APPENDIX 1. EXAMPLES OF STATISTICAL ANALYSIS

1. PURPOSE. This appendix contains illustrations of a method using statistical analysis to demonstrate compliance with maximum and time-weighted average permissible cabin ozone concentrations established by Section 121.578 of the Federal Aviation Regulations (FAR).

2. EXPLANATION OF TERMS AND SYMBOLS.

a. OZMAX is the permissible maximum ozone concentration inside an airplane cabin as established by FAR Part 121 which may not exceed a value of 0.25 parts per million by volume (ppmv), sea level equivalent (SLE), at any point in time.

b. OZTWA is the permissible time-weighted average (TWA) of the ozone concentration inside an airplane cabin over a flight segment as established by FAR Part 121 which may not exceed a value of 0.1 ppmv, SLE, for each flight segment that exceeds 4 hours.

c. OZSLE is ozone concentration in ppmv referenced to standard conditions of 25° C and 760 millimeters of mercury pressure.

d. (P/P_o) is the ratio of cabin pressure (P) to sea level pressure P_o). This ratio is used to obtain the SLE ozone concentration from the ozone concentration at altitude assuming the cabin temperature is 25° C. OZSLE = $(P/P_o)(O_3)$. Some representative values which can be used in operational calculations are:

For P of:	P/P_o is:
5000 feet	0.83
6000 feet	0.80
7000 feet	0.77
8000 feet	0.74

NOTE: The use of standard P/P_o tables can result in errors of up to 7 percent due to the use of temperatures other than 25° C.

e. R is the retention ratio of the ambient (outside) ozone which enters the airplane cabin after going through the air conditioning system and, in most cases, the engines. Normally, the retention ratio is from 0.75 to 1.00 without cabin air recirculation and can be as low as 0.4 to 0.6 with cabin air recirculation. However, the retention ratio for a particular aircraft may differ from these values depending on the cabin air exchange rate, the interior surface to volume relationship, and the amount of cabin air recirculated.

f. E is the efficiency of a filter or catalytic converter installed to remove a portion of the ambient ozone before it enters the airplane cabin. For the purpose of this appendix, the word "filter" is used to describe either type of device. An airplane without a filter would have E = 0.

g. T_{18} is the flight time above 18,000 feet.

h. T_{FS} is the total flight segment time (block time).

i. OZ16 is the estimated ambient ozone concentration obtained from statistics with a confidence level of 84 percent. As explained in Appendix 2 of this advisory circular, preferable data for this purpose are the ozonesonde statistics given in Appendix A of Report FAA-EQ-78-03. Examples of these data for February are reproduced on pages 12 to 19 of this appendix. In using these data, it should be remembered that they are central values for five degrees latitude and 2000 feet altitude boxes.

j. Although there are many flight routes which are not specifically covered by the data on these pages, the data can be used to interpolate the ozone statistics for any flight route. An example of this is shown in Figure 1 for the month of February where OZ16 values are presented for flight levels 410, 390, and 370. The heavy dashed areas are the regions covered by the ozonesonde data. The Japan and western Europe data used in this example have been linearly interpolated to obtain resolution increments of five degrees similar to those used in the eastern and western North American regions. (For 30N, the Japan ozone data have been set to one-half the value at 32N since a linear interpolation gives negative values). Where data exist at a common latitude, they have been linearly interpolated to determine the values for the Pacific and Atlantic areas and are shown in the lighter dashed regions. For latitudes where there are no Japan or western Europe data, the appropriate North American data should be used. The following examples of this procedure to determine OZ16 values for flight level 410 are given:

Longitude	Latitude	OZ16	Obtained From Extension of the
160 E	65 N	1.2ppmv	western North American data
160 E	70 N	1.3ppmv	eastern North American data
40 W	65 N	1.1ppmv	eastern North American data
40 W	70 N	1.3ppmv	eastern North American data

For the southern hemisphere, the data can be (1) obtained from a mirror image of the northern hemisphere data with a 6-month seasonal shift. For example, ozone data for Janaury at 45 S, 80 W would be obtained from the July ozone data at 45 N, 80 W; or (2) calculated by averaging the northern hemisphere data over all longitudes at a given north latitude and using the resulting value for the same south latitude, again with a 6-month seasonal shift.

3. DISCUSSION. In this appendix, the ozone statistics are used in 3 types of examples.

a. Type 1 - Direct determination if a flight complies with either the maximum or TWA cabin ozone concentrations established by FAR Part 121.

b. Type 2 - Determination of the filter efficiency (E) required for a particular flight to comply with the cabin ozone concentrations established by FAR Part 121.

c. Type 3 - Determination of the maximum flight altitude an airplane could fly given a geographical region, latitude and time of year and still comply with the cabin ozone concentrations established by FAR Part 121.

4. EXAMPLES - MAXIMUM CABIN OZONE CONCENTRATION (0.25 ppmv, SLE). The maximum cabin concentration using ozone statistics should be determined at each point along the route of flight and is given by:

$$OZMAX = (1-E)(OZ16)(R)(P/P_O) \qquad \text{(Equation 1)}$$

In all examples, the value for R is 0.8 and the value for (P/P_O) is 0.77 (a cabin altitude of 7,000 feet). Equation 1 then becomes:

$$\begin{aligned} OZMAX &= (0.8)(0.77)(1-E)(OZ16) \\ &= (0.62)(1-E)(OZ16) \qquad \text{(Equation 2)} \end{aligned}$$

a. Type 1 - Example to determine if any point along a flight route is in compliance with the maximum cabin ozone concentration (0.25 ppmv, SLE). From the ozonesonde statistics on Page 16 of this appendix (Page A-15 of the ozonesonde statistics) look up OZ16 using the following example information:

Region: eastern North America
Month: February
Flight level: 370

(1) Case 1. Latitude: 50° North

Page 16 of this appendix (Page A-15 of the ozonesonde statistics) gives OZ16 = 0.50 ppmv.

Therefore (assuming E = 0, or no filter):

$$OZMAX = (0.62)(0.50) = 0.31 \text{ ppmv}$$

THIS POINT ALONG THE FLIGHT ROUTE WOULD NOT HAVE DEMONSTRATED COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 40° North

Page 17 of this appendix (Page A-16 of the ozonesonde statistics) gives OZ16 = 0.40 ppmv.

Therefore (assuming E = 0, or no filter):

$$OZMAX = (0.62)(0.40) = 0.25 \text{ ppmv.}$$

THIS POINT ALONG THE FLIGHT ROUTE WOULD HAVE DEMONSTRATED COMPLIANCE WITH THE MAXIMUM OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

b. Type 2 - Example to determine the filter efficiency required to show compliance at a point along the flight route with the maximum cabin ozone concentration. Equation 2 can be rewritten to determine E, the filter efficiency:

$$E = 1 - \left[\frac{OZMAX}{(0.62)(OZ16)}\right] \qquad \text{(Equation 3)}$$

For OZMAX = 0.25 ppmv, Equation 3 becomes:

$$E = 1 - \left[\frac{(0.25)}{(0.62)(OZ16)}\right]$$

$$E = 1 - \left[\frac{(0.40)}{(OZ16)}\right] \qquad \text{(Equation 4)}$$

(1) Case 1. Latitude: 50° North
OZ16 0.50 ppmv

$$E = 1 - \left[\frac{(0.40)}{(0.50)}\right]$$

$$= 1 - (0.80) = 0.20 = 20\%$$

INSTALLATION OF A FILTER WHICH REMOVED 20 PERCENT OF THE OZONE ENTERING THE CABIN WOULD ENABLE THIS POINT ALONG THE FLIGHT ROUTE TO SHOW COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 45° North

NO FILTER REQUIRED FOR THIS POINT ALONG THE FLIGHT ROUTE AS COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121 WAS SHOWN DURING EXAMPLE TYPE 1, CASE 2.

(3) Variation of Type 2. The filter efficiency required for an airplane to show compliance with the maximum cabin ozone concentration for a point along any flight route can be determined using the method of the Type 2 example. For a worst case analysis, the following assumptions are made:

$P/P_O = 0.74$ (Cabin Altitude of 8,000 feet - maximum pressure differential of 8.9 pounds per square inch at 45,000 feet)

R = 1.0 (All ambient ozone enters the airplane cabin)

At flight level 450 the maximum ozone concentration at an 84 percent confidence level the ozone statistics [paragraph 3(a)2, Appendix A] is found to be 1.8 ppmv during February at 80° north latitude in the eastern North American region. This is shown on page 15 of this appendix.

Equation 1 can be written as:

$$E = 1 - \left[\frac{OZMAX}{(OZ16)(R)(P/P_O)}\right]$$

$$= 1 - \left[\frac{0.25}{(1.8)(1.0)(0.74)}\right]$$

$$= 1 - 0.19 = 0.81 = 81\%$$

INSTALLATION OF A FILTER WHICH REMOVED 81 PERCENT OF THE OZONE ENTERING THE CABIN WOULD ENABLE AN AIRPLANE TO SHOW COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121 UNDER THE WORST CASE CONDITIONS (ANY POINT ALONG ANY FLIGHT ROUTE).

c. Type 3 - Example to determine the maximum flight altitude allowed to show compliance at a point along a flight route with the maximum cabin ozone concentration. Equation 2 can be rewritten to determine OZ16, the ambient ozone concentration derived from statistics with a confidence of 84 percent.

$$OZ16 = \left[\frac{OZMAX}{(0.62)(1-E)}\right] \qquad \text{(Equation 5)}$$

For OZMAX = 0.25 ppmv and no filter E = 0, Equation 5 becomes:

$$OZ16 = \left[\frac{(0.25)}{(0.62)}\right]$$

$$= 0.40 \text{ ppmv}$$

(1) Case 1. Latitude: 50° North

For this case, page 16 of this appendix (Page A-15 of the ozonesonde statistics) shows the OZ16 value of 0.40 ppmv occurs for flight level 340. (This value is determined by straight line interpolation between the OZ16 values of 0.35 ppmv and 0.45 ppmv occurring at flight levels 330 and 350, respectively. The use of straight line interpolation is permissible where appropriate.)

THIS POINT ALONG THE FLIGHT WOULD HAVE TO BE FLOWN AT OR BELOW 34,000 FEET TO SHOW COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 40° North

For this case, page 17 of this appendix (page A-16 of the ozonesonde statistics) shows the OZ16 value of 0.40 ppmv occurs for flight level 370.

THIS POINT ALONG THE FLIGHT WOULD HAVE TO BE FLOWN AT OR BELOW 37,00 FEET TO SHOW COMPLIANCE WITH THE MAXIMUM CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

d. Variation of Type 3. The example shown for Type 3 can be extended to show compliance with the maximum cabin ozone concentration established by FAR Part 121 at any latitude for any month of the year. One example of such a determination is shown in Figure 2 for an airplane flying in eastern North America with R = 0.8, E = 0, and a cabin altitude of 7,000 feet (which, like the Type 3 example, gives a required OZ16 of 0.40 ppmv).

5. Examples - Time-Weighted Average (TWA) Cabin Ozone Concentration (.1 ppmv, SLE). To determine the TWA cabin ozone concentration, the OZ16 values are used to ensure that the ozone statistics are known with an 84 percent confidence value for any one flight (the 50 percent value would only give a confidence value of 50 percent that a flight would meet the required ozone concentration standard).

a. The TWA cabin ozone concentration using ozone statistics is given by Equation 6 which is similar to Equation 1 with time-weighted OZ16 values for flight segments at constant latitude and altitude in the same geographic area.

$$OZ16 = (1-E)(R)(P/P_o) \left[\sum_{i=1}^{N} (OZ16)_i \, T_i/T_{FS} \right] \text{(Equation 6)}$$

WHERE: N is the number of individual flight segments at a constant latitude and altitude in the same geographical area; T_i is the flight segment, above flight level 180, at a constant latitude and altitude in the same geographic area.

NOTE: $\sum_{i=1}^{N} T_i = T_{18}$

$(OZ16)_i$ is the ambient ozone concentration obtained from the ozone statistics with a confidence level of 84 percent which is estimated to be encountered during the time period, T_i.

In all the example types shown, the following values are assumed: R = 0.8 and P/P_o = 0.77. Equation 6 then can be written as:

$$OZTWA = (0.8)(0.77)(1-E) \left[\sum_{i=1}^{N} (OZ16) \; (T_i/T_{FS}) \right]$$

$$OZTWA = (0.62)(1-E) \left[\sum_{i=1}^{N} (OZ16)_i (T_i/T_{FS}) \right] \quad \text{(Equation 7)}$$

b. Type 1 - Example to determine if a flight is in compliance with the TWA cabin ozone concentration. For all Type 1 examples, assume the following: the month is February, the flight level is 370, no filter (or E=0), and the flight segment (T_{FS}) is 5 hours. Two hours are flown in the eastern North American region (ENAR) and two hours are flown in the western North American region (WNAR) above flight level 180.

(1) Case 1. Latitude: 50° North

Pages A-15 and A-12 of the ozonesonde statistics (Figure 1 of this advisory circular) give OZ16 = 0.50 ppmv for the ENAR and OZ16 = 0.25 ppmv for the WNAR. Therefore, from Equation 7:

$$OZTWA = \left[\frac{(0.62)(0.50 \times 2 + 0.25 \times 2)}{5} \right] = 0.19 \text{ ppmv}$$

THIS FLIGHT WOULD NOT HAVE DEMONSTRATED COMPLIANCE WITH THE MAXIMUM TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 40° North

Pages A-16 and A-13 of the ozonesonde statistics (Figure 1 of this advisory circular) give OZ16 = 0.40 ppmv for the ENAR and OZ16 = 0.50 ppmv for the WNAR. Therefore:

$$OZTWA = \left[\frac{(0.62)(0.40 \times 2 + 0.50 \times 2)}{5}\right] = 0.22 \text{ ppmv}$$

THIS FLIGHT WOULD NOT HAVE DEMONSTRATED COMPLIANCE WITH THE MAXIMUM TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(3) Case 3. Latitude: 30° North

Figure 1 of this advisory circular (page A-16 and interpolation between pages A-16 and A-11 of the ozonesonde statistics) gives OZ16 = 0.12 ppmv for the ENAR and OZ16 = 0.10 ppmv for the WNAR. Therefore:

$$OZTWA = \left[\frac{(0.62)(0.12 \times 2 + 0.10 \times 2)}{5}\right] = 0.05 \text{ ppmv}$$

THIS FLIGHT WOULD HAVE DEMONSTRATED COMPLIANCE WITH THE MAXIMUM TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

c. Type 2 - Example to determine the filter efficiency required to show compliance with the TWA cabin ozone concentration. Equation 7 can be rewritten to determine E, the filter efficiency:

$$E = 1 - \left[\frac{(OZTWA)(T_{FS})}{(0.62)\left[\sum_{i=1}^{N} (OZ16)_i (T_i)\right]}\right] \qquad \text{(Equation 8)}$$

For OZMAX = 0.1 ppmv and the flight conditions of the example Type 1, Equation 8 becomes:

$$E = 1 - \left[\frac{(0.1)(5)/(0.62)}{2 \times (OZ16)_1 + 2 \times (OZ16)_2}\right]$$

$$= 1 - \left[\frac{(0.40)}{(OZ16)_1 + (OZ16)_2}\right] \qquad \text{(Equation 9)}$$

(1) Case 1. Latitude: 50° North

OZ16 is 0.50 ppmv for ENAR and 0.25 ppmv for WNAR. (see Type 1, Case 1)

$$E = 1 - \left[\frac{(0.40)}{(0.50 + 0.25)}\right]$$

$$= 1 - 0.53 = 0.47 = 47\%$$

INSTALLATION OF A FILTER WHICH REMOVES 47 PERCENT OF THE OZONE ENTERING THE CABIN WOULD ENABLE THIS FLIGHT TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 40° North

OZ16 = 0.40 ppmv for ENAR and 0.50 ppmv for WNAR. (see Type 1, Case 2)

$$E = 1 - \left[\frac{(0.40)}{(0.40 + 0.50)}\right]$$

$$= 1 - 0.44 = 0.56 = 56\%$$

INSTALLATION OF A FILTER WHICH REMOVES 56 PERCENT OF THE OZONE ENTERING THE CABIN WOULD ENABLE THIS FLIGHT TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(3) Case 3. Latitude: 30° North

NO FILTER REQUIRED AS COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121 WAS SHOWN DURING EXAMPLE TYPE 1, CASE 3.

d. Variation of Type 2. The filter efficiency required for an airplane to show compliance with the TWA cabin ozone concentration for the worst case can be determined using the method of the Type 2 example. For a worst case analysis, the assumptions are the same as were used for the worst case analysis for the maximum ozone concentration example.

P/P_O = 0.74 ppmv

R = 1.0

Flight Level is 450

OZ16 = 1.8 ppmv

In addition, the total flight segment time (T_{FS}) is 14 hours, Equation 6 can be rewritten as:

$$E = 1 - \left[\frac{(OZTWA)(T_{FS})}{(OZ16)(R)(P/P_O)(T_{FS} - 1)}\right]$$

$$= 1 - \left[\frac{(0.1)(14)}{(1.8)(1.0)(0.74)(13)}\right]$$

$$= 1 - 0.08 = 0.92 = 92\%$$

INSTALLATION OF A FILTER WHICH REMOVES 92 PERCENT OF THE OZONE ENTERING THE CABIN WOULD ENABLE AN AIRPLANE TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121 UNDER THE WORST CASE CONDITIONS.

e. Type 3 - Example to determine the maximum flight altitude allowed to show compliance with the TWA cabin ozone concentration. Equation 7 can be rewritten to

determine OZ16, the ambient ozone concentration derived from statistics with a confidence of 84 percent.

$$(OZ16)_1(T_1) + (OZ16)_2(T_2) = \left[\frac{(OZTWA)(T_{FS})}{(0.62)(1-E)}\right]$$

For OZTWA = 0.10 ppmv, no filter (E=0), and a total flight segment of 5 hours, with 2 hours above 18,000 feet in both the ENAR and WNAR, Equation 10 becomes:

$$(OZ16)_1 + (OZ16)_2 = \left[\frac{(0.10)(5)}{(0.62)(2)}\right] = 0.40 \text{ ppmv}$$

(1) Case 1. Latitude: 50° North

For this case, pages A-12 and A-15 of the ozonesonde statistics show that $(OZ16)_1 + (OZ16)_2$ equals 0.51 ppmv at flight level 330 and 0.34 ppmv at flight level 310. Linear interpolation shows a value of 0.40 ppmv occurs for a flight level of 316.

THIS EXAMPLE FLIGHT WOULD HAVE TO FLY AT OR BELOW 31,600 FEET TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(2) Case 2. Latitude: 40° North

For this case, pages A-13 and A-16 of the ozonesonde statistics show that $(OZ16)_1 + (OZ16)_2$ equals 0.55 ppmv at a flight level of 330 and 0.38 ppmv at a flight level of 310. Linear interpolation shows a value of 0.40 ppmv occurs for a flight level of 312.

THIS EXAMPLE FLIGHT WOULD HAVE TO FLY AT OR BELOW 31,200 FEET TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

(3) Case 3. Latitude: 30° North

For this case, use of data on pages A-11 and A-16 of the ozonesonde statistics, interpolated as described in paragraph 2i of this appendix, shows $(OZ16)_1 + (OZ16)_2$ equals 0.63 ppmv at a flight level of 470 and 0.37 ppmv at a flight level of 450. Linear interpolation shows a value of 0.40 ppmv occurs for a flight level of 452.

THIS EXAMPLE FLIGHT WOULD HAVE TO FLY AT OR BELOW 45,200 FEET TO SHOW COMPLIANCE WITH THE TWA CABIN OZONE CONCENTRATION ESTABLISHED BY FAR PART 121.

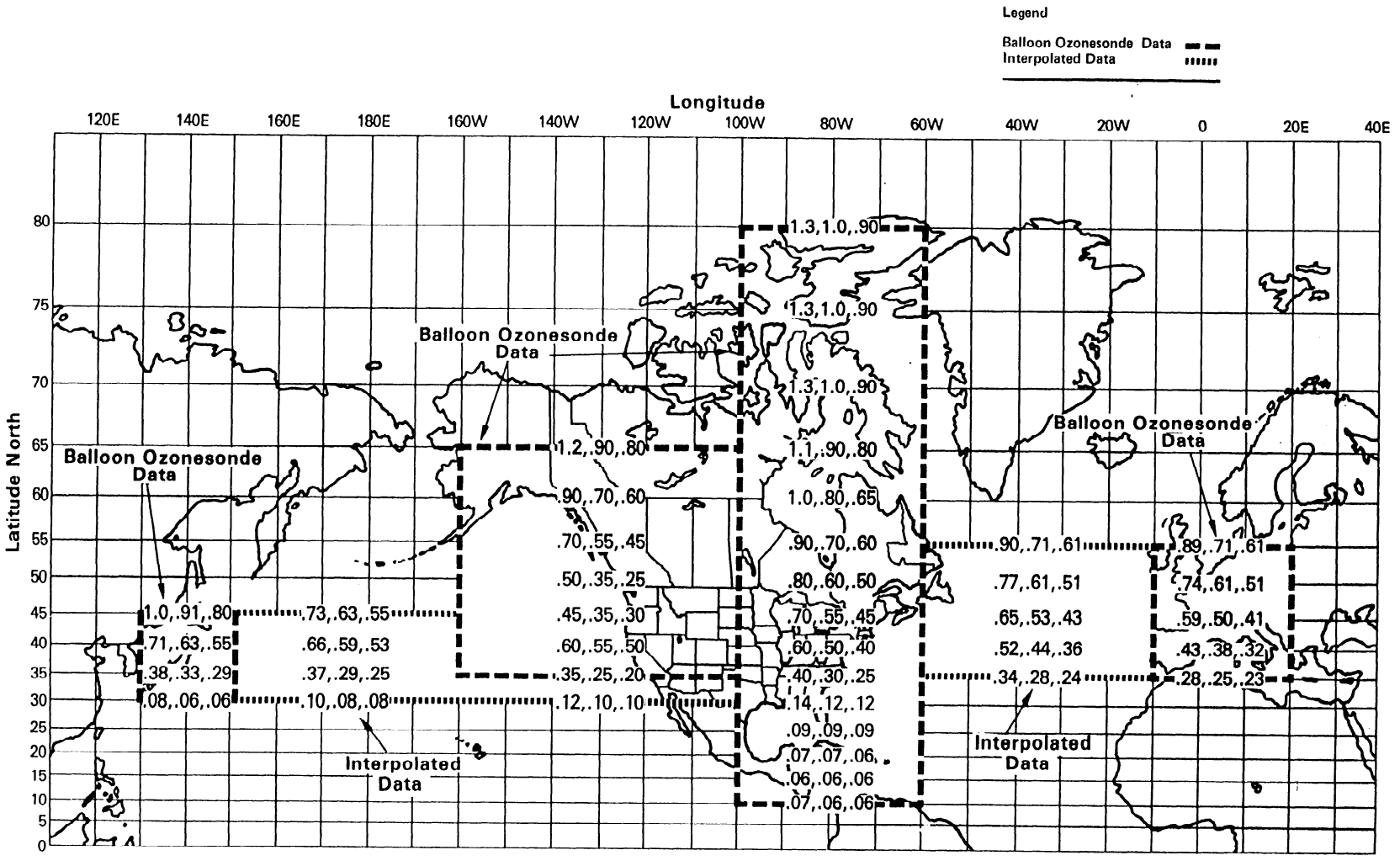
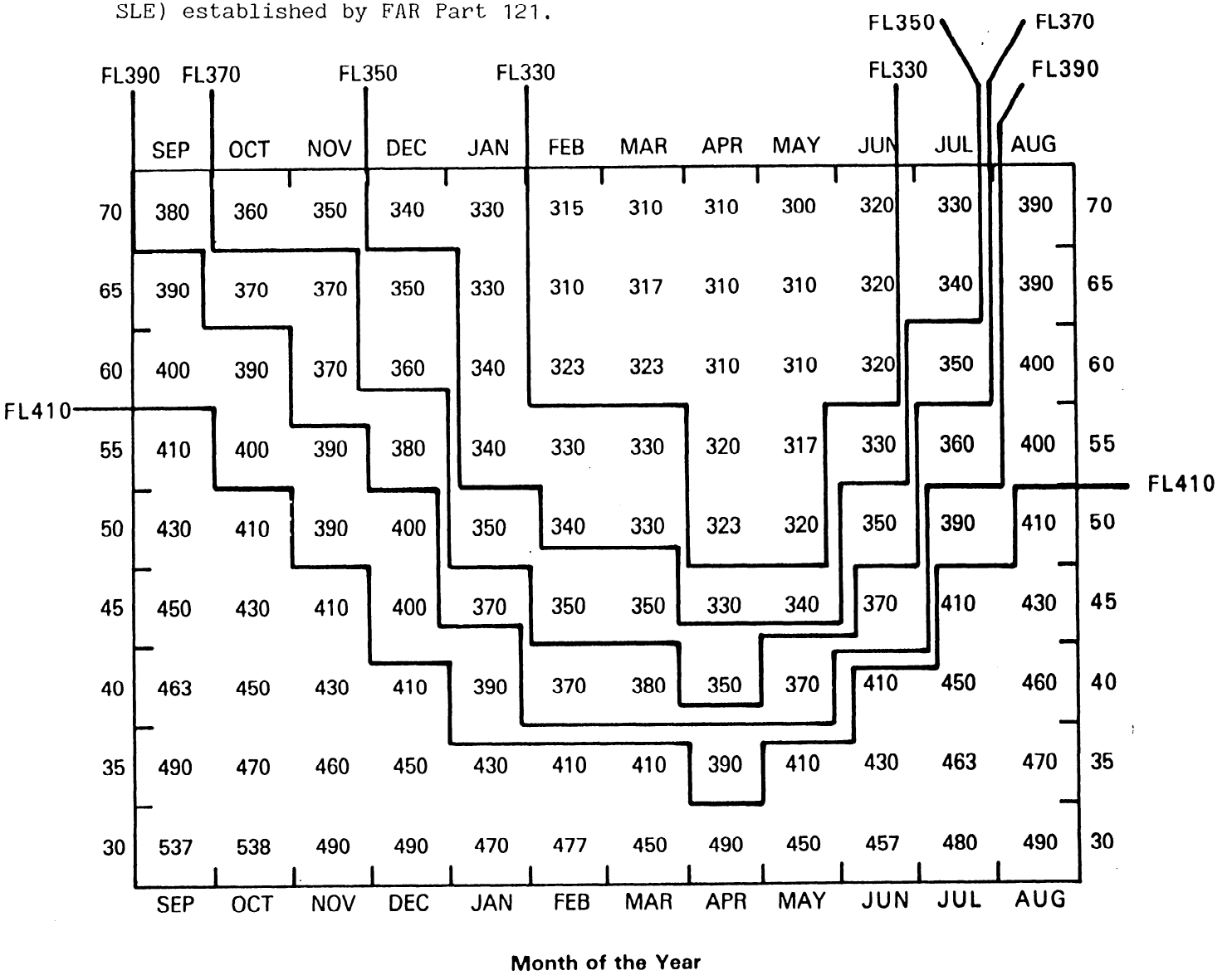


Figure 1. **0Z16 Values for February at flight levels 410, 390 and 370 obtained from FAA Report FAA-EQ-78-03 with linear interpolation between regions.**

Figure 2. Maximum flight level for an airplane flying in Eastern North America with R=0.8, E=0 (no filter) and a cabin altitude of 7,000 feet to show compliance with the maximum cabin ozone concentration (0.25 ppmv, SLE) established by FAR Part 121.



FEBRUARY - JAPAN

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

43°N N=18

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.3	2.9	3.4	4.0	3.4	1.2
570	2.1	2.6	3.2	3.7	3.2	1.0
550	1.8	2.3	2.9	3.5	3.0	.8
530	1.4	2.0	2.6	3.2	2.8	.60
510	1.3	1.9	2.4	2.9	2.5	.60
490	1.2	1.7	2.1	2.6	2.2	.55
470	1.1	1.4	1.8	2.2	1.9	.50
450	.9	1.2	1.5	1.8	1.5	.50
430	.8	1.1	1.3	1.6	1.3	.40
410	.7	.9	1.2	1.4	1.2	.35
390	.60	.8	1.0	1.3	1.1	.25
370	.50	.7	.9	1.1	.9	.20
350	.40	.55	.7	.9	.7	.16
330	.30	.40	.55	.7	.55	.12
310	.18	.25	.35	.45	.35	.06
290	.12	.18	.25	.30	.25	.04
270	.12	.16	.20	.30	.20	.04
250	.10	.14	.20	.25	.18	.04
230	.08	.12	.16	.20	.16	.03
210	.07	.10	.12	.14	.12	.03
190	.05	.07	.08	.10	.09	.03

36°N N=18

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.4	2.0	2.5	3.1	2.7	.8
570	1.3	1.8	2.4	2.9	2.5	.60
550	1.1	1.6	2.2	2.7	2.3	.40
530	.9	1.4	1.9	2.5	2.0	.20
510	.8	1.2	1.7	2.2	1.8	.18
490	.65	1.0	1.4	1.8	1.5	.16
470	.50	.8	1.1	1.4	1.2	.14
450	.35	.55	.7	.9	.8	.10
430	.30	.45	.65	.8	.7	.09
410	.25	.45	.60	.8	.7	.08
390	.25	.40	.60	.8	.7	.07
370	.20	.35	.55	.7	.60	.06
350	.20	.30	.45	.60	.55	.06
330	.16	.25	.35	.45	.45	.05
310	.12	.20	.30	.35	.35	.05
290	.10	.16	.20	.30	.30	.04
270	.09	.14	.20	.25	.25	.04
250	.08	.12	.18	.20	.20	.04
230	.07	.10	.14	.18	.18	.04
210	.06	.09	.12	.14	.14	.04
190	.05	.07	.08	.10	.09	.04

32°N N=14

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	.8	1.1	1.5	1.9	1.6	.35
570	.60	.9	1.3	1.6	1.4	.25
550	.45	.7	1.0	1.3	1.1	.18
530	.25	.50	.7	.9	.8	.09
510	.25	.45	.60	.8	.7	.08
490	.20	.35	.55	.7	.60	.07
470	.18	.30	.45	.55	.50	.06
450	.14	.25	.35	.40	.40	.05
430	.12	.20	.25	.35	.30	.04
410	.10	.16	.20	.25	.25	.03
390	.09	.12	.16	.20	.16	.02
370	.08	.12	.16	.18	.16	.02
350	.08	.12	.16	.20	.18	.03
330	.08	.12	.16	.20	.20	.03
310	.08	.12	.16	.20	.20	.04
290	.07	.12	.16	.20	.20	.04
270	.07	.10	.14	.18	.20	.04
250	.07	.10	.12	.16	.16	.04
230	.06	.09	.12	.14	.14	.04
210	.06	.08	.10	.12	.12	.03
190	.05	.07	.08	.10	.09	.03

FEBRUARY - WESTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

65°N N=3

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.5	2.9	3.3	3.7	2.9	1.9
570	2.3	2.7	3.1	3.5	2.7	1.9
550	2.2	2.5	2.9	3.2	2.6	1.8
530	2.0	2.3	2.6	3.0	2.4	1.7
510	1.8	2.1	2.4	2.8	2.2	1.5
490	1.6	1.9	2.2	2.6	2.0	1.3
470	1.5	1.7	2.0	2.3	1.8	1.1
450	1.3	1.5	1.8	2.1	1.6	.9
430	1.1	1.3	1.6	1.8	1.4	.8
410	1.0	1.2	1.3	1.5	1.2	.8
390	.8	.9	1.0	1.1	.9	.7
370	.7	.8	.9	1.0	.8	.60
350	.55	.65	.7	.8	.65	.45
330	.40	.45	.55	.60	.45	.30
310	.20	.25	.35	.40	.30	.12
290	.10	.18	.25	.30	.20	.05
270	.10	.16	.20	.25	.18	.04
250	.08	.12	.18	.20	.14	.04
230	.07	.10	.14	.16	.12	.04
210	.05	.07	.10	.12	.08	.03
190	.04	.05	.05	.06	.05	.03

60°N N=0

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.3	2.8	3.2	3.6	2.9	1.7
570	2.1	2.6	3.0	3.4	2.7	1.6
550	1.9	2.3	2.7	3.1	2.5	1.5
530	1.7	2.1	2.5	2.9	2.4	1.3
510	1.5	1.9	2.3	2.6	2.1	1.2
490	1.4	1.7	2.1	2.4	1.9	1.0
470	1.2	1.5	1.8	2.1	1.7	.9
450	1.0	1.3	1.6	1.8	1.4	.7
430	.9	1.1	1.3	1.5	1.2	.65
410	.8	.9	1.1	1.3	1.0	.60
390	.65	.7	.8	.9	.8	.50
370	.55	.60	.7	.8	.60	.45
350	.40	.50	.55	.65	.50	.35
330	.30	.35	.40	.50	.35	.20
310	.16	.20	.25	.35	.25	.10
290	.09	.14	.18	.25	.16	.04
270	.08	.12	.16	.20	.14	.03
250	.07	.10	.14	.18	.12	.03
230	.06	.08	.10	.14	.09	.03
210	.05	.06	.08	.10	.07	.03
190	.03	.04	.05	.06	.05	.02

55°N N=0

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.1	2.6	3.1	3.5	2.9	1.5
570	1.9	2.4	2.8	3.3	2.7	1.3
550	1.7	2.1	2.6	3.0	2.5	1.1
530	1.4	1.9	2.3	2.8	2.3	.9
510	1.3	1.7	2.1	2.5	2.0	.8
490	1.1	1.5	1.9	2.2	1.8	.7
470	1.0	1.3	1.6	1.9	1.5	.65
450	.8	1.1	1.3	1.6	1.2	.50
430	.7	.9	1.1	1.3	1.0	.45
410	.55	.7	.9	1.0	.8	.40
390	.45	.55	.65	.7	.55	.35
370	.35	.45	.50	.60	.45	.25
350	.30	.35	.40	.50	.35	.20
330	.20	.25	.30	.35	.25	.14
310	.12	.16	.20	.25	.16	.06
290	.06	.10	.14	.16	.12	.03
270	.06	.09	.12	.14	.10	.03
250	.05	.08	.10	.12	.09	.02
230	.04	.06	.08	.10	.07	.02
210	.04	.05	.07	.08	.06	.02
190	.03	.04	.05	.05	.04	.02

50°N N=10

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.9	2.4	2.9	3.4	2.9	1.3
570	1.7	2.2	2.7	3.2	2.7	1.1
550	1.4	1.9	2.4	2.9	2.4	.8
530	1.1	1.6	2.2	2.7	2.2	.55
510	1.0	1.5	1.9	2.4	2.0	.50
490	.9	1.3	1.7	2.1	1.7	.45
470	.7	1.1	1.4	1.7	1.4	.35
450	.55	.8	1.1	1.3	1.0	.30
430	.45	.65	.9	1.1	.8	.25
410	.35	.50	.65	.8	.60	.20
390	.25	.35	.40	.50	.35	.14
370	.20	.25	.35	.40	.30	.12
350	.16	.20	.25	.30	.20	.09
330	.12	.16	.20	.25	.16	.06
310	.07	.09	.12	.14	.10	.03
290	.04	.06	.08	.10	.07	.02
270	.04	.05	.07	.09	.06	.02
250	.04	.05	.06	.08	.06	.02
230	.03	.05	.06	.07	.05	.02
210	.03	.04	.05	.06	.05	.02
190	.03	.03	.04	.05	.04	.01

FEBRUARY - WESTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

45°N N=31

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.8	2.3	2.9	3.4	3.1	1.0
570	1.6	2.1	2.6	3.1	2.8	.8
550	1.3	1.8	2.3	2.8	2.5	.55
530	1.0	1.5	2.0	2.5	2.2	.25
510	.9	1.3	1.8	2.2	2.0	.25
490	.7	1.1	1.5	1.9	1.7	.20
470	.60	.9	1.3	1.6	1.4	.18
450	.45	.7	1.0	1.2	1.1	.16
430	.35	.60	.8	1.0	.9	.12
410	.30	.45	.65	.8	.7	.08
390	.20	.35	.45	.60	.45	.04
370	.18	.30	.40	.50	.35	.03
350	.14	.25	.30	.40	.30	.03
330	.10	.18	.25	.30	.25	.02
310	.07	.12	.16	.20	.18	.02
290	.05	.08	.12	.14	.14	.01
270	.05	.07	.10	.12	.12	.01
250	.04	.07	.09	.12	.12	.01
230	.04	.06	.08	.10	.09	.01
210	.04	.05	.07	.08	.07	.01
190	.03	.04	.05	.06	.05	.01

40°N N=69

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.8	2.3	2.8	3.4	3.5	.60
570	1.5	2.0	2.5	3.0	3.1	.45
550	1.2	1.7	2.2	2.7	2.7	.30
530	.9	1.4	1.8	2.3	2.2	.10
510	.8	1.2	1.6	2.1	2.1	.09
490	.7	1.1	1.5	1.8	1.9	.09
470	.60	.9	1.3	1.6	1.7	.08
450	.50	.8	1.0	1.3	1.4	.08
430	.45	.7	.9	1.2	1.2	.06
410	.40	.60	.9	1.1	1.0	.05
390	.35	.55	.8	1.0	.8	.03
370	.30	.50	.65	.9	.7	.03
350	.25	.40	.55	.7	.60	.03
330	.18	.30	.45	.55	.50	.02
310	.12	.20	.30	.40	.40	.02
290	.09	.16	.25	.30	.35	.02
270	.08	.14	.20	.25	.30	.02
250	.07	.12	.18	.25	.25	.02
230	.06	.10	.14	.18	.20	.02
210	.05	.08	.12	.14	.14	.01
190	.04	.06	.08	.09	.09	.01

35°N N=14

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.4	1.8	2.3	2.8	2.5	.65
570	1.2	1.6	2.1	2.5	2.3	.50
550	.9	1.4	1.8	2.3	2.1	.35
530	.60	1.1	1.6	2.0	1.9	.14
510	.55	1.0	1.4	1.8	1.7	.12
490	.45	.8	1.2	1.5	1.4	.10
470	.35	.65	.9	1.2	1.1	.08
450	.25	.50	.7	.9	.8	.05
430	.25	.40	.55	.7	.65	.05
410	.20	.35	.45	.60	.55	.04
390	.16	.25	.35	.45	.45	.04
370	.12	.20	.30	.40	.35	.04
350	.10	.18	.25	.35	.30	.03
330	.08	.14	.20	.25	.25	.02
310	.06	.10	.16	.20	.18	.01
290	.04	.08	.12	.16	.14	.01
270	.04	.08	.12	.14	.14	.01
250	.04	.07	.10	.14	.12	.01
230	.03	.06	.09	.12	.12	.01
210	.03	.06	.08	.10	.10	.01
190	.03	.05	.07	.09	.09	.01

FEBRUARY - EASTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

80° N N=17

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	3.4	4.0	4.7	5.4	4.8	1.3
570	3.1	3.7	4.4	5.0	4.5	1.3
550	2.8	3.4	4.0	4.6	4.2	1.2
530	2.5	3.0	3.6	4.1	3.9	1.1
510	2.3	2.8	3.3	3.8	3.5	1.0
490	2.0	2.5	2.9	3.4	3.2	.8
470	1.7	2.1	2.5	2.9	2.7	.7
450	1.4	1.8	2.1	2.5	2.3	.55
430	1.2	1.5	1.8	2.1	1.9	.40
410	1.1	1.3	1.6	1.8	1.6	.30
390	.8	1.0	1.2	1.4	1.2	.18
370	.7	.9	1.0	1.2	1.0	.14
350	.55	.7	.9	1.0	.8	.12
330	.45	.55	.65	.8	.65	.08
310	.30	.35	.45	.55	.45	.05
290	.20	.25	.30	.40	.35	.03
270	.18	.25	.30	.35	.30	.03
250	.16	.20	.25	.30	.25	.02
230	.14	.16	.20	.25	.18	.02
210	.10	.12	.14	.18	.14	.02
190	.06	.08	.09	.12	.09	.02

75° N N=40

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	3.2	3.9	4.6	5.3	4.8	1.3
570	3.0	3.6	4.3	4.9	4.5	1.2
550	2.7	3.3	3.9	4.5	4.2	1.1
530	2.4	2.9	3.5	4.1	3.9	1.0
510	2.2	2.7	3.2	3.7	3.5	.9
490	1.9	2.4	2.9	3.4	3.2	.8
470	1.7	2.1	2.5	2.9	2.7	.65
450	1.4	1.8	2.1	2.5	2.3	.55
430	1.2	1.5	1.8	2.1	1.9	.40
410	1.0	1.3	1.5	1.8	1.6	.30
390	.8	1.0	1.2	1.4	1.2	.18
370	.7	.9	1.0	1.2	1.0	.14
350	.55	.7	.9	1.0	.8	.12
330	.45	.55	.65	.8	.65	.08
310	.30	.35	.45	.50	.45	.05
290	.20	.25	.30	.35	.35	.03
270	.18	.20	.25	.30	.30	.03
250	.16	.20	.25	.25	.25	.02
230	.12	.16	.18	.20	.18	.02
210	.09	.12	.14	.16	.14	.02
190	.06	.07	.09	.10	.09	.02

70° N N=25

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	3.1	3.8	4.4	5.1	4.7	1.5
570	2.8	3.5	4.1	4.8	4.4	1.3
550	2.5	3.2	3.8	4.4	4.1	1.2
530	2.2	2.8	3.4	4.1	3.7	1.0
510	2.0	2.6	3.2	3.7	3.3	.9
490	1.8	2.3	2.8	3.3	3.0	.8
470	1.6	2.0	2.5	2.9	2.5	.65
450	1.4	1.7	2.1	2.5	2.1	.55
430	1.2	1.5	1.8	2.1	1.8	.40
410	1.0	1.3	1.5	1.8	1.4	.30
390	.8	1.0	1.2	1.4	1.1	.18
370	.7	.9	1.0	1.2	.9	.14
350	.55	.7	.9	1.0	.8	.12
330	.45	.55	.65	.8	.60	.08
310	.30	.35	.45	.50	.45	.05
290	.20	.25	.30	.35	.35	.03
270	.18	.20	.25	.30	.30	.03
250	.16	.18	.20	.25	.25	.02
230	.12	.16	.18	.20	.18	.02
210	.09	.12	.14	.16	.14	.02
190	.05	.07	.08	.10	.08	.02

65° N N=5

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.9	3.6	4.3	4.9	4.6	1.5
570	2.6	3.3	3.9	4.6	4.2	1.3
550	2.4	3.0	3.6	4.2	3.9	1.2
530	2.0	2.6	3.2	3.8	3.5	1.0
510	1.9	2.4	2.9	3.5	3.2	.9
490	1.7	2.1	2.6	3.1	2.8	.8
470	1.4	1.9	2.3	2.7	2.4	.65
450	1.2	1.6	1.9	2.3	2.0	.50
430	1.0	1.3	1.7	2.0	1.7	.35
410	.9	1.1	1.4	1.7	1.3	.25
390	.7	.9	1.1	1.3	1.0	.16
370	.60	.8	1.0	1.1	.8	.12
350	.50	.65	.8	.9	.7	.10
330	.40	.50	.65	.7	.55	.08
310	.30	.40	.45	.55	.40	.05
290	.20	.30	.35	.40	.35	.04
270	.18	.25	.30	.35	.30	.03
250	.14	.18	.20	.25	.25	.03
230	.10	.12	.16	.18	.18	.02
210	.08	.10	.12	.14	.14	.02
190	.05	.06	.08	.09	.08	.02

FEBRUARY - EASTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

60°N N=4

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.7	3.4	4.1	4.7	4.4	1.5
570	2.5	3.1	3.7	4.4	4.0	1.3
550	2.2	2.8	3.4	4.0	3.7	1.0
530	1.9	2.4	3.0	3.5	3.3	.8
510	1.7	2.2	2.7	3.2	3.0	.7
490	1.5	2.0	2.4	2.9	2.7	.65
470	1.3	1.7	2.1	2.5	2.3	.55
450	1.0	1.4	1.7	2.1	1.9	.45
430	.9	1.2	1.5	1.8	1.6	.35
410	.7	1.0	1.3	1.5	1.3	.25
390	.60	.8	1.0	1.2	1.0	.14
370	.50	.65	.8	1.0	.8	.10
350	.40	.55	.7	.9	.7	.09
330	.30	.45	.55	.65	.55	.07
310	.25	.30	.40	.45	.40	.05
290	.16	.25	.30	.35	.35	.04
270	.14	.18	.25	.30	.30	.03
250	.10	.14	.18	.20	.25	.03
230	.07	.10	.14	.16	.18	.02
210	.06	.08	.10	.12	.14	.02
190	.04	.06	.07	.09	.08	.01

55°N N=8

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.5	3.2	3.8	4.5	4.0	1.4
570	2.3	2.9	3.5	4.1	3.7	1.1
550	2.0	2.6	3.2	3.7	3.4	.8
530	1.7	2.2	2.8	3.3	3.1	.50
510	1.5	2.0	2.5	3.0	2.8	.45
490	1.4	1.8	2.2	2.7	2.5	.40
470	1.1	1.5	1.9	2.3	2.1	.35
450	.9	1.3	1.6	1.9	1.7	.30
430	.8	1.1	1.4	1.6	1.4	.25
410	.65	.9	1.1	1.4	1.2	.18
390	.50	.7	.9	1.1	.9	.09
370	.45	.60	.8	.9	.8	.07
350	.35	.50	.65	.8	.65	.07
330	.30	.40	.50	.60	.55	.06
310	.20	.30	.35	.45	.40	.05
290	.14	.20	.25	.30	.30	.04
270	.12	.16	.20	.25	.25	.03
250	.09	.12	.16	.20	.20	.03
230	.06	.09	.12	.14	.16	.02
210	.05	.07	.09	.12	.12	.02
190	.04	.06	.07	.09	.08	.02

50°N N=10

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.4	3.0	3.6	4.2	4.0	1.4
570	2.1	2.7	3.3	3.9	3.8	1.1
550	1.8	2.4	3.0	3.5	3.5	.8
530	1.5	2.1	2.6	3.1	3.3	.40
510	1.4	1.9	2.3	2.8	3.0	.40
490	1.2	1.6	2.1	2.5	2.6	.35
470	1.0	1.4	1.8	2.1	2.2	.35
450	.8	1.1	1.4	1.7	1.8	.30
430	.7	.9	1.2	1.5	1.5	.25
410	.60	.8	1.0	1.2	1.3	.16
390	.45	.60	.8	.9	1.0	.07
370	.40	.50	.65	.8	.9	.05
350	.30	.45	.55	.65	.7	.04
330	.25	.35	.45	.55	.55	.03
310	.16	.25	.30	.40	.40	.02
290	.12	.18	.25	.30	.30	.02
270	.09	.14	.18	.25	.25	.02
250	.07	.10	.14	.18	.20	.02
230	.05	.07	.10	.12	.16	.02
210	.04	.06	.08	.10	.12	.02
190	.04	.05	.07	.08	.09	.01

45°N N=20

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.2	2.8	3.4	4.0	3.8	1.1
570	1.9	2.5	3.1	3.6	3.8	.9
550	1.6	2.2	2.7	3.3	3.7	.65
530	1.3	1.8	2.3	2.8	3.6	.40
510	1.2	1.6	2.1	2.6	3.2	.35
490	1.0	1.4	1.9	2.3	2.8	.30
470	.9	1.2	1.6	1.9	2.3	.25
450	.7	1.0	1.3	1.6	1.8	.20
430	.60	.8	1.1	1.3	1.6	.16
410	.50	.7	.9	1.1	1.4	.10
390	.40	.55	.7	.9	1.2	.03
370	.30	.45	.60	.8	1.1	.02
350	.25	.40	.50	.65	.9	.02
330	.20	.30	.40	.50	.7	.01
310	.14	.20	.30	.35	.50	.01
290	.10	.16	.20	.25	.40	.01
270	.08	.12	.18	.20	.35	.01
250	.06	.10	.14	.16	.30	.01
230	.05	.07	.10	.12	.25	.01
210	.04	.06	.08	.10	.20	.01
190	.04	.06	.07	.09	.16	.01

FEBRUARY - EASTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

40°N N=40

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.9	2.6	3.2	3.8	3.8	.9
570	1.7	2.3	2.8	3.4	3.8	.65
550	1.4	1.9	2.5	3.0	3.7	.45
530	1.1	1.6	2.1	2.6	3.6	.20
510	1.0	1.4	1.9	2.3	3.1	.18
490	.8	1.2	1.6	2.0	2.6	.16
470	.7	1.1	1.4	1.8	2.0	.14
450	.55	.8	1.1	1.4	1.3	.10
430	.45	.7	1.0	1.2	1.2	.08
410	.40	.60	.8	1.0	1.1	.05
390	.30	.50	.65	.8	1.1	.03
370	.25	.40	.55	.7	1.0	.02
350	.20	.35	.45	.60	.8	.02
330	.16	.25	.35	.45	.65	.01
310	.10	.18	.25	.35	.50	.01
290	.08	.12	.18	.25	.40	.01
270	.07	.12	.16	.20	.35	.01
250	.06	.09	.12	.16	.30	.01
230	.05	.07	.10	.12	.25	.01
210	.05	.07	.09	.10	.20	.01
190	.04	.06	.08	.09	.18	.01

35°N N=15

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.6	2.1	2.6	3.1	2.9	.8
570	1.3	1.8	2.3	2.8	2.6	.60
550	1.1	1.5	1.9	2.3	2.3	.40
530	.8	1.2	1.5	1.9	2.0	.16
510	.7	1.0	1.4	1.7	1.7	.14
490	.60	.9	1.2	1.5	1.4	.12
470	.50	.7	1.0	1.2	1.1	.10
450	.35	.55	.7	.9	.8	.08
430	.30	.45	.60	.8	.7	.06
410	.25	.40	.50	.65	.65	.05
390	.20	.30	.40	.50	.60	.03
370	.18	.25	.35	.45	.55	.03
350	.14	.20	.30	.40	.45	.02
330	.12	.18	.25	.30	.35	.02
310	.08	.14	.18	.25	.25	.01
290	.06	.10	.14	.18	.20	.01
270	.06	.09	.12	.16	.20	.01
250	.05	.08	.10	.14	.18	.01
230	.04	.07	.09	.10	.18	.01
210	.04	.06	.08	.10	.14	.01
190	.04	.05	.07	.08	.10	.01

30°N N=10

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.2	1.6	2.1	2.5	2.0	.40
570	1.0	1.4	1.7	2.1	1.7	.30
550	.7	1.1	1.4	1.7	1.2	.18
530	.45	.7	1.0	1.2	.8	.08
510	.40	.60	.8	1.0	.65	.07
490	.30	.50	.65	.8	.55	.06
470	.25	.35	.45	.60	.40	.05
450	.14	.20	.25	.30	.25	.04
430	.12	.16	.20	.25	.20	.04
410	.10	.14	.18	.25	.18	.03
390	.09	.12	.16	.20	.16	.03
370	.08	.12	.16	.18	.16	.03
350	.07	.10	.14	.18	.16	.02
330	.06	.09	.12	.16	.18	.02
310	.05	.08	.10	.14	.18	.01
290	.05	.07	.10	.12	.18	.01
270	.04	.07	.09	.12	.16	.01
250	.04	.06	.08	.10	.16	.01
230	.04	.06	.08	.09	.14	.01
210	.04	.05	.07	.08	.10	.01
190	.03	.05	.06	.08	.08	.01

25°N N=8

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	.65	.8	1.0	1.2	1.2	.25
570	.55	.7	.9	1.1	1.0	.20
550	.40	.60	.8	.9	.7	.14
530	.30	.45	.60	.8	.50	.07
510	.25	.40	.50	.65	.40	.06
490	.20	.30	.40	.50	.35	.05
470	.14	.20	.25	.35	.25	.04
450	.08	.10	.14	.16	.16	.03
430	.07	.09	.12	.14	.14	.03
410	.07	.09	.12	.14	.12	.03
390	.07	.09	.12	.16	.12	.03
370	.06	.09	.12	.14	.12	.03
350	.06	.08	.10	.12	.12	.02
330	.05	.07	.09	.12	.12	.02
310	.04	.06	.08	.10	.12	.01
290	.04	.06	.07	.09	.12	.01
270	.04	.05	.07	.09	.10	.01
250	.04	.05	.07	.08	.10	.01
230	.03	.05	.06	.08	.09	.01
210	.03	.05	.06	.07	.08	.01
190	.03	.04	.06	.07	.06	.01

FEBRUARY - EASTERN NORTH AMERICA

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

20°N N=8

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	.35	.45	.60	.7	.55	.18
570	.25	.35	.45	.55	.45	.14
550	.18	.25	.30	.35	.30	.10
530	.09	.12	.16	.18	.14	.06
510	.08	.10	.14	.16	.12	.05
490	.07	.10	.12	.16	.12	.05
470	.06	.09	.10	.14	.09	.04
450	.05	.07	.09	.12	.07	.03
430	.05	.07	.09	.10	.07	.03
410	.05	.07	.09	.10	.08	.04
390	.05	.07	.09	.10	.08	.04
370	.05	.06	.08	.10	.08	.04
350	.04	.06	.07	.09	.07	.03
330	.04	.05	.06	.08	.06	.03
310	.03	.04	.05	.07	.05	.02
290	.03	.04	.05	.06	.05	.02
270	.03	.04	.05	.06	.05	.02
250	.03	.04	.05	.06	.04	.01
230	.03	.04	.05	.06	.04	.01
210	.03	.04	.05	.06	.04	.01
190	.03	.04	.05	.06	.04	.01

15°N N=5

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	.35	.45	.55	.65	.50	.14
570	.25	.35	.45	.55	.40	.12
550	.18	.25	.30	.35	.30	.08
530	.09	.12	.16	.20	.14	.05
510	.08	.12	.16	.18	.12	.04
490	.07	.10	.14	.16	.12	.04
470	.06	.08	.10	.14	.09	.03
450	.04	.06	.09	.10	.07	.02
430	.04	.06	.08	.10	.07	.02
410	.04	.06	.08	.10	.07	.02
390	.04	.06	.08	.10	.07	.02
370	.04	.06	.08	.10	.07	.02
350	.04	.05	.07	.09	.06	.02
330	.04	.05	.06	.08	.05	.01
310	.03	.04	.05	.07	.04	.01
290	.03	.04	.05	.06	.04	.01
270	.03	.04	.05	.06	.04	.01
250	.03	.04	.05	.06	.04	.01
230	.03	.04	.05	.06	.04	.01
210	.03	.04	.05	.06	.04	.01
190	.03	.04	.05	.06	.04	.01

10°N N=8

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	.35	.45	.55	.65	.50	.12
570	.25	.35	.45	.55	.40	.10
550	.18	.25	.30	.35	.25	.07
530	.09	.14	.16	.20	.14	.04
510	.08	.12	.16	.20	.12	.04
490	.07	.10	.14	.18	.12	.03
470	.07	.10	.12	.16	.10	.03
450	.06	.08	.10	.14	.08	.02
430	.05	.07	.10	.12	.08	.02
410	.05	.07	.09	.12	.07	.01
390	.04	.06	.08	.10	.06	.01
370	.04	.06	.07	.09	.06	.01
350	.04	.05	.07	.08	.05	.01
330	.03	.05	.06	.08	.05	.01
310	.03	.04	.05	.07	.04	.01
290	.03	.04	.05	.06	.04	.01
270	.03	.04	.05	.06	.04	.01
250	.03	.04	.05	.06	.04	.01
230	.03	.04	.05	.06	.04	.01
210	.03	.04	.05	.06	.05	.01
190	.03	.04	.05	.06	.05	.01

FEBRUARY - WESTERN EUROPE

UNIT: PPMV

PERCENTAGES INDICATE PROBABILITY OF EXCEEDING AMOUNT SHOWN.

52°N N=38

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	2.2	2.8	3.5	4.1	3.8	1.1
570	1.9	2.5	3.1	3.7	3.5	.8
550	1.5	2.1	2.6	3.2	3.1	.60
530	1.1	1.7	2.2	2.7	2.8	.30
510	1.1	1.5	2.0	2.5	2.5	.25
490	1.0	1.4	1.8	2.3	2.2	.20
470	.9	1.3	1.7	2.1	1.9	.16
450	.7	1.1	1.4	1.8	1.5	.09
430	.65	.9	1.3	1.6	1.3	.07
410	.55	.8	1.1	1.3	1.0	.05
390	.40	.65	.9	1.1	.8	.04
370	.35	.55	.7	.9	.7	.03
350	.30	.45	.60	.7	.55	.03
330	.20	.30	.45	.55	.45	.02
310	.12	.20	.30	.35	.35	.02
290	.08	.14	.20	.25	.25	.02
270	.07	.12	.18	.25	.25	.02
250	.07	.10	.16	.20	.20	.02
230	.06	.09	.12	.16	.16	.01
210	.05	.08	.10	.14	.12	.01
190	.04	.06	.08	.09	.09	.01

47°N N=128

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.8	2.4	3.1	3.7	3.8	.20
570	1.6	2.2	2.8	3.4	3.4	.20
550	1.3	1.8	2.4	2.9	3.1	.18
530	1.0	1.5	2.0	2.5	2.7	.16
510	.9	1.4	1.8	2.3	2.5	.14
490	.8	1.2	1.6	2.1	2.2	.10
470	.7	1.1	1.4	1.8	2.0	.07
450	.60	.9	1.2	1.5	1.6	.03
430	.50	.8	1.1	1.3	1.5	.02
410	.45	.65	.9	1.1	1.3	.02
390	.35	.55	.7	.9	1.2	.02
370	.30	.45	.60	.8	1.0	.02
350	.20	.35	.50	.65	.8	.02
330	.16	.25	.35	.45	.60	.02
310	.10	.16	.20	.30	.35	.02
290	.06	.10	.14	.18	.25	.02
270	.05	.08	.12	.14	.18	.02
250	.05	.07	.09	.12	.14	.01
230	.04	.06	.07	.08	.09	.01
210	.04	.05	.07	.08	.09	.01
190	.04	.05	.06	.07	.08	.01

39°N N=6

FLIGHT LEVEL	MEAN	16%	2%	.1%	MAX	MIN
590	1.6	2.2	2.9	3.5	2.4	.7
570	1.4	2.0	2.5	3.1	2.1	.65
550	1.3	1.7	2.2	2.6	1.9	.55
530	1.1	1.4	1.8	2.1	1.6	.45
510	.9	1.2	1.5	1.8	1.4	.35
490	.8	1.0	1.3	1.5	1.1	.30
470	.55	.8	1.0	1.2	.9	.18
450	.35	.50	.7	.9	.60	.08
430	.30	.45	.55	.7	.50	.07
410	.30	.40	.50	.60	.45	.08
390	.25	.35	.40	.50	.40	.09
370	.25	.30	.35	.40	.35	.08
350	.18	.20	.25	.30	.30	.06
330	.12	.16	.20	.25	.20	.04
310	.06	.09	.12	.14	.12	.02
290	.04	.06	.08	.10	.08	.01
270	.04	.06	.08	.10	.08	.01
250	.04	.06	.08	.10	.08	.01
230	.04	.06	.08	.10	.09	.02
210	.04	.06	.08	.10	.09	.02
190	.04	.06	.08	.09	.08	.02

APPENDIX 2. ALTERNATE OZONE DATA SETS

1. PURPOSE. This appendix discusses the Global Air Sampling Program (GASP) ozone data and the ozonesonde balloon data used in example flights in Appendix 1 of this advisory circular.

2. EXPLANATION. The ozone concentration balloon data of Appendix A of Report FAA-EQ-78-03 listed in paragraph 3a(2) of this advisory circular is acceptable to the FAA for statistical analysis to determine compliance with the cabin ozone concentrations established by Section 121.578 of the FAR. Any other data set would have to have an equivalent vertical (2,000 feet), temporal (monthly), and latitudinal (5 degrees) resolution to be acceptable for purposes of compliance demonstration.

a. For example, in Appendix B of Report FAA-EQ-78-03, data are presented which were collected during the Global Air Sampling Program by the National Aeronautics and Space Administration (NASA). The GASP data have greater geographical coverage; however, as currently tabulated, they do not provide the required vertical, temporal or latitudinal resolution to be used for compliance demonstration. When the resolution of the balloon data is collapsed to that of the GASP data, the results of the two measurement programs agree statistically. This indicates that both data sets are valid; however, the GASP data, in their present tabulation, do not show the necessary resolution elements to be acceptable to the FAA.

b. For example, the balloon data for the eastern North American region at 45° north and of a flight level of 390 give ozone values at the 84 percent confidence level of 0.35, 0.45, and 0.55 ppmv for December, January, and February, respectively. For the western North American region the values are 0.30, 0.35, 0.35 ppmv. At flight level 390, the GASP data show an ozone value at the 84 percent confidence level of 0.37 ppmv for the winter season, between 40° and 90° west longitude at a latitude between 42° and 48° north (page B-6 of Report FAA-EQ-78-03). Between 90° and 140° west longitude, the value is also 0.37 ppmv. This typical example shows that use of the GASP data for showing compliance by statistical methods would not properly account for the expected ambient ozone values which change by as much as 0.25 ppmv during these 3 months. Even though more data points are obtained by GASP at the flight levels between 350 and 390, as presently tabulated, the required resolution elements are not provided.

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