

AD-A056 867 FEDERAL AVIATION ADMINISTRATION WASHINGTON D C OFFIC--ETC F/G 1/5
AIRLINE DELAY TRENDS 1972 - 1977.(U)
JUL 78 S MORIN, S M HOROWITZ
UNCLASSIFIED FAA-FM-78-11

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AIRLINE DELAY TRENDS

1972 - 1977.

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Seymour M./Horowitz

AD No. ~~1~~
DDC FILE COPY



(12) 51p.

(11) July 1978

(9) FINAL REPORT

Document is available to the U.S. public through
the National Technical Information Service
Springfield, Virginia 22161

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AUG 1 1978
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Prepared for
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
OFFICE OF SYSTEMS ENGINEERING MANAGEMENT
WASHINGTON, D.C. 20591

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Technical Report Documentation Page

1. Report No. FAA-EM-78-11	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle AIRLINE DELAY TRENDS 1972-1977		5. Report Date July 1978	
		6. Performing Organization Code	
		8. Performing Organization Report No.	
7. Author(s) Stephen Morin, Seymour M. Horowitz		10. Work Unit No. (TRAIS)	
9. Performing Organization Name and Address U. S. Department of Transportation Transportation Systems Center Kendall Square Cambridge, MA 02142		11. Contract or Grant No.	
		13. Type of Report and Period Covered Final Report 1972 thru 1977	
12. Sponsoring Agency Name and Address U. S. Department of Transportation Federal Aviation Administration Office of Systems Engineering Management Washington, D. C. 20591		14. Sponsoring Agency Code	
15. Supplementary Notes Reference: Report No. FAA-EM-74-11, Airline Delay Trends, 1972-1973			
16. Abstract This document is an updated edition (data for the years 1976-1977 are included) of the Annual Airline Delay Trends Report published since 1974. These reports provide estimates of block, airborne, and ground delays for approximately 325 route segments connecting 20 of the most active U. S. airports, and serviced by the domestic scheduled air carriers. Delay information as presented in this summary edition consists of airborne and ground data for each of the 20 airports in the study, displayed in both table and graph form, for the years 1972 through 1977. This information was obtained from the Civil Aeronautics Board ER-586 Service Segment data in combination with other airline operational data. With this report, a new format is introduced for presenting comparative estimates of trends in airline delays. A05 870 D019221			
17. Key Words Traffic Activity Airborne Delays Ground Times and Delays		18. Distribution Statement Document is available to the U. S. public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages	22. Price

Subject: Airline Delay Trends; CAB Data File for the
years 1976-1977

For the past several years, we have been issuing annual reports of trends in delays experienced by the nation's scheduled airlines operating from the 20 largest domestic airports. These data which are processed by the Transportation System Center, are derived from the block operational-time information, both ground and airborne, sent to the CAB as part of the airline's monthly reporting system. By comparing the times actually recorded in commercial service with a fixed standard of good performance, comprehensive estimates of airline block-time delays were derived and categorized according to flight number, airline and aircraft type. A further separation of the ground component of delays into their arrival and departure directions, was made possible by combining the CAB data base with the ground time information provided by the Port Authority of New York, New Jersey for the three major airports serving the New York City area. (For a more complete description of the data and the methodology used in estimating delays, see FAA Report EM-74-11, "Airline Delay Trends, 1972-1973"). Previous reports presented these delay data in all of this considerable level of detail: Airborne delays for 325 individuals route segments were categorized according to the airline

and aircraft equipment serving the route; ground delays for 20 individual airports were categorized according to arrival or departure direction, and by the hourly interval, "busy" (0700 to 2259 hrs.) or "dull" (2300 to 0659 hrs.) during which the ground operation took place.

The data are still being compiled in this level of detail for use in specific study projects, and are available on request from the FAA, Office of System Engineering and Management, (AEM-100). They will no longer be issued in published versions, however. Instead, we have been attempting to arrive at a summary format which will provide highlight information concerning the general trend in operational delays encountered throughout the system. We think that a format satisfactory for this purpose is provided by the percentage array shown in figures 1 thru 3.

To begin with, tables 1.1a and 1.1b, (p. 9) which have been reproduced from previous reports, provide a listing of the airlines and airports included in the data base.

Delays are defined as the difference between the operational times actually experienced by the airlines, recorded by the CAB, and the nominal time shown in tables 1.2 and 1.3. These nominal standards were actually

In figures 1.3 thru 1.7, (pps. 21-25) the operational times experienced for individual flight numbers for a month of scheduled airline services have been compared to standard times for the approximately 325 route segments that were actually flown out of a theoretical limit of 380 segments resulting from a maxtrix of 20 airport origins and destinations. The delays were summarized for a full year and then arrayed in an accumulated percentage distribution of numbers of flights whose delays were less than or equal to the "n" minutes shown on the abscissa; "n" being a parameter of the analysis. This distributional array shown in figures 1.3 thru 1.7 is a convenient method for displaying trends in the total operational time performance for the 20 airport network.

A similar array of the percentage distribution of delays is shown for the airborne component only in figures 2.3 thru 2.7 (pps. 26-30). By superimposing these profiles

from one year to the next, trends in delays are readily identified. The more "bowed" or extended to the right the profile is, the greater is the increase in delays. By using these profiles in this manner, it can be seen that no dramatic increases in delays have taken place for the airport network described during the years for which the data are available. It is clear that the shifts in profiles for the 5 years for which data are shown have been very small; all profiles fall within a narrow range.

It facilitates comparisons in these profiles to select any given percentile shown on the ordinate axis and to compare the trend in delays shown on the abscissa. This comparison is shown in table 2 (p. 31) for the 50th percentile:

Note that there has been a "mixed" trend from 1973 to 1977 in the total block time performance of the scheduled airlines, (column A.) with peak years occurring in 1974 and 1977. A break-down of this block time performance into its ground and airborne components (the airborne component is shown in column B) indicates that the airborne component of delays has been decreasing from the peak year shown in 1974. Thus, the observed increase in total block times observed in 1977 is due to delays on

the ground; the system-wide increase in the ground component, measured at the 50th percentile, is approximately 0.5 minutes for the year from 1976 to 1977.

It is, of course, possible to compare operational times against any performance standard, and not just the ones shown in tables 1.2 and 1.3. As an analytical exercise in order to provide a frame of reference for the dimension of the delay being reported in this FAA study, the CAB data were processed and compared to the standards imposed by the scheduled times published each month in the Official Airline Guide. The cumulative percentage distribution of delays measured against this, OAG, standard is shown in figures 3.3 thru 3.7 (pps. 32-36). The OAG standard is observed to be much more lenient than the standards shown in tables 1.2 and 1.3: Delays measured against OAG schedules at the 50th percentile are on the order of 2-3 minutes, (see table 2, Column C) and not the 12-13 minutes estimated according to the definition used in this analysis and shown in Column A; 33% of the flights are not delayed at all when measured against OAG published standards, and 85% of the flights are delayed less than 10 minutes (figures 3.3 thru 3.7). The main reason why the delay estimates measured against published schedules show very good compliance is that the delays are already built

into the schedules. Another reason is the fact that the CAB data do not include delays caused by equipment failures or by the late boarding of aircraft. They include only those delays incurred once the aircraft is moving under its own power from the departure ramp to its subsequent full stop arrival at the destination ramp.

The OAG-standard delay data shown in table 2, Column C, (p. 31) show a similar pattern of peak-year delays in 1974 and 1977. However, it must be stressed that these OAG data are provided as a frame of reference only, since OAG schedules do not satisfy the condition that the standard for defining airline delays be fixed and constant. As stated previously, changes in OAG schedules are frequently made in order to conform to changes in operational experience.

The comparison in average monthly delays for the latest years 1976 and 1977 can be observed from figure 4.1, (p. 37) which provides a graphical presentation of airborne and ground delays for a composite route made up of the top 50 segments. Note that these data, in their annual summary form, confirm the previously noted pattern of a slight decrease in delays for the airborne component

of blocktime delays for the year 1976 to 1977, and an increase of 0.5 minutes for the ground component.

A tabular presentation of similar data, summarized for the years 1972 thru 1977, for a composite route made up of the top 50 segments is shown in table 3 (p. 38). Note that the delays for this smaller network (50 route segments compared to the total of 325 actually flown) confirm the pattern of a "mixed" trend: no dramatic changes have taken place; the highest block delays were reached in 1974, but the ground component of these delays for 1976 and 1977 already exceed those shown in 1974.

The monthly pattern of airborne delays for a selected number of individual routes comprising the list of the top 50 segments, is shown in figures 4.2 thru 4.11 (pps. 39-48). The nominal standards against which the performance is being measured in order to define delays were taken from table 1.2 and are shown on the bottom of the figure.

The list of top 50 route segments is dominated by the nation's busiest airport, O'Hare International (ORD). Table 4 depicts the trend for average monthly airborne delays at ORD, for the years 1972 thru 1977 (p. 49). The

flight activity levels shown represent the numbers of observations contained in the CAB data base for the 20 x 20 matrix of airports included in this FAA study. Note the familiar airborne delay pattern for ORD of a peak year in 1974, with continued improvement since then. In addition, there has been a significant improvement in the "worst month" performance for the year; a worst peak of 0:24 minutes of airborne delays in 1974 has been reduced to 0:17 minutes in 1977. This lowering in the peak average monthly airborne delays at ORD during 1977 is confirmed by the measure of the standard deviation calculated for the twelve months of the year. The improvement in making delays more consistent and less dispersed is shown by the estimates for the values of standard deviation shown in the last column of table 4. The standard deviation of 2.8 minutes in 1977 reflects a considerable improvement in the ability to reduce peak delays. In 1972, the standard deviation was 4.2 minutes.

Any comments, questions or requests for more detailed information should be directed to me at AEM-100, 426-9553.

SEYMOUR M. HOROWITZ

Program Manager, AEM-100

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TABLE 1-1 MAJOR AIRPORTS AND AIR CARRIERS INCLUDED IN STUDY

AIRPORT CODE	AIRPORT NAME
1. ATL	William B. Hartsfield Atlanta International
2. BOS	Boston - Logan
3. CLT	Cleveland - Hopkins International
4. DFW a./	Dallas/Fort Worth
5. DCA	Washington National
6. DEN	Denver - Stapleton International
7. DTW	Detroit Metro
8. EWR	Newark (New Jersey)
9. JFK	John F. Kennedy International (New York City)
10. LAX	Los Angeles International
11. LGA	La Guardia (New York City)
12. MIA	Miami International
13. MSP	Minneapolis/St. Paul International
14. MSY	New Orleans International (Moisant)
15. ORD	O'Hare (Chicago)
16. PHL	Philadelphia International
17. PIT	Greater Pittsburgh
18. SEA	Seattle/Tacoma International
19. SFO	San Francisco International
20. STL	Lambert - St. Louis International

a./ Annual reports for the years 1972-1973 include data for DAL.

Dallas/Fort Worth Field

b./

AIRLINE CODE	AIRLINE NAME
1. AL	Allegheny Airlines, Inc.
2. AA	American Airlines, Inc.
3. BN	Brantiff Airways, Inc.
4. CO	Continental Air Lines, Inc.
5. DL	Delta Air Lines, Inc.
6. EA	Eastern Air Lines, Inc.
7. FL	Frontier Airlines, Inc.
8. HA	Air West, Inc. - (Hughes)
9. MO	Mohawk Airlines, Inc.
10. NA	National Airlines, Inc.
11. NC	North Central Airlines, Inc.
12. NE	Northeast Airlines, Inc.
13. NW	Northwest Airlines, Inc.
14. OZ	Ozark Air Lines, Inc.
15. PA	Pan American World Airways, Inc.
16. PI	Piedmont Aviation, Inc.
17. SO	Southern Airways, Inc.
18. TT	Texas International Airways, Inc.
19. TW	Trans World Airlines, Inc.
20. UA	United Air Lines, Inc.
21. WA	Western Air Lines, Inc.

b./ Data for specific airlines do not appear in this summary volume. Please refer to reports for individual years for this information.

TABLE 1-2

NOMINAL AIRBORNE TIMES* DEPARTING BOS							NOMINAL AIRBORNE TIMES* DEPARTING ATL						
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
ATL	BOS	340	1:50	7201			BOS	ATL	946	2:07	7208	3:35	7203
ATL	CLE	554	1:13	7201			BOS	CLE	563	1:19	7205		
ATL	DAL	721	1:29	7203	2:36	7205	BOS	DAL	1551	3:23	7209		
ATL	DCA	547	1:07	7212			BOS	DCA	399	0:59	7210	1:30	7204
ATL	DFW	731	1:35	7404			BOS	DEN	1766	3:57	7208		
ATL	DTW	595	1:16	7203			BOS	DFW	1561	3:35	7407		
ATL	EAP	745	1:27	7212	2:10	7202	BOS	DTW	632	1:29	7205		
ATL	JFK	760	1:26	7207	2:46	7208	BOS	LAR	231	0:40	7210	0:40	7212
ATL	LAX	1946	3:46	7204			BOS	JFK	187	0:29	7203	0:56	7202
ATL	LGA	761	1:31	7212	2:10	7202	BOS	LAX	2611	5:36	7206		7209
ATL	MIA	595	1:15	7209	1:59	7204	BOS	LGA	165	0:30	7211	3:38	
ATL	MSP	906	1:59	7207			BOS	MIA	1258	2:32	7202		
ATL	MSY	425	0:57	7203	1:34	7204	BOS	MSP	1124	2:40	7205		
ATL	ORU	606	1:15	7204	2:19	7205	BOS	MSY	1367	2:59	7209		
ATL	PHL	666	1:17	7212			BOS	ORU	567	1:48	7211		
ATL	PIT	526	1:10	7203			BOS	PHL	280	0:42	7210	1:24	7204
ATL	SFO	2139	4:26	7207			BOS	PIT	496	1:15	7204	2:02	7211
ATL	STL	484	1:06	7207			BOS	SEA	2496	5:46	7208		
							BOS	SFO	2704	5:43	7205		
							BOS	STL	1046	2:21	7206		

*Airborne Times (Values in off to minutes)

NOMINAL AIRBORNE TIMES
DEPARTING DCA

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO
CLE	ATL	554	1:19	7202			DCA	ATL	547	1:19	7208
CLE	BOS	563	1:04	7204			DCA	BOS	399	0:53	7204
CLE	DAL	1015	2:08	7206			DCA	CLE	310	0:50	7208
CLE	DCA	310	0:47	7201			DCA	DTW	405	1:05	7205
CLE	DEN	1213	2:42	7208			DCA	ENR	199	0:31	7212
CLE	DFW	1021	2:15	7407			DCA	JFK	213	0:37	7202
CLE	DTW	95	0:18	7202	0:24	7209	DCA	LGA	214	0:29	7211
CLE	ENR	404	0:57	7201			DCA	MIA	920	1:59	7210
CLE	JFA	425	1:00	7201			DCA	MSP	931	2:05	7205
CLE	LAX	2053	4:27	7208			DCA	ORD	612	1:22	7207
CLE	LGA	418	0:49	7207			DCA	PHL	120	0:24	7203
CLE	MIA	1080	2:20	7206			DCA	PIT	205	0:35	7204
CLE	MSP	622	1:30	7205			DCA	STL	719	1:39	7205
CLE	MSY	921	2:18	7511							
CLE	ORD	316	0:50	7206							
CLE	PHL	363	0:50	7202							
CLE	PIT	105	0:15	7211	0:26	7209					
CLE	SFO	2162	4:45	7211							
CLE	STL	487	1:06	7208							

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING DEN						NOMINAL AIRBORNE TIMES DEPARTING DFW							
ROUTE	SEGMENT	DISTANCE ST. MILE	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
DEN	BOS	1766	3:19	7201			DFW	FTL	731	1:27	7402		
DEN	CLE	1213	2:15	7201			DFW	BOS	1561	3:05	7402		
DEN	DAL	654	1:21	7202			DFW	CLE	1021	2:03	7402		
DEN	DFW	645	1:23	7412			DFW	DFW	645	1:31	7410		
DEN	DTA	1195	2:05	7212			DFW	DTA	927	1:54	7411		
DEN	EUR	1617	2:53	7212			DFW	LAP	1372	2:37	7412		
DEN	JFK	1638	3:07	7201			DFW	JFK	1391	2:36	7402		
DEN	LAX	249	1:50	7201			DFW	LAX	1245	2:27	7407		
DEN	MSP	693	1:21	7211			DFW	LIA	1322	2:41	7412		
DEN	MSY	1067	2:15	7312			DFW	MIA	1121	2:11	7402		
DEN	ORD	900	1:41	7212			DFW	MSP	922	1:53	7411		
DEN	PAL	1570	2:57	7201			DFW	MSY	447	0:51	2412		
DEN	PIT	1307	2:41	7310			DFW	ORD	802	1:34	7412		
DEN	SEA	1013	2:17	7202			DFW	PAL	1302	2:30	7412		
DEN	SFO	856	2:04	7206			DFW	PIT	1067	2:06	7403		
DEN	STL	781	1:34	7210			DFW	SEA	1660	3:47	7410		
							DFW	STL	1465	3:09	7406		
							DFW	STL	550	1:11	7402		

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TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING DTW					NOMINAL AIRBORNE TIMES DEPARTING EWR				
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO
DTW	ATL	595	1:19	7202	EW2	ATL	745	1:34	7201
DTW	BOS	632	1:17	7201	EW2	BOS	201	0:24	7210
DTW	CLE	95	0:23	7209	EW2	CLE	404	1:06	7211
DTW	DAL	962	2:12	7207	EW2	DAL	1365	2:49	7208
DTW	DCA	405	0:59	7204	EW2	DCA	199	0:34	7205
DTW	DEN	1135	2:32	7204	EW2	DEN	1617	3:30	7205
DTW	DFW	967	1:57	7407	EW2	DFW	1372	3:07	7407
DTW	EW2	488	1:03	7212	EW2	DTW	488	1:15	7208
DTW	JFK	509	1:03	7201	EW2	JFK	21	0:08	7204
DTW	LAX	1979	4:09	7208	EW2	LAX	2454	5:06	7208
DTW	LGA	501	1:04	7210	EW2	MIA	1086	2:16	7212
DTW	MIA	1146	2:18	7209	EW2	MSP	1008	2:35	7203
DTW	MSP	528	1:16	7205	EW2	MSY	1167	2:34	7208
DTW	MSY	926	1:55	7206	EW2	ORD	719	1:32	7203
DTW	ORD	235	0:38	7205	EW2	PHL	80	0:21	7205
DTW	PHL	454	1:01	7203	EW2	PIT	319	0:50	7205
DTW	PIT	231	0:33	7206	EW2	SFO	2565	5:40	7203
DTW	SFO	2079	4:28	7206	EW2	STL	872	1:56	7205
DTW	STL	440	1:09	7206					

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TABLE J-2 (Continued)

NOMINAL AIRBORNE TIMES LEAVING JFK					NOMINAL AIRBORNE TIMES DEPARTING LAX				
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO
JFK	ATL	760	1:32	7210			1946	3:37	7202
JFK	BOS	187	0:21	7208			2611	4:35	7209
JFK	CLE	425	1:07	7205			2053	3:54	7210
JFK	DAL	1363	2:57	7206			1246	2:20	7212
JFK	DCA	213	0:40	7203			849	1:40	7208
JFK	DEN	1638	3:37	7206			1235	2:23	7403
JFK	DFW	1391	2:58	7407			1979	3:42	7210
JFK	DTW	509	1:19	7202			2454	4:10	7204
JFK	EMR	21	0:11	7210			2475	4:33	7212
JFK	LAX	2475	5:05	7202			2342	4:18	7211
JFK	MIA	1090	2:14	7209	4:10	7201	1535	3:01	7210
JFK	MSP	1029	2:20	7205			1670	3:06	7202
JFK	MSY	1162	2:29	7208			1744	3:14	7205
JFK	ORD	740	1:45	7205			2402	4:27	7210
JFK	PHL	94	0:16	7204			2136	4:03	7212
JFK	PIT	340	0:42	7203	1:23	7302	954	1:58	7208
JFK	SEA	2421	5:23	7205			338	0:46	7204
JFK	SFO	2546	4:49	7206			1592	2:59	7212
JFK	STL	632	2:05	7206					

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING LGA							NOMINAL AIRBORNE TIMES DEPARTING MIA						
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
LGA	ATL	761	1:36	7203	2:35	7207	MIA	ATL	595	1:18	7210		
LGA	BOS	185	0:26	7212	0:35	7201	MIA	BOS	1258	2:29	7211		
LGA	CLE	418	1:03	7205			MIA	CLE	1080	2:20	7209		
LGA	DAL	1381	2:53	7208			MIA	DAL	1110	2:27	7209		
LGA	DCA	214	0:29	7208	0:40	7204	MIA	DCA	920	1:53	7206		
LGA	DFW	1388	3:02	7411			MIA	DFW	1121	2:34	7407		
LGA	DTW	501	1:14	7208			MIA	DTW	1146	2:27	7209		
LGA	JFK	11	0:11	7202			MIA	EUR	1086	2:15	7201	3:36	7207
LGA	MIA	1096	2:20	7206	4:10	7202	MIA	JFK	1090	2:08	7202		
LGA	MSP	1020	2:18	7203			MIA	LAX	2342	4:35	7209		
LGA	MSY	1183	2:41	7208			MIA	LGA	1096	2:15	7201		
LGA	ORD	733	1:31	7210			MIA	MSP	1501	3:20	7204		
LGA	PHL	95	0:29	7209			MIA	MSY	675	1:28	7208		
LGA	PIT	335	0:52	7210	1:19	7211	MIA	ORD	1178	2:34	7204		
LGA	STL	888	2:01	7209			MIA	PHL	1014	2:05	7206	3:06	7201
							MIA	PIT	1013	2:07	7211		
							MIA	SFO	2585	5:19	7209		
							MIA	STL	1068	2:23	7208		

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING MSP						NOMINAL AIRBORNE TIMES DEPARTING MSY					
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME
MSP	ATL	906	1:58	7204		MSY	ATL	425	0:54	7211	1:26
MSP	BOS	1124	2:14	7212		MSY	BOS	1367	2:40	7211	
MSP	CLE	622	1:18	7202		MSY	CLE	921	2:03	7512	
MSP	DAL	853	1:48	7201		MSY	DAL	437	0:56	7212	
MSP	DCA	931	1:52	7211		MSY	DEN	1067	2:22	7309	
MSP	DFW	693	1:32	7211		MSY	DFW	447	1:00	7406	
MSP	DTA	862	1:50	7406		MSY	DTM	926	2:00	7207	
MSP	EWR	528	1:13	7202		MSY	EWR	1167	2:09	7211	
MSP	JFK	1008	2:02	7212		MSY	JFK	1182	2:15	7205	
MSP	LAX	1029	2:02	7201		MSY	LAX	1670	3:31	7208	
MSP	LGA	1535	3:18	7206		MSY	LGA	1183	2:13	7211	
MSP	MIA	1020	2:01	7212		MSY	MIA	675	1:23	7210	
MSP	MIL	1501	3:15	7202		MSY	ORD	837	1:46	7204	
MSP	ORD	334	0:43	7204	1:20	MSY	PAL	1088	2:19	7211	
MSP	PHL	981	2:00	7212		MSY	PIT	918	1:50	7202	
MSP	SFO	1399	3:04	7205		MSY	SFO	1911	3:57	7206	
MSP	SFO	1589	3:27	7205		MSY	STL	604	1:21	7205	
MSP	STL	440	1:03	7208	1:51						
				7304							

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TABLE 1-2 (Continued)

NOMINAL AIRBORNE TIMES DEPARTING ORD					NOMINAL AIRBORNE TIMES DEPARTING PHL				
ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO
ORD	ATL	606	1:07	7209	PHL	ATL	666	1:14	7207
ORD	BOS	667	1:36	7206	PHL	BOS	280	0:36	7211
ORD	CLE	316	0:38	7203	PHL	CLE	363	0:57	7205
ORD	DAL	799	1:35	7204	PHL	DAL	1295	2:46	7208
ORD	DCA	612	1:13	7202	PHL	DCA	120	0:25	7208
ORD	DEN	900	1:57	7206	PHL	DEN	1570	3:33	7207
ORD	DFW	802	1:38	7411	PHL	DFW	1302	2:43	7405
ORD	DTW	235	0:31	7201	PHL	DTW	454	1:10	7205
ORD	EMR	719	1:24	7211	PHL	EMR	81	0:18	7210
ORD	JFK	740	1:27	7202	PHL	JFK	93	0:21	7206
ORD	LAX	1744	3:35	7212	PHL	LAX	2402	5:06	7208
ORD	LGA	733	1:26	7212	PHL	LGA	95	0:25	7202
ORD	MIA	1198	2:23	7203	PHL	MIA	1014	2:05	7210
ORD	MSP	334	0:51	7208	PHL	MSP	980	2:18	7205
ORD	MSY	837	1:47	7205	PHL	MSY	1088	2:25	7208
ORD	PHL	678	1:21	7201	PHL	ORD	678	1:36	7207
ORD	PIT	412	0:54	7202	PHL	PIT	268	0:43	7205
ORD	SEA	1720	3:43	7208	PHL	SFO	2521	5:31	7208
ORD	SFO	1846	3:53	7208	PHL	STL	814	1:55	7207
ORD	STL	238	0:38	7205					

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TABLE 1-3
NOMINAL DEPARTURE AND ARRIVAL GROUND TIME *

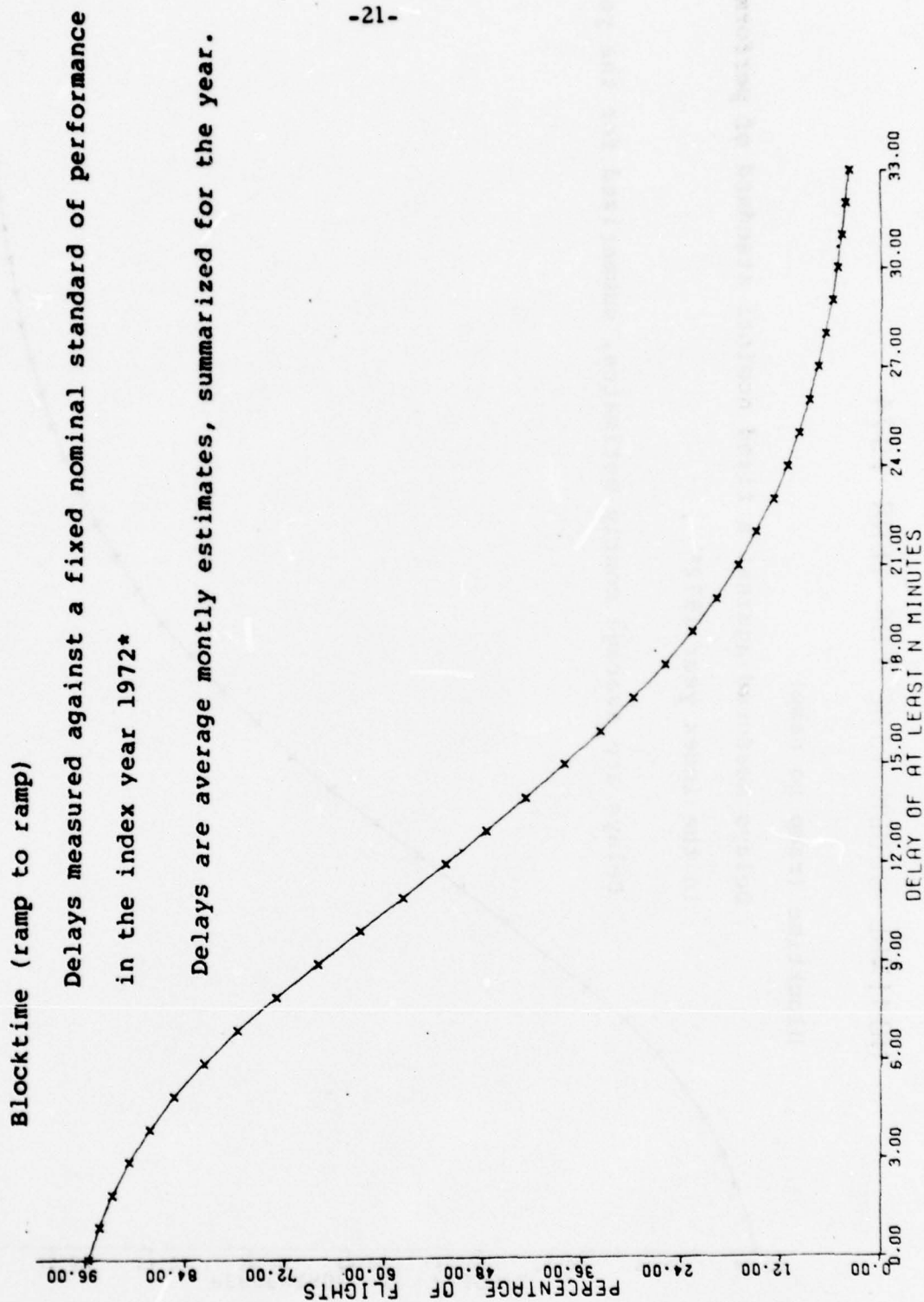
AIRPORT	DEPARTURE	ARRIVAL
ATL	8	4
BOS	9	2
CLE	7	3
DCA	9	3
DEN	3	2
DFW	6	3
DTW	8	3
ENR	9	4
JFK	15	7
LAX	9	3
LGA	8	4
MIA	7	2
MSP	5	2
MSY	4	2
ORD	9	5
PHI	7	2
PIT	2	2
SFA	6	2
SFD	8	3
STL	3	2

ALL TIMES ARE IN MINUTES

*Ground Times (Taxi times, including holding, to and from the ramp)

FIGURE 1.3

NOMINAL BLOCK TIME FOR YEAR 1973



*see attached Tables I-2 and I-3.

(reference FAA-EM-77-12; p.3)

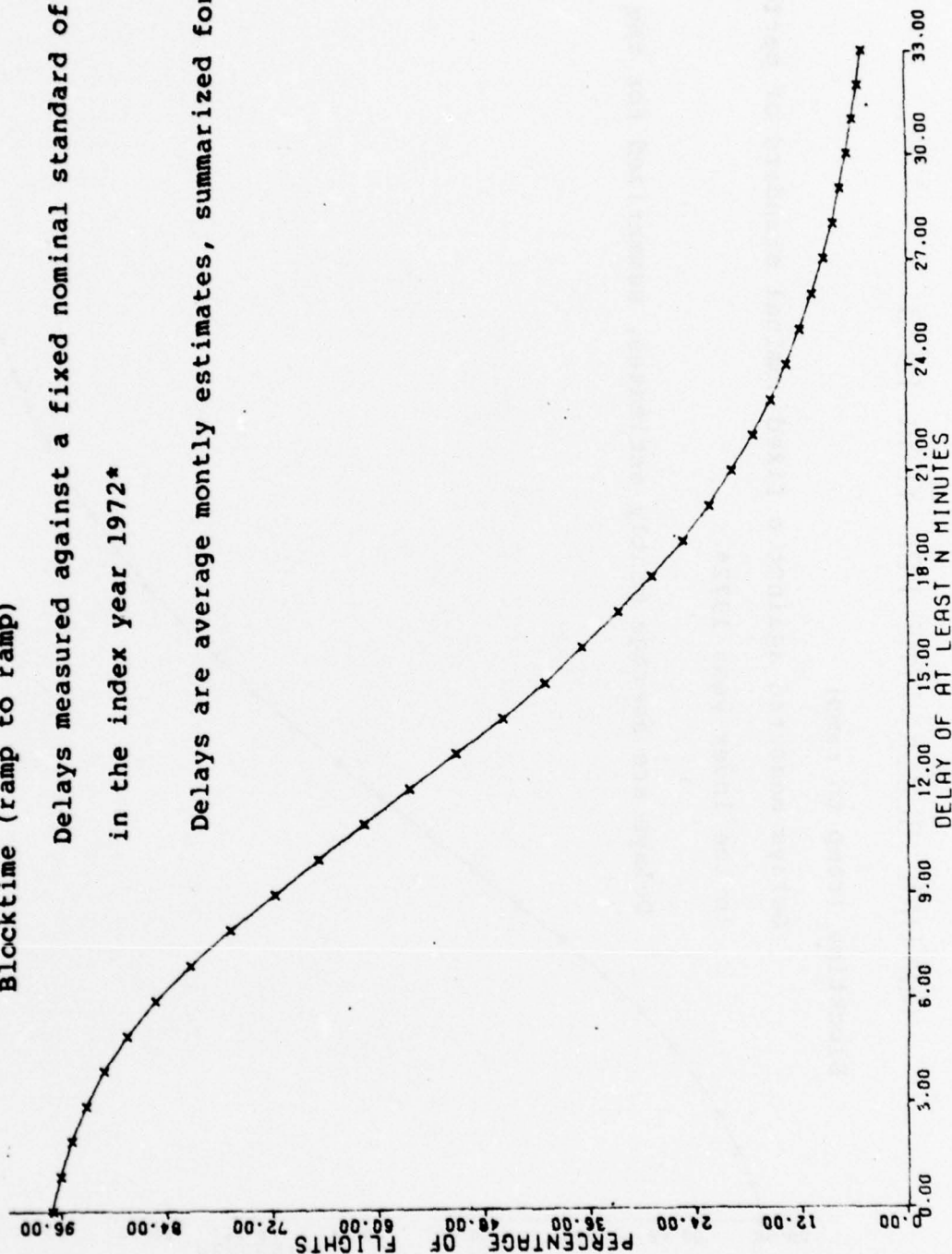
FIGURE 1.4

NOMINAL BLOCK TIME FOR YEAR 1974

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.



*see attached Tables I-2 and I-3.

(reference FAA-EM-77-12; p.3)

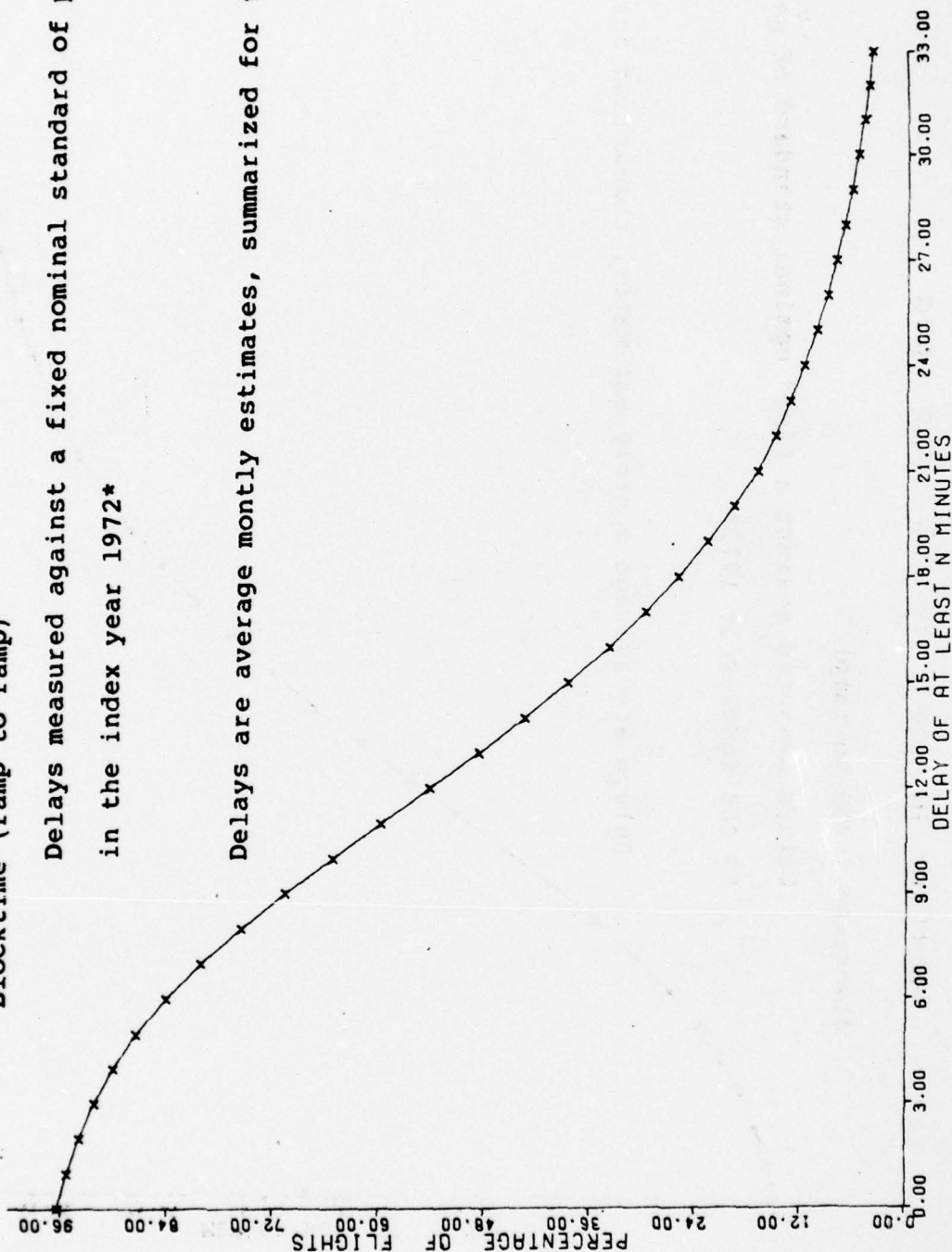
FIGURE 1.5

NOMINAL BLOCK TIME FOR YEAR 1975

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

Delays are average montly estimates, summarized for the year.



*see attached Tables I-2 and I-3.
(reference FAA-EM-77-12; p.3)

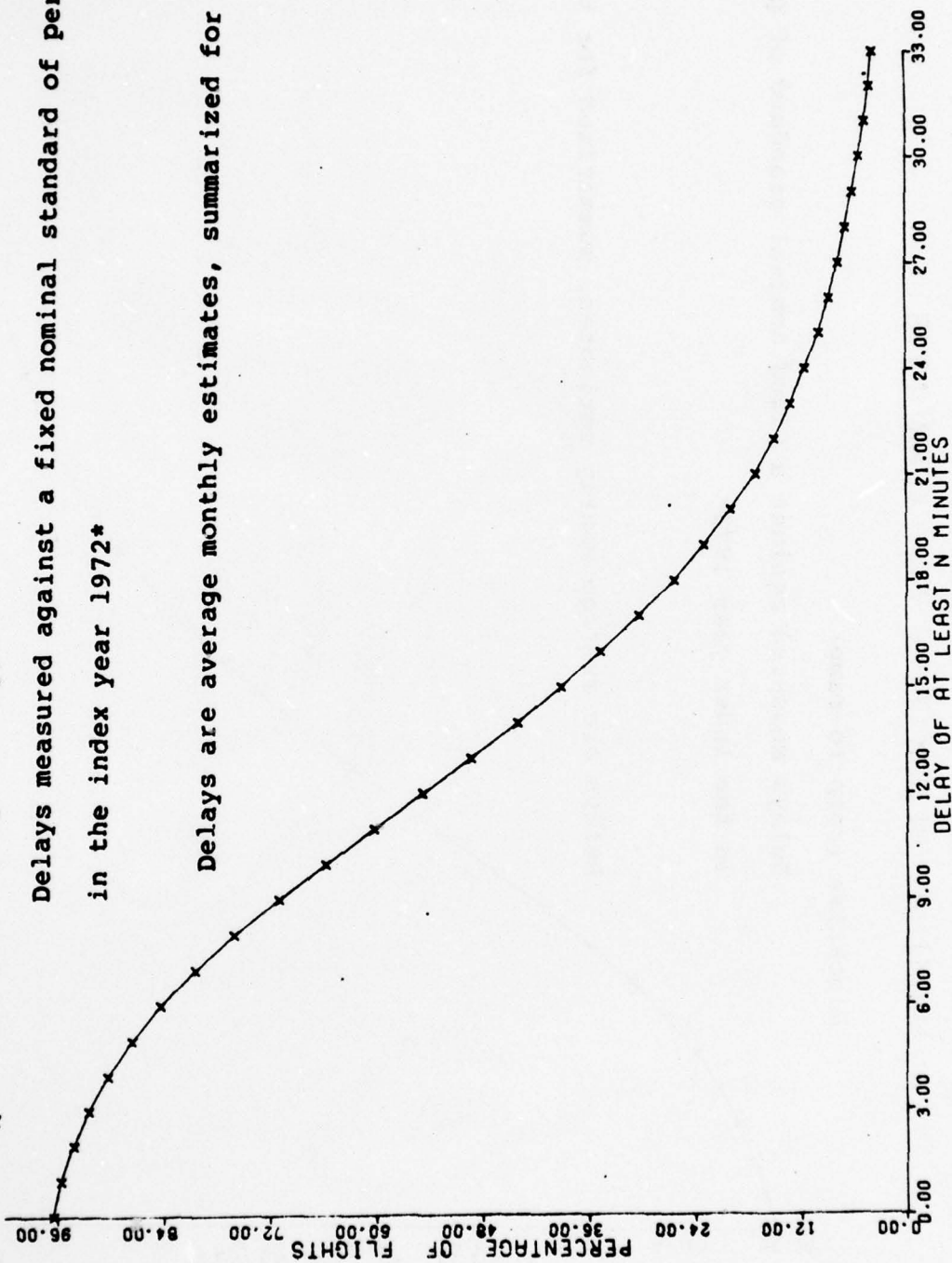
FIGURE 1.6

NOMINAL BLOCK TIME FOR YEAR 1976

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performance
in the index year 1972*

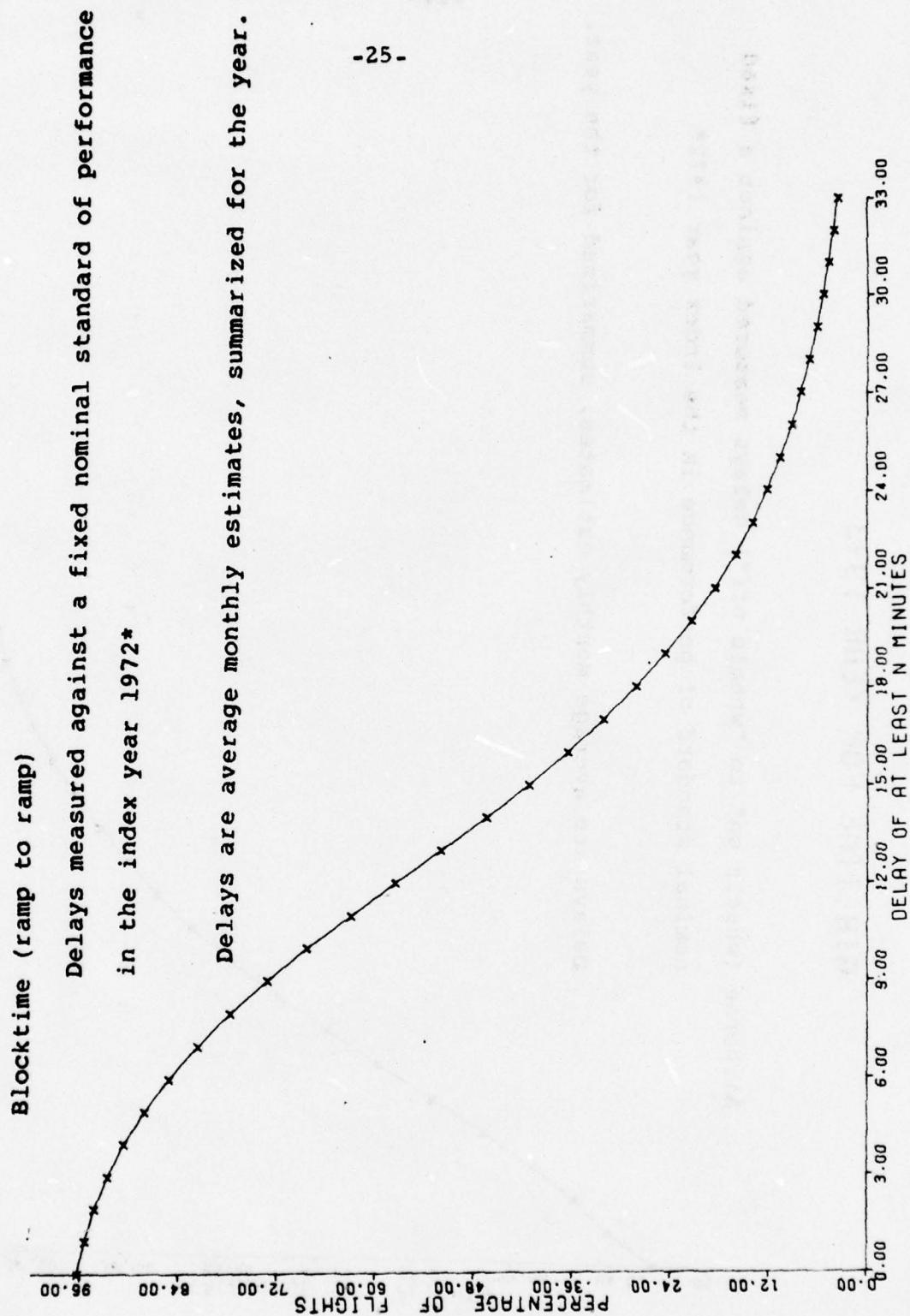
Delays are average monthly estimates, summarized for the year.



*see attached Tables I-2 and I-3.
(reference FAA-EM-77-12; p.3)

FIGURE 1.7

NOMINAL BLOCK TIME FOR YEAR 1977



*see attached Tables I-2 and I-3.

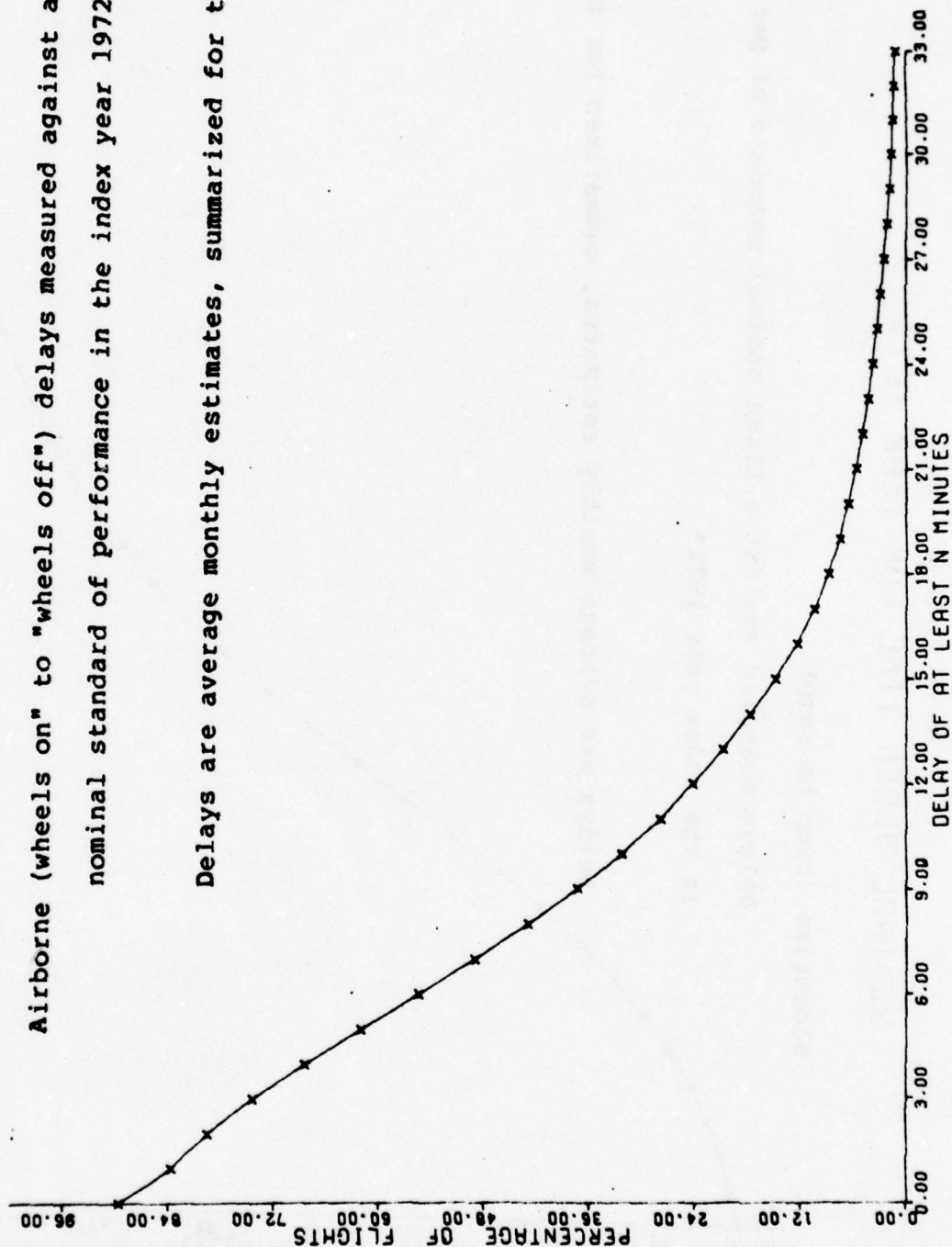
(reference FAA-EM-77-12; p.3)

FIGURE 2.3

AIR TIME FOR YEAR 1973

Airborne (wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

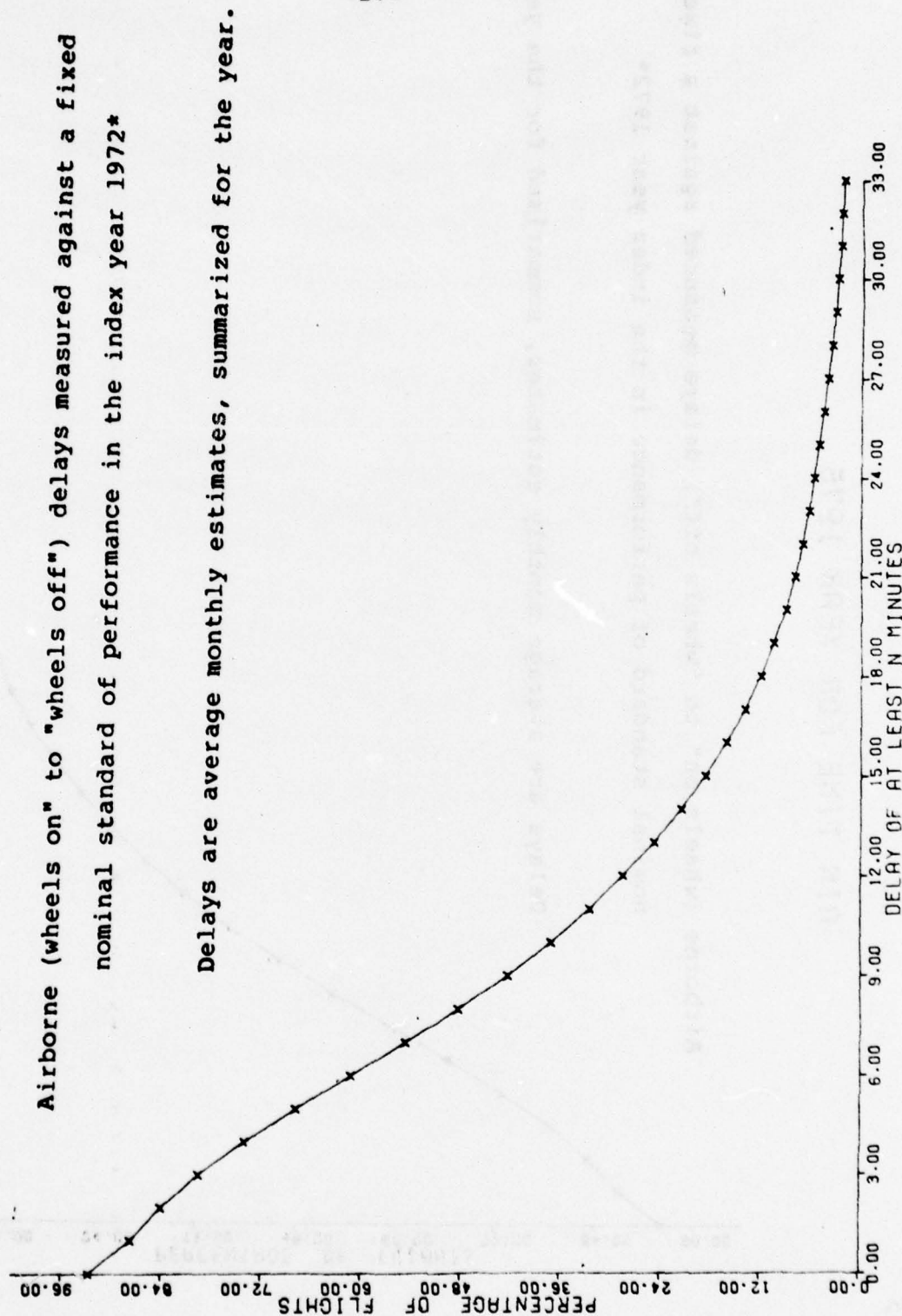
Delays are average monthly estimates, summarized for the year.



*see attached Table I-2.

FIGURE 2.4

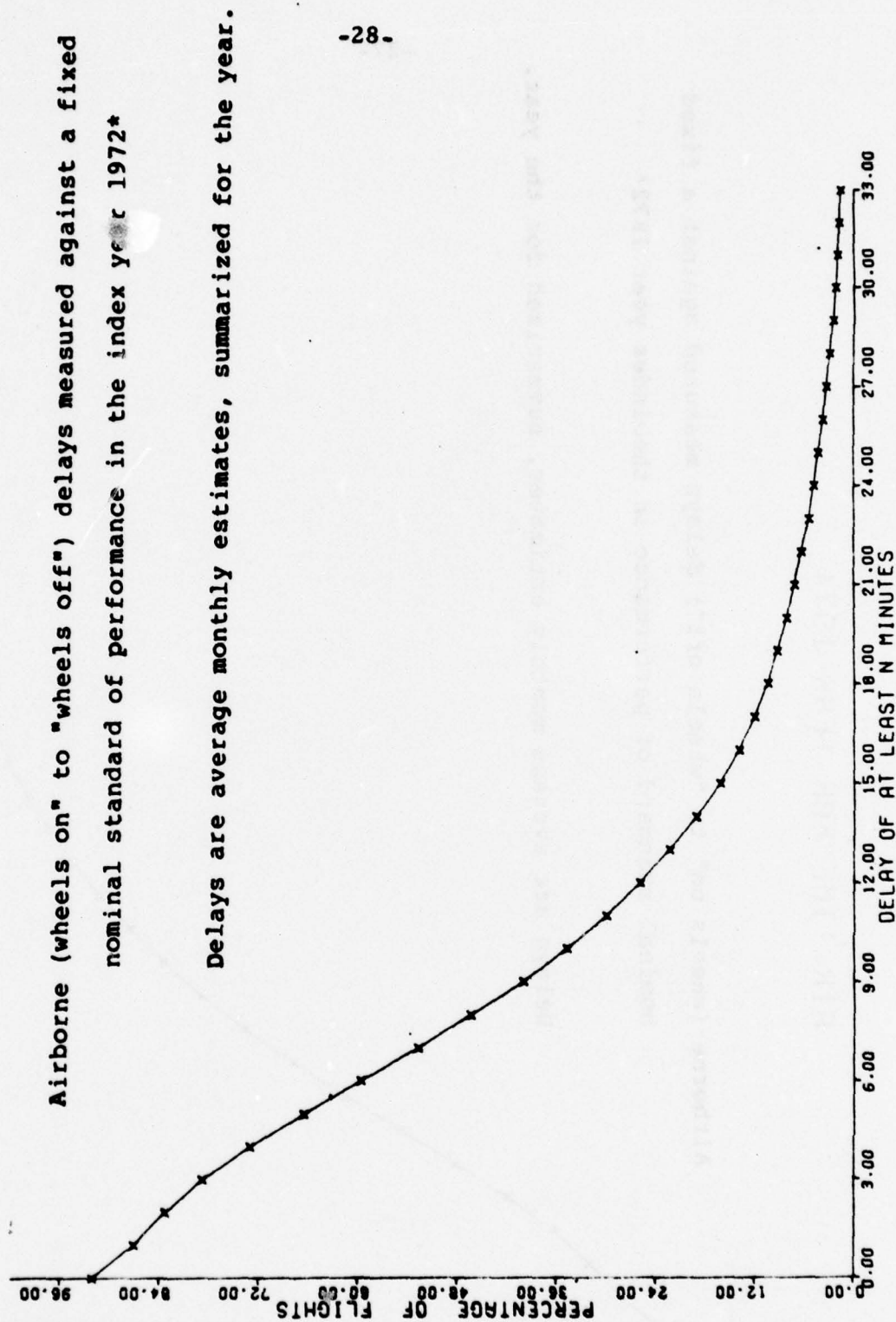
AIR TIME FOR YEAR 1974



*see attached Table I-2.

FIGURE 2.5

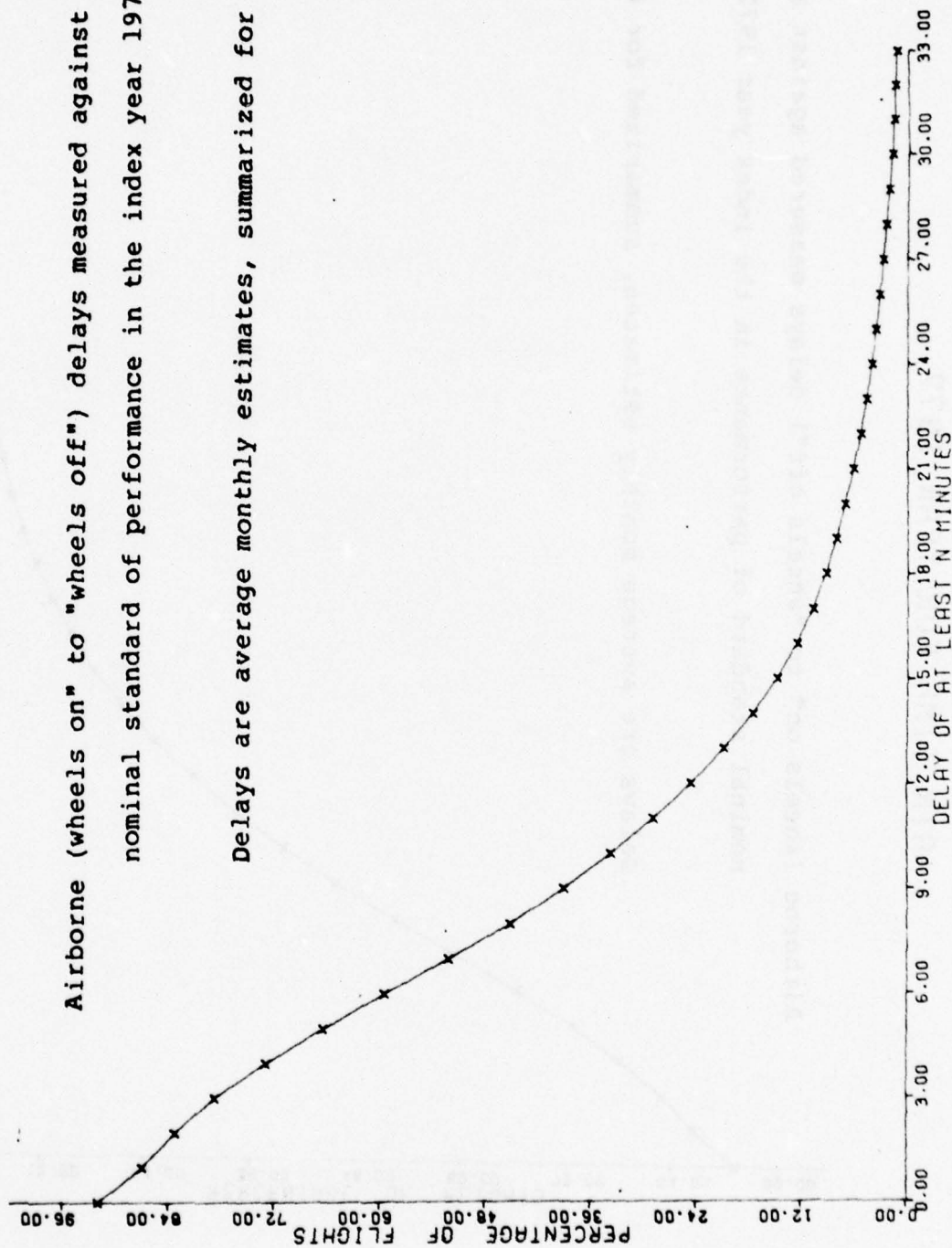
AIR TIME FOR YEAR 1975



*see attached Table I-2.

FIGURE 2.6

AIR TIME FOR YEAR 1976



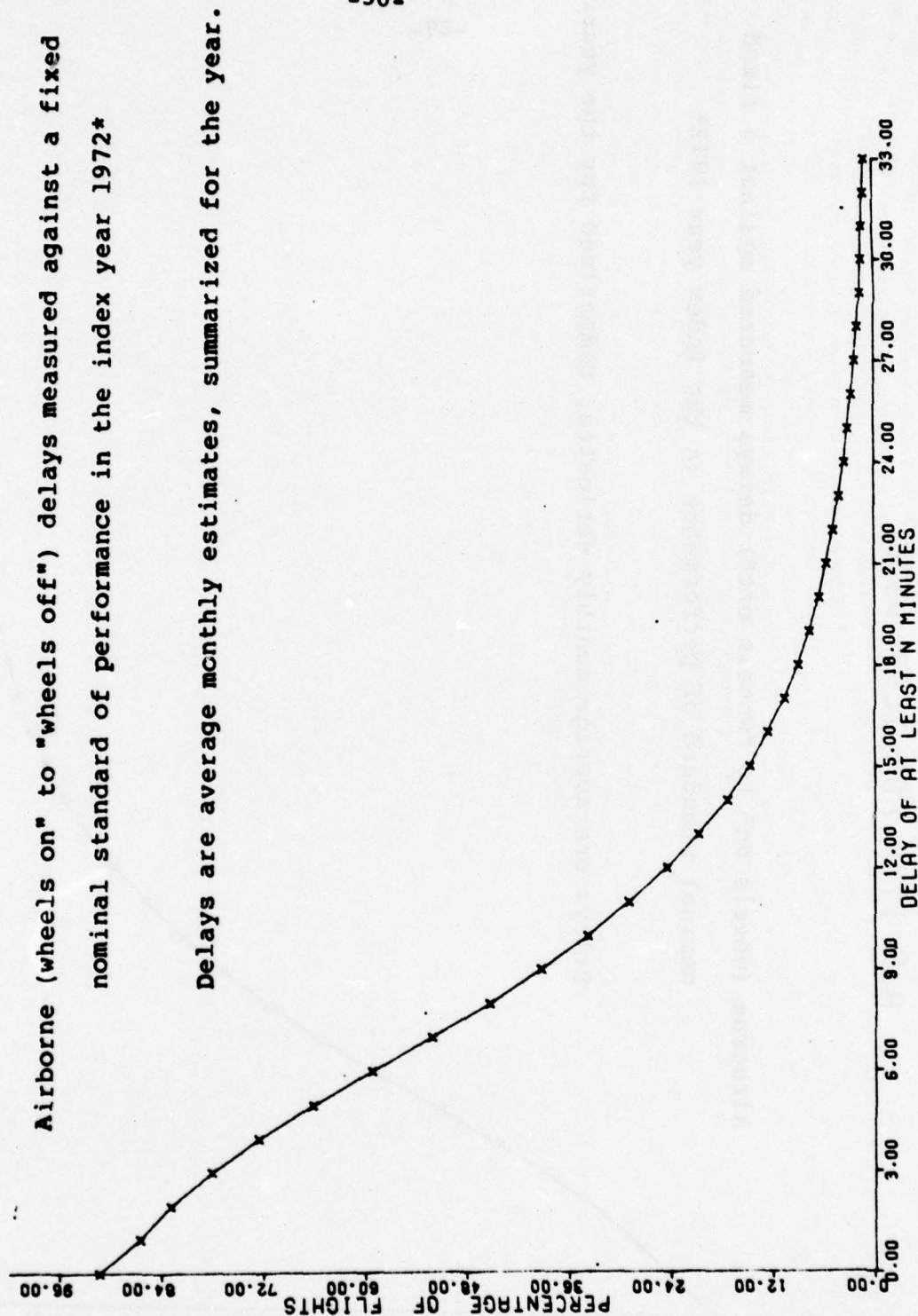
Airborne (wheels on" to "wheels off") delays measured against a fixed nominal standard of performance in the index year 1972*

Delays are average monthly estimates, summarized for the year.

*see attached Table I-2.

FIGURE 2.7

AIR TIME FOR YEAR 1977



*see attached Table I-2.

COMPARISON 50th PERCENTILE RANKING OF DELAYS

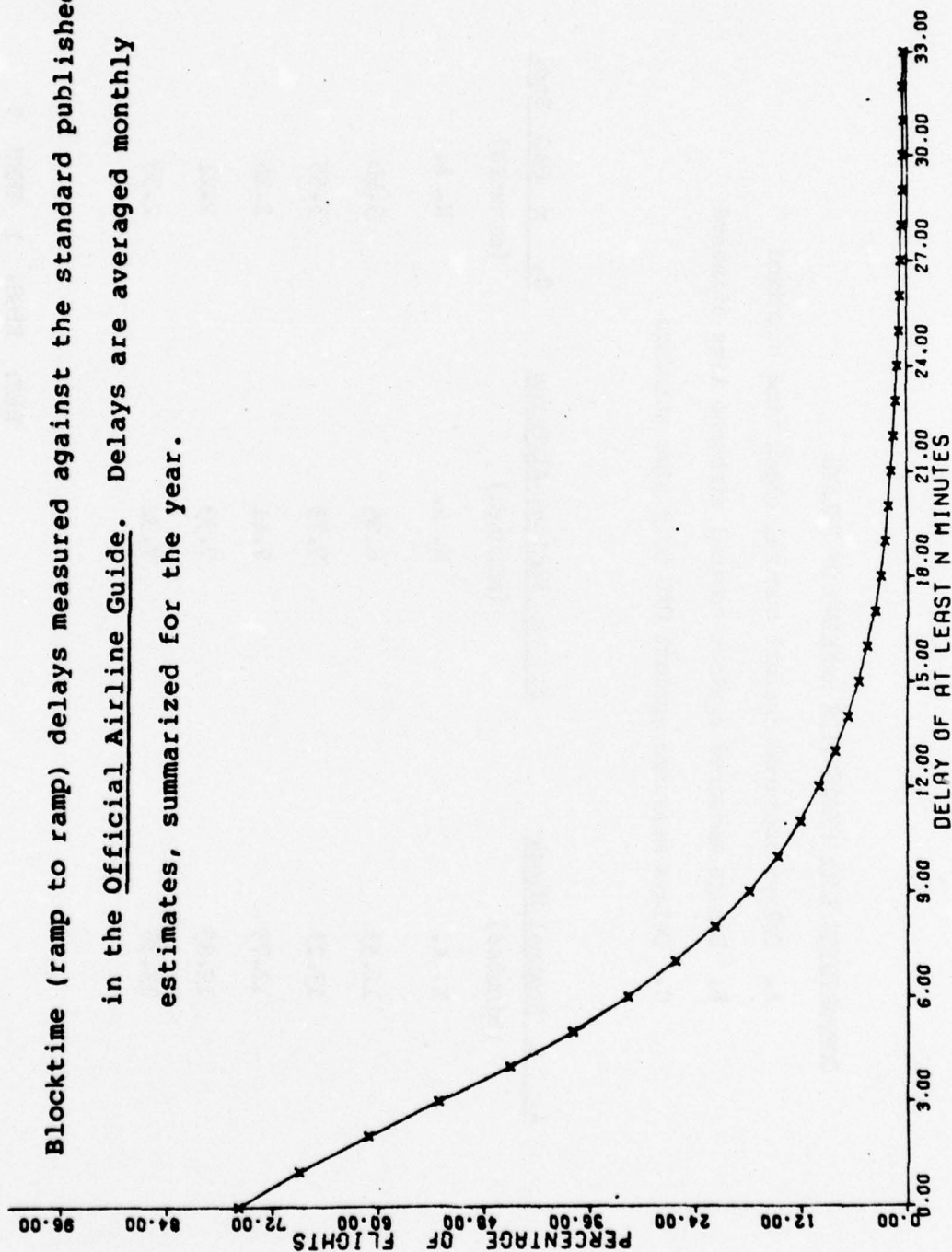
- A. Delays measured against nominal block time standard
 B. Delays measured against nominal airborne time standard
 C. Delays measured against OAG trip time standard

	<u>A. x Nominal Block</u> (minutes)	<u>B. x Nominal Airborne</u> (minutes)	<u>C. x OAG Std.</u> (minutes)
1972	N. A.	N. A.	N. A.
1973	12.53	6.85	3.40
1974	13.23	7.75	3.55
1975	12.75	7.41	2.26
1976	12.85	7.33	2.21
1977	13.36	7.32	2.36

FIGURE 3.3

OAG FOR YEAR 1973

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.



OAG FOR YEAR 1974

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

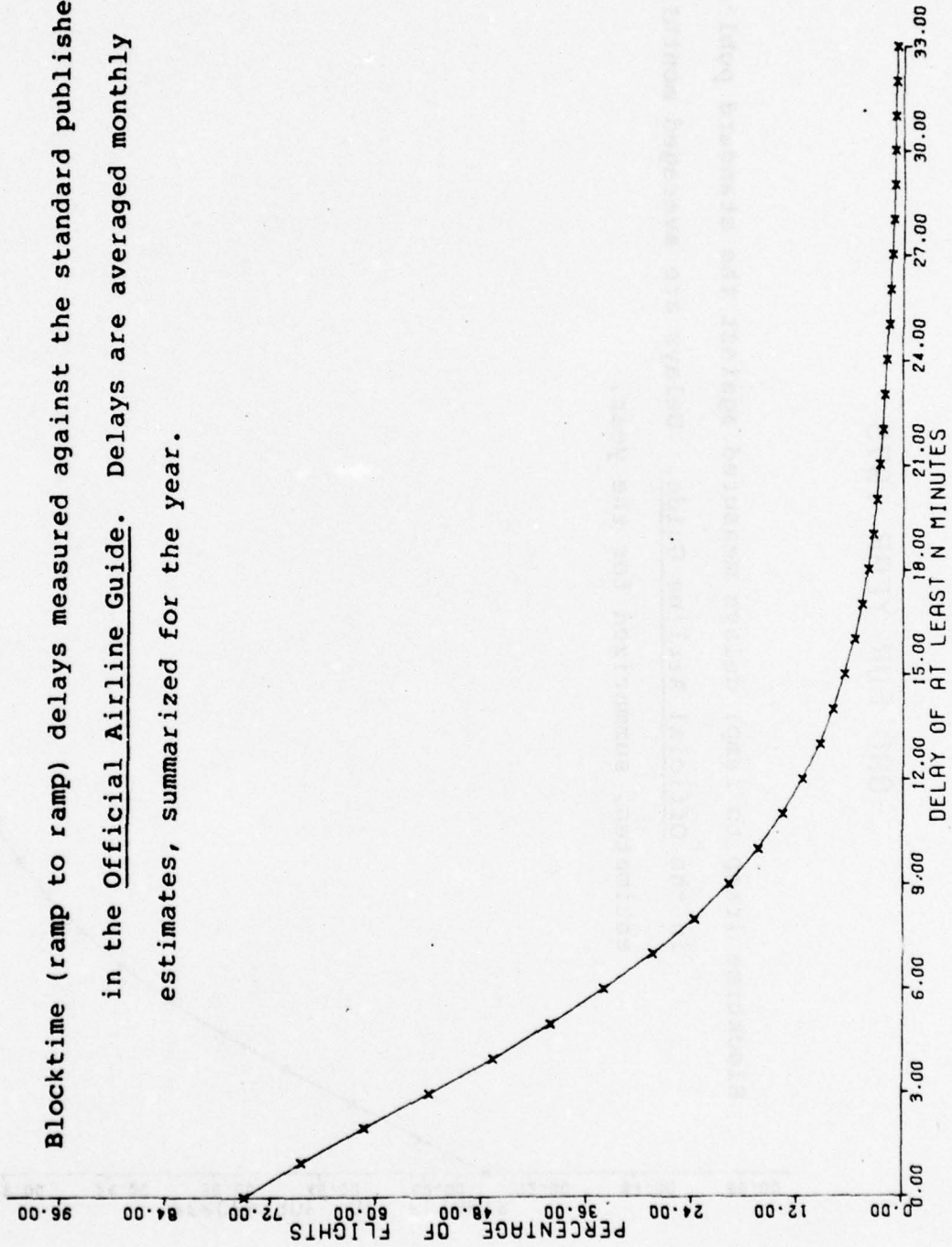


FIGURE 3.4

FIGURE 3.5

OAG FOR YEAR 1975

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

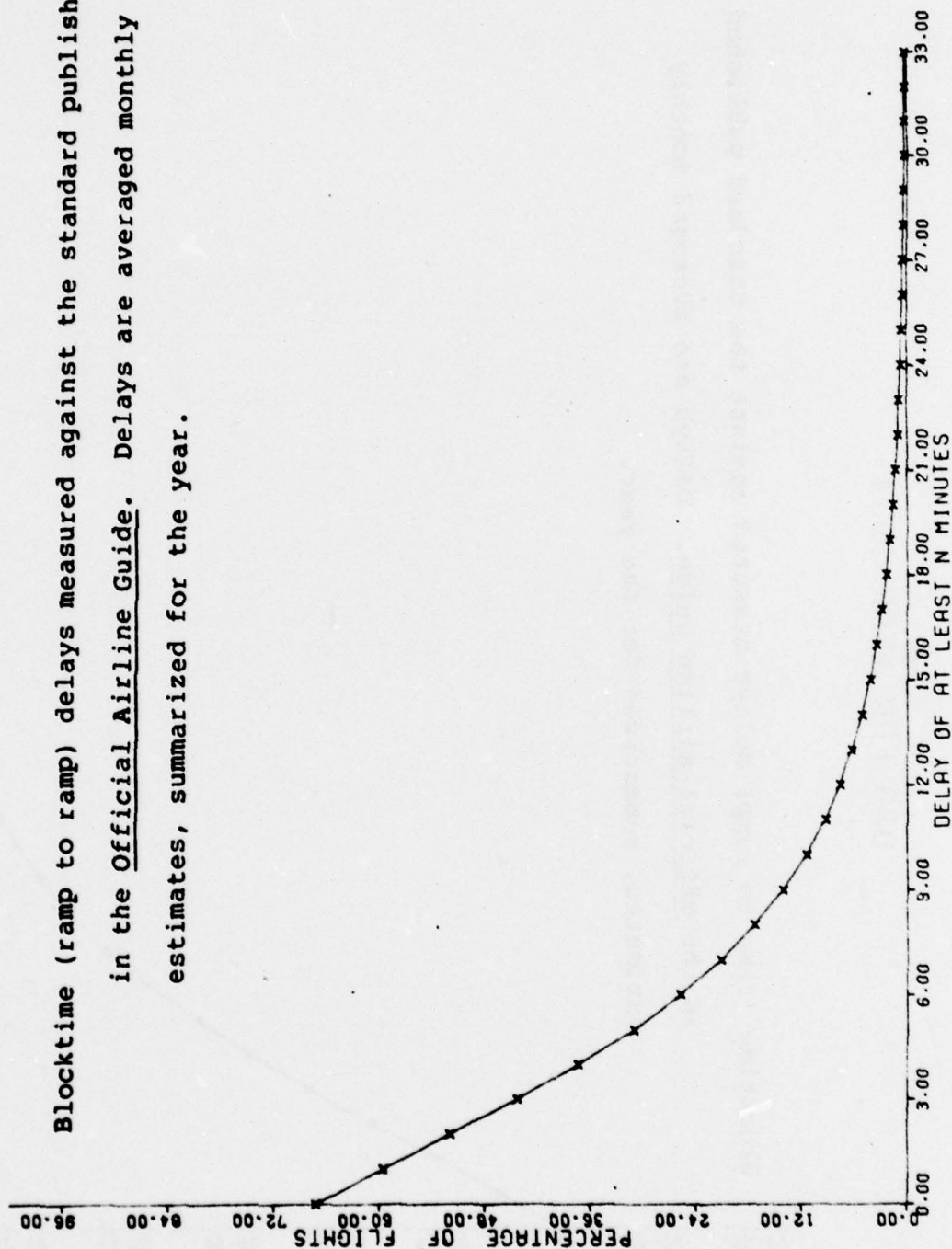


FIGURE 3.6

OAG FOR YEAR 1976

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.

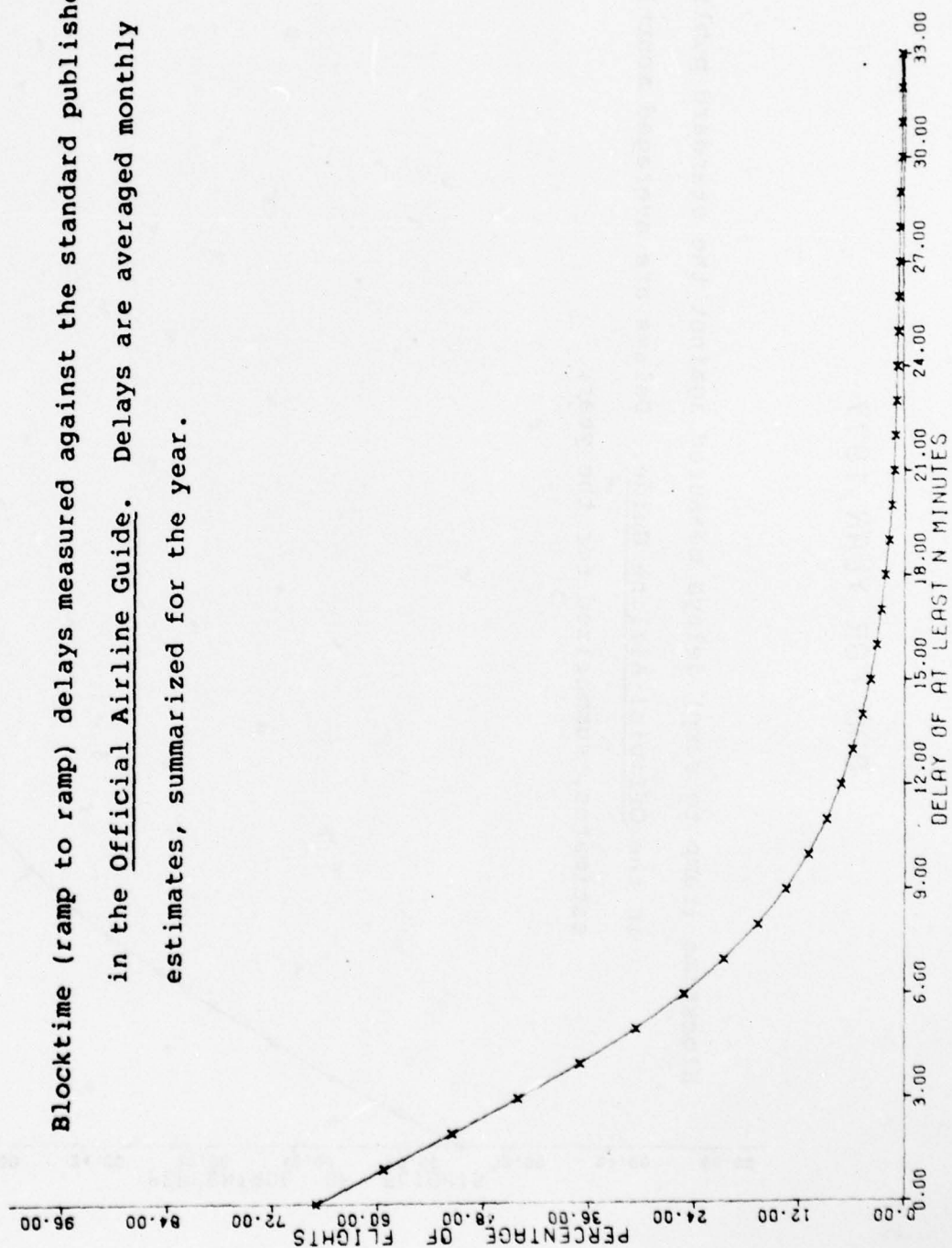
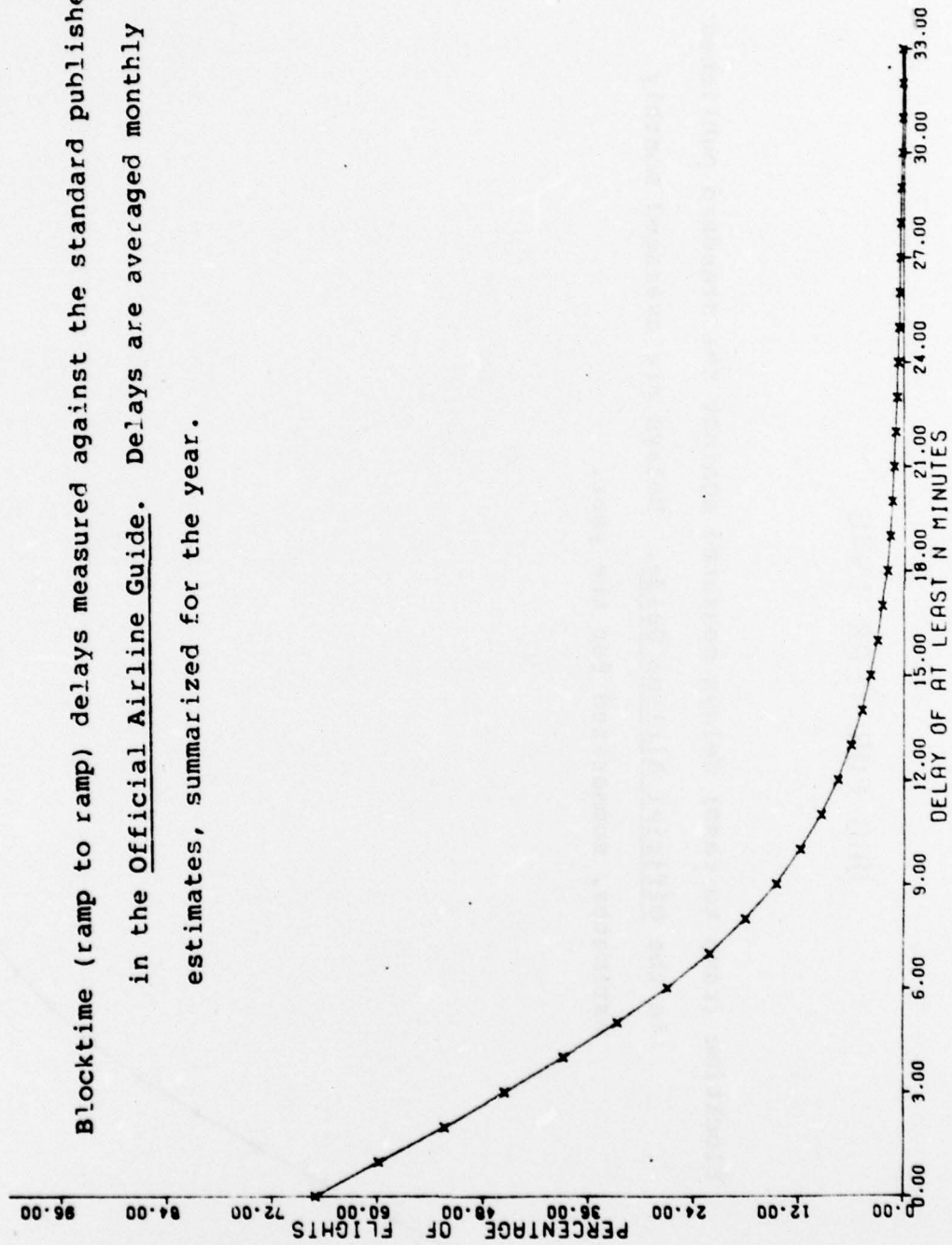


FIGURE 3.7

OAG FOR YEAR 1977

Blocktime (ramp to ramp) delays measured against the standard published in the Official Airline Guide. Delays are averaged monthly estimates, summarized for the year.



AVERAGE MONTHLY AIRBORNE AND GROUND DELAYS

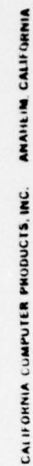


TABLE 3

ANNUAL TREND IN AVERAGE MONTHLY DELAYS
COMPOSITE OF TOP 50 ROUTE SEGMENTS

	<u>AIRBORNE</u> (minutes)	<u>GROUND</u> (minutes)	<u>TOTAL BLOCK DELAY</u> (minutes)
1972	9	4	13
1973	9	6	15
1974	11	5	16
1975	10	5	15
1976	9	6	15
1977	9	6	15

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reference:

Figure 4.1, for years 1976-1977
see previous annual reports for
earlier years.

FIGURE 4.2 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT ATL TO DFW

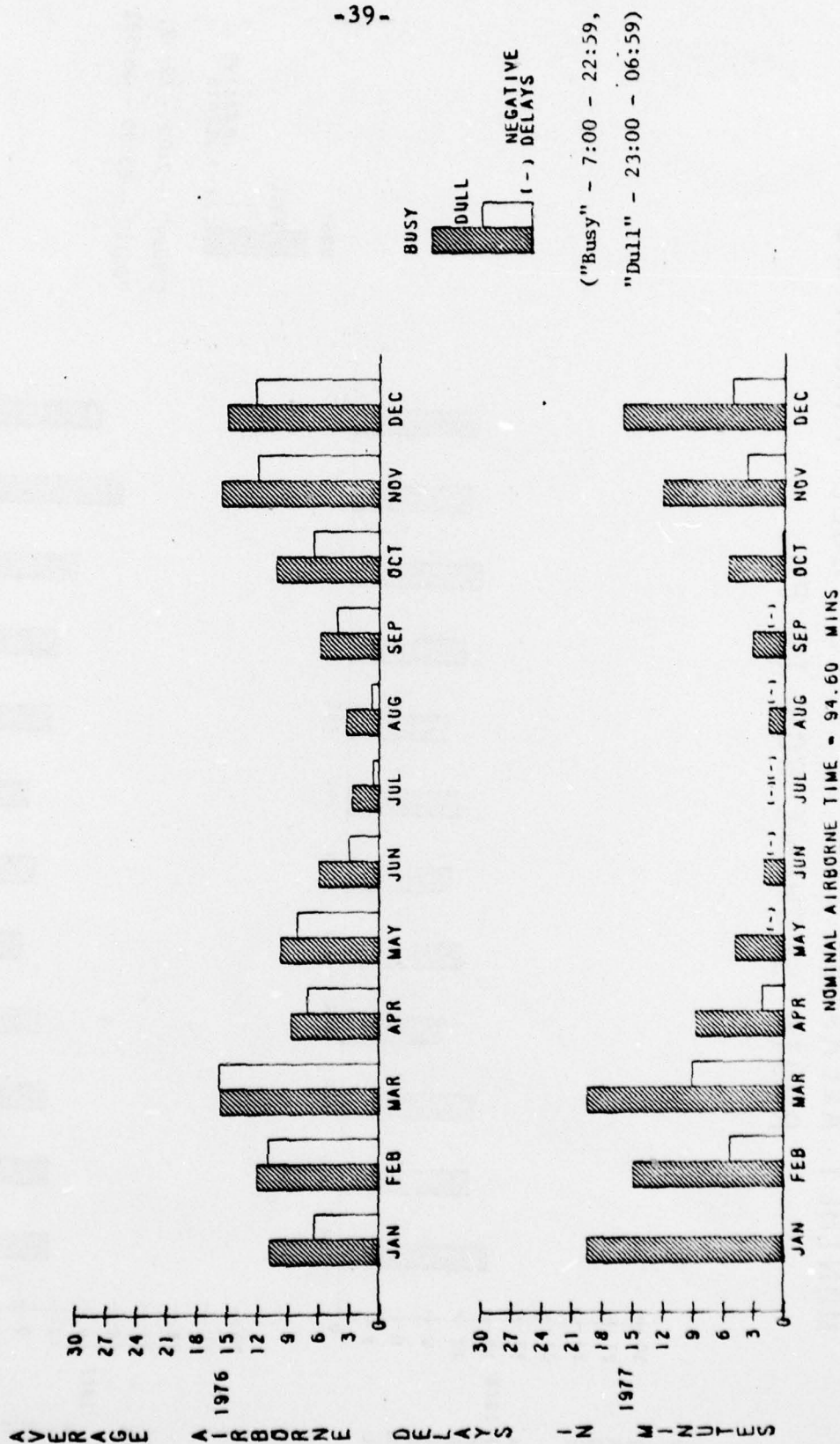


FIGURE 4.3

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS ROUTE SEGMENT BOS TO PHL

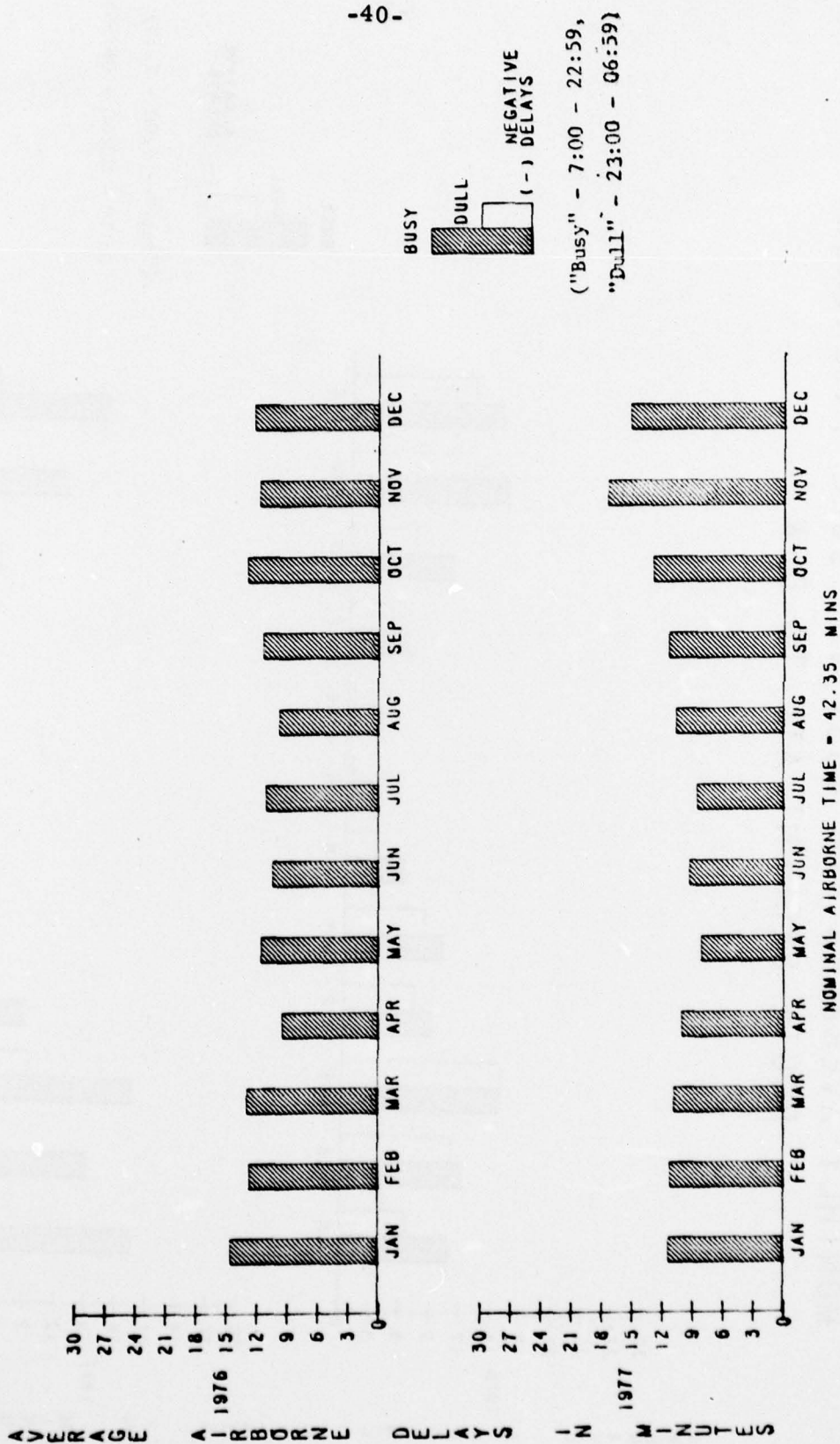


FIGURE 4.4 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT CLE TO DTW

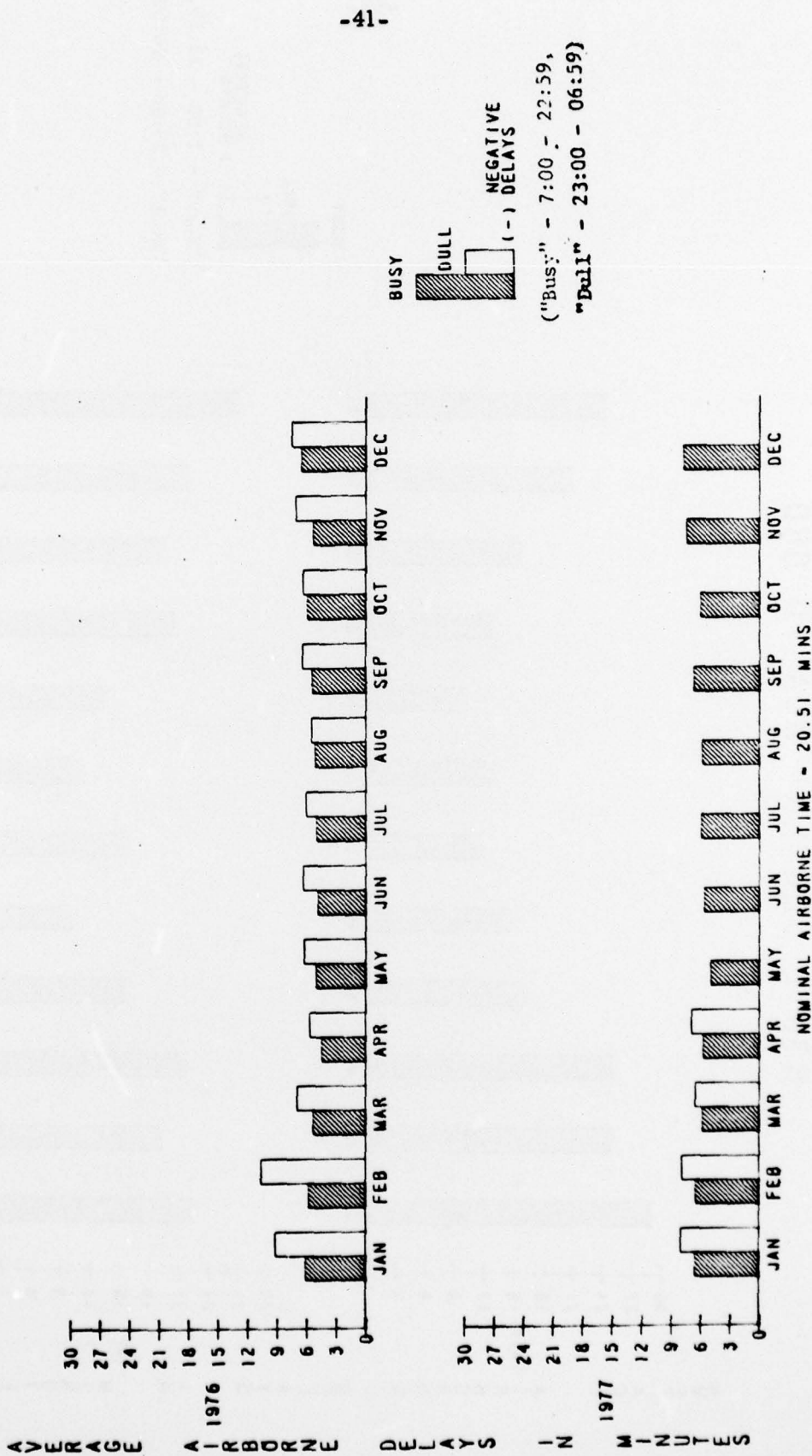


FIGURE 4.5 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT DCA TO ORD

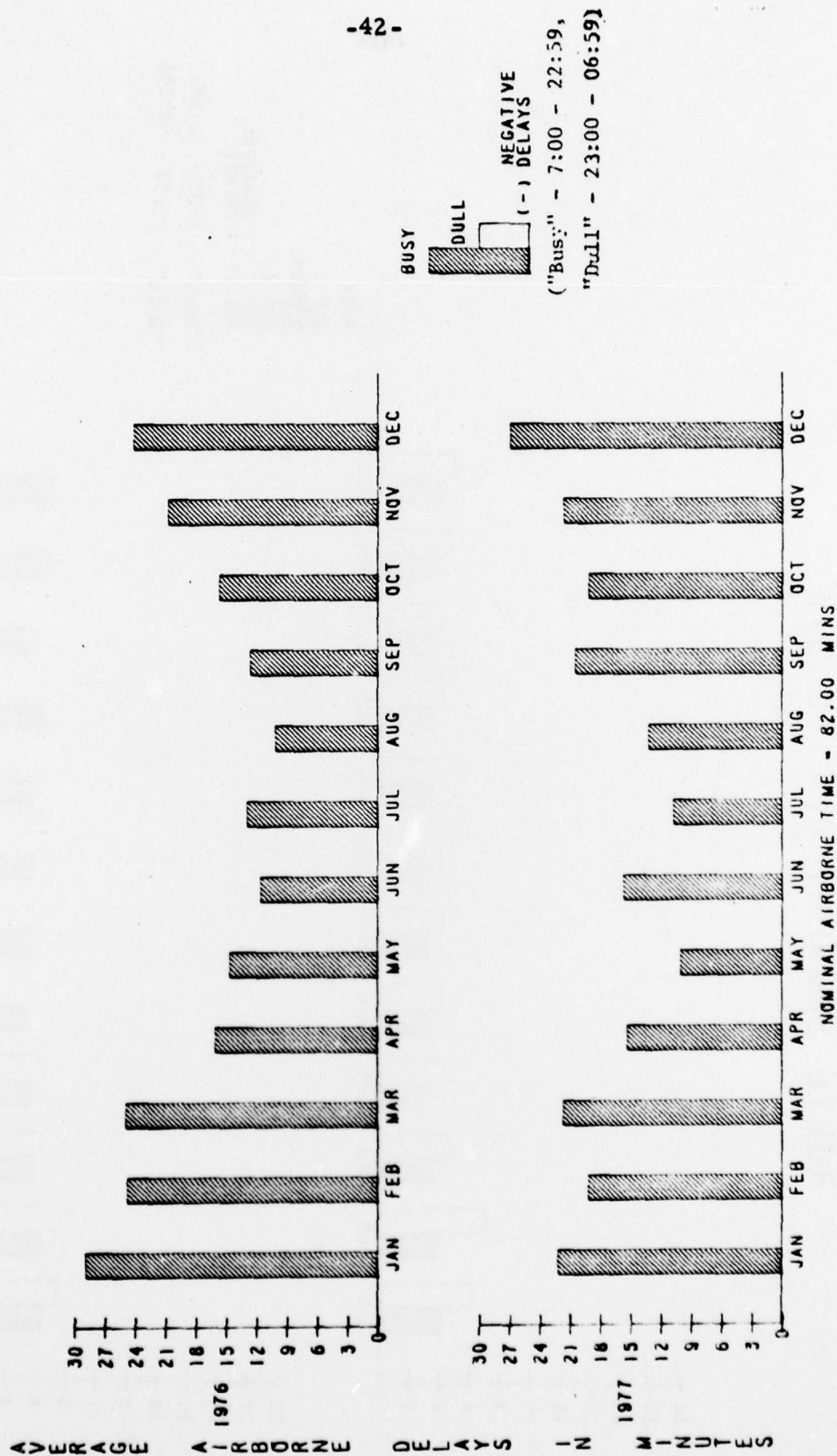


FIGURE 4-6

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS ROUTE SEGMENT DEN TO ORD

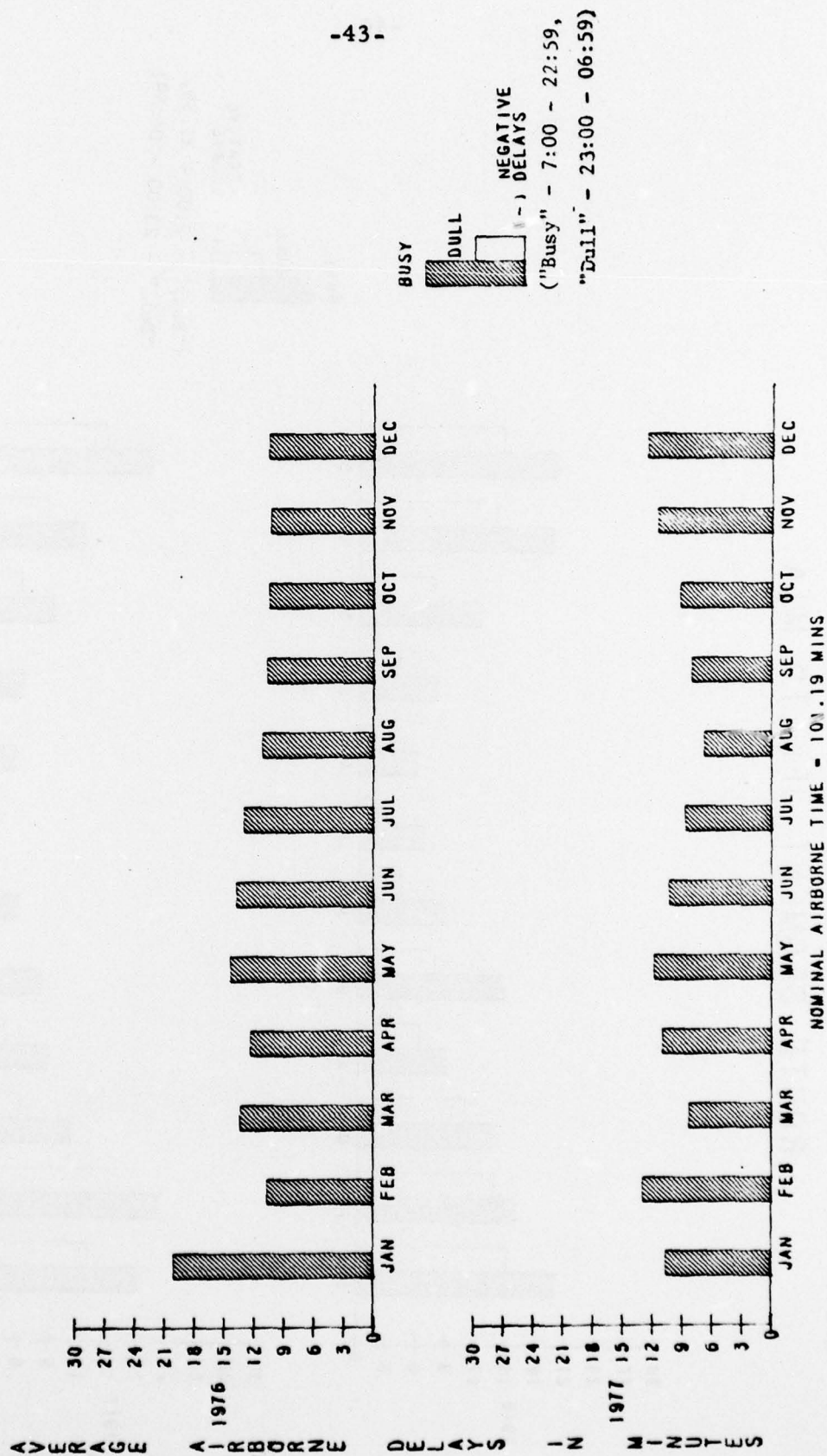


FIGURE 4.7 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT JFK TO MIA

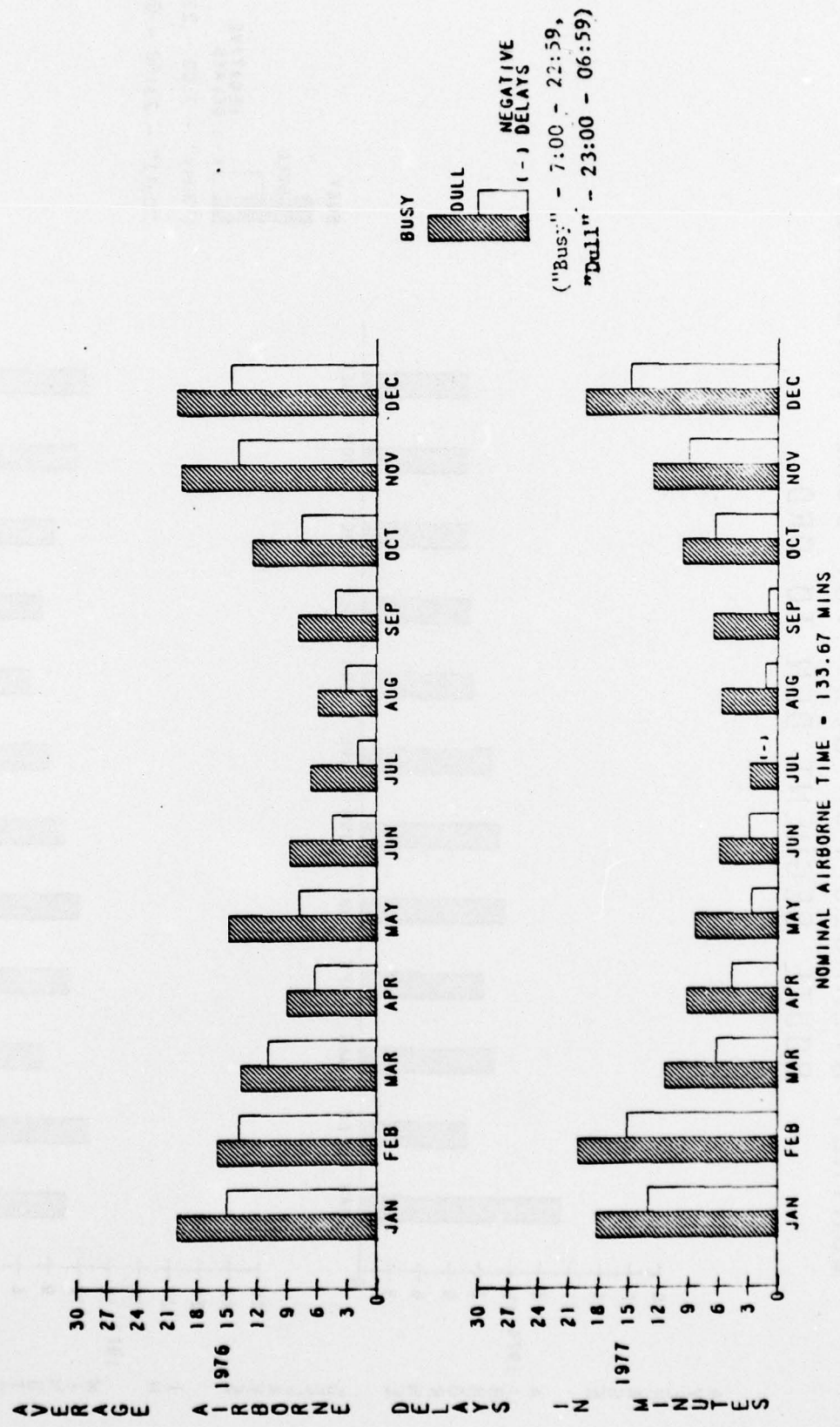


FIGURE 4-8 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT LAX TO SFO

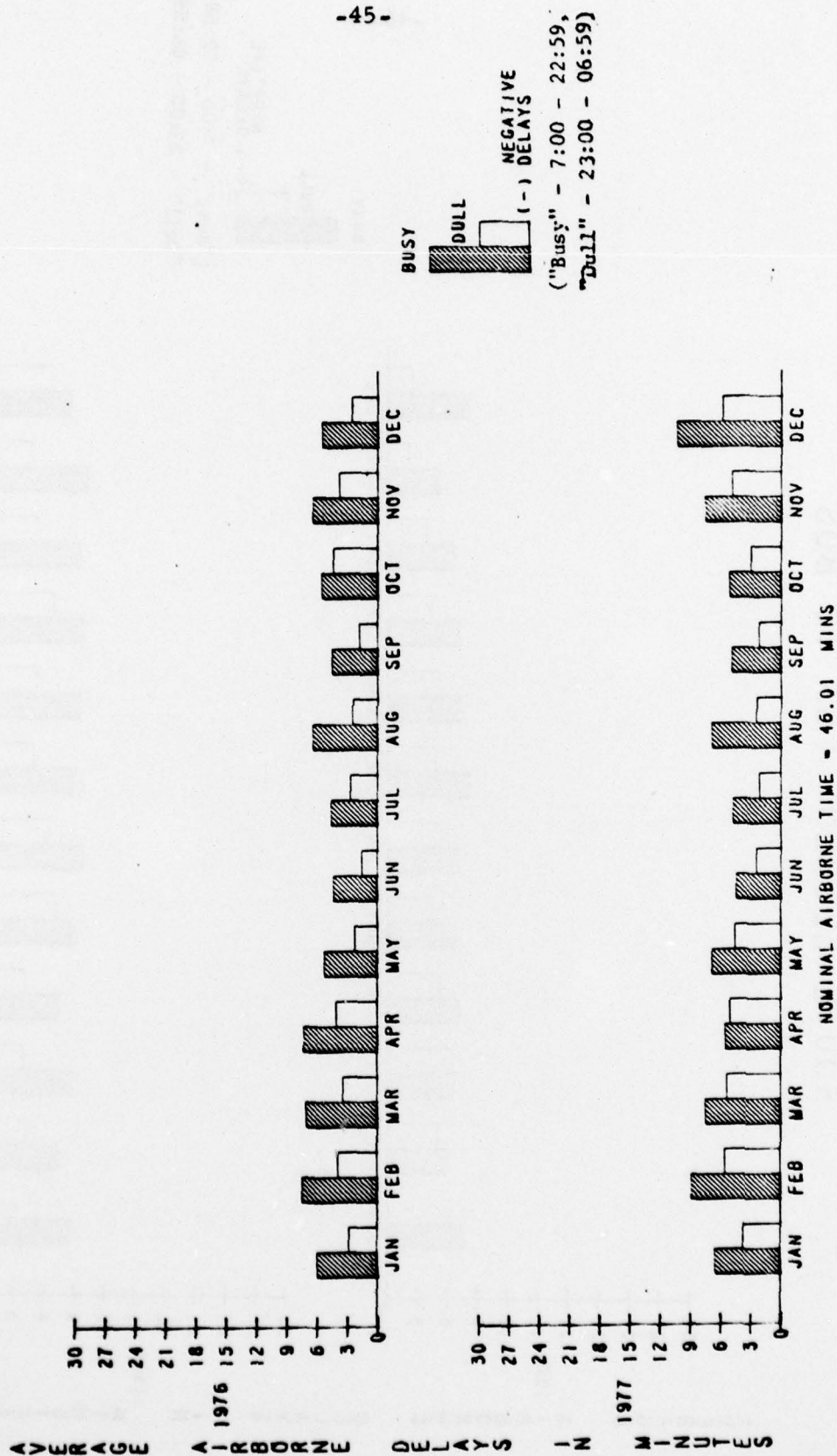


FIGURE 2.9

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS ROUTE SEGMENT LGA TO BOS

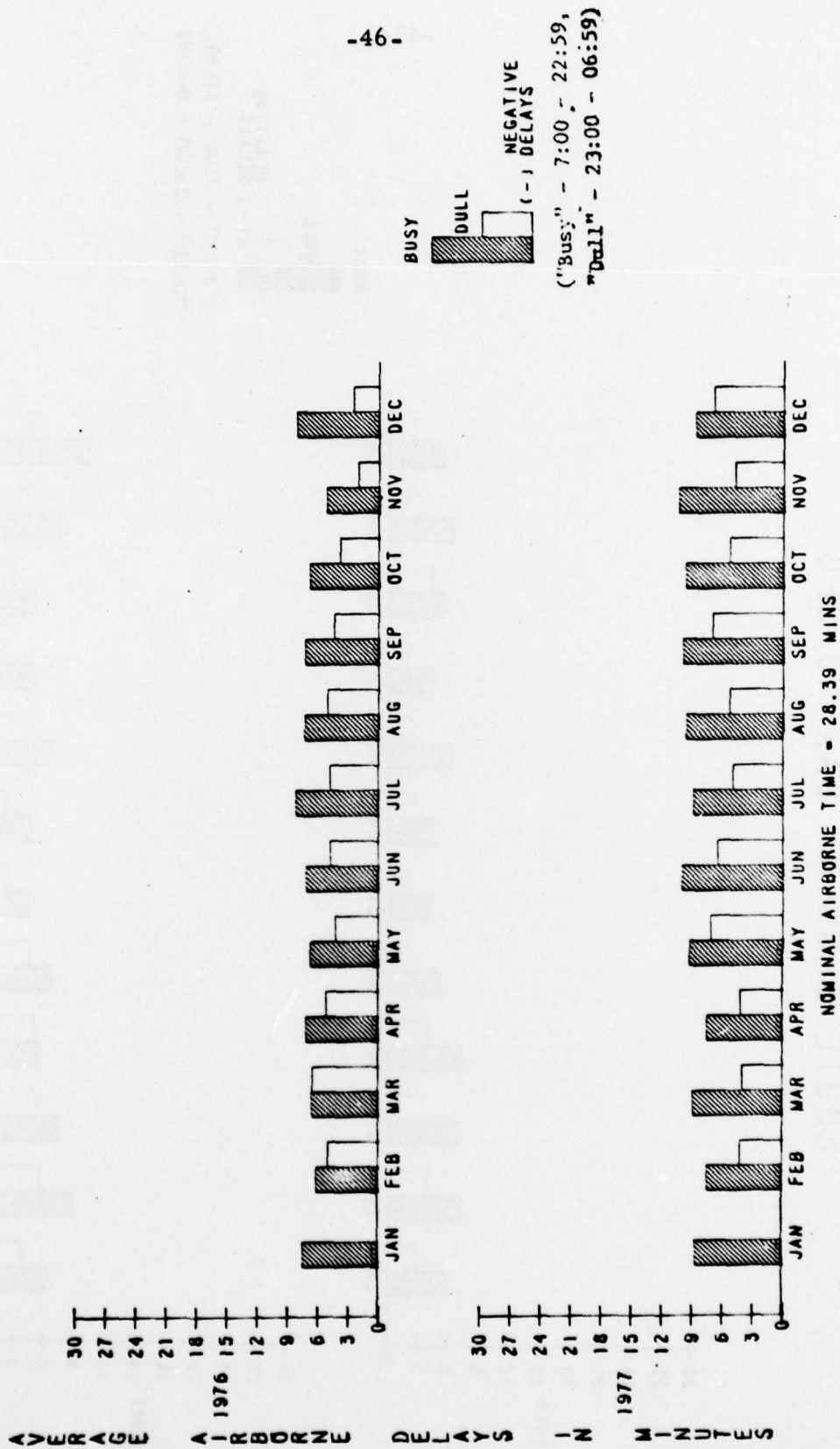


FIGURE 2.10

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS ROUTE SEGMENT ORD TO STL

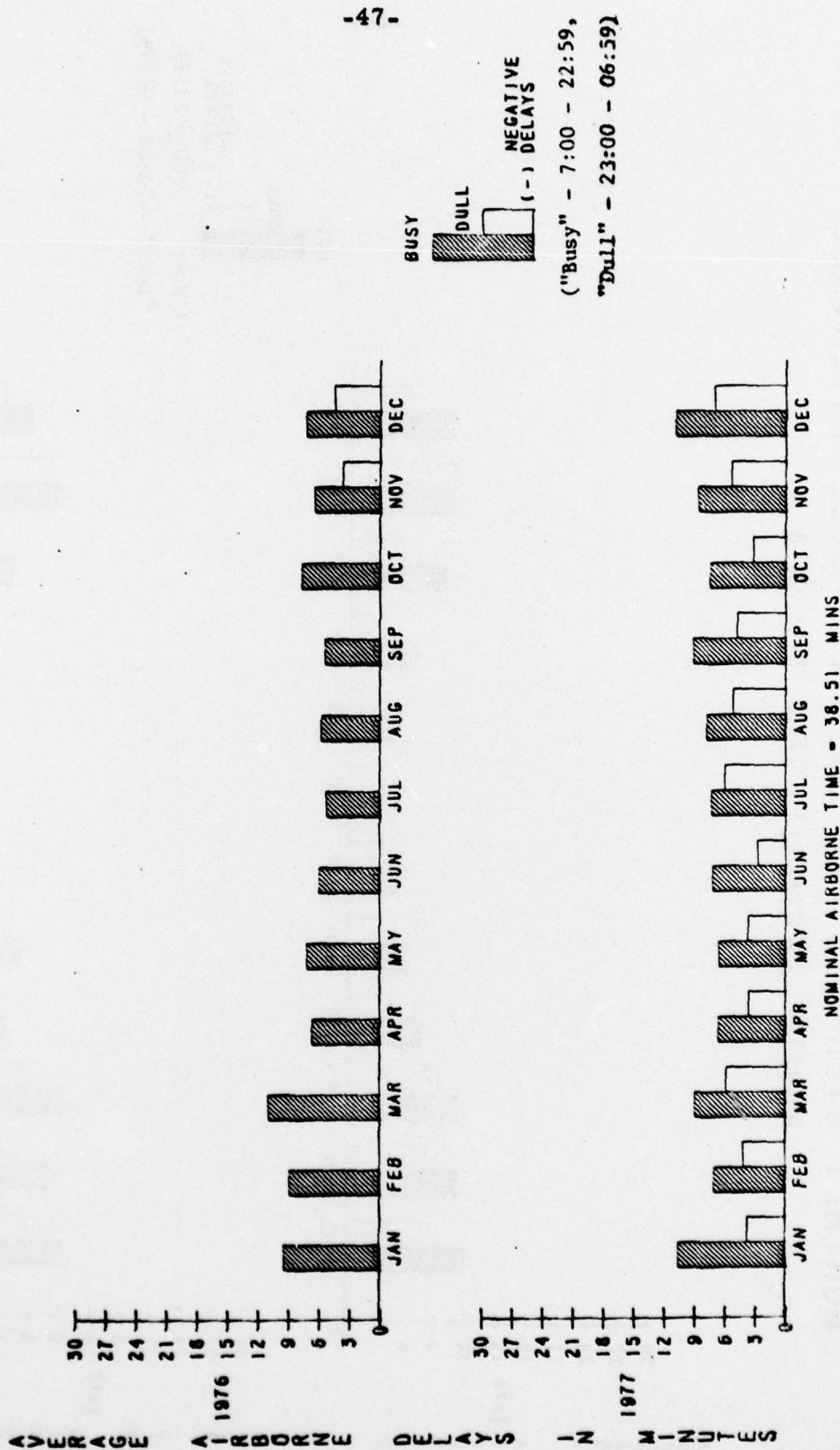


FIGURE 4.11

AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS ROUTE SEGMENT SFO TO SEA

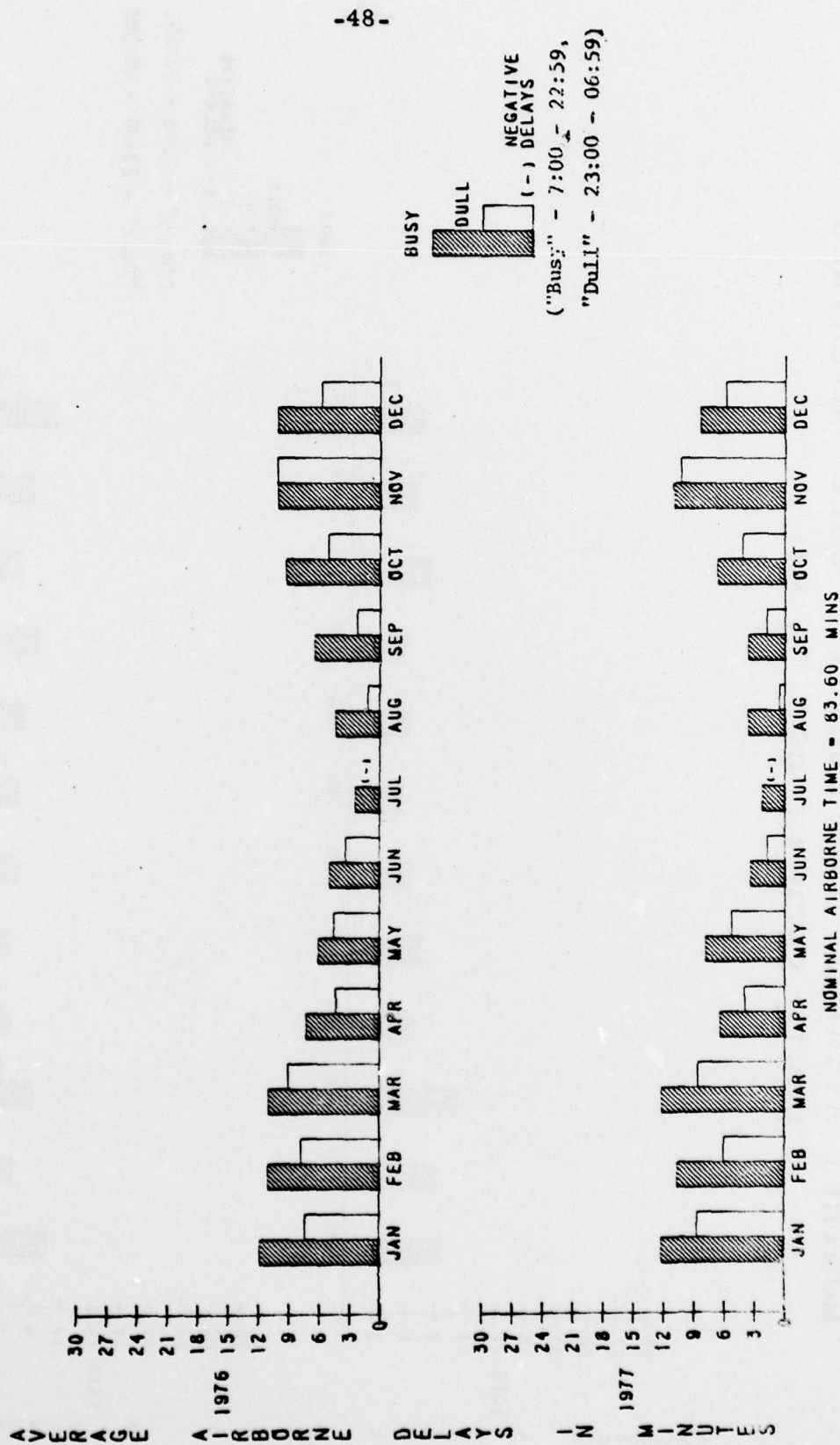


TABLE 4

AVERAGE MONTHLY AIRBORNE DELAYS FOR
ROUTE SEGMENTS TERMINATING AT ORD

	<u>#FLIGHTS</u>	<u>AVG. AIRBORNE DELAY</u> (minutes)	<u>PEAK MONTH</u> (minutes)	<u>STD. DEVIATION</u> (minutes)
1972	106,613	0:11	Jan. 0:16	4.2
1973	105,827	0:13	Mar. 0:21	4.0
1974	85,704	0:17	Sept. 0:24	3.6
1975	103,090	0:14	Jan. 0:20	3.6
1976	101,528	0:13	Jan. 0:23	4.3
1977	103,941	0:12	Dec. 0:17	2.8