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NASA GLOBAL ATMOSPHERIC SAMPLING PROGRAM (GASP) DATA REPORT FOR TAPES VL0010 & VL0012

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SUMMARY

Atmospheric trace constituents in the upper troposphere and lower stratosphere are being measured as part of the Global Atmospheric Sampling Program (GASP), using fully automated air sampling systems on board the NASA CV-990 research aircraft and four commercial B-747 aircraft in routine airline service.

This report is the ninth of a series of reports which describes the data currently available from GASP, including flight routes and dates, instrumentation, data processing procedures, and data tape specifications. In-situ measurements of atmospheric ozone, carbon monoxide, water vapor, and clouds, and related meteorological and flight information obtained during 690 flights of aircraft N533PA and N4711U from January 3 through October 4, 1977 are reported. Measurements of ozone levels within the first class cabin of these aircraft are also reported. These data are now available from the National Climatic Center, Asheville, NC, 28801. In addition to the GASP data, tropopause pressures obtained from time and space interpolation of National Meteorological Center (NMC) archived data for the dates of the flights are included.

INTRODUCTION

This report announces the availability of atmospheric trace constituent data obtained during 336 flights of the GASP-equipped B-747SP N533PA from January 21, 1977 through October 4, 1977 and 354 flights of B-747 N4711U from January 3, 1977 through September 20, 1977.

The objectives of the NASA Global Atmospheric Sampling Program are to provide baseline data of selected atmospheric constituents in the upper troposphere and lower stratosphere and to document and analyze these data to 1) provide a better understanding of the dynamics of the atmosphere in the region where commercial aircraft fly, and 2) provide initial value boundary conditions for atmospheric models being used to assess potential adverse effects from aircraft exhaust emissions on the natural atmosphere.

The GASP program began in 1972 with a feasibility study of the concept of using commercial airliners in routine service to obtain atmospheric data. Since then, this program has progressed from design and acquisition of hardware to collecting global data on a daily basis (refs. 1-6). Fully automated GASP systems have been operated on a United Airlines B-747, two Pan American World Airways B-747's, a Qantas Airways of Australia B-747, and the NASA CV-990 research aircraft. The GASP system design, the measurement instruments, the on-board computer for automatic control and data management, and system maintenance procedures are described in references 7 and 8. Analyses of GASP data are reported in references 9-17.

In addition to the ambient atmospheric constituent measurements, GASP began, in March 1977, to make measurements of cabin ozone levels on aircraft N533PA and N4711U. These aircraft are providing simultaneous measurements of cabin and ambient ozone on flights of varying duration, and at different flight levels, geographical locations, and seasons. Based on Occupational Safety and Health Administration (OSHA) ozone standards, and analysis of the available data (including GASP ambient ozone measurement (refs. 15 and 18) and simultaneous cabin and ambient ozone measurements from selected GASP flights (ref. 17)), the Federal Aviation Administration (FAA) has issued a Notice of Proposed Rulemaking (NPRM) regarding acceptable levels of ozone in aircraft cabins (ref. 19).

This report is the ninth in a series of reports to announce the availability of GASP data from the National Climatic Center, Asheville, North Carolina, 28801. Data for March 1975 through December 1976 are archived on tapes VL0001-VL0008 (refs. 20-26). Continuous record data obtained on Pan Am's Fiftieth Anniversary around-the-world-via-the-poles flight on October 28-31, 1977 are archived on tape VL0009 (ref. 27). For each of these tapes, the time periods covered, and the GASP aircraft from which data are archived are identified in table I. Data obtained by Pan Am N533PA from January 21-October 4, 1977 are archived on tape VL0010, and data obtained by United N4711U from January 3-September 20, 1977 are archived on tape VL0012.

DATA ACQUISITION

For each GASP flight, data acquisition begins on ascent through the 6 km altitude flight level, and terminates on descent through 6 km. A complete GASP sampling cycle is 60 minutes, divided into 12 five minute sampling segments. During alternate segments (at 10 minute intervals), air sample data are recorded for all instruments. During the intervening segments the system is in one of six different calibration cycles to allow for in-flight checks on instrument operation (if required). Whenever any calibration cycle is not needed for a given instrument, that instrument acquires air sample data during the segment. For normal GASP sampling a 16 second recording is made at the end of each five minute sampling segment.

Cassette tapes, on which the data are recorded onboard the aircraft in serial format, are transcribed to computer-compatible form for data reduction. At this stage, laboratory instrument calibration information required for data processing is included, redundant and non-usable data are removed, and the data are re-transcribed to final form and units. On the GASP archive tapes, the data are grouped by aircraft and identified by flights with the airports of departure and arrival designated by the standard three-letter airport code (ref. 28). Detailed specifications and formats for the GASP data are given in Appendix A. Data for each flight begins with an FLHT record (table A-I) to provide flight identification information. This record is followed by a series of DATA records (table A-II), one for each recording made during the flight. Summary tabulations for tapes VL0010 and VL0012 showing the route, date, number of DATA records, and constituent data available for each flight are given in tables II and III.

MEASUREMENTS

For each in-situ constituent measurement, an instrument ID number is given in the FLHT record for each flight for which constituent data are available; otherwise, ID = 'M'. In addition, each measurement has an associated TAG in each DATA record. If TAG = 'M', data are not available for that record, and the data field has been set equal to zero.

Ozone

Ozone measurements are made using an ultraviolet absorption ozone photometer (ref. 29). The concentration of atmospheric ozone is determined by measuring the difference in intensity of an ultraviolet light beam which alternately passes through the sample gas and an ozone-free zero gas (generated within the instrument). The instrument output is digital, and the register is up-dated at the end of each 20 second measuring cycle. The range of this instrument is from 3 to 20,000 ppbv (parts per billion by volume), with a sensitivity of 3 ppbv. Data from flight tests of the instrument are given in reference 3.

Prior to February 1977, GASP ozone instruments were checked (over the range 0 to 1000 ppbv) against an ozone generator which was calibrated at 1000 ppbv by the one percent neutral buffered potassium iodide (KI) method (ref. 30). Based on the average of these KI calibrations the GASP ozone instruments read the correct ozone concentrations of an air sample at 1 atmosphere pressure and 25 degrees C when the span is set at 58200.

Recent laboratory studies comparing ozone measurement techniques (refs. 31 and references therein) have reported that the KI method may actually give ozone levels which are from 10 to 30 percent high depending on the details of the procedure used. Because of this uncertainty of the KI procedure as a standard for ozone measurements, GASP ozone instruments are now calibrated by comparison with a commercial U. V. photometer maintained at Lewis as a transfer standard. This transfer standard is periodically (about every 6 months) calibrated against the Jet Propulsion Laboratory 5 meter path length U. V. photometer (ref. 31). With the span setting of the transfer standard and the GASP ozone instruments set at 58200, the JPL calibrations indicate that the GASP data are 9 percent high. To date these span settings have not been readjusted.

In-flight monitoring of the ozone instrument includes measurement of the instrument zero by flowing the sample through a charcoal filter external to the instrument, and measurement of the electronic span setting and control frequencies. The instrument is not calibrated in-flight with an ozone calibration gas due to the difficulty of generating a precisely known ozone concentration in the flight system. Periodic checks for calibration consistency are performed in the laboratory.

Ambient ozone measurement. The air sample is pressurized to nominally 100 kPa (1 atm) prior to measurement of the ozone level. The ozone readings are corrected for drift of the instrument zero by subtracting the most current zero-level reading. To account for differences in regulated pressure between GASP systems, and to account for variations in the air sample temperature and pressure during flight, the zero-corrected ozone levels are normalized to standard atmospheric pressure and to a temperature of 25 degrees C. Data are not reported if the pressure of the sample entering the ozone instrument is less than aircraft cabin pressure.

The destruction of ozone in the tetrafluoroethylene (TFE) sample lines from the inlet probe to the instrument, and in the TFE-coated diaphragm pump is periodically measured on board the aircraft under conditions simulating operation in flight. The ozone mixing ratio at

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the probe inlet (O_3, in ppbv) is expressed in terms of the measured ozone mixing ratio (O_{3m}, in ppbv) as

$$O3 = (1+a)O3m \qquad (1)$$

with the constant 'a' determined by a regression analysis on the appropriate destruction test data. For the data reported on tapes VLC010 and VLC012, the ozone destruction corrections were made using (1+a) = 1.028 and (1+a) = 1.044 respectively. The uncertainty in these approximations is ± 2 percent. The destruction constants used are given in the FLHT record for each flight (see table A-I).

In previous reports a more complicated form of equation (1) was reported (refs. 21-26) which accounted separately for destruction of ozone by thermal and wall effects (refs. 32-34). Although the percentage of the incoming ozone destroyed by wall effects decreases with increasing concentrations, the percentage of the incoming ozone destroyed by the thermal mechanism increases with increasing concentration. Since both mechanisms are likely contributing to the system destruction, it is not surprising that the destruction data are approximated well with a linear relationship which gives a constant percentage destruction.

As mentioned above, reported ozone levels have been corrected for drift of the instrument zero, for differences in the densities between the sampling and laboratory conditions, and for ozone destruction in the sample lines and pump. Zero level data appear in cal cycle 1 and are identified by a 'Z' tag. The density ratio factor is given by RHOR in the DATA records. Ozone data values reported have been calculated as follows:

$$O3 = (1+a)*(RHOR)*(O3r - O3z) \qquad (2)$$

where

O3z is the most current zero
O3r is the measured (uncorrected) ozone mixing ratio
RHOR is the density correction
(1+a) is the destruction correction (see Eq. (1))

Three ozone data values are reported in the DATA records (see table A-II). The reading at the time the recording is made is O3. The mean ozone level for the 128 seconds preceding the recording is O3A, and the standard deviation of the measured ozone levels for that period is O3S. Because for some DATA records O3 is available, but O3A and/or O3S are not, all three values are tagged separately. Note that during continuous recordings (MODE = 10, or TYPE = 'L', or TYPE = 'C') O3A = O3S = 0 and their respective tags are set equal to 'M'.

Cabin ozone measurement. For the GASP measurement of cabin ozone, the air is drawn from a 0.62 cm diameter port, located about 1.5 m above the floor on the wall of the staircase to the upper deck in the first class cabin. This port is extended about .62 cm from the wall surface to minimize drawing air from along the wall. About 6 m of 0.62 cm diameter TFE-coated tubing is used between this port and the analyzer.

Cabin ozone data are processed in a manner directly analogous to that used for the ambient ozone levels. That is, cabin ozone levels (O33, in ppbv) are calculated as follows:

$$O33=(CDENS)*(O33r-O33z) \quad (3)$$

where

O33z is the most current zero
O33r is the measured (uncorrected) ozone mixing ratio
CDENS is the density correction. Assumed air sample temperature=15 deg C at cabin pressure.

Zero level data appear in cal cycle 1, and are identified by a 'Z' tag. The density ratio factor, CDENS, is given in the DATA records for each observation, so that the raw data readings can be extracted and alternate processing schemes employed at the analysts' option.

From the beginning of the N533PA cabin ozone measurements on April 3, 1977, until the installation of a charcoal filter system on August 6, 1977, high-temperature (15th compressor stage) bleed was used intermittently for cabin air as a technique to reduce ozone levels. For data obtained after May 12th, signals are available in the GASP DATA records (BLDGND and BLDFLT, see table A-II) which indicate the use of high-temperature bleed as follows:

a) If BLDFLT > BLDGND, and BLDFLT ≤ 73, and BLDGND < 73, 15th stage bleed is on.
b) If BLDFLT ≤ BLDGND, or BLDFLT > 73, or BLDGND ≥ 73, 15th stage bleed is off.

These fields are relevant only for aircraft N533PA, and only for data obtained after May 12th. Although 15th stage bleed was used occasionally prior to that date its use was not coded into the GASP data.

Carbon Monoxide

The carbon-monoxide measurement is made with an infra-red absorption analyzer using dual isotope fluorescence. In the dual isotope fluorescence technique, alternating pulses of IR radiation spectra from a single source are produced that are an exact match of the vibrational-rotational absorption bands of $C^{12}C^{16}$ and $C^{13}C^{16}$. These two IR radiation spectra are passed through a single air-sample chamber. The CO present in the air sample (98.9% of all naturally occuring carbon-monoxide is $C^{12}O^{16}$) will absorb the $C^{12}O^{16}$ radiation but not the $C^{13}O^{16}$ radiation. Thus the $C^{13}O^{16}$ radiation pulse is a reference against which the absorption of $C^{12}O^{16}$ can be measured. After passing through the air-sample chamber, the alternating radiation pulses are converted to electrical signals by a solid-state IR detector. Ratio comparison of the two signal levels yields a voltage corresponding to the CO concentration in the air sample.

The air sample, pressurized to 100 kPa (1 atm) passes through a dessicant cartridge to remove water vapor, and through a particulate filter before admission to the air-sample chamber. Inlet pressure and temperature are measured to permit corrections for density effects. Data are normalized to standard atmospheric pressure and to a temperature of 25 degrees C. The analyzer zero-output level is monitored at 20 minute intervals by diverting the air sample through a heated, hopcalite scrubber to remove all traces of CO from the air sample. Carbon-monoxide concentrations are corrected for zero drift by subtracting the most current zero-output level as discussed below. The electronic gain of the analyzer is monitored once per hour.

Output of the analyzer is a linear 0 to 5V DC signal corresponding to the CO level of the air sample. Sensitivity, adjusted during calibration, is 250 ppbv per volt. Limit of detectability is 20 ppbv. Because a change in analyzer ambient temperature causes a zero shift, and because the data system cannot accept a negative voltage, the zero-output level is set at 2V DC. Full scale output thus corresponds to 750 ppbv.

The analyzers are calibrated with CO in nitrogen gas mixtures obtained from the National Bureau of Standards. The CO content of these mixtures is accurately known so as to serve as NBS Standard Reference Materials. The lowest concentration of CO obtainable as an NBS/SRM is about 10 ppmv. Therefore, a precision flow blender is used to dilute this mixture with proportionate amounts of CO-free nitrogen to obtain sample flows in the range of 100 ppbv to 900 ppbv. Calibrations using the diluted NBS/SRM are estimated to be accurate to within $\pm$ 2 percent.

Early in the GASP program, calibrations were also performed with nitrogen cylinders whose CO content was determined from a comparison with an NBS/SRM calibration. The use of these span gases for calibration has been discontinued because of the variability of the CO level over a period of time.

Each analyzer is calibrated prior to its installation on an aircraft. A check on this calibration is performed upon its removal to determine any change in sensitivity. Uncertainty of the CO measurement is the result of cablibration errors, change in sensitivity between calibrations, and random fluctuation of the output signal. For the data reported herein, the measurement error ranges from ± 4 to ± 10 percent of reading due to calibration error and sensitivity change. The standard error due to random fluctuation of the output signal is ± 14 ppbv.

Carbon monoxide data are processed according to the following:

$$CO = .25(RHOR)(COv-COz) \quad (4)$$

where

COz is the most current zero (mv)
COv is the local CO voltage (mv)
RHOR is the density correction

During the course of each flight, the CO zero level may vary appreciably. Because the data reduction always uses the 'most current' values available, and new COz's are obtained at nominally 20 minute intervals, COz variations can introduce errors in the reported CO mixing ratios. For example, if the true CO mixing ratio is constant, a difference of 100 mv in two consecutive zeros would result in an error of up to 25 ppbv in the reported CO level. To assist in identifying data which may have a significant error due to zero level variation, any COz reading which differs from the previous zero by more than 100 mv has had the normal 'Z' tag replaced with a 'C' tag. CO data readings that occur between 2 zeros that differ by more than 200 mv have been edited out.

Three carbon monoxide data values are reported in the DATA records (see table A-II). The reading at the time the recording is made is CO. The mean carbon monoxide level for the 128 seconds preceding the recording is COA, and the standard deviation of the measured carbon monoxide levels for that period is COSD. Because for some DATA records CO is available, but COA and/or COSD are not, all three values are tagged separately. Note that during continuous recordings (MODE = 10, or TYPE = 'L', or TYPE = 'C'), COA = COSD = 0 and their respective tags are set equal to 'M'.

Water Vapor

Atmospheric water vapor is measured with an aluminum oxide dew-frost point hygrometer (ref. 35). The sensing element consists of a small strip of aluminum which is anodized to provide a porous oxide layer. A very thin coating of gold is evaporated over this structure. The aluminum base and the gold layer form the two electrodes of a capacitor whose impedance varies with the amount of water adsorbed on the porous surface.

This instrument provides dew-frost point temperatures (DFPT) from -110 degrees C to +40 degrees C for air sample temperatures from -65 degrees C to +40 degrees C. The air temperature is measured with a thermistor mounted on the sensor probe. The sensors are calibrated by the manufacturer, with a specified DFPT accuracy of ± 3 degrees C for -110 degrees C ≤ DFPT ≤ -60 degrees C and ± 2 degrees C for -60 degrees C < DFPT ≤ +40 degrees C.

The sensors are re-calibrated in an environmental chamber at NASA-Lewis prior to installation on the aircraft. Calibration gas is provided by blending room air (DFPT = 10 degrees C), laboratory service air (DFPT = -40 degrees C), and liquid nitrogen boil-off (DFPT = -70 degrees C). The calibration is performed by comparing the aluminum oxide sensor output with the dew-frost point temperature measured by a cooled-mirror hygrometer. Because the sensor output varies with air-sample temperature, calibration is performed at room temperature, -20 degrees C and -40 degrees C. Upon removal from the aircraft, sensors are re-calibrated again at room temperature. Data are used only if the recalibrations are within the limits specified above.

The water vapor sensor is mounted in a de-iced airscoop of the type used on B-747 aircraft for measurement of outside air temperature. The mounting of the sensor and the thermistor within the scoop is similar to that of the "B-57 Air Sampler" described in reference 36. GASP flight test data using this mounting are reported in reference 3. Because the scoop mount results in measurement at stagnation conditions, the water vapor-pressure calculated from the indicated DFPT is corrected by the ratio of static to total pressure, and then used to calculate the ambient water-vapor mixing ratio (in parts per million by weight, ppmw) and the ambient air dew-frost point.

Laboratory tests on the aluminum oxide hygrometer have shown several serious deficiencies which must be considered in evaluating the flight data. In these tests the response of the aluminum oxide hygrometer was compared to two cooled-mirror hygrometers; an aircraft-type undergoing response testing with the aluminum oxide hygrometer, and the laboratory standard cooled-mirror hygrometer mentioned previously. The DFPT readings of the two cooled-mirror hygrometers generally agreed to within 1 degree C. Their response was faster than the response of the aluminum oxide hygrometer by about a factor of 10, thus the cooled-mirror hygrometer data were used as actual dew-frost point temperature.

Response to step change in sensor temperature at constant DFPT. As mentioned in a previous paragraph, the indicated DFPT is dependent on the equilibrium air-sample temperature. This effect is included in the data reduction through the use of temperature dependent calibration curves. In addition, however, the sensor has been found to have a transient response to changes in ambient temperature at constant DFPT (see ref. 3). This response is dependent on both the magnitude of the temperature change, and the rate of change. In response to a decrease in temperature of 20 degrees C at the rate of 2 degrees C/min, the indicated DFPT decreased during the temperature transient to less than the actual DFPT, and then slowly increased toward the true value with a time constant of approximately an hour. Thus a decreasing ambient temperature at constant dew-frost point will result in indicated DFPT values which are too low, and conversely increasing ambient temperature at constant dew-frost point will result in indicated DFPT values which are too high.

Response to step change in DFPT at constant sensor temperature. The time constant (to achieve 63 percent of a step change in DFPT) of the aluminum oxide hygrometer was found to vary from 8 to 30 minutes depending on the equilibrium air-sample temperature and the magnitude and direction of the step change in DFPT. In going from wet-to-dry conditions, the indicated DFPT was higher than the actual DFPT, and conversely, in going from dry-to-wet the indicated DFPT was lower than the actual DFPT.

Sensor response during simulated climbout. The most severe gradients in ambient temperature and water vapor are encountered as the aircraft climbs to cruise altitude, with ambient temperature and DFPT both decreasing. The response characteristics described in the preceding paragraphs suggest that the aluminum oxide hygrometer would indicate too high a DFPT in response to the decreasing humidity, but would indicate too low a DFPT in response to the decreasing temperature. Thus the possibility exists for compensating effects.

Response following saturation. The recovery of the sensor from saturated conditions, as would be encountered with the passage of the aircraft through clouds, was found to be very slow. Laboratory test data showed that, after having been subjected to saturated conditions for 40 minutes, the aluminum oxide hygrometer continued to indicate saturation for an additional 30 minutes after the air was no longer saturated. The test was terminated at this time, and no data are available for the time required for the aluminum oxide hygrometer reading to return to the true DFPT. This slow response characteristic is apparent in the flight data also whenever prolonged saturation is indicated.

Because of the necessity of interpreting the water vapor measurements in terms of the response characteristics described above, and in relation to other measurements, water vapor data are reported only for flights for which data for at least one other constituent are also available. On the tape, water vapor data are reported as both dew-frost point temperature (DFPTA) and water vapor mixing ratio (WVMRA) in the DATA records (see table A-II). Whenever the indicated dew-frost point temperature is equal to the static air temperature, DFTAGA = 'S', as a flag to the fact that saturated conditions were encountered.

Cloud Detector and Light Scattering Particles

Flight test experience with the light-scattering particle counters included in the GASP systems (see ref. 3) has indicated that flight through clouds results in a significantly greater count of the largest size particles (D > 3 micrometers) than is obtained in clear air. A simple cloud detector is thus available by observing the counting rate of the largest size particles. This signal is monitored for 256 seconds prior to each data recording. The time (in seconds) during which the cloud rate, CLDRT, is greater than a preset level, CLDHI, is interpreted as time in clouds (CLSEC; see table A-II). The CLDHI level was programmed on board the United airliner based on visual observation of a light haze, and corresponds to a local particle density (for D > 3 micrometers) of 66,000 particles/cubic meter. If CLSEC > C, CLTAG = 'C'. If cloud data are not available, CLTAG = 'M'.

The number of cloud encounters (CLAYR; see table A-II) is also available. Whenever clouds are detected (CLDRT > CLDHI), this is interpreted as a continuous encounter until cloud-free air is detected. This determination requires a second preset level, CLDLO. If n is the number of times that the cloud rate crosses CLDHI and CLDLO (or CLDLO and CLDHI) in succession, then CLAYR = (n+1)/2. For the data reported herein CLDLO was set at CLDHI/8.

Except for clouds, data from the light scattering particle counters have not been reported previously due to a rather large uncertainty in the total particle count resulting from nonuniform illumination of the sample volume, and high noise-to-signal ratios on channels measuring particles less than 1.4 microns in diameter. However, in response to requests, and as a supplement to the time-in-clouds data, measured particle densities, in particles/ambient cubic meter, are reported for particles > .45, > 1.4, and > 3 microns in diameter. The latter channel is the one used by the cloud detector, although the particle densities are obtained over a 60 second sampling period, whereas the sampling time for the cloud detection is 256 seconds.

The particle density data reported are subject to variations between instruments due to differences in illumination of the sample volume. Our preliminary indication is that the resultant difference in magnitude may be on the order of ± 1/2 cycle (X or / by a factor of 3). A detailed mapping of the sample volume light field has not been made for any of the instruments flown on GASP B-747's nor has any attempt been made to correct or normalize the data. It should also be noted that the minimum detectable particle density is approximately 30 particles/ambient cubic meter.

Particle density and cloud data are reported when available in the DATA record for each sampling period. There are no calibration cycles for this instrument, so all CYCLES are data. Since a pre-recording sampling period is required for these measurements, data do not appear for continuous recordings (MODE = 10, or TYPE = 'L'). For all flights in which particle or cloud data are reported, the instrument ID number is given in the FLHT records, otherwise PCSID = PCEID = 'M'.

Filter Samples

Atmospheric concentration data for sulfates, nitrates, chlorides, and fluorides are provided by exposure and subsequent laboratory analysis of filter samples. Filter exposures are programmed to occur at altitudes greater than 9.6 kilometers on the first flight of every third calendar day, provided that an unexposed filter is available. Filters are normally exposed for two hours, although shorter exposures may occur if the aircraft descends to an altitude less than 9.6 kilometers before two hours have elapsed.

Filter data are included in the FLHT record (table A-I) for each flight. If an exposure occurs (FILEX = 'T'), and if data from the laboratory analysis are available (FDATA = 'T'), the date, time, altitude, and position for the beginning and end of the exposure period, the type of filter, and the constituent data are reported. The data from the laboratory analysis (in micrograms/filter) are divided by the integrated filter flow rate (in ambient cubic meters), and data are reported as micrograms/cubic meter.

Multi-filter apparatus. The multi-filter apparatus is an enclosed slide mechanism which accommodates a filter magazine containing eight individual filter holders. Filter insertion, retraction, and advancement are automatic upon command from the GASP system control unit. Airflow for the apparatus is supplied from an external probe (25 mm diameter) and expanded in the sampling duct (67 mm diameter).

Filter preparation. All filter exposures for which data have been reported to date were made using IPC-1478 filter paper. This is a low resistance, cellulose type material made from second cut cotton linters with cotton scrim backing for added strength. This paper was specially designed for high altitude air sampling and thus features low pressure drop, high flow rate, and good retention for small airborne particles. This paper is impregnated with dibutoxyethylphthalate during manufacture to improve collection efficiency.

Prior to use, this paper must be washed to remove residual amounts of water soluble contaminants (ref. 37). Semi-automatic washing apparatus is available to process up to 25 filters at one time. An auxiliary tray is loaded with individual filters each sandwiched between stainless steel support screens. The washing procedure is essentially as follows:

a) Immerse filters in carbonate buffer solution (0.024M sodium carbonate and 0.030M sodium bicarbonate) and soak for 5-10 minutes.
b) Rinse in deionized water about 3 times.
c) Immerse in 0.1M acetic acid solution and soak for 3-5 minutes.
d) Rinse in deionized water about 3 times.
e) Wash filter group at least 4 times in automatic-cycling washer system using deionized water saturated with dibutoxyethylphthalate.
f) Dry in washer chamber with clear filtered air warmed to 36-40 degrees C.
g) Place filters in dessicator and vacuum dry overnight.

Samples from each wash group are analyzed for background levels of contamination to verify the washing procedure.

Upon acceptance, the group of filters is transferred to a clean room for filter holder assembly and sealing. The filter holder assemblies are sealed in ultra-clean polyethylene bags to prevent contamination during shipping and handling. After filter exposure and removal from the aircraft, each magazine is re-bagged and carefully re-packaged for return shipment and analysis.

__Filter analysis.__ Prior to analysis, each filter is cut into four equal segments for separate constituent analysis, if necessary, and for comparative repeat analyses. Sulfate, nitrate, chloride, and fluoride ion concentrations are determined by ion chromatography. The basics of this analysis technique are described in references 38-40. This procedure requires wetting a filter segment with 10 ml of carbonate buffer (0.0024M sodium carbonate; and 0.003M sodium bicarbonate) as the extracting solution. A 0.5 ml sample is injected into the ion chromatograph flow system, which includes a carbonate eluent background, an anion separator column, a suppressor column for anion conversion to its acid form, and a conductivity detector.

The instrument is calibrated using solutions with known concentrations of the various anions in the extractant. Calculations of the anion concentration are made by comparing the constituent peak heights from the sample chromatograms to those obtained with the standard calibrating solution. The fluoride ion identification is still tentative. Further verification is necessary because the possibility of an interferring agent has not been completely eliminated.

The net amount of any constituent on a filter was deduced by subtracting an average background level determined from several reference filter blanks which were removed from unexposed filter holder assemblies. The background levels in micrograms per filter were approximately 1.9 for sulfate, 7.7 for nitrate, 3.3 for chloride, and 3.3 for fluoride. No other adjustment for any contamination due to handling and shipping was made. A summary of the filter data on tape VL0012 is provided in table IV.

FLIGHT AND METEOROLOGICAL DATA

In addition to the air sample measurements, aircraft flight data are obtained with each data recording to precisely describe conditions when the data are acquired. Aircraft position, heading, and the computed wind speed and direction are obtained from the inertial navigation system (INS). Altitude, air speed, and static air temperature are collected from the central air data computer (CADC) in the aircraft. Date and time are provided by a separate GASP clock-calendar unit. The above parameters are obtained once per DATA record. The vertical acceleration of the aircraft is obtained from the aircraft flight recording system at the rate of 8 per second which provides 32 data points for each DATA record. The formats and units for these data are given in table A-II.

The programming for the GASP systems initiates a continuous recording whenever the vertical acceleration of the aircraft exceeds preset limits. This recording then continues until the acceleration has remained within limits for one minute. These limits are currently set at 0.8 and 1.2 G's to correspond to "light-to-moderate" turbulence. Continuous recordings triggered by an acceleration limit are identified by TYPE = 'L', and the number of times (out of 32) that the acceleration has exceeded the limits is given by NE (see table A-II). For any flight during which one or more limit recordings occurred, LIMCHK = 'T' in the FLHT record for that flight (see table A-I).

For each DATA record, the date, time, latitude, and longitude have been used to calculate the solar elevation angle (ref. 41). This is designated as ZEN in table A-II. Note that -90 deg < ZEN < +90 deg, where ZEN = +90 deg if the sun is directly overhead. The flight altitude is used to determine the solar elevation angle at sunrise and sunset, and day and night observations are identified by SUNTAG = ' ' and 'N' respectively. If GMT is not available for a given record (GMTTAG = 'M'), SUNTAG = 'M', and ZEN = 0.

The primary purpose of the flight and meteorological data is to provide supporting information for the constituent measurements. However, these data, particularly the wind and temperature measurements, may be of interest even where constituent data are not available, and therefore are reported for all GASP flights.

TROPOPAUSE PRESSURE DATA

The National Meteorological Center (NMC) is presently maintaining a library of gridded meteorological data fields. Among these are tropopause pressures, available on a twice daily basis (0000 and 1200 GMT), gridded into a 37 by 144 array for each hemisphere (2.5 degree intervals in both latitude and longitude).

The tropopause pressure corresponding to each GASP data location is obtained by time and space interpolation from the NMC arrays. These pressures and the corresponding geopotential heights for the standard atmosphere are included in the GASP DATA records (TRPRMB and TRPRHM in table A-II). For normal interpolations (within a 12 hour interval) TPTAG = ' '. If however, NMC data are missing for one reporting period such that the interpolation must be performed within a 24 hour interval, TPTAG = 'L'. If NMC data are missing for two or more consecutive reporting periods the time interpolation is not performed. In this case if the time of the GASP data point is within six hours of an NMC reporting period for which data are available, the space interpolated values at that reporting period are returned and TPTAG = 'E', but if the time of the GASP data point is not within 6 hours of an NMC reporting period for which data are available, TRPRMB = TRPRHM = 0, and TPTAG = 'M'. For GASP records in which the observation time is not available, 1200 GMT has been assumed for tropopause interpolation, and TPTAG = 'T'. Whenever tropopause pressure values are available, DELP = TRPRMB - PAMB, and DELHGT = ALTMAV - TRPRHM are also reported.

Tropopause pressures in the NMC 2-hemisphere arrays are determined by means of the Flattery global analysis method (ref. 42). This procedure makes use of the vertical temperature profiles calculated for each NMC grid point, and tests the slope of the profile curve upwards from the first mandatory pressure level. Although the two hemisphere arrays were not available prior to July 1977, the Flattery analysis scheme was used for tropopause pressures archived in the NMC 65 by 65 arrays prior to December 17, 1975. Tropopause pressures determined by this method have been shown previously to correlate well with GASP constituent data (refs. 9-15).

CABIN OZONE DATA ANALYSES

Summary Tabulations

Because of the interest expressed by industry and government in the GASP cabin and ambient ozone measurements, a summary of these data from tapes VL0010 and VL0012 is given in tables V and VI respectively. The parameters presented were selected based on the requirements of reference 19, and include for each flight the route, departure date, data time interval, and cabin and ambient ozone data. All ozone levels are mixing ratios expressed in parts per million by volume (ppmv).

Entries appear for all flights from tapes VL0010 and VL0012 for which cabin ozone measurements are available. The number of these observations for each flight is given in the column headed ND following the departure date. The elapsed time from the first to the last cabin ozone measurement for each flight is given in the TOTAL hours column. An 'M' next to the TOTAL indicates that the observation time was not available for one or more measurements during the flight. Note that since the GASP system does not obtain data at altitudes below 6 km (FL195), the TOTAL time shown here is less than the segment time specified in ref. 19. The time during which the cabin ozone level exceeded 0.1 ppmv is given in the O3>0.1 column.

The mean (MEAN) and mean + 1 standard deviation (M+SD) cabin ozone levels are time weighted averages over the time period given by TOTAL. The maximum observed cabin ozone level is self-explanatory. The maximum time weighted average cabin ozone level during any two hour interval in the flight is given under 2HR. If TOTAL < 2 hours, the value appearing in the 2HR column is the flight mean.

Next, the number of data points, time-weighted mean and mean + 1 standard deviation, and maximum values of ambient ozone are given for each flight. Note that for some flights listed, ambient ozone data are not available.

For measurement periods in which both cabin and ambient ozone data are available, and in which the ambient ozone level is greater than 0.1 ppmv, the ratio of cabin to ambient ozone is calculated. The number of these data points, as well as the mean and standard deviation, are given following the ambient ozone data for each flight.

The final column in table V indicates the compressor bleed/filter status, when available, for aircraft N533PA. A 'B' in this column for flights after 5/12/77, indicates that high-temperature (15th compressor stage) bleed was used for cabin air during one or more measurement periods in the flight. Because documentation is not available on the use of 15th stage bleed prior to May 12th, these flights are identified by a '?', although the cabin/ambient ozone ratios suggest that high temperature bleed was used on several flights. An 'F' in the final column identifies flights after a charcoal filter system was installed on 8/6/77.

Discussion

Although a comprehensive analysis of the GASP cabin and ambient ozone data must await the availability of data currently in preparation, a few observations can be made based on the data included on tapes VL0010 and VL0012.

First, cabin ozone is not likely to be a problem unless the aircraft is flying through high levels of ambient ozone. These conditions are encountered most frequently at high altitudes, high latitudes, and in the winter and spring (ref. 15), since ambient ozone levels increase with altitude above the tropopause, and the height of the tropopause decreases with increasing latitude and is lowest in the early spring. Thus it is not surprising that many of the reports of passenger and crewmember discomfort which alerted industry and government to the cabin ozone problem in the winter of 1976-77 came from aircraft which were in use on high-altitude, long duration flights at northerly latitudes.

N533PA. Figure 1 (from VL0010, file 2, flight 67) shows the GASP cabin and ambient ozone records for a flight from London (LHR) to New York (JFK) on 5/15/77. Most of this flight was at FL390 at latitudes from 45N to 60N. During this time, the minimum and maximum ambient ozone levels were .210 and .730 ppmv respectively. Cabin ozone levels varied from .230 ppmv to .560 ppmv, and the local ratio of cabin to ambient ozone ranged from 0.65 to values greater than 1.0. (Although the measurements of cabin and ambient ozone are simultaneous, the cabin level at any instant would not be expected to correlate exactly with the ambient level at the same instant due to the recirculation and exchange rate of cabin air.)

This figure indicates that at least for this flight, on this aircraft, there was an ozone problem in terms of the specifications in reference 19. Table V gives a summary of the data for this as well as the other 194 flights of N533PA from 4/6-8/12/77 for which cabin ozone measurements are available. In addition to documenting the results, these figures indicate the effectiveness of several techniques implemented to reduce cabin ozone levels.

One method of destroying ozone is to heat the inlet air to a higher temperature. This was accomplished on N533PA by bleeding air for the cabin from the 15th stage of the engine compressor instead of the lower temperature 8th compressor stage normally used. A flight during which 15th stage bleed was used is shown in figure 2 (from VL0010, file 3, flight 1). This flight was from New York (JFK) to Tokyo (HND) on 6/1/77. The GASP recorder was operated continuously during this flight; the data shown here are averages over 12 minute intervals. High temperature bleed was used for 6.25 hrs beginning at 2236 GMT.

Since obtaining cabin air from high pressure compressor stages imposes a fuel penalty, other methods of ozone destruction were sought. On 6/6/77 the aircraft air conditioning system was modified to increase the recirculation of air in the cabin. Although this did cause a decrease in the ratio of cabin to ambient ozone, it did not solve the problem, and high temperature bleed continued to be used frequently. On 8/6/77, a charcoal filter system was installed in the inlet air ducts. Data from the twelve flights following this installation (VL0010, file 4, flights 85-96) show a marked decrease in the ratio of cabin/ambient ozone.

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The time history of the ozone retention on N533PA is given in figure 3. The plotted values are averages for each flight, with bleed-off and bleed-on data shown separately. This chronology is summarized in table VII. The as-manufactured aircraft, without high temperature bleed in use showed an average retention (cabin/ambient) ratio of .825. With high temperature bleed in use this ratio dropped to .268. After the air recirculation system modification (without 15th stage bleed), the retention ratio was .552, or 27 percent lower than for the unmodified aircraft. For the modified configuration with high temperature bleed, the mean retention ratio was .221. Finally, after the installation of the charcoal filter, the retention ratio was down to .056. Two important factors, which can only be evaluated when additional data become available, are the long term effectiveness of the filter system, and its effectiveness during a "high-ozone season".

N4711U. The GASP cabin and ambient ozone data from tape VL0012 summarized in table VI document the ozone levels encountered by a B-747-100 from 3/26-6/15/77. This data set is not complicated by the use of high temperature bleed or air conditioning system modifications as there were none. Figure 4 shows a typical flight record (VL0012, file 2, flight 14) from this aircraft. For all N4711U flights for which both cabin and ambient ozone data are available, the mean ratio of cabin/ambient ozone was .465. The 270 hours of cabin ozone data for the 82 flights in table VI represent an average of 3.3 hrs/flight, with the cabin ozone level greater than 0.1 ppmv 29 percent of the time.

In terms of the rule proposed in ref. 19 for currently certified aircraft, we have the following: a) the proposed maximum level for cabin ozone of .3 ppmv was exceeded on 17 percent of the flights (14/82), and b) a segment time-weighted average of .1 ppmv was exceeded on 17 percent of the flights of more than 3 hr scheduled duration (13/78). The first of these is obtained directly from the values in table VI, but the second requires some further explanation. In table VI there are 24 flights of more than 3 hours schedule time for which the MEAN is greater than .1 ppmv. For each of these we assumed a (typical tropospheric) ozone mixing ratio of .05 ppmv for the time difference between the scheduled flight time (FLTET) and the data time (TOTAL), and calculated a time-weighted average, FLTAVE, for the scheduled time as follows:

$$\text{FLTAVE} = \frac{(\text{TOTAL}*\text{MEAN})+((\text{FLTET}-\text{TOTAL})*.05)}{\text{FLTET}}$$

This value exceeded .1 ppmv on 13 flights.

For new aircraft, the proposed rule would require that the time-weighted average ozone level be less than .1 ppmv during any two hour interval. If the data in table VI were for a new aircraft, the proposed rule would have been exceeded on 46 percent of the flights.

CONCLUDING REMARKS

Atmospheric constituent data and related flight and meteorological data obtained during flights of GASP-equipped aircraft N533PA and N4711U from January 21 through October 4, 1977, and from January 3 through September 20, 1977, respectively, are now available. These data may be obtained on GASP tapes VLC010 and VLC012 from the National Climatic Center, Federal Building, Asheville, NC, 28801. Flight routes and dates, instrumentation, data processing procedures, and data tape specifications and formats are discussed in this report.

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TABLE I - GASP DATA ON TAPES VLCC01-VL0009

Tape	File	Aircraft	Dates	FLHT*	DATA+	Data**	Ref
VL0001	1	N655PA	3/11/75- 3/30/75	43	1919	O	20
VL0002	1	N4711U	3/23/75-10/21/75	159	7274	O,W	21
VL0003	1	N655PA	5/02/75- 5/30/75	49	2173	O	22
VL0004	1	N4711U	12/26/75- 3/07/76	73	3572	O,W,F	23
"	2	N655PA	1/22/76- 3/25/76	66	3757	O,F,B	23
VL0005	1	N4711U	3/29/76- 5/29/76	100	4892	O,W	24
"	2	N655PA	3/25/76- 5/13/76	86	4716	O,B	24
"	3	N533PA	4/13/76- 6/13/76	28	2640	O,B	24
VL0006	1	N655PA	7/11/76- 9/26/76	131	8724	O,F,B	25
"	2	N533PA	7/08/76- 9/14/76	45	3594	O,B	25
"	3	VH-EBE	7/13/76- 8/31/76	69	3977	O	25
VL0007	1	N712NA	10/28/76-11/18/76	14	3481	O	26
"	2	N4711U	11/24/76-12/30/76	75	3756	O,F	26
"	3	N533PA	9/30/76- 1/02/77	146	13773	O,W	26
VL0008	1	N655PA	10/15/76- 1/10/77	165	10122	F	26
	2	VH-EBE	9/26/76- 1/09/77	286	15525		26
VL0009	1	N533PA	10/28/77-10/29/77	1	9162	O,C,A,P,Z	27
"	2	N533PA	10/29/77-10/29/77	1	8890	O,C,A,P,Z	27
"	3	N533PA	10/29/77-10/30/77	1	11487	O,C,A,P,Z	27
"	4	N533PA	10/30/77-10/31/77	1	9640	O,C,A,P,Z	27

* Number of flights
\+ Number of DATA records
** Constituent measurements:
- C - Ozone
- W - Water vapor
- F - Filter data
- B - Sample bottle data
- C - Carbon monoxide
- A - Condensation nuclei
- E - Particles and/or clcuds
- Z - Cabin ozone

TABLE II - GASP FLIGHTS ON TAPE VL0010

A) FILE 1 (PANAM-N533PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA*	Data**
1	GP185	JFK-HND	1/21/77	1729-0613	150	O W P
2	"	HND-LAX	1/22/77	0936-1758	111	O W P
3	"	LAX-HND	1/22/77	2220-0830	142	O W P
4	"	HND-JFK	1/23/77	1206-2327	205	O W P
5	"	JFK-BAH	1/25/77	0009-1054	124	O W P
6	"	BAH-JFK	1/26/77	0732-2056	158	W P
7	"	JFK-HND	1/28/77	1708-0614	235	O W P
8	"	HND-LAX	1/29/77	0938-1812	135	O W P
9	GP188	JFK-SFO	2/ 2/77	2319-0406	129	W P
10	"	SFO-AKL	2/ 3/77	0636-1812	171	
11	"	AKL-SYD	2/ 3/77	2008-2254	44	W P
12	"	SYD-AKL	2/ 4/77	0537-0747	26	W P
13	"	AKL-SFO	2/ 4/77	0945-2033	141	W P
14	"	SFO-AKL	2/ 5/77	0634-1830	210	
15	"	AKL-SYD	2/ 5/77	2041-2251	25	
16	"	SYD-SFO	2/ 6/77	0547-1823	110	
17	"	SFO-JFK	2/ 6/77	2045-0050	50	
18	"	JFK-BAH	2/ 7/77	2354-1047	202	
19	"	BAH-JFK	2/ 9/77	0735-2019	150	
20	"	JFK-GIG	2/11/77	0238-1047	72	
21	"	GIG-JFK	2/12/77	0225-1051	80	
22	"	JFK-HND	2/12/77	1749-0629	107	
23	"	HND-JFK	2/14/77	1201-2307	89	
24	"	JFK-HND	2/15/77	1742-0624	121	
25	"	HND-LAX	2/16/77	0949-1725	55	
26	"	LAX-HND	2/16/77	2222-0847	80	
27	GP193	JFK-GIG	2/18/77	0301-1059	56	
28	"	GIG-JFK	2/19/77	0227-1055	68	
29	"	JFK-HND	2/19/77	1751-0611	90	
30	"	HND-LAX	2/20/77	0951-1746	75	
31	"	LAX-HND	2/20/77	2223-0838	77	
32	"	HND-JFK	2/21/77	1206-2309	79	
33	GP194	JFK-HND	2/26/77	1734-0630	119	
34	"	HND-LAX	2/27/77	0947-1754	52	
35	"	LAX-HND	2/27/77	2236-0833	86	
36	"	HND-JFK	2/28/77	1158-2302	97	
37	"	JFK-HND	3/ 1/77	2342-0611	48	
38	"	HND-LAX	3/ 2/77	0937-1808	71	
39	"	LAX-HND	3/ 2/77	2222-0937	89	
40	"	HND-JFK	3/ 3/77	1206-2326	145	
41	"	JFK-HND	3/ 4/77	1741-2309	36	
42	GP209	JFK-BAH	3/22/77	0001-1121	134	O W
43	"	BAH-JFK	3/23/77	2121-0925	155	O W P
44	"	JFK-HND	3/24/77	1724-0644	155	O W
45	"	HND-LAX	3/25/77	1016-1831	95	O W P

TABLE II - A) VL0010, FILE 1 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
46	GP209	LAX-HND	3/25/77	0000-0000M	144	O W
47	"	HND-JFK	3/26/77	1308-2357	163	O W P
48	"	JFK-GIG	3/27/77	0335-1136	109	O W
49	"	GIG-JFK	3/28/77	0201-1051	104	
50	GP206	JFK-DFW	3/28/77	1606-1845	52	W P
51	"	DFW-HNL	3/28/77	2042-0407	66	W P
52	"	HNL-PPG	3/29/77	0559-1039	54	W P
53	"	PPG-PPT	3/29/77	1217-1432	26	W P
54	"	PPT-PPG	3/29/77	1906-2122	42	W P
55	"	PPG-HNL	3/29/77	2324-0339	51	W P
56	"	HNL-DFW	3/30/77	0616-1206	66	W P
57	"	DFW-JFK	3/30/77	1406-1606	24	W P
58	"	JFK-SFO	3/30/77	2257-0413	80	W P
59	"	SFO-AKL	3/31/77	0636-1842	184	W P
60	"	AKL-SYD	3/31/77	2041-2311	28	
61	"	SYD-AKL	4/ 1/77	0542-0742	24	
62	"	AKL-SFO	4/ 1/77	0954-2058	132	
63	GP210	SFO-AKL	4/ 2/77	0638-1832	142	
64	"	AKL-SYD	4/ 2/77	2038-2303	30	
65	"	SYD-SFO	4/ 3/77	0601-1821	146	
66	"	SFO-JFK	4/ 3/77	2142-0207	50	
-----					6586	

\+ Number of DATA records
M GASP GMT not available for one or more data points
** Constituent measurements: O - Ozone
W - Water vapor
P - Particles and/or clouds

TABLE II - GASP FLIGHTS ON TAPE VL0010

B) FILE 2 (PANAM-N533PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA*	Data**	
1	GP211	JFK-JFK	4/ 6/77	1323-1517	80		P Z
2	"	JFK-HND	4/ 6/77	1801-0646	152		P Z
3	"	HND-LAX	4/ 7/77	0949-1824	101		P Z
4	"	LAX-HND	4/ 7/77	2222-0822	118		P Z
5	"	HND-JFK	4/ 8/77	1204-2324	132		P Z
6	"	JFK-GIG	4/ 9/77	0227-1047	98		P Z
7	"	GIG-JFK	4/10/77	0147-1017	100		P Z
8	"	JFK-HND	4/10/77	1744-0625	177		P Z
9	"	HND-LAX	4/11/77	0940-1800	98		P Z
10	"	LAX-HND	4/11/77	2219-0849	123		P Z
11	"	HND-JFK	4/12/77	1210-2339	147		P Z
12	GP212	JFK-HND	4/13/77	1724-0604	148		P Z
13	"	HND-LAX	4/14/77	0959-1830	97		P Z
14	GP221	LAX-HND	4/14/77	2219-0859	126		P Z
15	"	HND-JFK	4/15/77	1207-2342	135		P Z
16	"	JFK-GIG	4/16/77	0254-1055	98		P Z
17	"	GIG-JFK	4/17/77	0201-1035	103		P Z
18	"	JFK-HND	4/17/77	1734-0653	174		P Z
19	"	HND-LAX	4/18/77	1611-0038	95		P Z
20	"	LAX-HND	4/19/77	0328-1430	144		P Z
21	"	HND-JFK	4/19/77	1630-0332	146		P Z
22	GP217	JFK-HND	4/20/77	1800-0651	153		P Z
23	"	HND-LAX	4/21/77	1029-1851	95		P Z
24	GP224	LAX-HND	4/21/77	2221-0830	122		P Z
25	"	HND-JFK	4/22/77	1213-2338	136		P Z
26	"	JFK-GIG	4/23/77	0253-1058	94		P Z
27	"	GIG-JFK	4/24/77	0221-1104	116		P Z
28	"	JFK-HND	4/24/77	1635-0525	152		P Z
29	"	HND-JFK	4/25/77	1013-2143	135		P Z
30	"	JFK-HND	4/26/77	1655-0543	195	O	P Z
31	"	HND-LAX	4/27/77	0821-1706	130	O	P Z
32	"	LAX-HND	4/27/77	2021-0641	117	O	P Z
33	"	HND-JFK	4/28/77	1035-2136	130	O	P Z
34	GP225	JFK-HND	4/29/77	1629-0525	183	O	P Z
35	"	HND-LAX	4/30/77	0830-1651	143	O	P Z
36	"	LAX-HND	4/30/77	2017-0602	114	O	P Z
37	"	HND-JFK	5/ 1/77	0950-2118	132	O	P Z
38	"	JFK-DFW	5/ 2/77	1509-1737	46	O	P Z
39	"	DFW-HNL	5/ 2/77	1938-0234	96	O	P Z
40	"	HNL-PPG	5/ 3/77	0502-0932	53	O	P Z
41	"	PPG-PPT	5/ 3/77	1105-1322	44	O	P Z
42	"	PPT-PPG	5/ 3/77	1818-2043	29	O	P Z
43	"	PPG-HNL	5/ 3/77	2224-0249	52	O	P Z
44	"	HNL-DFW	5/ 4/77	0526-1143	89	O	P Z
45	"	DFW-JFK	5/ 4/77	1333-1543	25	O	P Z

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TABLE II - B) VLOC10, FILE 2 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**			
46	GP226	JFK-SFO	5/ 4/77	2232-0327	77	O		P	Z
47	"	SFO-AKL	5/ 5/77	0549-1756	163	C		P	Z
48	"	AKL-SYD	5/ 5/77	2008-2243	32	O		P	Z
49	"	SYD-AKL	5/ 6/77	0507-0707	22	C		P	Z
50	"	AKL-SFO	5/ 6/77	0927-2017	129	C		P	Z
51	"	SFO-JFK	5/ 8/77	1949-0033	67	C		P	Z
52	"	JFK-DFW	5/ 9/77	1745-2010	27	O		P	Z
53	"	DFW-HNL	5/ 9/77	2234-0603	104	C		P	Z
54	"	HNL-PPG	5/10/77	0807-1254	93	O	C	P	Z
55	"	PPG-PPT	5/10/77	1435-1640	21	C		P	Z
56	"	PPT-PPG	5/10/77	1842-2113	31	O		P	Z
57	"	PPG-HNL	5/10/77	2243-0258	49	O		P	Z
58	"	HNL-DFW	5/11/77	0548-1143	99	O		P	Z
59	"	DFW-JFK	5/11/77	1319-1533	41	C		P	Z
60	"	JFK-LHR	5/13/77	2340-0505	65	O	C	P	Z
61	"	LHR-AMS	5/14/77	0658-0707	3	O		P	Z
62	"	AMS-LHR	5/14/77	1004-1019	4	O		P	Z
63	"	LHR-JFK	5/14/77	1255-1910	75	O	C	P	Z
64	"	JFK-LHR	5/15/77	0013-0541	63	O		P	Z
65	"	LHR-AMS	5/15/77	0718-0728	3	O		P	Z
66	"	AMS-LHR	5/15/77	0950-1000	3	O		P	Z
67	"	LHR-JFK	5/15/77	1226-1831	73	C	C	P	Z
68	GP233	JFK-DFW	5/16/77	1519-1729	11	O		P	Z
69	"	DFW-HNL	5/16/77	1934-0250	46	O		P	Z
70	"	HNL-PPG	5/17/77	0506-0946	16	O		P	Z
71	"	PPG-PPT	5/17/77	1147-1312	6			P	
72	"	PPT-PPG	5/17/77	1826-2044	12	O		P	Z
73	"	PPG-HNL	5/17/77	2308-0303	17	O		P	Z
74	"	HNL-DFW	5/18/77	0656-1241	24	O		P	Z
75	"	DFW-JFK	5/18/77	1432-1647	9	O		P	Z
76	"	JFK-SFO	5/18/77	2254-0330	23	O		P	Z
77	"	SFO-AKL	5/19/77	0601-1748	64	C		P	Z
78	"	AKL-SYD	5/19/77	1942-2257	12	O		P	Z
79	"	SYD-AKL	5/20/77	0505-0705	14	C		P	
80	"	AKL-SFO	5/20/77	0927-1957	58	O		P	Z
81	"	SFO-AKL	5/21/77	0711-1901	68	C	C	P	Z
82	"	AKL-SYD	5/21/77	2126-2356	15	O		P	Z
83	"	SYD-SFO	5/22/77	0555-1811	60	O	C	P	Z
84	"	SFO-JFK	5/22/77	2056-0047	25	O	C	P	Z
85	"	JFK-BAH	5/23/77	2314-1048	79	O	C	P	Z
86	"	BAH-JFK	5/25/77	2129-0946	83	O	C	P	Z
87	"	BOS-DTW	5/26/77	1919-2014	3			P	
88	"	DTW-LHR	5/26/77	2215-0658	38	O	C	P	Z
89	"	LHR-DTW	5/27/77	1018-1950	39	O	C	P	Z
90	"	DTW-BOS	5/27/77	2221-2251	5			P	

TABLE II - B) VL0010, FILE 2 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
91	GF233	BOS-LHR	5/28/77	0101-0531	17	O P Z
92	"	LHR-BOS	5/28/77	1055-1555	32	O C P Z
93	"	BOS-DTW	5/28/77	1846-1942	6	O P Z
94	"	DTW-BOS	5/28/77	2207-2252	5	O P Z
95	"	BOS-LHR	5/29/77	0052-0603	21	O P Z
96	"	LHR-BOS	5/29/77	1008-1548	38	O C P Z
97	"	JFK-LHR	5/30/77	1431-2001	29	P Z
98	"	BRU-LHR	5/31/77	0750-0800	3	O P Z
99	"	LHR-JFK	5/31/77	1036-1621	40	O C P Z
-----					7355	

\+ Number of DATA records

** Constituent measurements: O - Ozone
C - Carbon monoxide
P - Particles and/or clouds
Z - Cabin ozone

TABLE II - GASP FLIGHTS ON TAPE VLC010

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C) FILE 3 (PANAM=N533PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
1	GP235	JFK-HND	6/ 1/77	1633-0502	2109	O C P Z
2	"	HND-JFK	6/ 2/77	1001-2204	1524	O C P Z
-----					3633	

\+ Number of DATA records
** Constituent measurements:
O - Ozone
C - Carbon monoxide
P - Particles and/or clouds
Z - Cabin ozone

TABLE II - GASP FLIGHTS ON TAPE VLC010

D) FILE 4 (PANAM-N533PA).

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**			
1	GP252	JFK-HND	6/ 3/77	1624-0533	189	O	C	P	Z
2	"	HND-LAX	6/ 4/77	0815-1715	95	O	C	P	Z
3	"	LAX-SEA	6/ 4/77	1956-2131	39	O		P	Z
4	"	SEA-SFO	6/ 9/77	0849-2031	29	O		P	Z
5	"	SFO-LHR	6/10/77	0129-1013	111	O	C	P	Z
6	"	LHR-SEA	6/10/77	1404-2232	96	O	C	P	Z
7	"	SEA-LHR	6/11/77	0129-0924	84	O	C	P	Z
8	"	LHR-SFO	6/11/77	1345-2317	107	O	C	P	Z
9	"	SFO-LHR	6/12/77	0151-1043	105	O	C	P	Z
10	"	LHR-SEA	6/12/77	1351-2212	94	O	C	P	Z
11	"	SEA-LHR	6/13/77	0122-0943	123	O	C	P	Z
12	"	LHR-SFO	6/13/77	1305-2240	112	O	C	P	Z
13	"	SFO-LHR	6/14/77	0126-1026	104	O	C		Z
14	"	LHR-SFO	6/14/77	1350-2320	109	O	C		Z
15	"	SFO-LHR	6/15/77	0138-1037	112	O	C		Z
16	"	LHR-SFO	6/15/77	1353-2328	411	O	C		Z
17	GP243	SFO-LHR	6/17/77	0225-1132	121	O	C	P	Z
18	"	LHR-SEA	6/17/77	1412-2237	101	O	C	P	Z
19	"	SEA-LHR	6/18/77	0136-0941	97	O	C	P	Z
20	"	LHR-SFO	6/18/77	1247-2217	113	O	C	P	Z
21	"	SFO-LHR	6/19/77	0138-1048	99	O	C	P	Z
22	"	LHR-SEA	6/19/77	0000-0000M	80	O	C	P	Z
23	"	SEA-LHR	6/20/77	0200-0945	106	O	C	P	Z
24	"	LHR-SFO	6/20/77	1250-2210	112	O	C	P	Z
25	"	SFO-LHR	6/21/77	0136-1059	132	O	C	P	Z
26	"	LHR-SEA	6/21/77	1335-2200	97	O	C	P	Z
27	"	SEA-LHR	6/22/77	0124-0929	101	O	C	P	Z
28	"	LHR-SFO	6/22/77	1235-2203	113	O	C	P	Z
29	"	SFO-LHR	6/24/77	0143-1053	106				Z
30	"	LHR-SEA	6/24/77	1339-2206	112				Z
31	"	SEA-LHR	6/25/77	0120-0905	93	O	C	P	Z
32	"	LHR-SFO	6/25/77	1315-2250	107	O	C	P	Z
33	"	SFO-LHR	6/26/77	0142-1026	98			P	Z
34	"	LHR-SEA	6/26/77	1334-2200	103			P	Z
35	"	SEA-LHR	6/27/77	0125-0916	104			P	Z
36	"	LHR-SFO	6/27/77	1304-2244	115			P	Z
37	"	SFO-LHR	6/28/77	0146-1051	100			P	Z
38	"	LHR-SEA	6/28/77	1329-2154	99			P	Z
39	"	SEA-LHR	6/29/77	0122-0907	90			P	Z
40	"	LHR-SFO	6/29/77	1246-2211	117			P	Z
41	"	SFO-AKL	6/30/77	0551-1751	138			P	Z
42	"	AKL-SYD	6/30/77	2028-2259	51			P	Z
43	"	SYD-AKL	7/ 1/77	0501-0656	22			P	Z
44	"	AKL-SFO	7/ 1/77	0929-2044	136			P	Z
45	GP250	SFO-AKL	7/ 2/77	0601-1731	147			P	Z

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TABLE II - D) VL0010, FILE 4 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
46	GP250	AKL-SYD	7/ 2/77	1951-2211	27	P Z
47	"	SYD-SFO	7/ 3/77	0529-1834	152	P Z
48	"	SFO-JFK	7/ 3/77	2217-0224	63	P Z
49	"	JFK-HND	7/ 4/77	1625-0443	155	P Z
50	"	HND-LAX	7/ 5/77	0811-1706	103	P Z
51	"	LAX-HND	7/ 5/77	2024-0635	119	P Z
52	"	HND-JFK	7/ 6/77	0949-2135	148	P Z
53	"	JFK-CPH	7/ 7/77	0322-0949	76	P Z
54	"	CPH-JFK	7/ 7/77	1148-1834	78	P Z
55	"	JFK-HND	7/ 8/77	1636-0436	137	C C P Z
56	"	HND-LAX	7/ 9/77	0845-1743	117	O C P Z
57	"	LAX-HND	7/ 9/77	2027-0628	118	C C P Z
58	"	HND-JFK	7/10/77	0943-2121	146	O C P Z
59	"	JFK-CPH	7/11/77	0227-0857	73	O C P Z
60	"	CPH-JFK	7/11/77	1224-1912	92	O C P Z
61	"	JFK-BAH	7/11/77	2256-1012	127	O C P Z
62	"	BAH-JFK	7/12/77	2123-0943	149	O C P Z
63	"	JFK-HND	7/14/77	2035-0854	145	O C P Z
64	"	HND-JFK	7/15/77	1121-2232	132	O C P Z
65	"	JFK-CPH	7/16/77	0213-0833	72	O C P Z
66	"	CPH-JFK	7/16/77	1110-1810	81	O C P Z
67	"	JFK-HND	7/17/77	1640-0505	144	O C P Z
68	"	HND-LAX	7/18/77	0711-1544	92	O C P Z
69	"	LAX-HND	7/18/77	2022-0627	116	O C P Z
70	"	HND-JFK	7/19/77	0844-2019	126	O C P Z
71	GP261	JFK-HND	7/28/77	1635-0450	138	O C P Z
72	"	HND-LAX	7/29/77	0835-1740	102	O C Z
73	"	LAX-HND	7/29/77	2129-0704	108	O C Z
74	"	HND-JFK	7/30/77	1003-2205	149	O C Z
75	"	JFK-HND	7/31/77	0000-0437M	229	O C Z
76	"	HND-LAX	8/ 1/77	0811-1734	107	O C Z
77	"	LAX-HND	8/ 1/77	2022-0609	116	O C Z
78	"	HND-JFK	8/ 2/77	0957-2140	154	O C Z
79	"	JFK-HND	8/ 3/77	1639-0514M	154	O C Z
80	"	HND-LAX	8/ 4/77	0814-0000M	86	O C Z
81	"	LAX-HND	8/ 4/77	0000-0556M	113	O C Z
82	"	HND-JFK	8/ 5/77	0000-0000M	154	O C Z
83	"	JFK-CPH	8/ 6/77	0000-0858M	83	O C Z
84	"	CPH-JFK	8/ 6/77	1202-1912	82	O C Z
85	"	JFK-SEA	8/ 7/77	1648-2203	59	O C Z
86	"	SEA-HND	8/ 8/77	0000-0850	97	O C Z
87	"	HND-JFK	8/ 8/77	1118-2256	288	O C Z
88	"	JFK-CPH	8/ 9/77	0216-0833	94	O C Z
89	"	CPH-JFK	8/ 9/77	1113-1903	93	C C Z
90	"	JFK-CPH	8/10/77	0159-0834	76	O C Z

TABLE II - D) VL0010, FILE 4 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**		
91	GP261	CPH-JFK	8/10/77	0000-0000M	69	O	C	Z
92	"	JFK-SFO	8/11/77	0000-0000M	61	O	C	Z
93	"	SFO-AKL	8/11/77	0000-0000M	133	O	C	Z
94	"	AKL-SYD	8/11/77	0000-2236M	29	O	C	Z
95	"	SYD-AKL	8/12/77	0539-0736	20	O	C	Z
96	"	AKL-SFO	8/12/77	0900-2013	131	O	C	Z
-----					10643			

\+ Number of DATA records
M GASP GMT not available for one or more data points
** Constituent measurements: O - Ozone
C - Carbon monoxide
P - Particles and/or clouds
Z - Cabin ozone

TABLE II - GASP FLIGHTS ON TAPE VL0010

E) FILE 5 (PANAM-N533PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA+	Data**		
1	GP269	SFO-AKL	8/13/77	0715-1915	135	O	C	
2	"	AKL-SYD	8/13/77	2125-2345	31	O	C	
3	"	SYD-SFO	8/14/77	0615-1819	139	O	C	
4	"	SFO-JFK	8/14/77	2102-0052	43	O	C	
5	"	JFK-HND	8/16/77	1733-0622	147	O	C	P
6	"	HND-LAX	8/17/77	0923-1821	106	O	C	P
7	"	LAX-HND	8/17/77	2130-0720	114	O	C	P
8	"	HND-JFK	8/18/77	1102-2211	123	O	C	P
9	"	JFK-HND	8/19/77	1730-0635	150	O	C	P
10	"	HND-LAX	8/20/77	0939-1817	128	O	C	P
11	"	LAX-HND	8/20/77	2133-0707	107	O	C	P
12	"	HND-JFK	8/21/77	0956-2126	158	O	C	P
13	"	JFK-CPH	8/22/77	0126-0726	65	O	C	P
14	"	CPH-JFK	8/22/77	1224-1929	77	O	C	P
15	"	JFK-BAH	8/23/77	0007-1057	120	O	C	P
16	"	BAH-JFK	8/24/77	2204-1132	147	O	C	P
17	"	JFK-HND	8/25/77	1728-0556	143	O	C	P
18	"	HND-LAX	8/26/77	0822-1637	88	O	C	P
19	"	LAX-HND	8/26/77	2135-0805	117	O	C	P
20	"	HND-JFK	8/27/77	1105-2230	117	O	C	P
21	"	JFK-HND	8/28/77	1641-0516	141	O	C	P
22	"	HND-LAX	8/29/77	0819-1657	93	O	C	P
23	"	LAX-HND	8/29/77	2040-0654	121	O	C	P
24	"	HND-JFK	8/30/77	0953-2118	116	O	C	P
25	GP291	JFK-HND	8/31/77	1646-0501	156	O	C	P
26	"	HND-LAX	9/ 1/77	0820-1700	104	O	C	P
27	"	LAX-HND	9/ 1/77	2030-0650	121	O	C	P
28	"	HND-JFK	9/ 2/77	1021-2139	133	O	C	P
29	"	JFK-CPH	9/ 3/77	0327-0932	72	O	C	P
30	"	CPH-JFK	9/ 3/77	1153-1908	84	O	C	P
31	"	JFK-CPH	9/ 4/77	0203-0810	74	O	C	P
32	"	CPH-JFK	9/ 4/77	1110-1814	80	O	C	P
33	"	JFK-HND	9/ 6/77	1649-0544	168	O	C	P
34	"	HND-LAX	9/ 7/77	0813-1713	103	O	C	P
35	"	LAX-HND	9/ 7/77	2022-0616	117	O	C	P
36	"	HND-JFK	9/ 8/77	0955-2100	163	O	C	P
37	"	JFK-CPH	9/ 9/77	0314-0914	116	O	C	P
38	"	CPH-JFK	9/ 9/77	1159-1919	85	O	C	P
39	"	JFK-HND	9/10/77	1640-0510	144	O	C	P
40	"	HND-LAX	9/11/77	0821-1751	108	O	C	P
41	"	LAX-HND	9/11/77	2024-0555	111	O	C	P
42	"	HND-JFK	9/12/77	0944-2020	123	O	C	P
43	GP272	JFK-HND	9/13/77	1631-0537	154	O		P
44	"	HND-LAX	9/14/77	0809-1710	101	O		P
45	GP279	LAX-HND	9/14/77	2018-0555	108	O		P

TABLE II - E) VLOC10, FILE 5 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**	
46	GP279	HND-JFK	9/15/77	0942-2032	123	O	P
47	"	JFK-HND	9/16/77	1637-0555	168	O	P
48	"	HND-LAX	9/17/77	1606-1636	7	O	P
49	GP261	JFK-HND	9/20/77	1635-0553	244	O	P
50	"	HND-LAX	9/21/77	0923-1708	86	O	P
51	GP284	JFK-HND	9/23/77	1636-0546	152	O	P
52	"	HND-LAX	9/24/77	0807-1647	103	O	P
53	"	LAX-HND	9/24/77	2035-0704	138	O	P
54	"	HND-JFK	9/25/77	1013-2234	141	O	P
55	"	BOS-LHR	9/26/77	0451-1001	51	O	P
56	"	LHR-BOS	9/26/77	1425-2037	82	O	P
57	"	BOS-LHR	9/27/77	0157-0707	59	O	P
58	"	LHR-BOS	9/27/77	1118-1753	76	O	P
59	"	BOS-DTW	9/27/77	1958-2059	180	O	P
60	"	DTW-BOS	9/27/77	2238-2325	23	O	P
61	"	BOS-LHR	9/28/77	0239-0739	50	O	P
62	"	LHR-JFK	9/28/77	1121-1813	67	O	P
63	"	JFK-SFO	9/28/77	2243-0353	55	O	P
64	"	SFO-AKL	9/29/77	0701-1851	133	O	P
65	"	AKL-SYD	9/29/77	2126-0001	22	O	P
66	"	SYD-AKL	9/30/77	0610-0809	35	O	P
67	"	AKL-SFO	9/30/77	1022-2147	117	O	P
68	"	SFO-AKL	10/ 1/77	0643-1818	118	O	P
69	"	AKL-SYD	10/ 1/77	2041-2306	28	O	P
70	"	SYD-SFO	10/ 2/77	0502-1740	153	O	P
71	"	SFO-JFK	10/ 2/77	2026-0011	24	O	P
72	"	JFK-HND	10/ 3/77	1634-0522	147	O	P
73	"	HND-LAX	10/ 4/77	0808-1655	120	O	P
-----					7875		

\+ Number of DATA records

** Constituent measurements:
- O - Ozone
- C - Carbon monoxide
- P - Particles and/or clouds

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE III - GASP FLIGHTS ON TAPE VL0012

A) FILE 1 (UAL-N4711U)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
1	GE182	SFO-HNL	1/ 3/77	1919-2338	51	O F
2	"	HNL-SFO	1/ 4/77	0153-0552	93	C
3	"	SFO-JFK	1/ 4/77	2251-0241	43	O
4	"	JFK-SFO	1/ 5/77	1533-2027	71	C
5	"	CLE-ORD	1/21/77	1427-1452	6	
6	"	ORD-SFO	1/22/77	2210-0130	41	
7	"	ORD-LAX	1/24/77	0059-0409	38	
8	"	LAX-HNL	1/24/77	1835-2317	69	
9	"	HNL-SFO	1/25/77	0122-0518	65	
10	GE187	SFO-JFK	1/25/77	2216-0202	38	
11	"	JFK-SFO	1/26/77	1530-2016	34	
12	"	SFO-HNL	1/26/77	2248-0316	39	
13	"	HNL-SFO	1/27/77	1020-1348	19	
14	"	SFO-HNL	1/27/77	1746-2222	46	
15	"	HNL-LAX	1/28/77	0036-0359	24	
16	"	LAX-HNL	1/28/77	1810-2303	38	
17	"	HNL-SFO	1/30/77	0056-0433	28	
18	"	SFO-JFK	1/30/77	2310-0254	30	
19	"	JFK-SFO	1/31/77	1526-2018	39	
20	"	SFO-HNL	1/31/77	2238-0256	29	
21	"	HNL-SFO	2/ 1/77	1045-1421	26	
22	"	SFO-HNL	2/ 1/77	1738-2153	40	
23	"	SFO-LAX	2/ 9/77	1951-2006	3	
24	"	LAX-JFK	2/ 9/77	2333-0339	32	
25	"	LAX-HNL	2/11/77	0102-0542	101	
26	"	HNL-LAX	2/11/77	1930-2335	47	
27	"	LAX-DEN	2/13/77	0210-0340	19	
28	"	DEN-LAX	2/13/77	1753-1908	16	
29	"	LAX-HNL	2/13/77	2139-0209	52	
30	"	HNL-SFO	2/14/77	1957-2342	60	
31	GE191	SFO-SFO	3/ 4/77	0417-0455	30	
32	GE198	SFO-JFK	3/ 4/77	2229-0224	37	
33	"	JFK-SFO	3/ 5/77	1550-2032	34	
34	"	SFO-HNL	3/ 5/77	2259-0249	23	
35	"	HNL-ORD	3/ 6/77	0635-1330	50	
36	"	CLE-ORD	3/11/77	1417-1431	3	
37	"	ORD-HNL	3/11/77	1714-0101	74	
38	GE197	SFO-JFK	3/19/77	2208-0150	43	O
39	"	JFK-SFO	3/20/77	1529-2014	58	O
40	"	SFO-HNL	3/20/77	2344-0347	49	C
41	"	HNL-SFO	3/21/77	1956-2356	47	C
42	GE202	SFO-HNL	3/22/77	0347-0755	43	O
43	"	HNL-SFO	3/22/77	2212-2357	22	O
44	"	SFO-JFK	3/23/77	2218-0213	47	C
45	"	JFK-SFO	3/24/77	1529-2041	94	O

TABLE III - A) VLCC12, FILE 1 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA*	Data**
46	GF202	SFO-HNL	3/24/77	2243-0237	59	O
47	"	HNL-LAX	3/25/77	0936-1351	162	C
48	"	LAX-ORD	3/25/77	1611-1851	31	O
49	"	ORD-SFO	3/25/77	2211-0126	36	O
-----					2181	

* Number of DATA records
** Constituent measurements: C - Ozone
F - Filter data

ORIGINAL PAGE IS
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TABLE III - GASP FLIGHTS ON TAPE VLC012

B) FILE 2 (UAL-N4711U)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**			
1	GP203	SFO-ORD	3/26/77	1846-2130	50		C	Z	
2	"	ORD-LAX	3/27/77	0056-0409	71		C	Z	
3	"	LAX-JFK	3/27/77	2031-0024	61		C	Z	
4	"	JFK-LAX	3/28/77	1724-2206	58			Z	
5	GP204	LAX-SEA	3/29/77	0157-0338	22			Z	
6	"	SEA-ORD	3/29/77	1625-1912	52		C	Z	
7	"	ORD-LAX	3/29/77	2232-0141	39			Z	
8	"	LAX-JFK	3/30/77	2036-0009	452	O	C	Z	
9	GP205	JFK-LAX	3/31/77	1736-2247	92	C	C	Z	
10	"	LAX-SEA	4/ 1/77	0156-0334	35	O		Z	
11	"	SEA-ORD	4/ 1/77	1626-1901	32	C	C	Z	
12	"	ORD-LAX	4/ 1/77	2205-0130	41	O		Z	
13	"	LAX-JFK	4/ 2/77	2030-0026	64	O		Z	
14	"	JFK-LAX	4/ 3/77	1735-2231	56	O	C	Z	
15	"	LAX-HNL	4/ 4/77	0047-0509	51	O	C	Z	
16	"	HNL-SFO	4/ 4/77	1957-2347	36	O	C	Z	
17	GP208	HNL-SFO	4/ 5/77	2005-2355	45	C	C	Z	
18	"	SFO-ORD	4/ 6/77	1841-2134	35	O	C	Z	
19	"	ORD-LAX	4/ 7/77	0104-0404	35	O	C	Z	
20	"	LAX-JFK	4/ 7/77	2038-0033	47	O	C	Z	
21	"	JFK-LAX	4/ 8/77	1722-2157	50	C	C	Z	
22	"	LAX-SEA	4/ 9/77	0211-0329	16	O		Z	
23	"	SEA-ORD	4/ 9/77	1615-1959	49	C	C	Z	
24	"	ORD-LAX	4/ 9/77	2204-0109	35	O	C	Z	
25	"	LAX-HNL	4/10/77	0404-0844	51	C	C	Z	
26	"	HNL-SFO	4/10/77	1956-2348	41	O		Z	
27	"	SFO-HNL	4/11/77	0201-0621	42	O	C	Z	
28	"	HNL-SFO	4/11/77	0854-1254	43	O		Z	
29	GP213	SFO-ORD	4/11/77	1841-2133	50	O		Z	
30	"	ORD-LAX	4/12/77	0056-0403	38	O		Z	
31	"	LAX-JFK	4/12/77	2036-0046	49	C		Z	
32	"	JFK-LAX	4/13/77	1730-2200	53	O		Z	
33	"	LAX-HNL	4/14/77	0051-0507	51	O		Z	
34	"	HNL-SFO	4/14/77	1959-0004	49	O		Z	
35	GP216	SFO-HNL	4/15/77	0401-0802	46	O		Z	F
36	"	HNL-SFO	4/15/77	1021-1413	46	O		Z	
37	"	SFO-ORD	4/15/77	1840-2145	36	O		Z	
38	"	ORD-LAX	4/16/77	0113-0408	65	O		Z	
39	"	LAX-HNL	4/16/77	1808-2238	53	O		Z	
40	"	HNL-SFO	4/17/77	0104-0454	41	O		Z	
41	GP220	SFO-HNL	4/19/77	1745-2210	53	O		Z	
42	"	HNL-LAX	4/20/77	0006-0351	46	O		Z	
43	"	LAX-JFK	4/20/77	2031-0041	48	O		Z	
44	"	JFK-LAX	4/21/77	1733-2158	49	O		Z	F
45	"	LAX-HNL	4/22/77	0044-0518	70	O		Z	

TABLE III - B) VLCC12, FILE 2 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA+	Data**		
46	GF220	HNL-LAS	4/22/77	0933-1403	54	C	Z	
47	"	LAS-LAX	4/22/77	1616-1626	3	O	Z	
48	"	LAX-JFK	4/22/77	2030-0040	48	C	Z	
49	"	JFK-LAX	4/23/77	1727-2152	38	O	Z	
50	"	LAX-HNL	4/24/77	0042-0522	51	O	Z	F
51	"	HNL-LAX	4/24/77	0939-1329	43	O	Z	
52	"	LAX-ORD	4/24/77	1540-1830	14	C	Z	
53	"	ORD-LAX	4/24/77	2114-0014	17	O	Z	
54	"	LAX-HNL	4/25/77	1702-2157	58	C	Z	
55	"	HNL-SFO	4/26/77	0004-0339	40	O	Z	
56	GF223	SFO-HNL	4/26/77	1634-2104	55	C	Z	
57	"	HNL-LAX	4/26/77	2259-0249	44	O	Z	
58	"	LAX-HNL	4/27/77	1706-2151	53	O	Z	
59	"	HNL-SFO	4/27/77	2357-0336	44	O	Z	
60	"	SFO-ORD	4/28/77	1741-2031	34	C	Z	
61	"	ORD-SEA	4/29/77	0002-0312	37	O	Z	
62	"	SEA-ORD	4/29/77	1517-1752	32	C	Z	
63	"	ORD-SFO	4/29/77	2131-0051	38	O	Z	
64	"	SFO-JFK	4/30/77	2119-0124	47	C	Z	
65	"	JFK-SFO	5/ 1/77	1432-1907	54	O	Z	
66	"	SFO-HNL	5/ 1/77	2139-0144	42	C	Z	
67	"	HNL-SFO	5/ 2/77	1959-0019	50	O	Z	
68	GF228	SFO-ORD	5/ 3/77	1746-2031	26	C	Z	
69	"	ORD-SEA	5/ 4/77	0000-0256	22	O	Z	
70	"	ORD-LAX	5/ 4/77	2116-0027	72	C	Z	
71	"	LAX-JFK	5/ 5/77	1933-2325	32			
72	"	JFK-LAX	5/ 6/77	1632-2117	25			
73	"	LAX-HNL	5/ 6/77	2347-0419	44			
74	"	HNL-LAX	5/ 7/77	1927-2331	19			
75	"	LAX-DEN	5/ 8/77	0147-0257	10			
76	"	DEN-LAX	5/ 8/77	1758-1758	1			
77	"	LAX-HNL	5/ 8/77	2047-0117	10			
78	"	HNL-SFO	5/ 9/77	1958-2343	5			
79	"	SFO-JFK	5/11/77	2113-0119	28			
80	"	JFK-SFO	5/12/77	1433-1853	17			
81	"	SFO-HNL	5/12/77	2132-0151	32			
82	"	HNL-LAX	5/13/77	2118-2333	27			
83	"	LAX-DEN	5/14/77	0147-0312	17			
84	"	DEN-LAX	5/14/77	1713-1813	13			
85	"	LAX-HNL	5/14/77	2031-0100	69			
86	"	HNL-ORD	5/15/77	0337-1037	81			
87	"	ORD-YYZ	5/15/77	1254-1324	7			
88	"	YYZ-ORD	5/15/77	1615-1645	7			
89	"	ORD-HNL	5/15/77	1920-0305	92			
90	"	HNL-ORD	5/16/77	0532-1233	81			

TABLE III - E) VL0012, FILE 2 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA*	Data**
91	GF228	HNL-SFO	5/18/77	2030-2355	39	
92	GF232	SFO-JFK	5/19/77	2137-0201	148	
93	"	JFK-SFO	5/20/77	1435-1900	47	
94	"	SFO-HNL	5/31/77	0502-0912	45	O C Z
95	"	HNL-SFO	5/31/77	1957-2355	11	
96	GF245	JFK-LAX	6/10/77	1631-2100	49	O C Z
97	"	LAX-HNL	6/10/77	2326-0346	31	C C Z
98	"	LAX-ORD	6/11/77	1751-2036	31	O C Z
99	"	ORD-SEA	6/12/77	0135-0330	19	O C Z
100	"	SEA-ORD	6/12/77	1526-1801	12	O Z
101	"	ORD-HNL	6/12/77	2151-0739	27	Z
102	"	HNL-SFO	6/13/77	2130-2354	33	O C Z
-----					4669	

* Number of DATA records
** Constituent measurements: O - Ozone
F - Filter data
C - Carbon monoxide
Z - Cabin ozone

TABLE III - GASP FLIGHTS ON TAPE VLC012

C) FILE 3 (UAL-N4711U)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA*	Data**
1	GE239	SFO-HNL	6/14/77	0324-0728	26	Z
2	"	HNL-SFO	6/14/77	1222-1342	8	
3	"	SFO-HNL	6/14/77	1649-2052	25	C Z
4	"	HNL-LAX	6/14/77	2301-0306	37	C Z
5	"	LAX-JFK	6/15/77	1957-2331	39	Z
6	"	JFK-ORD	6/16/77	0237-0237	1	
7	GE253	LAX-HNL	6/20/77	2036-0054	64	C
8	"	HNL-ORD	6/21/77	0351-1102	82	C
9	"	HNL-LAX	6/22/77	0040-0505	52	C
10	"	LAX-JFK	6/22/77	1932-2333	60	
11	"	JFK-LAX	6/23/77	0246-0726	55	C
12	"	LAX-HNL	6/23/77	1808-2238	54	C
13	"	HNL-SFO	6/24/77	0101-0516	50	
14	"	SFO-ORD	6/24/77	1751-2046	36	C
15	"	ORD-JFK	6/24/77	2332-0018	21	
16	"	JFK-SFO	6/25/77	1505-1935	52	C
17	"	SFO-HNL	6/25/77	2130-0130	61	C
18	"	HNL-ORD	6/26/77	0513-1233	83	C
19	"	ORD-HNL	6/26/77	1611-2320	82	C
20	"	HNL-SFO	6/27/77	1956-0011	48	
21	GE251	SFO-HNL	6/28/77	0319-0709	45	
22	"	HNL-SFO	6/28/77	0923-1328	50	
23	"	SFO-HNL	6/28/77	1632-2032	49	
24	"	ORD-HNL	6/29/77	1853-0233	90	C
25	"	HNL-ORD	6/30/77	0514-1210	89	
26	"	ORD-HNL	6/30/77	1721-0114	91	C
27	"	HNL-ORD	7/ 1/77	0326-1011	79	
28	"	ORD-JFK	7/ 1/77	1237-1337	13	
29	"	JFK-LAX	7/ 1/77	1633-2103	53	
30	"	LAX-HNL	7/ 1/77	2335-0410	56	
31	"	HNL-LAX	7/ 2/77	0855-1301	46	
32	"	LAX-ORD	7/ 2/77	1753-2038	31	
33	"	ORD-SEA	7/ 3/77	0027-0342	39	
34	"	SEA-ORD	7/ 3/77	1522-1757	30	
35	"	ORD-LAX	7/ 3/77	2121-0023	35	
36	"	LAX-HNL	7/ 4/77	0259-0729	52	C
37	"	HNL-LAX	7/ 4/77	1030-1445	52	
38	"	LAX-HNL	7/ 4/77	1759-2224	54	
39	"	HNL-SFO	7/ 5/77	0058-0450	44	
40	"	SFO-ORD	7/ 5/77	1735-2020	33	
41	"	ORD-JFK	7/ 5/77	2246-2331	10	
42	"	JFK-SFO	7/ 6/77	1437-1917	57	
43	"	SFO-HNL	7/ 6/77	2135-0148	61	
44	"	HNL-LAX	7/ 7/77	0831-1233	46	
45	"	LAX-ITO	7/ 7/77	1856-2316	51	

TABLE III - C) VL0012, FILE 3 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
46	GE251	ITO-LAX	7/ 8/77	0133-0521	42	
47	"	LAX-ORD	7/ 8/77	0805-1040	29	
48	"	ORD-PIT	7/ 8/77	1300-1320	5	
49	"	PIT-ORD	7/ 8/77	1549-1620	7	
50	"	ORD-LAX	7/ 8/77	1850-2201	38	
51	"	LAX-JFK	7/ 9/77	0625-1015	44	
52	"	JFK-ORD	7/ 9/77	1533-1649	51	
53	"	ORD-HNL	7/ 9/77	1900-0250	91	
54	"	HNL-ORD	7/10/77	0515-1208	79	
55	"	ORD-HNL	7/10/77	1600-2339	92	
56	"	ITO-ORD	7/11/77	0407-1101	132	
57	"	ORD-HNL	7/11/77	1430-2200	88	
58	"	HNL-LAX	7/12/77	0038-0453	50	
59	"	LAX-HNL	7/12/77	1811-2236	51	
60	"	HNL-SFO	7/13/77	0110-0510	49	
61	GF246	SFO-ORD	7/13/77	1737-2022	32	
62	"	ORD-JFK	7/13/77	2316-0014	11	
63	"	JFK-SFO	7/14/77	1448-1923	49	
64	GF251	SFO-HNL	7/14/77	2144-0159	49	
65	"	HNL-ORD	7/15/77	0351-1036	79	
66	"	ORD-HNL	7/16/77	1620-2350	88	
67	"	HNL-LAX	7/17/77	1925-2340	47	
68	"	LAX-DEN	7/18/77	0150-0310	17	
69	"	DEN-LAX	7/18/77	1655-1815	16	
70	"	LAX-HNL	7/18/77	2026-0058	54	
71	"	HNL-ORD	7/19/77	0319-1029	86	
72	"	ORD-JFK	7/19/77	1244-1349	13	
73	"	JFK-LAX	7/19/77	1644-2051	45	
74	"	LAX-HNL	7/19/77	2341-0416	55	
75	"	HNL-LAX	7/20/77	0831-1231	49	
76	"	LAX-ORD	7/20/77	1755-2055	35	
77	"	ORD-SEA	7/21/77	0016-0316	36	
78	"	SEA-ORD	7/21/77	1520-1753	44	
79	"	ORD-LAX	7/21/77	2144-0034	33	
80	GE247	LAX-HNL	7/22/77	0304-0729	52	C
81	"	HNL-LAX	7/22/77	1940-2345	43	C
82	"	LAX-DEN	7/23/77	0151-0313	24	
83	"	DEN-LAX	7/23/77	1653-1813	17	
84	"	LAX-HNL	7/23/77	2057-0145	56	C
85	"	HNL-SFO	7/24/77	0938-1333	44	C
86	"	SFO-HNL	7/24/77	1639-2052	57	C
87	"	HNL-LAX	7/24/77	2258-0308	49	C
88	"	LAX-ORD	7/25/77	0838-1123	34	
89	"	ORD-PIT	7/25/77	1304-1324	4	
90	"	PIT-ORD	7/25/77	1549-1624	8	

TABLE III - C) VL0012, FILE 3 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
91.	GE247	ORD-LAX	7/25/77	1839-2139	33	
92.	"	LAX-HNL	7/26/77	1710-2149	55	C
93	"	HNL-SFO	7/26/77	2355-0348	56	
-----					4418	

\+ Number of DATA records

** Constituent measurements: C - Carbon monoxide
Z - Cabin ozone

TABLE III - GASP FLIGHTS ON TAPE VL0012

D) FILE 4 (UAL-N4711U)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
1	GE258	SFO-ORD	7/27/77	1738-2018	31	
2	"	ORD-SFO	7/27/77	2243-2333	11	
3	"	SFO-HNL	7/30/77	0253-0712	50	
4	"	HNL-LAX	7/30/77	0911-1311	46	
5	"	LAX-ORD	7/30/77	1749-2029	30	
6	"	ORD-SEA	7/31/77	0009-0319	35	
7	"	SEA-ORD	7/31/77	1519-1754	30	
8	"	ORD-LAX	7/31/77	2138-0048	37	
9	"	LAX-HNL	8/ 1/77	0256-0720	52	F
10	"	HNL-LAX	8/ 1/77	1035-1435	46	
11	"	LAX-ORD	8/ 1/77	1748-2033	34	
12	"	ORD-SEA	8/ 2/77	0009-0325	39	
13	"	SEA-ORD	8/ 2/77	1527-1757	31	
14	"	ORD-LAX	8/ 2/77	2129-0037	38	
15	"	LAX-HNL	8/ 3/77	0302-0737	53	
16	"	HNL-LAX	8/ 3/77	1024-1425	48	
17	"	LAX-HNL	8/ 3/77	1710-2153	71	
18	"	HNL-SFO	8/ 3/77	2347-0332	45	
19	"	SFO-HNL	8/ 4/77	2020-0047	64	F
20	"	HNL-ORD	8/ 5/77	0349-1025	90	
21	"	ORD-HNL	8/ 6/77	1708-0103	95	
22	"	HNL-LAX	8/ 7/77	0829-1224	48	F
23	"	LAX-HNL	8/ 7/77	1706-2141	54	
24	"	HNL-SFO	8/ 7/77	2359-0344	42	
25	GF265	SFO-HNL	8/ 8/77	2012-0029	49	
26	"	HNL-LAX	8/ 9/77	0212-0612	45	
27	"	LAX-ITO	8/ 9/77	1907-2327	53	
28	"	ITO-LAX	8/10/77	0134-0517	41	F
29	"	LAX-ORD	8/10/77	0815-1050	31	
30	"	ORD-PIT	8/10/77	1303-1328	5	
31	"	PIT-ORD	8/10/77	1604-1634	6	
32	"	ORD-LAX	8/10/77	1834-2149	37	
33	"	JFK-ORD	8/11/77	1528-1633	13	
34	"	ORD-HNL	8/11/77	1952-0331	83	
35	"	HNL-LAX	8/12/77	1933-2333	43	
36	"	LAX-DEN	8/13/77	0216-0318	12	F
37	"	DEN-LAX	8/13/77	1702-1822	16	
38	"	LAX-HNL	8/13/77	2041-0116	53	
39	"	HNL-ORD	8/14/77	0330-1010	76	
40	"	ORD-YYZ	8/14/77	1239-1304	6	
41	"	YYZ-ORD	8/14/77	1614-1700	9	
42	"	ORD-HNL	8/14/77	1907-0302	93	
43	"	HNL-SFO	8/15/77	2013-2348	39	
44	"	SFO-HNL	8/16/77	0314-0729	49	F
45	"	HNL-SFO	8/16/77	0932-1317	46	

TABLE III - D) VL0012, FILE 4 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA*	Data**
46	GP265	SFO-HNL	8/16/77	1644-2054	48	
47	"	HNL-LAX	8/16/77	2322-0320	48	
48	"	LAX-ITO	8/17/77	1926-2345	50	
49	"	ITO-LAX	8/18/77	0149-0535	45	
50	"	LAX-ORD	8/18/77	0804-1044	31	
51	"	ORD-PIT	8/18/77	1255-1315	5	
52	"	PIT-ORD	8/18/77	1556-1631	8	
53	"	ORD-LAX	8/18/77	1834-2139	33	
54	"	LAX-JFK	8/19/77	0611-1000	45	
55	"	JFK-ORD	8/19/77	1529-1654	16	
56	"	ORD-HNL	8/19/77	1649-0253	89	
57	"	HNL-SFO	8/20/77	0927-1312	44	
58	"	SFO-HNL	8/20/77	1632-2037	48	
59	"	SFO-HNL	8/31/77	0249-0659	47	
60	"	HNL-SFO	8/31/77	0935-1324	40	
61	GP275	SFO-HNL	8/31/77	1631-2036	45	
62	"	HNL-LAX	8/31/77	2258-0303	39	
63	"	LAX-ITO	9/ 1/77	1908-2313	42	
64	"	ITO-LAX	9/ 2/77	0136-0536	38	
65	"	LAX-DTW	9/ 2/77	0815-1115	30	
66	"	DTW-PIT	9/ 2/77	1352-1357	2	
67	"	PIT-ORD	9/ 2/77	1606-1636	7	
68	"	ORD-LAX	9/ 2/77	1847-2152	32	
69	"	LAX-SFO	9/ 2/77	2346-0006	5	
70	"	SFO-LAX	9/ 3/77	0147-0212	5	
71	"	LAX-SFO	9/ 3/77	0402-0417	4	
72	"	JFK-SFO	9/ 4/77	1432-1907	50	
73	"	SFO-HNL	9/ 4/77	2126-0141	45	
74	"	HNL-SFO	9/ 5/77	0930-1320	43	
75	"	SFO-HNL	9/ 5/77	1627-2042	50	
76	"	HNL-LAX	9/ 5/77	2318-0313	46	
77	"	LAX-JFK	9/ 6/77	0613-1003	37	
78	"	ORD-HNL	9/ 6/77	1852-0234	74	
79	"	ORD-HNL	9/ 7/77	1606-2350	96	
80	"	HNL-ORD	9/ 8/77	0316-1001	70	
81	"	ORD-YYZ	9/ 8/77	1315-1340	6	
82	"	YYZ-ORD	9/ 8/77	1553-1645	36	
83	"	ORD-HNL	9/ 8/77	1916-0304	97	
84	"	HNL-LAX	9/ 9/77	1002-1402	44	
85	"	LAX-HNL	9/ 9/77	1719-2157	53	
86	"	HNL-SFO	9/ 9/77	2346-0336	45	
87	"	SFO-ORD	9/10/77	1739-2019	30	
88	"	ORD-JFK	9/10/77	2236-2326	10	
89	"	JFK-SFO	9/11/77	1435-1924	54	
90	"	SFO-HNL	9/11/77	2142-0152	41	

TABLE III - D) VLC012, FILE 4 CONCLUDED

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL (GMT)	DATA+	Data**
91	GE275	HNL-LAX	9/12/77	0833-1228	38	
92	"	LAX-ORD	9/12/77	1522-1808	36	
93	"	ORD-SFO	9/12/77	2126-0041	36	
94	"	SFO-HNL	9/13/77	0307-0717	46	
95	"	HNL-SFO	9/13/77	0937-1332	42	
96	"	SFO-HNL	9/13/77	1626-2041	42	
97	"	HNL-LAX	9/13/77	2302-0252	45	
98	"	LAX-JFK	9/14/77	2000-2353	47	
99	"	LAX-ORD	9/15/77	1519-1759	26	
100	"	ORD-SFO	9/15/77	2216-0128	43	
101	GE277	SFO-ORD	9/16/77	1808-2053	32	
102	"	ORD-JFK	9/16/77	2302-2352	11	
103	"	JFK-SFO	9/17/77	1459-1959	60	
104	"	SFO-HNL	9/17/77	2220-0235	52	
105	"	HNL-LAX	9/18/77	1932-2335	63	
106	"	LAX-DEN	9/19/77	0152-0301	15	
107	"	DEN-ORD	9/19/77	0502-0617	16	
108	"	LAX-ORD	9/20/77	0803-1033	31	
109	"	ORD-PIT	9/20/77	1315-1340	6	
110	"	PIT-ORD	9/20/77	1548-1628	9	
-----					4394	

+ Number of DATA records
** Constituent measurements: F - filter data

TABLE IV - FILTER DATA ON TAPE VL0012

Exposure Data					
Filter no.	430-6	301-1	301-3	301-4	201-2
File,Flight	1,1	2,35	2,44	2,50	4,9
Date	1/3/77	4/15/77	4/21/77	4/24/77	8/1/77
Time, GMT	1928-2128	0411-0611	1742-1942	0051-0251	0312-0511
Latitude, deg	37-31N	36-30N	40-39N	34-29N	33-28N
Longitude, deg	125-141W	125-142W	77-96W	121-138W	122-140W
Altitude, km	9.7-11.0	9.6-10.7	9.9-11.9	9.8-11.0	10.2-11.0
Region **	M	T	M	U	T
Constituent Data					
SC4=, ug/m³	.054	.012	.018	.055	.023
NO3-, "	.050	.019	.025	.041	.049
Cl- , "	.001	.006	.004	.004	.000
F- , "	.003	.004	.004	.000	.000

** - T - Troposphere
S - Stratosphere
M - Mixed
U - Uncertain

TABLE IV - FILTER DATA ON TAPE VL0012, CONCLUDED

Exposure Data					
Filter no.	201-3	201-4	201-5	201-6	201-8
File, Flight	4,19	4,22	4,28	4,36	4,44
Date	8/4/77	8/7/77	8/10/77	8/13/77	8/16/77
Time, GMT	2029-2230	0839-1039	0144-0339	0212-0312	0326-0526
Latitude, deg	37-31N	22-29N	21-28N	35-39N	37-31N
Longitude, deg	125-141W	156-138W	152-135W	116-106W	126-143W
Altitude, km	9.8-11.0	9.8-11.6	9.8-11.6	9.8-10.4	10.2-11.0
Region **	T	T	T	T	U
Constituent Data					
SO4=, ug/m3	.007	.011	.005	.007	.036
NO3-, "	.020	.020	.005	.022	.039
Cl- , "	.000	.000	.000	.000	.003
F- , "	.000	.000	.000	.000	.001

** - T - Troposphere
S - Stratosphere
M - Mixed
U - Uncertain

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TABLE V - CABIN OZONE DATA SUMMARY FOR TAPE VL0010

A) FILE 2 (PANAM-N533PA)

			CABIN OZONE							AMBIENT OZONE				CABIN/AMBIENT (FOR AMBIENT >.1)			
				HOURS		PPMV					PPMV						
FLT	FLIGHT ROUTE	DEPART DATE	ND	TOTAL	O3>.1	MEAN	M+SD	MAX	2HR	ND	MEAN	M+SD	MAX	ND	MEAN	SD	+
1	JFK-JFK	4/ 6/77	23	1.90	1.30	.222	.413	.618	.222	0				0			?
2	JFK-HND	4/ 6/77	99	12.58	8.17	.219	.438	1.089	.328	0				0			?
3	HND-LAX	4/ 7/77	65	8.17	5.33	.183	.302	.499	.277	0				0			?
4	LAX-HND	4/ 7/77	80	9.83	6.42	.210	.390	.757	.487	0				0			?
5	HND-JFK	4/ 8/77	84	11.08	4.33	.141	.273	.558	.199	0				0			?
6	JFK-GIG	4/ 9/77	65	8.15	1.15	.055	.116	.313	.134	0				0			?
7	GIG-JFK	4/10/77	65	8.17	1.33	.084	.201	.456	.242	0				0			?
8	JFK-HND	4/10/77	93	12.52	9.52	.326	.510	.616	.490	0				0			?
9	HND-LAX	4/11/77	63	8.08	3.00	.110	.207	.467	.235	0				0			?
10	LAX-HND	4/11/77	78	10.25	3.75	.089	.133	.217	.161	0				0			?
11	HND-JFK	4/12/77	78	11.15	6.98	.221	.388	.573	.424	0				0			?
12	JFK-HND	4/13/77	99	12.58	9.32	.143	.237	.545	.233	0				0			?
13	HND-LAX	4/14/77	61	8.10	5.60	.267	.457	.730	.527	0				0			?
14	LAX-HND	4/14/77	83	10.67	6.33	.230	.458	.794	.621	0				0			?
15	HND-JFK	4/15/77	89	11.50	4.05	.110	.221	.539	.259	0				0			?
16	JFK-GIG	4/16/77	62	8.02	.25	.036	.062	.138	.073	0				0			?
17	GIG-JFK	4/17/77	67	8.48	1.50	.057	.127	.315	.162	0				0			?
18	JFK-HND	4/17/77	101	13.32	8.37	.313	.551	.776	.646	0				0			?
19	HND-LAX	4/18/77	63	8.45	6.20	.295	.473	.596	.513	0				0			?
20	LAX-HND	4/19/77	84	10.95	2.92	.114	.241	.620	.301	0				0			?
21	HND-JFK	4/19/77	83	11.03	8.43	.275	.515	.840	.695	0				0			?
22	JFK-HND	4/20/77	90	12.68	10.35	.304	.479	.658	.584	0				0			?
23	HND-LAX	4/21/77	60	8.20	7.12	.230	.354	.559	.309	0				0			?
24	LAX-HND	4/21/77	77	9.98	8.82	.414	.619	.732	.581	0				0			?
25	HND-JFK	4/22/77	89	11.17	5.75	.128	.240	.516	.282	0				0			?
26	JFK-GIG	4/23/77	52	6.83	1.00	.058	.124	.241	.133	0				0			?
27	GIG-JFK	4/24/77	66	8.55	.75	.042	.082	.198	.094	0				0			?
28	JFK-HND	4/24/77	100	12.67	6.75	.176	.327	.520	.378	0				0			?
29	HND-JFK	4/25/77	88	11.17	6.42	.203	.385	.700	.448	0				0			?
30	JFK-HND	4/26/77	95	12.55	7.80	.251	.458	.696	.560	95	.348	.633	.985	63	.721	.168	?
31	HND-LAX	4/27/77	61	7.52	5.62	.253	.407	.526	.370	61	.368	.593	.789	53	.702	.140	?
32	LAX-HND	4/27/77	69	9.17	4.33	.134	.250	.477	.293	69	.442	.730	.966	51	.363	.268	?
33	HND-JFK	4/28/77	85	10.85	5.08	.135	.247	.525	.296	85	.517	.770	.941	72	.277	.180	?
34	JFK-HND	4/29/77	98	12.85	4.40	.143	.303	.671	.487	98	.530	.837	1.104	83	.337	.289	?
35	HND-LAX	4/30/77	65	8.18	3.98	.179	.336	.532	.412	64	.269	.514	.820	34	.651	.128	?
36	LAX-HND	4/30/77	76	9.50	8.33	.220	.342	.541	.415	76	.646	.864	1.091	74	.395	.253	?
37	HND-JFK	5/ 1/77	79	10.30	10.13	.394	.580	.741	.576	79	.631	.845	.978	78	.626	.204	?
38	JFK-DFW	5/ 2/77	18	2.17	2.17	.216	.265	.289	.216	18	.299	.387	.453	17	.697	.108	?
39	DFW-HNL	5/ 2/77	52	6.72	5.55	.230	.398	.677	.470	53	.308	.526	.821	49	.736	.126	?
40	HNL-PPG	5/ 3/77	31	4.25	.00	.021	.037	.058	.029	30	.036	.059	.098	0			?

TABLE V - A) VL0010, FILE 2 CONTINUED

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE ND	CABIN OZONE HOURS TOTAL	CABIN OZONE HOURS O3>.1	CABIN OZONE PPMV MEAN	CABIN OZONE PPMV M+SD	CABIN OZONE PPMV MAX	CABIN OZONE PPMV 2HR	AMBIENT OZONE ND	AMBIENT OZONE PPMV MEAN	AMBIENT OZONE PPMV M+SD	AMBIENT OZONE PPMV MAX	CABIN/AMBIENT (FOR AMBIENT >.1) ND	CABIN/AMBIENT (FOR AMBIENT >.1) MEAN	CABIN/AMBIENT (FOR AMBIENT >.1) SD	*
41	PPG-PPT	5/ 3/77	17	2.12	.00	.019	.029	.041	.020	17	.030	.041	.074	0			?
42	PPT-PPG	5/ 3/77	18	2.33	.00	.018	.021	.023	.018	18	.036	.043	.047	0			?
43	PPG-HNL	5/ 3/77	18	4.25	.00	.017	.022	.033	.023	32	.040	.057	.108	1	.306		?
44	HNL-DFW	5/ 4/77	45	6.03	.92	.072	.109	.192	.096	44	.103	.164	.380	19	.658	.167	?
45	DFW-JFK	5/ 4/77	15	1.92	1.17	.154	.238	.255	.154	15	.249	.387	.469	12	.631	.102	?
46	JFK-SFO	5/ 4/77	40	4.92	4.23	.203	.314	.539	.294	40	.294	.469	.702	35	.683	.109	?
47	SFO-AKL	5/ 5/77	93	11.87	.58	.044	.079	.221	.096	92	.075	.139	.371	26	.544	.104	?
48	AKL-SYD	5/ 5/77	19	2.33	.00	.053	.068	.111	.054	19	.089	.113	.189	3	.591	.018	?
49	SYD-AKL	5/ 6/77	13	1.67	.00	.060	.078	.092	.060	13	.099	.122	.124	6	.547	.163	?
50	AKL-SFO	5/ 6/77	84	10.67	1.67	.080	.224	.645	.293	85	.130	.336	.865	22	.695	.411	?
51	SFO-JFK	5/ 8/77	34	4.57	3.70	.250	.398	.501	.294	32	.376	.559	.656	31	.741	.106	?
52	JFK-DFW	5/ 9/77	15	2.25	1.25	.157	.316	.667	.167	15	.480	.758	1.036	14	.337	.171	?
53	DFW-HNL	5/ 9/77	56	7.32	5.72	.217	.356	.551	.402	57	.258	.441	.734	49	.869	.171	?
54	HNL-PPG	5/10/77	34	4.53	.00	.029	.047	.079	.035	36	.028	.041	.055	0			?
55	PPG-PPT	5/10/77	14	2.00	.00	.015	.020	.031	.015	13	.029	.038	.041	0			?
56	PPT-PPG	5/10/77	18	2.35	.17	.032	.060	.134	.037	16	.039	.051	.075	0			?
57	PPG-HNL	5/10/77	32	4.08	.08	.023	.042	.143	.024	32	.032	.042	.067	0			?
58	HNL-DF"	5/11/77	45	5.83	4.17	.182	.316	.541	.305	45	.223	.391	.619	34	.841	.248	?
59	DFW-JFK	5/11/77	16	2.00	1.17	.094	.140	.156	.094	16	.349	.562	.640	15	.298	.167	?
60	JFK-LHR	5/13/77	42	5.25	5.25	.403	.511	.552	.479	42	.562	.666	.777	42	.706	.177	B
61	LHR-AMS	5/14/77	1	.00	.00			.064		1			.080	0			
62	AMS-LHR	5/14/77	1	.00	.00			.036		1			.071	0			
63	LHR-JFK	5/14/77	48	6.00	4.50	.303	.507	.612	.522	48	.533	.659	.772	47	.520	.329	B
64	JFK-LHR	5/15/77	40	5.25	4.83	.304	.453	.532	.444	40	.336	.512	.670	40	.951	.311	
65	LHR-AMS	5/15/77	1	.00	.00			.085		1			.097	0			
66	AMS-LHR	5/15/77	1	.00	.00			.050		1			.086	0			
67	LHR-JFK	5/15/77	49	6.00	6.00	.412	.516	.558	.494	49	.418	.547	.726	48	.996	.168	
68	JFK-DFW	5/16/77	4	.67	.00	.070	.087	.100	.070	4	.086	.091	.104	1	.962		
69	DFW-HNL	5/16/77	25	7.02	3.43	.128	.195	.261	.218	25	.133	.186	.223	15	.931	.330	
70	HNL-PPG	5/17/77	4	2.25	.75	.038	.080	.132	.070	4	.037	.045	.047	0			
72	PPT-PPG	5/17/77	7	1.75	.00	.046	.065	.077	.046	7	.054	.088	.104	2	.702	.039	
73	PPG-HNL	5/17/77	10	3.25	.00	.032	.048	.063	.038	10	.022	.041	.058	0			
74	HNL-DFW	5/18/77	11	3.58	3.58	.226	.275	.292	.246	11	.248	.284	.296	11	.893	.112	
75	DFW-JFK	5/18/77	3	1.33	.17	.139	.204	.210	.139	3	.127	.195	.216	2	1.019	.047	
76	JFK-SFO	5/18/77	8	3.00	1.92	.260	.489	.596	.348	8	.297	.568	.723	5	.801	.178	
77	SFO-AKL	5/19/77	31	11.62	.00	.033	.048	.098	.062	31	.052	.070	.103	1	.728		
78	AKL-SYD	5/19/77	7	1.67	1.50	.096	.143	.146	.096	7	.123	.187	.190	4	.775	.048	
80	AKL-SFO	5/20/77	33	10.42	.00	.028	.043	.086	.043	34	.047	.069	.146	2	.702	.120	

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TABLE V - A) VL0010, FILE 2 CONCLUDED

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE HOURS ND	CABIN OZONE HOURS TOTAL	CABIN OZONE HOURS O3>.1	CABIN OZONE PPMV MEAN	CABIN OZONE PPMV M+SD	CABIN OZONE PPMV MAX	CABIN OZONE PPMV 2HR	AMBIENT OZONE ND	AMBIENT OZONE PPMV MEAN	AMBIENT OZONE PPMV M+SD	AMBIENT OZONE PPMV MAX	CABIN/AMBIENT (FOR AMBIENT >.1) ND	CABIN/AMBIENT MEAN	CABIN/AMBIENT SD ✦
81	SFO-AKL	5/21/77	47	11.50	.08	.033	.052	.110	.055	47	.048	.067	.125	1	.600	
82	AKL-SYD	5/21/77	4	1.17	.00	.071	.085	.088	.071	4	.093	.142	.142	1	.620	
83	SYD-SFO	5/22/77	35	12.02	2.08	.050	.093	.166	.115	34	.067	.116	.201	5	.769	.163
84	SFO-JFK	5/22/77	16	3.77	2.35	.109	.161	.207	.140	16	.122	.172	.223	8	.891	.153
85	JFK-BAH	5/23/77	49	10.58	9.00	.240	.364	.533	.424	49	.304	.461	.655	46	.791	.124
86	BAH-JFK	5/25/77	51	12.12	6.00	.188	.364	.566	.526	51	.351	.568	.673	41	.546	.309 B
88	DTW-LHR	5/26/77	20	5.08	4.08	.341	.456	.509	.393	20	.536	.634	.753	20	.659	.198 B
89	LHR-BOS	5/27/77	13	2.83	2.83	.438	.500	.565	.459	13	.467	.540	.599	13	.941	.102
91	BOS-LHR	5/28/77	3	.92	.92	.163	.256	.284	.163	3	.188	.298	.339	2	.851	.014
92	LHR-BOS	5/28/77	16	3.58	3.58	.394	.480	.482	.433	17	.403	.515	.536	16	.953	.126
93	BOS-DTW	5/28/77	2	.17	.00	.078	.091	.091	.078	3	.088	.123	.124	1	.734	
94	DTW-BOS	5/28/77	3	.67	.58	.147	.218	.218	.147	3	.198	.264	.263	2	.679	.150
95	BOS-LHR	5/29/77	5	2.00	2.00	.375	.501	.509	.375	5	.402	.525	.529	5	.911	.120
96	LHR-BOS	5/29/77	18	3.58	3.58	.440	.578	.551	.457	18	.463	.560	.574	17	.962	.096
97	JFK-LHR	5/30/77	13	3.42	3.42	.295	.405	.437	.336	0				0		
98	BRU-LHR	5/31/77	1	.00	.00			.029		1			.096	0		
99	LHR-JFK	5/31/77	26	5.42	4.00	.288	.446	.634	.431	26	.431	.566	.756	26	.665	.250 B

✦ '?'=Use of 15th stage bleed unknown
'B'=15th stage bleed on for one or more data points

TABLE V - CABIN OZONE DATA SUMMARY FOR TAPE VL0010

B) FILE 3 (PANAM-N533PA)

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE ND	HOURS TOTAL	HOURS O3>.1	PPMV MEAN	PPMV M+SD	PPMV MAX	PPMV 2HR	AMBIENT OZONE ND	PPMV MEAN	PPMV M+SD	PPMV MAX	CABIN/AMBIENT (FOR AMBIENT >.1) ND	MEAN	SD +
1	JFK-HND	6/ 1/77	1089	11.38	7.97	.186	.328	.524	.423	1087	.373	.552	.635	812	.516	.266 B
2	HND-JFK	6/ 2/77	860	11.87	8.83	.221	.361	.665	.392	862	.329	.465	.612	730	.722	.272 B

+ 'B'=15th stage bleed on for one or more data points

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TABLE V - CABIN OZONE DATA SUMMARY FOR TAPE VL0010

C) FILE 4 (PANAM-N533PA)

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE: ND	HOURS: TOTAL*	HOURS: O3>.1	PPMV: MEAN	PPMV: M+SD	PPMV: MAX	PPMV: 2HR	AMBIENT OZONE: ND	PPMV: MEAN	PPMV: M+SD	PPMV: MAX	CABIN/AMBIENT (FOR AMBIENT >.1): ND	MEAN	SD +	
1	JFK-HND	6/ 3/77	109	12.98	6.05	.192	.371	.531	.454	110	.271	.478	.633	82	.602	.268	B
2	HND-LAX	6/ 4/77	63	8.83	3.17	.126	.259	.447	.297	62	.196	.383	.559	30	.642	.215	B
3	LAX-SEA	6/ 4/77	8	1.00	.00	.031	.038	.038	.031	8	.045	.060	.064	0			
4	SEA-SFO	6/ 9/77	11	1.53	1.17	.249	.344	.391	.249	11	.354	.495	.489	9	.708	.120	B
5	SFO-LHR	6/10/77	62	8.57	7.22	.292	.444	.486	.425	62	.437	.661	.714	53	.673	.127	
6	LHR-SEA	6/10/77	60	8.05	4.63	.109	.178	.442	.139	60	.509	.683	.742	60	.235	.147	B
7	SEA-LHR	6/11/77	55	7.75	6.92	.303	.432	.464	.419	55	.430	.614	.667	51	.711	.108	
8	LHR-SFO	6/11/77	67	9.28	7.76	.278	.400	.449	.402	68	.434	.571	.619	65	.630	.222	B
9	SFO-LHR	6/12/77	63	8.53	7.28	.225	.330	.435	.320	63	.334	.465	.584	58	.676	.164	
10	LHR-SEA	6/12/77	62	8.18	5.32	.113	.162	.353	.129	62	.421	.541	.572	61	.275	.116	B
11	SEA-LHR	6/13/77	60	8.18	7.67	.319	.433	.500	.437	56	.389	.514	.595	54	.848	.197	
12	LHR-SFO	6/13/77	73	9.33	9.25	.222	.319	.442	.349	73	.479	.595	.671	72	.478	.199	B
13	SFO-LHR	6/14/77	64	8.83	5.17	.121	.186	.314	.153	63	.326	.475	.570	53	.370	.199	B
14	LHR-SFO	6/14/77	70	9.33	7.42	.198	.313	.421	.339	71	.435	.578	.665	68	.472	.205	B
15	SFO-LHR	6/15/77	64	8.82	6.25	.174	.275	.366	.311	64	.310	.467	.609	53	.542	.225	B
16	LHR-SFO	6/15/77	69	9.33	6.00	.124	.183	.313	.182	69	.401	.536	.600	68	.370	.190	B
17	SFO-LHR	6/17/77	67	8.83	5.17	.183	.303	.378	.342	67	.470	.660	.730	62	.372	.190	B
18	LHR-SEA	6/17/77	65	6.25	4.75	.175	.278	.376	.318	66	.549	.686	.716	65	.352	.216	B
19	SEA-LHR	6/18/77	63	7.92	6.50	.214	.320	.385	.341	63	.499	.679	.690	58	.441	.166	B
20	LHR-SFO	6/18/77	72	9.08	4.92	.139	.209	.339	.196	72	.475	.636	.724	72	.355	.230	B
21	SFO-LHR	6/19/77	65	8.92	5.17	.172	.282	.330	.292	65	.464	.653	.690	64	.365	.183	B
22	LHR-SEA	6/19/77	39	.00M	.00			.392		39			.795	39	.435	.167	B
23	SEA-LHR	6/20/77	45	6.00	4.17	.123	.162	.301	.147	47	.550	.693	.667	42	.229	.069	B
24	LHR-SFO	6/20/77	74	9.25	4.83	.126	.226	.323	.250	75	.458	.643	.696	68	.322	.249	B
25	SFO-LHR	6/21/77	62	9.22	4.42	.141	.231	.341	.275	62	.446	.649	.780	54	.374	.309	B
26	LHR-SEA	6/21/77	60	8.17	4.92	.152	.231	.308	.252	61	.490	.655	.743	60	.341	.181	B
27	SEA-LHR	6/22/77	60	7.92	3.58	.087	.115	.125	.109	60	.492	.694	.787	54	.201	.121	B
28	LHR-SFO	6/22/77	72	9.30	3.13	.110	.178	.298	.183	72	.433	.645	.683	66	.294	.179	B
29	SFO-LHR	6/24/77	70	9.00	6.50	.201	.310	.360	.322	0				0			
30	LHR-SEA	6/24/77	61	8.25	4.57	.132	.223	.372	.255	0				0			B
31	SEA-LHR	6/25/77	60	7.58	6.00	.230	.330	.370	.332	56	.485	.649	.708	54	.523	.195	B
32	LHR-SFO	6/25/77	71	9.42	2.92	.116	.209	.337	.270	53	.515	.610	.633	53	.259	.178	B
33	SFO-LHR	6/26/77	66	8.57	4.25	.107	.156	.271	.146	0				0			B
34	LHR-SEA	6/26/77	59	8.13	4.72	.185	.309	.399	.359	0				0			B
35	SEA-LHR	6/27/77	61	7.68	7.52	.277	.338	.357	.300	0				0			
36	LHR-SFO	6/27/77	74	9.50	3.83	.125	.213	.358	.274	0				0			B
37	SFO-LHR	6/28/77	63	6.75	4.42	.133	.218	.303	.266	0				0			B
38	LHR-SEA	6/28/77	62	8.25	4.83	.144	.230	.321	.276	0				0			B
39	SEA-LHR	6/29/77	58	7.58	3.92	.143	.226	.311	.264	0				0			B
40	LHR-SFO	6/29/77	69	9.10	2.17	.100	.153	.292	.172	0				0			B

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TABLE V - C) V10010, FILE 4 CONTINUED

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE: HOURS: NO	CABIN OZONE: HOURS: TOTAL*	CABIN OZONE: HOURS: O3>.1	CABIN OZONE: PPMV: MEAN	CABIN OZONE: PPMV: M+SD	CABIN OZONE: PPMV: MAX	CABIN OZONE: PPMV: 2HR	AMBIENT OZONE: NO	AMBIENT OZONE: PPMV: MEAN	AMBIENT OZONE: PPMV: M+SD	AMBIENT OZONE: PPMV: MAX	CABIN/AMBIENT (FOR AMBIENT >.1) NO	CABIN/AMBIENT (FOR AMBIENT >.1) MEAN	CABIN/AMBIENT (FOR AMBIENT >.1) SD +
41	SFO-AKL	6/30/77	92	11.83	.17	.035	.055	.119	.054	0				0		
42	AKL-SYD	6/30/77	20	2.35	2.02	.244	.375	.475	.272	0				0		
43	SYD-AKL	7/ 1/77	7	.83	.83	.248	.287	.296	.246	0				0		
44	AKL-SFO	7/ 1/77	76	11.05	.25	.036	.059	.116	.068	0				0		
45	SFO-AKL	7/ 2/77	89	11.27	.50	.036	.061	.146	.073	0				0		
46	AKL-SYD	7/ 2/77	17	2.17	2.08	.189	.252	.281	.196	0				0		
47	SYD-SFO	7/ 3/77	99	12.83	.00	.042	.064	.095	.075	0				0		
48	SFO-JFK	7/ 3/77	33	3.95	.25	.049	.074	.132	.059	0				0		
49	JFK-HND	7/ 4/77	94	12.13	2.50	.098	.157	.301	.193	0				0		B
50	HND-LAX	7/ 5/77	56	8.67	2.92	.087	.123	.158	.136	0				0		B
51	LAX-HND	7/ 5/77	79	10.10	7.83	.167	.270	.383	.256	0				0		
52	HND-JFK	7/ 6/77	89	11.60	6.00	.143	.233	.302	.247	0				0		
53	JFK-CPH	7/ 7/77	46	6.28	5.95	.223	.303	.356	.316	0				0		
54	CPH-JFK	7/ 7/77	50	6.60	5.95	.207	.273	.325	.247	0				0		
55	JFK-HND	7/ 8/77	82	11.58	4.33	.076	.142	.200	.156	87	.374	.544	.571	70	.210	.150 B
56	HND-LAX	7/ 9/77	67	8.80	2.30	.069	.140	.270	.140	70	.174	.316	.536	39	.379	.187
57	LAX-HND	7/ 9/77	75	9.85	1.33	.035	.080	.194	.110	75	.140	.248	.451	30	.310	.167 B
58	HND-JFK	7/10/77	83	11.38	6.00	.117	.211	.293	.217	85	.315	.518	.593	62	.407	.176 B
59	JFK-CPH	7/11/77	46	6.25	4.00	.142	.251	.330	.256	46	.306	.505	.555	32	.500	.151
60	CPH-JFK	7/11/77	51	6.63	3.92	.177	.299	.363	.324	53	.330	.538	.630	41	.526	.205
61	JFK-BAH	7/11/77	75	11.10	3.92	.087	.169	.257	.186	75	.214	.380	.555	46	.453	.168
62	BAH-JFK	7/12/77	91	12.00	4.92	.097	.136	.310	.248	92	.204	.421	.608	65	.393	.159
63	JFK-HND	7/14/77	93	12.15	7.25	.163	.272	.357	.309	93	.306	.487	.568	71	.547	.153
64	HND-JFK	7/15/77	79	10.93	3.00	.066	.134	.310	.140	79	.156	.277	.511	48	.456	.176
65	JFK-CPH	7/16/77	47	6.08	3.92	.163	.268	.324	.277	47	.344	.539	.610	38	.485	.136
66	CPH-JFK	7/16/77	53	6.83	5.42	.240	.348	.398	.352	54	.398	.564	.612	49	.615	.138
67	JFK-HND	7/17/77	94	12.08	2.33	.075	.140	.263	.211	58	.334	.518	.572	77	.253	.182 B
68	HND-LAX	7/18/77	60	8.30	.97	.061	.117	.270	.130	60	.137	.230	.483	38	.435	.158
69	LAX-HND	7/18/77	72	9.92	.83	.023	.056	.132	.060	74	.083	.144	.374	16	.467	.218 B
70	HND-JFK	7/19/77	80	11.33	3.56	.070	.117	.184	.131	81	.223	.375	.552	70	.309	.140 B
71	JFK-HND	7/28/77	84	11.00	8.75	.206	.315	.415	.343	84	.209	.461	.540	63	.675	.145
72	HND-LAX	7/29/77	54	7.92	1.67	.053	.105	.176	.114	55	.120	.220	.510	27	.492	.148
73	LAX-HND	7/29/77	59	7.50	6.00	.205	.308	.378	.295	51	.322	.479	.530	43	.715	.183
74	HND-JFK	7/30/77	89	11.87	3.83	.086	.174	.307	.208	90	.203	.347	.509	58	.402	.288 B
75	JFK-HND	7/31/77	49	6.17	.75	.063	.111	.231	.106	53	.151	.241	.462	33	.413	.177 B
76	HND-LAX	8/ 1/77	68	9.22	2.67	.089	.173	.339	.206	70	.155	.251	.504	43	.562	.156
77	LAX-HND	8/ 1/77	77	9.62	3.33	.085	.157	.301	.197	77	.143	.258	.511	39	.583	.163
78	HND-JFK	8/ 2/77	88	11.55	4.37	.094	.157	.311	.150	88	.243	.395	.518	67	.429	.271 B
79	JFK-HND	8/ 3/77	95	4.05M	1.08	.068	.132	.255	.118	95	.147	.254	.505	67	.478	.133
80	HND-LAX	8/ 4/77	51	6.92M	1.68	.065	.133	.271	.169	52	.124	.232	.419	25	.549	.140

TABLE V - C) VL0010, FILE 4 CONCLUDED

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE: HOURS: ND	CABIN OZONE: HOURS: TOTAL*	CABIN OZONE: HOURS: O3>.1	CABIN OZONE: PPMV: MEAN	CABIN OZONE: PPMV: M+SD	CABIN OZONE: PPMV: MAX	CABIN OZONE: PPMV: 2HR	AMBIENT OZONE: ND	AMBIENT OZONE: PPMV: MEAN	AMBIENT OZONE: PPMV: M+SD	AMBIENT OZONE: PPMV: MAX	CABIN/AMBIENT (FOR AMBIENT >.1): ND	CABIN/AMBIENT (FOR AMBIENT >.1): MEAN	CABIN/AMBIENT (FOR AMBIENT >.1): SD +	
81	LAX-HND	8/ 4/77	73	7.98M	.27	.030	.063	.147	.070	73	.106	.215	.460	19	.350	.118	B
82	HND-JFK	8/ 5/77	83	6.05M	3.38	.108	.179	.296	.176	85	.215	.355	.491	55	.425	.193	B
83	JFK-CPH	8/ 6/77	46	5.00M	3.03	.151	.238	.335	.237	46	.330	.432	.481	45	.449	.191	B
84	CPH-JFK	8/ 6/77	52	7.00	6.08	.186	.260	.315	.262	54	.318	.428	.479	49	.573	.077	
85	JFK-SEA	8/ 7/77	28	4.73	.00	.002	.007	.022	.004	38	.119	.205	.314	11	.036	.053	F
86	SEA-HND	8/ 8/77	61	8.58	.00	.007	.020	.071	.019	64	.158	.315	.501	19	.074	.152	F
87	HND-JFK	8/ 8/77	93	11.38	.00	.005	.020	.052	.020	95	.202	.358	.506	49	.049	.050	F
88	JFK-CPH	8/ 9/77	44	5.70	.00	.006	.014	.033	.011	46	.138	.233	.423	22	.043	.044	F
89	CPH-JFK	8/ 9/77	22	7.33	.00	.011	.023	.044	.024	60	.210	.341	.495	20	.070	.086	F
90	JFK-CPH	8/10/77	35	6.42	.00	.018	.035	.064	.030	48	.240	.382	.502	30	.068	.088	F
91	CPH-JFK	8/10/77	21	.00M	.00			.080		37			.465	10	.055	.036	F
92	JFK-SFO	8/11/77	34	.00M	.00			.075		40			.154	11	.027	.044	F
93	SFO-AKL	8/11/77	31	.00M	.00			.059		86			.443	0			F
94	AKL-SYD	8/12/77	18	1.35M	.00	.005	.015	.032	.005	18	.185	.230	.246	18	.049	.048	F
95	SYD-AKL	8/12/77	11	1.78	.00	.014	.017	.021	.014	11	.164	.257	.328	6	.069	.044	F
96	AKL-SFO	8/12/77	75	11.05	.00	.003	.009	.029	.008	83	.047	.085	.183	8	.010	.017	F
	VL0010	8/6-8/12	10264	1393.71	665.81	.149	.295	1.089	.695	6720	.296	.520	1.104	4662	.486	.281	

* 'M'=Observation time not available for one or more data points
\+ 'B'=15th stage bleed on for one or more data points
'F'=Charcoal filter installed

TABLE VI - CABIN OZONE DATA SUMMARY FOR TAPE VL0012

A) FILE 2 (UNITED-N4711U)

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE ND	HOURS TOTAL	HOURS O3>.1	PPMV MEAN	PPMV M+SD	PPMV MAX	PPMV 2HF	AMBIENT OZONE ND	PPMV MEAN	PPMV M+SD	PPMV MAX	CABIN/AMBIENT (FOR AMBIENT >.1) ND	MEAN	SD
1	SFC-ORD	3/26/77	22	2.73	.08	.048	.072	.125	.057	0				0		
2	ORD-LAX	3/27/77	28	3.10	.33	.059	.085	.120	.071	0				0		
3	LAX-JFK	3/27/77	30	3.72	.00	.034	.053	.081	.046	0				0		
4	JFK-LAX	3/28/77	37	4.52	2.85	.093	.144	.192	.135	0				0		
5	LAX-SEA	3/29/77	12	1.60	.48	.068	.120	.168	.066	0				0		
6	SEA-ORD	3/29/77	21	2.53	1.27	.084	.134	.164	.087	0				0		
7	ORD-LAX	3/29/77	24	3.03	2.08	.106	.141	.188	.107	0				0		
8	LAX-JFK	3/30/77	28	3.47	.00	.038	.056	.092	.045	28	.091	.114	.131	12	.376	.129
9	JFK-LAX	3/31/77	42	5.18	3.52	.159	.255	.377	.221	42	.335	.580	.854	29	.508	.233
10	LAX-SEA	4/ 1/77	11	1.47	1.30	.262	.321	.323	.262	10	.691	.742	.765	10	.389	.063
11	SEA-ORD	4/ 1/77	17	2.42	2.25	.288	.380	.395	.324	18	.605	.841	.851	15	.471	.143
12	ORD-LAX	4/ 1/77	25	3.17	2.75	.246	.349	.375	.305	25	.644	.923	.991	24	.374	.069
13	LAX-JFK	4/ 2/77	29	3.77	2.67	.171	.249	.296	.234	29	.421	.709	.807	26	.472	.253
14	JFK-LAX	4/ 3/77	34	4.68	4.27	.216	.312	.411	.302	35	.605	.876	1.044	33	.363	.067
15	LAX-HNL	4/ 4/77	31	4.63	.25	.052	.076	.145	.063	32	.092	.115	.151	14	.459	.156
16	HNI-SFC	4/ 4/77	23	3.67	.00	.048	.069	.099	.053	23	.104	.144	.223	11	.365	.132
17	HNI-SFC	4/ 5/77	29	3.83	.00	.054	.073	.095	.058	29	.122	.146	.171	24	.436	.147
18	SFO-ORD	4/ 6/77	22	2.68	.42	.077	.114	.171	.074	22	.181	.275	.386	16	.474	.295
19	ORD-LAX	4/ 7/77	22	2.75	.92	.106	.191	.377	.126	22	.143	.195	.236	17	.544	.319
20	LAX-JFK	4/ 7/77	28	3.75	2.42	.145	.236	.369	.205	30	.320	.493	.678	28	.473	.167
21	JFK-LAX	4/ 8/77	32	4.42	2.42	.139	.233	.322	.221	32	.319	.530	.746	29	.436	.116
22	LAX-SEA	4/ 9/77	9	1.00	.83	.132	.192	.237	.134	9	.408	.627	.634	9	.358	.128
23	SEA-ORD	4/ 9/77	20	2.57	1.25	.154	.263	.389	.169	20	.287	.483	.723	18	.508	.172
24	ORD-LAX	4/ 9/77	22	2.83	.57	.076	.106	.126	.087	22	.159	.226	.299	17	.462	.131
25	LAX-HNL	4/10/77	30	4.42	1.92	.097	.158	.217	.133	31	.187	.313	.561	21	.557	.266
26	HNL-SFO	4/10/77	17	3.70	.00	.052	.074	.089	.054	17	.127	.178	.224	9	.347	.105
27	SFC-HNL	4/11/77	28	4.17	1.17	.062	.117	.154	.086	27	.163	.240	.330	22	.496	.158
28	HNL-SFO	4/11/77	27	3.75	.17	.043	.070	.127	.060	27	.100	.151	.239	7	[illegible]	.324
29	SFC-ORD	4/11/77	23	2.87	1.95	.147	.216	.266	.173	23	.321	.456	.539	21	.451	.109
30	ORD-LAX	4/12/77	25	2.92	2.08	.181	.279	.372	.238	25	.447	.723	.968	22	.454	.170
31	LAX-JFK	4/12/77	31	3.90	1.08	.076	.133	.237	.106	31	.160	.274	.544	17	.459	.130
32	JFK-LAX	4/13/77	33	4.33	.50	.067	.097	.163	.085	33	.146	.245	.471	21	.430	.104
33	LAX-HNL	4/14/77	32	4.10	.17	.060	.086	.143	.069	33	.081	.100	.120	7	.627	.337
34	HNI-SFC	4/14/77	32	3.92	.25	.045	.069	.132	.049	32	.090	.112	.133	12	.464	.233
35	SFO-HNL	4/15/77	31	4.02	.00	.036	.046	.063	.036	31	.079	.099	.112	5	.343	.051
36	HNL-SFO	4/15/77	30	3.60	.07	.043	.060	.112	.046	30	.090	.103	.116	7	.462	.180
37	SFC-ORD	4/15/77	22	2.83	.92	.090	.132	.192	.102	22	.184	.306	.639	14	.465	.235
38	ORD-LAX	4/16/77	22	2.75	1.77	.112	.154	.230	.127	12	.164	.248	.370	9	.566	.214
39	LAX-HNL	4/16/77	33	4.25	.00	.034	.048	.076	.036	33	.076	.092	.105	1	.333	
40	HNI-SFO	4/17/77	14	1.67	.00	.041	.058	.076	.041	14	.092	.095	.096	0		

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TABLE VI - A) VL0012, FILE 2 CONCLUDED

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE: HOURS: ND	CABIN OZONE: HOURS: TOTAL	CABIN OZONE: HOURS: O3>.1	CABIN OZONE: PPMV: MEAN	CABIN OZONE: PPMV: M+SD	CABIN OZONE: PPMV: MAX	CABIN OZONE: PPMV: 2HR	AMBIENT OZONE: ND	AMBIENT OZONE: PPMV: MEAN	AMBIENT OZONE: PPMV: M+SD	AMBIENT OZONE: PPMV: MAX	CABIN/AMBIENT (FOR AMBIENT >.1): ND	CABIN/AMBIENT (FOR AMBIENT >.1): MEAN	CABIN/AMBIENT (FOR AMBIENT >.1): SD
41	SFO-HNL	4/19/77	36	4.42	.75	.075	.138	.264	.111	36	.144	.273	.528	11	.461	.164
42	HNL-LAX	4/20/77	28	3.58	.17	.055	.081	.127	.064	29	.096	.150	.226	11	.501	.149
43	LAX-JFK	4/20/77	29	3.83	1.25	.087	.139	.241	.122	30	.188	.328	.586	19	.461	.176
44	JFK-LAX	4/21/77	33	4.10	1.58	.106	.162	.251	.140	33	.202	.407	.683	16	.444	.283
45	LAX-HNL	4/22/77	35	4.40	.50	.059	.088	.148	.063	27	.099	.148	.343	9	.463	.118
46	HNL-LAS	4/22/77	35	4.33	.00	.030	.048	.090	.044	35	.079	.121	.208	9	.370	.088
47	LAS-LAX	4/22/77	1	.00	.00			.017		1			.046	0		
48	LAX-JFK	4/22/77	30	3.83	.33	.053	.091	.219	.071	30	.128	.241	.465	14	.360	.152
49	JFK-LAX	4/23/77	21	4.25	1.75	.088	.128	.182	.108	21	.215	.347	.495	18	.396	.253
50	LAX-HNL	4/24/77	32	4.27	1.02	.062	.099	.169	.087	33	.137	.253	.396	10	.259	.116
51	HNL-LAX	4/24/77	27	3.75	.42	.047	.079	.127	.064	27	.100	.178	.298	6	.365	.047
52	LAX-ORD	4/24/77	8	2.67	1.17	.102	.169	.202	.129	8	.301	.596	.750	4	.395	.156
53	ORD-LAX	4/24/77	5	1.25	1.18	.139	.183	.191	.139	5	.265	.317	.313	5	.480	.099
54	LAX-HNL	4/25/77	37	4.75	.17	.046	.077	.182	.054	38	.069	.088	.110	2	.395	.014
55	HNL-SFO	4/26/77	27	3.42	.65	.064	.094	.126	.081	27	.085	.135	.199	9	.630	.202
56	SFO-HNL	4/26/77	28	4.50	.00	.055	.072	.098	.062	36	.121	.155	.235	14	.482	.085
57	HNL-LAX	4/26/77	28	3.67	1.58	.106	.181	.458	.138	28	.212	.270	.308	26	.520	.317
58	LAX-HNL	4/27/77	33	4.58	.00	.055	.071	.097	.065	29	.108	.132	.164	15	.439	.092
59	HNL-SFO	4/27/77	27	3.38	.73	.073	.119	.193	.094	27	.147	.239	.365	12	.489	.137
60	SFO-ORD	4/28/77	21	2.67	.17	.061	.082	.106	.068	21	.116	.168	.276	12	.510	.105
61	ORD-SEA	4/29/77	24	3.00	2.00	.128	.197	.320	.145	24	.284	.413	.575	23	.449	.115
62	SEA-ORD	4/29/77	18	2.33	1.33	.101	.133	.151	.101	19	.233	.323	.419	16	.456	.153
63	ORD-SFO	4/29/77	22	3.17	.25	.065	.099	.141	.084	22	.141	.203	.250	13	.457	.144
64	SFO-JFK	4/30/77	29	3.92	2.08	.118	.194	.293	.169	29	.234	.351	.496	20	.542	.324
65	JFK-SFO	5/ 1/77	34	4.42	1.50	.102	.183	.316	.178	34	.218	.410	.622	17	.450	.148
66	SFO-HNL	5/ 1/77	25	3.83	1.67	.091	.145	.190	.133	26	.165	.276	.416	13	.531	.159
67	HNL-SFO	5/ 2/77	32	4.17	.25	.048	.065	.109	.054	32	.089	.122	.176	5	.417	.102
68	SFO-ORD	5/ 3/77	17	2.75	.67	.086	.133	.211	.107	17	.183	.282	.446	13	.487	.138
69	ORD-SEA	5/ 4/77	14	2.60	2.60	.199	.268	.306	.230	14	.401	.519	.631	14	.530	.259
70	ORD-LAX	5/ 4/77	23	3.02	.88	.096	.163	.286	.110	22	.161	.265	.520	13	.604	.226
94	SFO-HNL	5/31/77	28	3.92	.00	.030	.043	.052	.036	28	.067	.086	.107	1	.290	
96	JFK-LAX	6/10/77	20	3.07	.83	.092	.130	.194	.105	28	.135	.216	.329	11	.706	.318
97	LAX-HNL	6/10/77	20	4.15	.23	.054	.076	.110	.064	20	.066	.093	.116	2	.412	.026
98	LAX-ORD	6/11/77	18	2.50	.67	.085	.120	.173	.091	16	.154	.253	.396	13	.542	.322
99	ORD-SEA	6/12/77	7	.92	.92	.226	.249	.256	.226	7	.447	.509	.506	7	.536	.113
100	SEA-ORD	6/12/77	7	2.17	.08	.065	.094	.106	.071	7	.139	.212	.241	4	.367	.128
101	ORD-HNL	6/12/77	15	2.00	.00	.043	.054	.062	.043	0				0		
102	HNL-SFO	6/13/77	10	1.33	.67	.112	.176	.267	.112	10	.227	.371	.481	7	.451	.102

TABLE VI - CABIN OZONE DATA SUMMARY FOR TAPE VL0012

B) FILE 3 (UNITED-N4711U)

FLT	FLIGHT ROUTE	DEPART DATE	CABIN OZONE: HOURS ND	HOURS TOTAL	HOURS O3>.1	PPMV MEAN	PPMV M+SD	PPMV MAX	PPMV 2HR	AMBIENT OZONE: ND	PPMV MEAN	PPMV M+SD	PPMV MAX	CABIN/AMBIENT (FOR AMBIENT >.1) ND	MEAN	SD
1	SFO-HNL	6/14/77	15	4.07	.78	.078	.140	.204	.100	0				0		
3	SFO-HNL	6/14/77	16	3.38	.83	.071	.100	.131	.079	0				0		
4	HNL-LAX	6/14/77	7	.83	.00	.043	.046	.049	.043	0				0		
5	LAX-JFK	6/15/77	21	2.88	.58	.057	.080	.112	.065	0				0		
	VL0012	3/26-6/15	1971	270.15	77.20	.087	.159	.458	.324	1727	.191	.376	1.044	541	.465	.201

TABLE VII - CORRELATION BETWEEN CABIN AND AMBIENT OZONE LEVELS FROM GASP TAPES VL0010 AND VL0012

Aircraft	Added technique for destroying ozone	ND	CABIN/AMBIENT (Ambient > .1) MEAN	SD	Correlation Coefficient
B-747SP (N533PA)	None	527*	.825	.208	.871
	15th stage compressor bleed	123*	.268	.132	.513
	Modified air recirculation without 15th stage bleed	1995	.552	.191	.813
	Modified air recirculation with 15th stage bleed	972	.211	.109	.415
	Charcoal filter	204	.056	.076	.260
B-747-100 (N4711U)	None	941	.465	.201	.859

*Data prior to 5/12/77 not used

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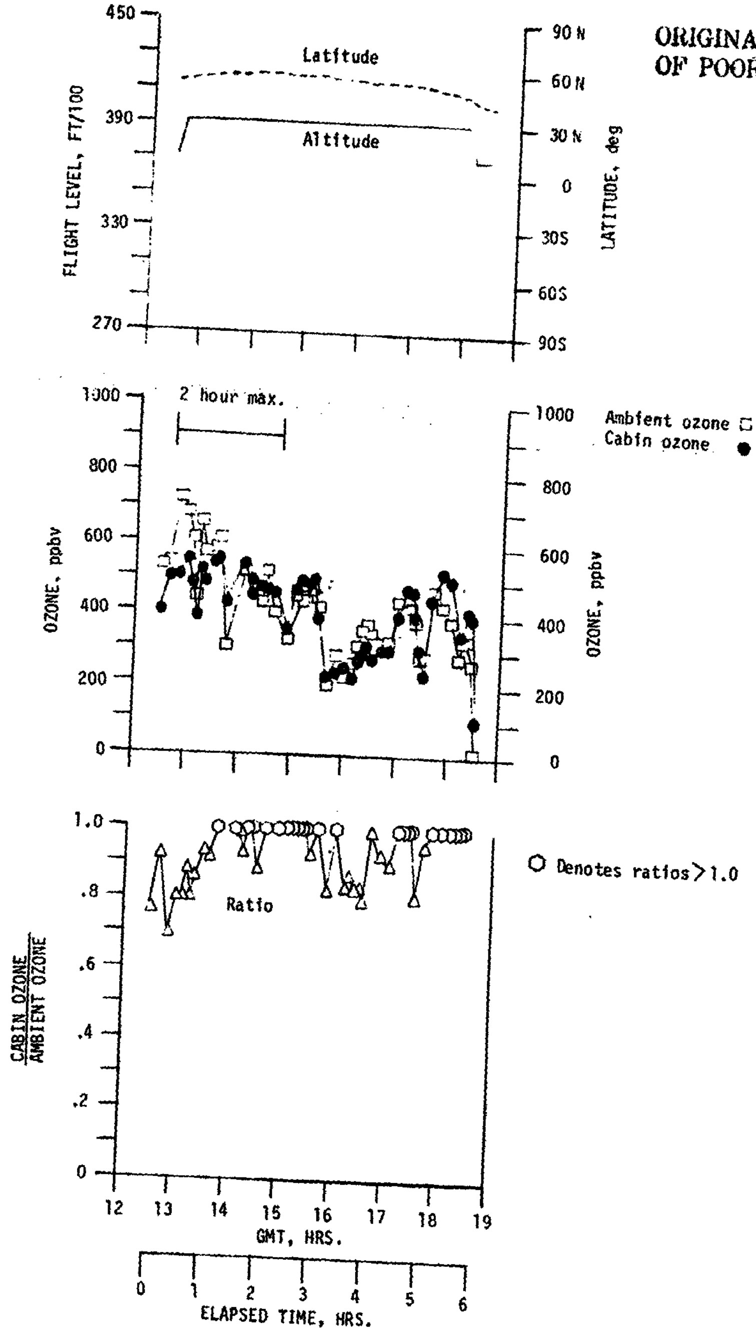

Figure 1. Flight record of GASP cabin and ambient ozone measurements from Pan Am N533PA, LHR-JFK, 5/15/77 (from tape VL0010, file 2, flight 67).

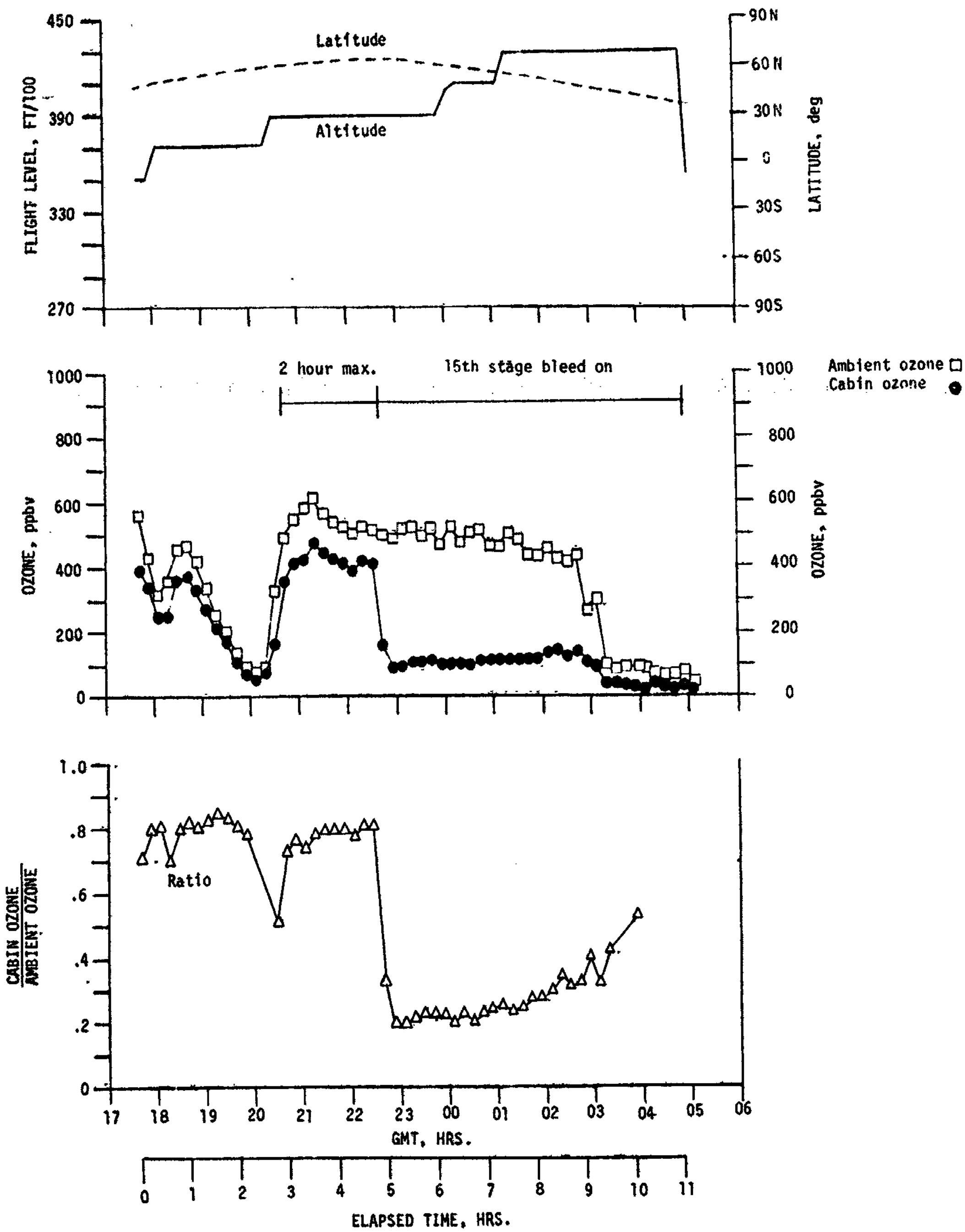

Figure 2. Flight record of GASP cabin and ambient ozone measurements from Pan Am N533PA, JFK+HND, 6/1/77 (from tape VL0010, file 3, flight 1).

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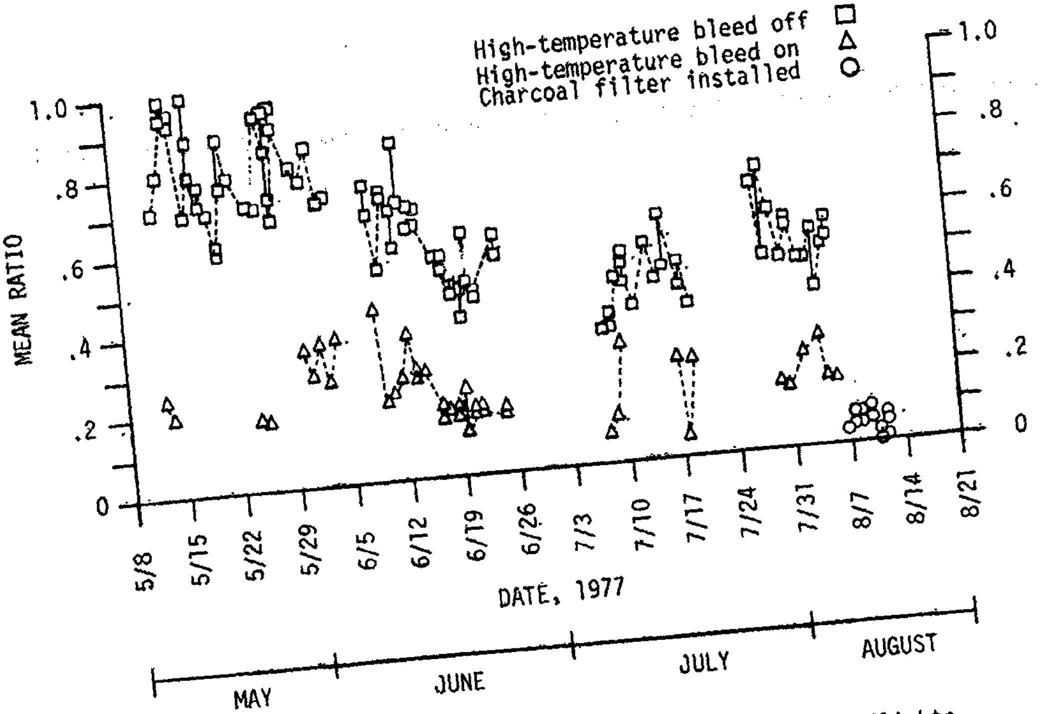

Figure 3. Mean ratio of cabin/ambient ozone for N533PA flights from 5/13/77 - 8/12/77. Plotted values are averages for each flight with bleed-off and bleed-on data separated.

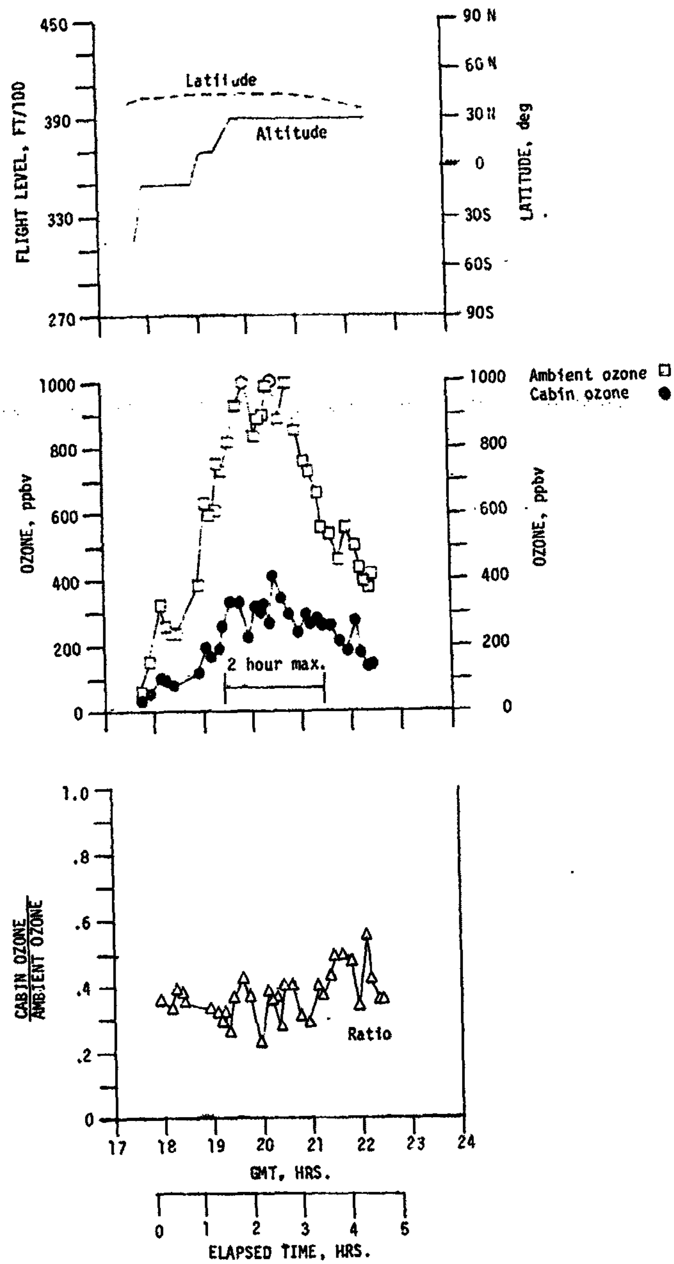

Figure 4. Flight record of GASP cabin and ambient ozone measurements from United N4711U, JFK-LAX, 4/3/77 (from tape VL0012, file 2, flight 14).

APPENDIX A - Specifications for GASP Archive Tapes (VLXXXX)

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GENERAL

1. Tapes are written in EBCDIC format using nine track tapes.

2. Tape density is 800 BPI.

3. Physical records (blocks) are 4096 bytes.

4. The tapes are unlabeled, and contain one or more GASP data files. (On tapes < VL0C09 these are followed by a tropopause pressure data file.)

GASP DATA FILE

1. Each GASP data file contains data from a single GASP aircraft. Within each file, data are grouped and identified by flights (takeoff to landing) in chronological order.

2. The GASP data for each flight begins with a logical FLHT record (flight identification data), which is followed by logical DATA records (one for each data recording made during the flight). Both FLHT and DATA records contain 512 bytes, hence there are 8 logical records per physical record (block).

3. An FLHT record will always be the first logical record in a block. However, every block need not begin with an FLHT record (i.e., if there are more than seven DATA records in a flight). If the FLHT record plus the available DATA records for a flight do not fill an integer number of blocks, the unused logical records in the final block are padded with zeros creating PADD records. The diagram below shows how several short flights would be blocked.

Block	1								2								3							
	F	D	D	D	D	D	P	P	F	D	D	D	D	D	D	D	D	D	F	F	P	P	P	P
Logical Record	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8

Block	4.	5	6
	F D D D D D D D	D D D D D D D D	F D D D D D D P
Logical Record	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8

where F is an FLHT record
      D is a DATA record
      P is a PADD record

4. The first four bytes in each logical record identify the record type as FLHT, DATA, or PADD. Detailed specification of the parameters and formats for FLHT and DATA records are given in Table A-I and A-II respectively.

   a) In each FLHT record, the number of DATA records to follow is given by NDATA (Bytes 78-81), and the number of blocks in the flight is given by NBLOCK (Bytes 82-84).

   b) For the last DATA record of each flight, LBFLG (Byte 5) = 'L'; for the last DATA record in each file, LBFLG = 'G' if the following file is a GASP data file, and LBFLG = 'T' if the following file is the tropopause pressure file; for all other DATA records, LBFLG = ' '.

   Note: DATA records with LBFLG ≠ ' ' will be followed by PADD records if the physical record (block) is not complete.

Table A-I Format for FLHT Records

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
1-4	RECID	A4	RECID = 'FLHT'
5-10	TAPID	A6	Original GASP tape number, GPXXX
11-25	ACID	A15	Aircraft ID: Airline and tail number
26-28	APTLV	A3	Airport of departure (3 letter code)
29-34	DATLV	3I2	Date first DATA record this flight; Mo=29-30, Da=31-32, Yr=33-34
35-38	TIMLV	2A2	Time (GMT) first DATA record this flight; Hr=35-36, Min=37-38
39-43	LATLV	F5.2	Latitude (deg) of APTLV
44	LALVT	A1	Hemisphere of LATLV; 'N' or 'S'
45-50	LONLV	F6.2	Longitude (deg) of APTLV
51	LOLVT	A1	Hemisphere of LONLV; 'E' or 'W'
52-54	APTAR	A3	Airport of arrival (3 letter code)
55-60	DATAR	3I2	Date last DATA record this flight; Mo=55-56, Da=57-58, Yr=59-60
61-64	TIMAR	2A2	Time (GMT) last DATA record this flight; Hr=61-62, Min=63-64
65-69	LATAR	F5.2	Latitude (deg) of APTAR
70	LAART	A1	Hemisphere of LATAR, 'N' or 'S'
71-76	LONAR	F6.2	Longitude (deg) of APTAR
77	LOART	A1	Hemisphere of LONAR, 'E' or 'W'
78-81	NDATA	I4	Number of DATA records for this flight - see OVRFLO, byte 508
82-84	NBLCCK	I3	Total number of blocks for this flight - see OVRFLO, byte 508
85-87	O3ID	A3	Ozone instrument ID number*
88-90	COID	A3	Carbon monoxide instrument ID number*
91-93	PCSID	A3	Particle counter sensor ID number*
94-96	PCEID	A3	Particle counter electronics ID number*
97-99	H2OID	A3	Water vapor sensor ID number*
100-102	HYGID	A3	Hygrometer ID number*
103-105	CNID	A3	Condensation nuclei instrument ID number*
106-117		4A3	Spares

Table A-I Continued

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
118-122	D1	F5.3	Smallest particle radius (micrometers) for PC range 1
123-127	D2	F5.3	Smallest particle radius (micrometers) for PC range 2
128-132	D3	F5.3	Smallest particle radius (micrometers) for PC range 3
133-137	D4	F5.3	Smallest particle radius (micrometers) for PC range 4
138-142	D5	F5.3	Smallest particle radius (micrometers) for PC range 5
143	LIMCHK	A1	LIMCHK='T' if acceleration limit exceeded (NE>0) on any DATA record this flight; otherwise LIMCHK='F'
144	FILEX	A1	FILEX='T' if filter exposed this flight; otherwise FILEX='F'
145	FDATA	A1	FDATA='T' if filter data on tape; otherwise FDATA='F'
146-149	FPAKN	I4	Filter pack number
150-151	FILTN	I2	Filter number
152-161	FTYPE	A10	Filter type
162-167	FDATON	3I2	Filter exposure start date; Mo=162-163,Da=164-165,Yr=166-167
168-171	FTIMON	2A2	Filter exposure start time; (GMT); Hr=168-169,Min 170-171
172-176	FLATON	F5.2	Filter exposure start latitude (deg)
177	FLAONT	A1	Filter exposure start latitude tag; 'N' or 'S'
178-183	FLCNCN	F6.2	Filter exposure start longitude (deg)
184	FLOONT	A1	Filter exposure start longitude tag; 'E' or 'W'
185-190	FHTMON	F6.0	Filter exposure start altitude (meters)
191-196	FDATOF	3I2	Filter exposure stop date; Mo=191-192,Da=193-194,Yr=195-196
197-200	FTIMOF	2A2	Filter exposure stop time (GMT); Hr=197-198,Min=199-200
201-205	FLATOF	F5.2	Filter exposure stop latitude (deg)
206	FLAOFT	A1	Filter exposure stop latitude tag; 'N' or 'S'
207-212	FLCNOF	F6.2	Filter exposure stop longitude (deg)
213	FLOOFT	A1	Filter exposure stop longitude tag; 'E' or 'W'
214-219	FHTMOF	F6.0	Filter exposure stop altitude (meters)

Table A-I Continued

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
220-229	FCOMP1	A10	Filter constituent 1 (name)
230-239	FCOMP2	A10	Filter constituent 2 "
240-249	FCOMP3	A10	Filter constituent 3 "
250-259	FCOMP4	A10	Filter constituent 4 "
260-269	FCOMP5	A10	Filter constituent 5 "
270-279	FDC1	F10.3	Data for constituent 1 (micrograms/m**3)
280-289	FDC2	F10.3	Data for constituent 2 (micrograms/m**3)
290-299	FDC3	F10.3	Data for constituent 3 (micrograms/m**3)
300-309	FDC4	F10.3	Data for constituent 4 (micrograms/m**3)
310-319	FDC5	F10.3	Data for constituent 5 (micrograms/m**3)
320	SBUEX	A1	SBUEX='T' if MODE=10 recording this flight; otherwise SBUEX='F'
321		A1	Spares**
322-324		I3	Spares**
325-332		4I2	Spares**
333-336		2A2	Spares**
337-341		F5.2	Spares**
342		A1	Spares**
343-348		F6.2	Spares**
349		A1	Spares**
350-355		F6.0	Spares**
356-361		3I2	Spares**
362-365		2A2	Spares**
366-370		F5.2	Spares**
371		A1	Spares**
372-377		F6.2	Spares**
378		A1	Spares**

Table A-I Completed

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
379-384		F6.0	Spares**
385-434		5A10	Spares**
435-444	FFLO	F10.1	Filter flow in ambient cubic meters**
445-484		4F10.1	Spares**
485-489	a	F5.3	03 destruction constant (see eq. 1)
490-494	b	F5.3	03 destruction constant (see eq. 1)
495-499	c	F5.1	03 destruction constant (see eq. 1)
500-507	d	E8.2	03 destruction constant (see eq. 1)
508	OVRFLO	I1	If OVRFLO>0, NDATA=NDATA+OVRFLO*7992, and NBLCCK=NBLCCK+OVRFLO*1000
509-512	SENS	F4.2	Carbon monoxide sensitivity correction factor

* If ID='M', no data for this instrument this flight

** Used on tapes VLOC04, VL0005, and VL0006 for reporting data from "grab" sample bottle exposures - see TM X-73574, TM X-73608, and TM 73727

Table A-II Format for DATA Records

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
1-4	RECID	A4	RECID= 'DATA'
5	LBFLG	A1	LBFLG='L' if this is the last data record this flight; LBFLG='G' if this is the last GASP data record in the file and the following file is a GASP data file; LBFLG='T' if this is the last GASP data record in the file and the following file is a tropopause pressure file; otherwise LBFLG=' '
6-9	RECORD	I4	Record number on TAPID*
10	FRAME	I1	Frame number on TAPID*
11-12	MODE	I2	Program mode*: = 4 - normal recordings = 10 - continuous recordings
13	TYPE	A1	Record type*: = 'N' for normal recordings = 'L' for continuous limit recordings = 'C' for continuous recordings**
14	CYCLE	A1	Calibration cycle number, or CYCLE='D' for data; cal and data cycles alternate at 5 min intervals, unless MODE = 10 or TYPE = 'L'
15-20	DATE	3I2	Mo=15-16, Da=17-18, Yr=19-20
21-24	TIME	2A2	Time (GMT), Hr=21-22, Min=23-24
25-30	ALTFAV	F6.0	Pressure altitude (ft)
31-36	ALTMAV	F6.0	Pressure altitude (meters) - see ALTAG, byte 44
37-43	PAMB	F7.2	Ambient static pressure in hPa - calc from ALTFAV
44	ALTAG	A1	ALTAG='C', 'D', or 'G' indicates climb, descent, or ground If ALTAG='T', ALTMAV and TRPRHM are geopotential heights (m)
45-49	LAT	F5.2	Latitude (deg)
50	LATAG	A1	Latitude hemisphere, 'N' or 'S'
51-56	LONG	F6.2	Longitude (deg)
57	LONGTAG	A1	Longitude hemisphere, 'E' or 'W'

Table A-II Continued

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
58-62	XI	F5.2	Aircraft position in NMC grid coordinates
63-67	YJ	F5.2	Aircraft position in NMC grid coordinates
68-71	HEADG	F4.0	Aircraft heading (deg)
72	HEADGT	A1	Tag for HEADG**
73-76	TASK	F4.0	True airspeed (knots)
77-81	XMATAS	F5.3	Flight mach number
82	TATAG	A1	Tag for TASK and XMATAS**
83-86	WS	F4.0	Wind speed (knots)
87-90	WSM	F4.0	Wind speed (meters/sec)
91	WSTAG	A1	Tag for WS and WSM**
92-95	WDEG	F4.0	Wind direction (deg)
96	WDEGTG	A1	Tag for WDEG**
97-100	SAT	F4.0	Static (ambient) air temperature (deg C)
101	SATAG	A1	Tag for SAT**
102-229	ACC(I)	32F4.2	Vertical acceleration (G's): 32 values each record at 8/sec
230-233	ACCMAX	F4.2	Max of ACC(I)
234-237	ACCMIN	F4.2	Min of ACC(I)
238-239	NE	I2	Number of times ACC(I) > 1.2 or ACC(I) < 0.8
240	ACCTAG	A1	Tag for ACC(I), ACCMAX, ACCMIN, NE**
241-245	ZEN	F5.1	Solar elevation angle (deg); 0 deg = horizontal
246	SUNTAG	A1	SUNTAG='N' if sun below horizon**
247-252	O3	F6.0	Ozone data (ppbv)
253	O3TAG	A1	Tag for O3**
			If O3TAG='Z', O3 = instrument zero (ppbv) - see text
254-259	O3A	F6.0	Ozone ave (ppbv): for 128 sec preceding recording
260	O3ATAG	A1	Tag for O3A**
261-266	O3S	F6.0	Ozone std deviation (ppbv): for 128 sec preceding recording
267	O3STAG	A1	Tag for O3S**

Table A-II Continued

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
268-273	DFPTA	F6.1	Dew/frost point temperature (deg C)
274-279	WVMRA	F6.1	Water vapor mixing ratio (ppmw)
280	DFTAGA	A1	Tag for DFPTA and WVMRA; if DFPTA ≥ SAT, DFTAGA='S'**
281-286	COAVG	F6.0	Carbon monoxide data (ppbv)
287	COTAGA	A1	Tag for COAVG**
			If COTAGA='Z', COAVG = instrument zero (mv) - see text
			If COTAGA='G', COAVG = instrument gain (mv) - see text
288-293	COA	F6.0	Carbon monoxide ave (ppbv): for 128 sec preceding recording
294	COATAG	A1	Tag for COA**
295-300	COSD	F6.0	Carbon monoxide std deviation (ppbv): for 128 sec preceding recording
301	COSTAG	A1	Tag for COSD**
302-311	PD1	1PE10.3	Particle density for particles > D1 (particles/m**3)
312	PDTAG1	A1	Tag for PD1**
313-322	PD2	1PE10.3	Particle density for particles > D2 (particles/m**3)
323	PDTAG2	A1	Tag for PD2**
324-333	PD3	1PE10.3	Particle density for particles > D3 (particles/m**3)
334	PDTAG3	A1	Tag for PD3**
335-344	PD4	1PE10.3	Particle density for particles > D4 (particles/m**3)
345	PDTAG4	A1	Tag for PD4**
346-355	PD5	1PE10.3	Particle density for particles > D5 (particles/m**3)
356	PDTAG5	A1	Tag for PD5**
357-361	CLSEC	F5.0	Time in clouds (sec) during 255 sec preceding recording
362-365	CLAYR	F4.0	Number of cycles in and out of clouds (layers) during 255 sec preceding recording
366	CLTAG	A1	Tag for CLSEC and CLAYR; if CLSEC > 0, CLTAG='C'**
367-373	TRPRMB	F7.2	Tropopause pressure in hPa (mb); time and space interpolated from NMC data fields+

Table A-II Continued

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
374	TPTAG	A1	Tag for tropopause data+ If TPTAG=' ', TRPRMB from 12 hour interpolation If TPTAG='L', TRPRMB from 24 hour interpolation If TPTAG='E', TRPRMB from nearest NMC reporting period If TPTAG='T', TRPRMB from 1200 GMT reporting period * If TPTAG='M', data not available
375-381	DELP	F7.2	DELP = TRPRMB - PAMB, in hPa (mb)+
382-387	TRPRHM	F6.0	Tropopause height in meters+ If ALTAG≠'I', TRPRHM from TRPRMB assuming std. atm. If ALTAG='I', TRPRHM interpolated from NMC data fields
388-394	DELHGT	F7.0	DELHGT = ALTFAV*.3048 - TRPRHM, in meters, where TRPRHM from TRPRMB assuming std. atm.+
395	GMTTAG	A1	Tag for TIME** ++
396-401	CNC	F6.0	Condensation nuclei data; number/cc
402	CNTAG	A1	Tag for CNC** If CNTAG='Z', CNC = instrument zero (mv) - see text
403-408	AVA	F6.0	Condensation nuclei data; number/cc - average over 240 sec prior to recording - see text
409	AVATAG	A1	Tag for AVA**
410-415	ATKMAX	F6.0	Max condensation nuclei (number/cc) during 240 sec period for AVA - see text
416	AMXTAG	A1	Tag for ATKMAX**
417-422	ATKMIN	F6.0	Min condensation nuclei (number/cc) during 240 sec period for AVA - see text
423	AMNTAG	A1	Tag for ATKMIN**
424-428	RHOR	F5.3	Density ratio correction used in processing O3 and CO data - see text

Table A-II Completed

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
429-433	DENS	F5.3	Density ratio correction used in processing CN data - see text
434-440	O33	F7.0	Inside (Cabin) ozone; ppbv
441	C33TAG	A1	Tag for O33
442-446	CDENS	F5.3	Density ratio correction used in processing O33 data - see text
447-452	SPFICM	F6.2	Conversion from particle counts to particle density
453-456	BLDGND	I4	15th stage bleed indicator--see text
457-460	BLDFLT	I4	15th stage bleed indicator--see text
461-512		52A1	Spares

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* Each recording period is 16 sec in duration with 4 frames/record; only 1 frame from each recording period is reported unless MODE = 10 or TYPE = 'L' or 'C'.

** If TAG='M', corresponding data field will be zero; the 'M' tag is used whenever data are not available, have been edited out, or an instrument is in a calibration cycle which is not used directly in the data processing.

\+ Added beginning with VL0004 to provide time and space interpolated tropopause data

++ Added beginning with VL0006 to identify records for which GMT is not available

\# Added beginning with VL0007 to identify tropopause data obtained from 1200 GMT arrays when GASP GMT is not available

\#\# Added beginning with VL0009 to identify continuous recordings with normal cal/data cycling - see CYCLE, byte 14.