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AIRLINE DELAY TRENDS 1972 - 1977.(U)
JUL 78 S MORIN, S M HOROWITZ
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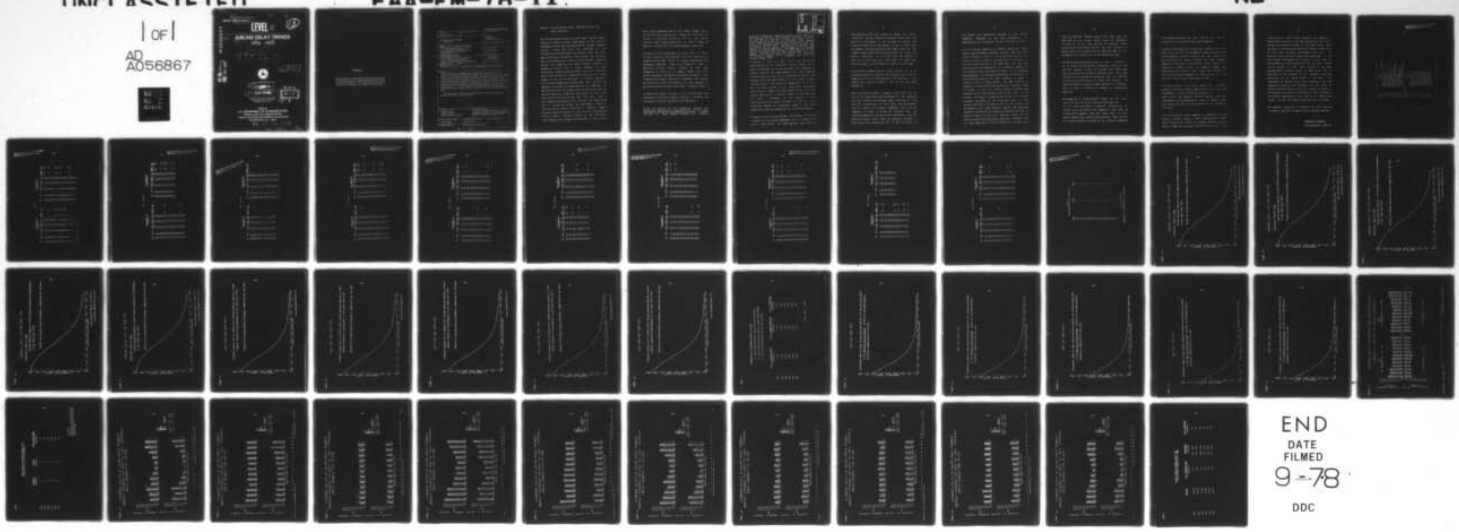

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LEVEL II

AIRLINE DELAY TRENDS
1972 - 1977.

Stephen Morin
Seymour M. Horowitz

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FINAL REPORT.

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
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NOTICE

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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.

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

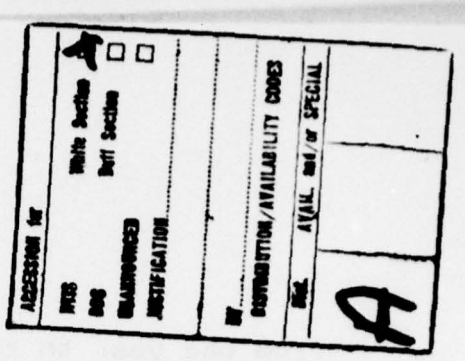
For the past several years, we have been issuing annual reports of trends in delays experienced by the nation's scheduled airlines operating from the 20 largest domestic airports. These data which are processed by the Transportation System Center, are derived from the block operational-time information, 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.b, (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



achieved in commercial operation during a given month in the index year of 1972. The standards times and the month in which they were observed to occur, are shown for the airborne portion of the trip, by individual route segment (e.g. "7209" indicates that the best operational time was achieved in September 1972). Several route segments may be involved in a single cross-country trip, but each segment is reported separately. By comparing the segment time actually experienced during a given month with the nominal standard that has been established for this segment, an estimate of delay is defined. In attempting to establish trends, it is necessary only that the standard remain fixed.

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 comparisions in these profiles to select any given precentile shown on the ordinate axis and to compare the trend in delays shown on the abscissa. This comparision 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

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

A.

AIRPORT CODE	AIRPORT NAME
1. ATL	William B. Hartsfield Atlanta International
2. BOS	Boston - Logan
3. CLE	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/Love Field

B.

AIRLINE CODE	AIRLINE NAME b./
1. AL	Allegheny Airlines, Inc.
2. AA	American Airlines, Inc.
3. BN	Braniff 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. RW	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. TI	Texas International Airways, Inc.
19. TW	Trans World Airlines, Inc.
20. UA	United Air Lines, Inc.
21. WA	Western Air Lines, Inc.

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

TABLE I-2

NOMINAL AIRBORNE TIMES*
DEPARTING ATL

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
ATL	BOS	946	1:50	7201		
ATL	CLE	554	1:13	7201		
ATL	DAL	721	1:29	7203	2:36	7205
ATL	DCA	547	1:07	7212		
ATL	DFW	731	1:35	7404		
ATL	DTW	595	1:16	7203		
ATL	EWR	745	1:27	7212	2:10	7202
ATL	JFK	760	1:26	7207	2:46	7208
ATL	LAX	1946	3:36	7204		
ATL	LGA	761	1:31	7212	2:10	7202
ATL	MIA	595	1:15	7209	1:59	7204
ATL	MSP	906	1:59	7207		
ATL	MSY	425	0:57	7203	1:34	7204
ATL	ORD	606	1:15	7204	2:19	7205
ATL	PHL	666	1:17	7212		
ATL	PIT	529	1:16	7203		
ATL	SEA	2182	4:26	7207		
ATL	STL	484	1:06	7207		

*Airborne Times ("wheels off" to "wheels on")

NOMINAL AIRBORNE TIMES*
DEPARTING BOS

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
BOS	ATL	946	2:07	7208	3:35	7203
BOS	CLE	563	1:19	7205		
BOS	DAL	1551	3:23	7209		
BOS	DCA	399	0:59	7210	1:30	7204
BOS	DEN	1766	3:57	7208		
BOS	DFW	1561	3:35	7407		
BOS	DTW	632	1:29	7205		
BOS	EWR	201	0:40	7210	0:40	7212
BOS	JFK	187	0:29	7203	0:56	7202
BOS	LAX	2611	5:36	7206		
BOS	LGA	185	0:30	7211	0:38	7209
BOS	MIA	1258	2:32	7202		
BOS	MSP	1124	2:40	7205		
BOS	MSY	1367	2:59	7209		
BOS	ORD	867	1:48	7211		
BOS	PHL	280	0:42	7210	1:24	7204
BOS	PIT	496	1:15	7204	2:02	7211
BOS	SEA	2496	5:46	7208		
BOS	SFO	2704	5:48	7205		
BOS	STL	1046	2:24	7206		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING CLE

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
CLE	ATL	554	1:19	7202		
CLE	BOS	563	1:04	7204		
CLE	DAL	1015	2:08	7206		
CLE	DCA	310	0:47	7201		
CLE	DEN	1213	2:42	7208		
CLE	DFW	1021	2:15	7407		
CLE	DTW	95	0:18	7202	0:24	7209
CLE	EWR	404	0:57	7201		
CLE	JFK	425	1:00	7201		
CLE	LAX	2053	4:27	7208		
CLE	LGA	418	0:49	7207		
CLE	MIA	1080	2:20	7206		
CLE	MSP	622	1:30	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		

NOMINAL AIRBORNE TIMES
DEPARTING DCA

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
DCA	ATL	547	1:19	7208	2:07	7205
DCA	BOS	399	0:53	7204	1:10	7212
DCA	CLE	310	0:50	7208		
DCA	DTW	405	1:05	7205		
DCA	EWR	199	0:31	7212	0:36	7202
DCA	JFK	213	0:37	7202		
DCA	LGA	214	0:29	7211	0:38	7201
DCA	MIA	920	1:59	7210	3:05	7206
DCA	MSP	931	2:05	7205		
DCA	ORD	612	1:22	7207		
DCA	PHL	120	0:24	7203	0:27	7201
DCA	PIT	205	0:35	7204		
DCA	STL	719	1:39	7205	2:41	7203

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING DEN

ROUTE	SEGMENT	DISTANCE ST. MILE	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
DEN	BOS	1766	3:19	7201		
DEN	CLE	1213	2:15	7201		
DEN	DAL	654	1:21	7202		
DEN	DFW	645	1:23	7412		
DEN	DTW	1175	2:05	7212		
DEN	EWR	1617	2:58	7212		
DEN	JFK	1638	3:07	7201		
DEN	LAX	849	1:50	7201		
DEN	MSP	693	1:21	7201		
DEN	MSY	1067	2:15	7312		
DEN	ORD	900	1:41	7212		
DEN	PHL	1570	2:57	7201		
DEN	PIT	1307	2:41	7310		
DEN	SEA	1019	2:17	7208		
DEN	SFO	856	2:04	7206		
DEN	STL	781	1:54	7210		

NOMINAL AIRBORNE TIMES
DEPARTING DFW

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
DFW	STL	731	1:27	7402		
DFW	BOS	1561	3:05	7402		
DFW	CLE	1021	2:03	7402		
DFW	DEN	645	1:31	7410		
DFW	DTW	987	1:54	7411		
DFW	EWR	1372	2:37	7412		
DFW	JFK	1391	2:36	7402		
DFW	LAX	1235	2:27	7407		
DFW	ORD	1324	2:41	7412		
DFW	MIA	1121	2:11	7402		
DFW	MSP	852	1:53	7411		
DFW	MSY	447	0:51	7412		
DFW	ORD	802	1:34	7412		
DFW	PHL	1392	2:30	7412		
DFW	PIT	1067	2:06	7403		
DFW	SEA	1660	3:47	7410		
DFW	SFO	1465	3:09	7406		
DFW	STL	550	1:11	7402		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING DTW

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
DTW	ATL	595	1:19	7202		
DTW	BOS	632	1:17	7201		
DTW	CLE	95	0:23	7209	0:23	7205
DTW	DAL	962	2:12	7207		
DTW	DCA	405	0:59	7204		
DTW	DEN	1135	2:32	7204		
DTW	DFW	967	1:57	7407		
DTW	EWR	488	1:03	7212		
DTW	JFK	509	1:03	7201		
DTW	LAX	1979	4:09	7208		
DTW	LGA	501	1:04	7210		
DTW	MIA	1146	2:18	7209		
DTW	MSP	528	1:16	7205		
DTW	MSY	926	1:55	7208		
DTW	ORD	235	0:38	7205		
DTW	PHL	454	1:01	7203		
DTW	PIT	201	0:33	7206		
DTW	SFO	2079	4:28	7206		
DTW	STL	440	1:09	7206		

NOMINAL AIRBORNE TIMES
DEPARTING EWR

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
EWR	ATL	745	1:34	7201	2:34	7203
EWR	BOS	201	0:24	7210	0:36	7201
EWR	CLE	404	1:06	7211		
EWR	DAL	1365	2:49	7208		
EWR	DCA	199	0:34	7205	0:45	7208
EWR	DEN	1617	3:30	7205		
EWR	DFW	1372	3:07	7407		
EWR	DTW	488	1:15	7208		
EWR	JFK	21	0:08	7204		
EWR	LAX	2454	5:06	7208		
EWR	MIA	1086	2:16	7212	3:32	7312
EWR	MSP	1008	2:35	7203		
EWR	MSY	1167	2:34	7208		
EWR	ORD	719	1:32	7203		
EWR	PHL	80	0:21	7205	0:27	7210
EWR	PIT	319	0:50	7205	1:19	7205
EWR	SFO	2565	5:40	7203		
EWR	STL	872	1:56	7205		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING JFK

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
JFK	ATL	760	1:32	7210		
JFK	BOS	187	0:21	7208		
JFK	CLE	425	1:07	7205		
JFK	DAL	1383	2:57	7206		
JFK	DCA	213	0:40	7203		
JFK	DEN	1638	3:37	7206		
JFK	DFW	1391	2:58	7407		
JFK	DTW	509	1:19	7202		
JFK	EWR	21	0:11	7210		
JFK	LAX	2475	5:05	7202		
JFK	MIA	1090	2:14	7209	4:10	7201
JFK	MSP	1029	2:20	7205		
JFK	MSY	1182	2:29	7208		
JFK	ORD	740	1:45	7205		
JFK	PHL	94	0:16	7204		
JFK	PIT	340	0:42	7203	1:23	7308
JFK	SEA	2421	5:23	7205		
JFK	SFO	2586	4:49	7208		
JFK	STL	892	2:05	7206		

NOMINAL AIRBORNE TIMES
DEPARTING LAX

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
LAX	ATL	1946	3:37	7202		
LAX	BOS	2611	4:35	7209		
LAX	CLE	2053	3:54	7210		
LAX	DAL	1246	2:20	7212	3:35	7204
LAX	DEN	849	1:40	7208		
LAX	DFW	1235	2:23	7403		
LAX	DTW	1979	3:42	7210		
LAX	EWR	2454	4:10	7204		
LAX	JFK	2475	4:33	7212		
LAX	MIA	2342	4:18	7211		
LAX	MSP	1535	3:01	7210		
LAX	MSY	1670	3:06	7202		
LAX	ORD	1744	3:14	7205		
LAX	PHL	2402	4:27	7210		
LAX	PIT	2136	4:03	7212		
LAX	SEA	954	1:58	7208		
LAX	SFO	338	0:46	7204	1:16	7209
LAX	STL	1592	2:59	7212		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING LGA

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
LGA	BOS	185	0:26	7212	0:35	7201
LGA	CLE	418	1:03	7205		
LGA	DAL	1381	2:53	7208		
LGA	DCA	214	0:29	7208	0:40	7204
LGA	DFW	1388	3:02	7411		
LGA	DTW	501	1:14	7208		
LGA	JFK	11	0:11	7202		
LGA	MIA	1096	2:20	7206	4:10	7202
LGA	MSP	1020	2:18	7203		
LGA	MSY	1183	2:41	7208		
LGA	ORD	733	1:31	7210		
LGA	PHL	95	0:29	7209		
LGA	PIT	335	0:52	7210	1:19	7211
LGA	STL	888	2:01	7209		

NOMINAL AIRBORNE TIMES
DEPARTING MIA

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
MIA	ATL	595	1:18	7210		
MIA	BOS	1258	2:29	7211		
MIA	CLE	1080	2:20	7209		
MIA	DAL	1110	2:27	7209		
MIA	DCA	920	1:53	7206		
MIA	DFW	1121	2:34	7407		
MIA	DTW	1146	2:27	7209		
MIA	EWR	1086	2:15	7201	3:36	7207
MIA	JFK	1090	2:08	7202		
MIA	LAX	2342	4:35	7209		
MIA	LGA	1096	2:15	7201		
MIA	MSP	1501	3:20	7204		
MIA	MSY	675	1:28	7208		
MIA	ORD	1178	2:34	7204		
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		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING MSP

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
MSP	ATL	906	1:58	7204		
MSP	BOS	1124	2:14	7212		
MSP	CLE	622	1:18	7202		
MSP	DAL	853	1:48	7201		
MSP	DCA	931	1:52	7211		
MSP	DEN	693	1:32	7211		
MSP	DFW	852	1:50	7406		
MSP	DTW	528	1:13	7202		
MSP	EWR	1008	2:02	7212		
MSP	JFK	1029	2:02	7201		
MSP	LAX	1535	3:18	7206		
MSP	LGA	1020	2:01	7212		
MSP	MIA	1501	3:15	7202		
MSP	ORD	334	0:43	7204	1:20	7209
MSP	PHL	981	2:00	7212		
MSP	SEA	1399	3:04	7205		
MSP	SFO	1589	3:27	7205		
MSP	STL	448	1:03	7208	1:51	7304

NOMINAL AIRBORNE TIMES
DEPARTING MSY

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
MSY	ATL	425	0:54	7211	1:26	7204
MSY	BOS	1367	2:40	7211		
MSY	CLE	921	2:03	7512		
MSY	DAL	437	0:56	7212	1:36	7209
MSY	DEN	1067	2:22	7309		
MSY	DFW	447	1:00	7406		
MSY	DTW	926	2:00	7207		
MSY	EWR	1167	2:09	7211		
MSY	JFK	1182	2:15	7205		
MSY	LAX	1670	3:31	7208		
MSY	LGA	1183	2:13	7211		
MSY	MIA	675	1:23	7210		
MSY	ORD	837	1:46	7204		
MSY	PHL	1088	2:19	7211		
MSY	PIT	918	1:50	7202		
MSY	SFO	1911	3:57	7206		
MSY	STL	604	1:21	7205		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING ORD

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
ORD	ATL	606	1:07	7209		
ORD	BOS	867	1:36	7206		
ORD	CLE	316	0:38	7203		
ORD	DAL	799	1:35	7204		
ORD	DCA	612	1:13	7202		
ORD	DEN	900	1:57	7206		
ORD	DFW	802	1:38	7411		
ORD	DTW	235	0:31	7201		
ORD	EWR	719	1:24	7211		
ORD	JFK	740	1:27	7202		
ORD	LAX	1744	3:35	7212		
ORD	LGA	733	1:26	7212		
ORD	MIA	1198	2:23	7203		
ORD	MSP	334	0:51	7208	1:11	7208
ORD	MSY	837	1:47	7205		
ORD	PHL	678	1:21	7201		
ORD	PIT	412	0:54	7202	1:31	7211
ORD	SEA	1720	3:43	7208		
ORD	SFO	1846	3:53	7208		
ORD	STL	258	0:38	7205	1.05	7212

NOMINAL AIRBORNE TIMES
DEPARTING PHL

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
PHL	ATL	666	1:14	7207		
PHL	BOS	280	0:36	7210	1:38	7211
PHL	CLE	363	0:57	7205		
PHL	DAL	1295	2:46	7208		
PHL	DCA	120	0:25	7208	0:37	7203
PHL	DEN	1570	3:33	7207		
PHL	DFW	1302	2:43	7405		
PHL	DTW	454	1:10	7205		
PHL	EWR	81	0:18	7210	0:26	7212
PHL	JFK	93	0:21	7206		
PHL	LAX	2402	5:06	7208		
PHL	LGA	95	0:25	7202		
PHL	MIA	1014	2:05	7210		
PHL	MSP	980	2:18	7205		
PHL	MSY	1088	2:25	7208		
PHL	ORD	678	1:36	7207		
PHL	PIT	268	0:43	7205	1:05	7208
PHL	SFO	2521	5:31	7208		
PHL	STL	814	1:55	7207		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING PIT

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
PIT	ATL	526	1:09	7207		
PIT	BOS	496	1:09	7201	1:51	7307
PIT	CLE	105	0:15	7212	0:32	7204
PIT	DAL	1061	2:09	7201		
PIT	DCA	205	0:33	7202		
PIT	DEN	1302	2:54	7308		
PIT	DFW	1067	2:18	7408		
PIT	DTW	201	0:35	7206		
PIT	EWR	319	0:50	7201	1:17	7209
PIT	JFK	340	0:46	7204	1:24	7305
PIT	LAX	2136	4:36	7207		
PIT	LGA	335	0:46	7211	1:09	7211
PIT	MIA	1013	2:00	7212		
PIT	MSY	918	1:59	7202		
PIT	ORD	412	1:04	7208	1:43	7209
PIT	PHL	268	0:33	7210	1:00	7211
PIT	SFO	2254	4:53	7205		
PIT	STL	553	1:22	7206	1:59	7303

NOMINAL AIRBORNE TIMES
DEPARTING SEA

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
SEA	BOS	2496	4:57	7209		
SEA	DAL	1669	3:18	7204		
SEA	DEN	1019	2:02	7203		
SEA	DFW	1660	3:18	7411		
SEA	JFK	2421	4:31	7201		
SEA	LAX	954	1:54	7204		
SEA	MSP	1399	2:42	7204		
SEA	ORD	1720	3:14	7204		
SEA	SFO	678	1:23	7203		
SEA	STL	1709	3:11	7211		

TABLE I-2 (Continued)

NOMINAL AIRBORNE TIMES
DEPARTING SFO

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
SFO	ATL	2139	4:00	7211		
SFO	BOS	2704	4:58	7201		
SFO	CLE	2162	4:11	7209		
SFO	DAL	1476	2:49	7209		
SFO	DEN	956	1:49	7202		
SFO	DFW	1465	2:43	7409		
SFO	DTW	2079	3:51	7201		
SFO	EWR	2565	4:45	7209		
SFO	JFK	2586	4:30	7204		
SFO	LAX	338	0:46	7212	1:13	7201
SFO	MIA	2585	4:56	7204		
SFO	MSP	1589	2:56	7201		
SFO	MSY	1911	3:39	7210		
SFO	ORD	1846	3:25	7204		
SFO	PHL	2521	4:42	7201		
SFO	PIT	2253	4:22	7203		
SFO	SEA	676	1:24	7206		
SFO	STL	1736	3:15	7210		

NOMINAL AIRBORNE TIMES
DEPARTING STL

ROUTE	SEGMENT	DISTANCE ST. MILES	NOMINAL JET TIME	DATE YR/MO	NOMINAL PROP TIME	DATE YR/MO
STL	ATL	484	1:04	7204	1:34	7302
STL	BOS	1046	1:58	7201		
STL	CLE	487	0:56	7201		
STL	DAL	546	1:14	7212		
STL	DCA	719	1:28	7208	2:12	7203
STL	DEN	781	1:48	7208		
STL	DFW	550	1:15	7406		
STL	DTW	440	0:55	7202		
STL	EWR	872	1:45	7201		
STL	JFK	892	1:49	7201		
STL	LAX	1592	3:20	7212		
STL	LGA	888	1:50	7204		
STL	MIA	1068	2:13	7210		
STL	MSP	448	1:05	7207		
STL	MSY	604	1:24	7206		
STL	ORD	258	0:38	7211	1:08	7201
STL	PHL	814	1:37	7201		
STL	PIT	553	1:08	7201	2:03	7303
STL	SEA	1709	3:40	7208		
STL	SFO	1736	3:46	7208		

TABLE I-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
FWR	9	4
JFK	15	7
LAX	9	3
LGA	8	4
MIA	7	2
MSP	5	2
MSY	4	2
ORD	9	5
PHL	7	2
PIT	2	2
SEA	6	2
SFO	8	3
STL	5	2

ALL TIMES ARE IN MINUTES

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

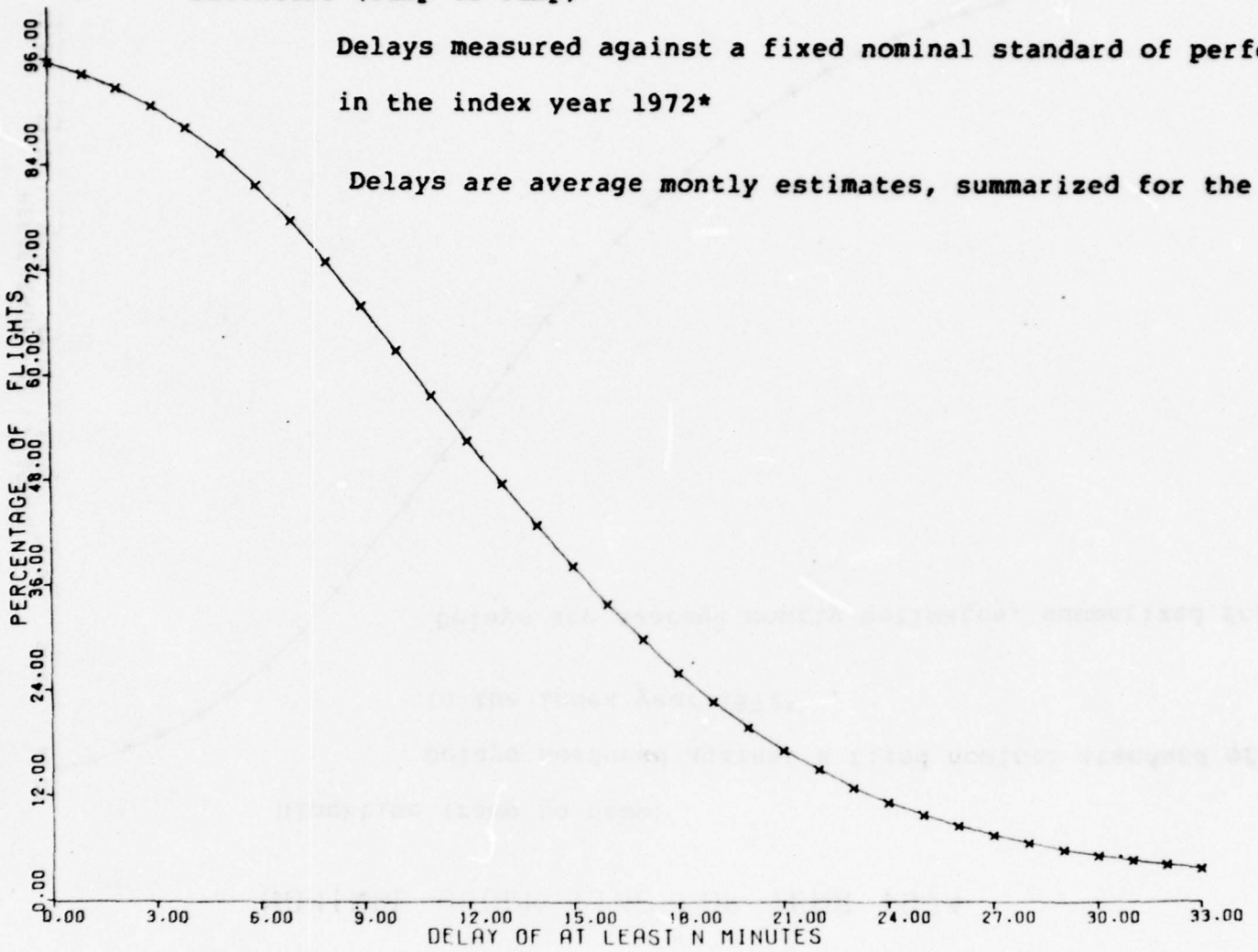
FIGURE 1.3

NOMINAL BLOCK TIME FOR YEAR 1973

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)

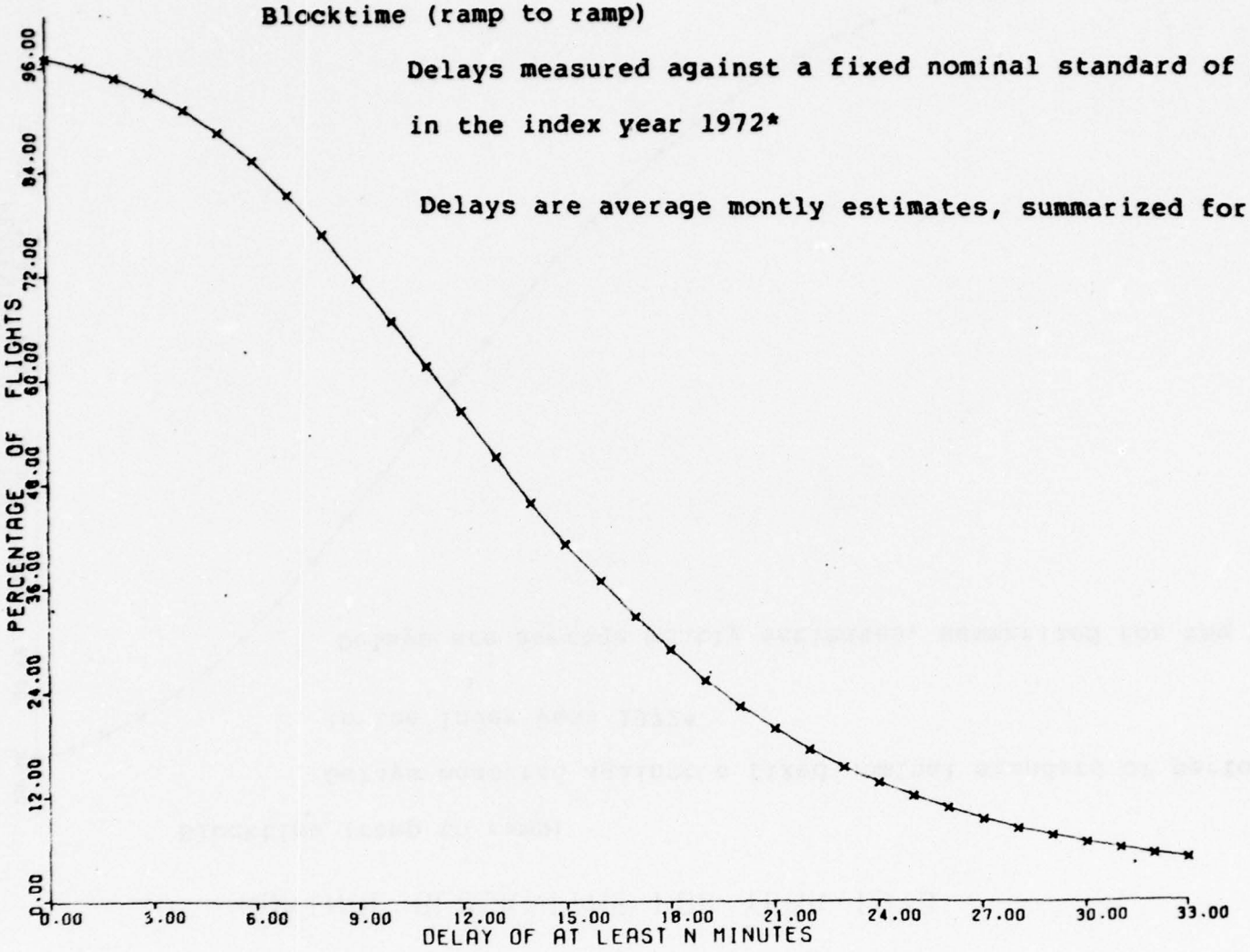
FIGURE 1.4

NOMINAL BLOCK TIME FOR YEAR 1974

Blocktime (ramp to ramp)

Delays measured against a fixed nominal standard of performanc 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)

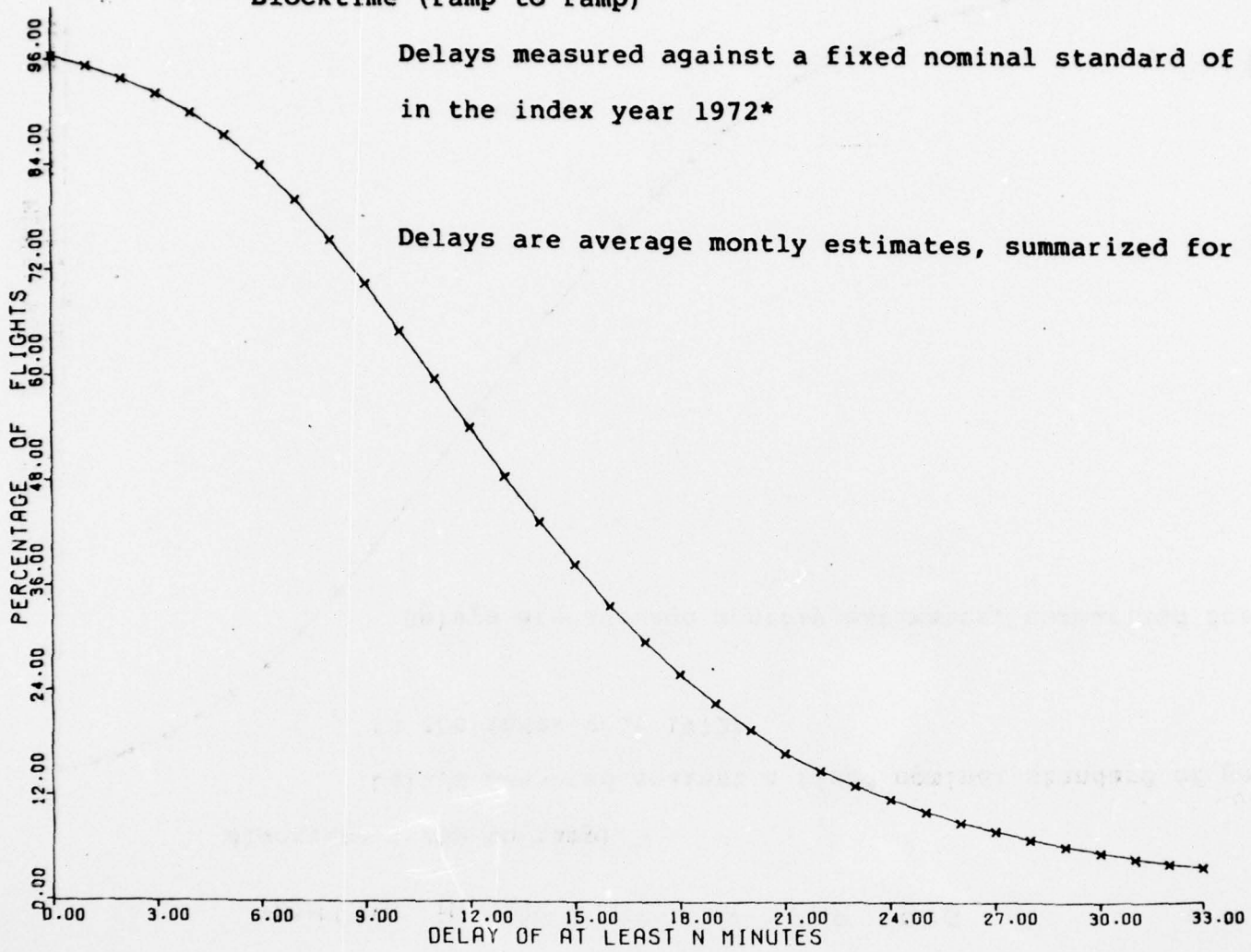
FIGURE 1.5

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)

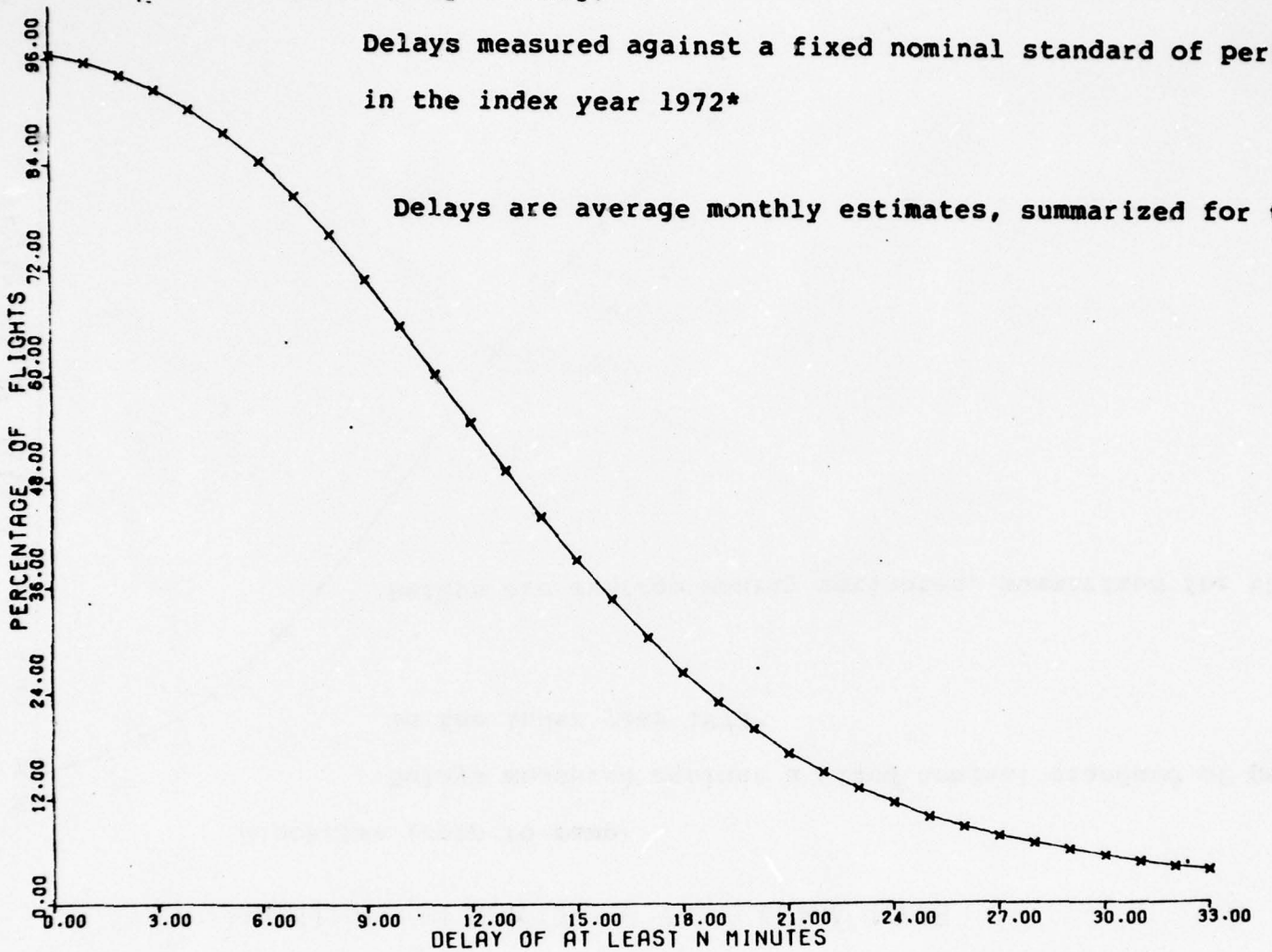
FIGURE 1.6

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)

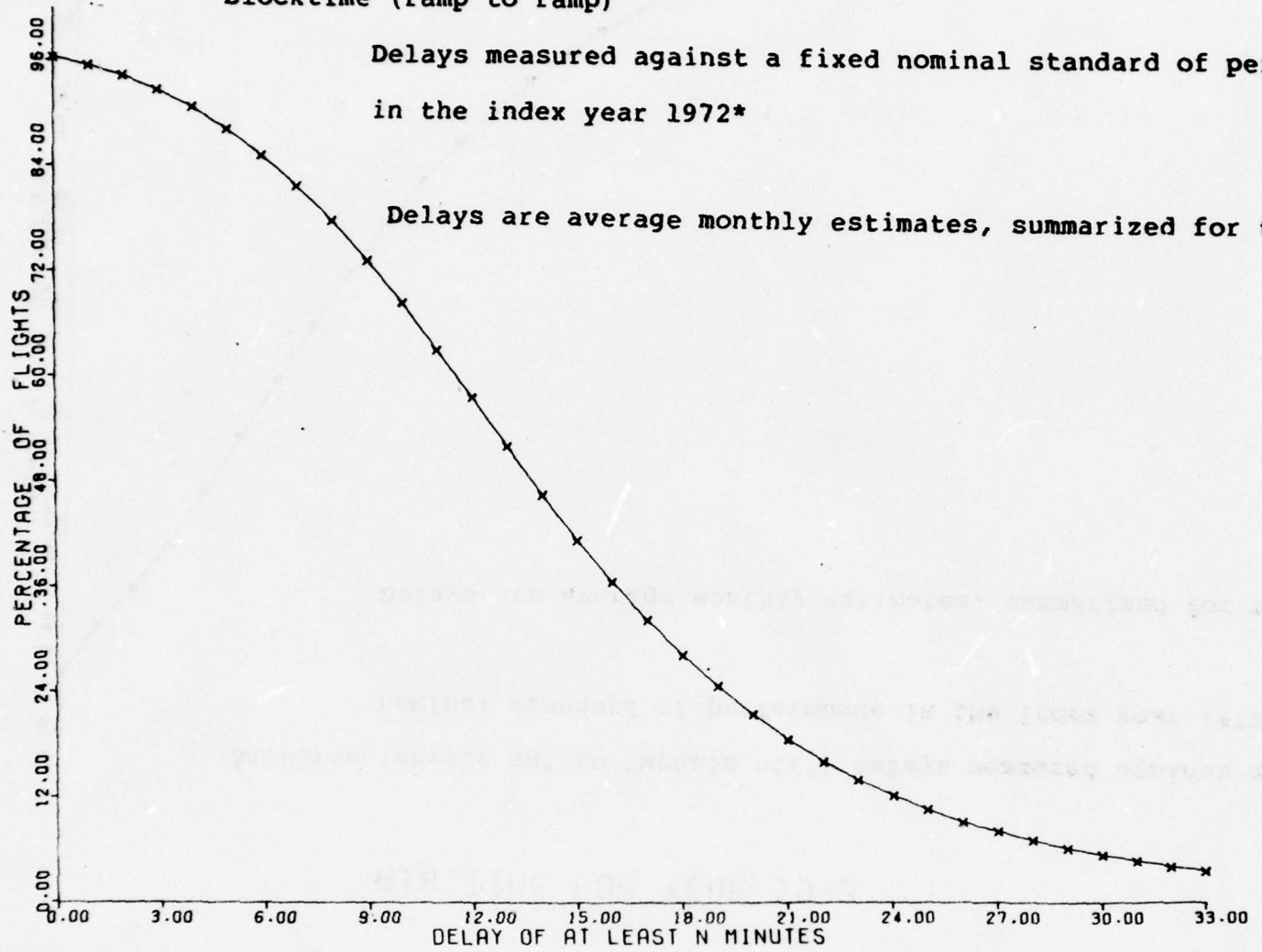
FIGURE 1.7

NOMINAL BLOCK TIME FOR YEAR 1977

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.

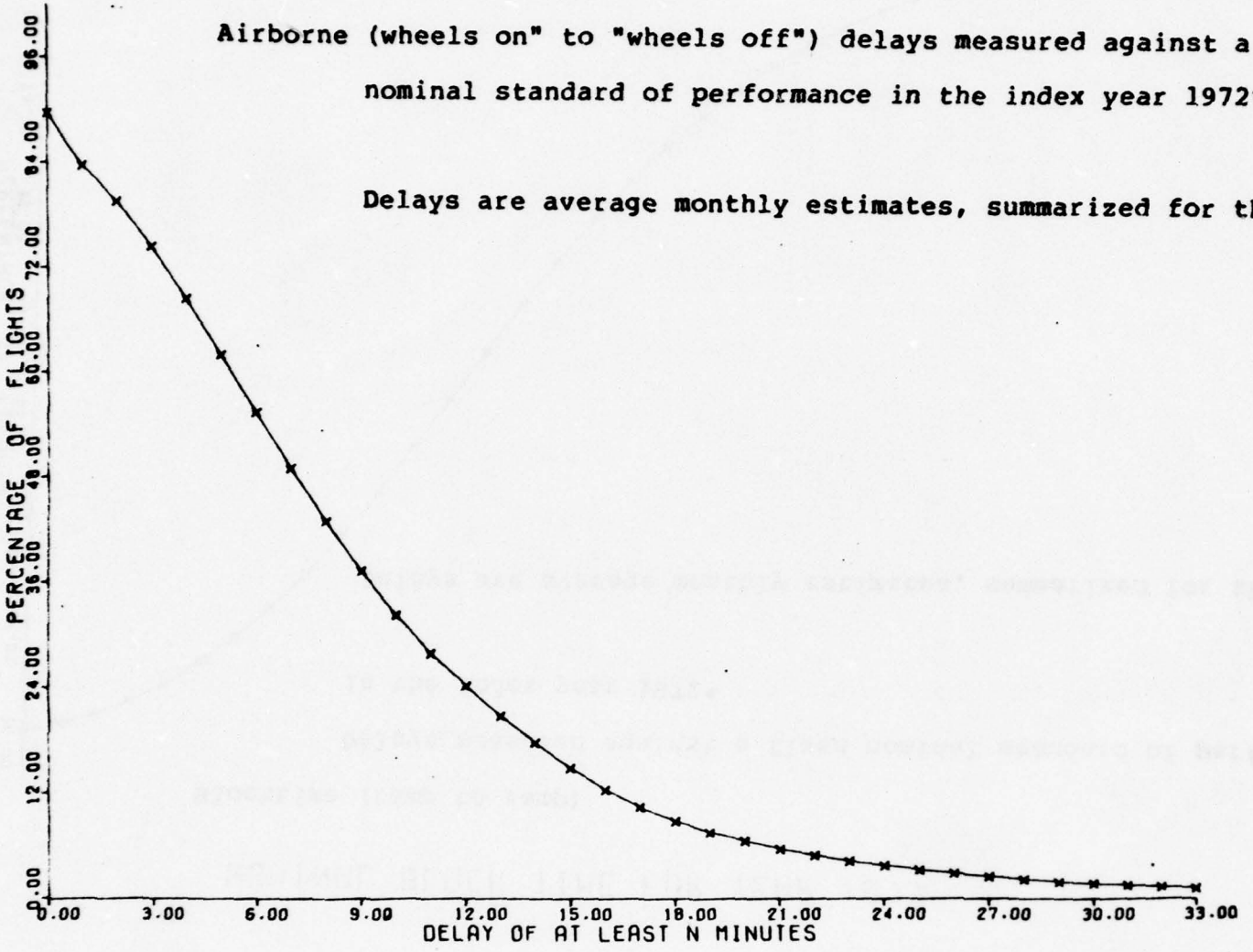
(reference FAA-EM-77-12; p.3)

FIGURE 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.



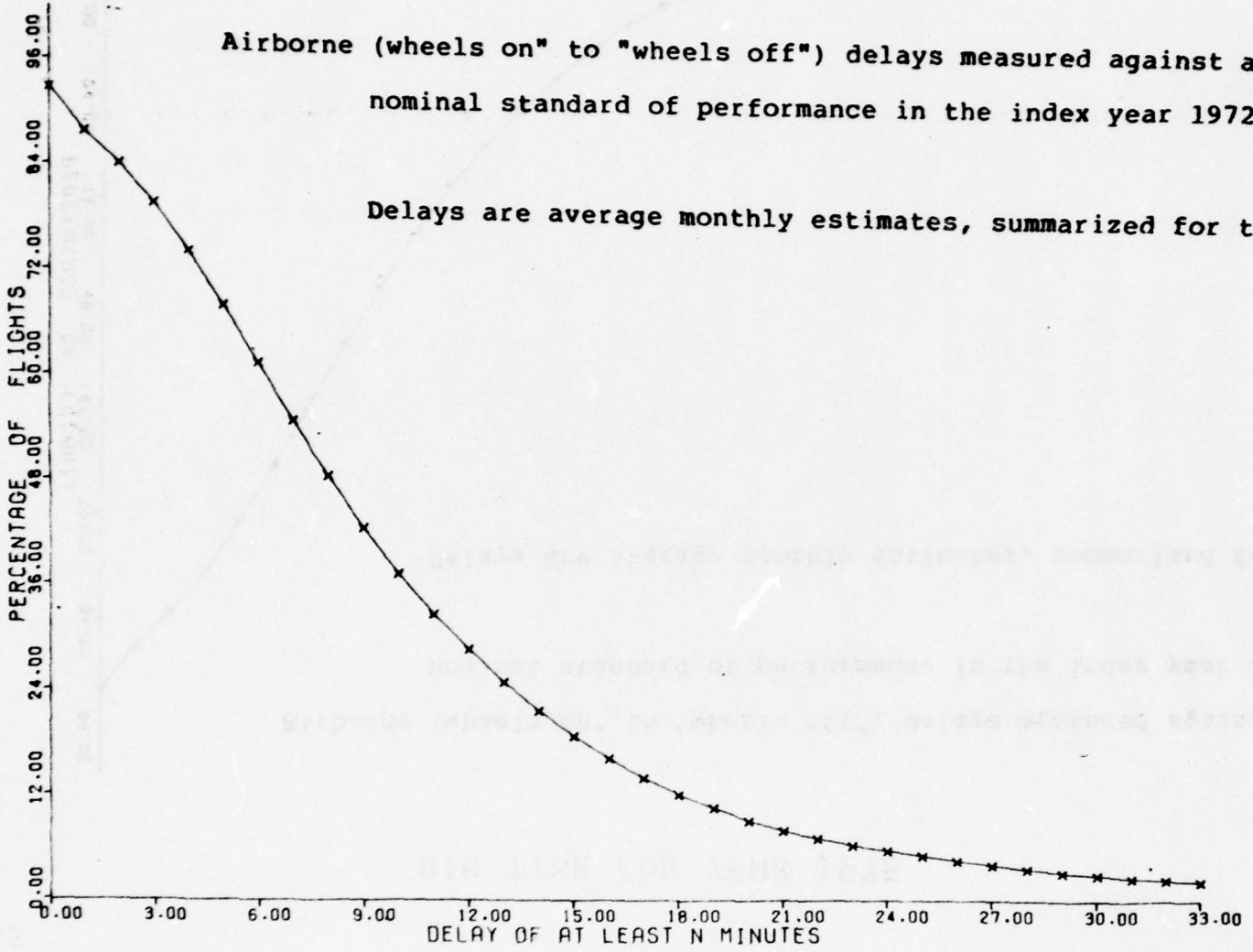
*see attached Table I-2.

FIGURE 2.4

AIR TIME FOR YEAR 1974

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

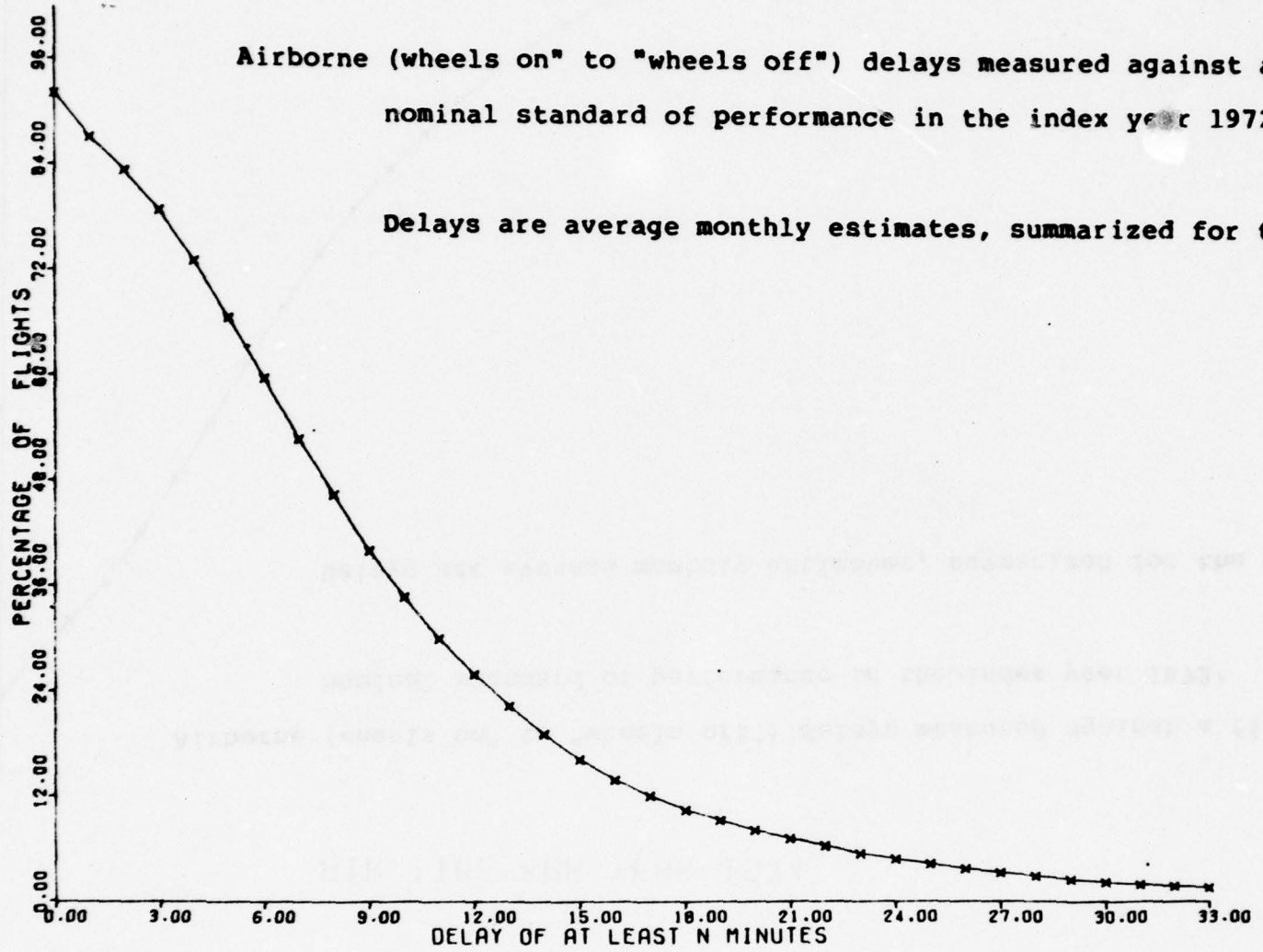
Delays are average monthly estimates, summarized for the year.



*see attached Table I-2.

FIGURE 2.5

AIR TIME FOR YEAR 1975



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.

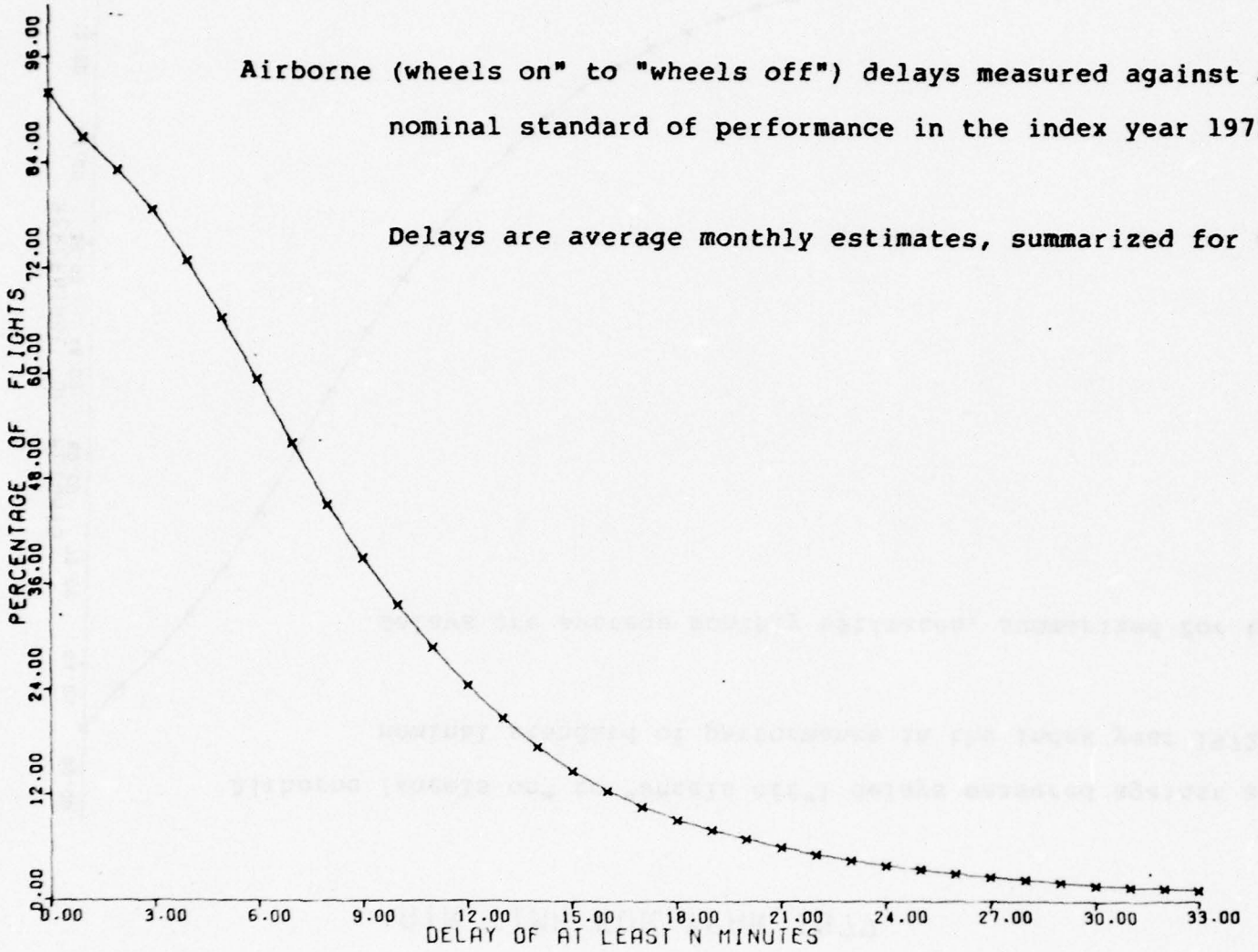
*see attached Table I-2.

FIGURE 2.6

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.



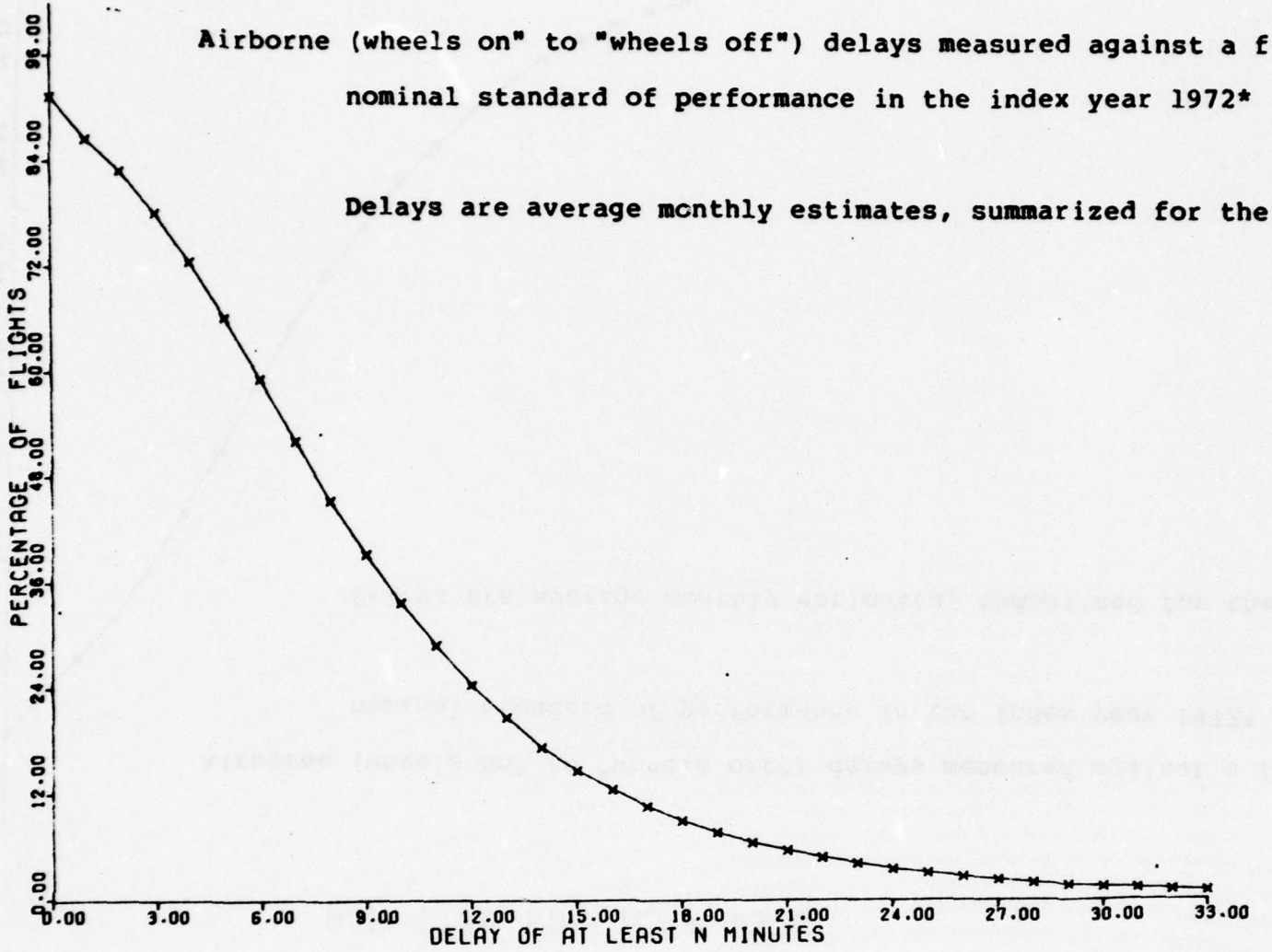
*see attached Table I-2.

FIGURE 2.7

AIR TIME FOR YEAR 1977

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.

TABLE 2

COMPARISION 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

	A. x Nominal Block (minutes)	B. x Nominal Airborne (minutes)	C. x OAG Std. (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

REF: FIGS. 1 THRU 3

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.

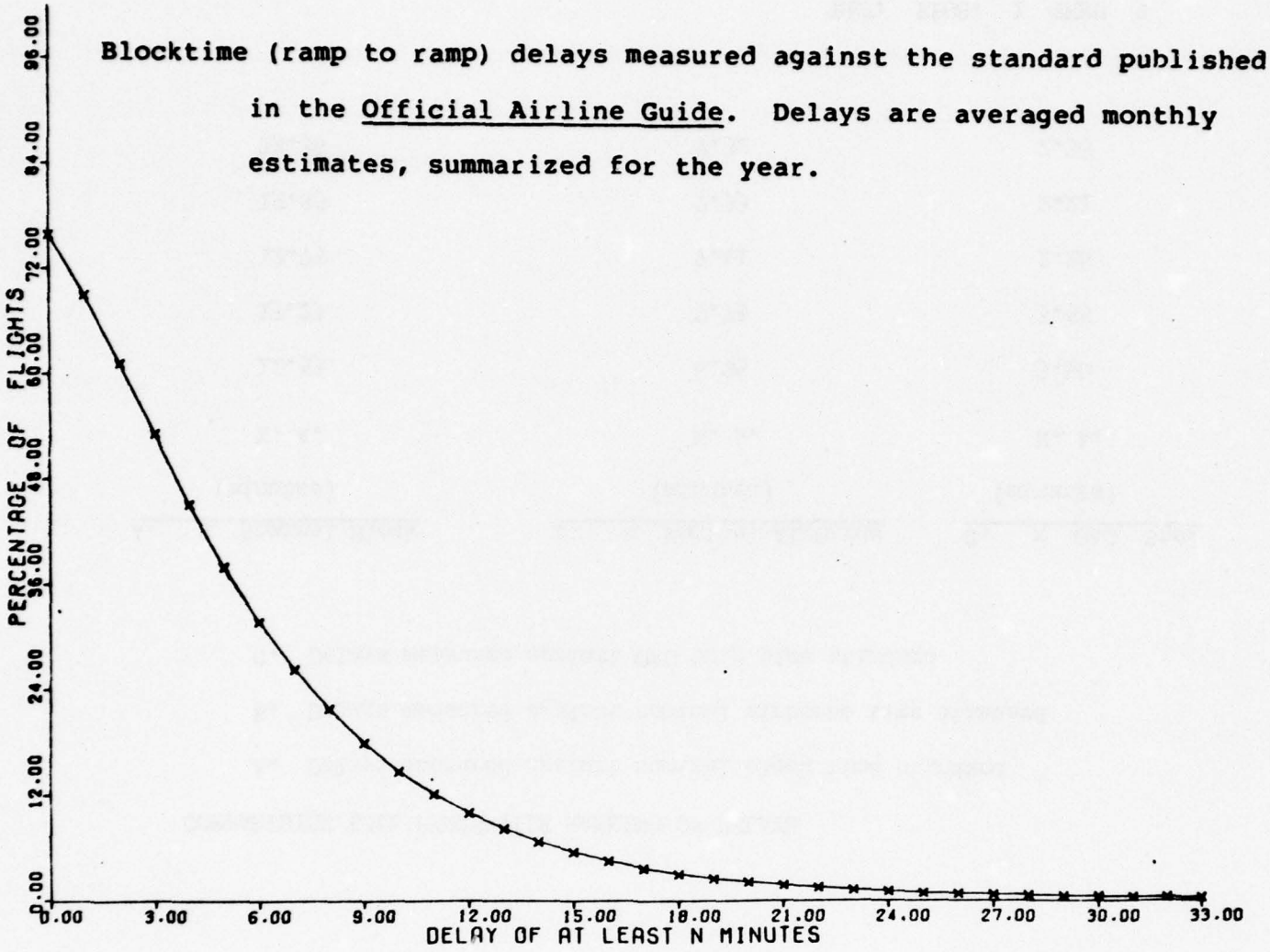


FIGURE 3.4

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.

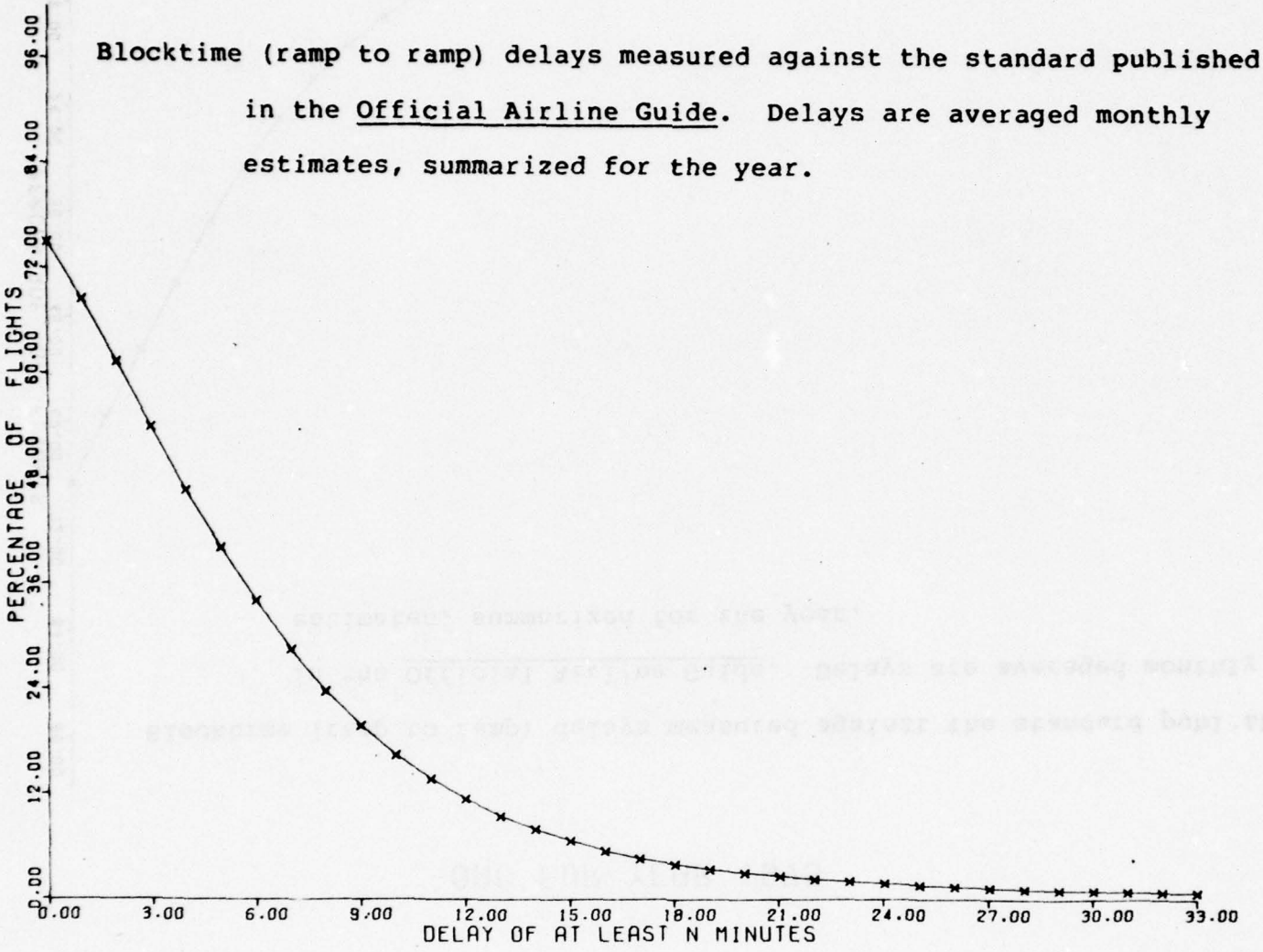


FIGURE 3.5

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.

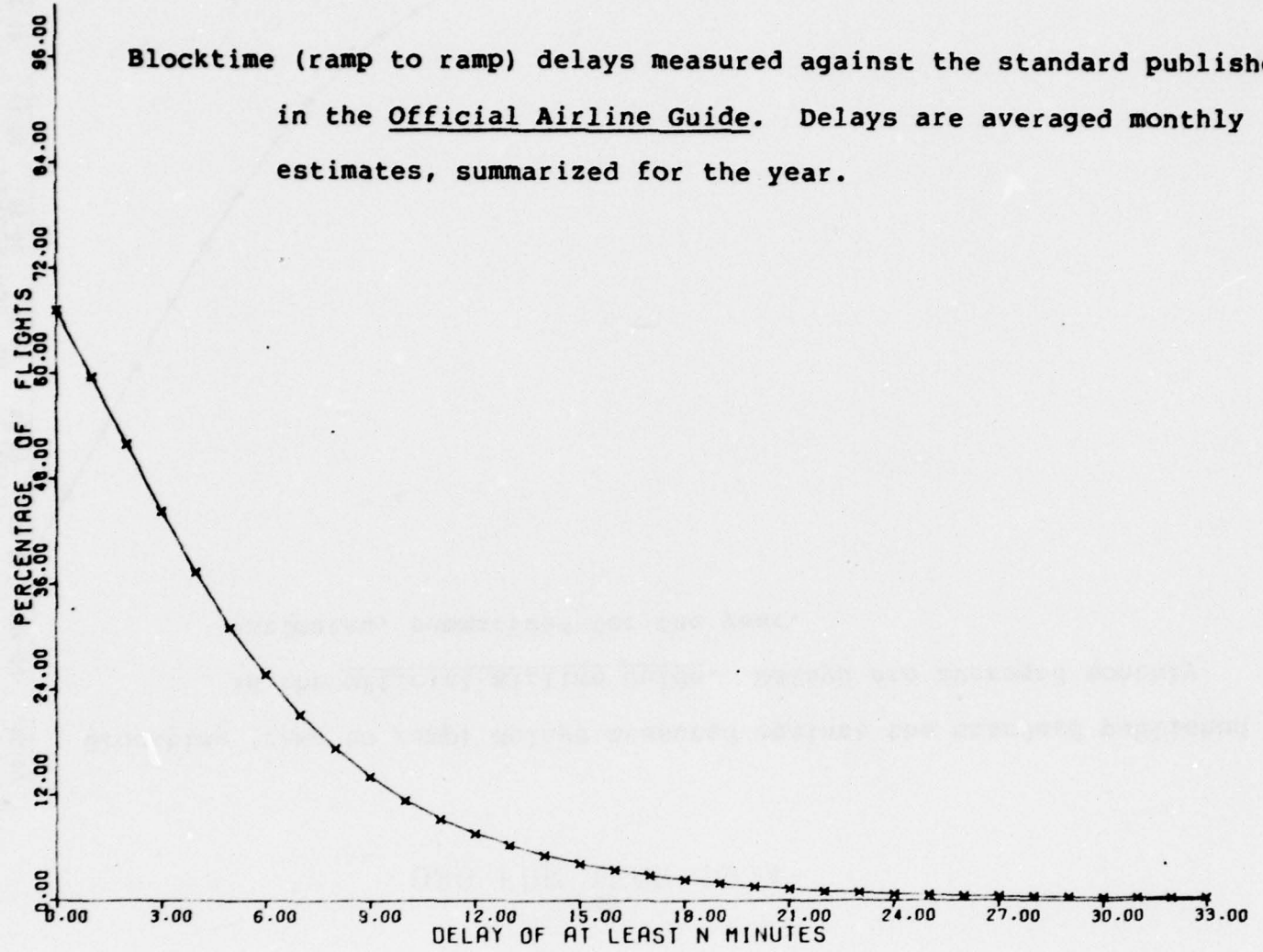


FIGURE 3.6

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.

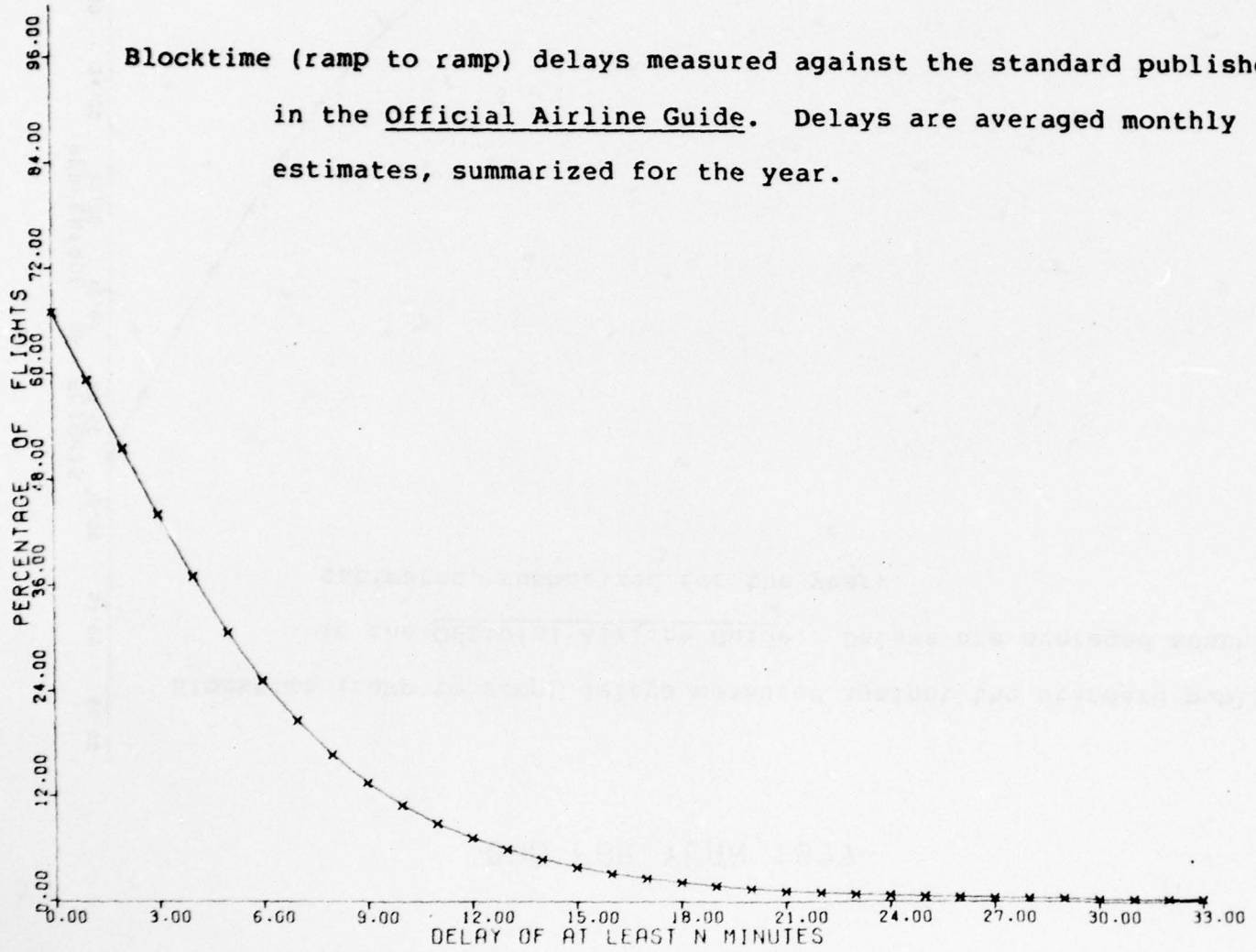


FIGURE 3.7

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.

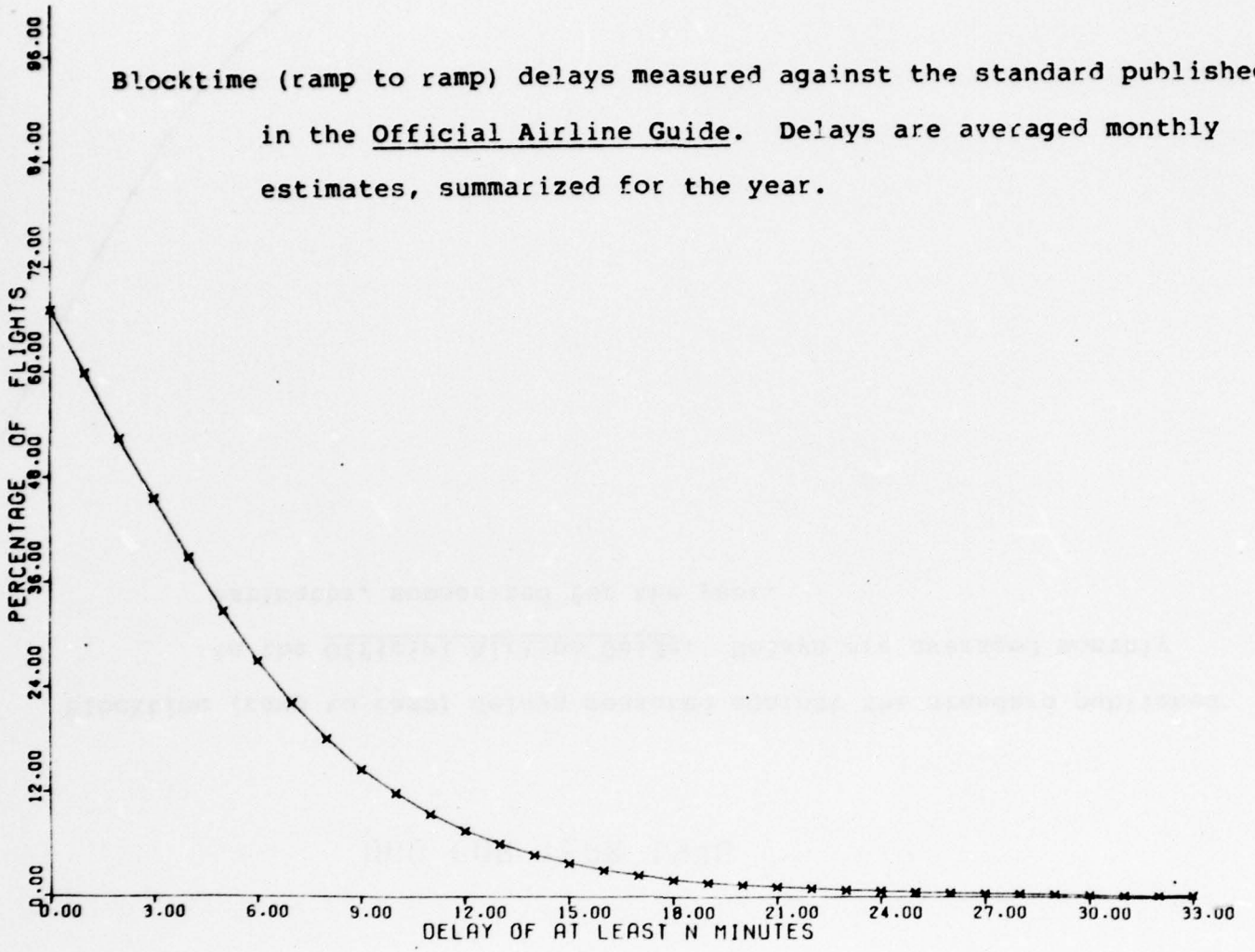


FIGURE 4.1

AVERAGE MONTHLY AIRBORNE AND GROUND DELAYS

COMPOSITE FOR TOP 50 ROUTE SEGMENTS

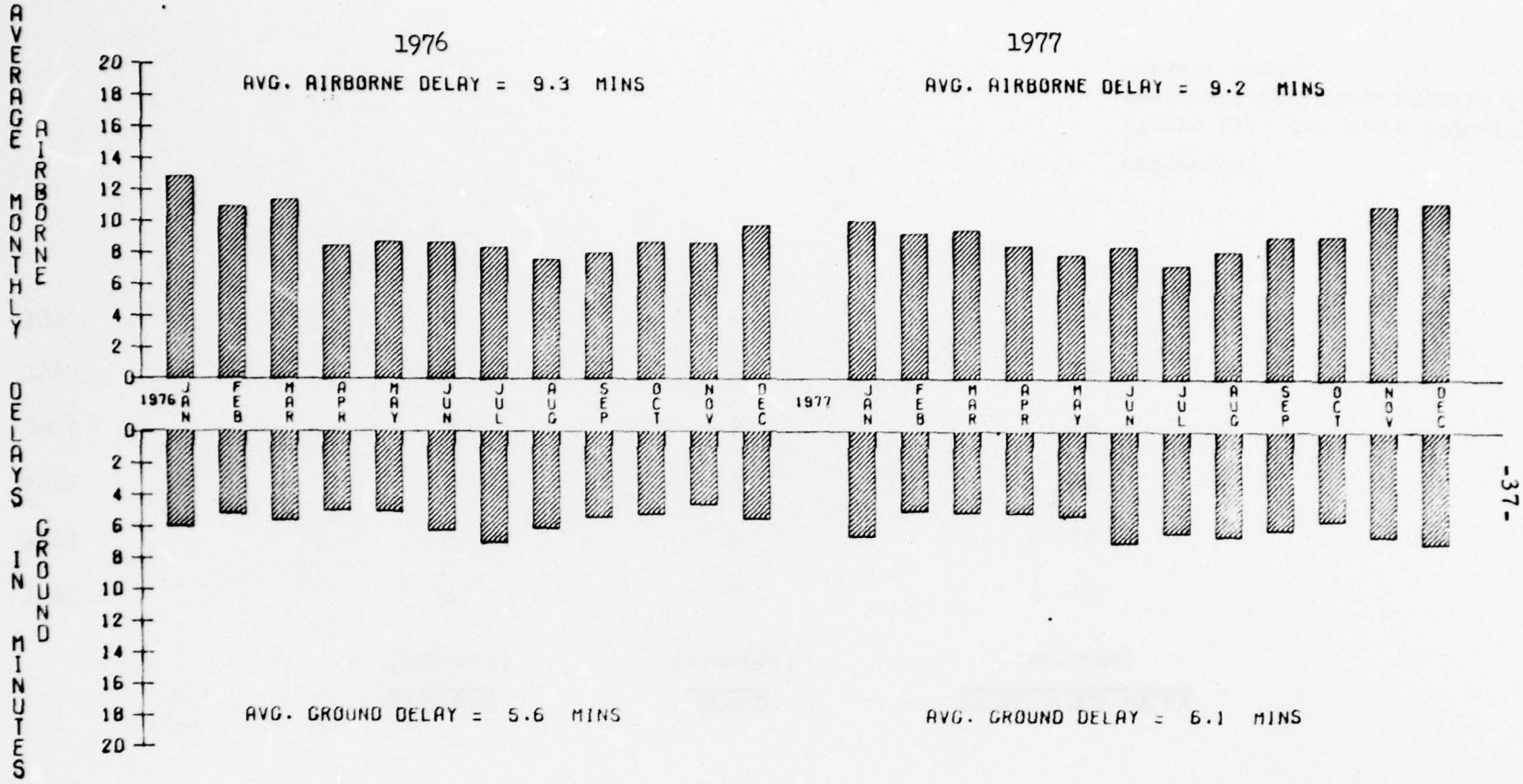


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TABLE 3

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

	AIRBORNE (minutes)	GROUND (minutes)	TOTAL BLOCK DELAY (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

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

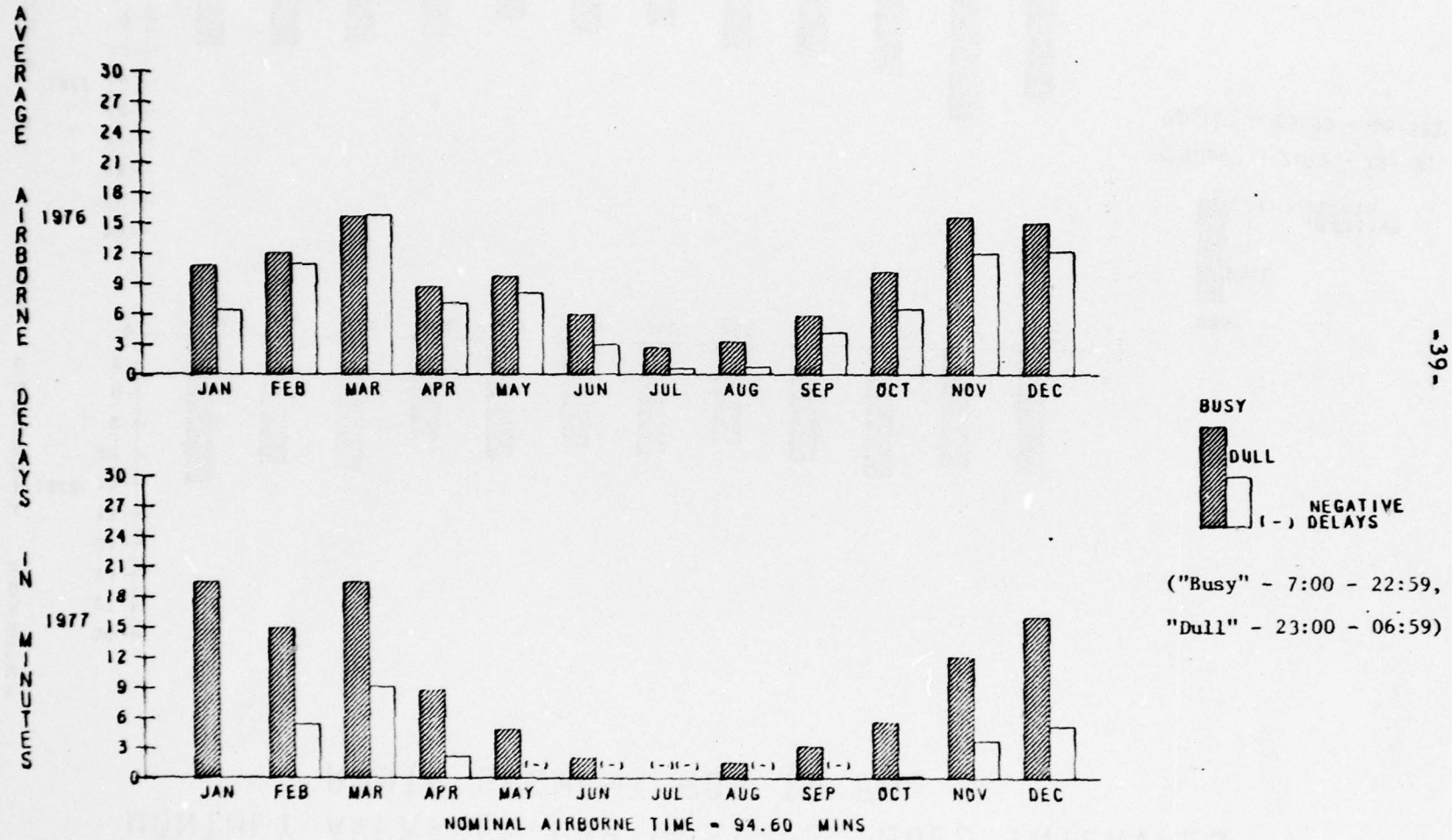

FIGURE 4.3

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

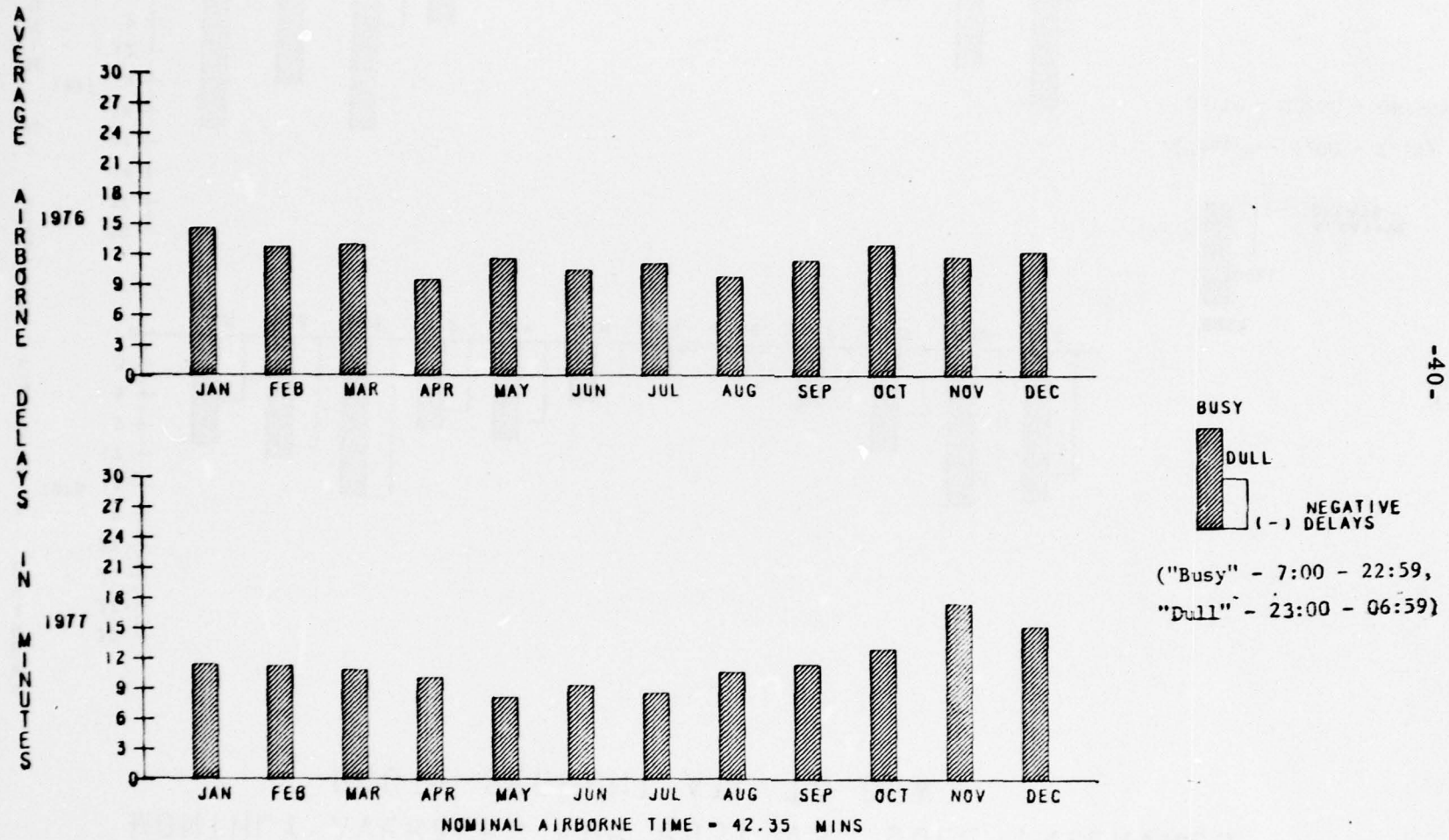

FIGURE 4.4 AIRBORNE DELAYS BY MAJOR ROUTE SEGMENT
MONTHLY AVERAGES FOR BUSY VS. DULL INTERVALS
ROUTE SEGMENT CLE TO DTW

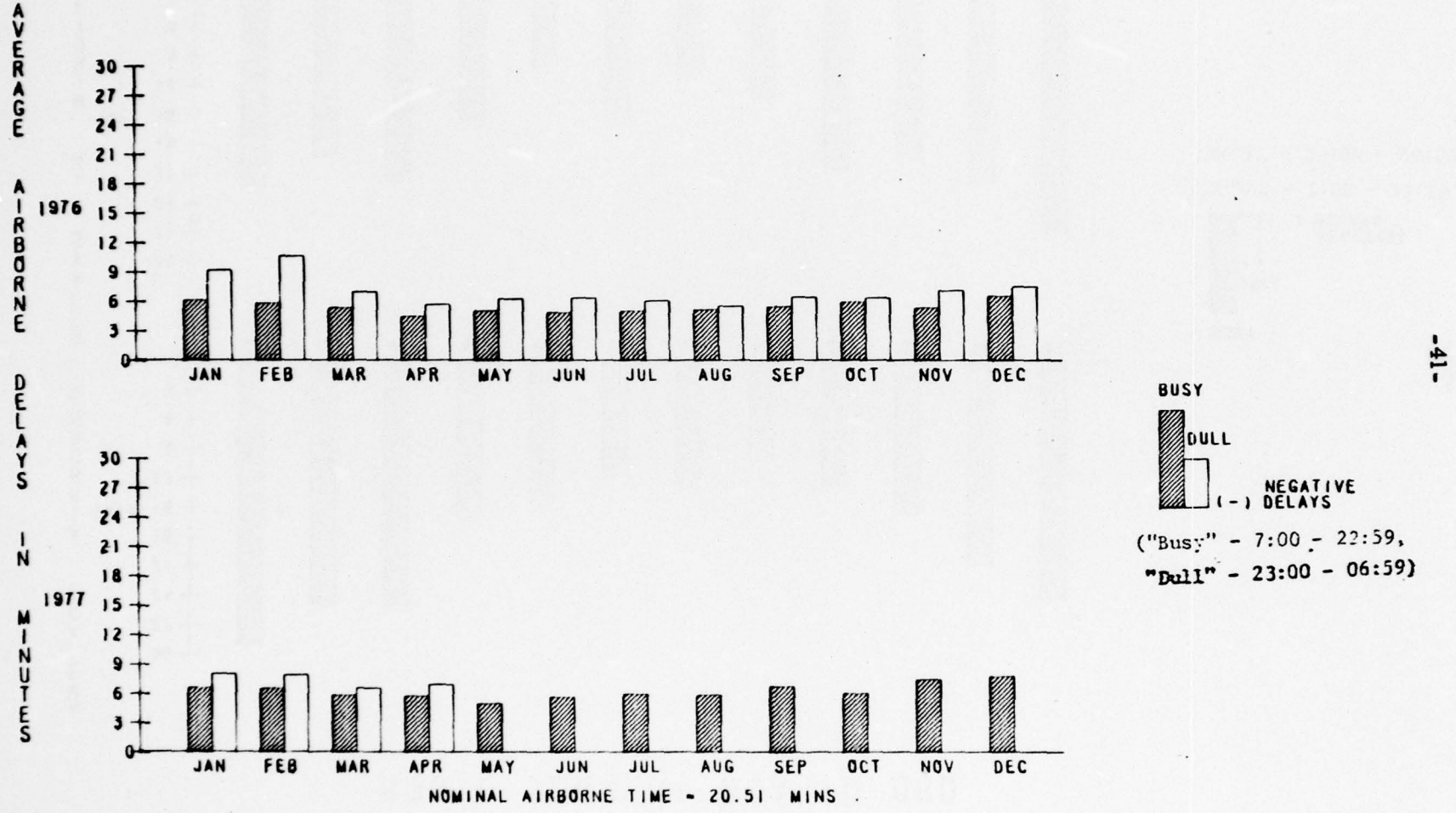

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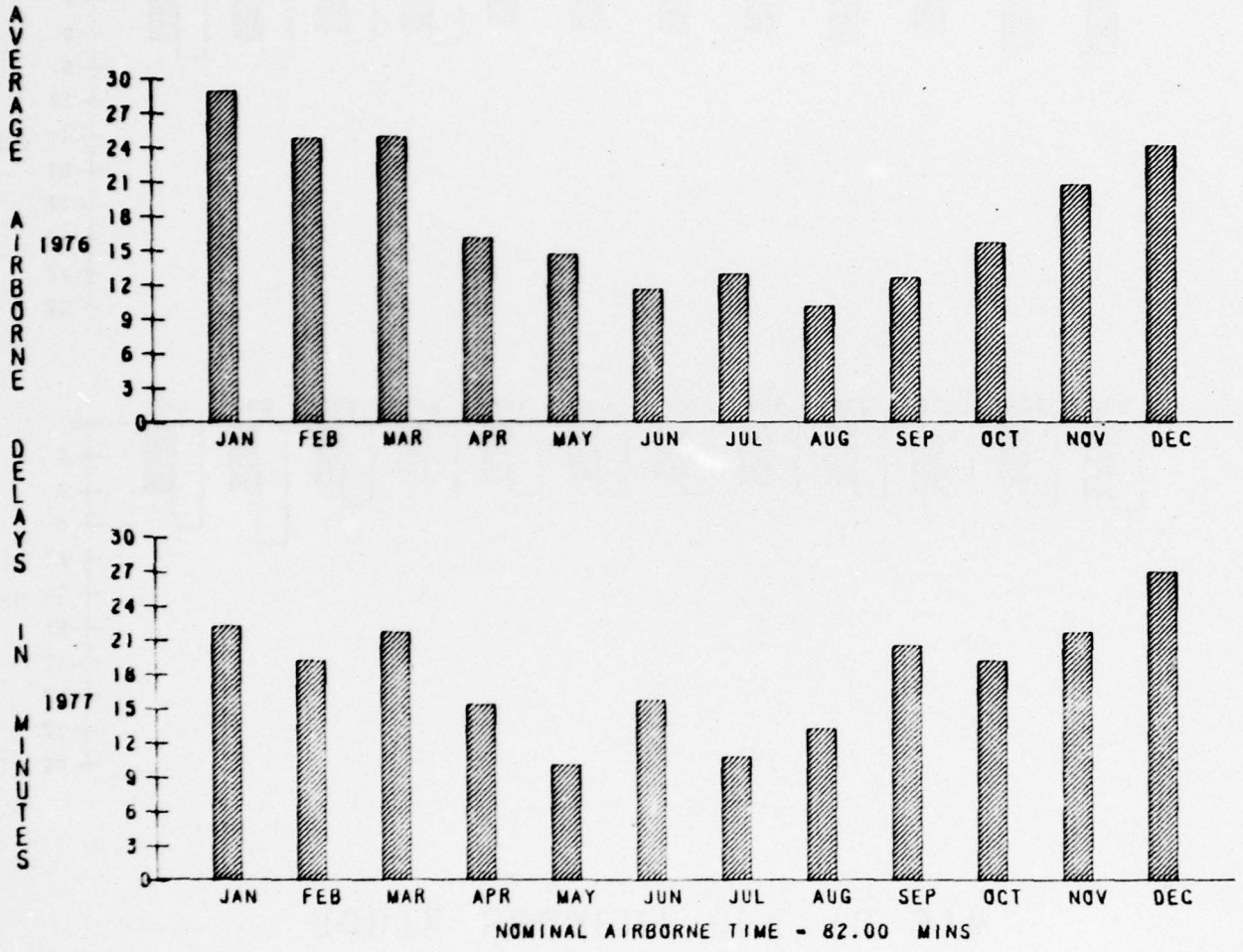
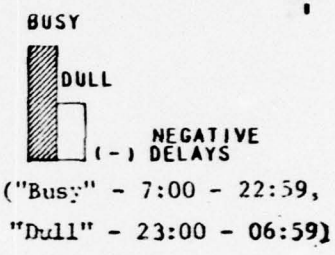
FIGURE 4.5

AIRBØRNE DELAYS BY MAJØR RØUTE SEGMENT MØNTHLY AVERAGES FØR BUSY VS. DULL INTERVALS RØUTE SEGMENT DCA TØ ØRD





("Busy" - 7:00 - 22:59,
"Dull" - 23:00 - 06:59)

FIGURE 4.6

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

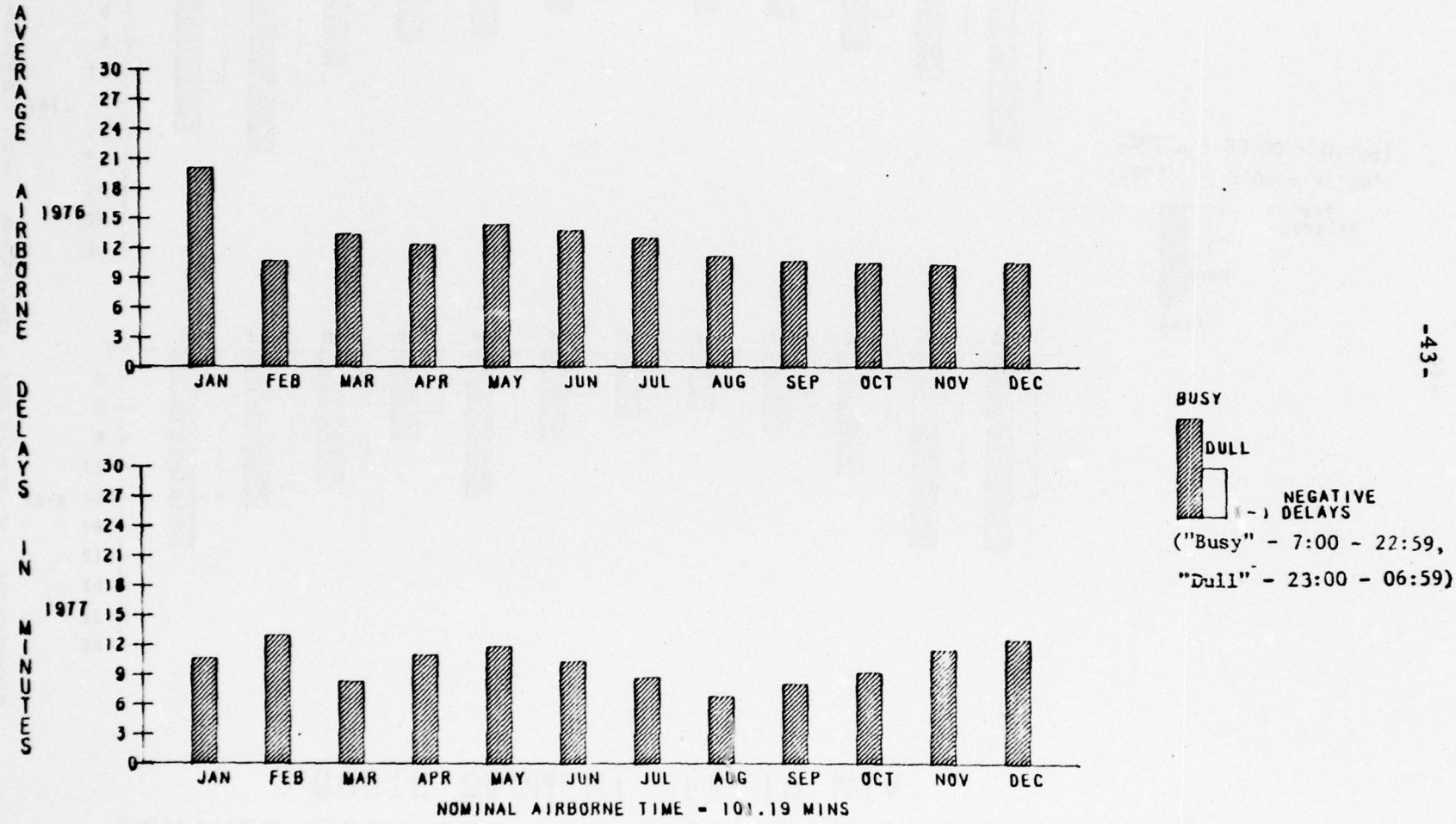


FIGURE 4.7

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

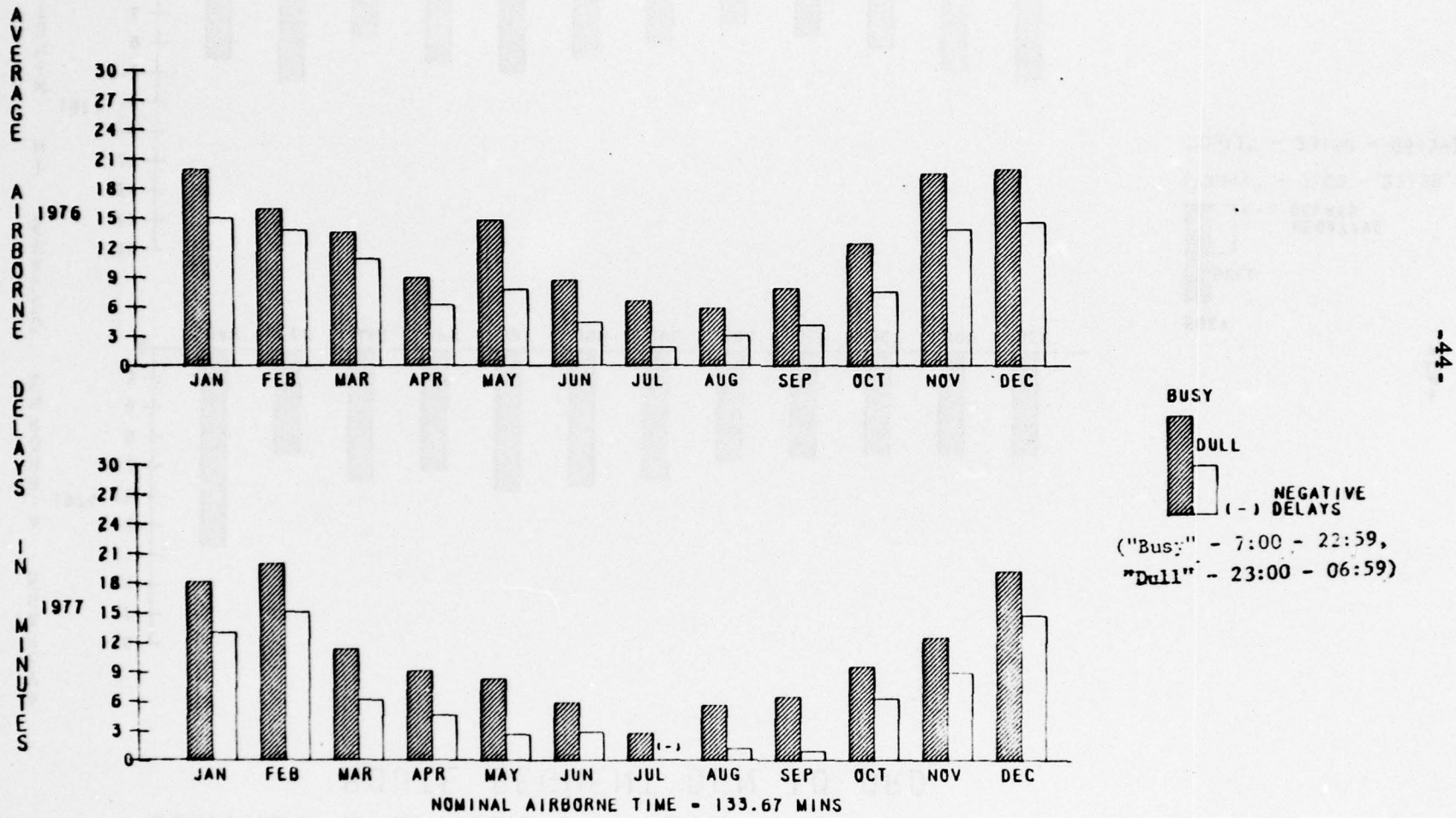


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FIGURE 4.8

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

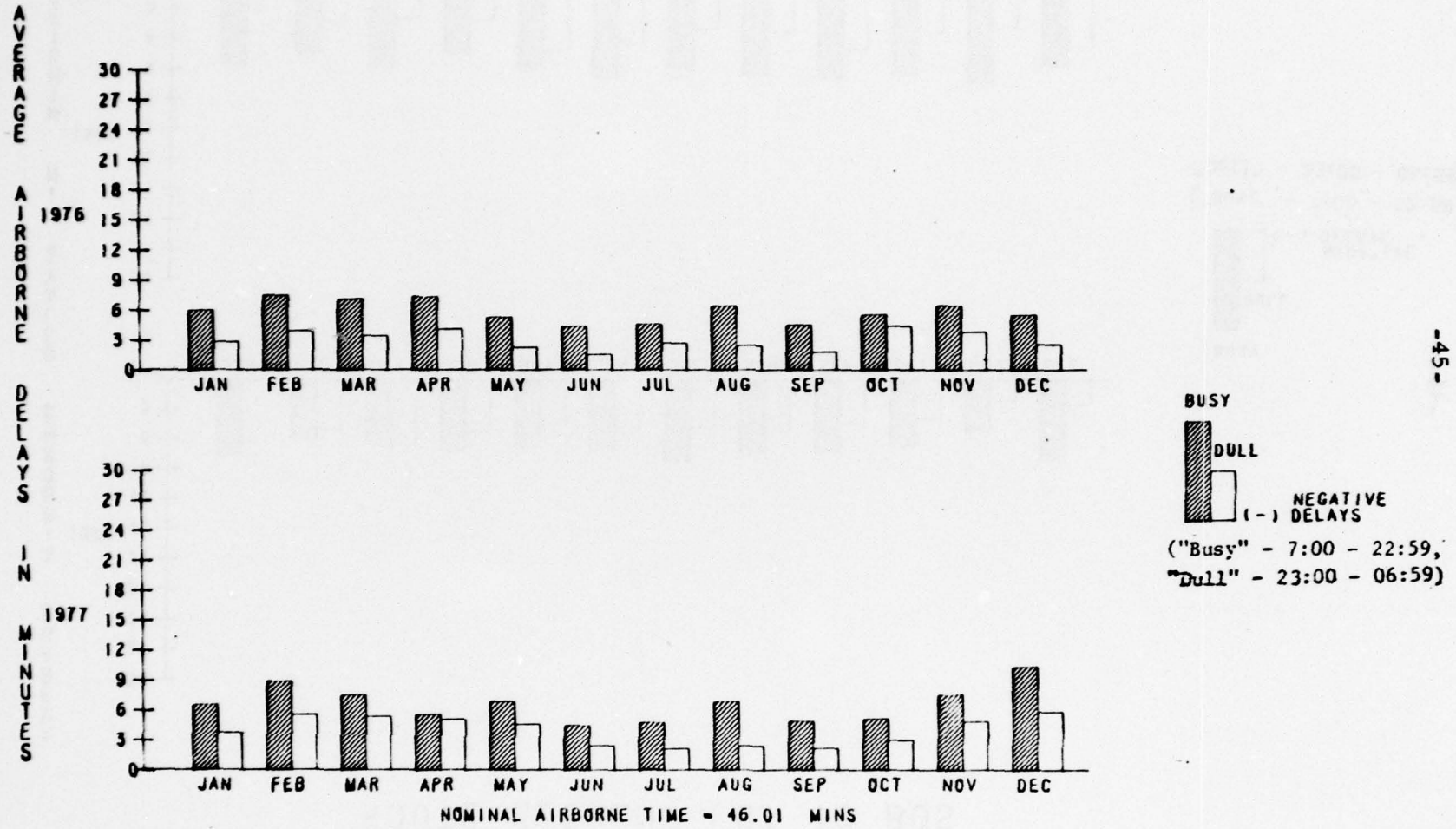

FIGURE 2.9

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

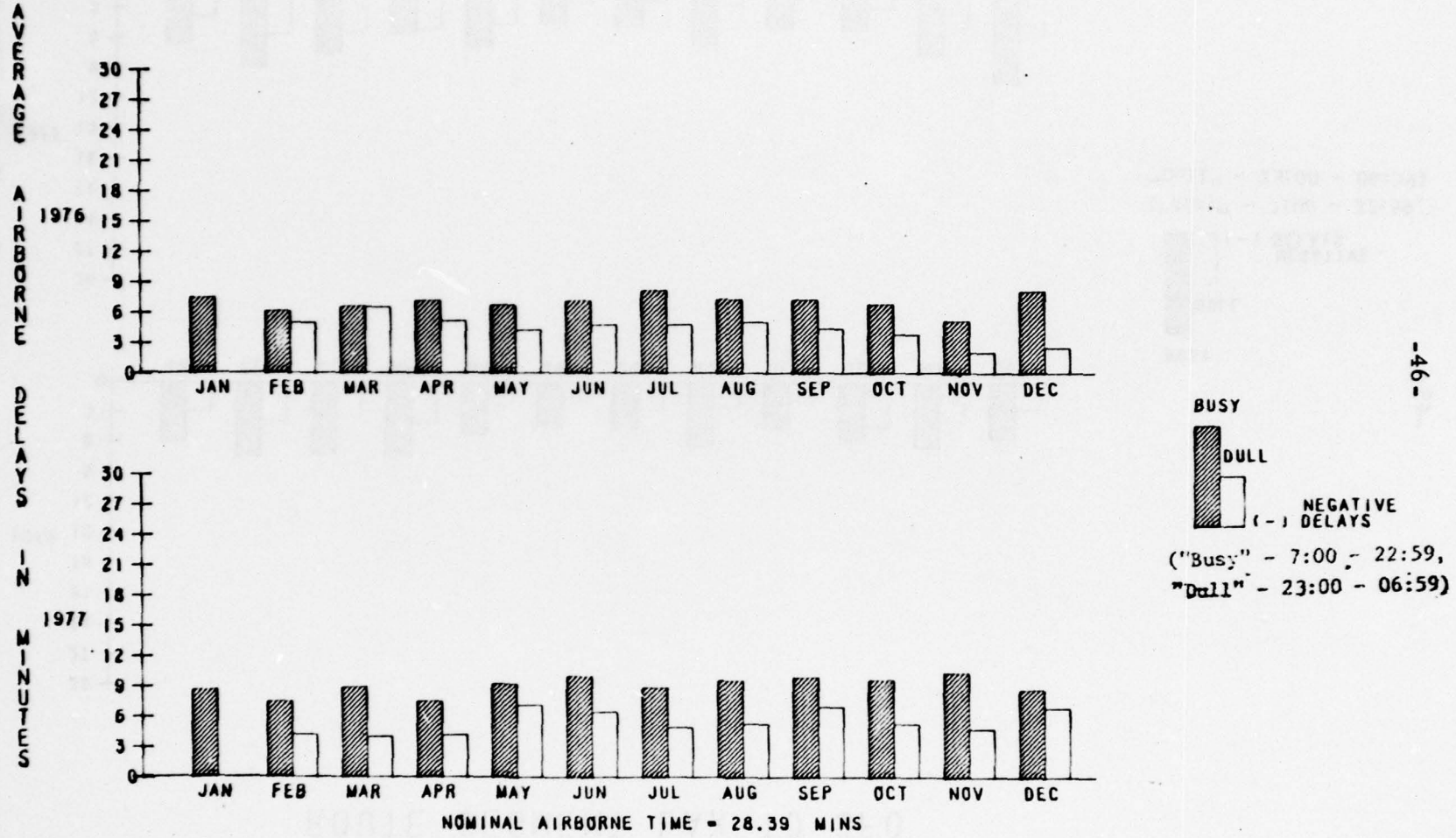

FIGURE 2.10

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

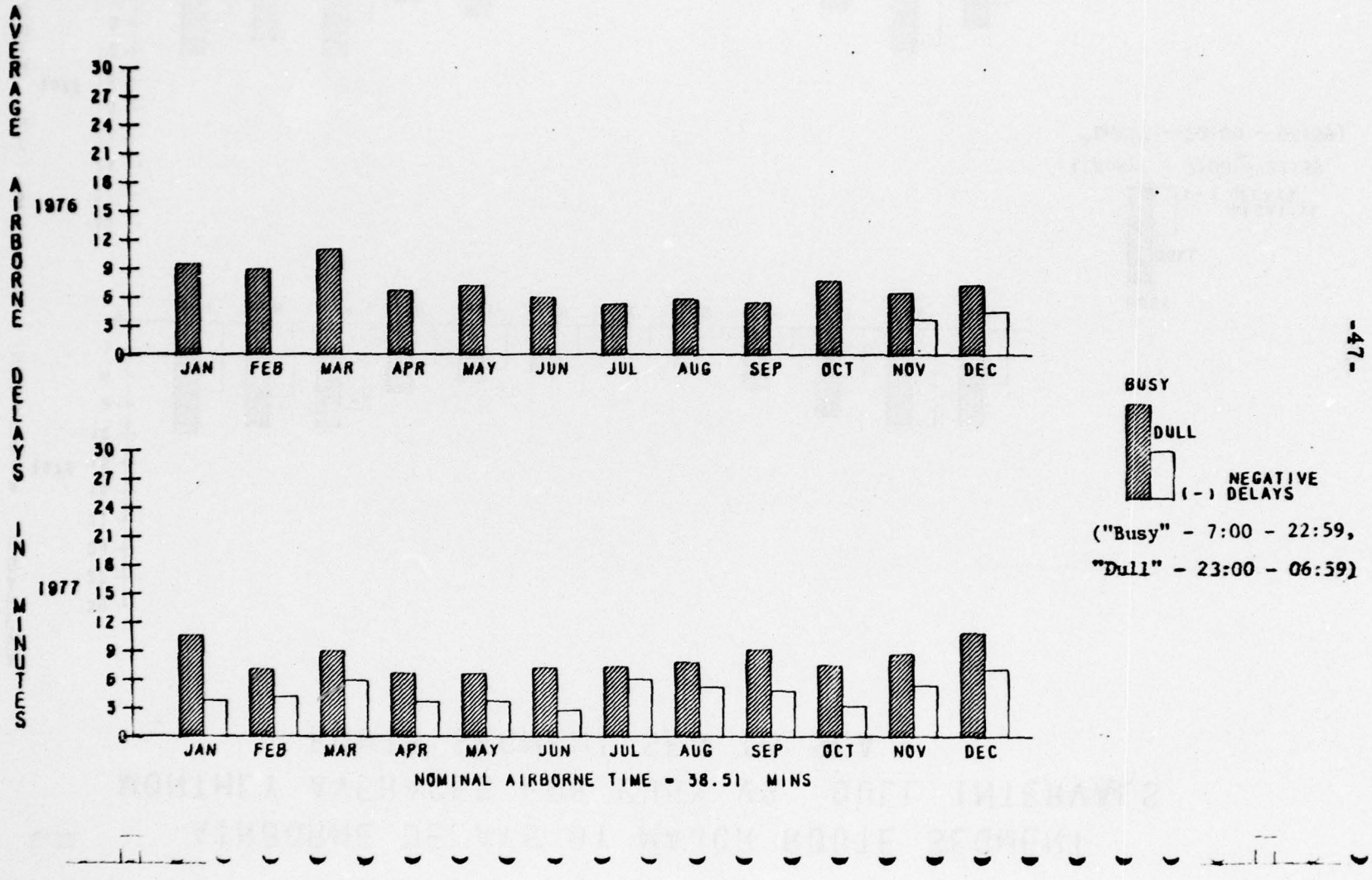

FIGURE 4.11

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

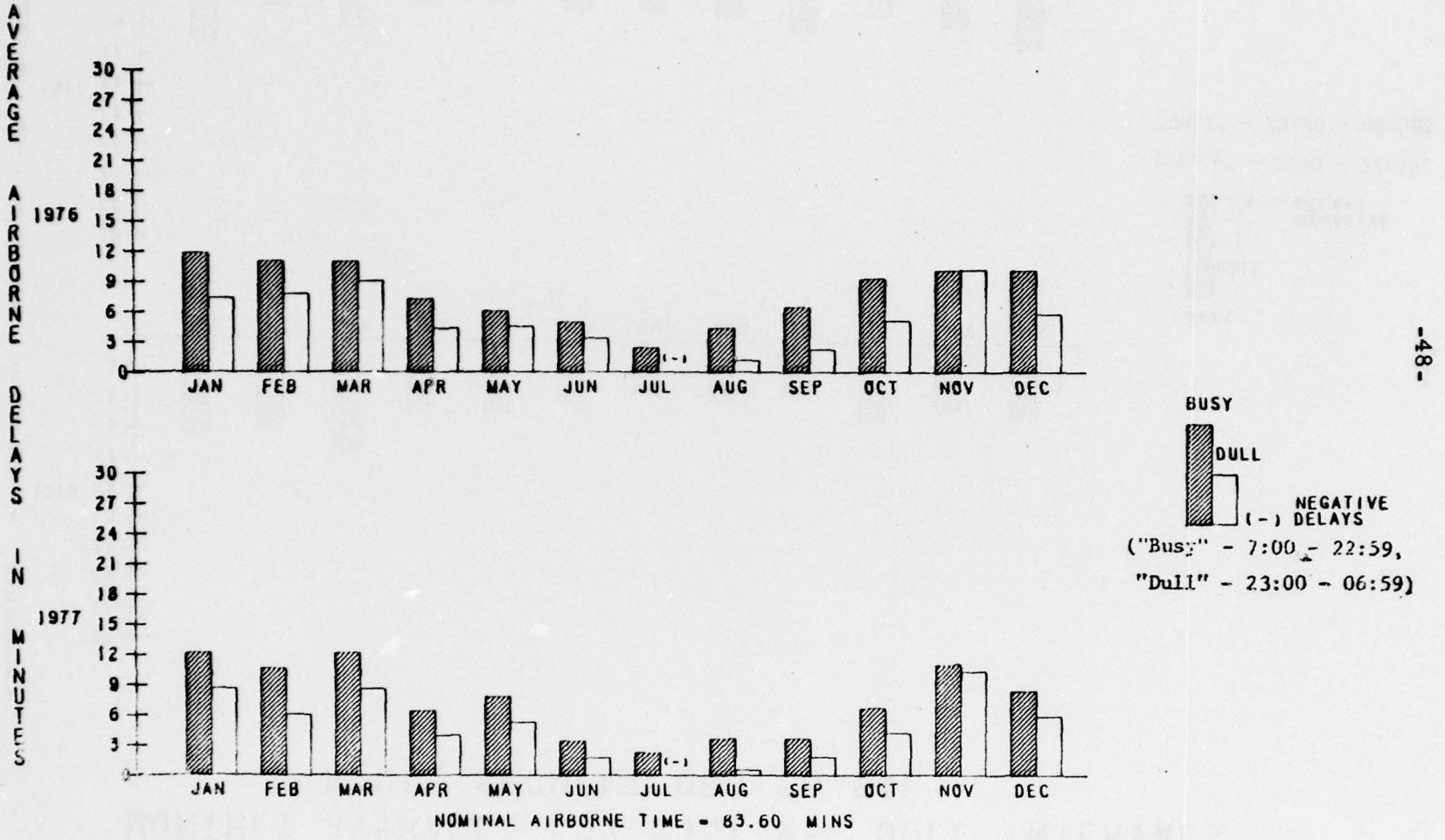

TABLE 4

AVERAGE MONTHLY AIRBORNE DELAYS FOR
ROUTE SEGMENTS TERMINATING AT ORD

	#FLIGHTS	AVG. AIRBORNE DELAY (minutes)	PEAK MONTH (minutes)	STD. DEVIATION (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