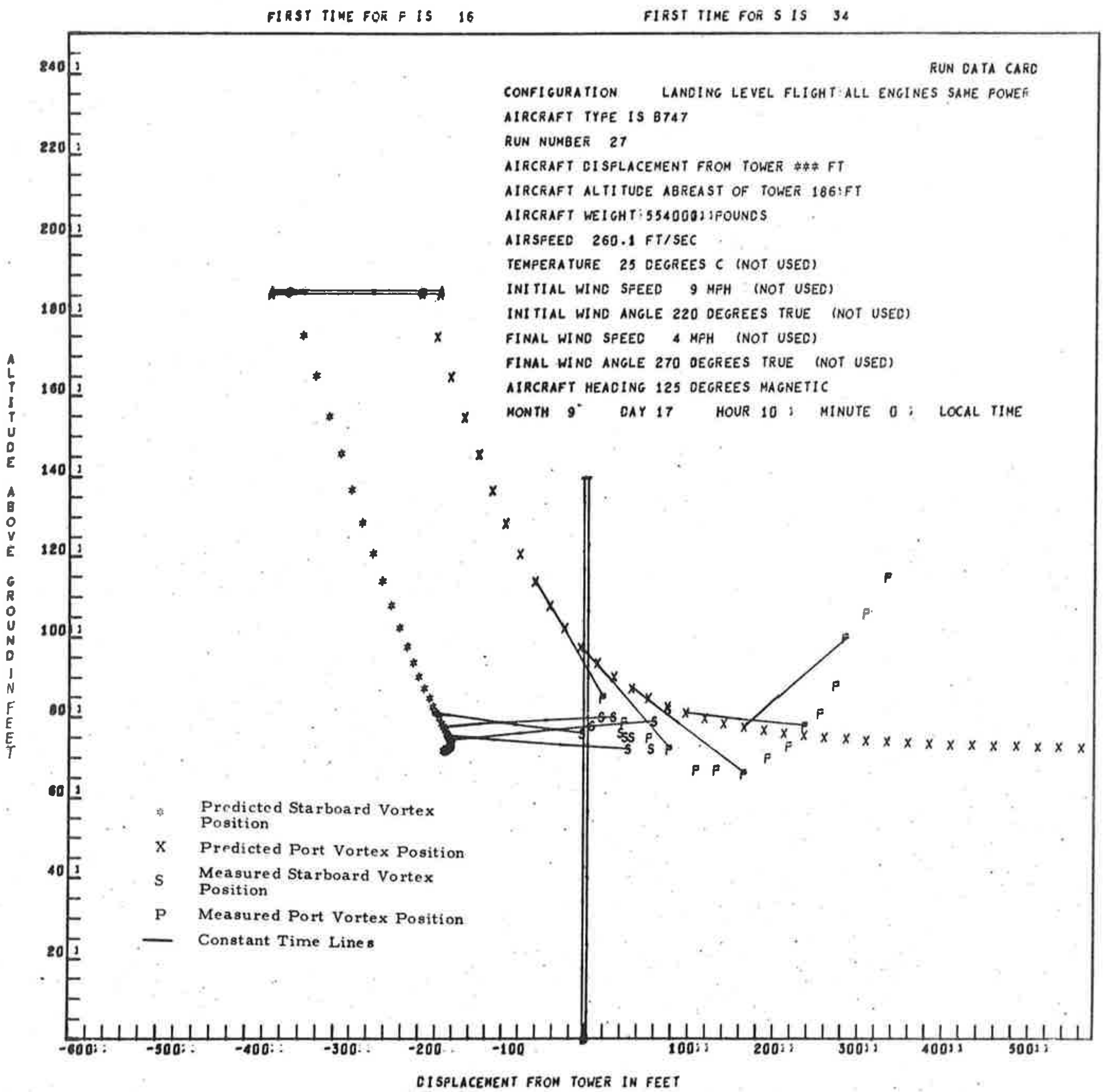

RUN 16 B747
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET

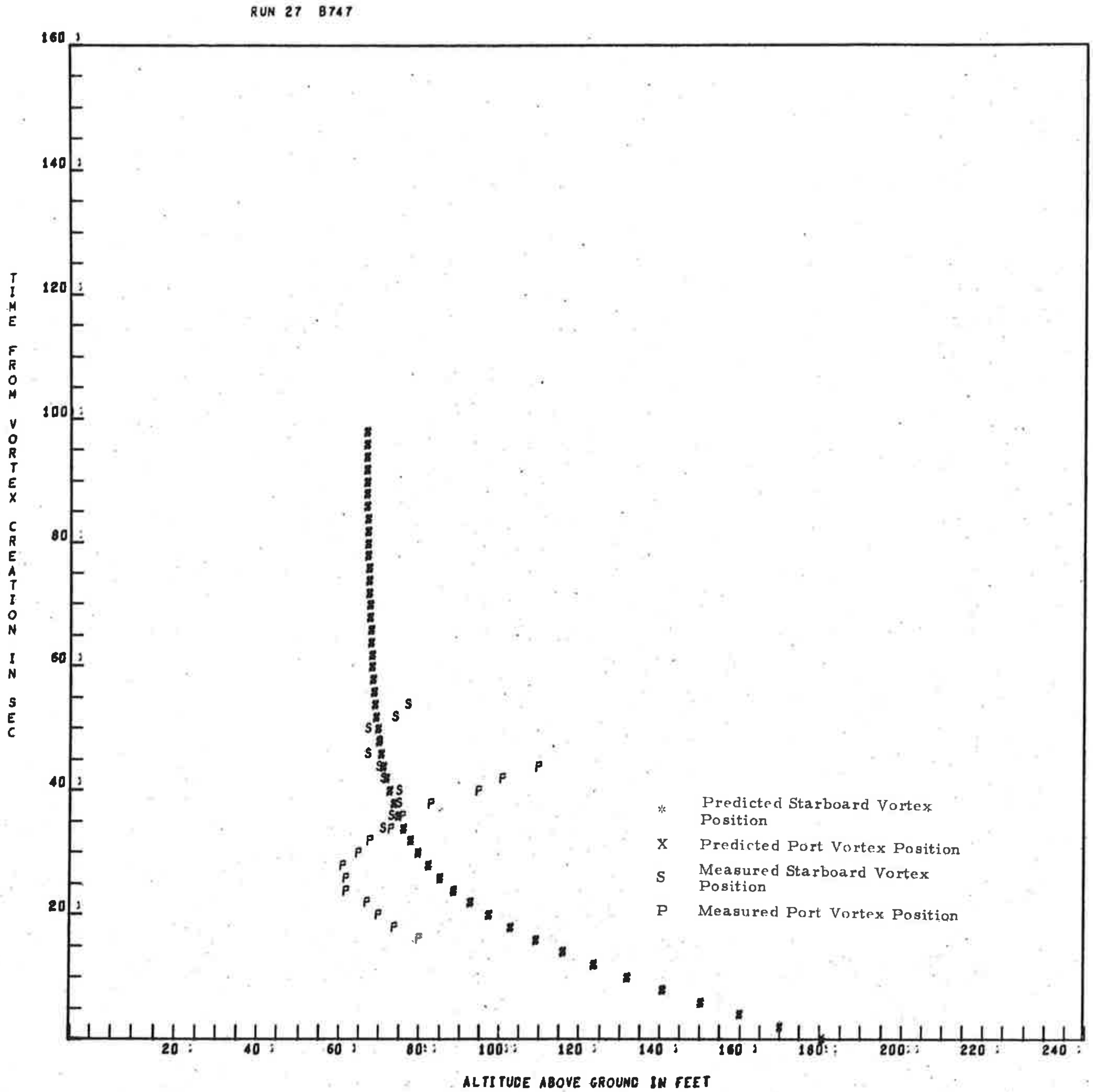

FIRST TIME FOR P IS 16
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 17
AIRCRAFT DISPLACEMENT FROM TOWER -229 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 187 FT
AIRCRAFT WEIGHT 478000. POUNDS
AIRSPEED 228.0 FT/SEC
TEMPERATURE 24 DEGREES C (NOT USED)
INITIAL WIND SPEED 9 MPH (NOT USED)
INITIAL WIND ANGLE 280 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 132 DEGREES MAGNETIC
MONTH 9 DAY 16 HOUR 10 MINUTE 52 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
— Constant Time Lines

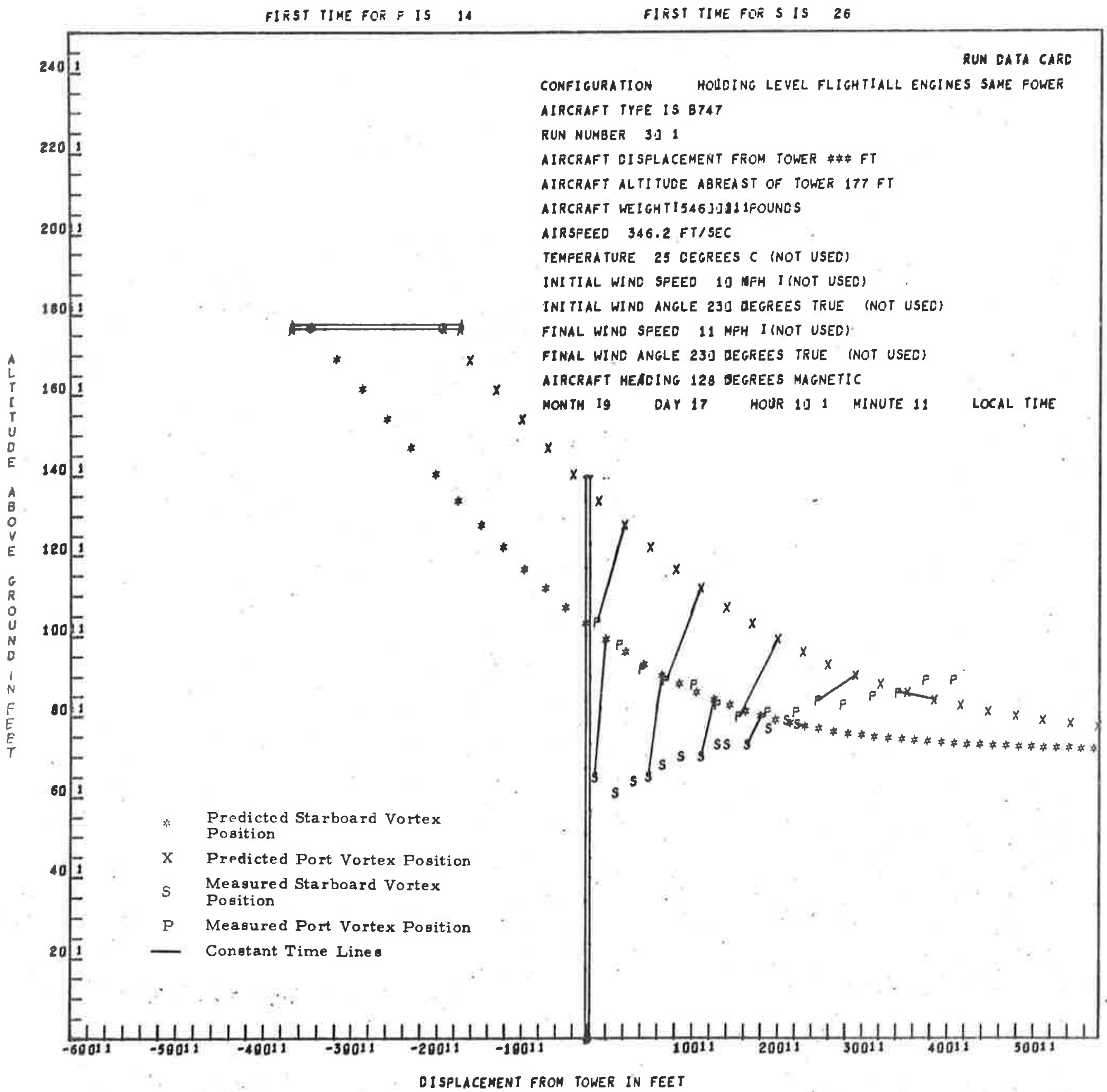


RUN 17 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 17 B747
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500

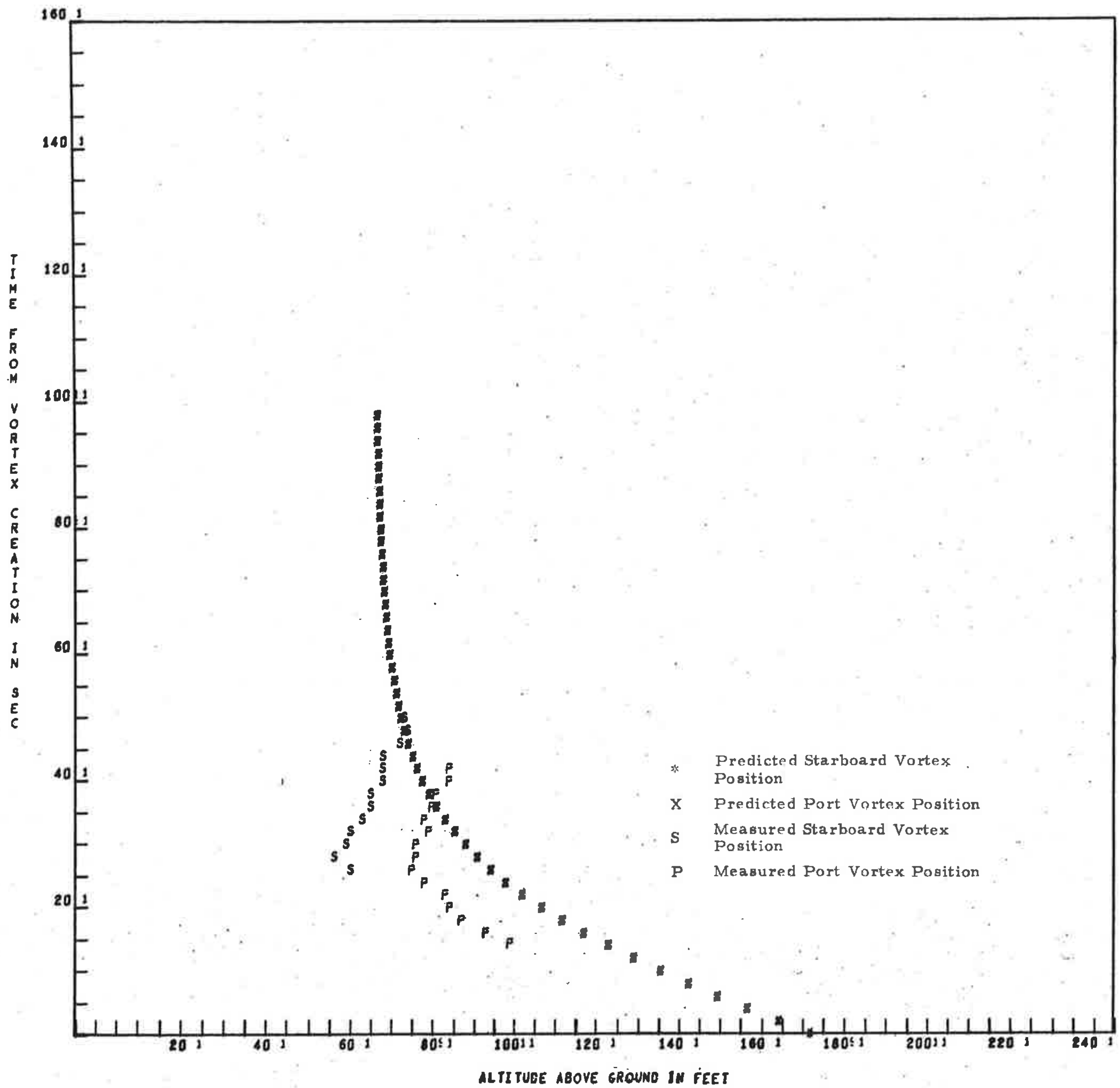

FIRST TIME FOR P IS 16
FIRST TIME FOR S IS 34
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 27
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 186 FT
AIRCRAFT WEIGHT 554000 POUNDS
AIRSPEED 260.1 FT/SEC
TEMPERATURE 25 DEGREES C (NOT USED)
INITIAL WIND SPEED 9 MPH (NOT USED)
INITIAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 4 MPH (NOT USED)
FINAL WIND ANGLE 270 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 125 DEGREES MAGNETIC
MONTH 9 DAY 17 HOUR 10 MINUTE 0 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines


RUN 27 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

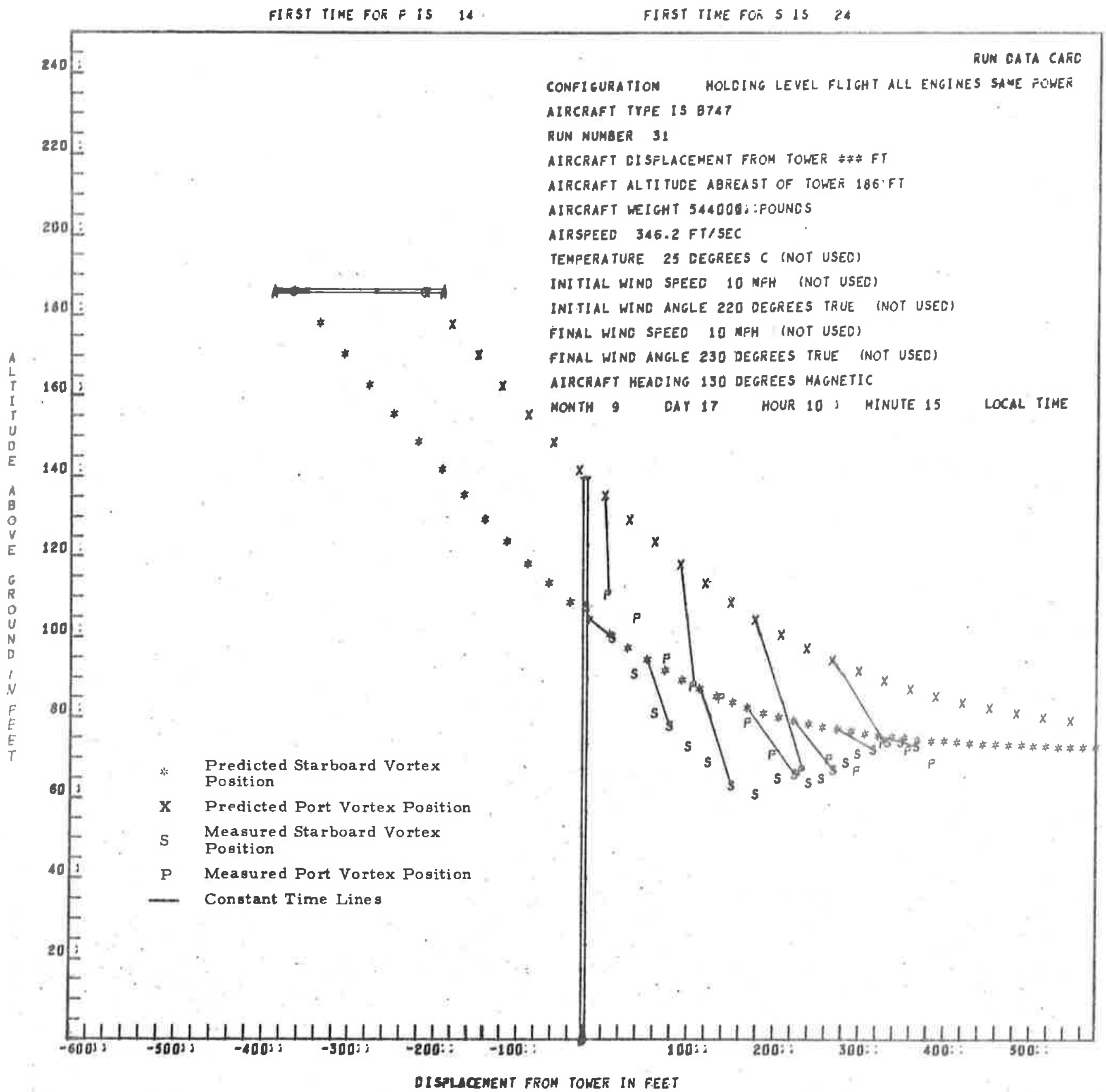


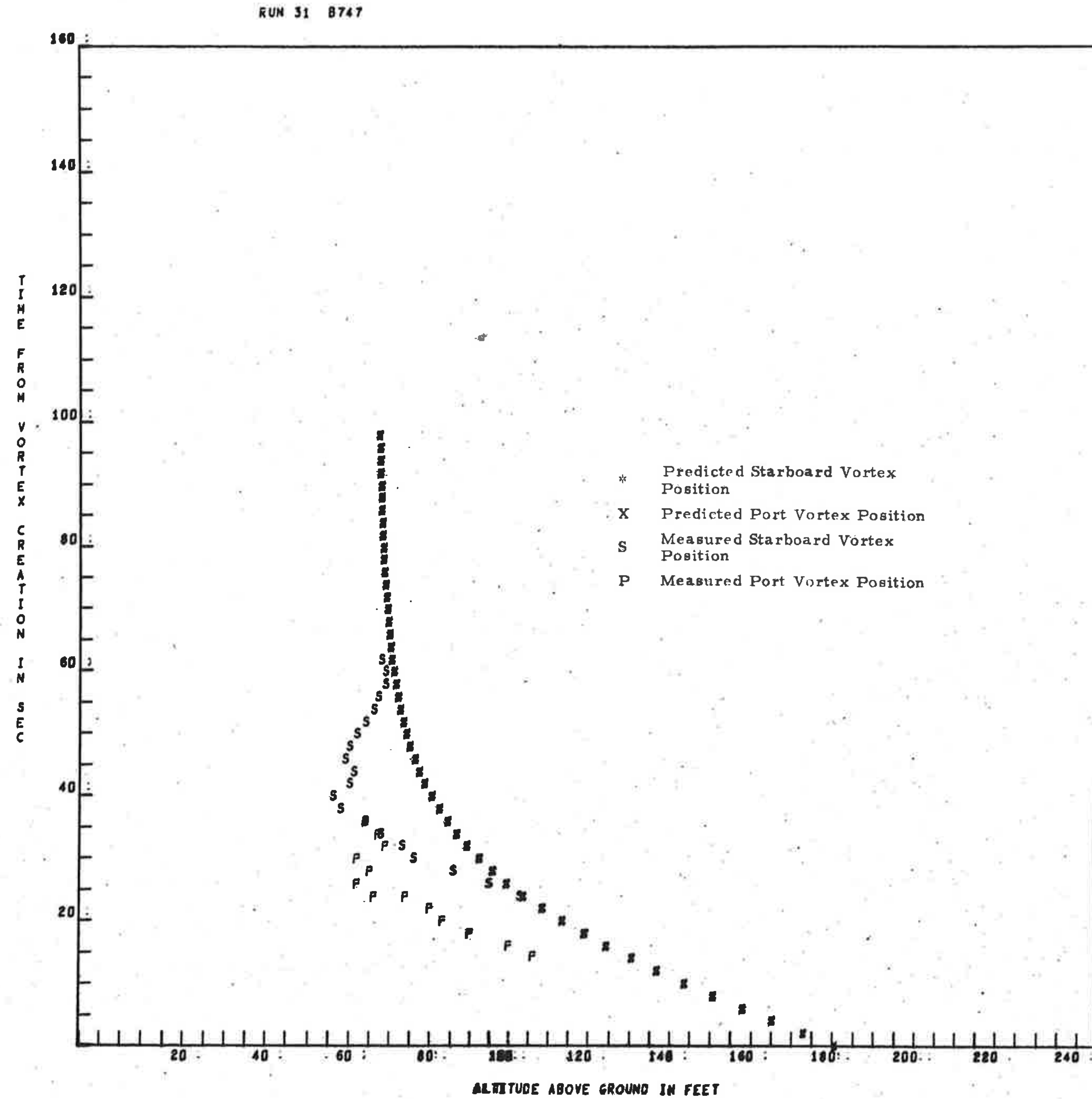
FIRST TIME FOR P IS 14
FIRST TIME FOR S IS 26
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHTIALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 30 1
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 177 FT
AIRCRAFT WEIGHTI5460011IPOUNDS
AIRSPEED 346.2 FT/SEC
TEMPERATURE 25 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH I(NOT USED)
INITIAL WIND ANGLE 230 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 11 MPH I(NOT USED)
FINAL WIND ANGLE 230 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 19 DAY 17 HOUR 10 1 MINUTE 11 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-60011
-50011
-40011
-30011
-20011
-10011
10011
20011
30011
40011
50011
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

RUN 30 B747

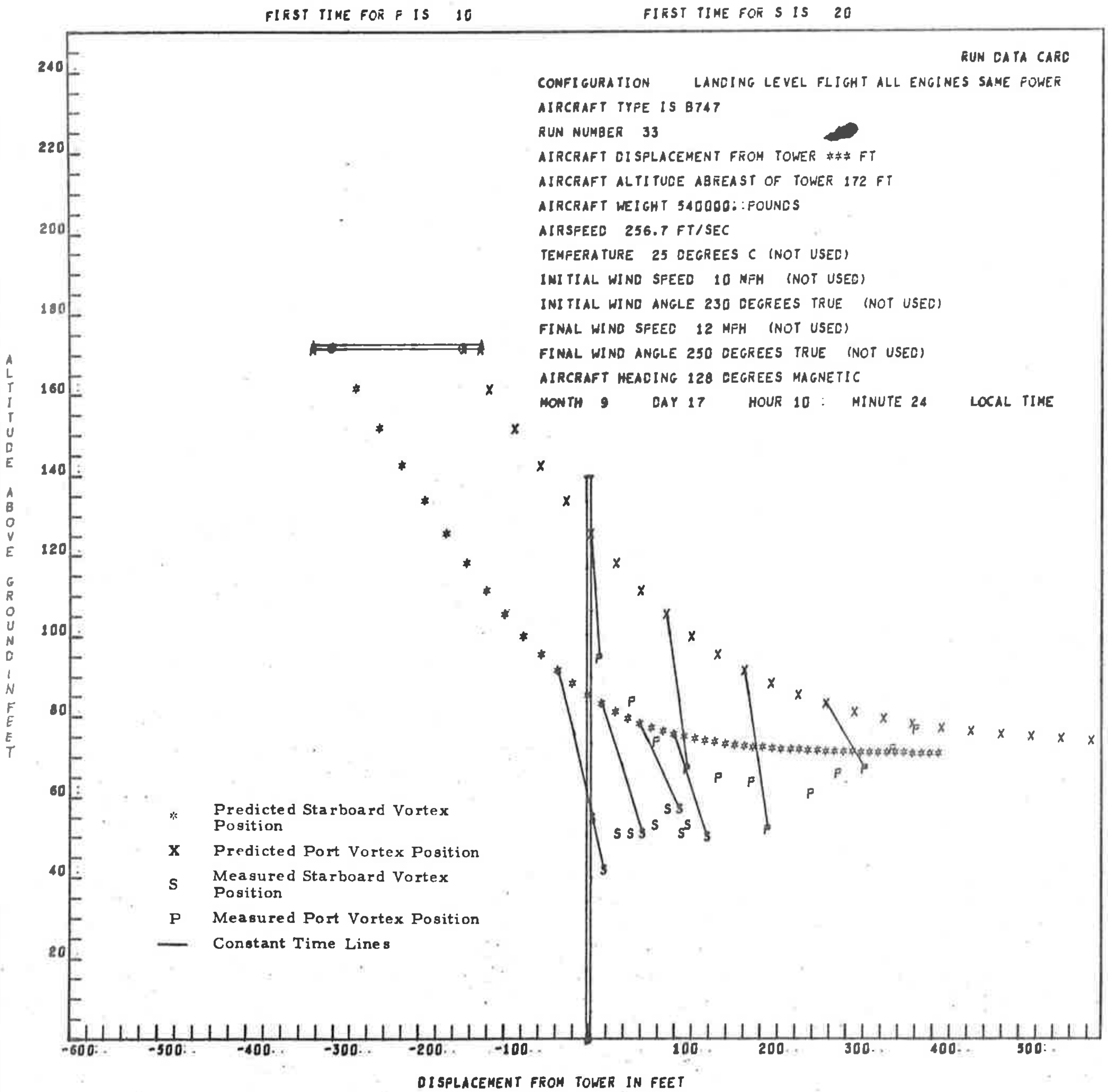


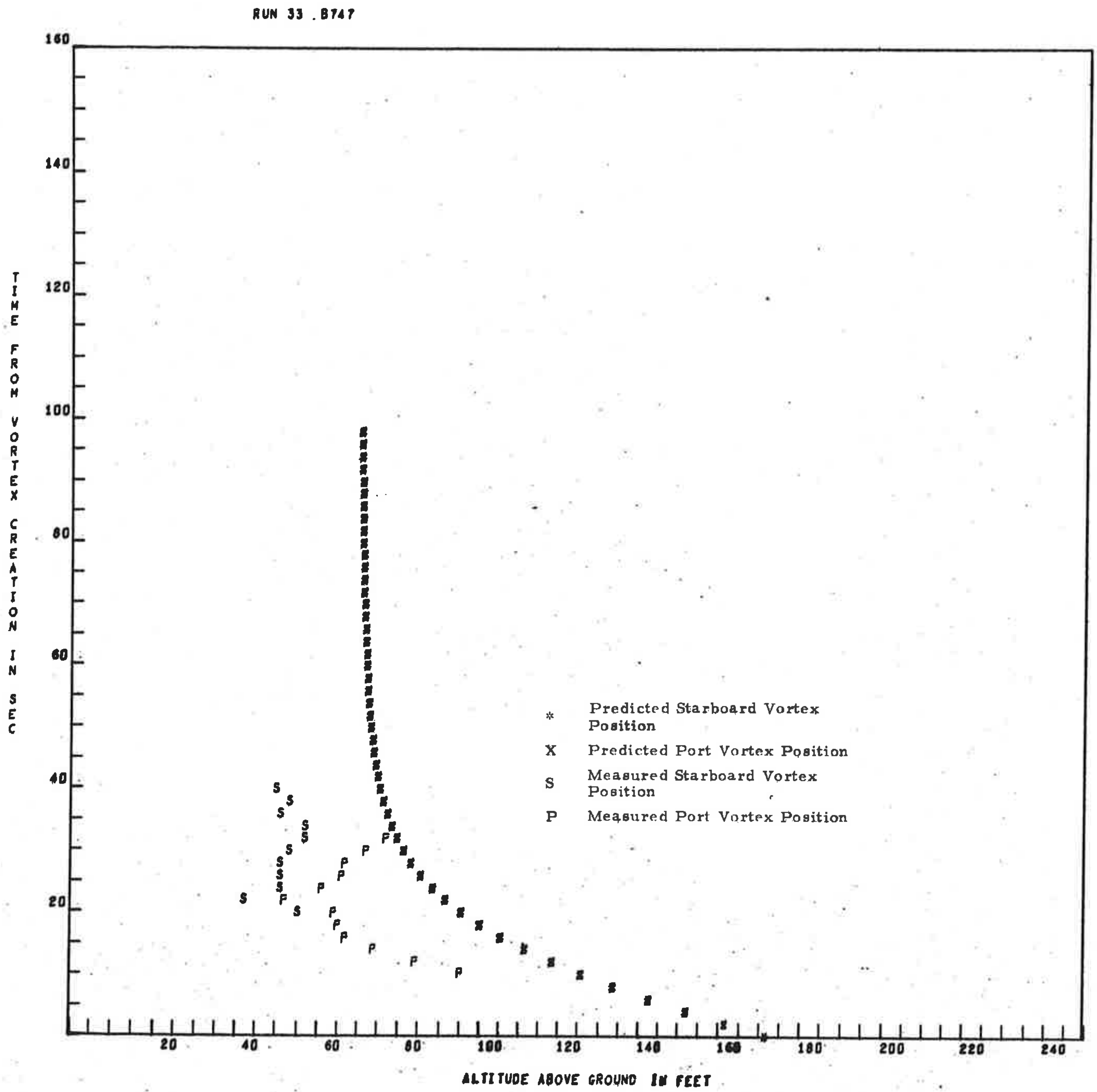
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


FIRST TIME FOR P IS 14
FIRST TIME FOR S IS 24
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 31
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 186 FT
AIRCRAFT WEIGHT 544000 POUNDS
AIRSPEED 346.2 FT/SEC
TEMPERATURE 25 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH (NOT USED)
INITIAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 10 MPH (NOT USED)
FINAL WIND ANGLE 230 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 9 DAY 17 HOUR 10 MINUTE 15 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

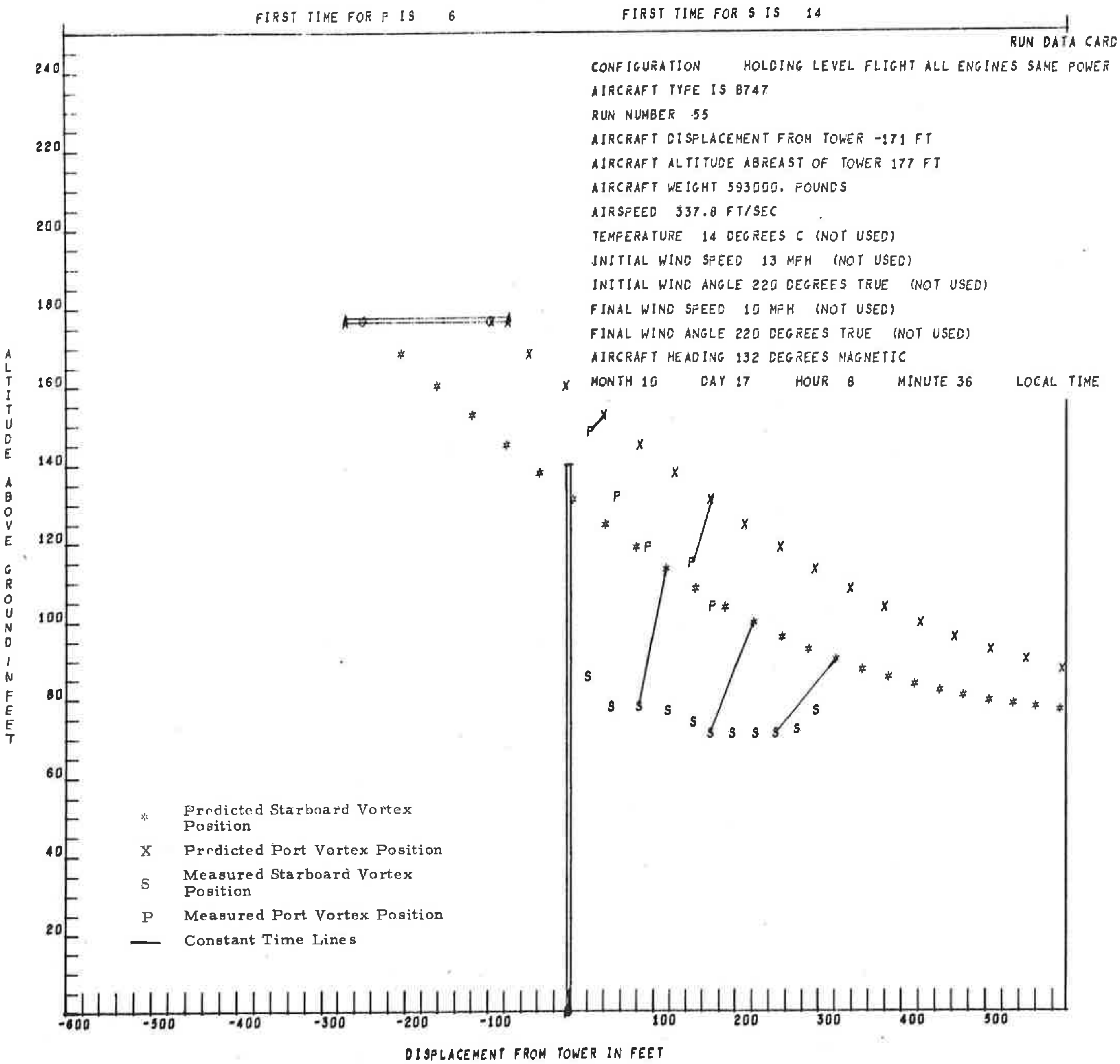


RUN 31 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

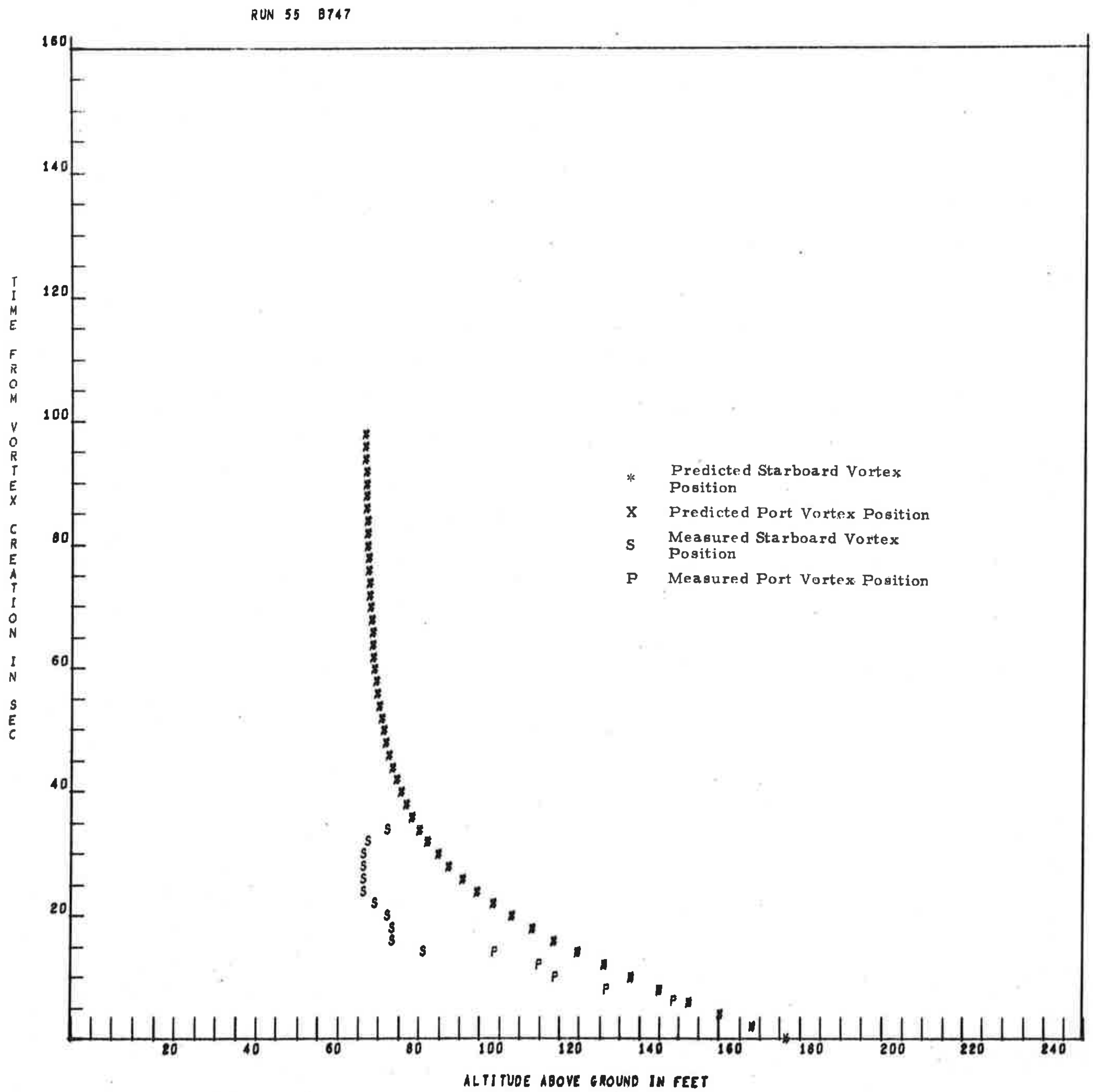

FIRST TIME FOR P IS 10
FIRST TIME FOR S IS 20
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 33
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 172 FT
AIRCRAFT WEIGHT 540000.:POUNDS
AIRSPEED 256.7 FT/SEC
TEMPERATURE 25 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH (NOT USED)
INITIAL WIND ANGLE 230 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 12 MPH (NOT USED)
FINAL WIND ANGLE 250 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 9 DAY 17 HOUR 10 MINUTE 24 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

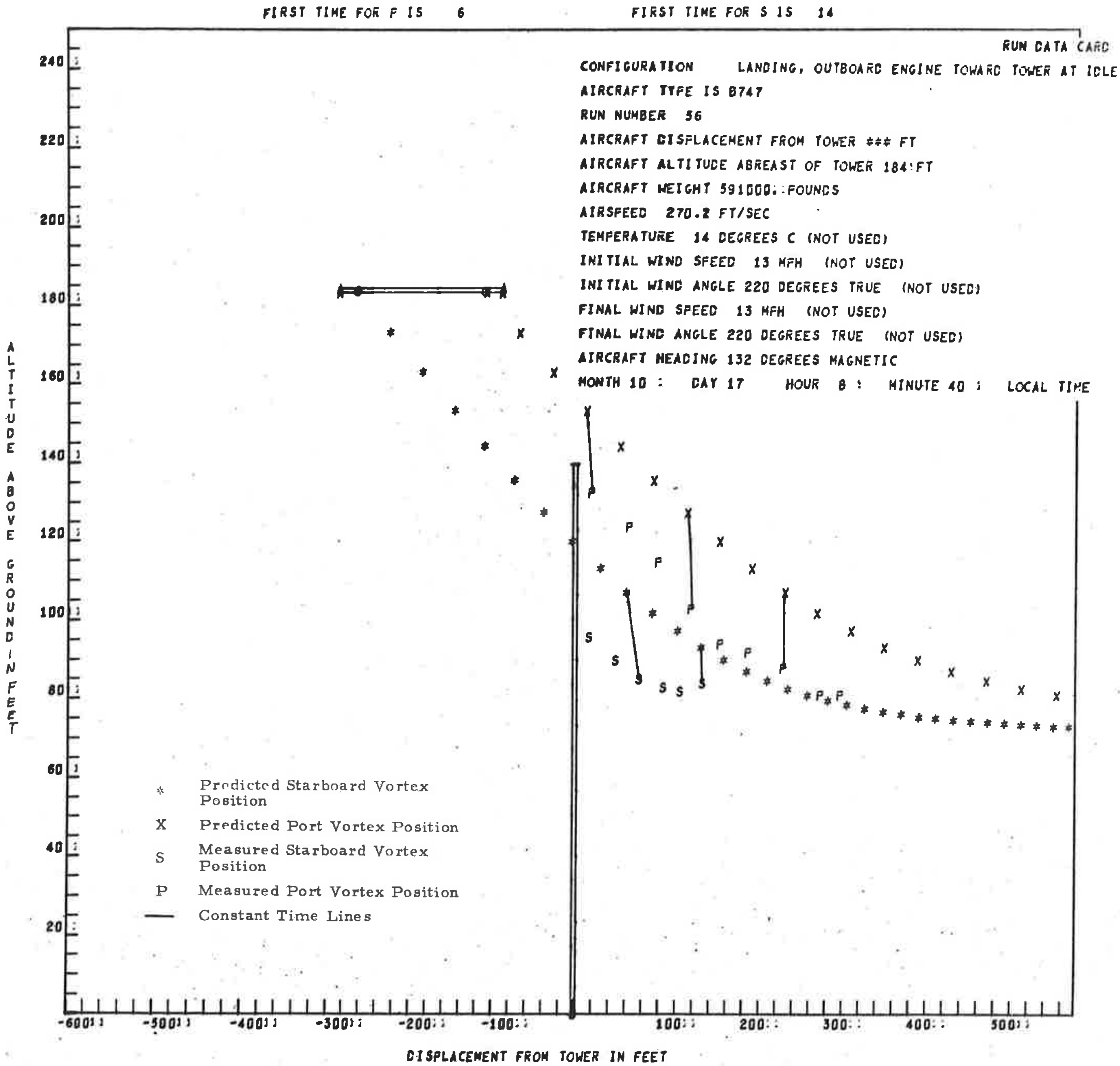


RUN 33 . B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



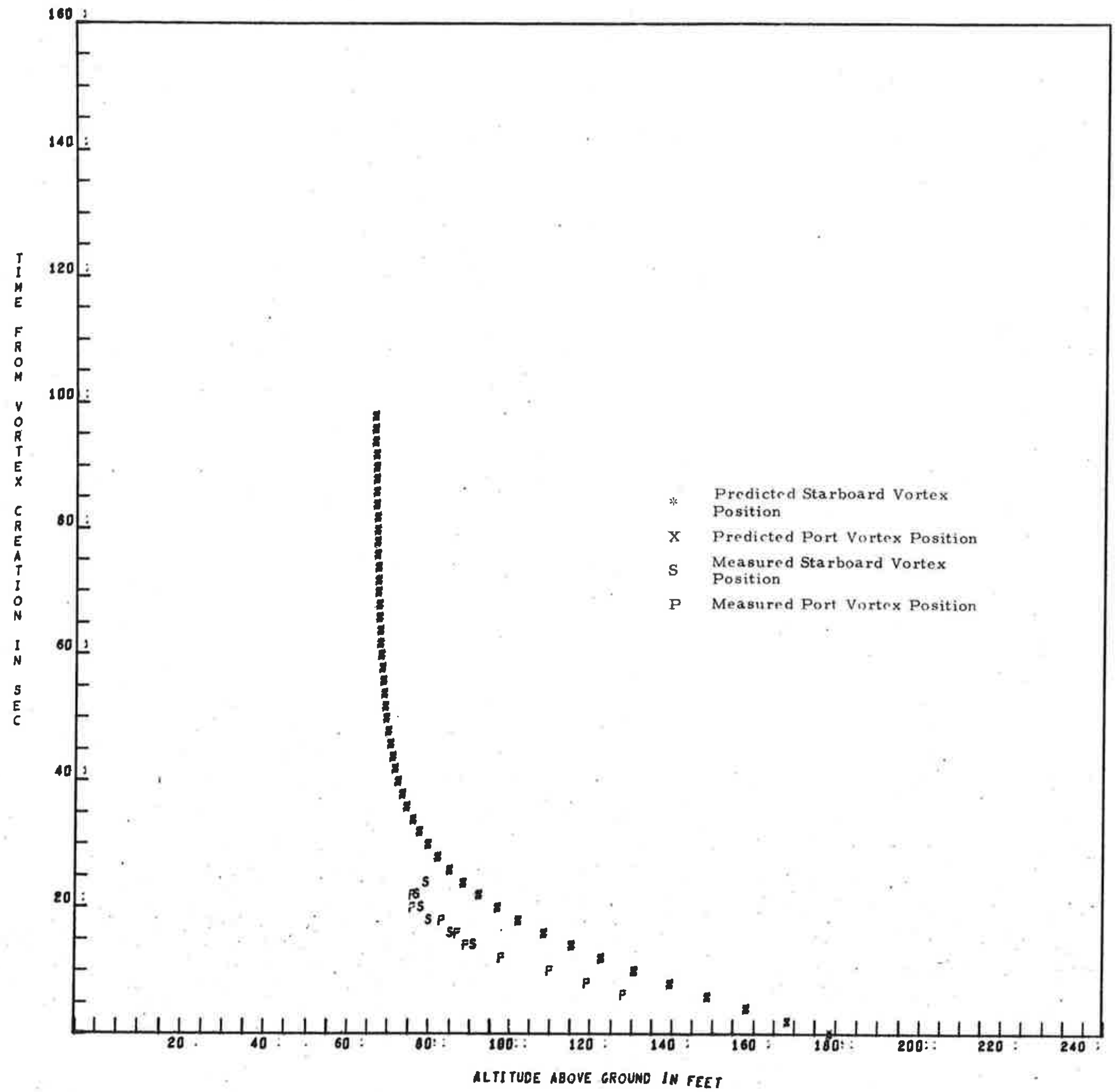
FIRST TIME FOR P IS 6
FIRST TIME FOR S IS 14
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 55
AIRCRAFT DISPLACEMENT FROM TOWER -171 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 177 FT
AIRCRAFT WEIGHT 593000. POUNDS
AIRSPEED 337.8 FT/SEC
TEMPERATURE 14 DEGREES C (NOT USED)
INITIAL WIND SPEED 13 MPH (NOT USED)
INITIAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 10 MPH (NOT USED)
FINAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 132 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 8 MINUTE 36 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines


RUN 55 B747
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

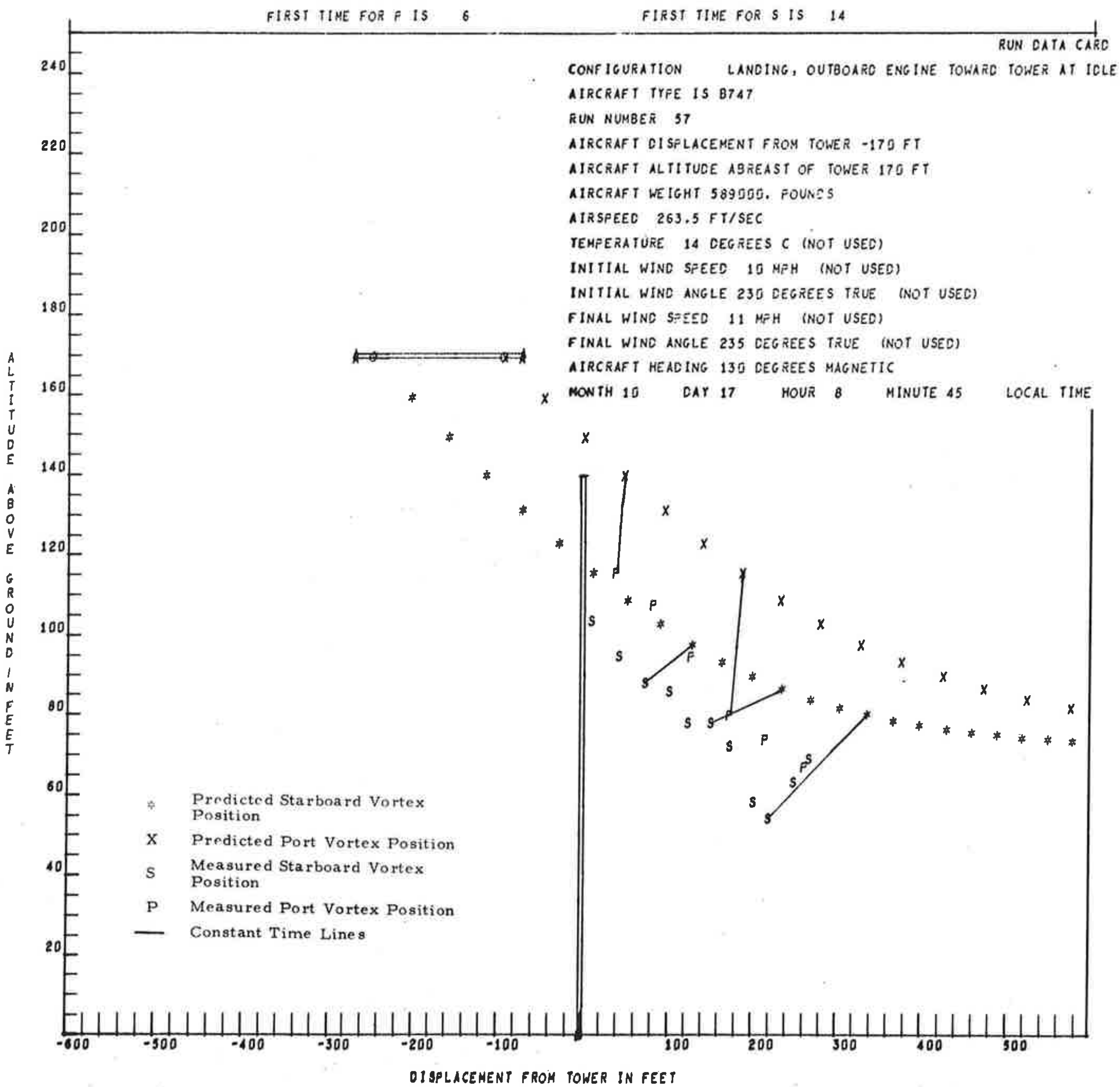


FIRST TIME FOR P IS 6
FIRST TIME FOR S IS 14
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B747
RUN NUMBER 56
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 184 FT
AIRCRAFT WEIGHT 591000. POUNDS
AIRSPEED 270.2 FT/SEC
TEMPERATURE 14 DEGREES C (NOT USED)
INITIAL WIND SPEED 13 MPH (NOT USED)
INITIAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 13 MPH (NOT USED)
FINAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 132 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 8 MINUTE 40 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

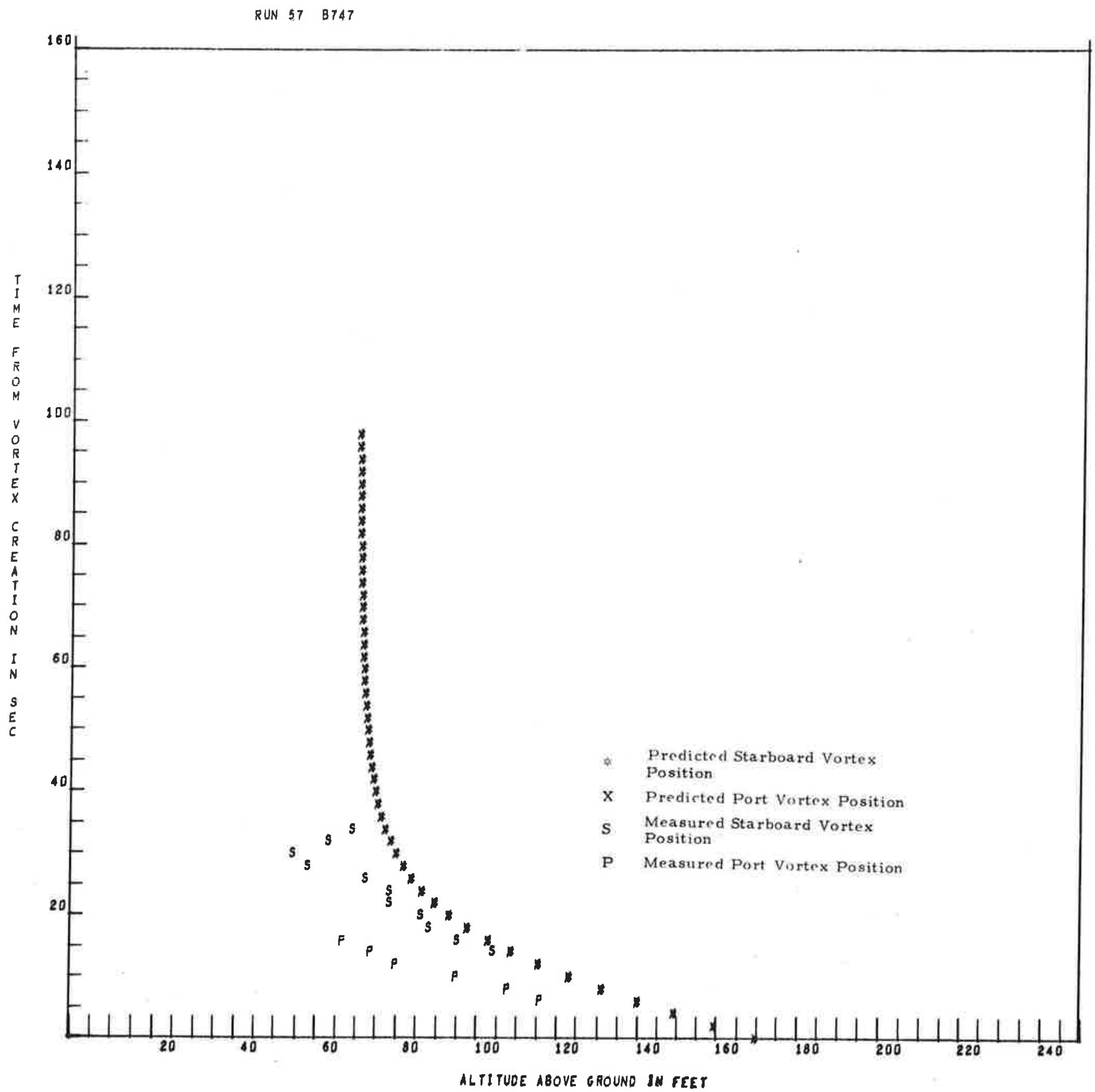
RUN 56 B747

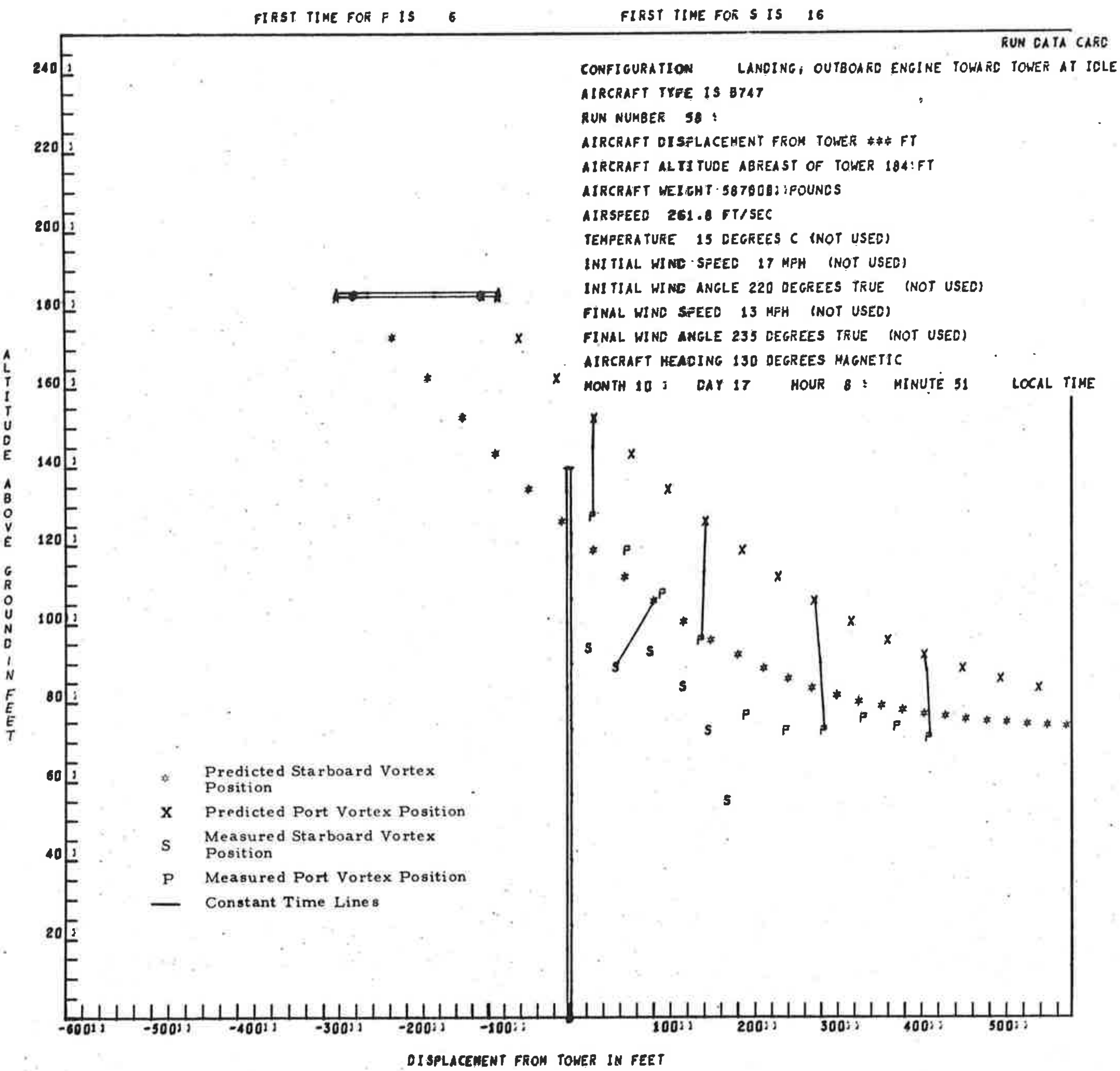


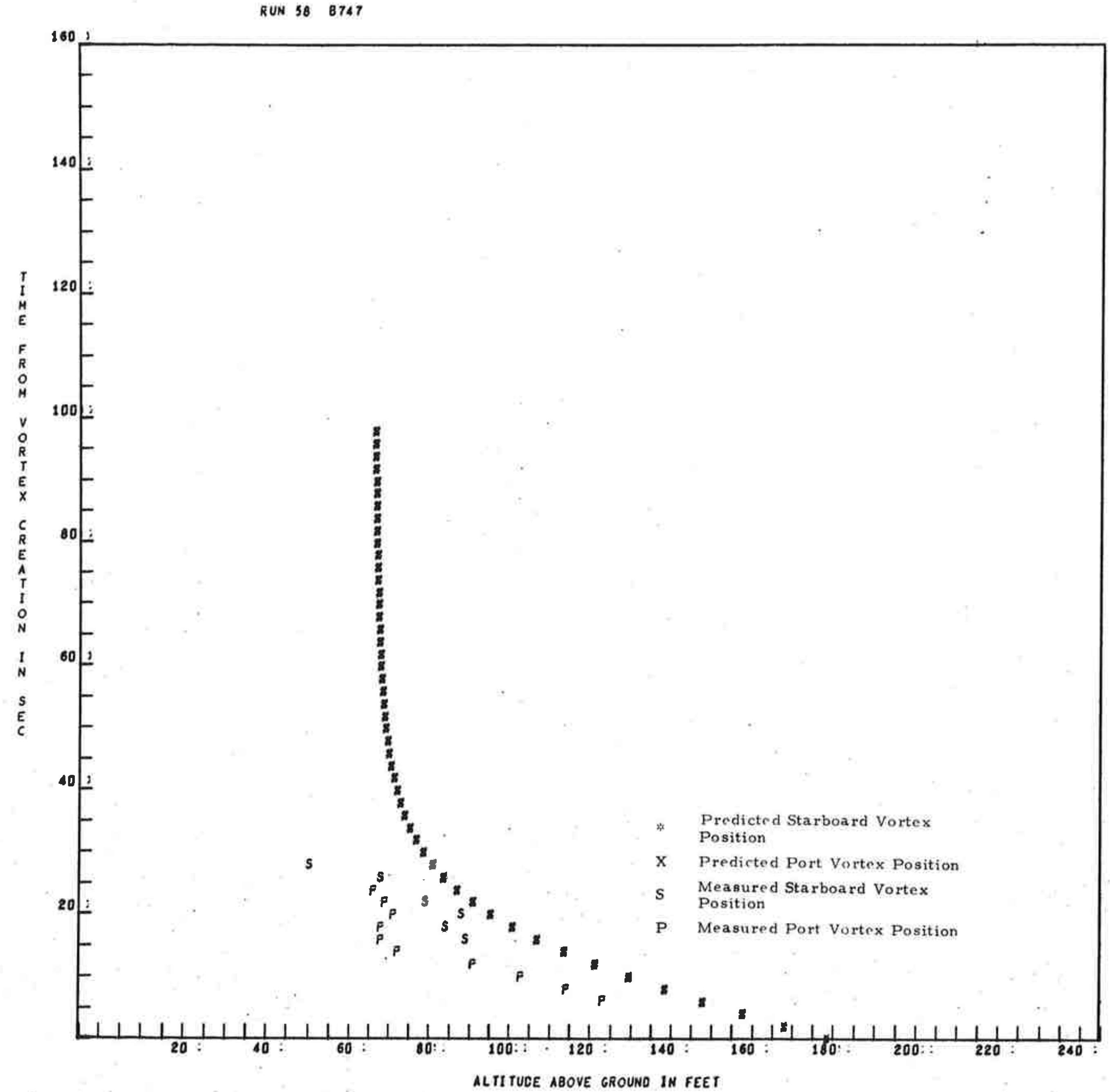
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



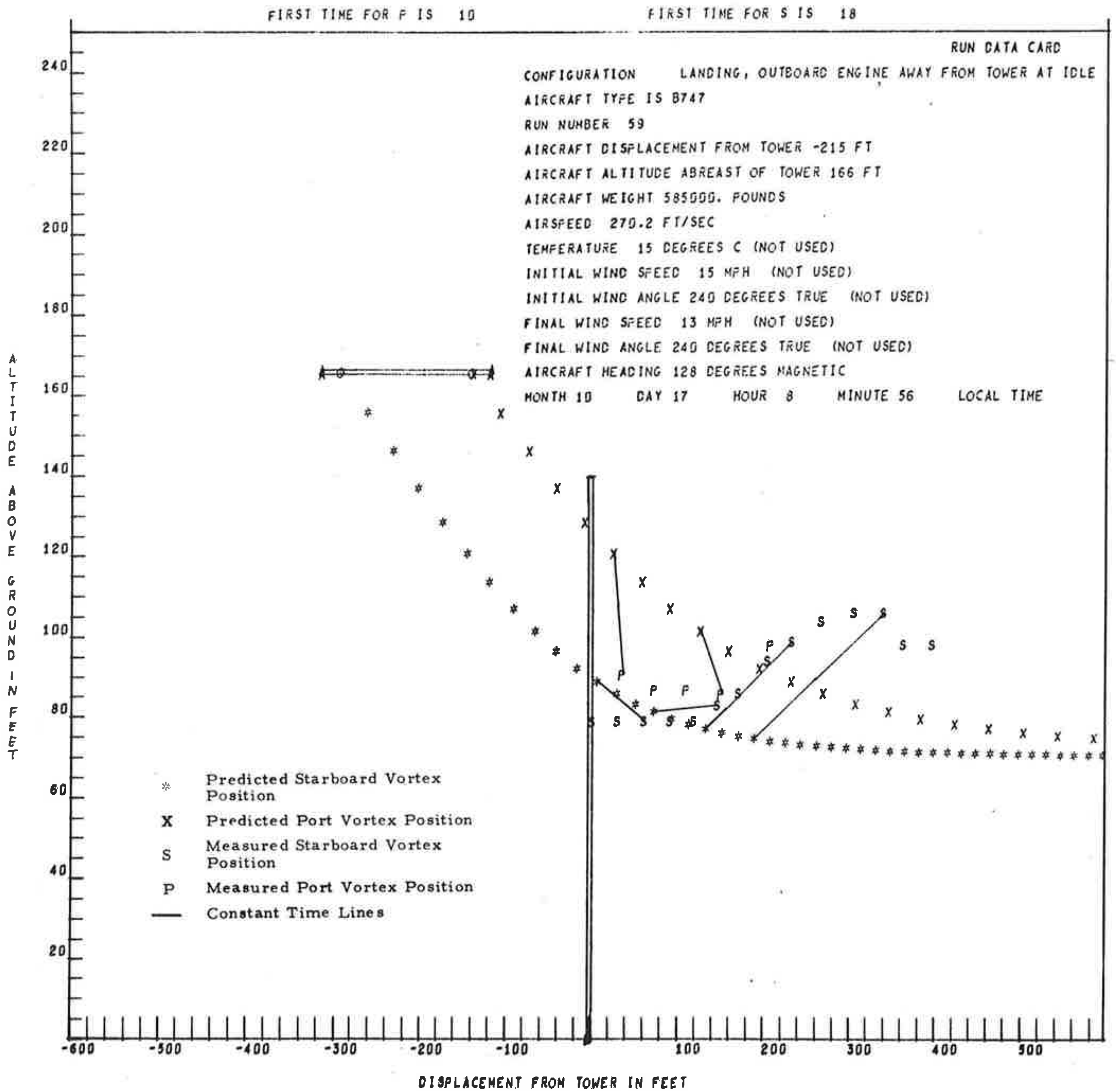
FIRST TIME FOR P IS 6
FIRST TIME FOR S IS 14
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B747
RUN NUMBER 57
AIRCRAFT DISPLACEMENT FROM TOWER -170 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 170 FT
AIRCRAFT WEIGHT 589000. POUNDS
AIRSPEED 263.5 FT/SEC
TEMPERATURE 14 DEGREES C (NOT USED)
INITIAL WIND SPEED 10 MPH (NOT USED)
INITIAL WIND ANGLE 230 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 11 MPH (NOT USED)
FINAL WIND ANGLE 235 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 8 MINUTE 45 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

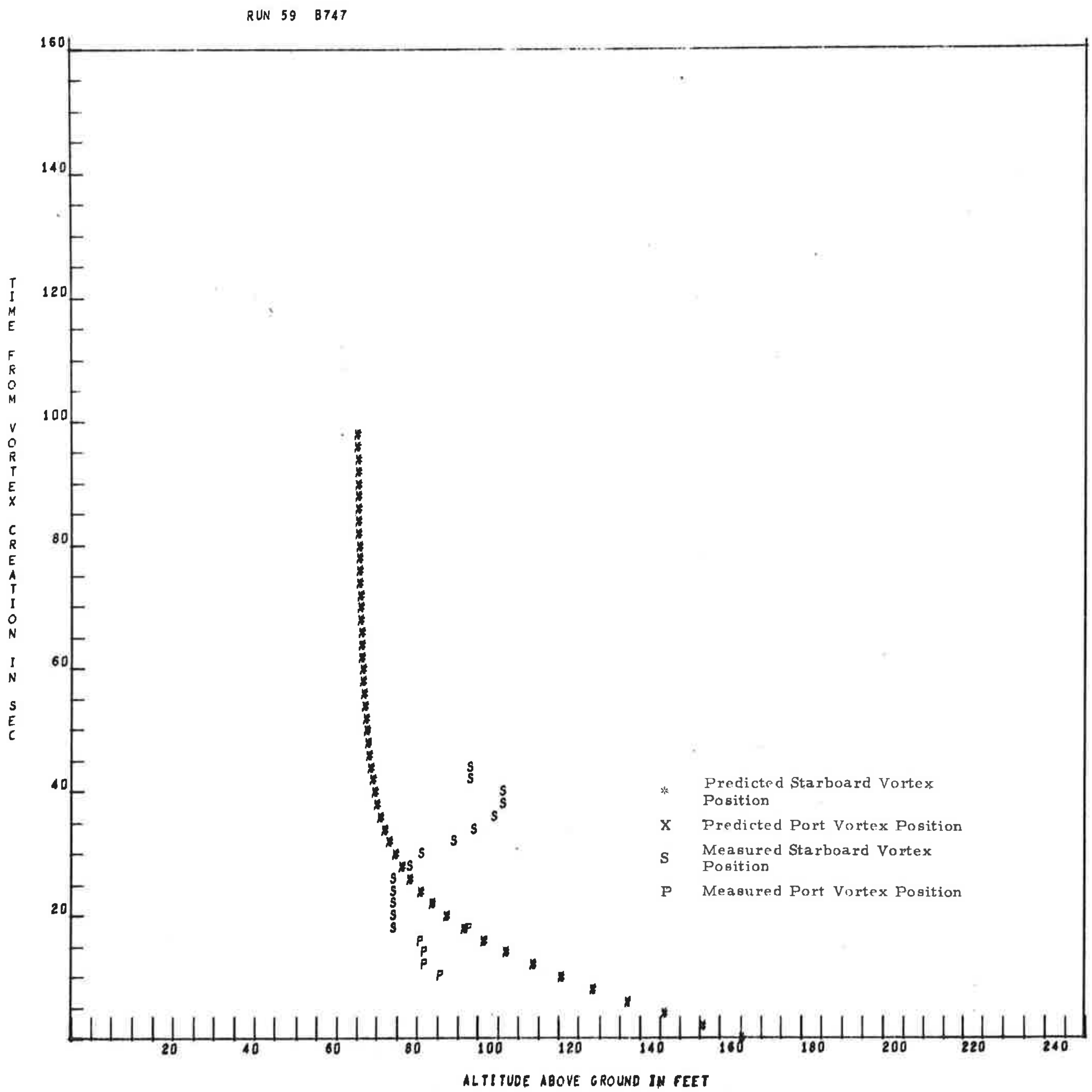

RUN 57 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

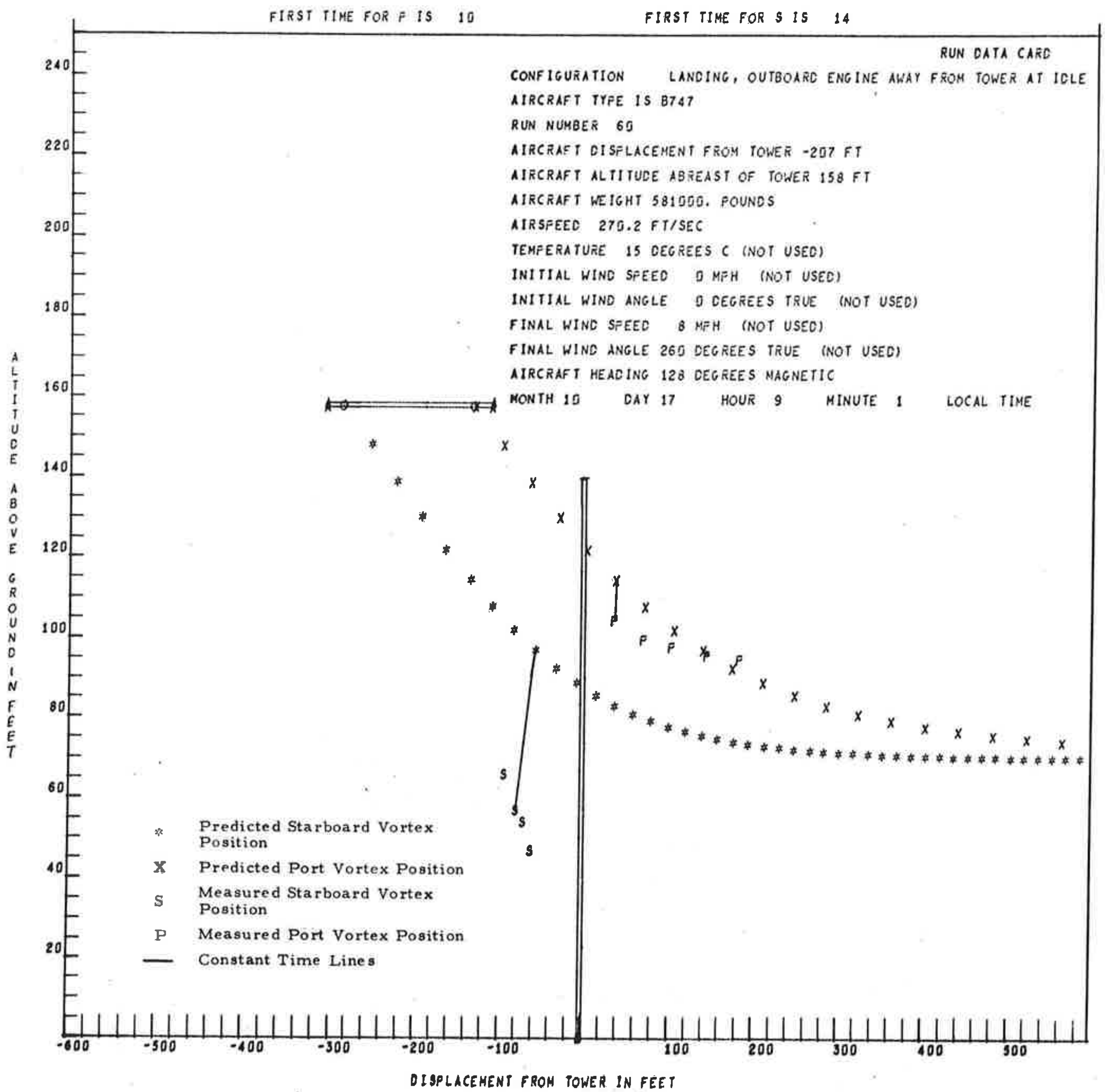

FIRST TIME FOR P IS 6
FIRST TIME FOR S IS 16
RUN DATA CARD
CONFIGURATION LANDING; OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B747
RUN NUMBER 58
AIRCRAFT DISPLACEMENT FROM TOWER *** FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 184 FT
AIRCRAFT WEIGHT 587808 POUNDS
AIRSPEED 261.8 FT/SEC
TEMPERATURE 15 DEGREES C (NOT USED)
INITIAL WIND SPEED 17 MPH (NOT USED)
INITIAL WIND ANGLE 220 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 13 MPH (NOT USED)
FINAL WIND ANGLE 235 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 8 MINUTE 51 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
-600
-500
-400
-300
-200
-100
100
200
300
400
500
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines



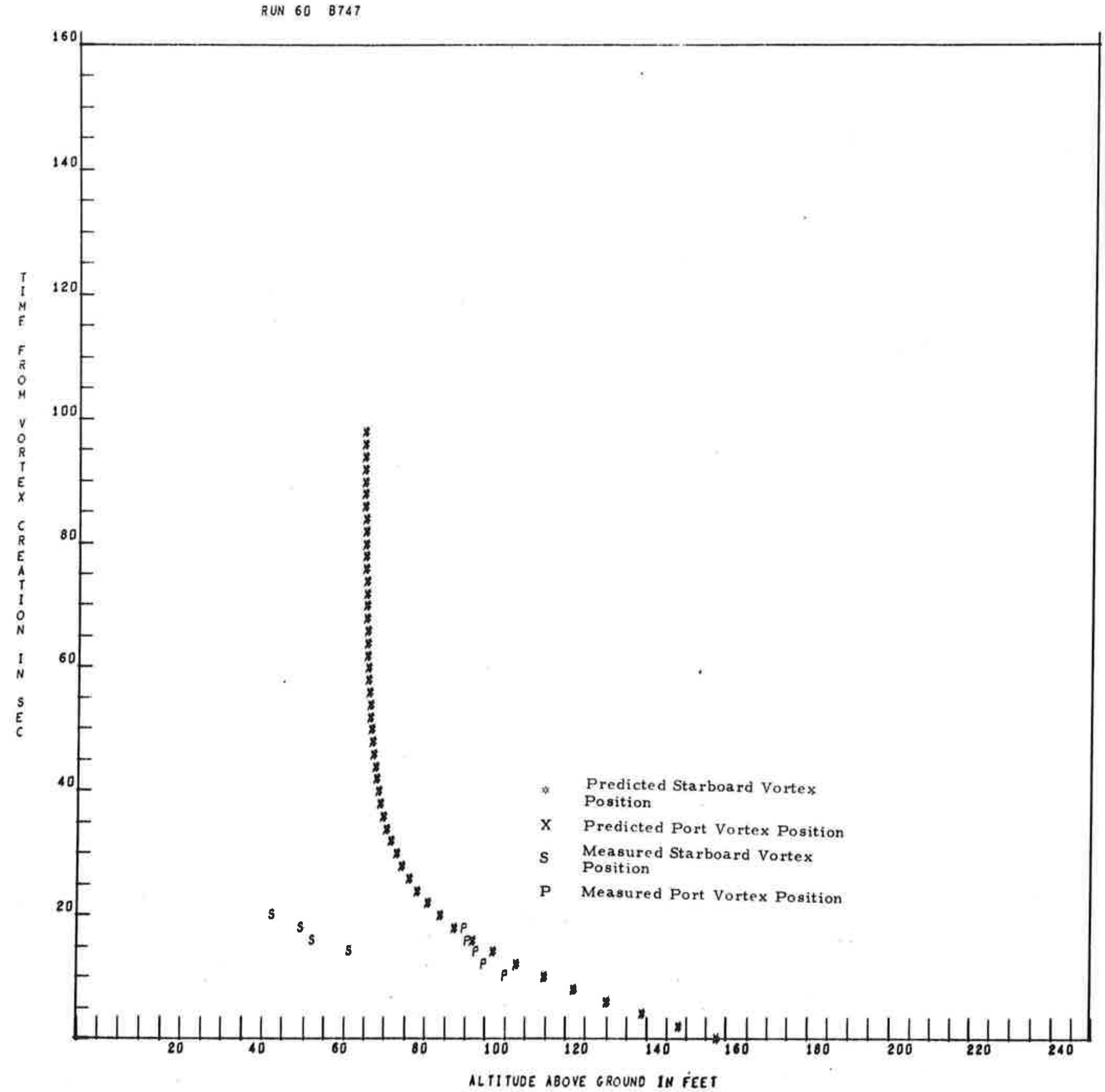
RUN 58 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

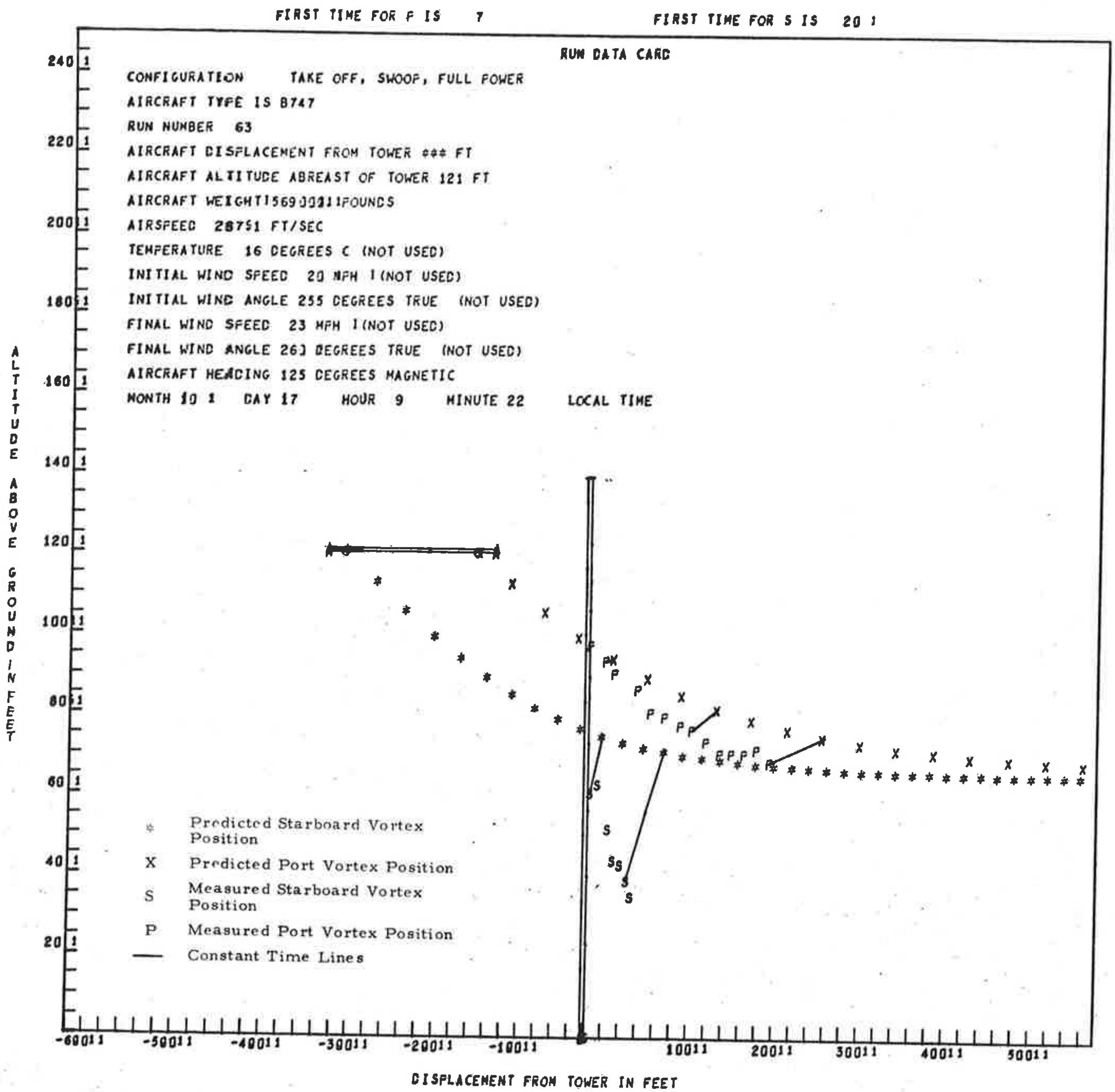

FIRST TIME FOR P IS 10
FIRST TIME FOR S IS 18
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
AIRCRAFT TYPE IS B747
RUN NUMBER 59
AIRCRAFT DISPLACEMENT FROM TOWER -215 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 166 FT
AIRCRAFT WEIGHT 585000. POUNDS
AIRSPEED 270.2 FT/SEC
TEMPERATURE 15 DEGREES C (NOT USED)
INITIAL WIND SPEED 15 MPH (NOT USED)
INITIAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 13 MPH (NOT USED)
FINAL WIND ANGLE 240 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 8 MINUTE 56 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines


RUN 59 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

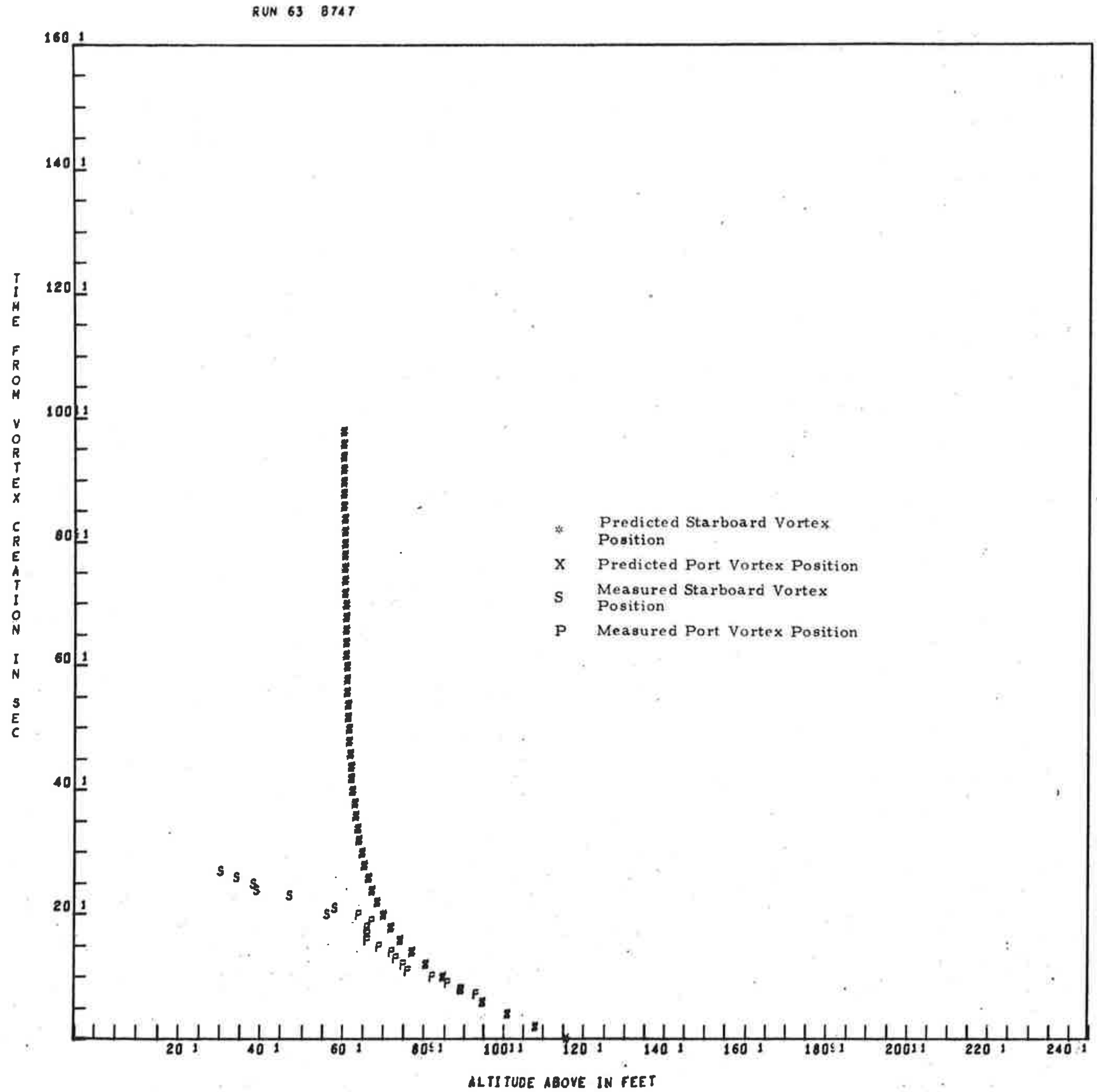


FIRST TIME FOR P IS 10
FIRST TIME FOR S IS 14
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
AIRCRAFT TYPE IS B747
RUN NUMBER 60
AIRCRAFT DISPLACEMENT FROM TOWER -207 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 158 FT
AIRCRAFT WEIGHT 581000. POUNDS
AIRSPEED 270.2 FT/SEC
TEMPERATURE 15 DEGREES C (NOT USED)
INITIAL WIND SPEED 0 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 260 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 10 DAY 17 HOUR 9 MINUTE 1 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

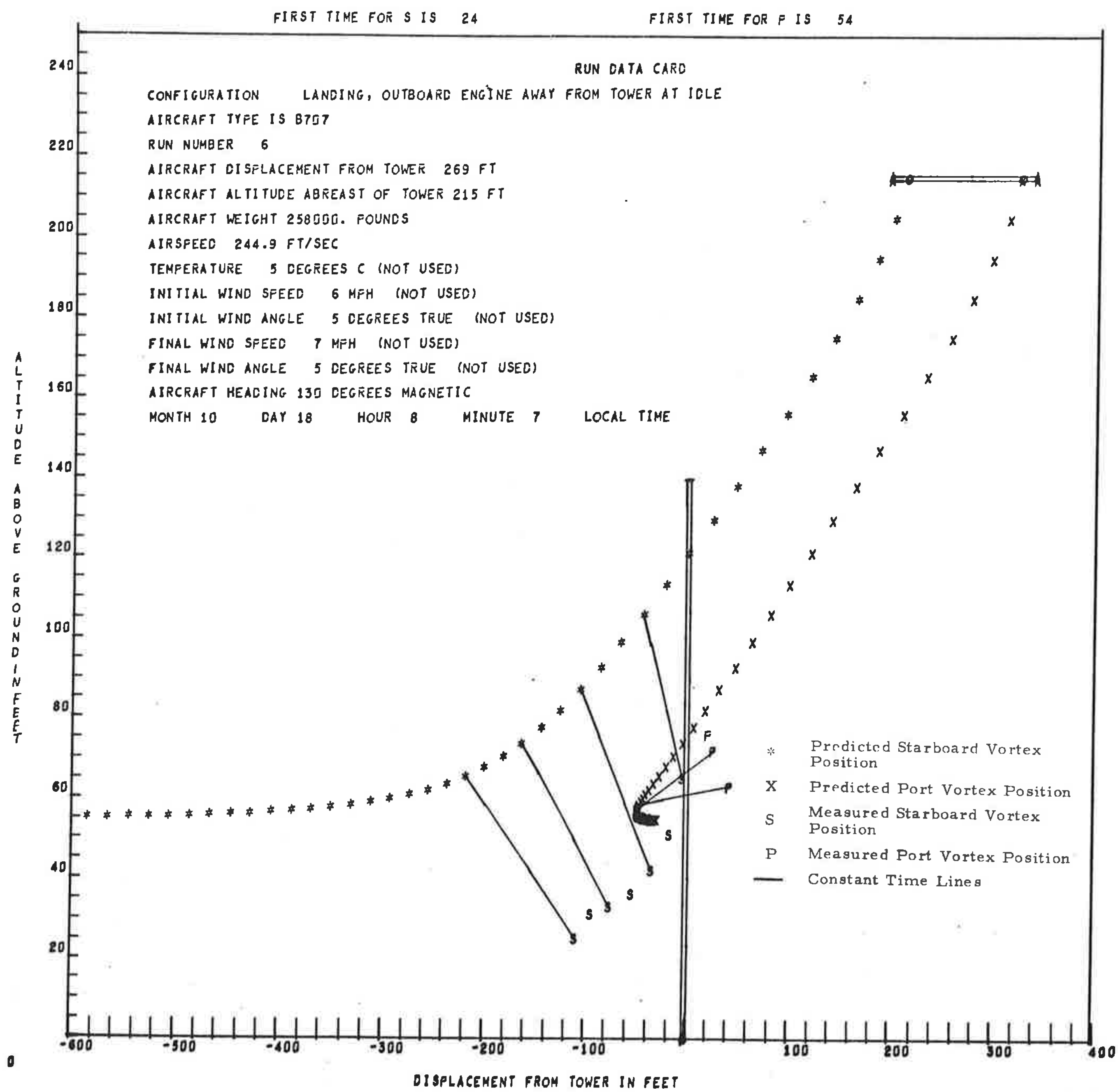

RUN 60 B747
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

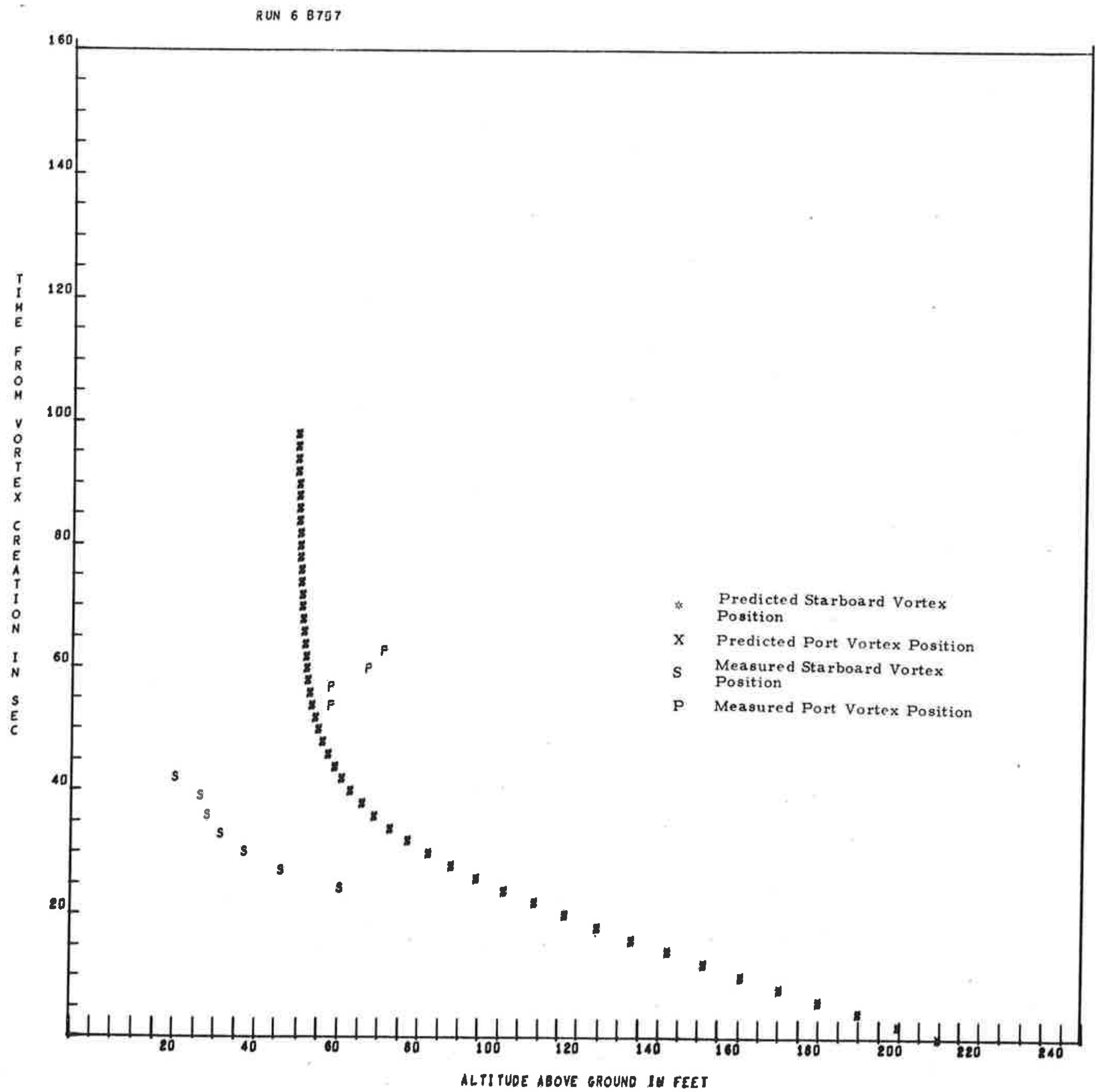


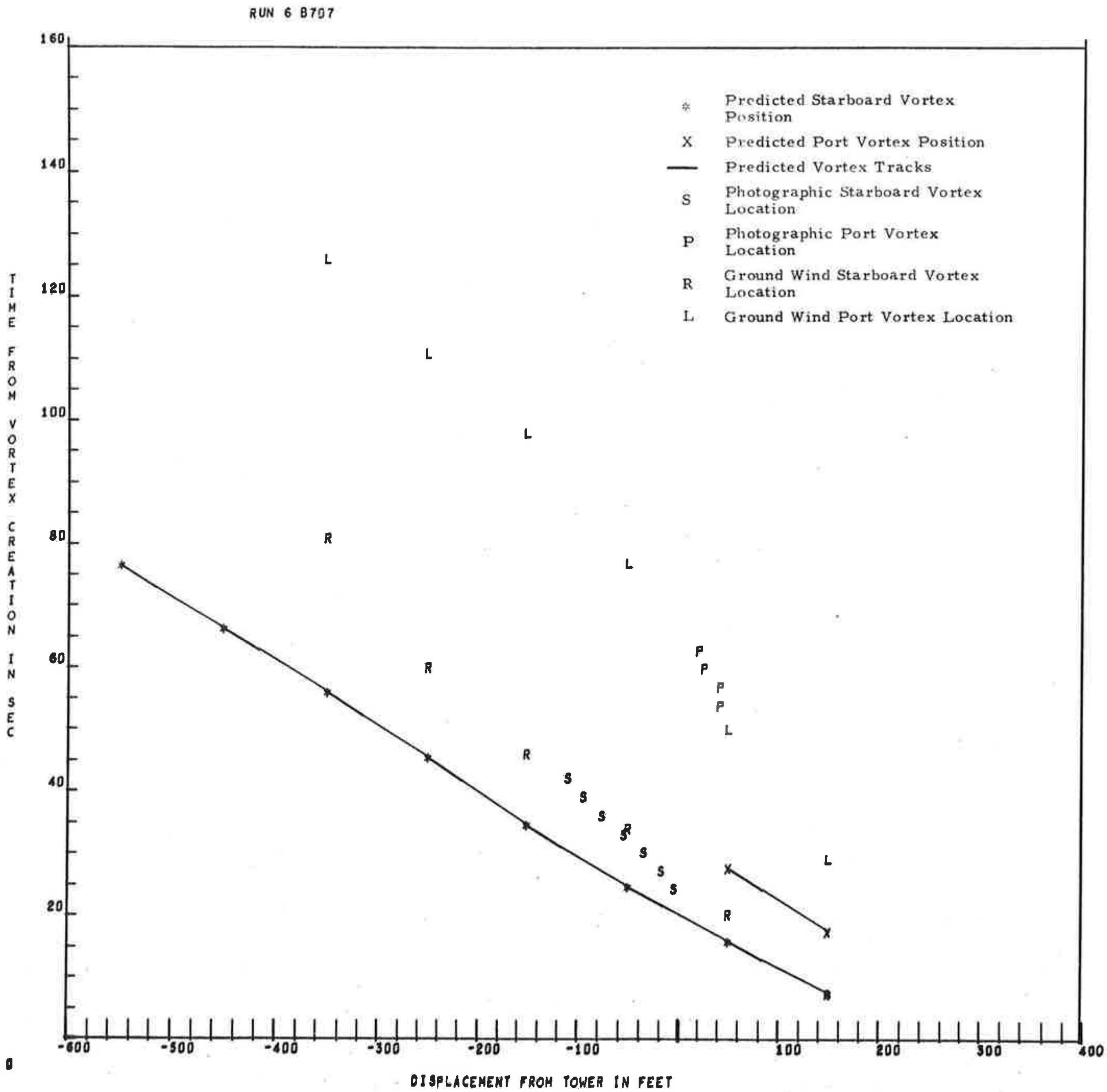
FIRST TIME FOR P IS 7
FIRST TIME FOR S IS 20 1
RUN DATA CARD
CONFIGURATION TAKE OFF, SWOOP, FULL POWER
AIRCRAFT TYPE IS B747
RUN NUMBER 63
AIRCRAFT DISPLACEMENT FROM TOWER ### FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 121 FT
AIRCRAFT WEIGHT1569 00011POUNDS
AIRSPEED 28751 FT/SEC
TEMPERATURE 16 DEGREES C (NOT USED)
INITIAL WIND SPEED 20 MPH 1(NOT USED)
INITIAL WIND ANGLE 255 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 23 MPH 1(NOT USED)
FINAL WIND ANGLE 261 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 125 DEGREES MAGNETIC
MONTH 10 1 DAY 17 HOUR 9 MINUTE 22 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240 1
220 1
200 1
180 1
160 1
140 1
120 1
100 1
80 1
60 1
40 1
20 1
-60011
-50011
-40011
-30011
-20011
-10011
10011
20011
30011
40011
50011
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
— Constant Time Lines



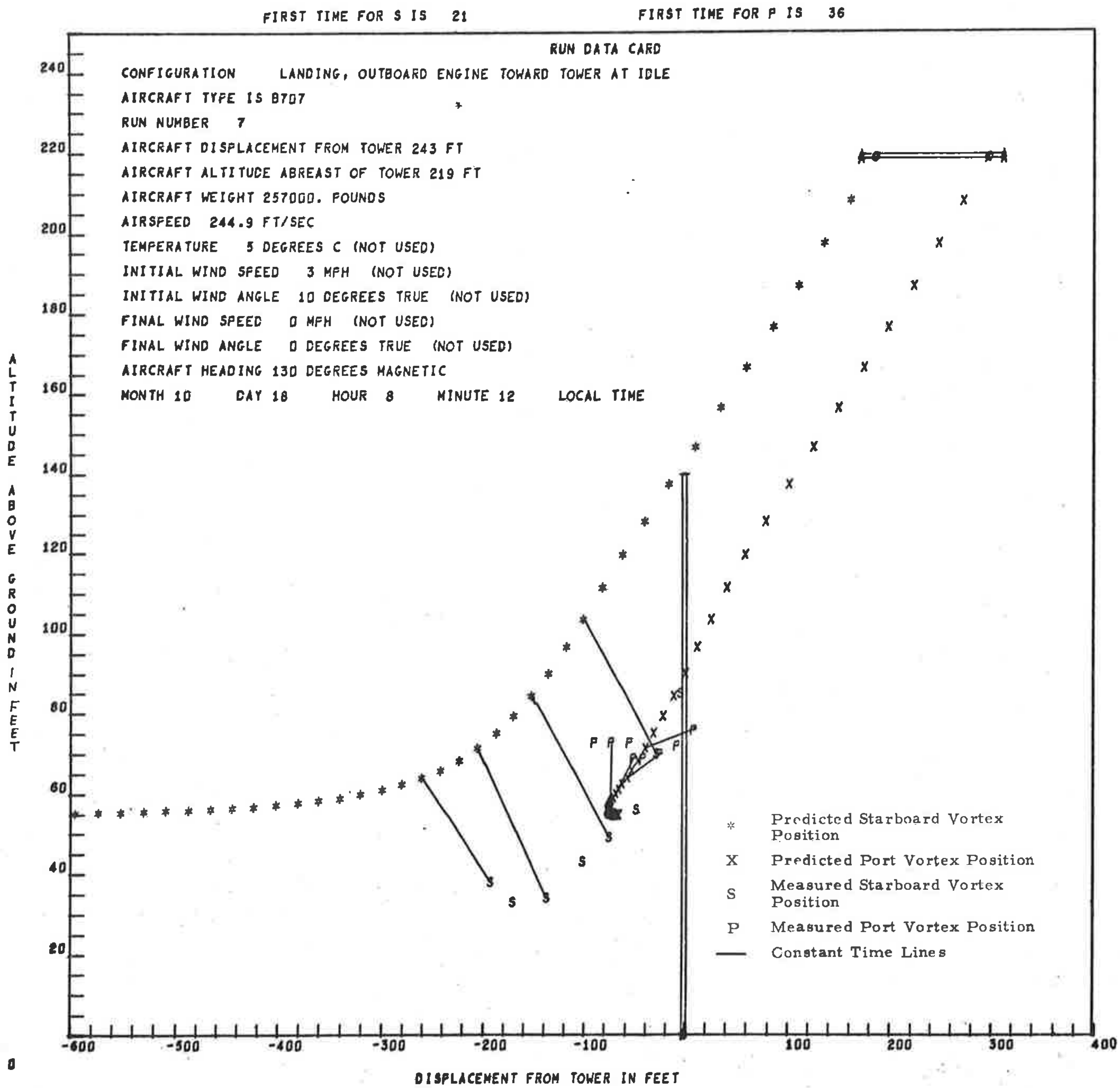
RUN 63 8747
160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE IN FEET

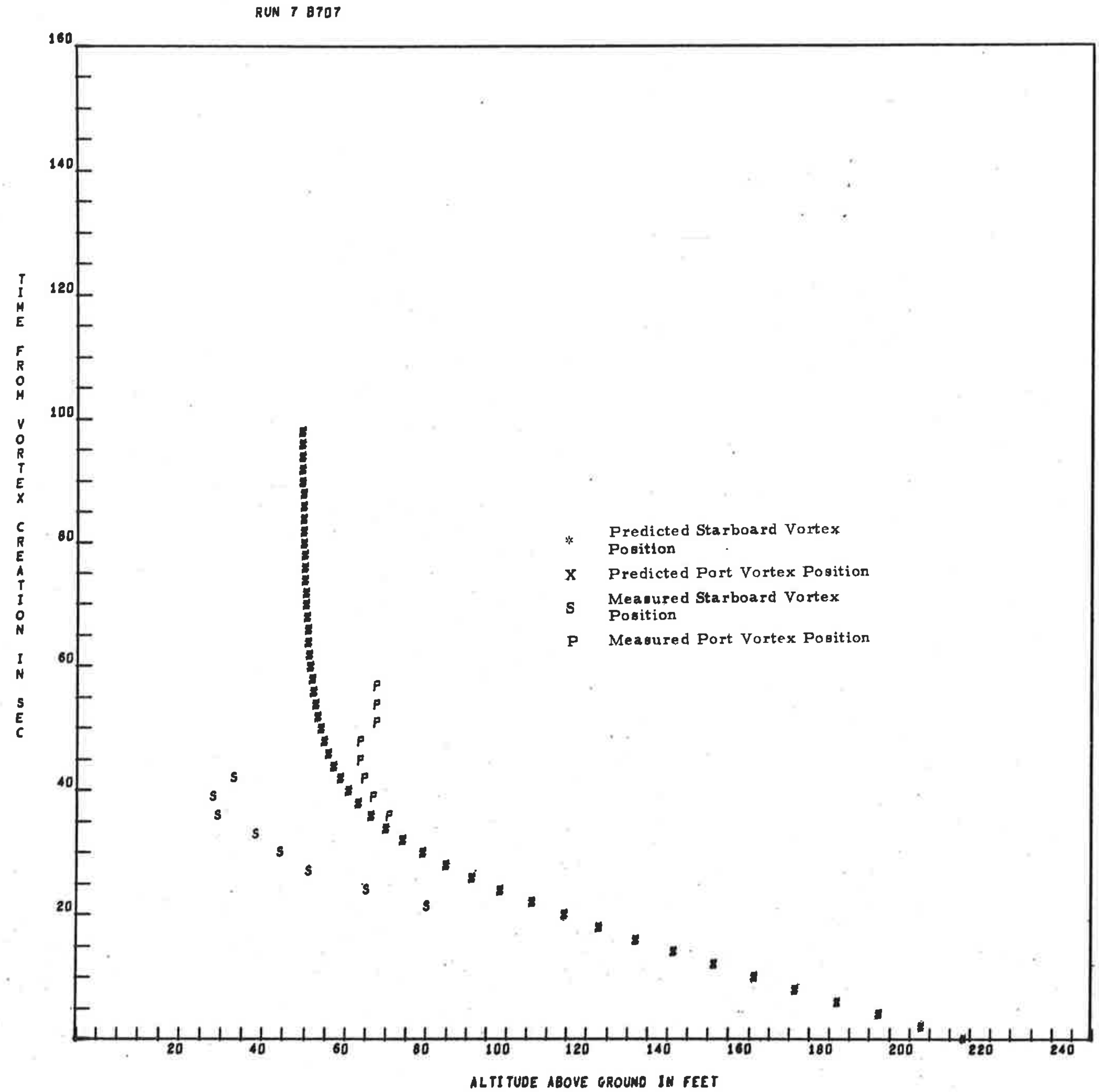

FIRST TIME FOR S IS 24
FIRST TIME FOR P IS 54
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 6
AIRCRAFT DISPLACEMENT FROM TOWER 269 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 215 FT
AIRCRAFT WEIGHT 258000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 5 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 7 MPH (NOT USED)
FINAL WIND ANGLE 5 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 8 MINUTE 7 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

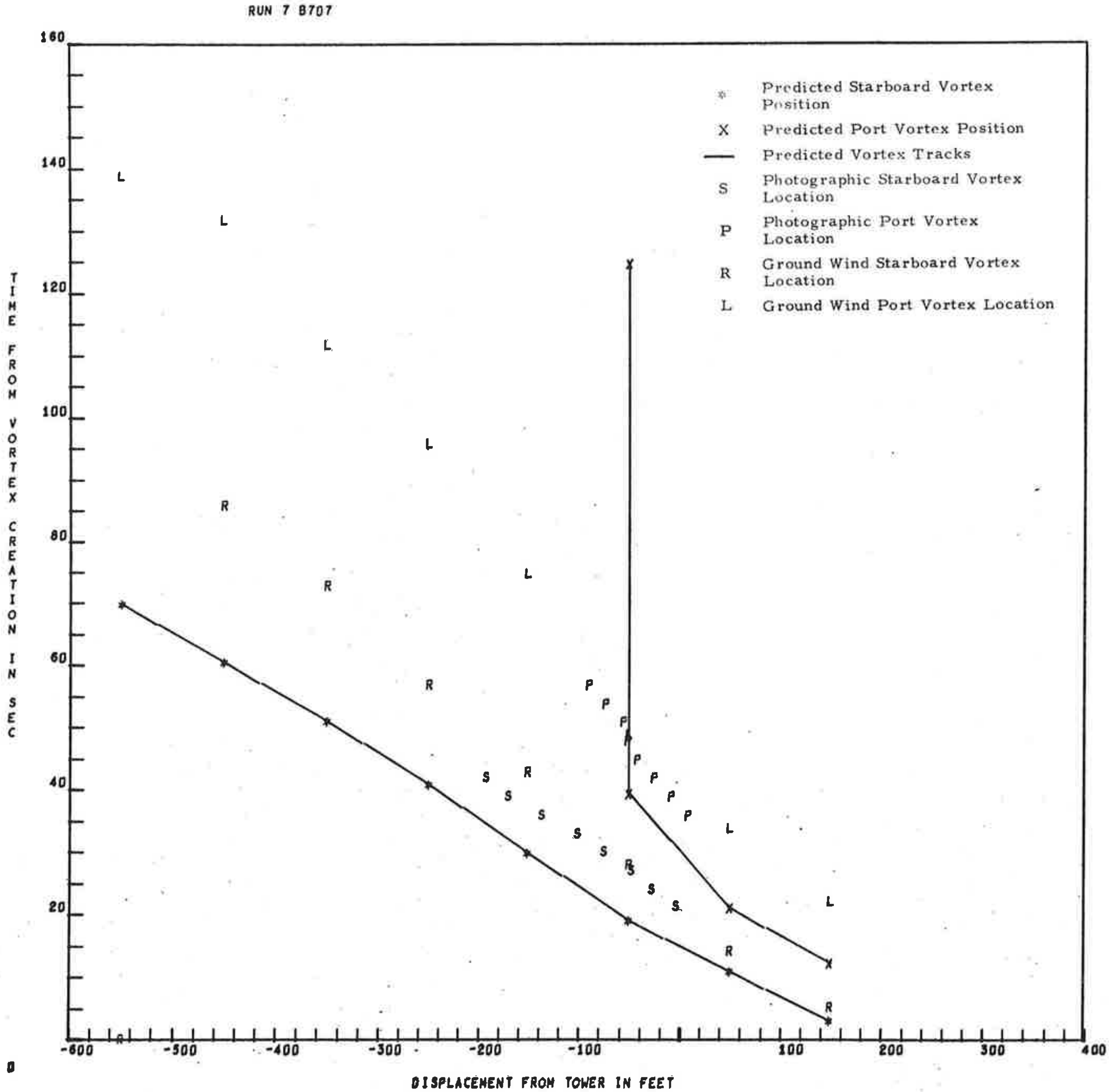

RUN 6 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



RUN 6 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

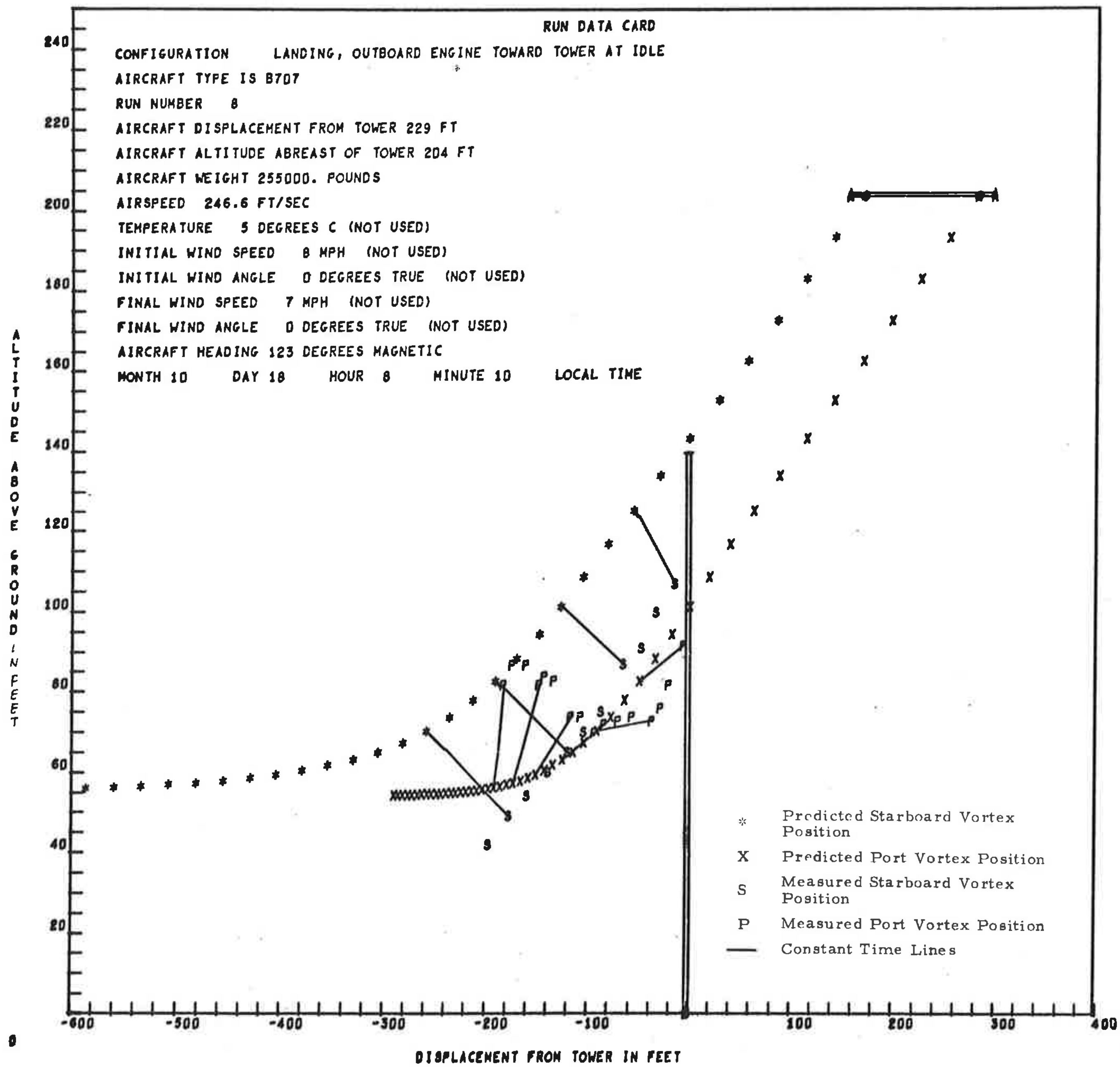

FIRST TIME FOR S IS 21
FIRST TIME FOR P IS 36
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 7
AIRCRAFT DISPLACEMENT FROM TOWER 243 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 219 FT
AIRCRAFT WEIGHT 257000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 3 MPH (NOT USED)
INITIAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 8 MINUTE 12 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
— Constant Time Lines

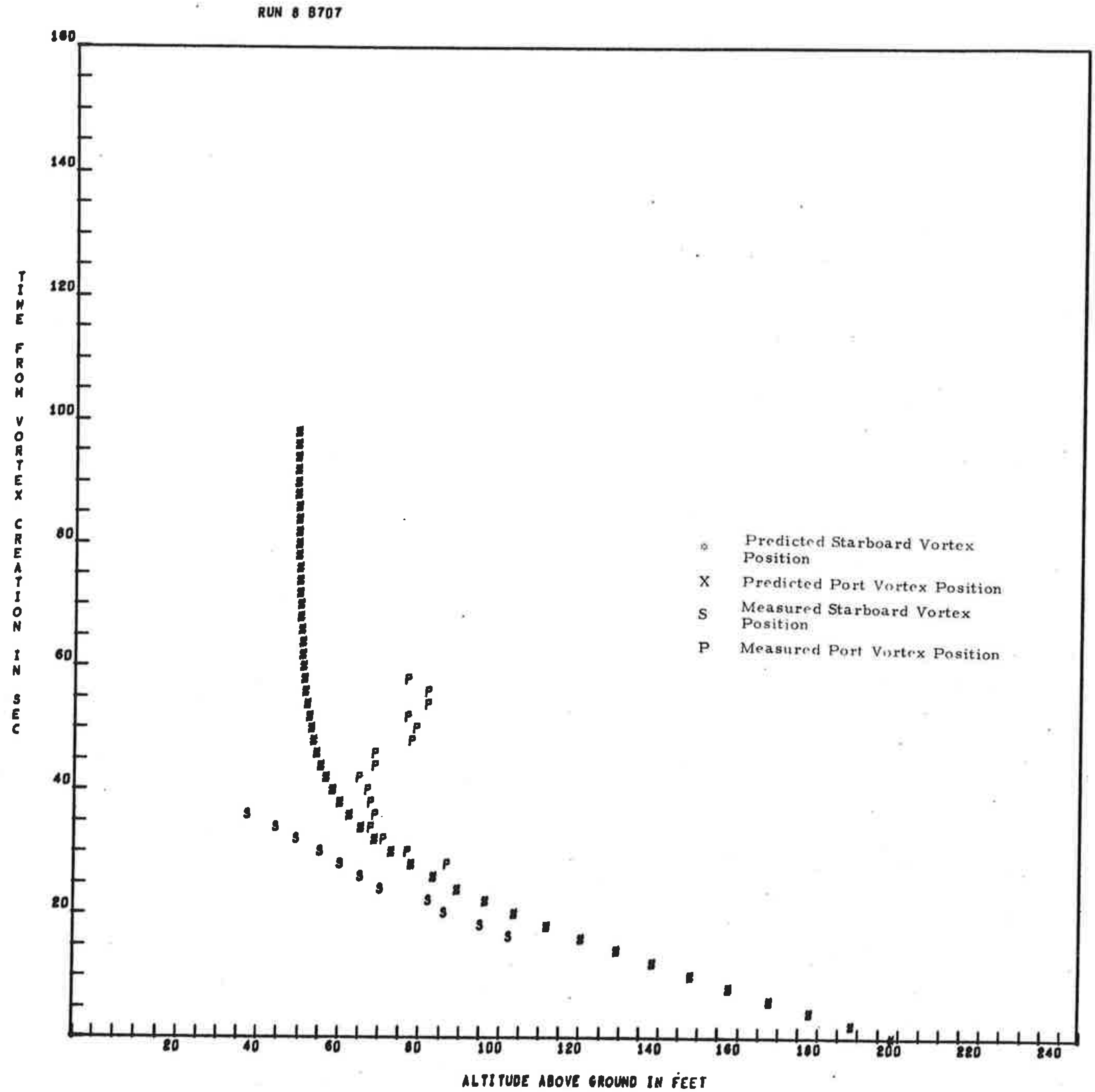

RUN 7 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



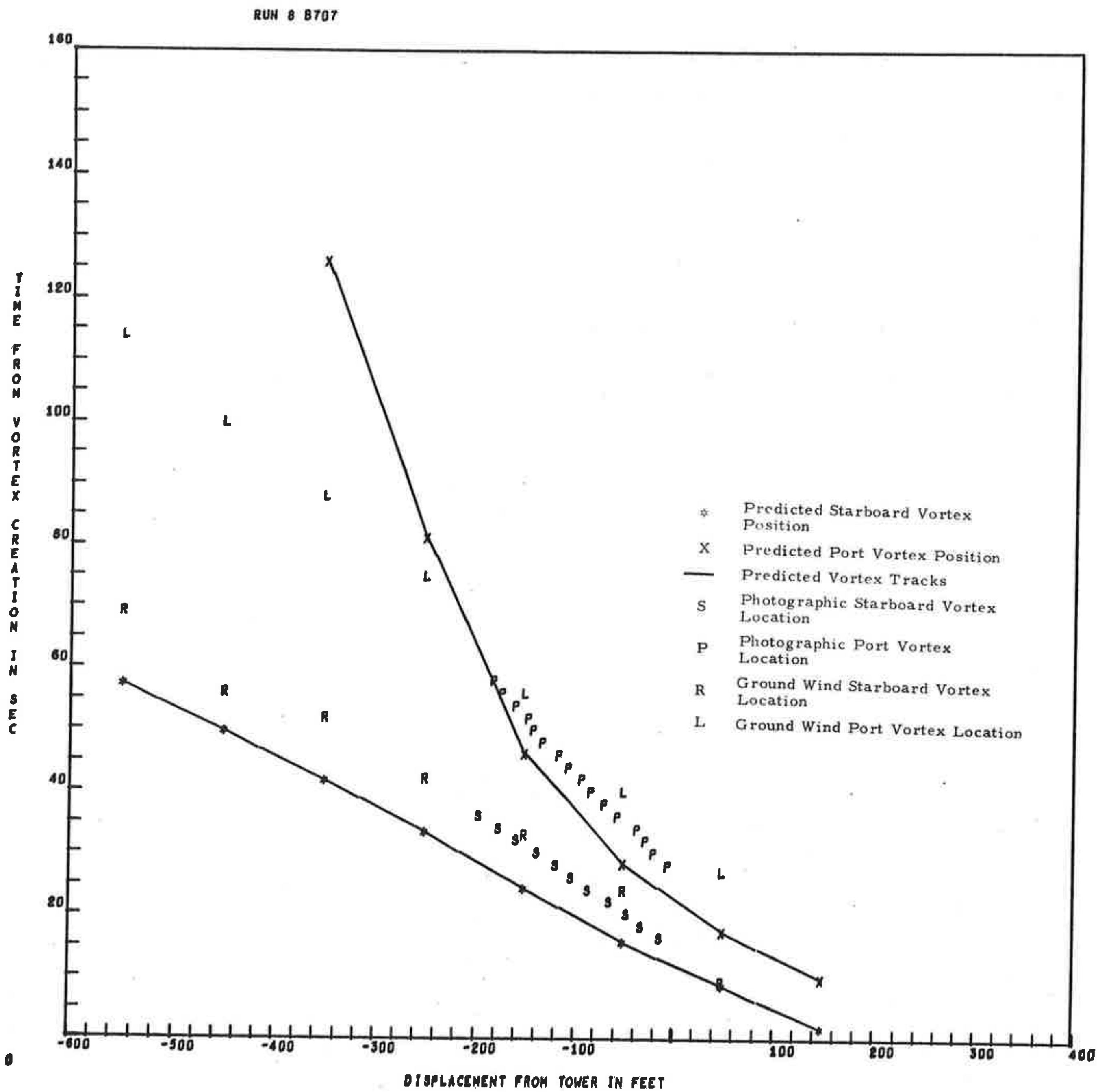
RUN 7 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

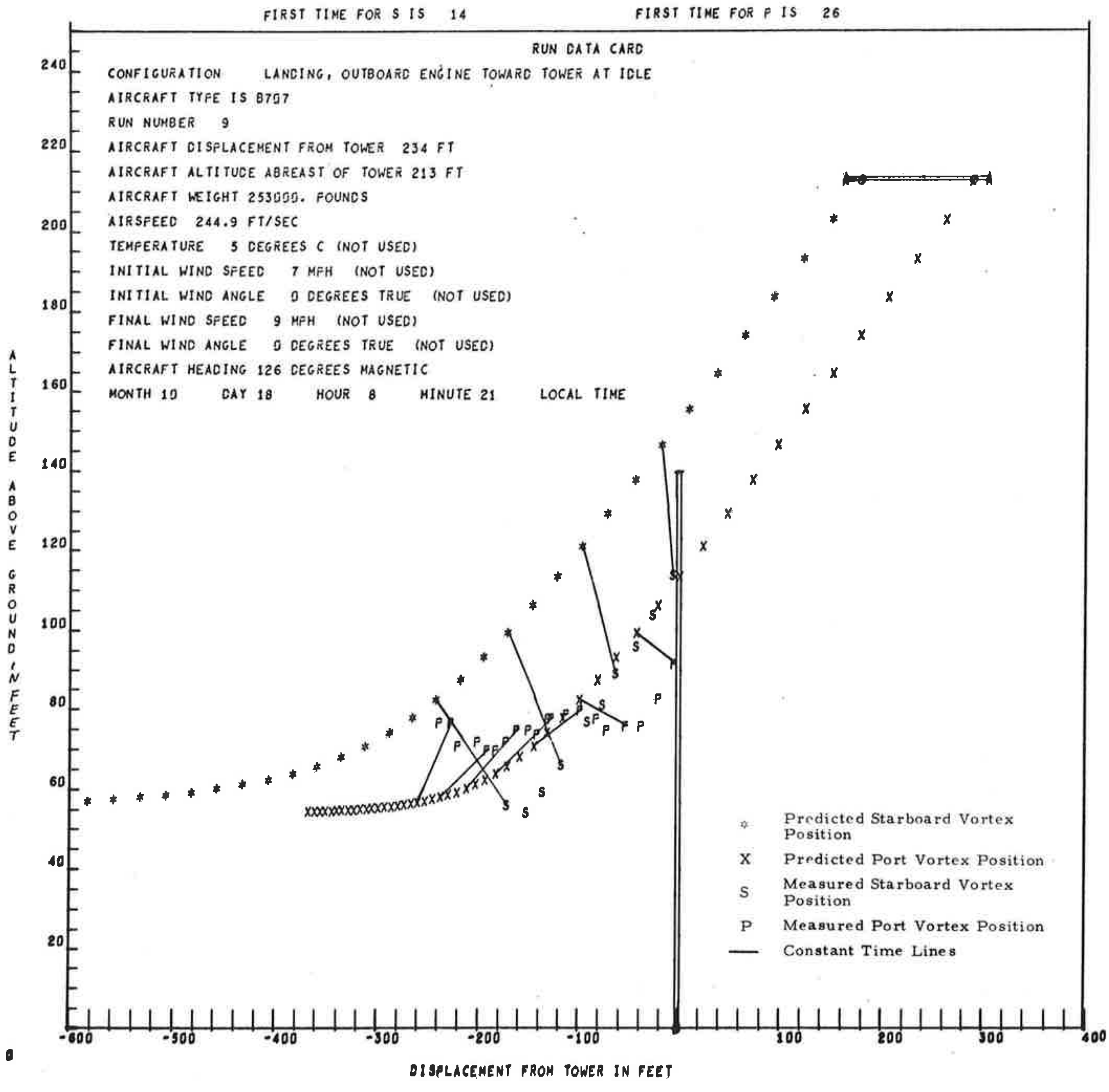
FIRST TIME FOR S IS 16 FIRST TIME FOR P IS 28



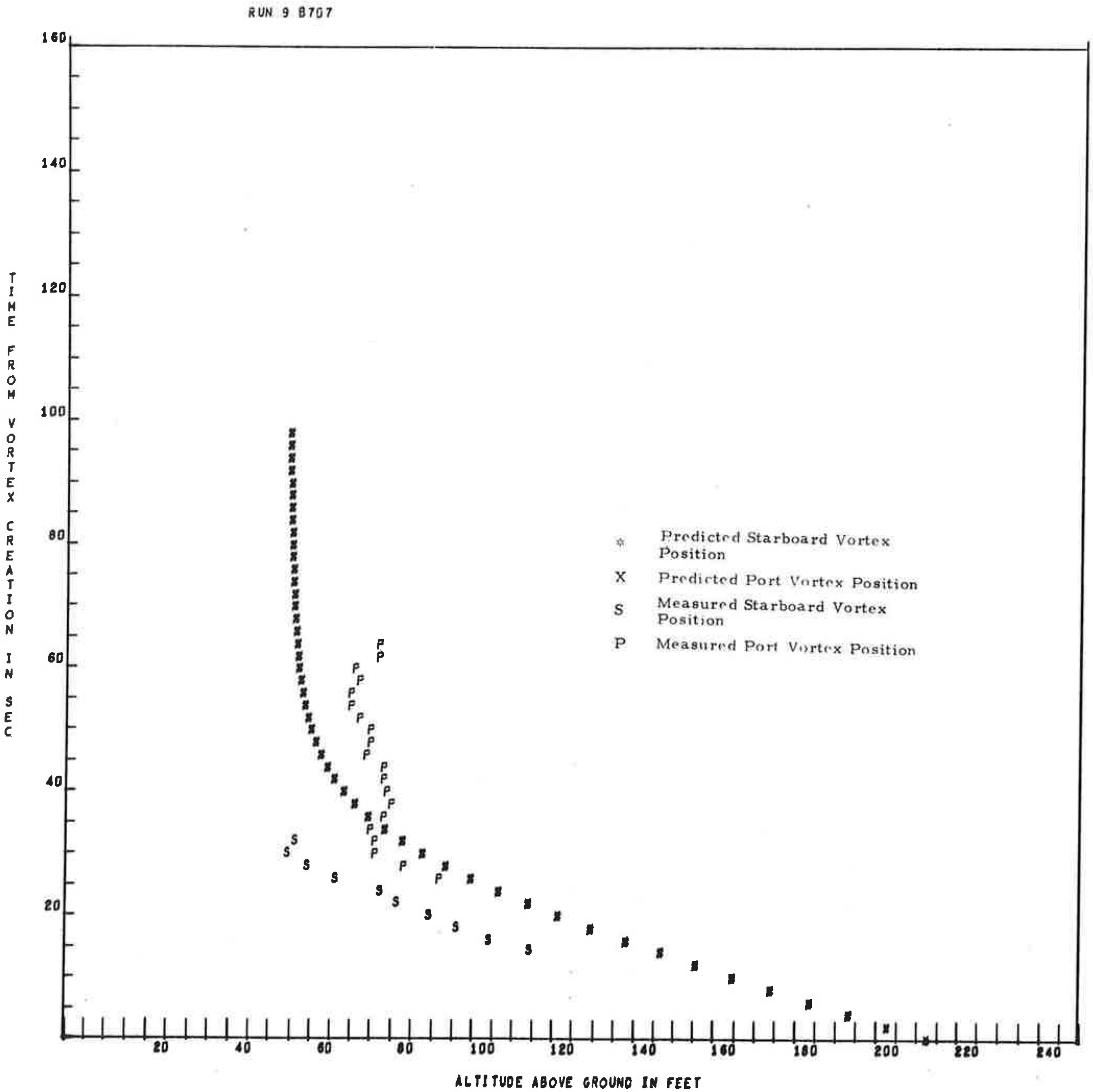


RUN 8 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

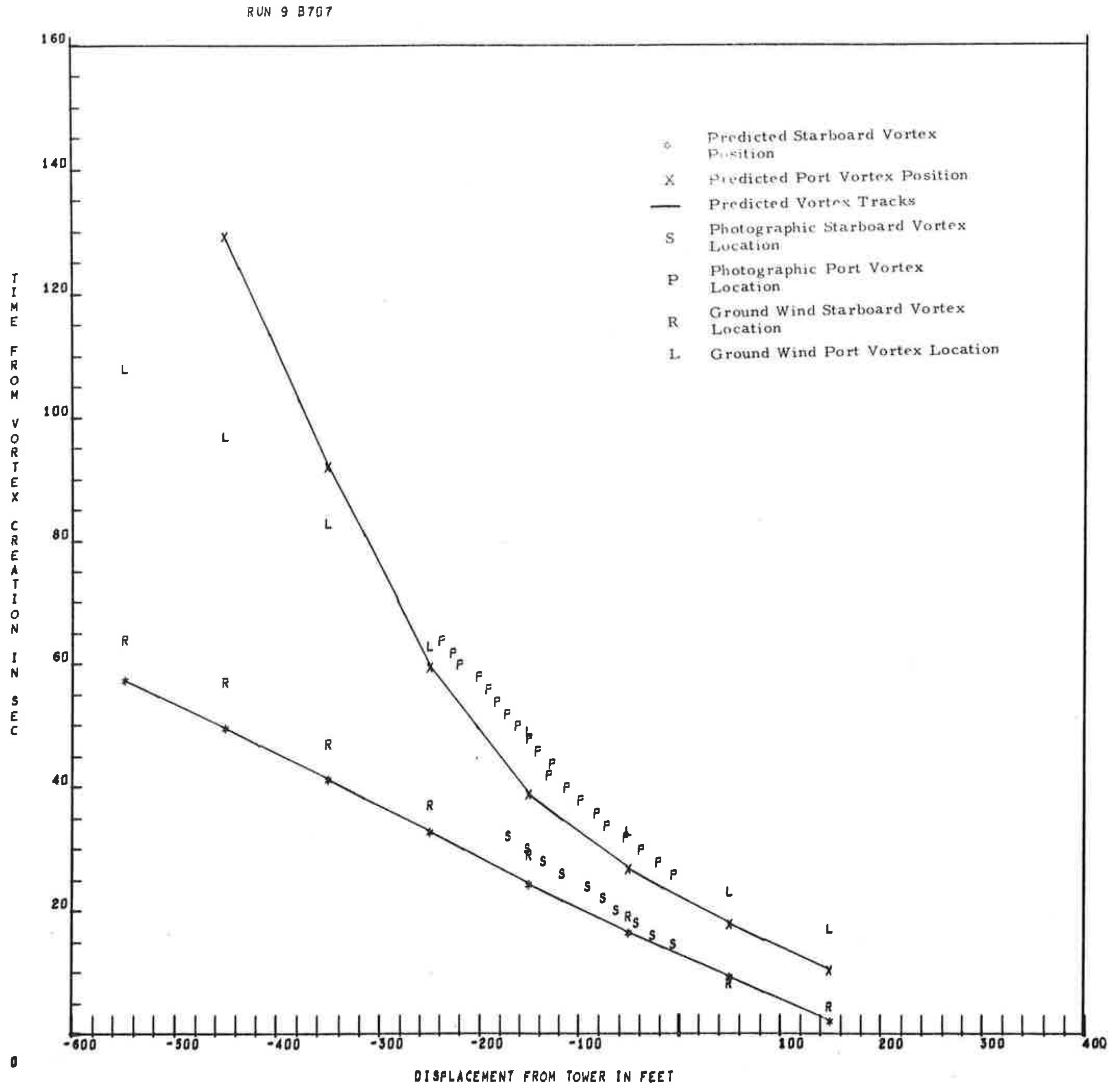

RUN 8 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location



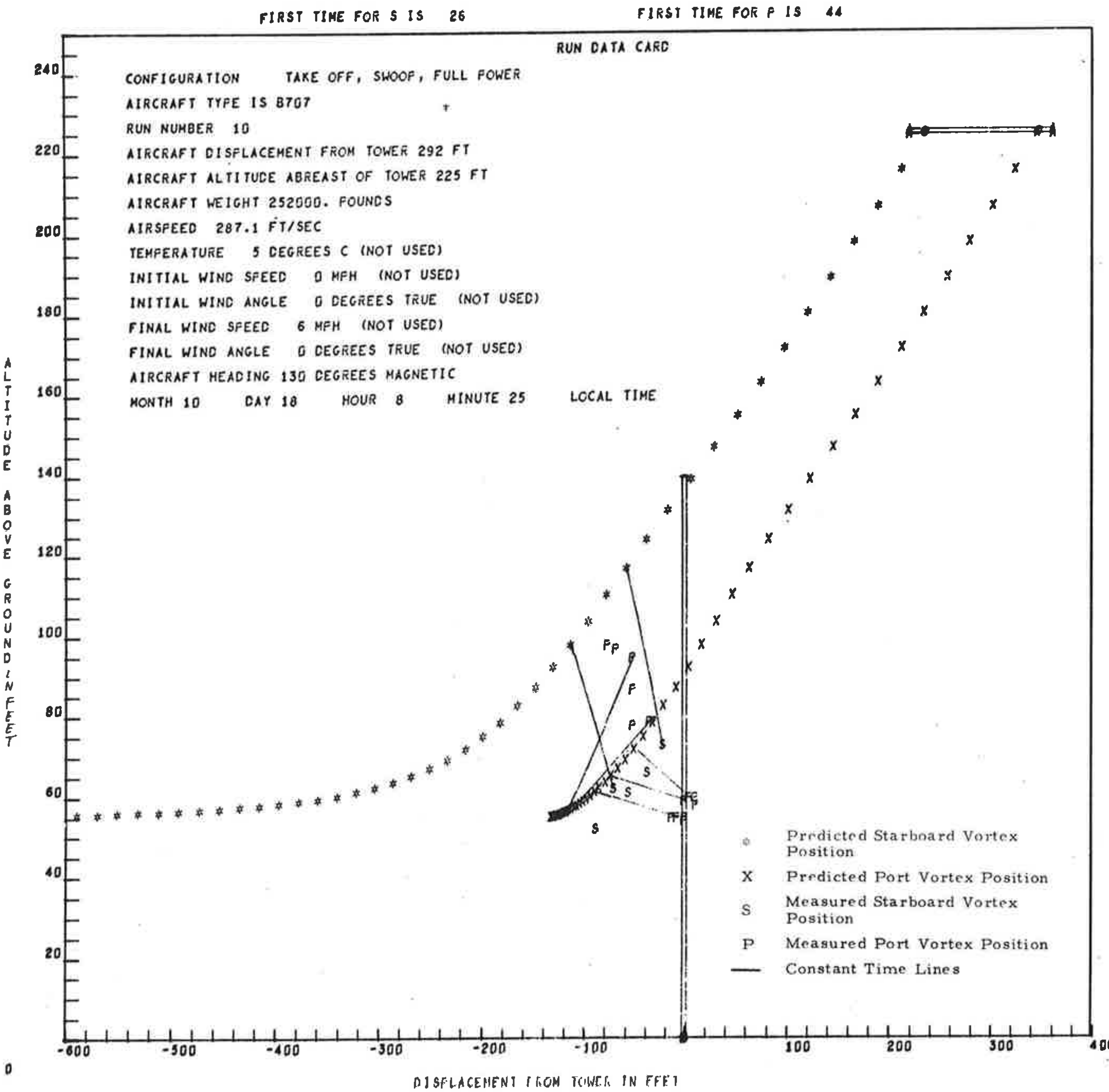
FIRST TIME FOR S IS 14
FIRST TIME FOR P IS 26
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 9
AIRCRAFT DISPLACEMENT FROM TOWER 234 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 213 FT
AIRCRAFT WEIGHT 253000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 7 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 9 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 126 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 8 MINUTE 21 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines



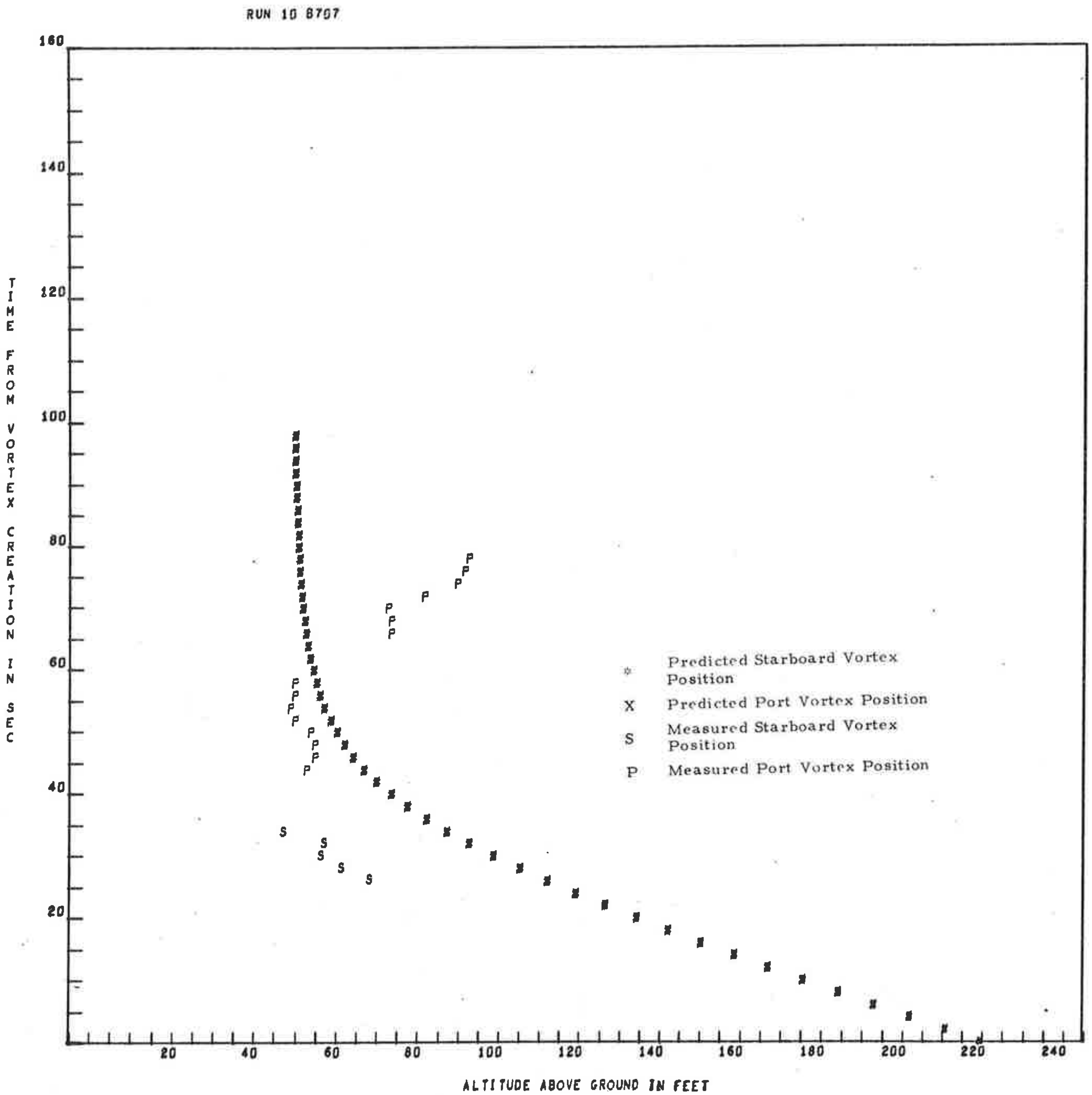
RUN 9 8707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

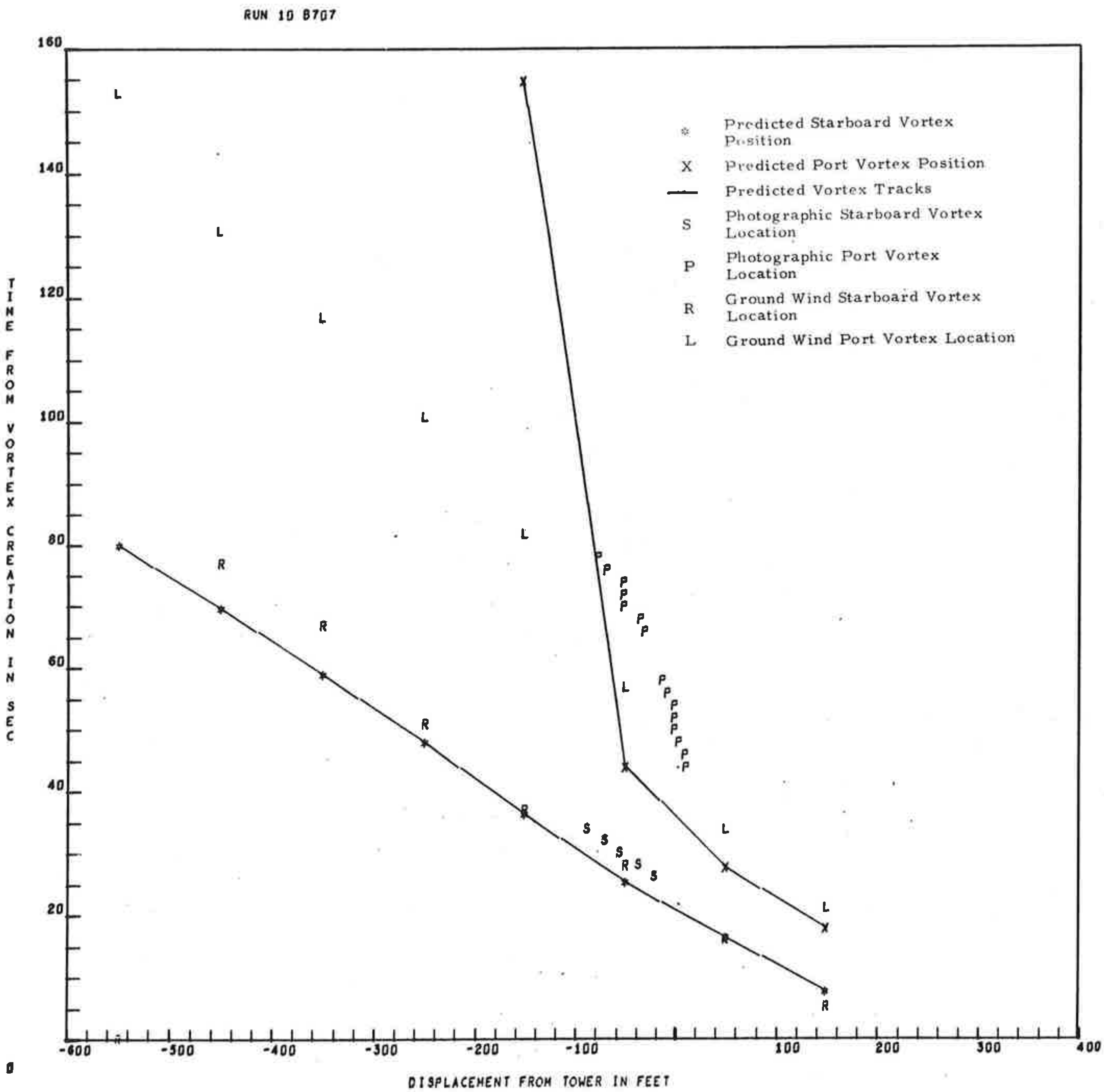


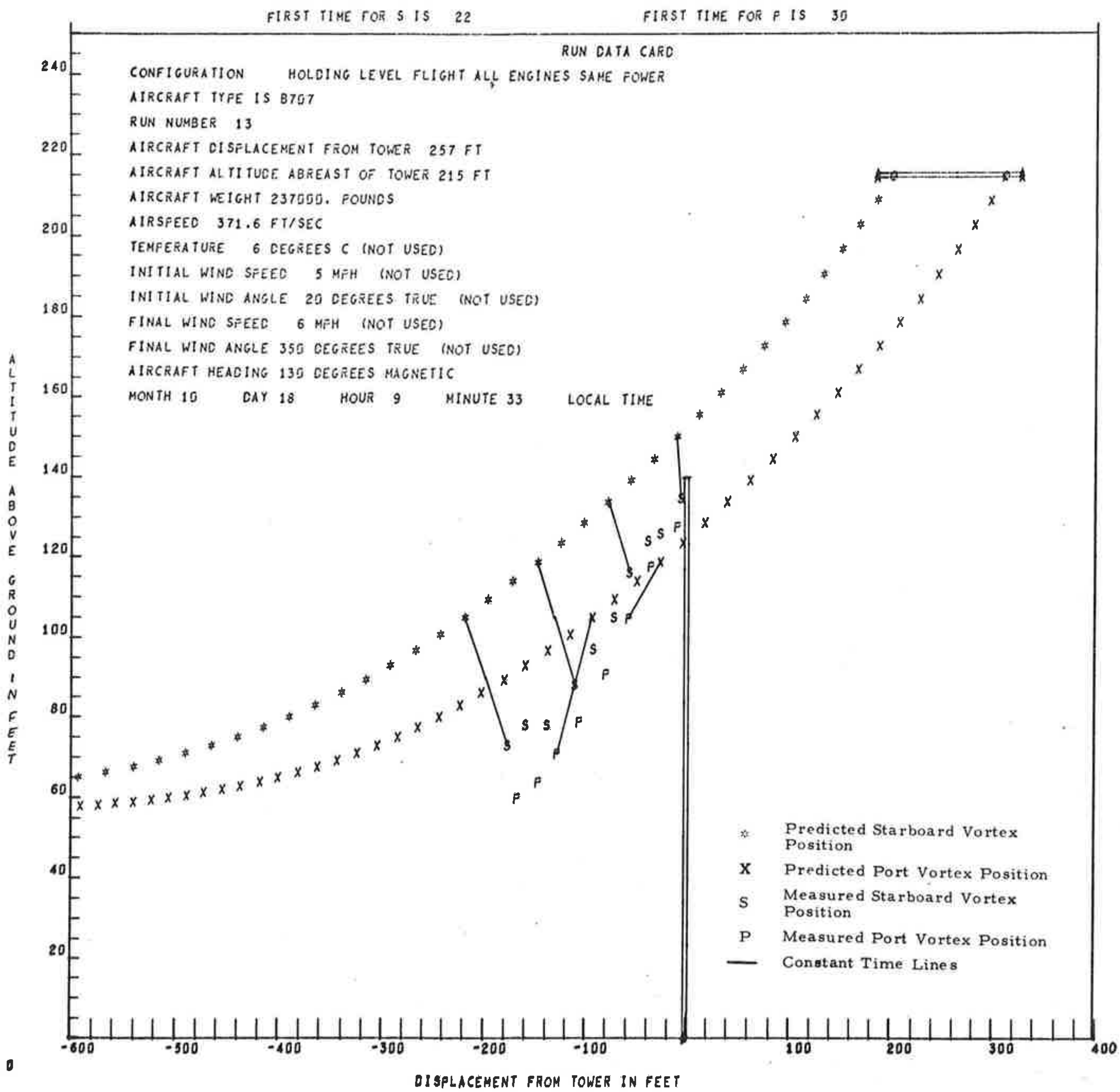
RUN 9 B707
160
140
120
100
80
60
40
20
0
TIME FROM VORTEX CREATION IN SEC
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

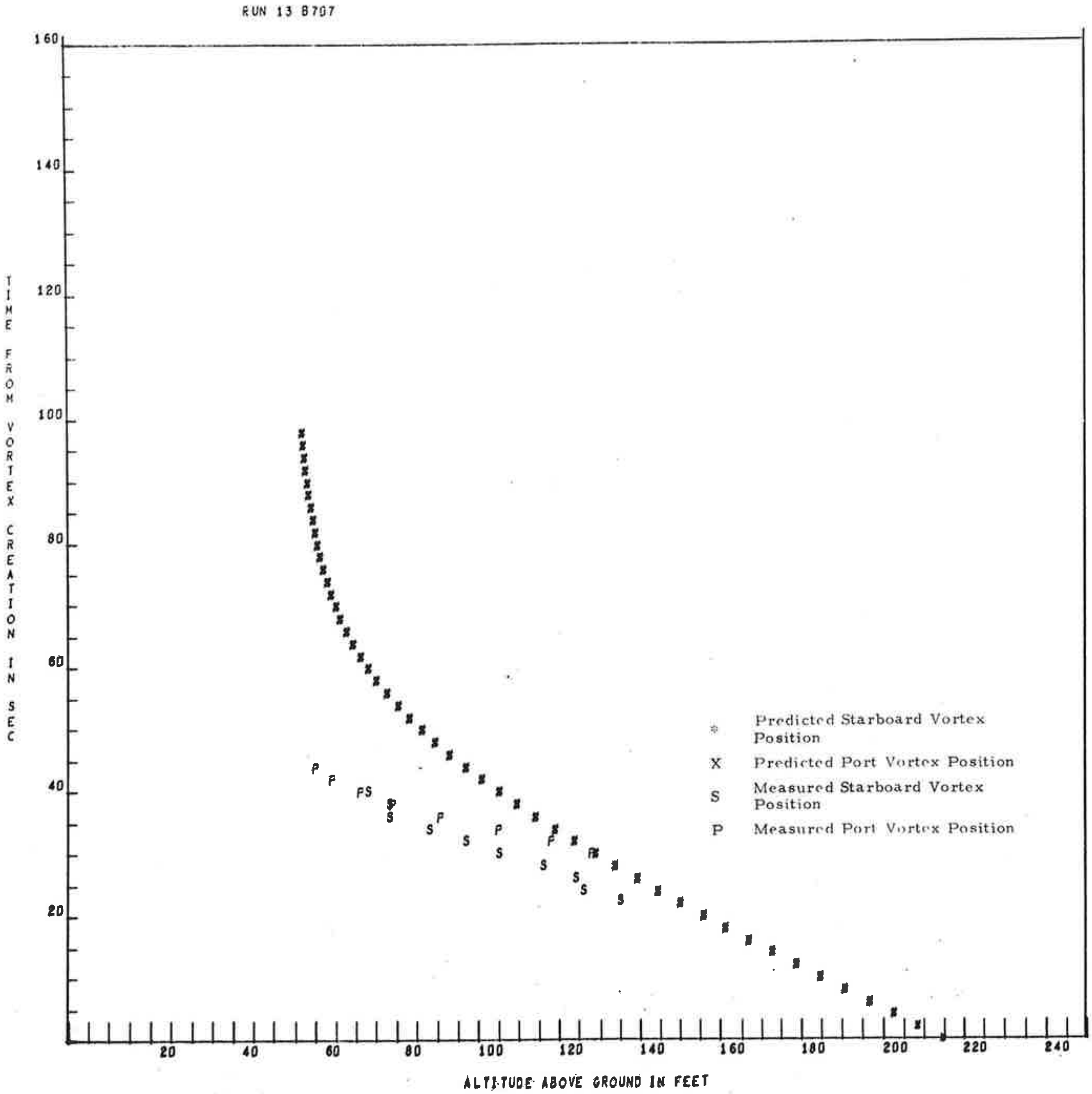


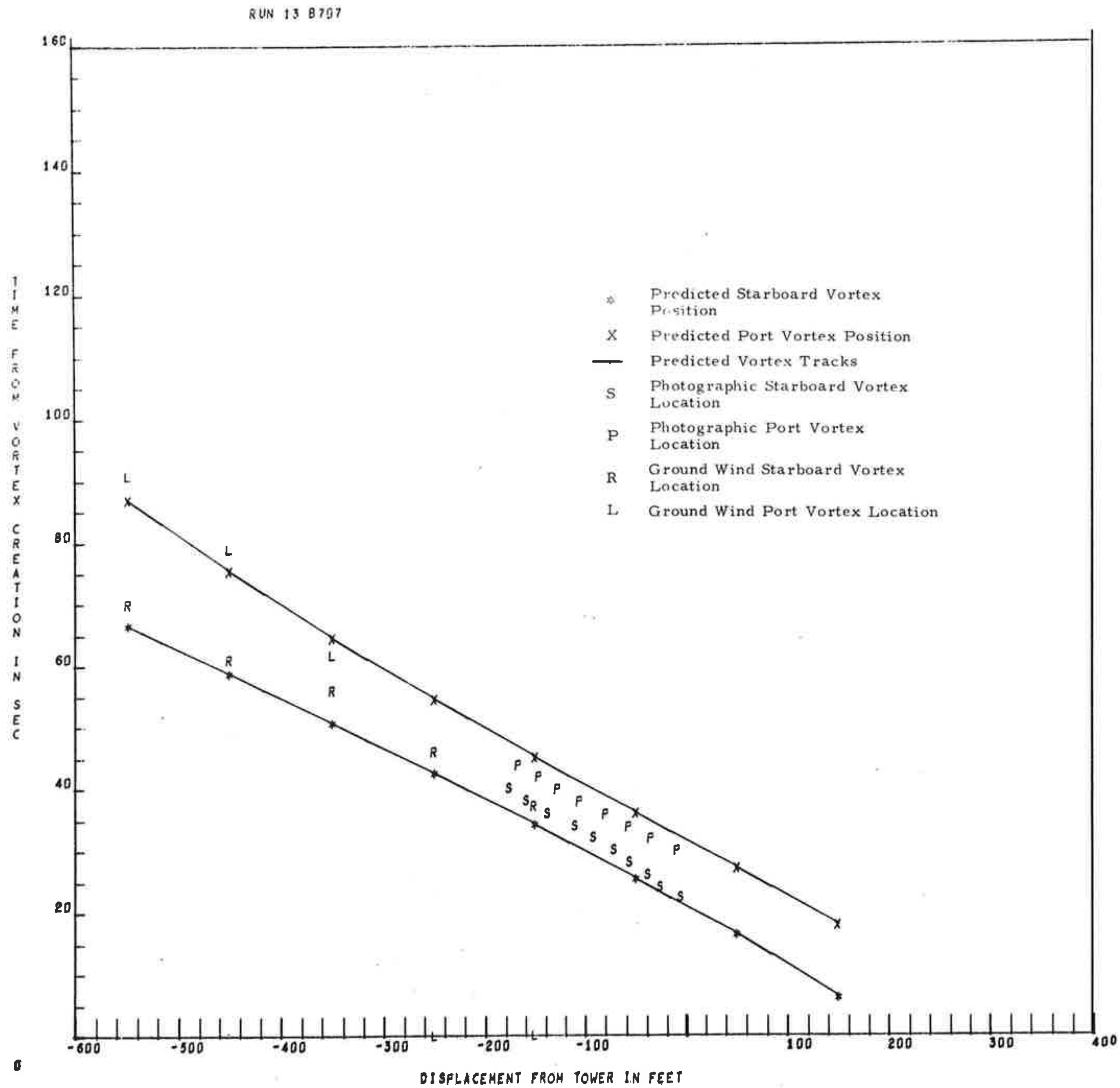
FIRST TIME FOR S IS 26
FIRST TIME FOR P IS 44
RUN DATA CARD
CONFIGURATION TAKE OFF, SWOOP, FULL POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 10
AIRCRAFT DISPLACEMENT FROM TOWER 292 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 225 FT
AIRCRAFT WEIGHT 252000. POUNDS
AIRSPEED 287.1 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 0 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 8 MINUTE 25 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

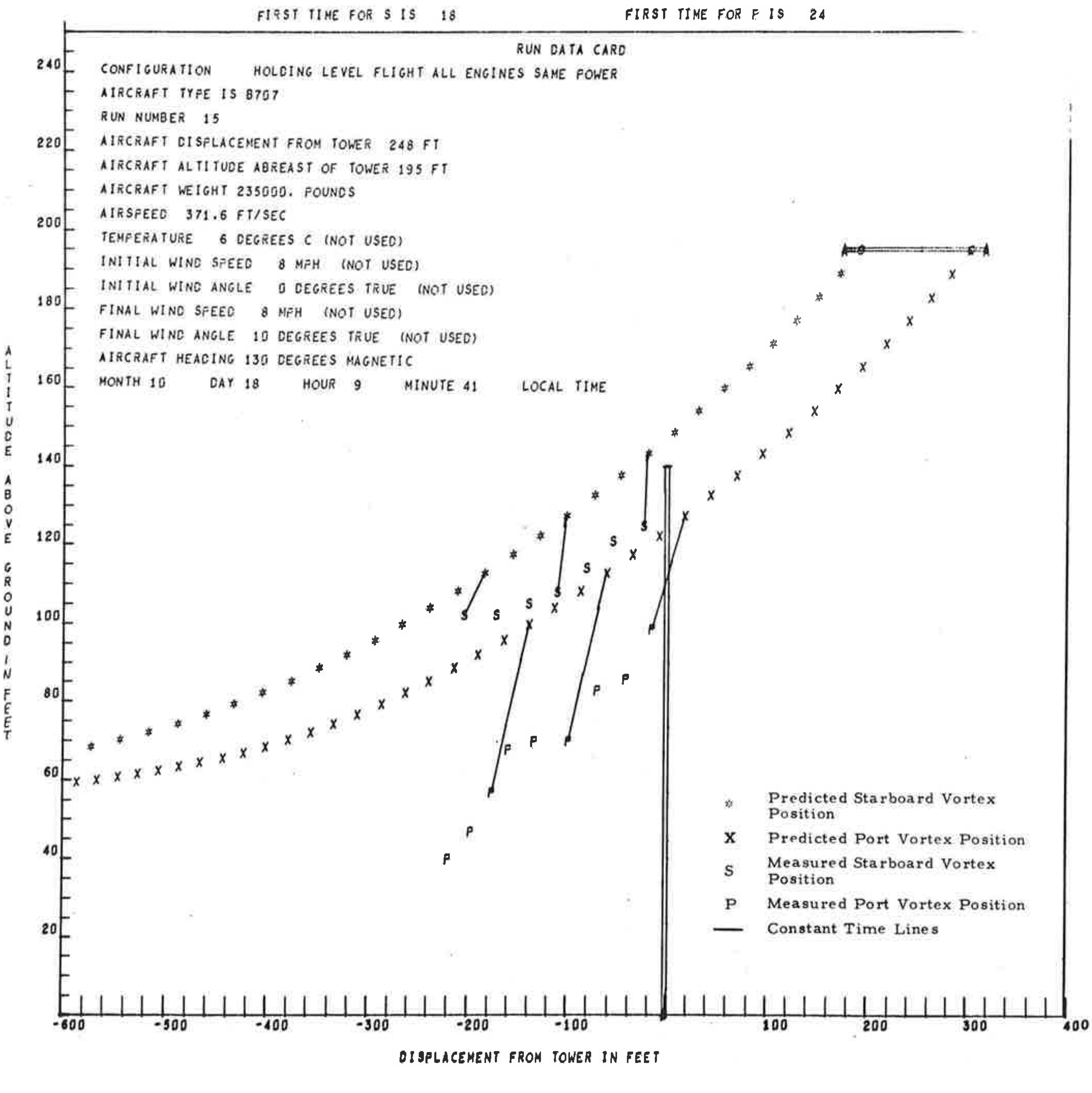

RUN 10 8707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 10 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

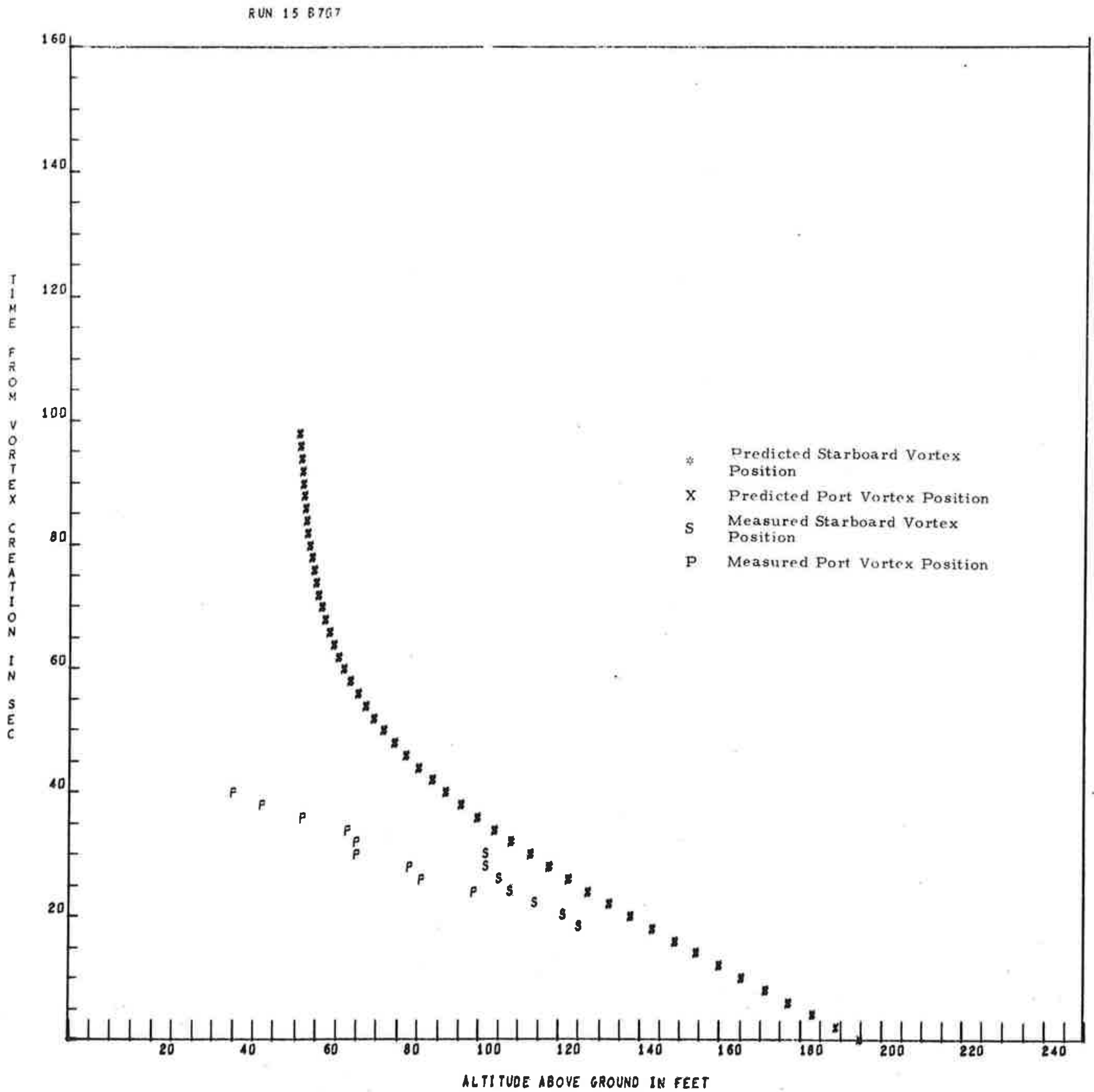

FIRST TIME FOR S IS 22
FIRST TIME FOR P IS 30
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 13
AIRCRAFT DISPLACEMENT FROM TOWER 257 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 215 FT
AIRCRAFT WEIGHT 237000. POUNDS
AIRSPEED 371.6 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 5 MPH (NOT USED)
INITIAL WIND ANGLE 20 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 350 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 9 MINUTE 33 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines


RUN 13 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

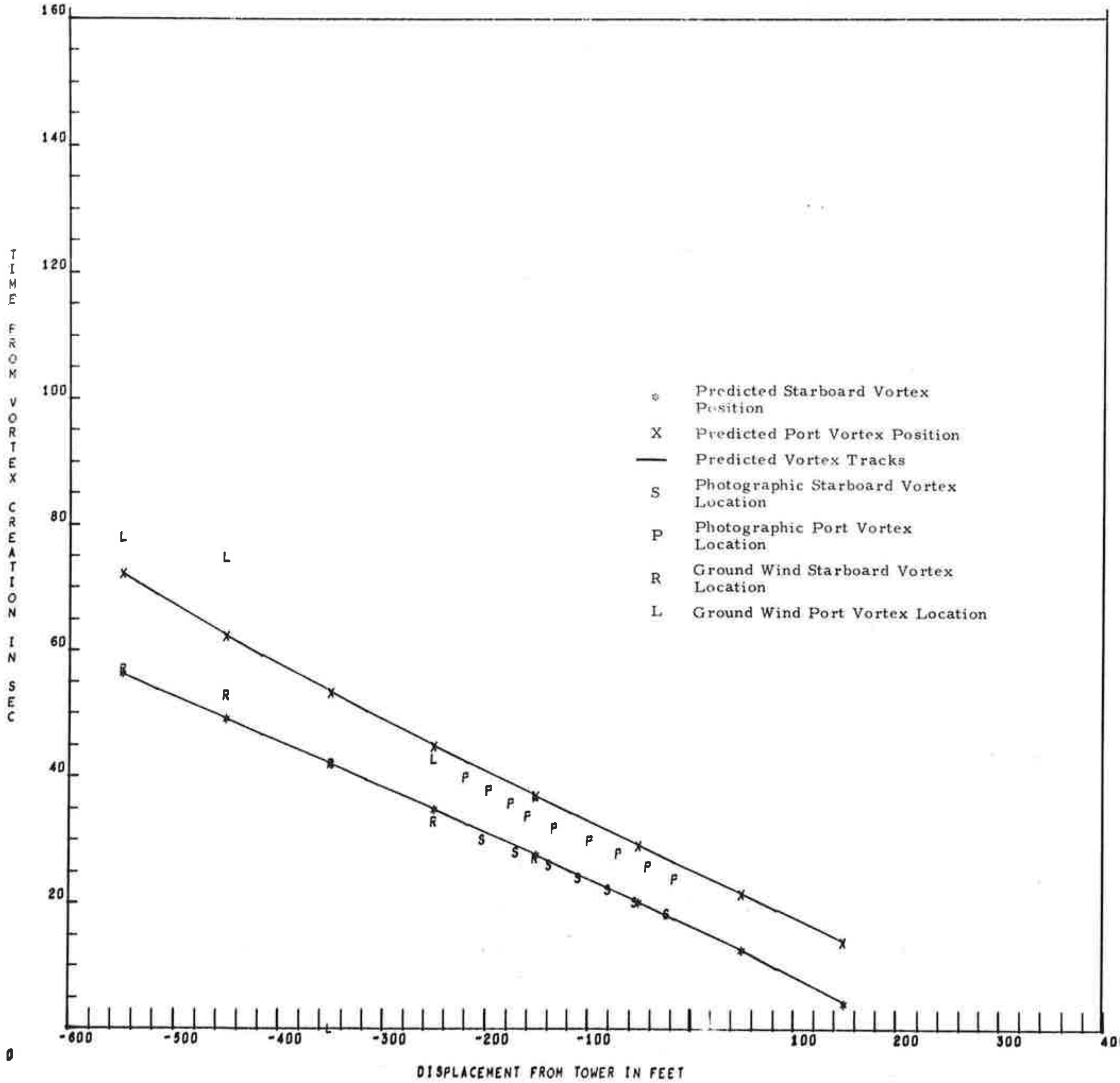

RUN 13 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400



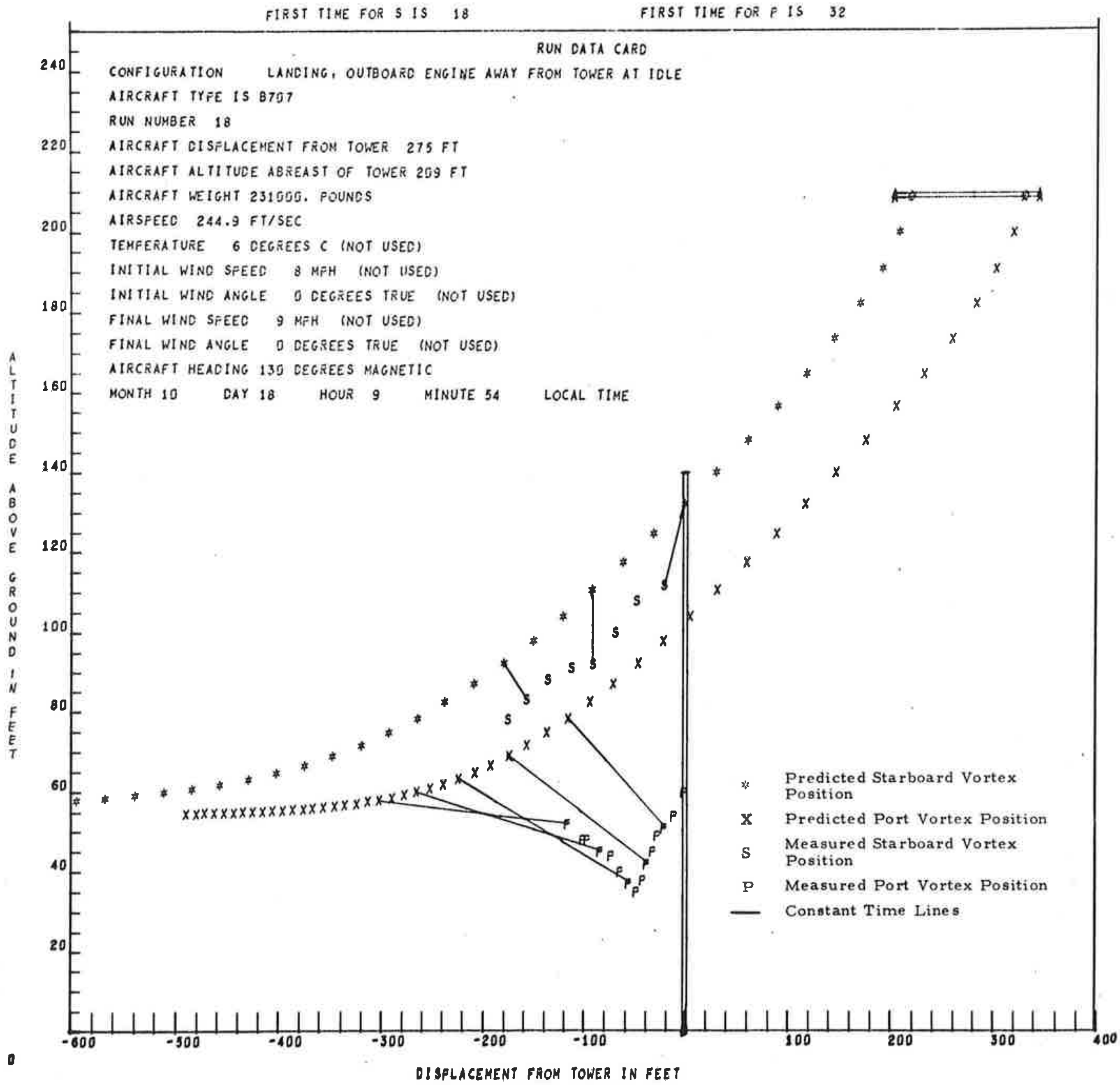
FIRST TIME FOR S IS 18
FIRST TIME FOR P IS 24
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 15
AIRCRAFT DISPLACEMENT FROM TOWER 248 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 195 FT
AIRCRAFT WEIGHT 235000. POUNDS
AIRSPEED 371.6 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 9 MINUTE 41 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
-600
-500
-400
-300
-200
-100
100
200
300
400
20
40
60
80
100
120
140
160
180
200
220
240
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines


RUN 15 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

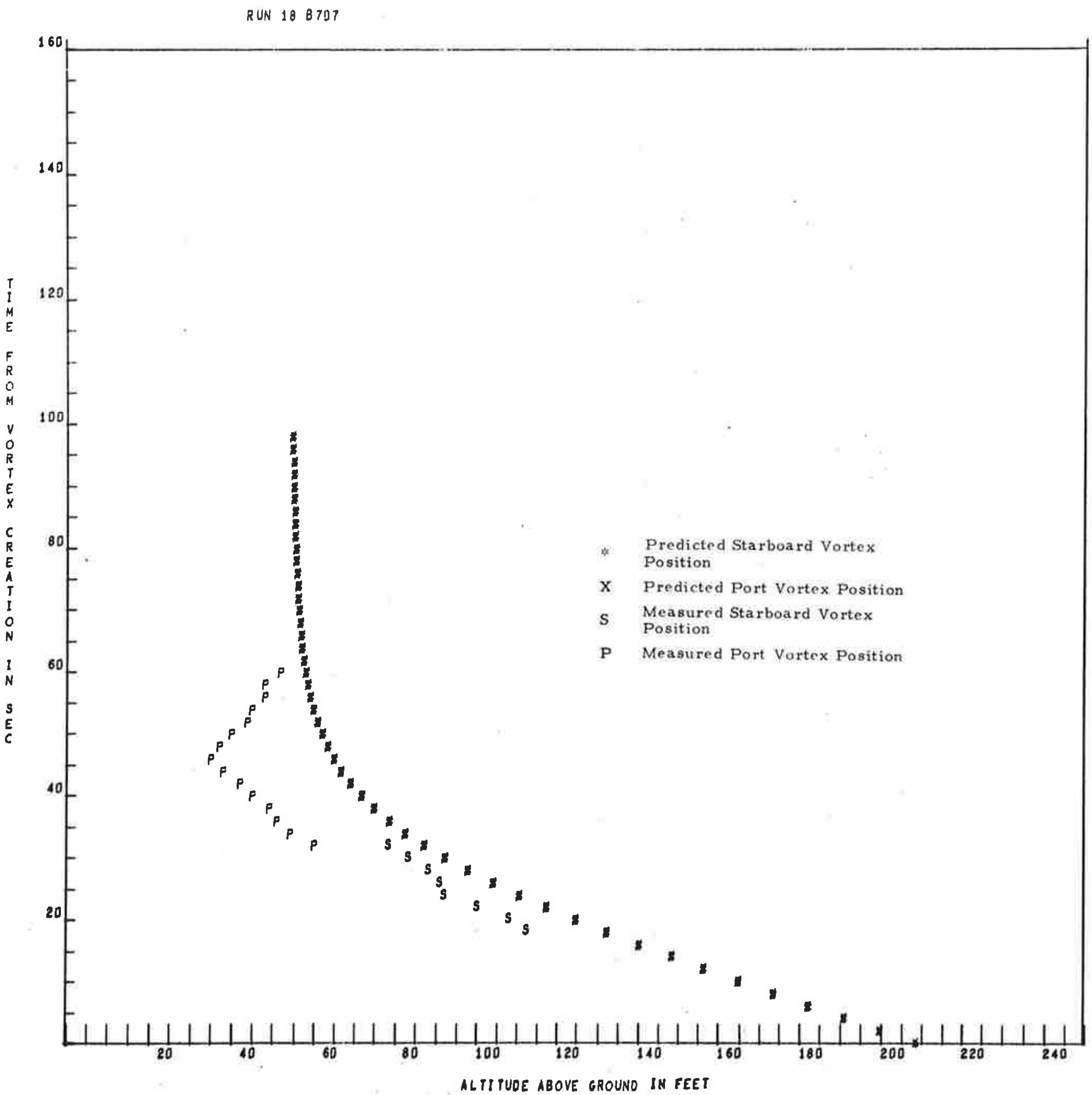
RUN 15 B707



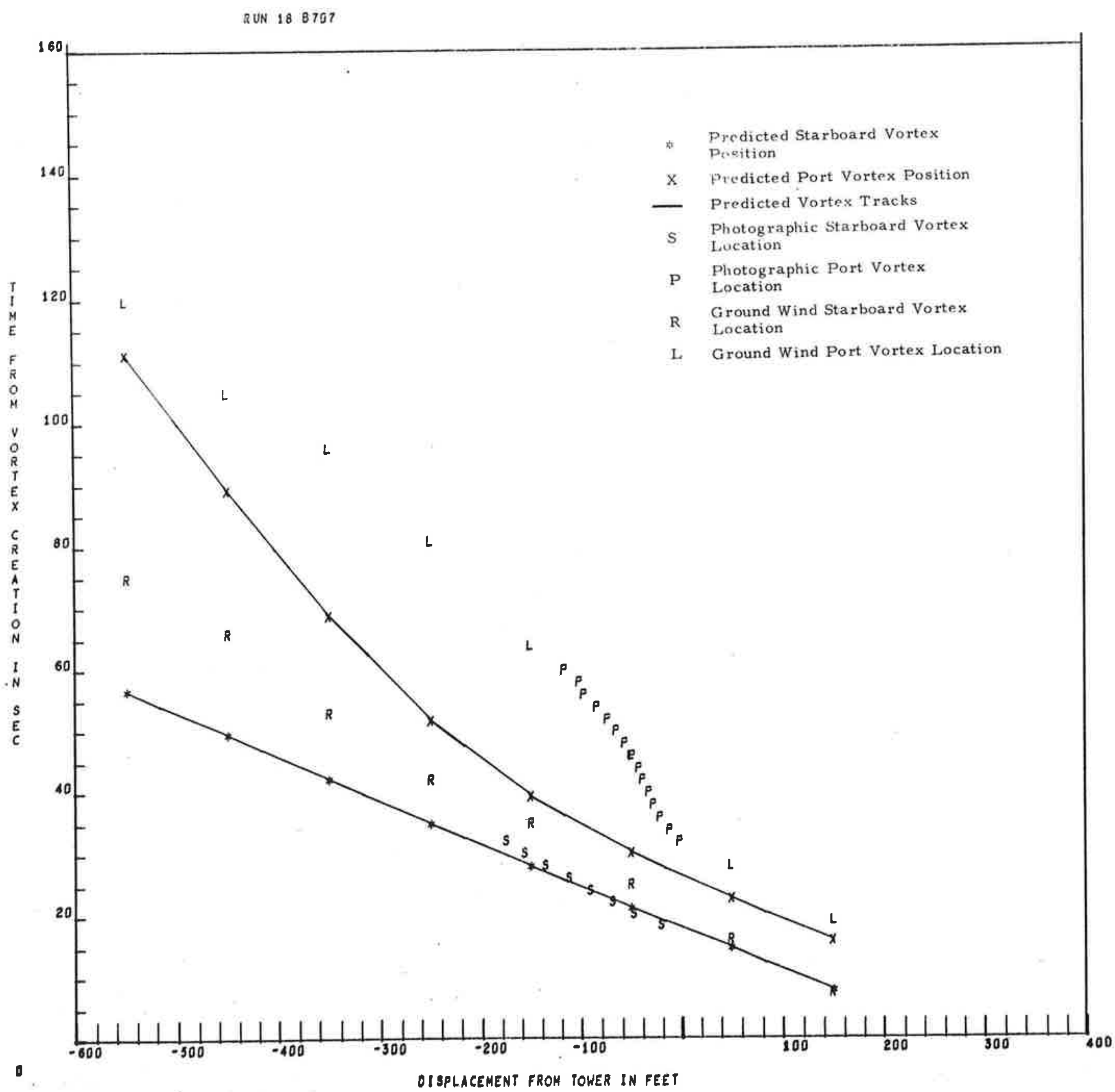
160
140
120
100
80
60
40
20
0
TIME FROM VORTEX CREATION IN SEC
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

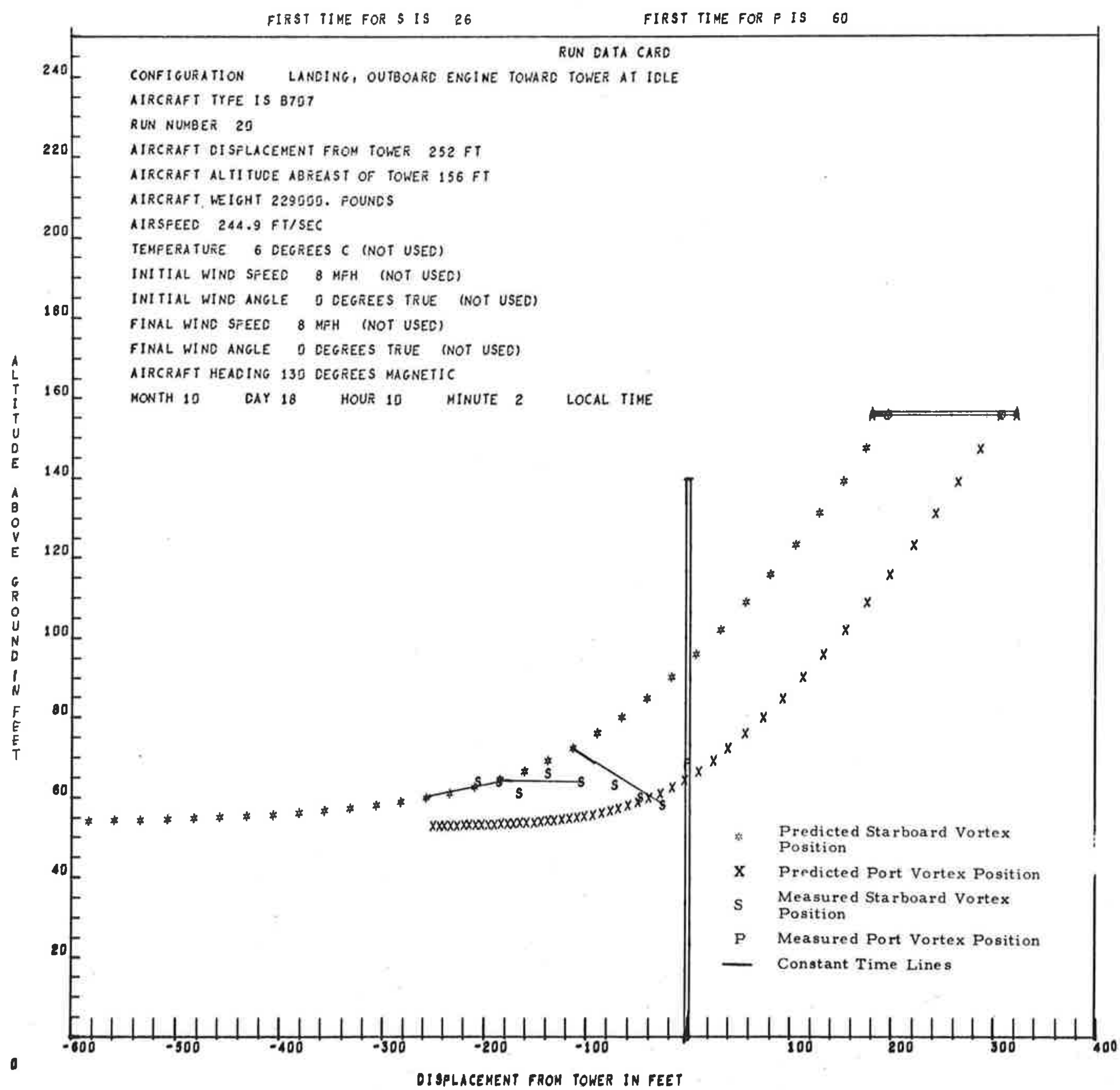


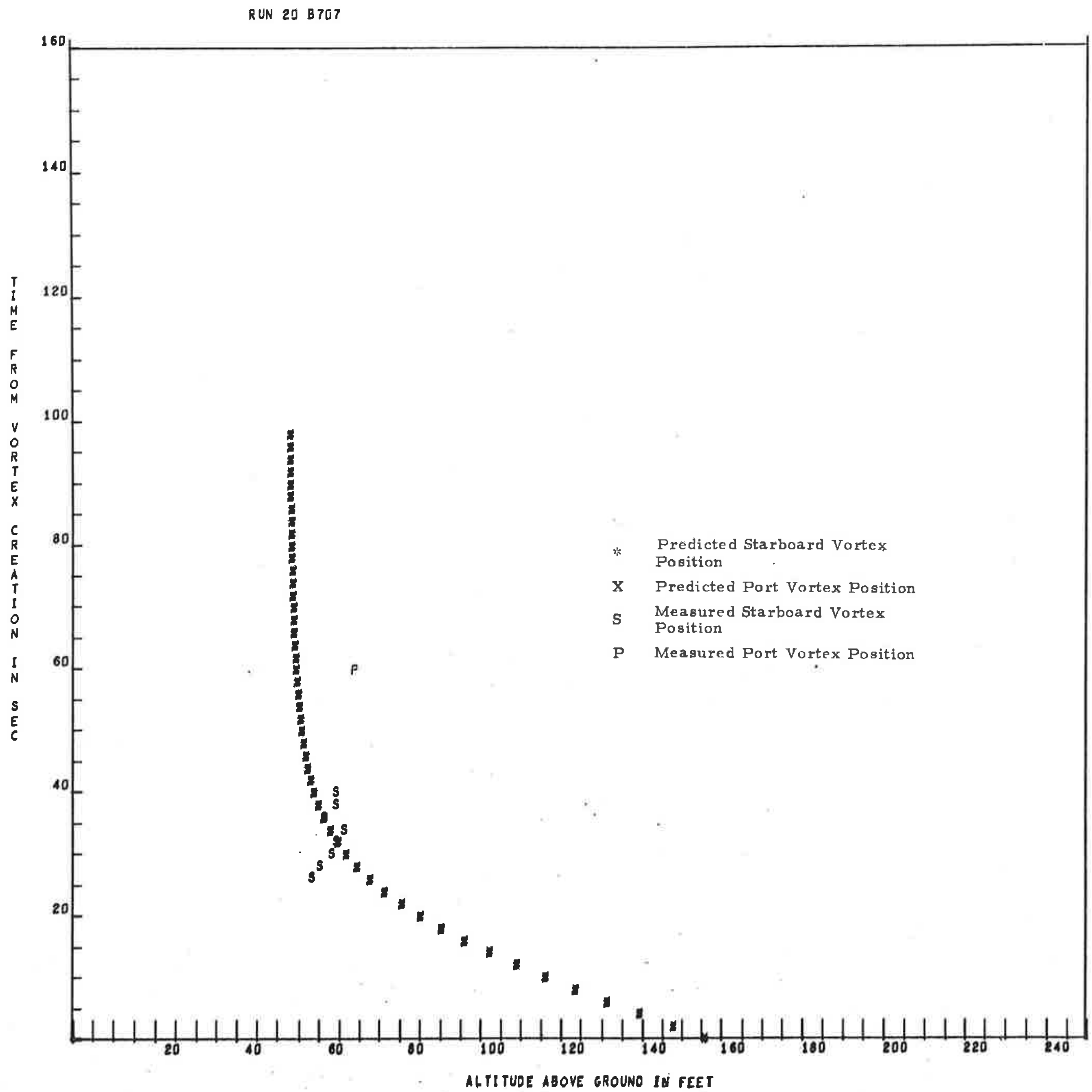
FIRST TIME FOR S IS 18
FIRST TIME FOR P IS 32
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE AWAY FROM TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 18
AIRCRAFT DISPLACEMENT FROM TOWER 275 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 209 FT
AIRCRAFT WEIGHT 231000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 9 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 9 MINUTE 54 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines

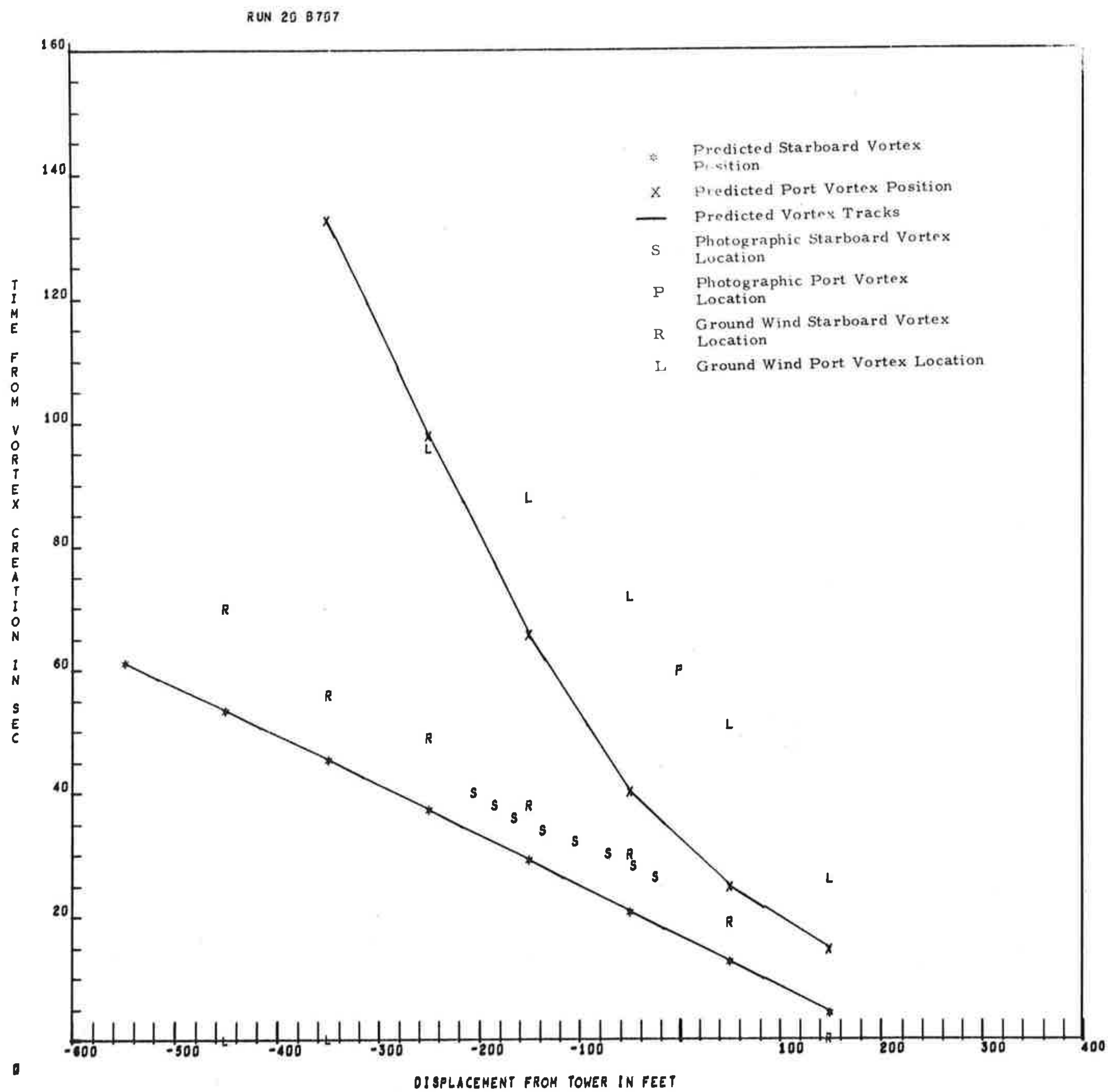


RUN 18 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

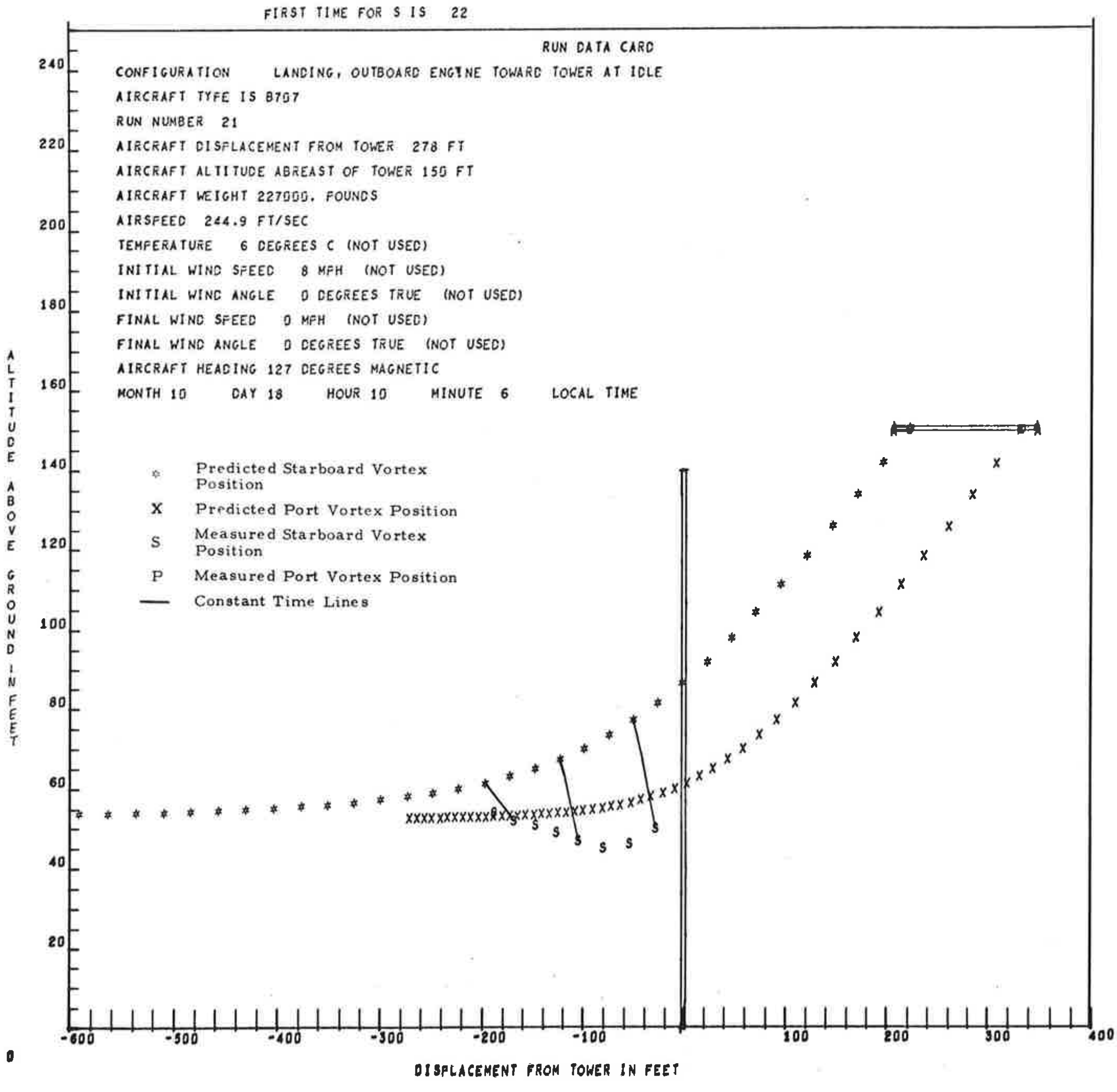

RUN 18 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location


FIRST TIME FOR S IS 26
FIRST TIME FOR P IS 60
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 20
AIRCRAFT DISPLACEMENT FROM TOWER 252 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 156 FT
AIRCRAFT WEIGHT 229000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 10 MINUTE 2 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

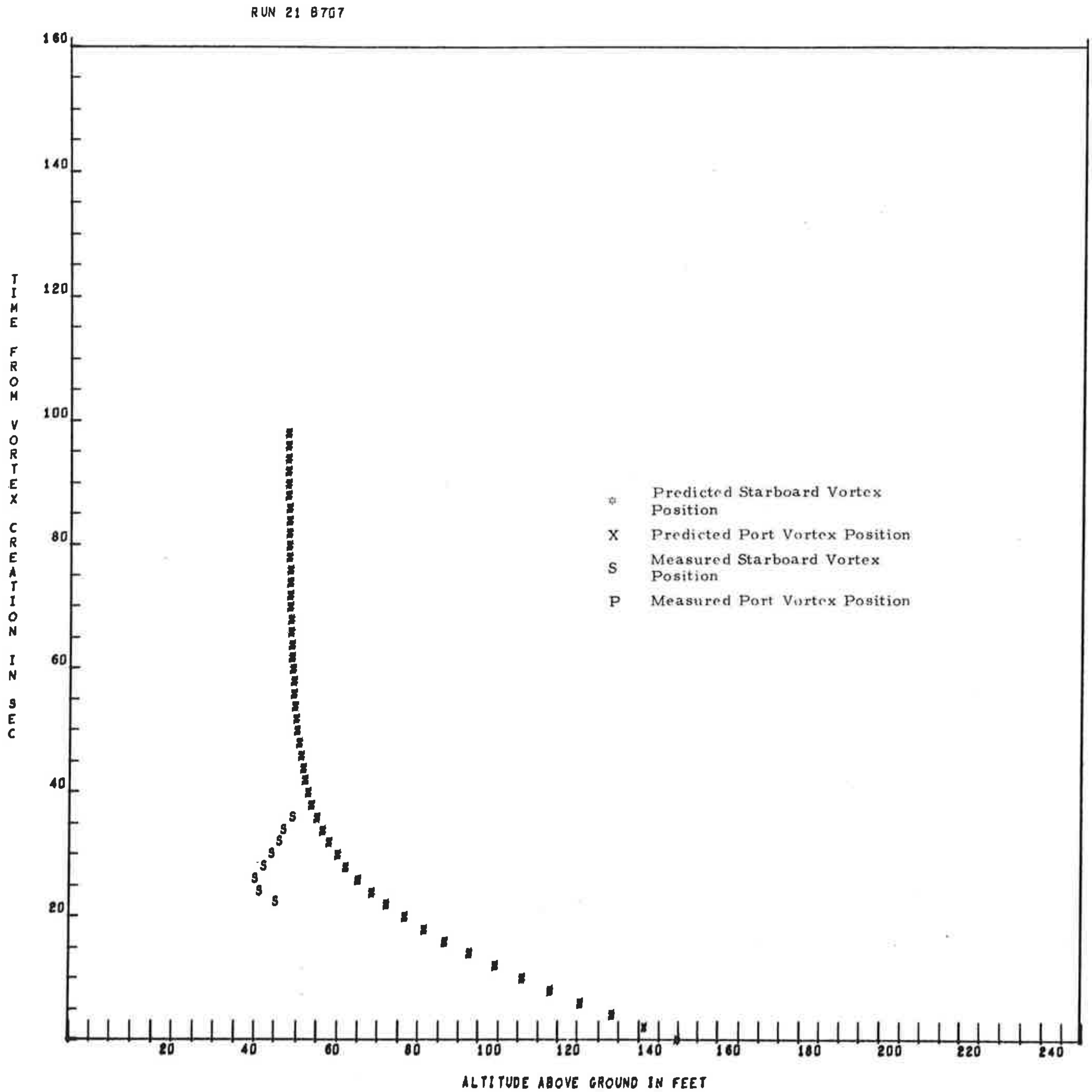

RUN 20 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
P
S
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

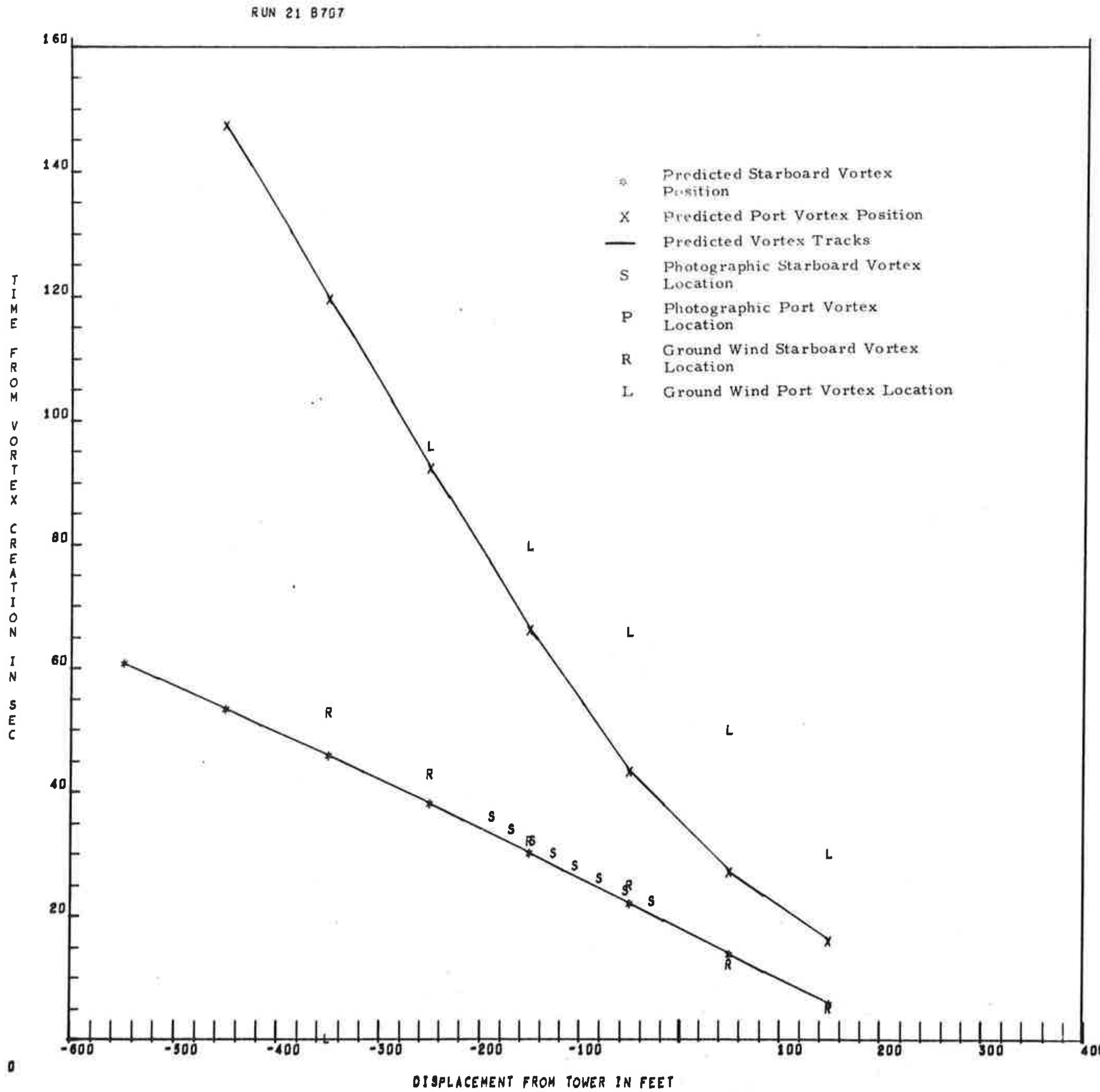


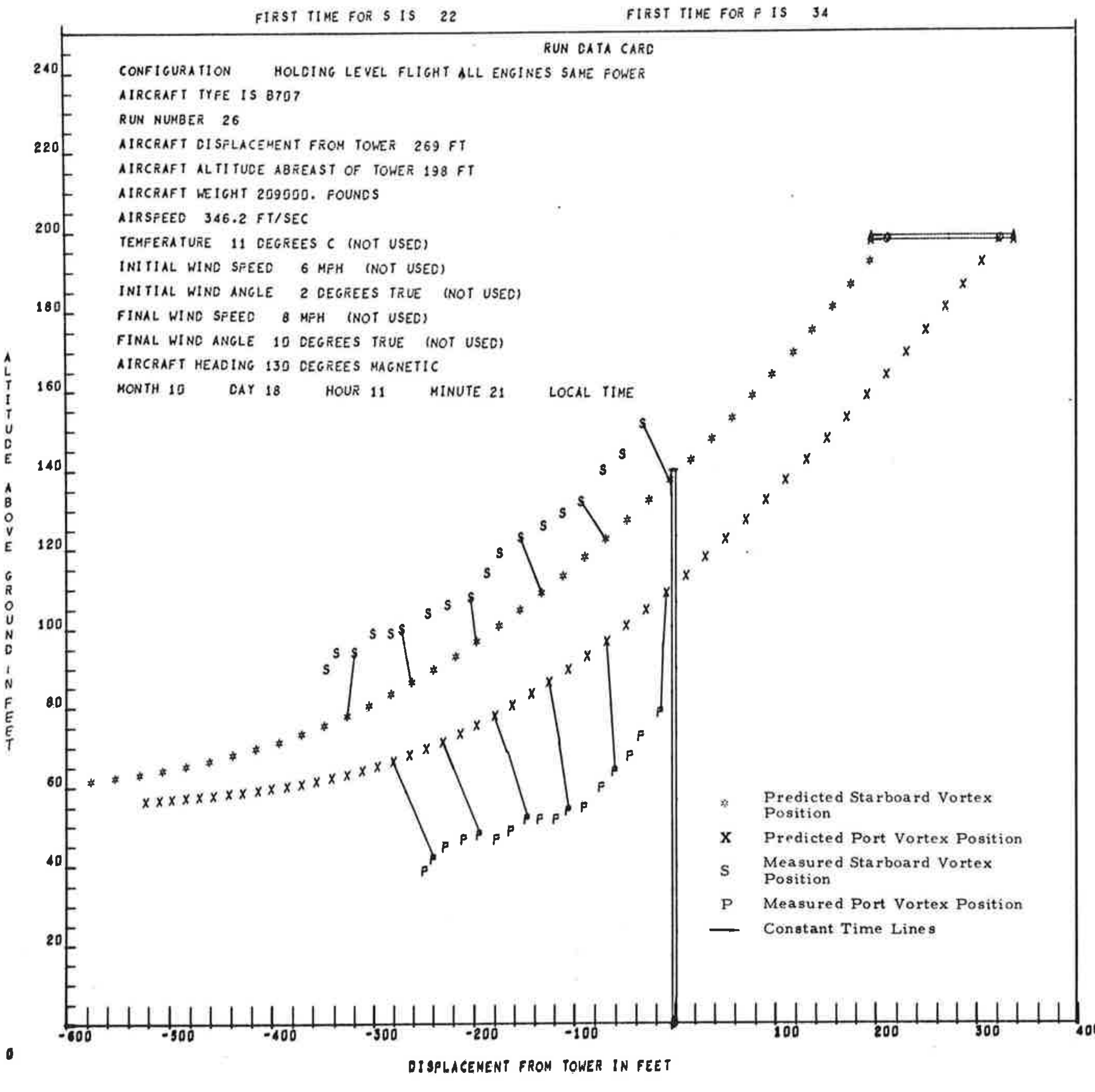
RUN 20 B707
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400



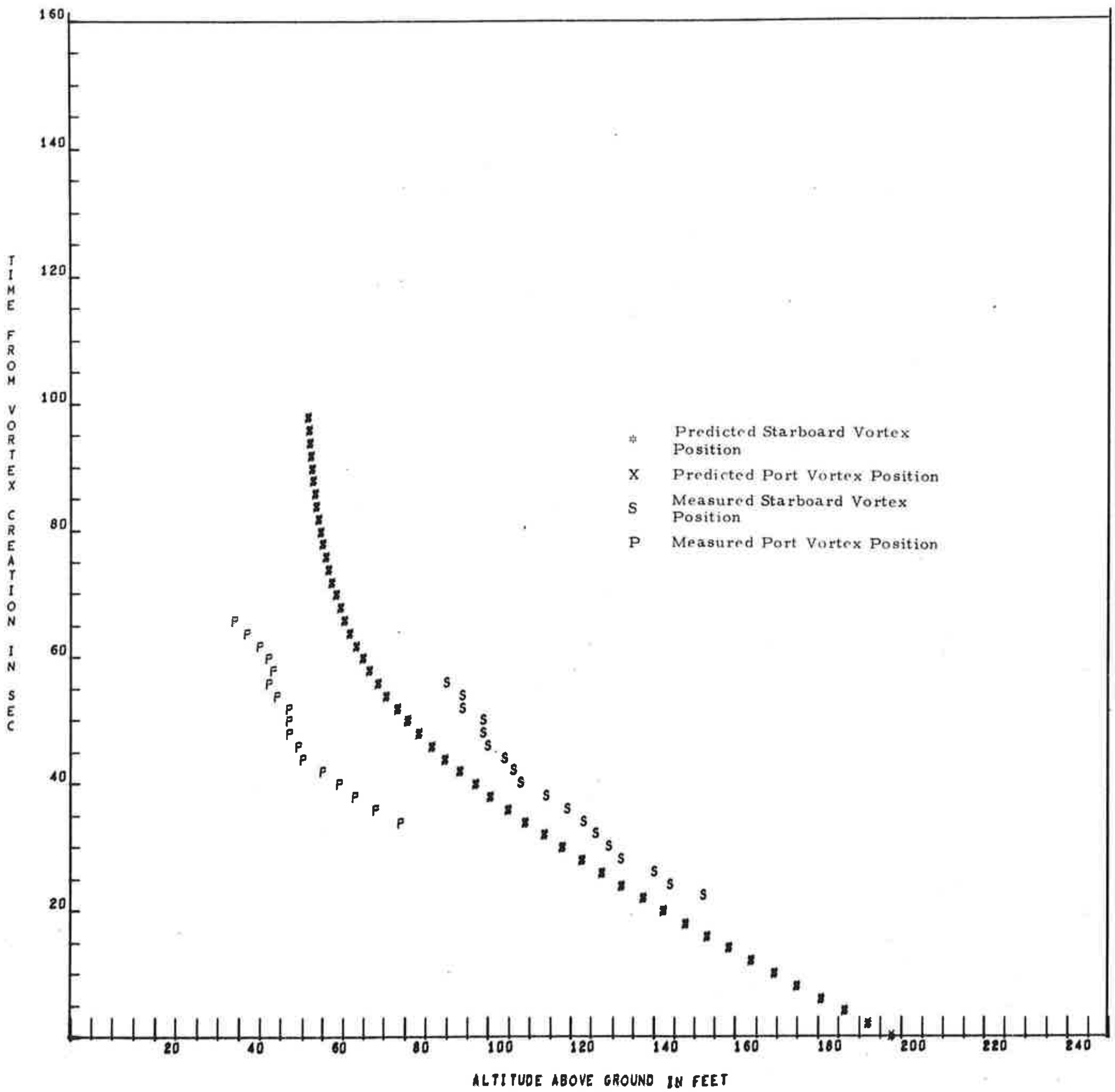
FIRST TIME FOR S IS 22
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 21
AIRCRAFT DISPLACEMENT FROM TOWER 278 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 150 FT
AIRCRAFT WEIGHT 227000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 8 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 127 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 10 MINUTE 6 LOCAL TIME
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET


RUN 21 8707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

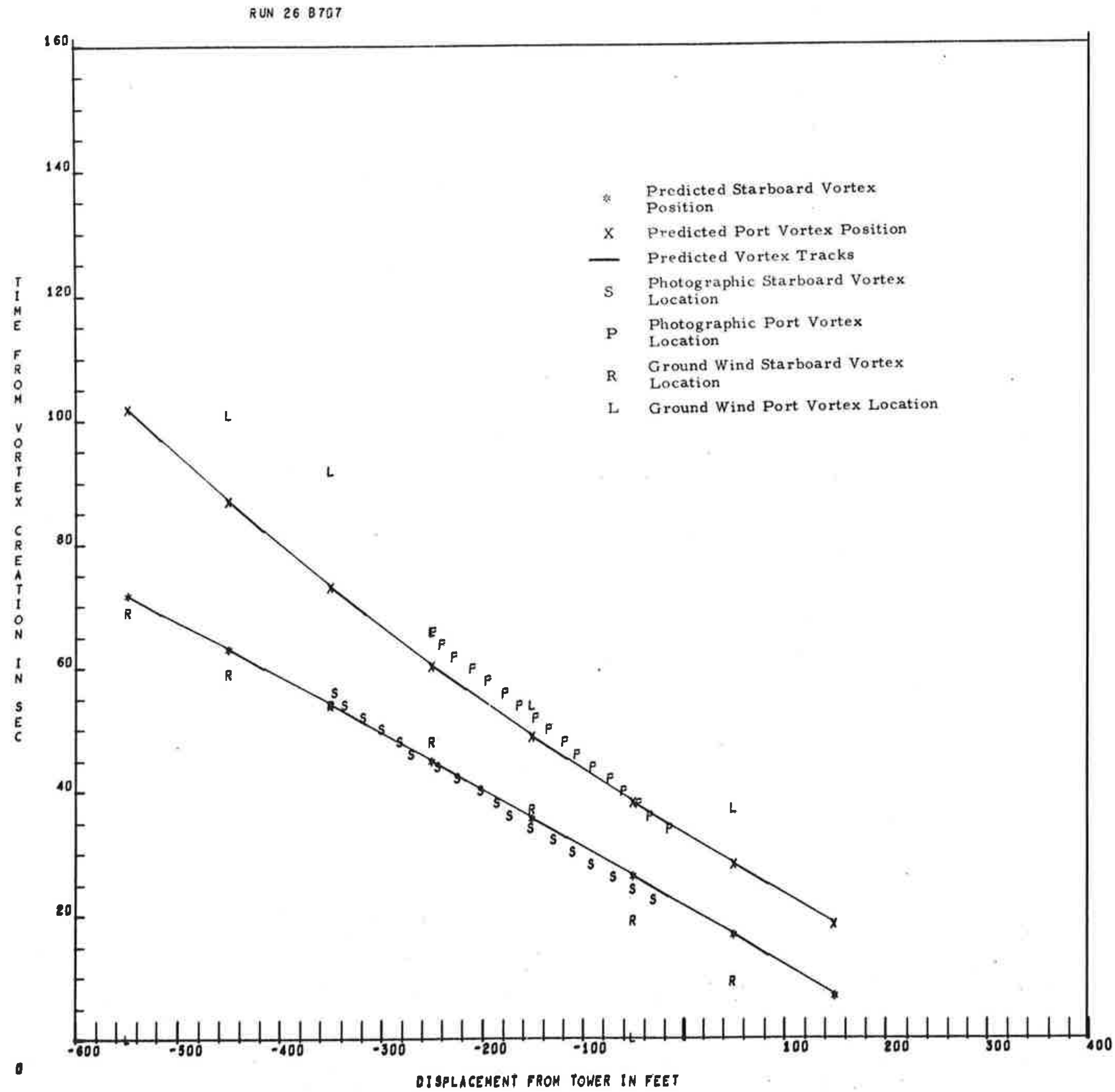

RUN 21 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400


FIRST TIME FOR S IS 22
FIRST TIME FOR P IS 34
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 26
AIRCRAFT DISPLACEMENT FROM TOWER 269 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 198 FT
AIRCRAFT WEIGHT 209000. POUNDS
AIRSPEED 346.2 FT/SEC
TEMPERATURE 11 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 2 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 10 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 11 MINUTE 21 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

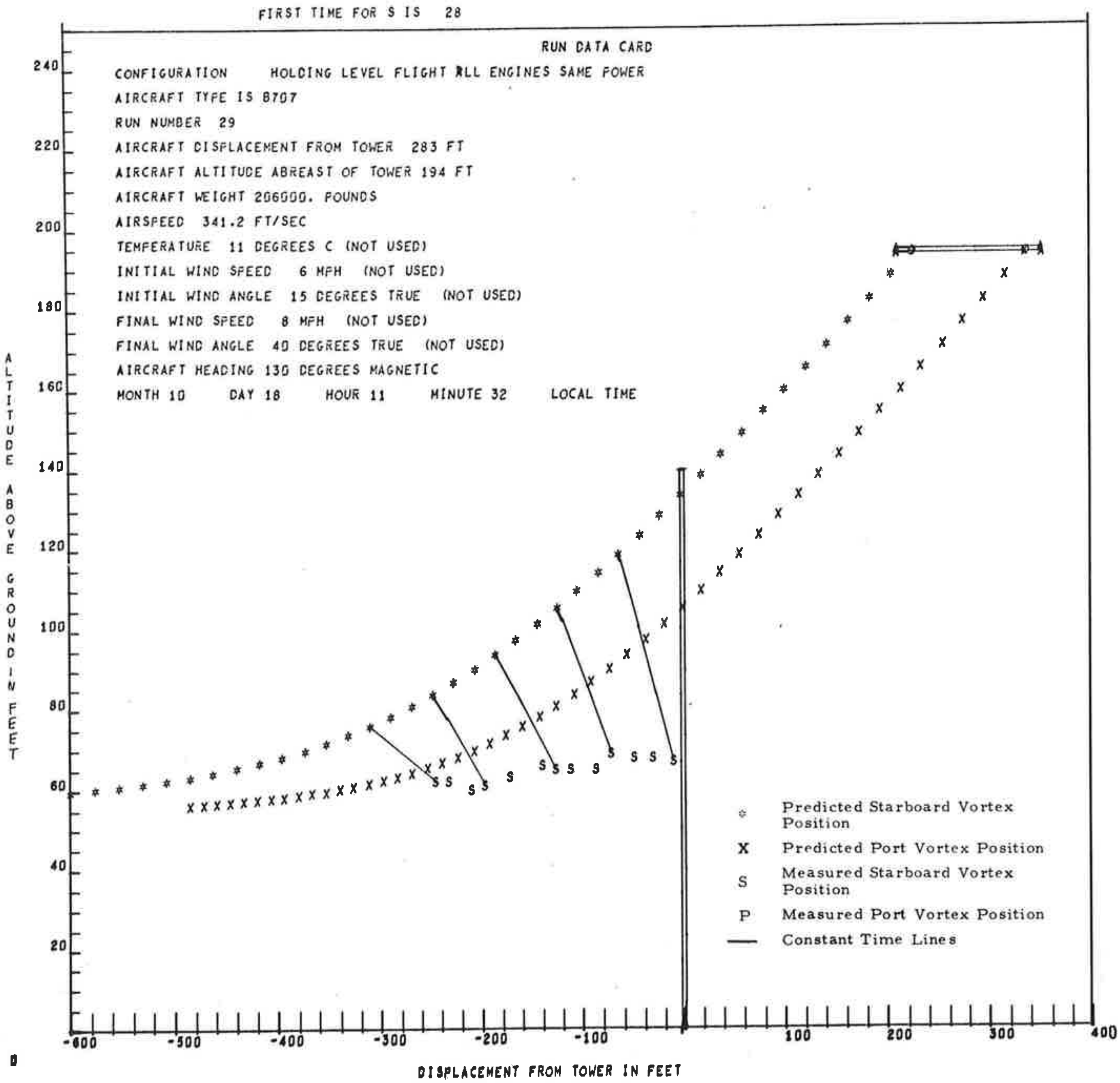
RUN 26 B707



160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

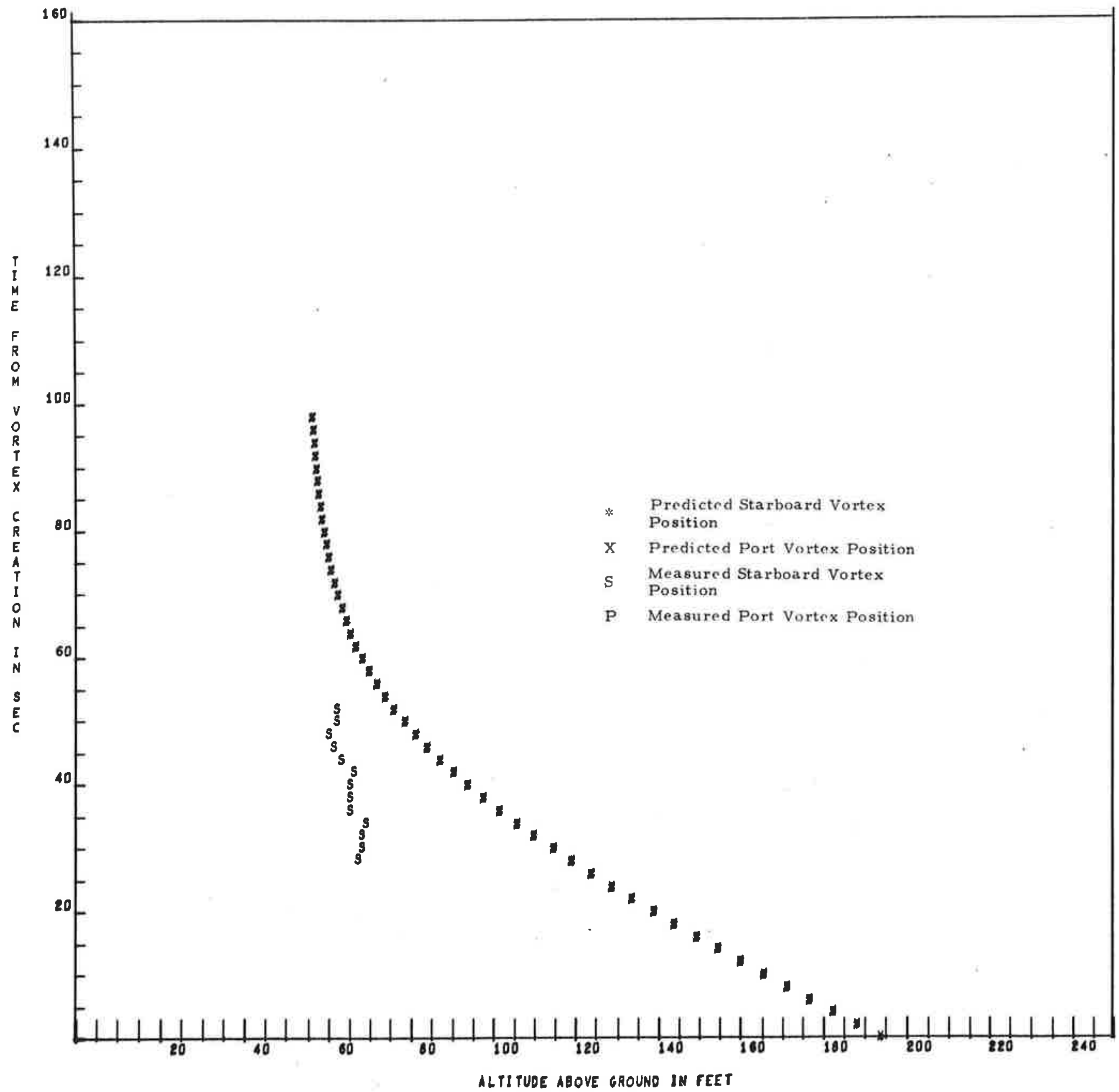


RUN 26 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location



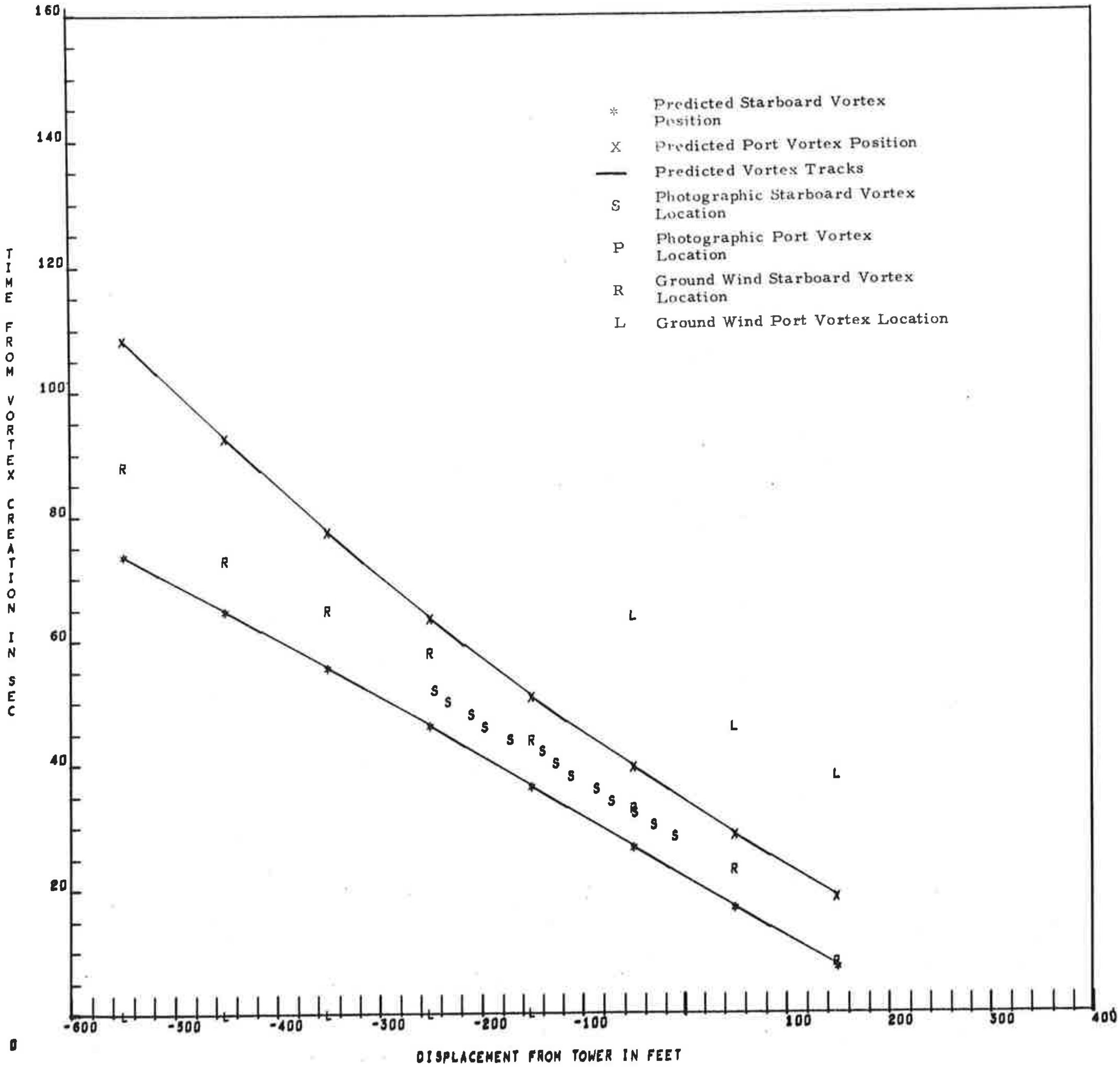
FIRST TIME FOR S IS 28
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 29
AIRCRAFT DISPLACEMENT FROM TOWER 283 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 194 FT
AIRCRAFT WEIGHT 206000. POUNDS
AIRSPEED 341.2 FT/SEC
TEMPERATURE 11 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 15 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 40 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 10 DAY 18 HOUR 11 MINUTE 32 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

RUN 29 B707



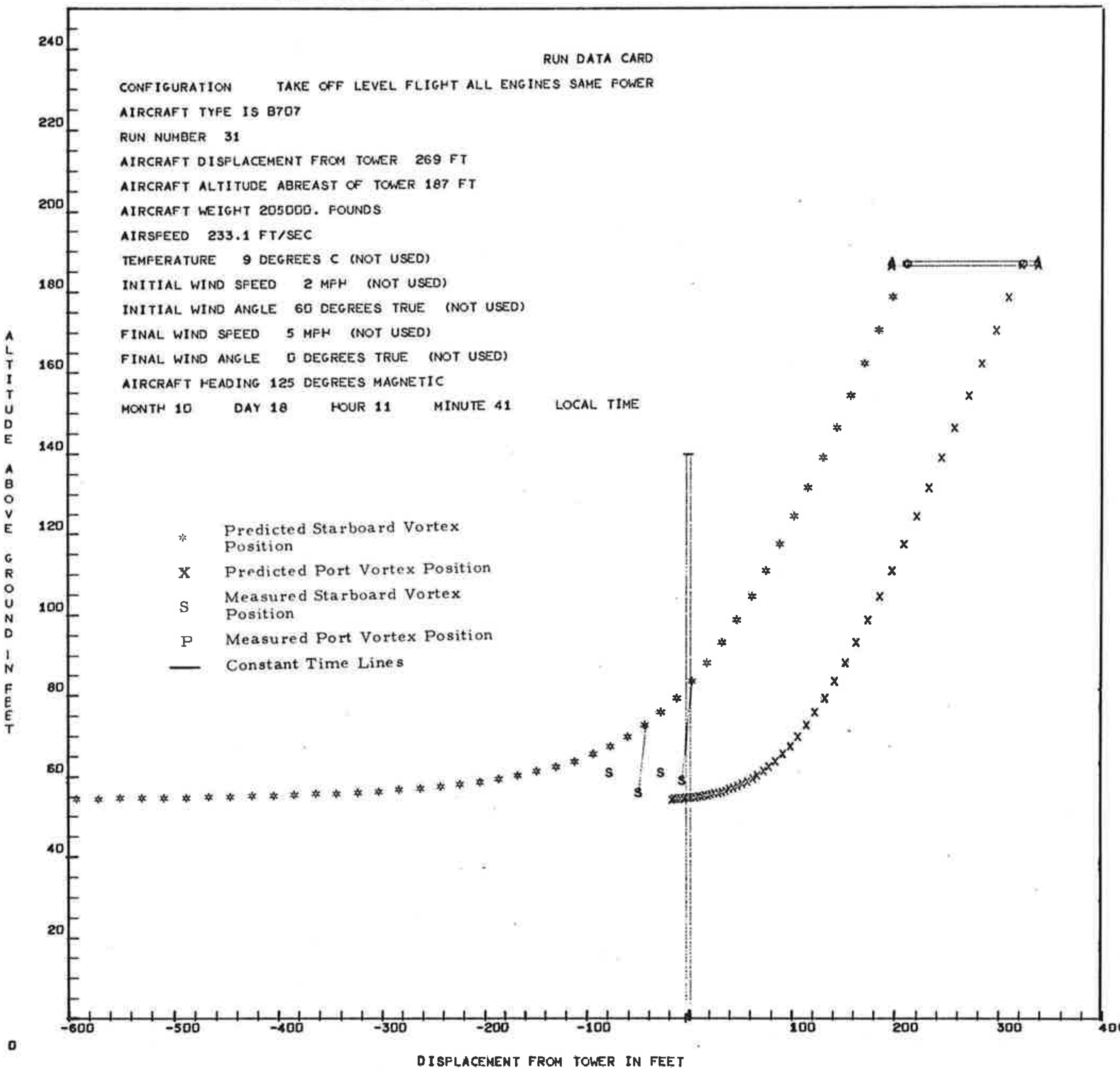
160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

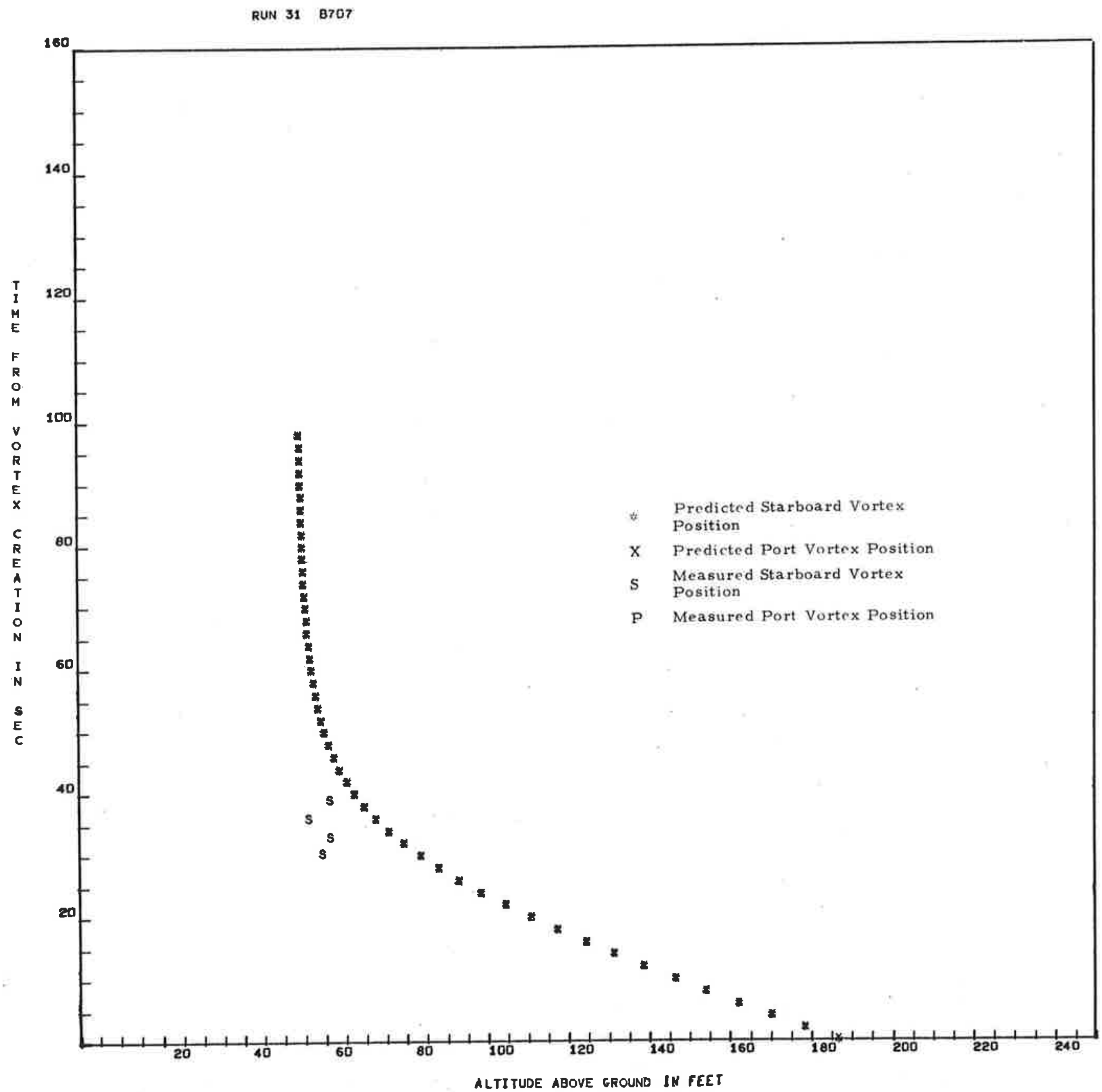
RUN 29 8707

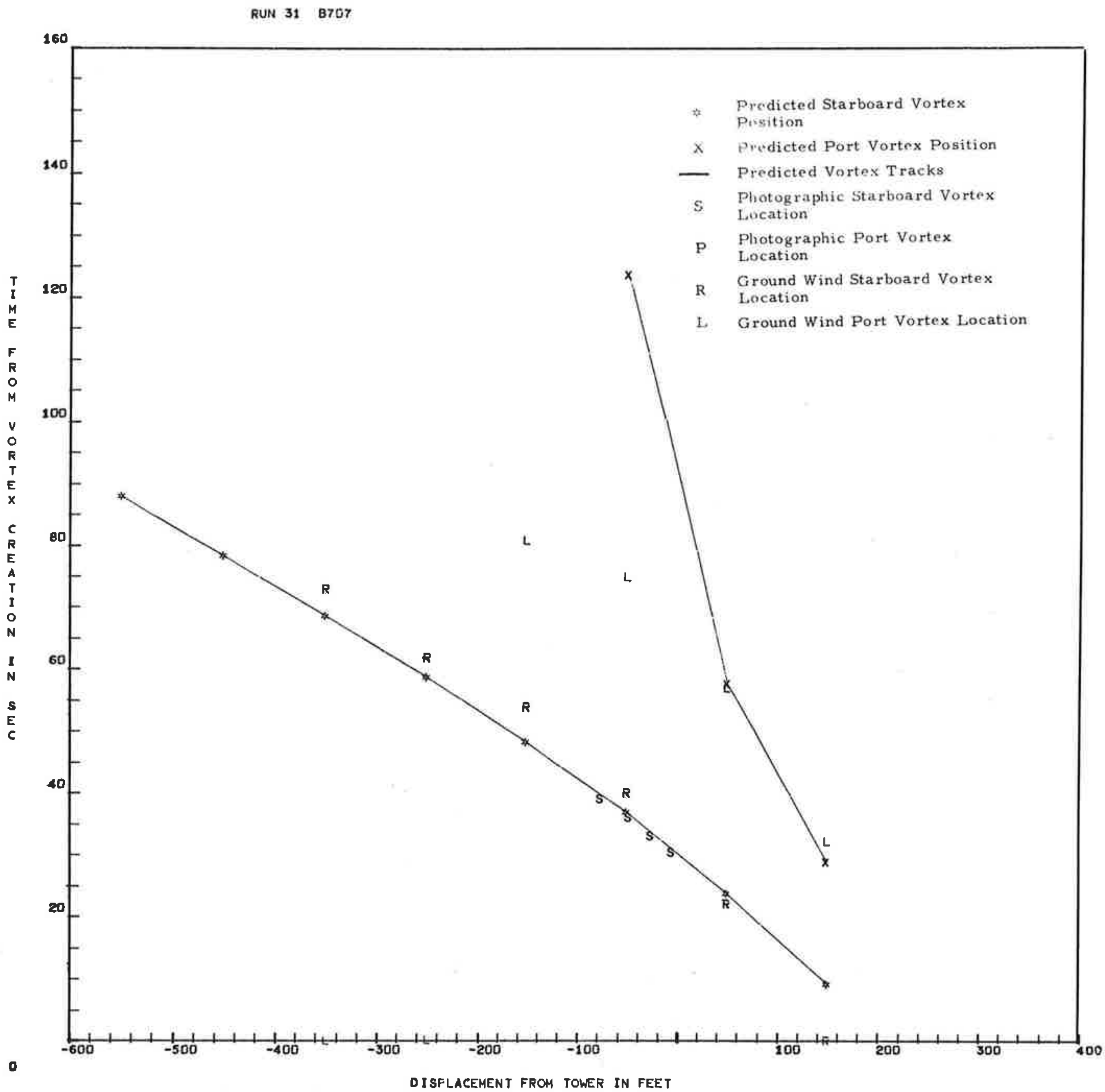


160
140
120
100
80
60
40
20
0
TIME FROM VORTEX CREATION IN SEC
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

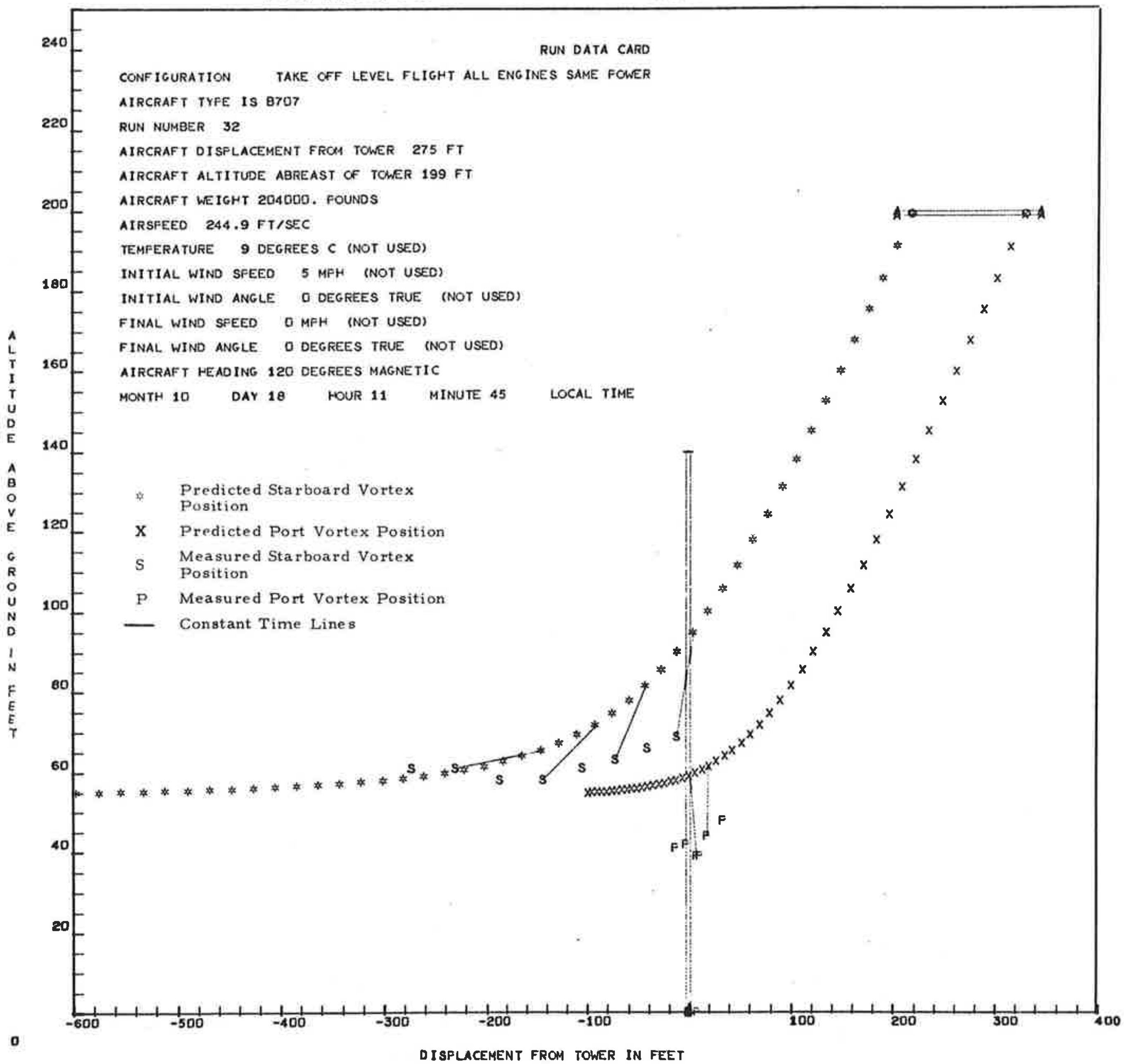
RUN 31 B707
FIRST TIME FOR S IS 30

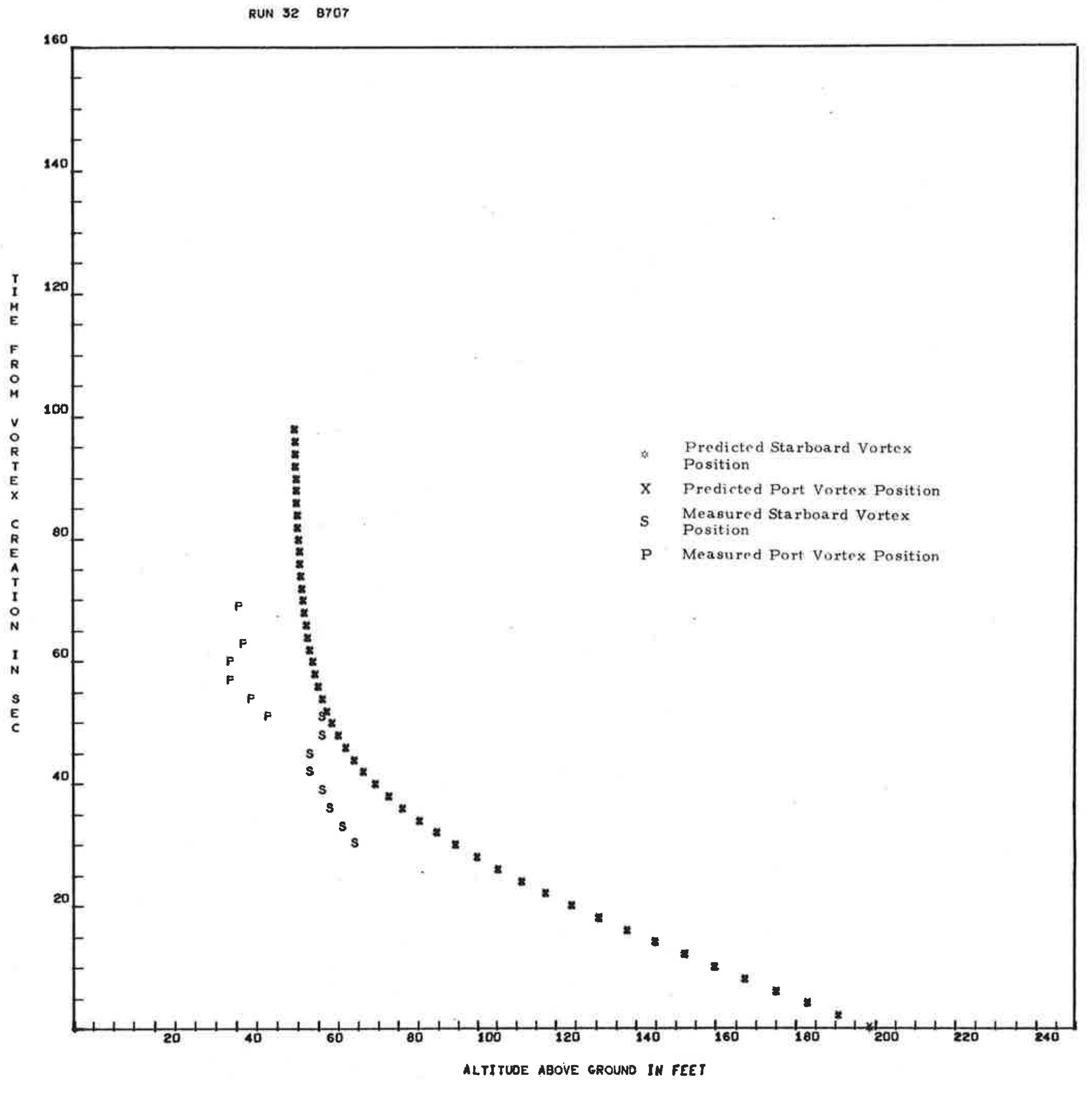



RUN 31 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position

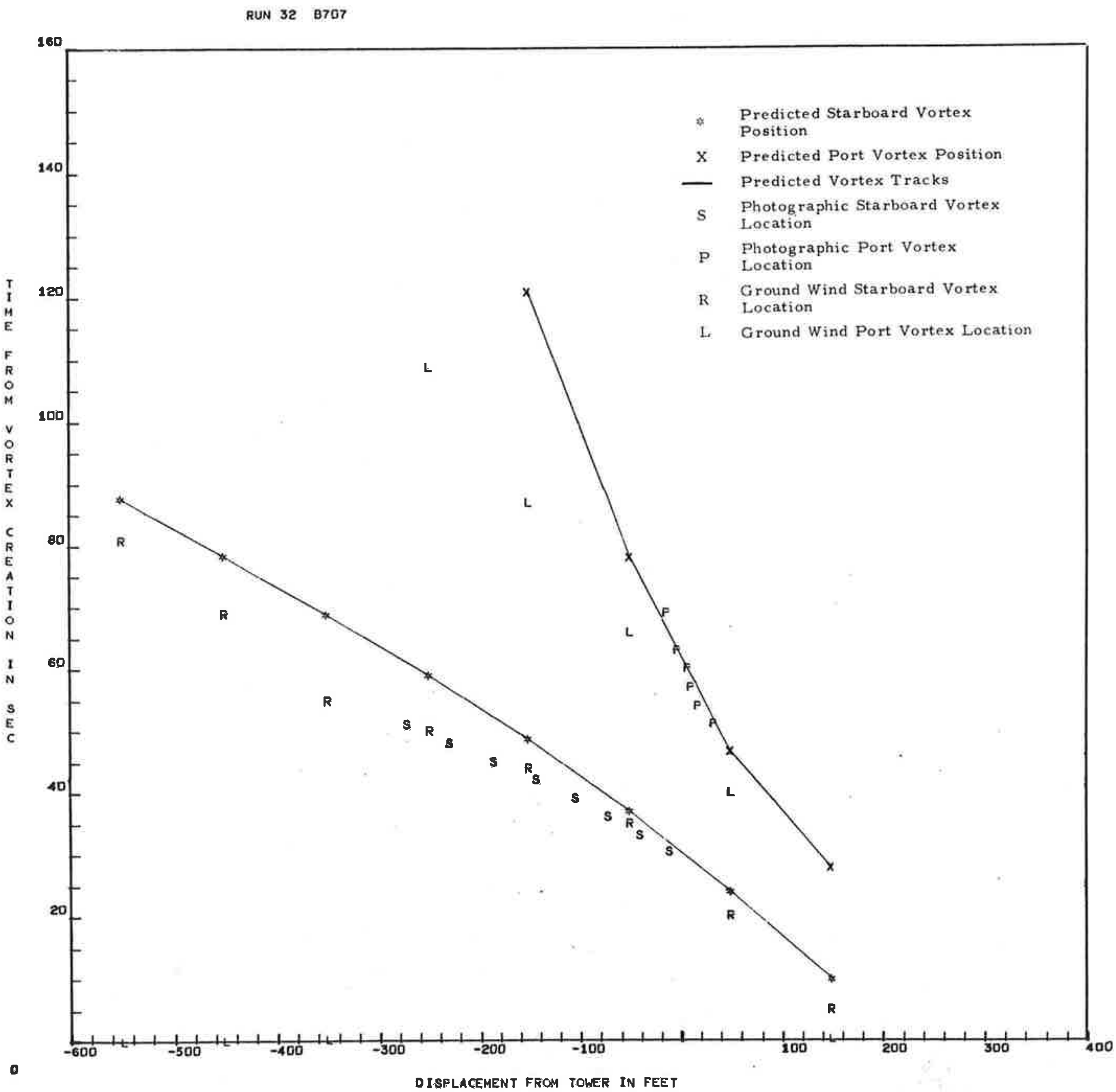

RUN 31 B707
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Predicted Vortex Tracks
Photographic Starboard Vortex Location
Photographic Port Vortex Location
Ground Wind Starboard Vortex Location
Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400

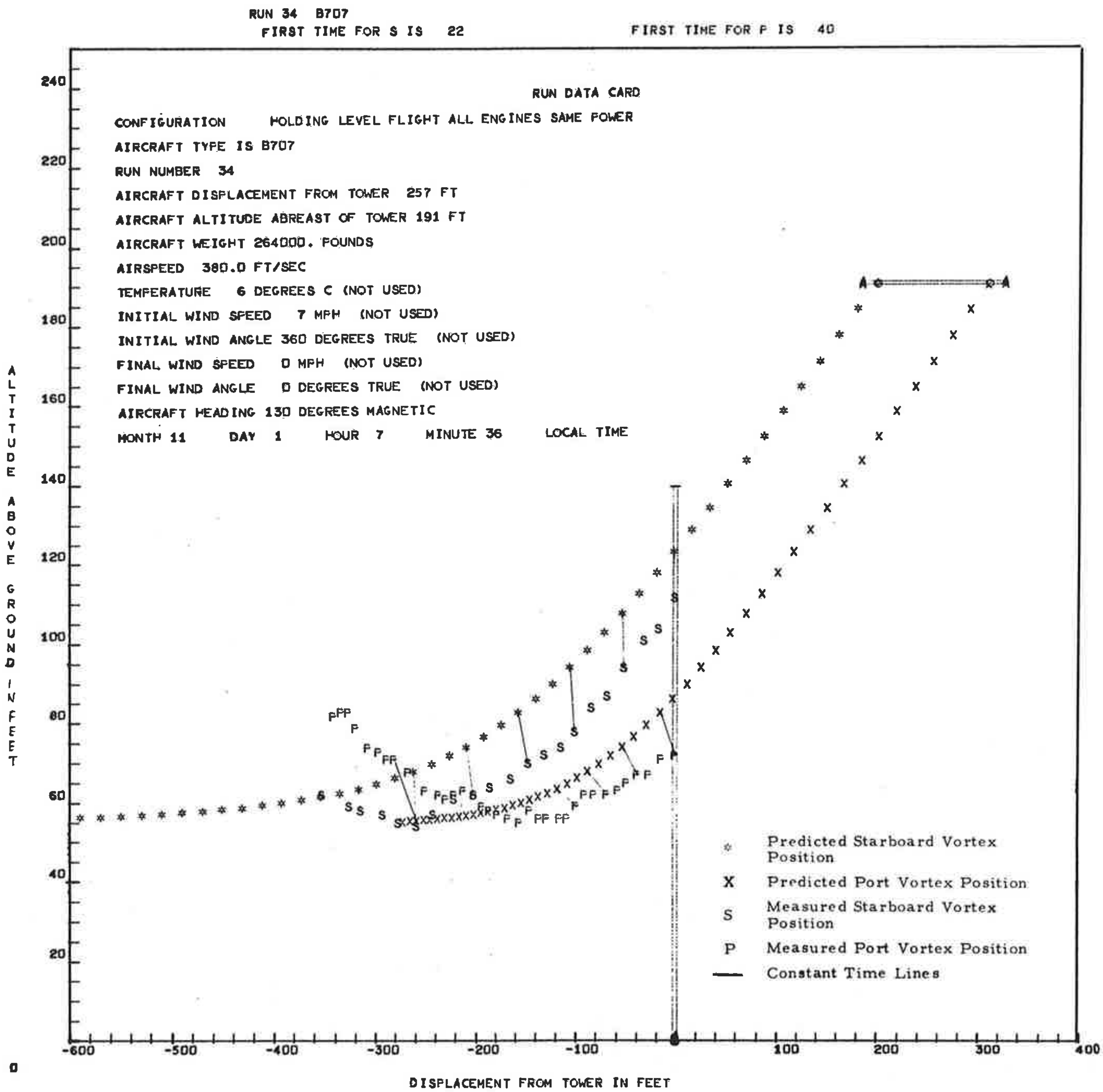
RUN 32 B707
FIRST TIME FOR S IS 30 FIRST TIME FOR P IS 51

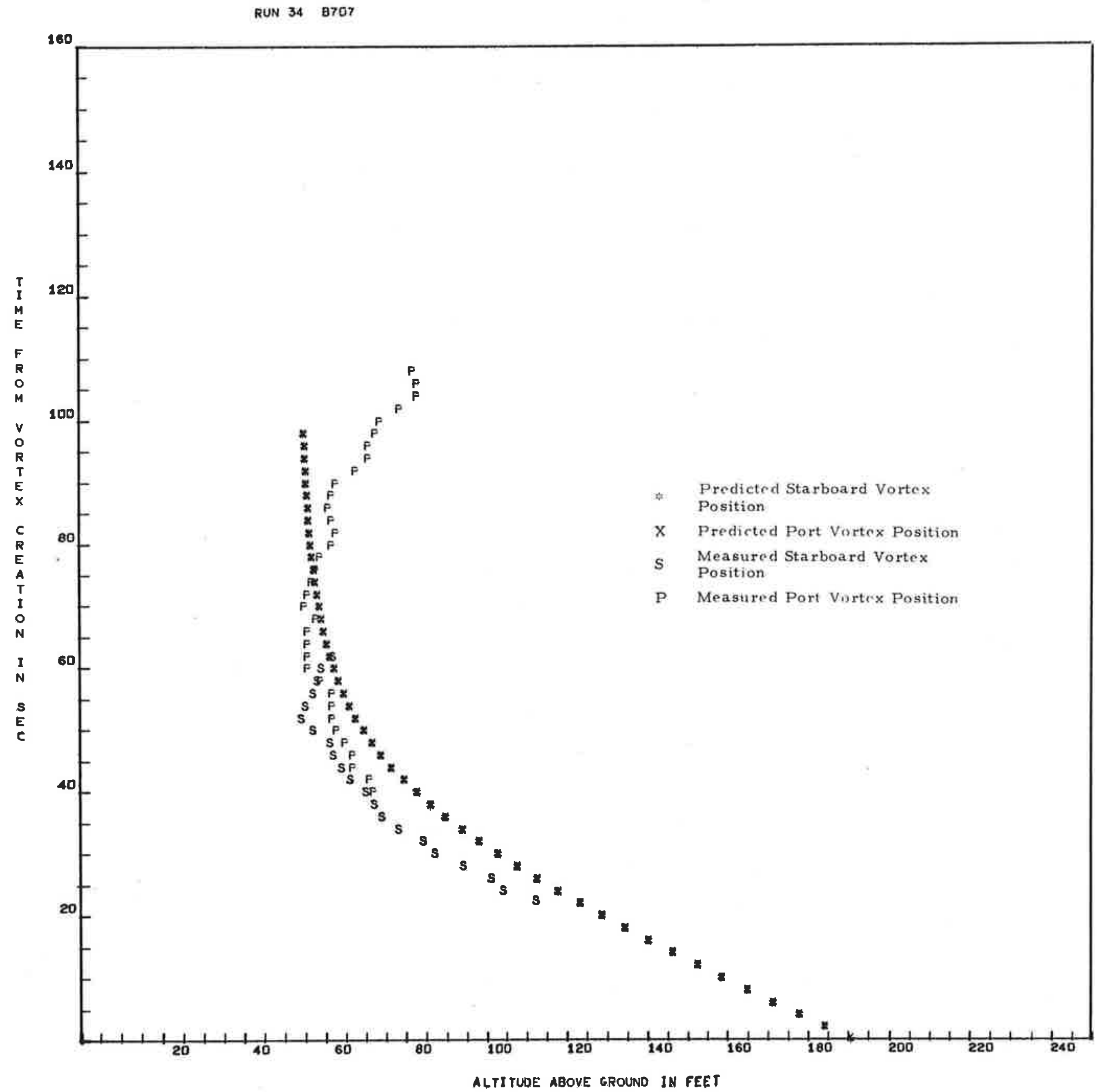




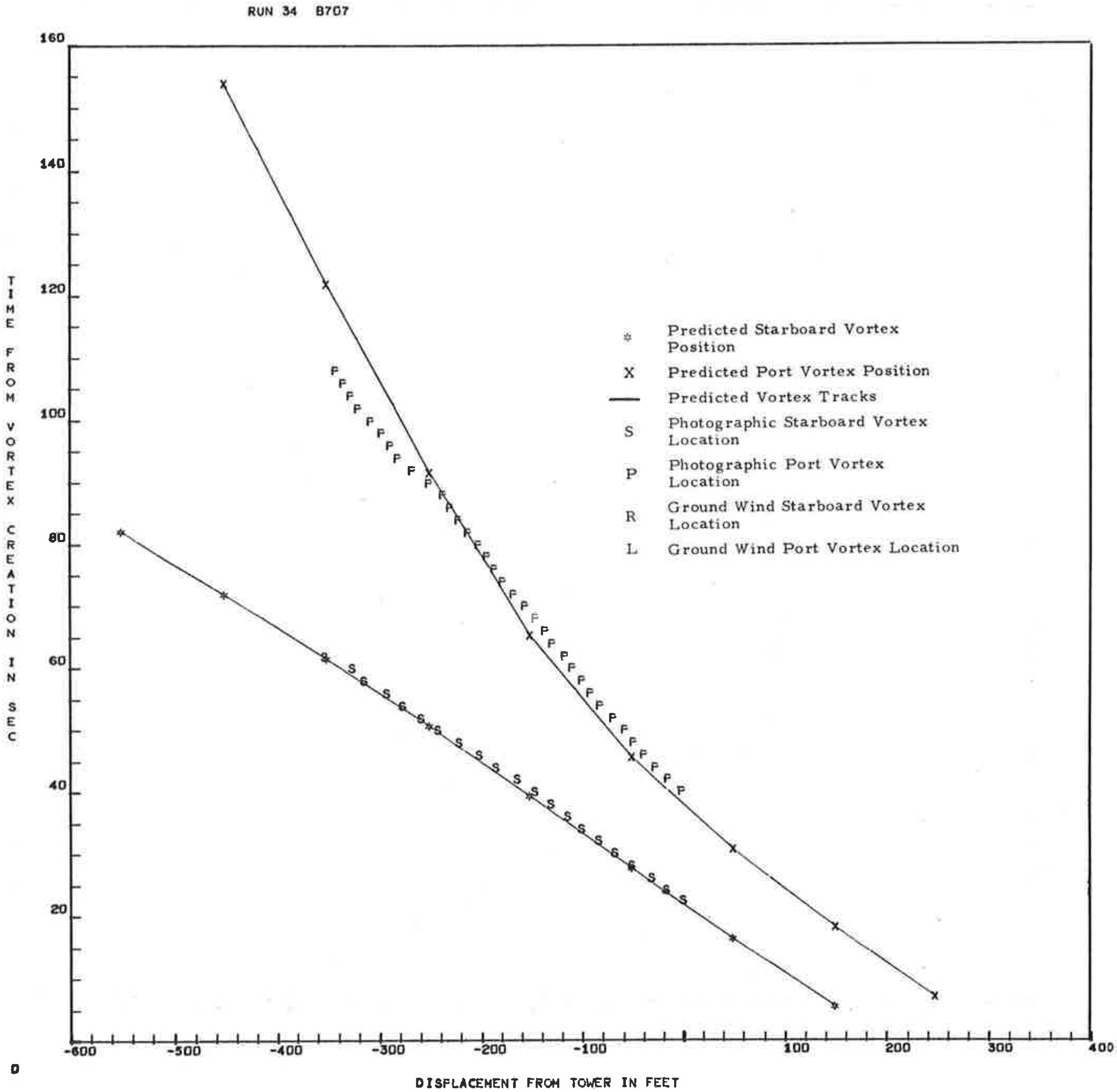
RUN 32 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 32 B707
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
0
20
40
60
80
100
120
140
160
-600
-500
-400
-300
-200
-100
100
200
300
400

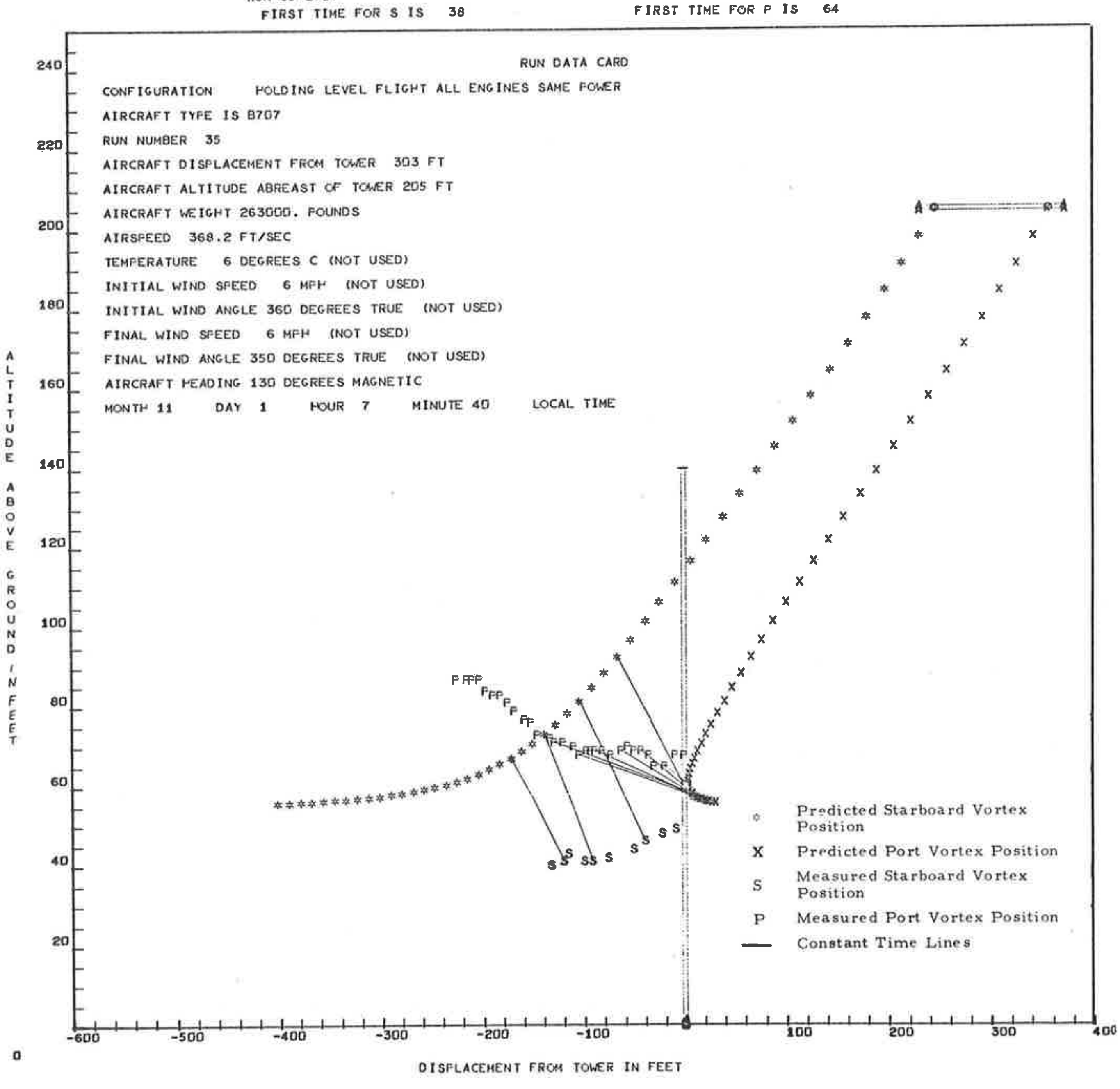

RUN 34 B707
FIRST TIME FOR S IS 22
FIRST TIME FOR P IS 40
RUN DATA CARD
CONFIGURATION HOLDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 34
AIRCRAFT DISPLACEMENT FROM TOWER 257 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 191 FT
AIRCRAFT WEIGHT 264000. POUNDS
AIRSPEED 380.0 FT/SEC
TEMPERATURE 6 DEGREES C (NOT USED)
INITIAL WIND SPEED 7 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 7 MINUTE 36 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines



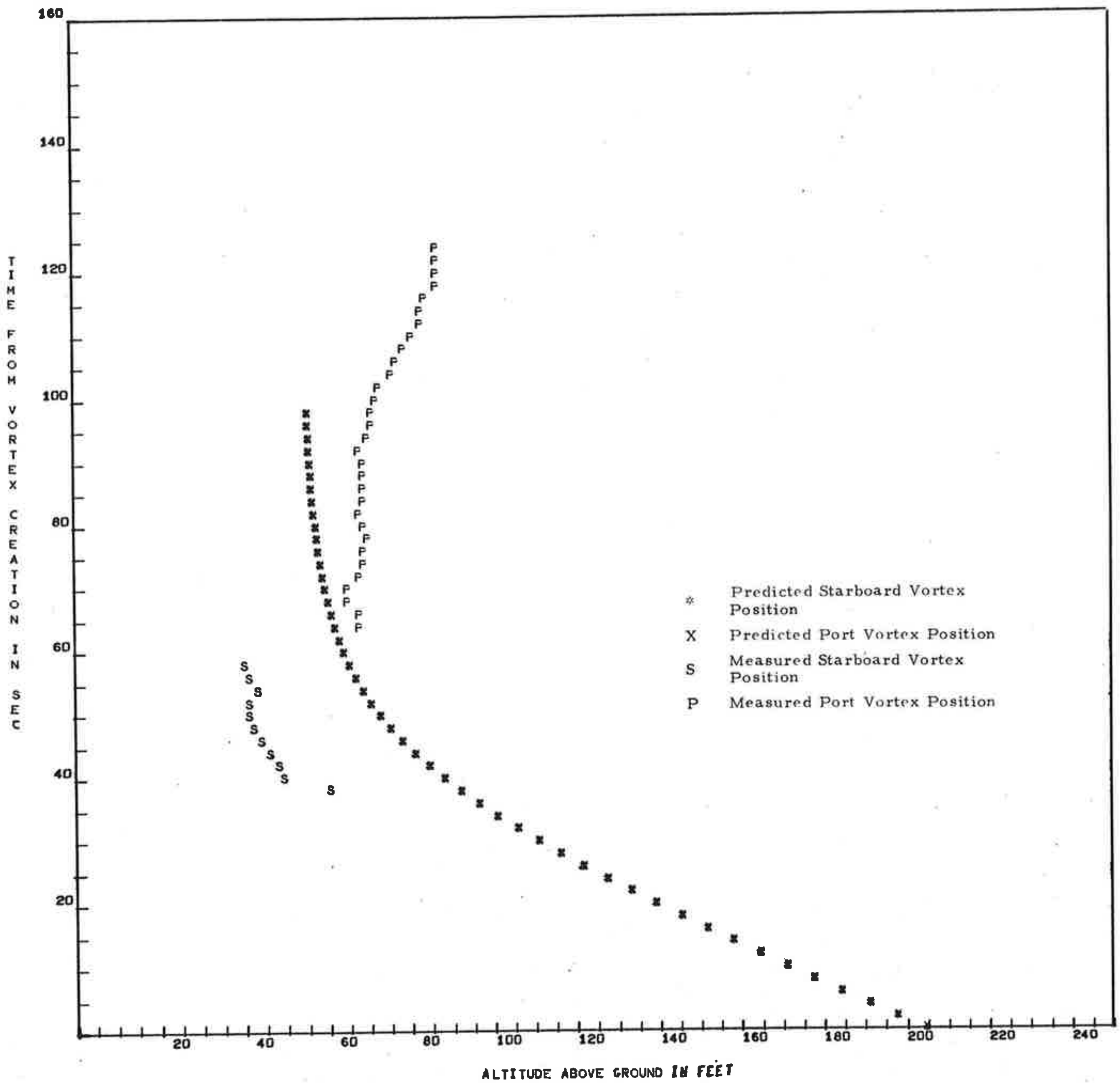
RUN 34 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 34 B707
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

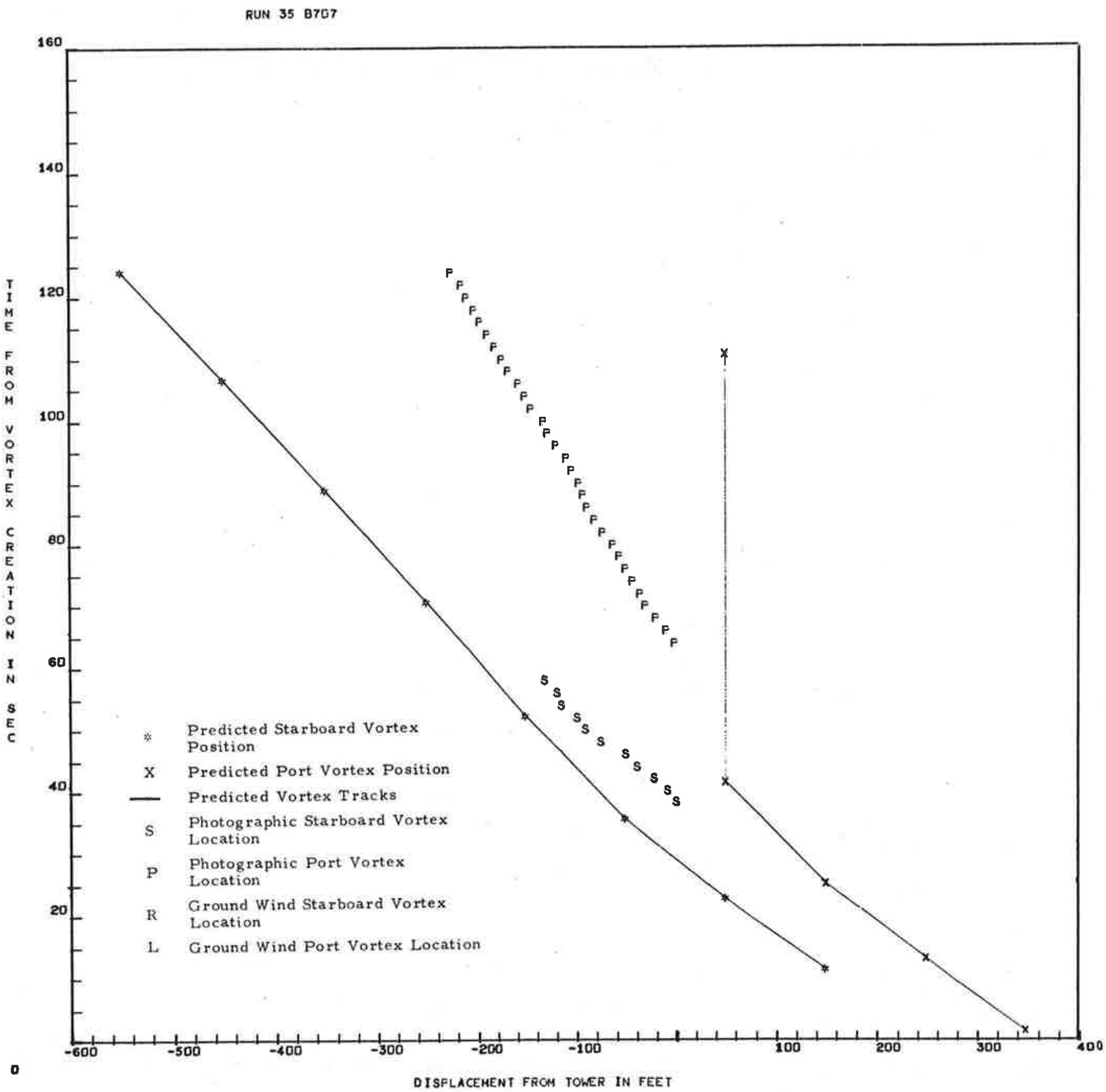
RUN 35 B707
FIRST TIME FOR S IS 38 FIRST TIME FOR P IS 64

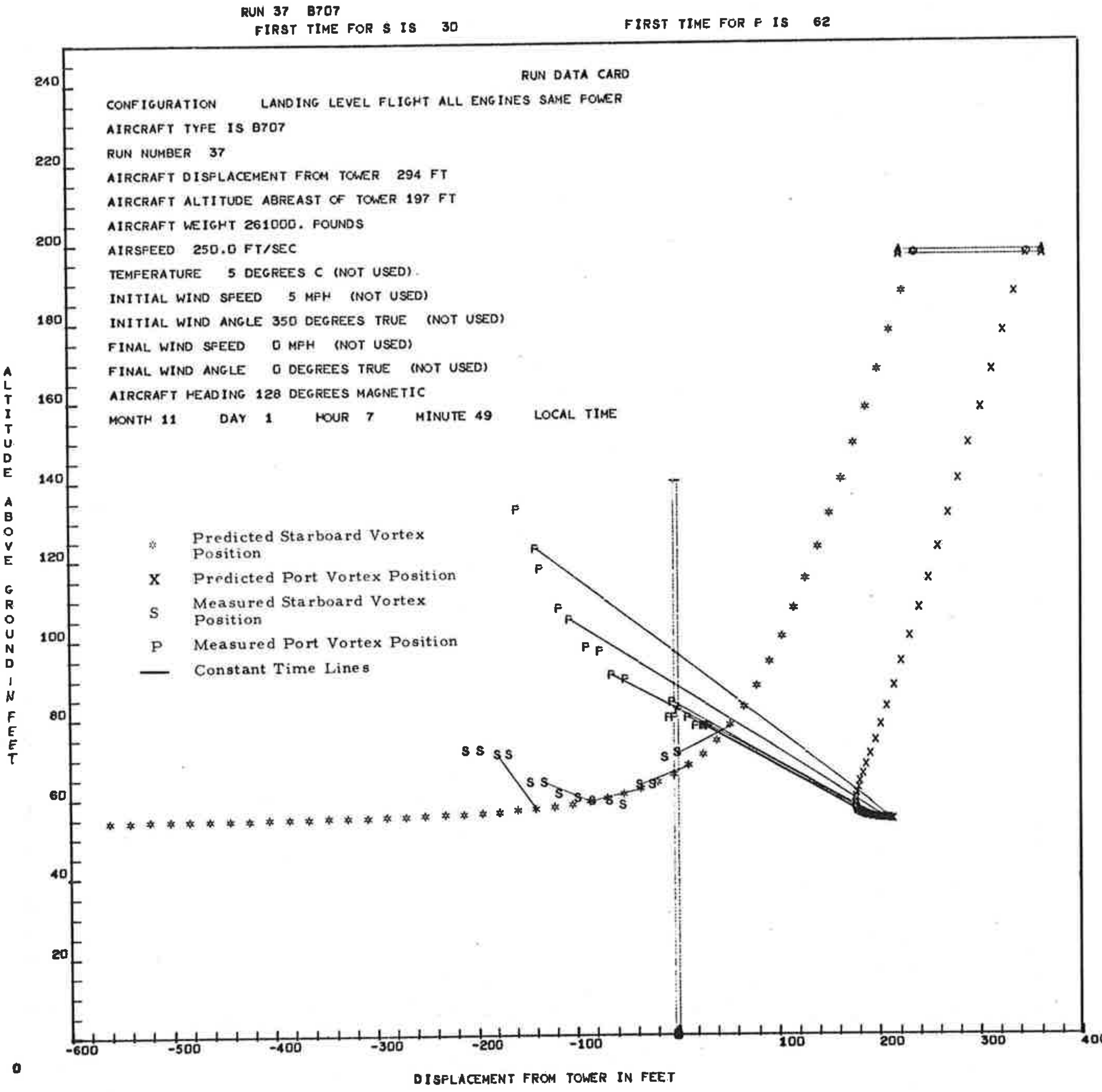


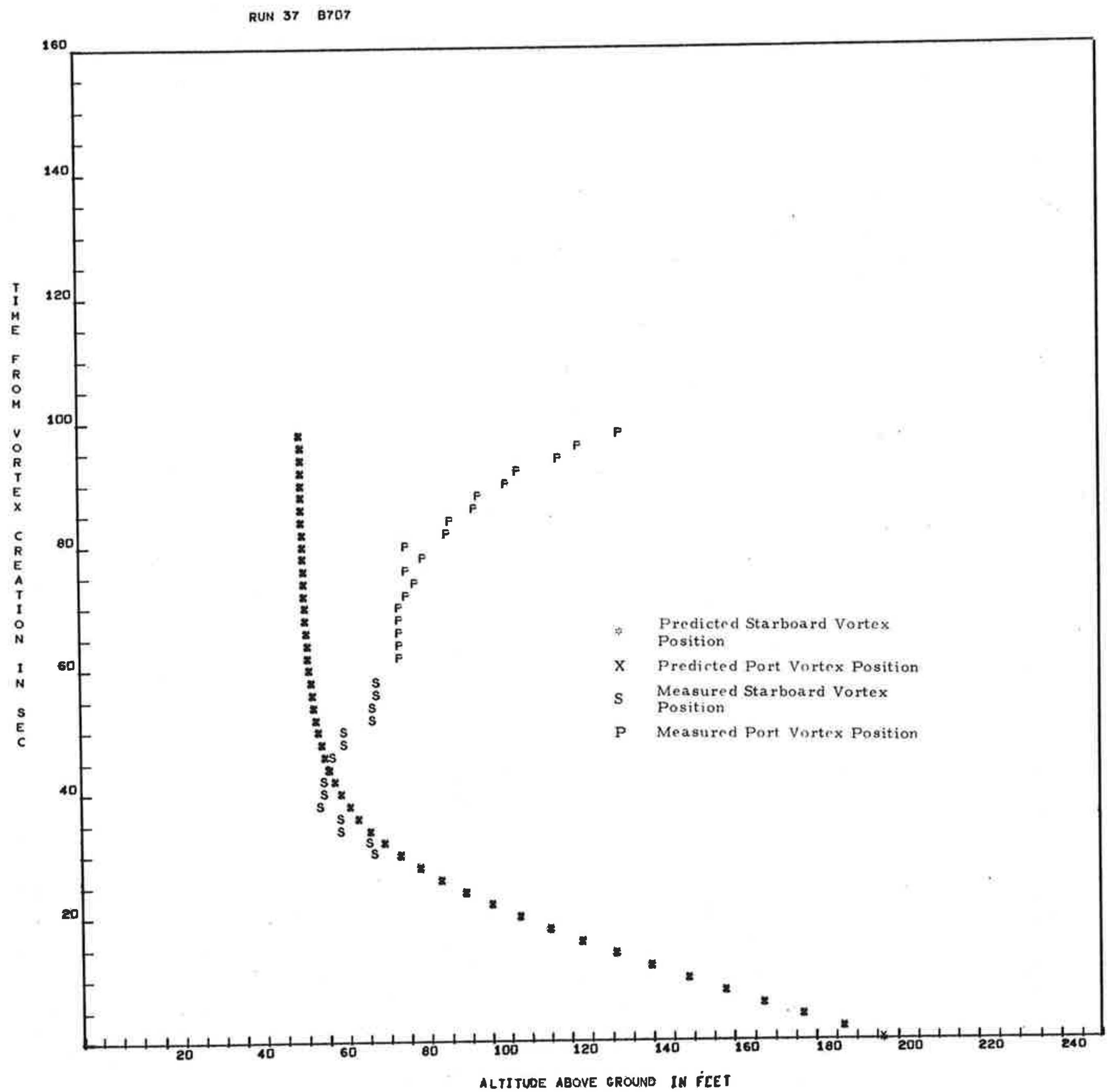
RUN 35 B707

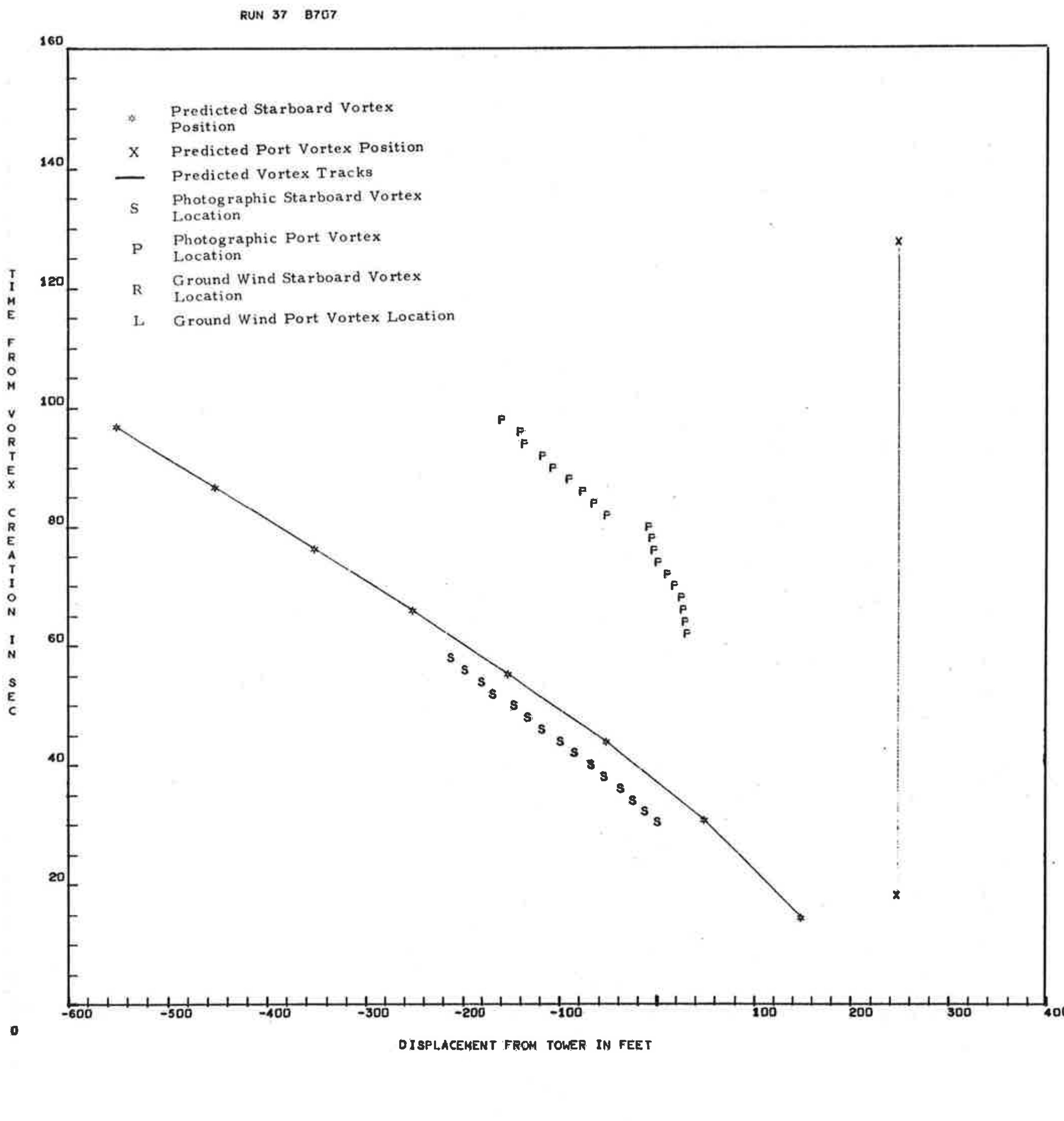


160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

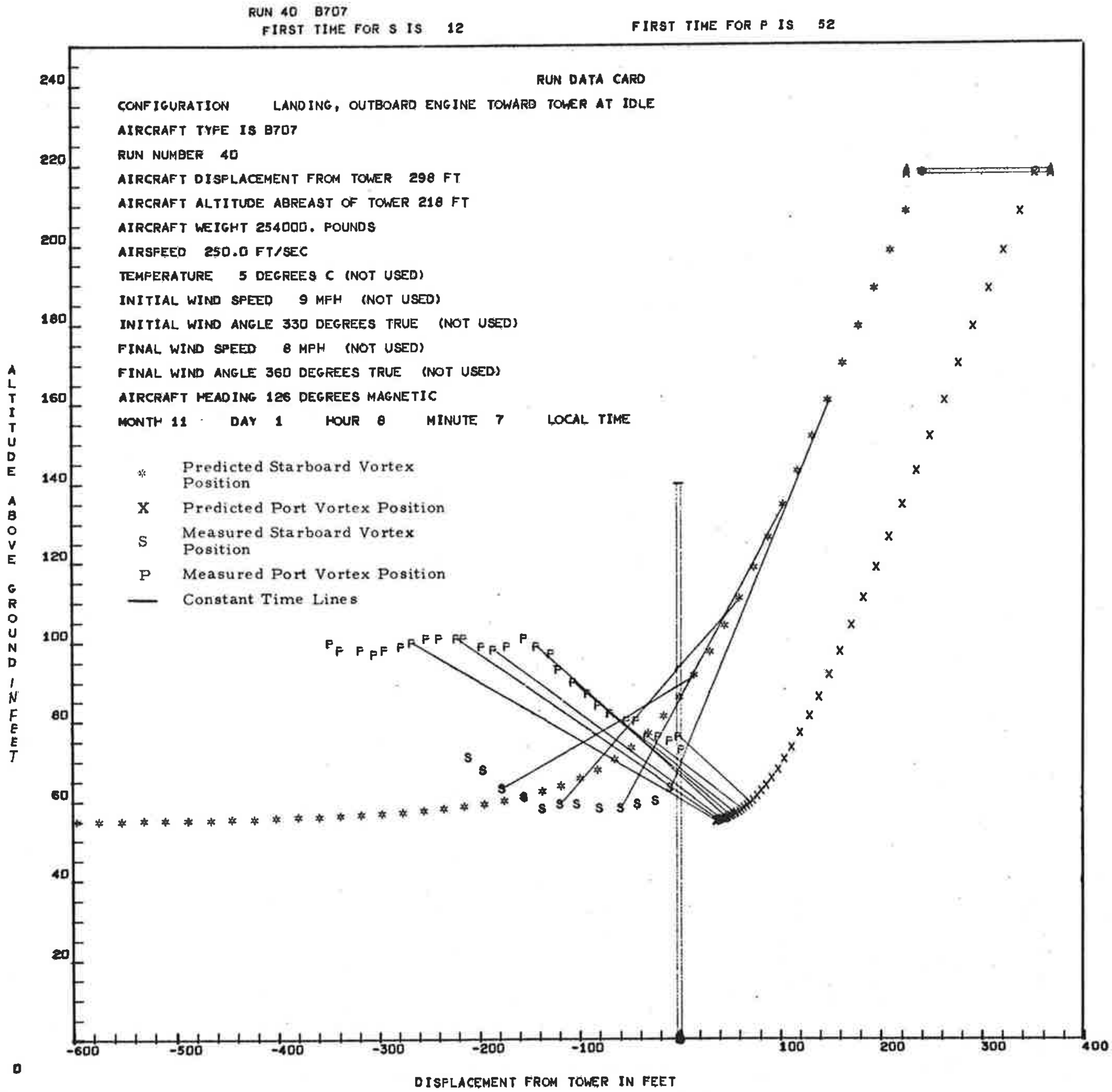

RUN 35 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location


RUN 37 B707
FIRST TIME FOR S IS 30
FIRST TIME FOR P IS 62
RUN DATA CARD
CONFIGURATION LANDING LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 37
AIRCRAFT DISPLACEMENT FROM TOWER 294 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 197 FT
AIRCRAFT WEIGHT 261000. POUNDS
AIRSPEED 250.0 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED).
INITIAL WIND SPEED 5 MPH (NOT USED)
INITIAL WIND ANGLE 350 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 0 MPH (NOT USED)
FINAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 7 MINUTE 49 LOCAL TIME
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET

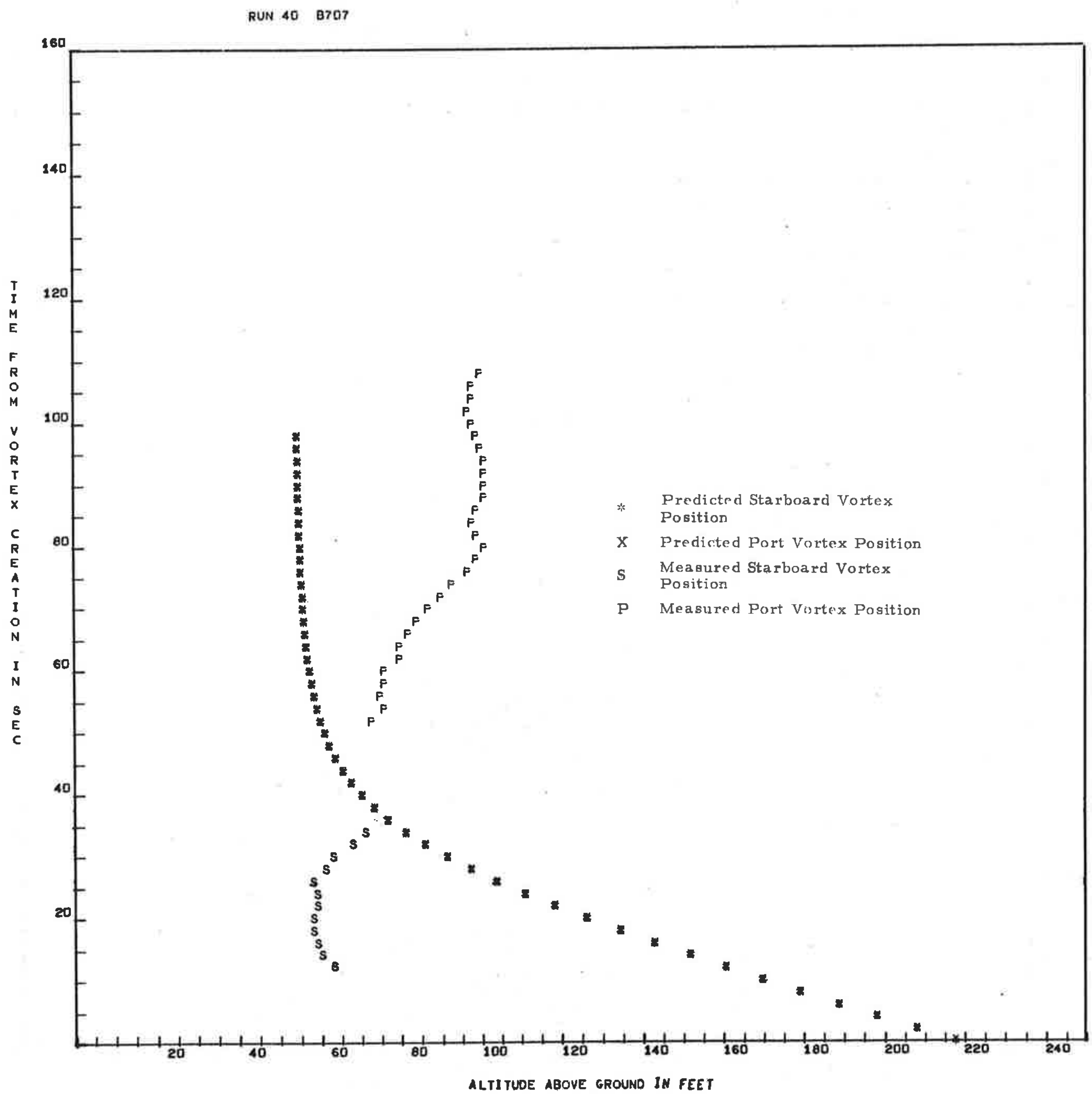

RUN 37 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



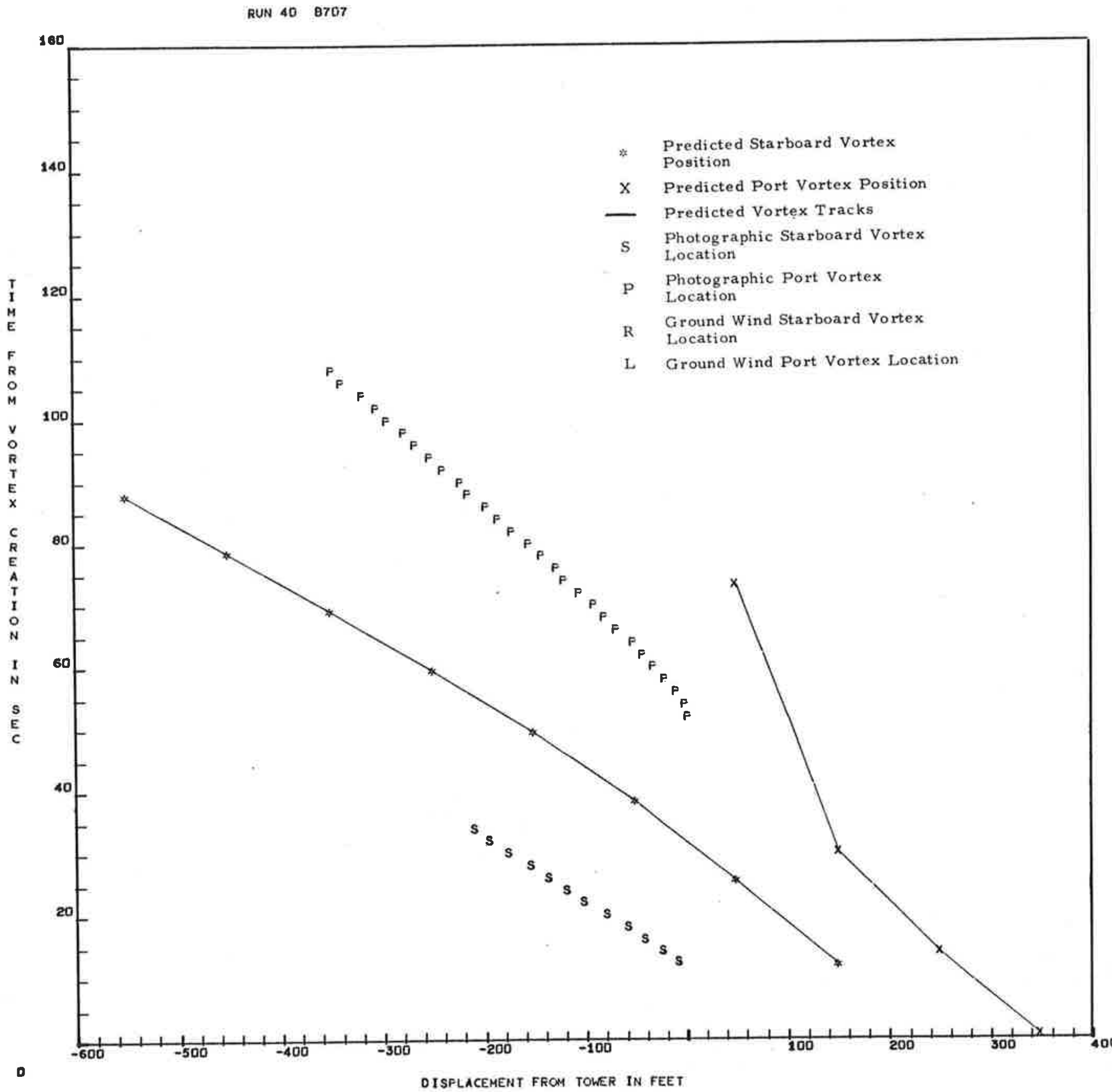
RUN 37 B707
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
0
20
40
60
80
100
120
140
160
-600
-500
-400
-300
-200
-100
100
200
300
400



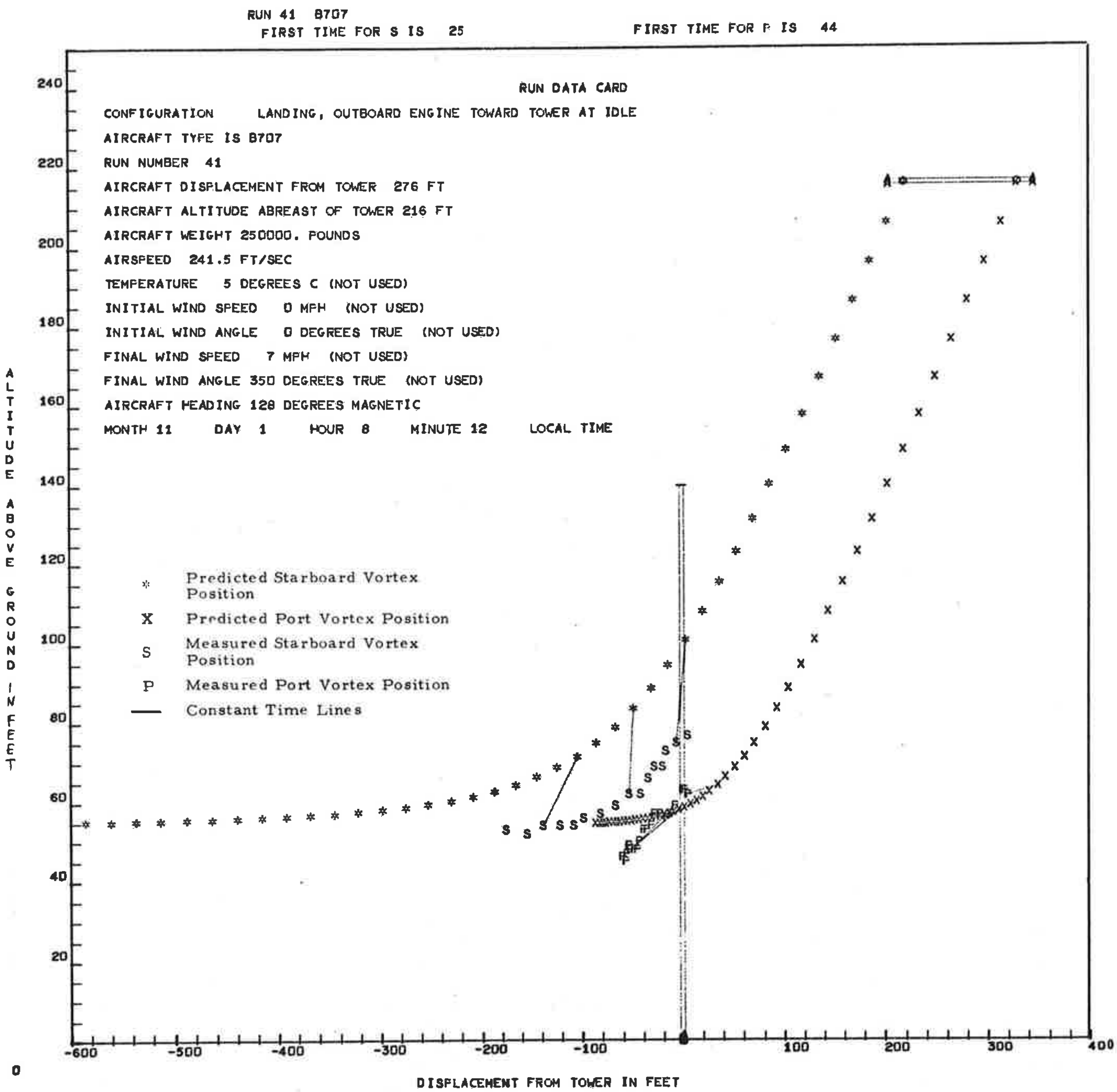
RUN 40 B707
FIRST TIME FOR S IS 12
FIRST TIME FOR P IS 52
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 40
AIRCRAFT DISPLACEMENT FROM TOWER 298 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 218 FT
AIRCRAFT WEIGHT 254000. POUNDS
AIRSPEED 250.0 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 9 MPH (NOT USED)
INITIAL WIND ANGLE 330 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 8 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 126 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 8 MINUTE 7 LOCAL TIME
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET

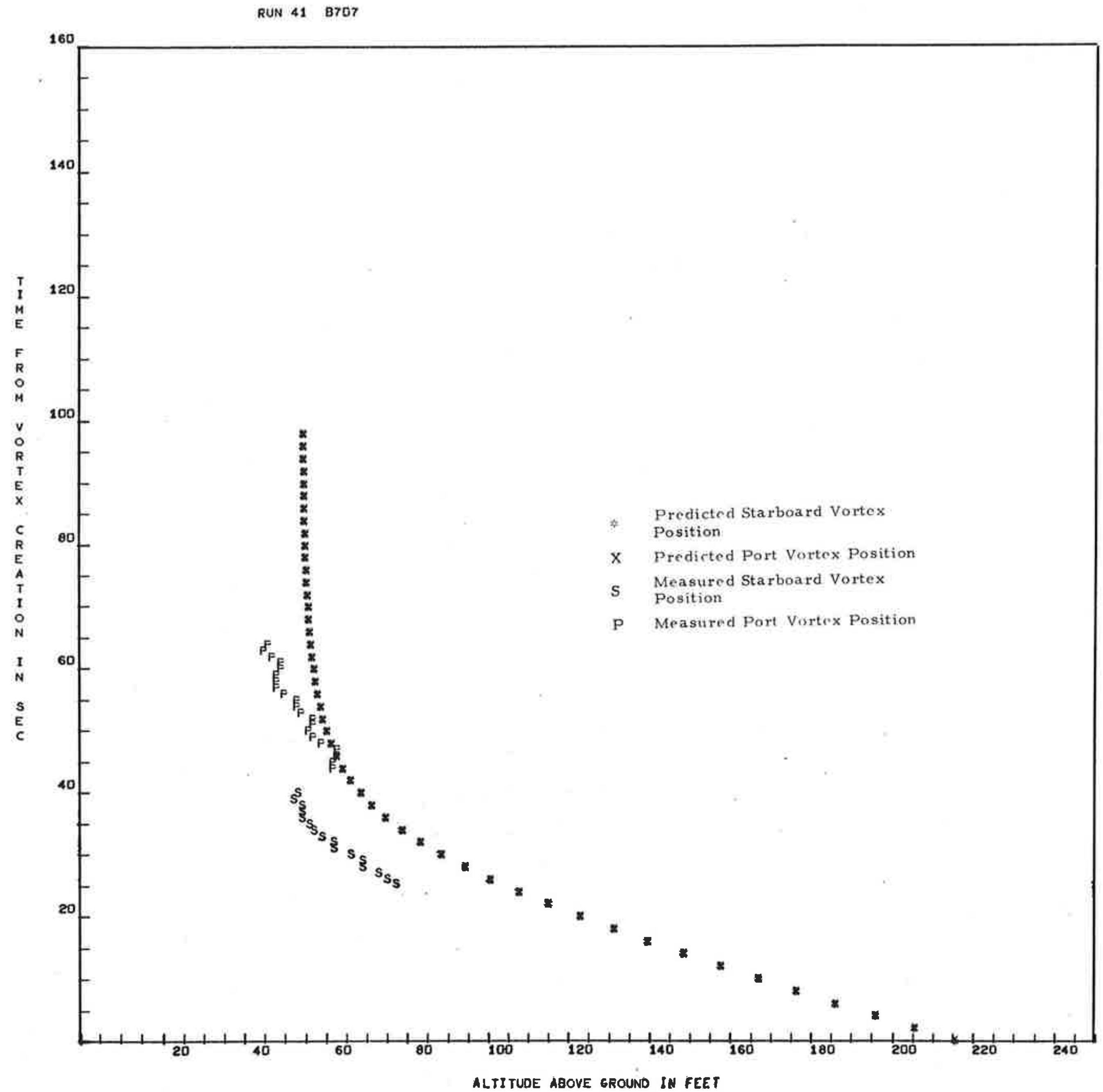


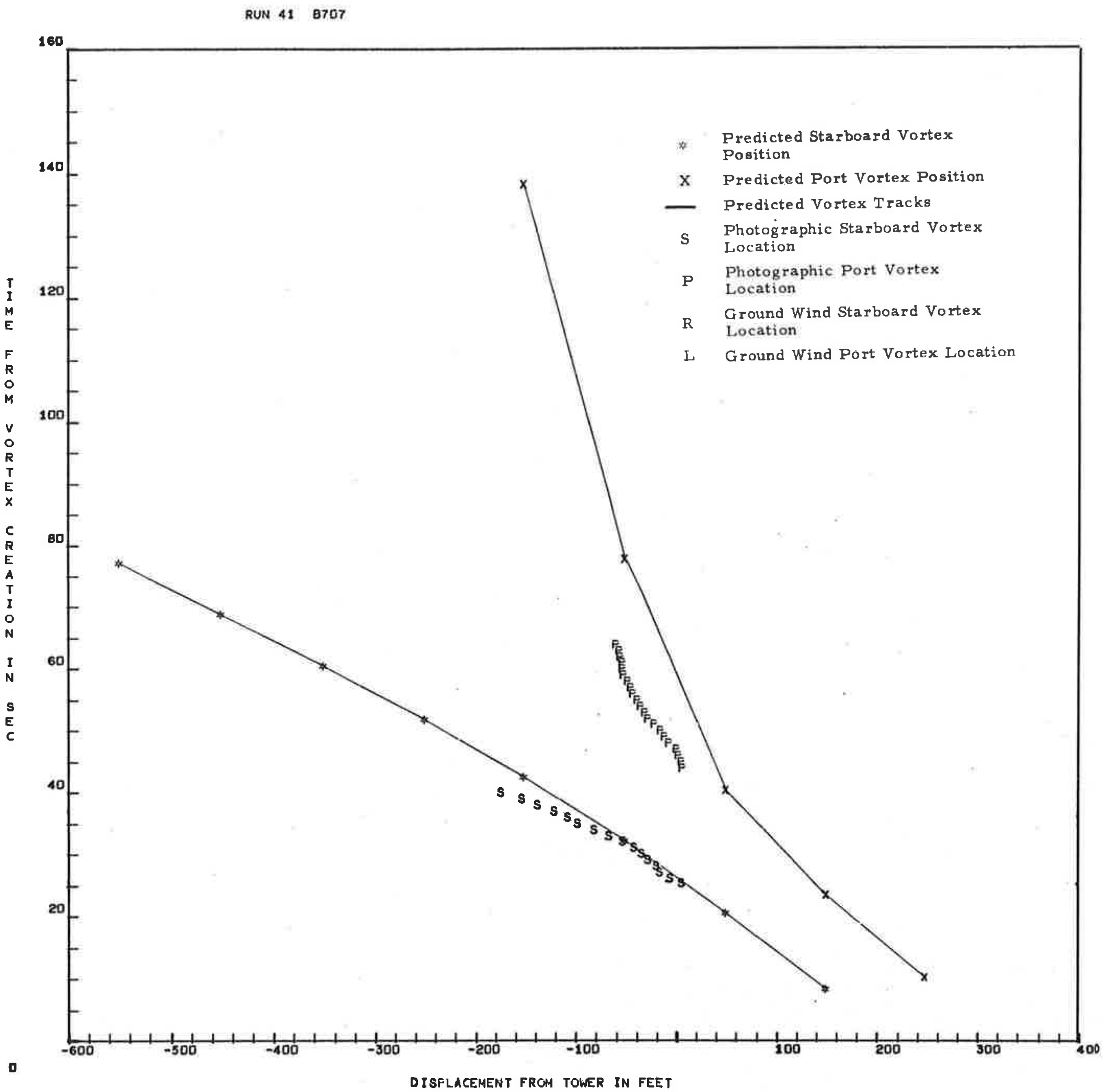
RUN 40 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

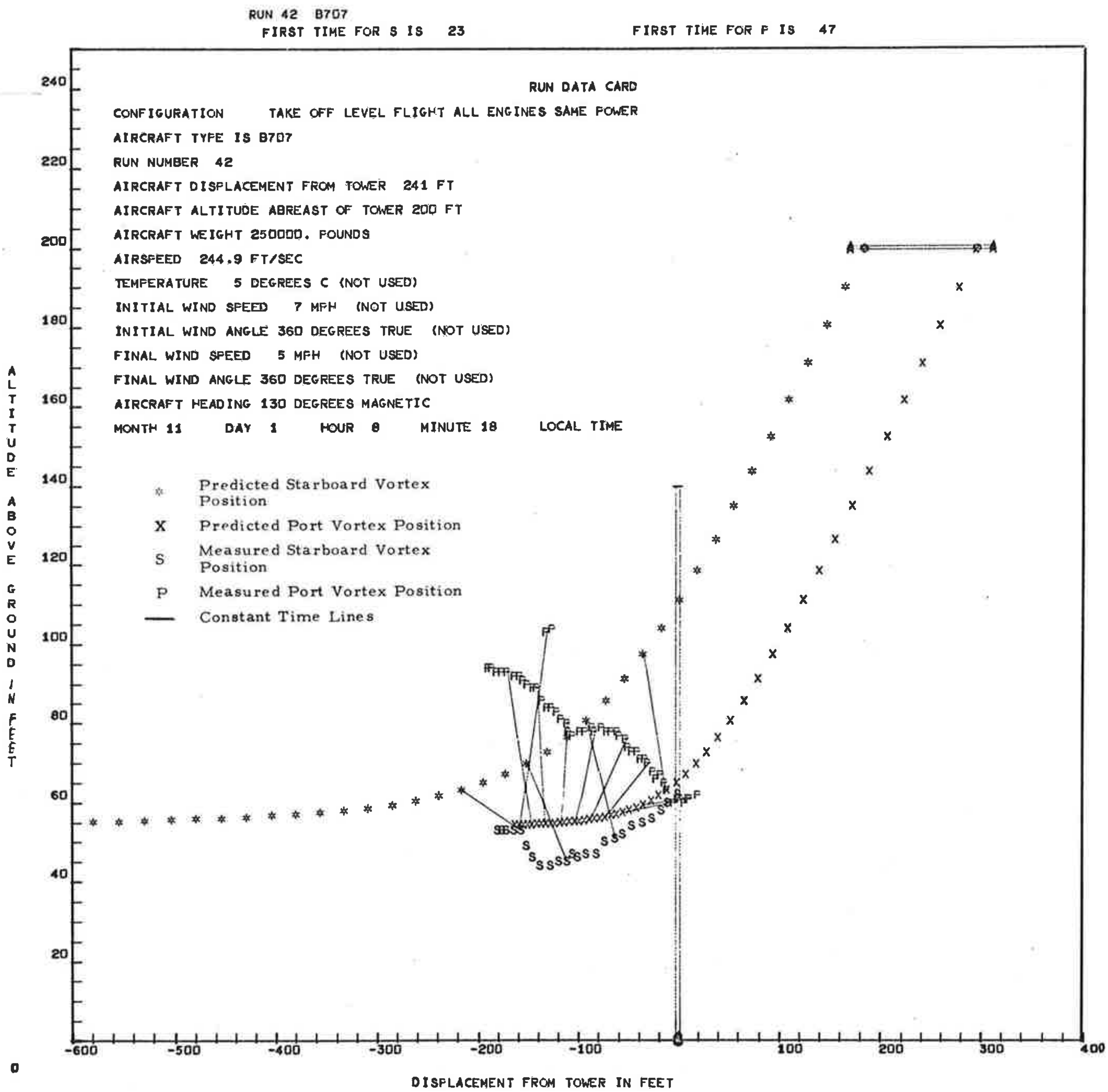


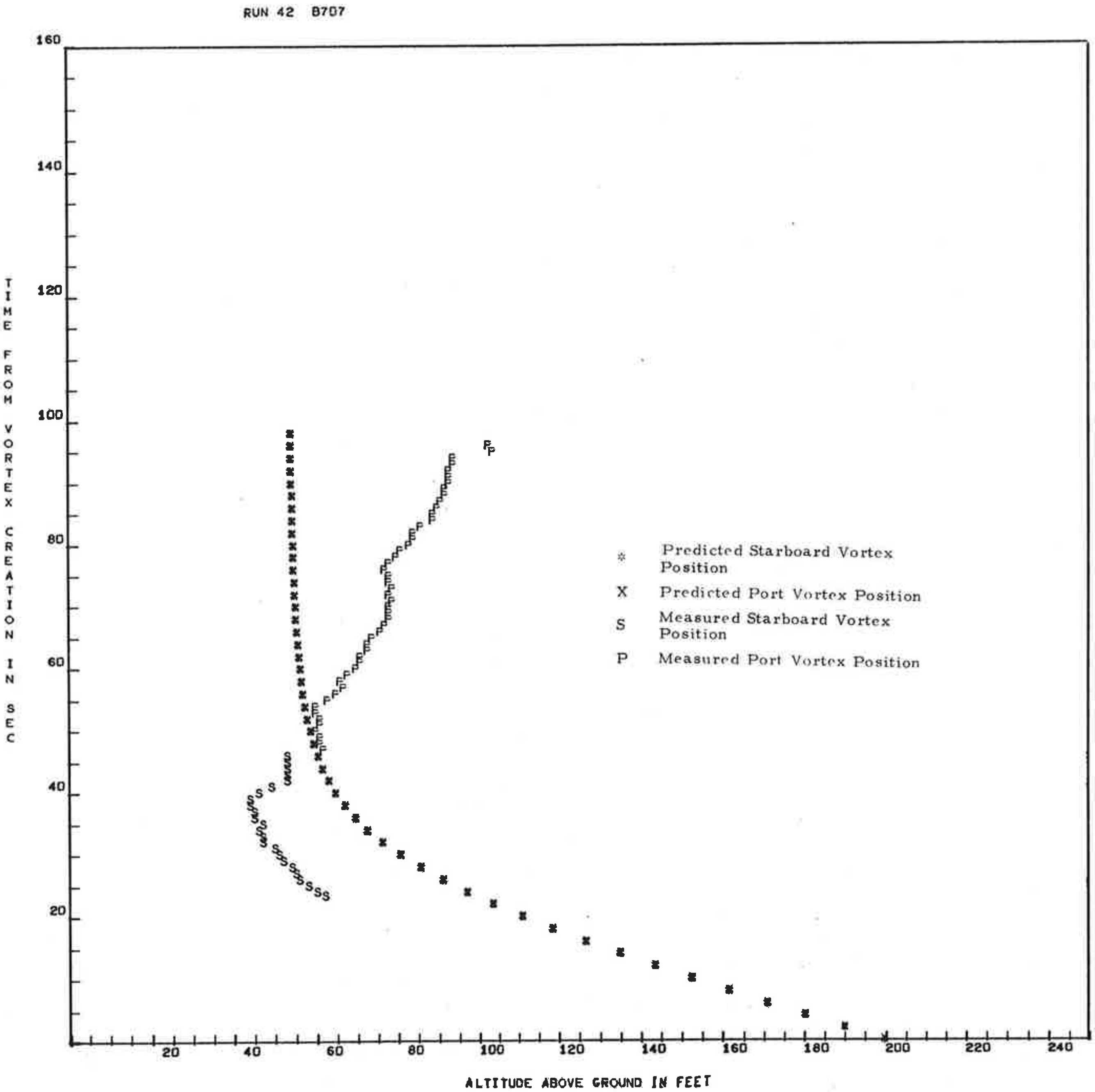
RUN 40 B707
TIME FROM VORTEX CREATION IN SEC
0
20
40
60
80
100
120
140
160
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

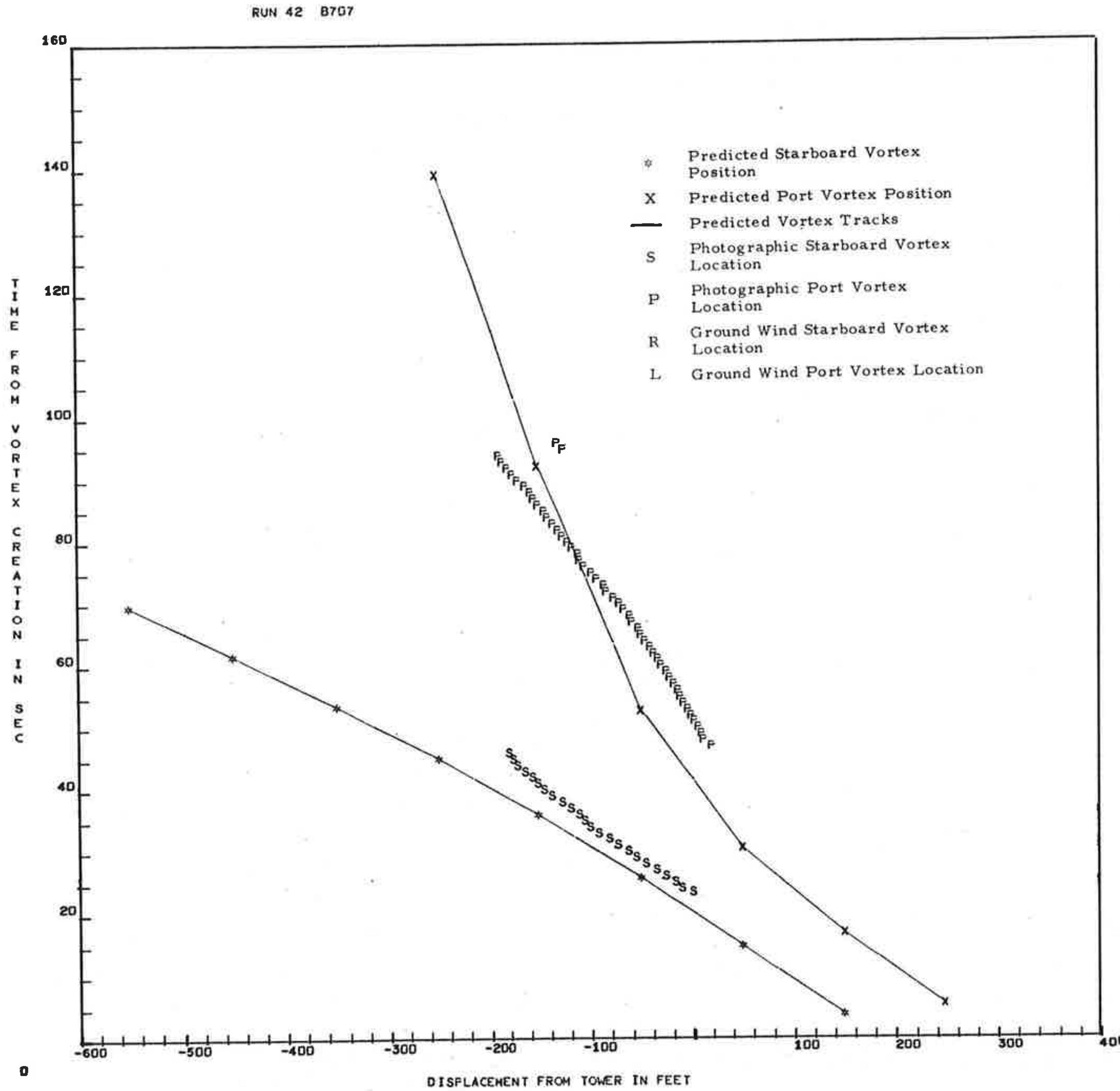

RUN 41 B707
FIRST TIME FOR S IS 25
FIRST TIME FOR P IS 44
RUN DATA CARD
CONFIGURATION LANDING, OUTBOARD ENGINE TOWARD TOWER AT IDLE
AIRCRAFT TYPE IS B707
RUN NUMBER 41
AIRCRAFT DISPLACEMENT FROM TOWER 276 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 216 FT
AIRCRAFT WEIGHT 250000. POUNDS
AIRSPEED 241.5 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 0 MPH (NOT USED)
INITIAL WIND ANGLE 0 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 7 MPH (NOT USED)
FINAL WIND ANGLE 350 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 128 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 8 MINUTE 12 LOCAL TIME
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400

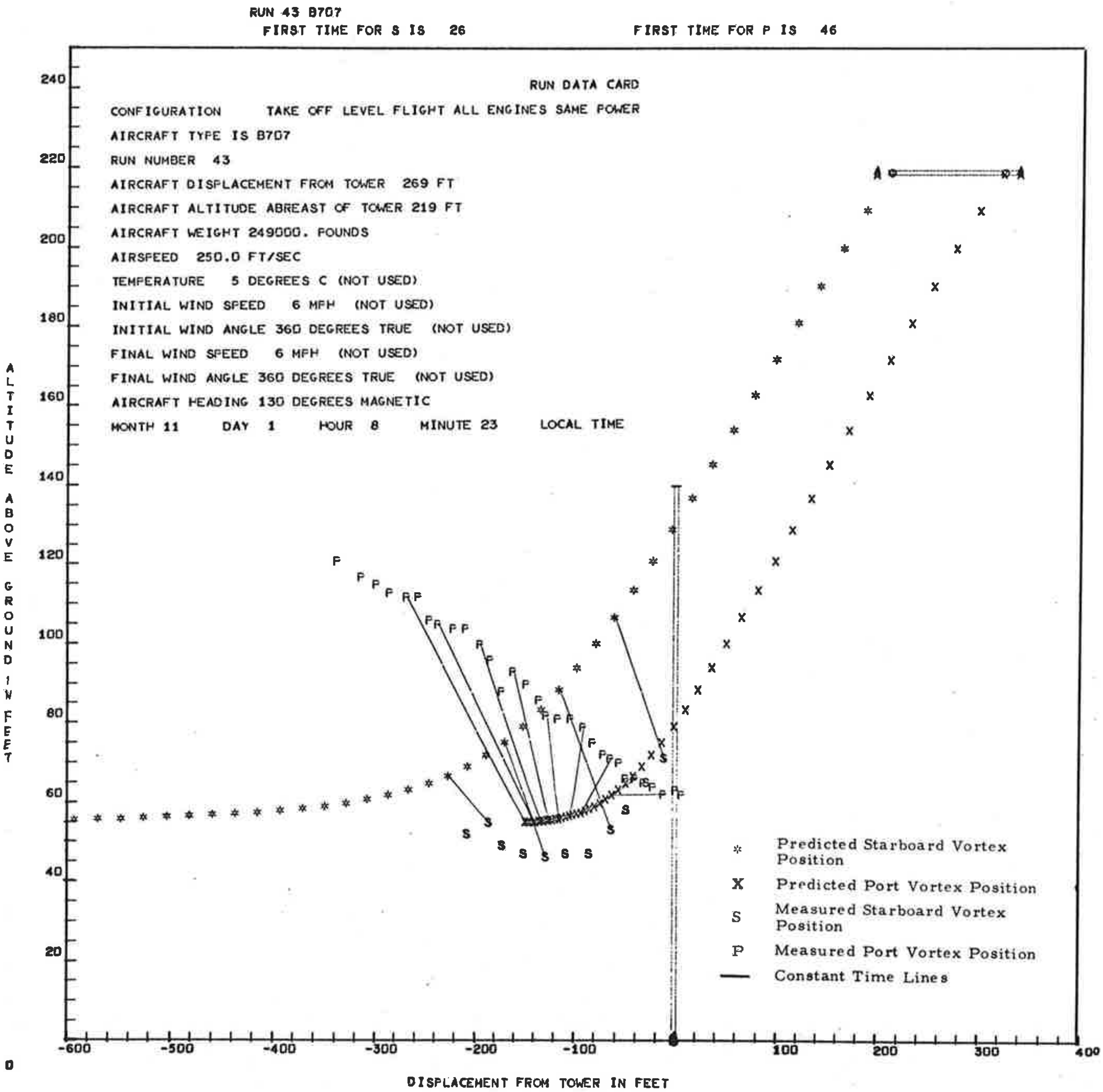

RUN 41 B707
TIME FROM VORTEX CREATION IN SEC
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 41 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location


RUN 42 B707
FIRST TIME FOR S IS 23
FIRST TIME FOR P IS 47
RUN DATA CARD
CONFIGURATION TAKE OFF LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 42
AIRCRAFT DISPLACEMENT FROM TOWER 241 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 200 FT
AIRCRAFT WEIGHT 250000. POUNDS
AIRSPEED 244.9 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 7 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 5 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 8 MINUTE 18 LOCAL TIME
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position
Constant Time Lines
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
240
220
200
180
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400

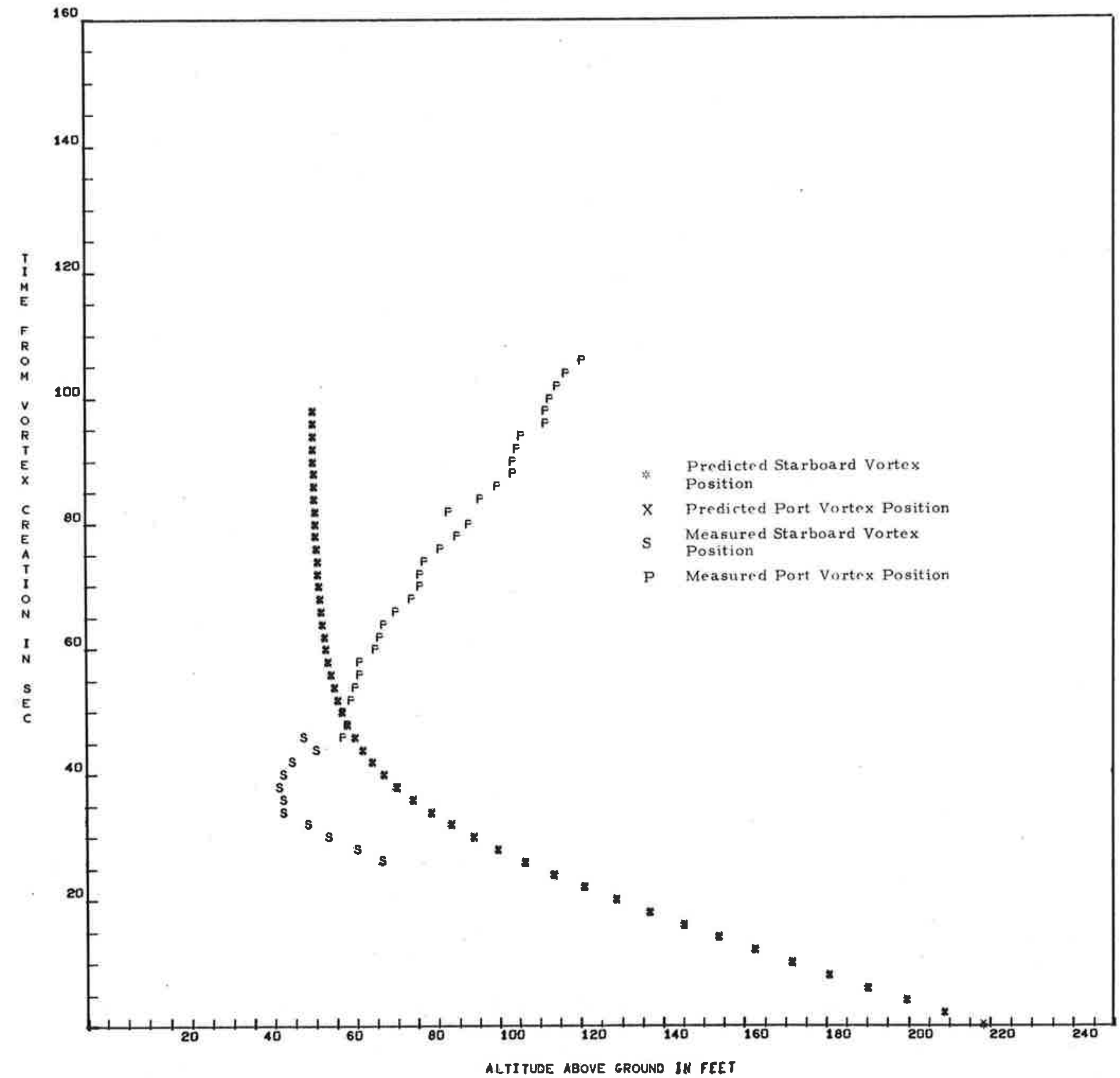

RUN 42 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
160
140
120
100
80
60
40
20
20
40
60
80
100
120
140
160
180
200
220
240
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position


RUN 42 B707
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location



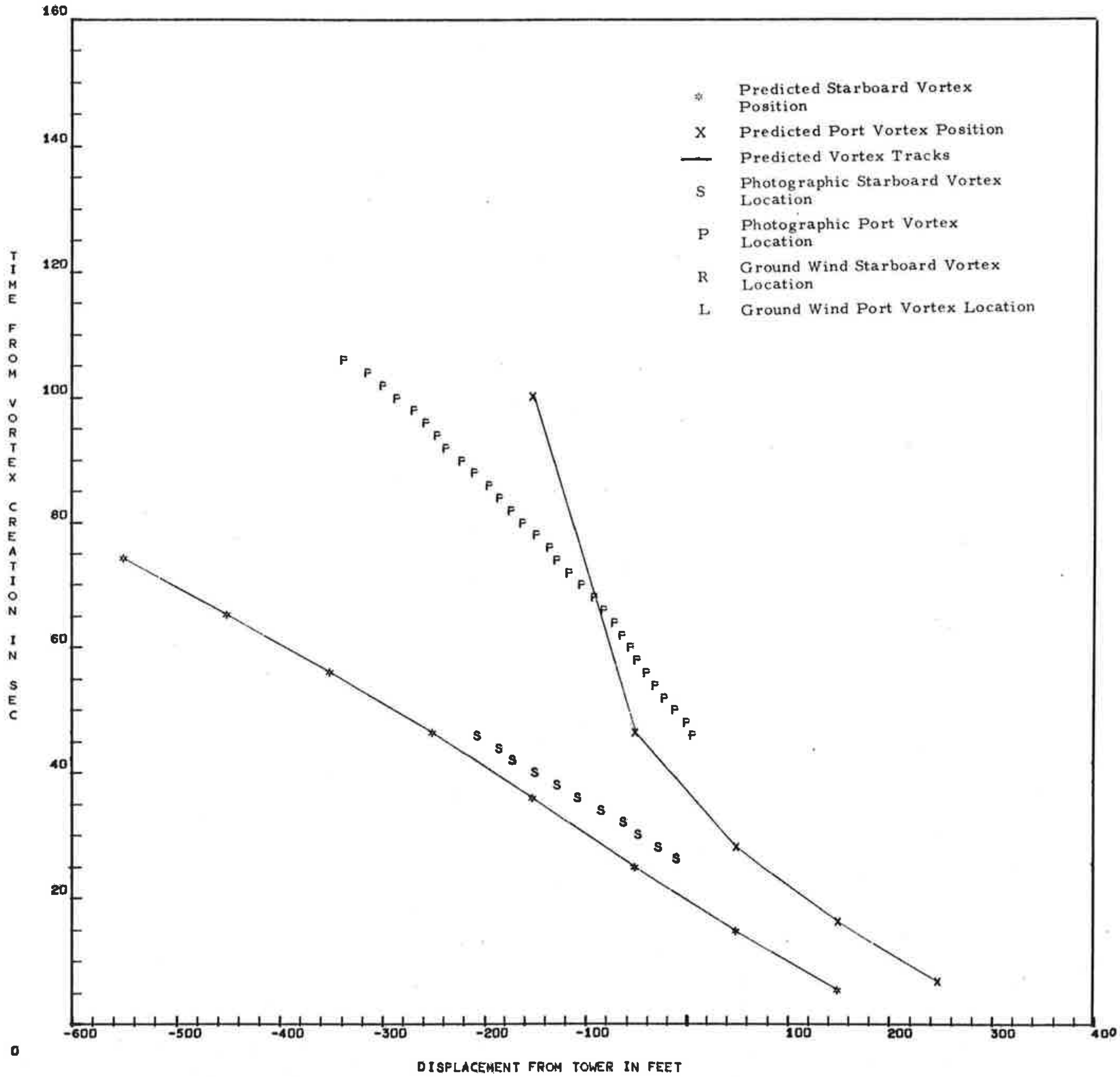
RUN 43 B707
FIRST TIME FOR S IS 26
FIRST TIME FOR P IS 46
RUN DATA CARD
CONFIGURATION TAKE OFF LEVEL FLIGHT ALL ENGINES SAME POWER
AIRCRAFT TYPE IS B707
RUN NUMBER 43
AIRCRAFT DISPLACEMENT FROM TOWER 269 FT
AIRCRAFT ALTITUDE ABREAST OF TOWER 219 FT
AIRCRAFT WEIGHT 249000. POUNDS
AIRSPEED 250.0 FT/SEC
TEMPERATURE 5 DEGREES C (NOT USED)
INITIAL WIND SPEED 6 MPH (NOT USED)
INITIAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
FINAL WIND SPEED 6 MPH (NOT USED)
FINAL WIND ANGLE 360 DEGREES TRUE (NOT USED)
AIRCRAFT HEADING 130 DEGREES MAGNETIC
MONTH 11 DAY 1 HOUR 8 MINUTE 23 LOCAL TIME
ALTITUDE ABOVE GROUND IN FEET
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
Predicted Port Vortex Position
Measured Starboard Vortex Position
Measured Port Vortex Position
Constant Time Lines

RUN 43 B707



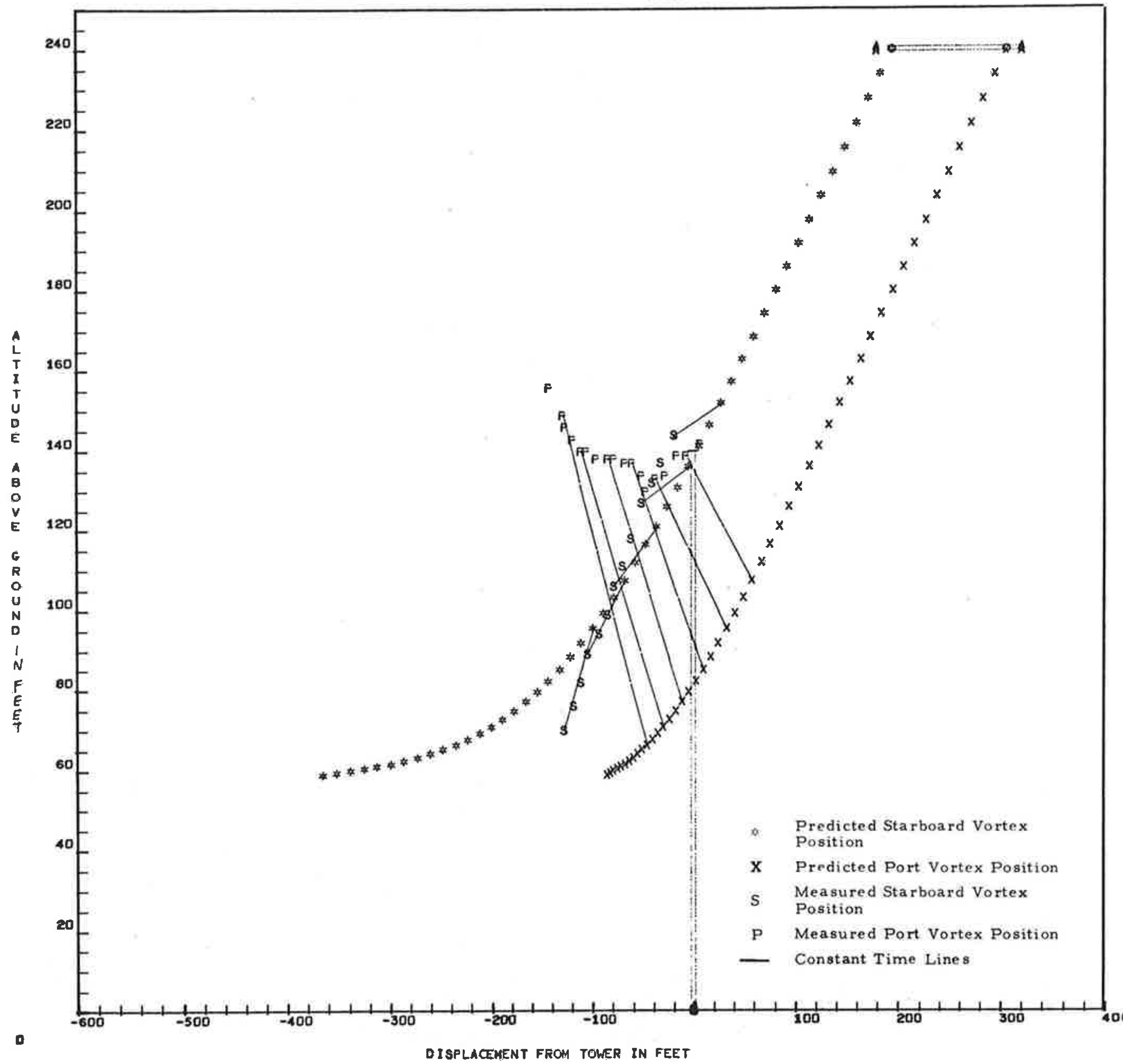
160
140
120
100
80
60
40
20
TIME FROM VORTEX CREATION IN SEC
20
40
60
80
100
120
140
160
180
200
220
240
ALTITUDE ABOVE GROUND IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position

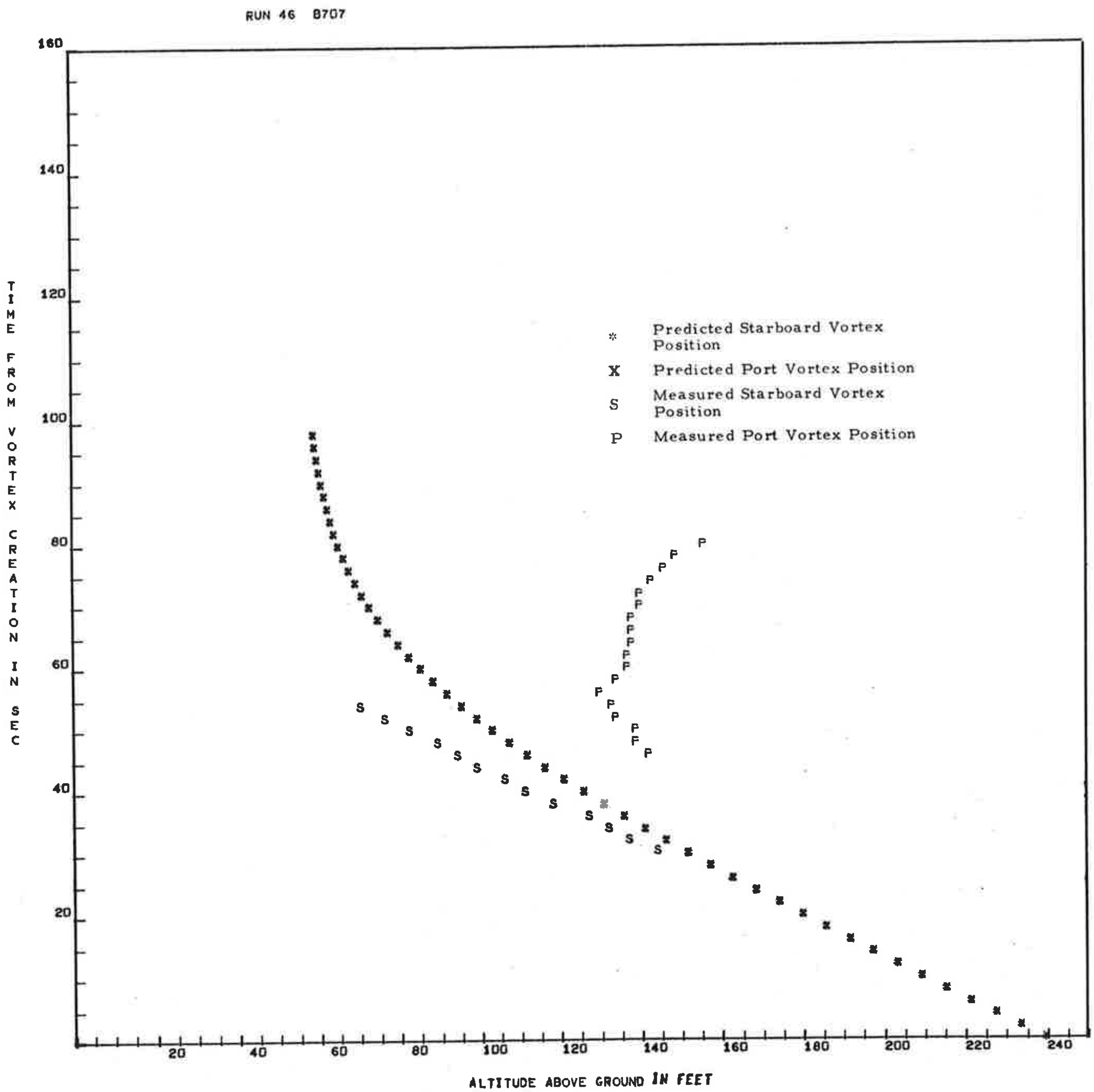
RUN 43 B707



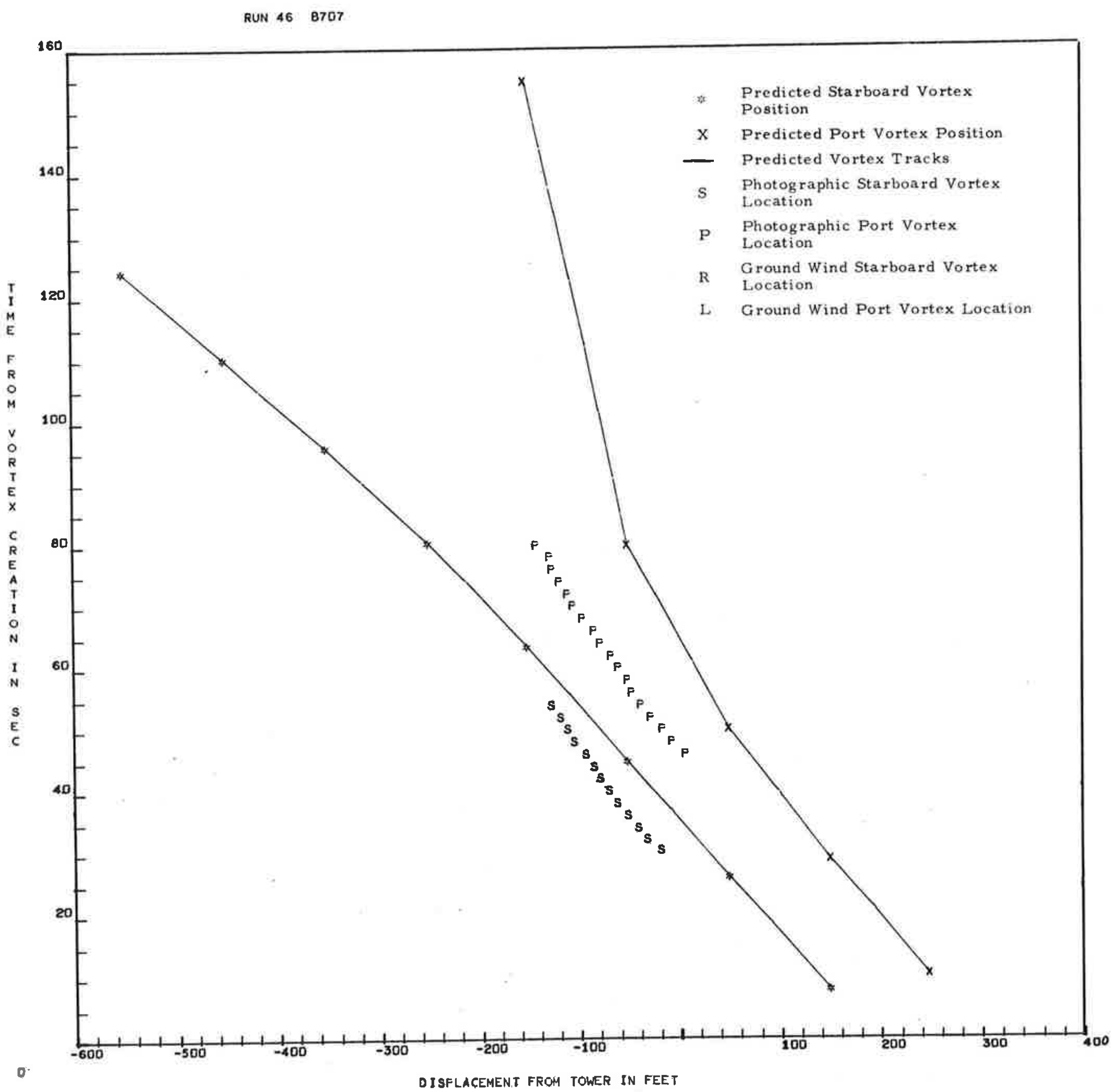
160
140
120
100
80
60
40
20
0
TIME FROM VORTEX CREATION IN SEC
-600
-500
-400
-300
-200
-100
100
200
300
400
DISPLACEMENT FROM TOWER IN FEET
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location

RUN 46 B707
FIRST TIME FOR S IS 30 FIRST TIME FOR P IS 46





RUN 46 B707
TIME FROM VORTEX CREATION IN SEC
ALTITUDE ABOVE GROUND IN FEET
* Predicted Starboard Vortex Position
X Predicted Port Vortex Position
S Measured Starboard Vortex Position
P Measured Port Vortex Position



RUN 46 B707
Predicted Starboard Vortex Position
X Predicted Port Vortex Position
Predicted Vortex Tracks
S Photographic Starboard Vortex Location
P Photographic Port Vortex Location
R Ground Wind Starboard Vortex Location
L Ground Wind Port Vortex Location
TIME FROM VORTEX CREATION IN SEC
DISPLACEMENT FROM TOWER IN FEET
160
140
120
100
80
60
40
20
0
-600
-500
-400
-300
-200
-100
100
200
300
400

Appendix H

REPORT OF INVENTIONS

After a diligent review of the work performed under this contract, no new innovation, discovery, improvement or invention was made.