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NASA Global Atmospheric Sampling Program (GASP) Data Report for Tape VL0014

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SUMMARY

Atmospheric trace constituents in the upper troposphere and lower stratosphere were measured, from March 1975 through June 1979 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 Boeing 747 airplanes in routine airline service.

This report is the 11th 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, cabin ozone, carbon monoxide, particles, clouds, condensation nuclei, water vapor, filter samples, and related meteorological and flight information obtained during 562 flights of aircraft N533PA, N4711U, N655PA, and VH-EBE from October 3, 1977 through January 5, 1978 are reported. These data are now available from the National Climatic Center, Asheville, North Carolina 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

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, acquisition, and flight testing of hardware (refs. 1 to 6) to collecting global data on a daily basis. Fully automated GASP systems have been operated on a United Airlines B747, two Pan American World Airways B747's, a Qantas Airways of Australia B747, 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 9-24.

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 provided simultaneous measurements of cabin and ambient ozone on flights of varing duration, and at different flight levels, geographical locations, and seasons (ref. 25-29). The Federal Aviation Administration (FAA) has recently issued a rule regarding acceptable levels of ozone in aircraft cabins (ref. 30).

This report is the 11th 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 to December 1976 are archived on tapes VL0001-VL0008 (refs. 31 to 37). Data for January to September, 1977 are on tapes VL0010-VL0013 (refs. 38 and 39). Continuous record data obtained on Pan Am's Fiftieth Anniversary around-the-world-via-the-poles flight on October 28 to 31, 1977 are archived on tape VL0009 (ref. 40). Data from Pan Am N533PA and N655PA, United N4711U, and Qantas VH-EBE from October 3,1977 to January 5, 1978, are archived on tape VL0014. For each of these tapes, the time periods covered and the GASP aircraft from which data are archived are identified in table I.

The sucess of the GASP of course depends on the dedicated effort of both government and contractor personnel. Specific questions about GASP systems, instrumentation, or data may be addressed to the authors, or to any of the NASA Lewis personnel listed below:

GASP system, instruments, & installations	- P. J. Perkins
	- L. C. Papathakos
Ozone measurement	- M. W. Tiefermann
Cloud detector and particle measurement	- T. W. Nyland
	- M. W. Tiefermann
Condensation nuclei measurement	- T. W. Nyland
Carbon monoxide measurement	- T. J. Dudzinski
Water vapor measurement	- T. J. Dudzinski
Filter analysis; SO4=, NO3-, Cl-, F-	- D. A. Otterson
Filter analysis; ^{7}Be	- D. C. Liu
Data acquisition system	- T. W. Nyland
Data tape specification and formats	- F. P. Michaelis
Data reduction and analysis	- J. D. Holdeman

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 twelve 5-min sampling segments. During alternate segments (at 10-min 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 5-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 nonusable data are removed, and the data are retranscribed 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. 41). 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 tape VL0014 showing the route, date, number of DATA records, and constituent data available for each flight are given in table II.

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. 42). 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. The GASP ozone instrument and the accuracy of the measurement are described in detail in reference 43.

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 1 percent neutral buffered potassium iodide (KI) method (ref. 44). 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 deg C when the span is set at 58200. Because of uncertainty regarding the KI procedure as a standard for ozone measurements (see ref. 45 and refs. therein), later calibrations were made by comparison with a commercial UV photometer maintained at Lewis as a transfer standard. This transfer standard was periodically (about every 6 months) calibrated against the Jet Propulsion Laboratory 5-meter path length UV photometer (ref. 45). With the span setting of the transfer standard and the GASP ozone instruments set at 58200, the JPL calibrations indicated that the GASP data were 9 percent high. To preserve GASP data consistency and inter comparability, span settings were not readjusted. Thus all published GASP ozone data are 9 percent high compared with the JPL calibrations. This is a systematic difference, and can easily be corrected for if the KI method is determined to be incorrect, and another method such as the UV photometer is adopted as the standard. The stability of 10 GASP ozone instruments over a 12-month period was within 1 percent. The random error of the ambient ozone measurement is 3 percent of reading (silicone pump diaphragms were used for all data reported herein) or 3 ppbv, whichever is greater (ref. 43).

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 because of the difficulty of generating a precisely known ozone concentration in the flight system. Periodic checks for calibration consistency are performed in the laboratory.

The recalibration criteria adopted was a calibration within 10 percent of the standard instrument. If an instrument failed this criteria upon removal from the aircraft, the data taken using that instrument is accompanied by an 'L' tag. Table III identifies the 'L' tagged data reported on VL0014.

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 deg 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 the probe inlet (O3, in ppbv) is expressed in terms of the measured ozone mixing ratio (O3m, in ppbv) as

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

with the constant a determined by a regression analysis on the appropriate destruction test data. For the data reported on tape VL0014, the ozone destruction corrections were made using $(1+a) = 1.028$. The uncertainty in this approximation is $\pm$ 2 percent. The destruction constants used are given in the FLHT record for each flight (see table A-I).

In previous reports (refs. 32 to 37) a more complicated form of equation (1) was reported which accounted separately for destruction of ozone by thermal and wall effects (refs. 46 to 48). 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 most 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. - For the GASP measurement of cabin ozone, the air is drawn from a 0.62-cm-diam 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 in extended about 0.62 cm from the wall surface to minimize drawing air from along the wall. About 6 m of 0.62-cm-diam 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:

$$O33=(CDENS)*(O33r-O33z)$$

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 alternats processing schemes employed at the analysts' option.

Carbon Monoxide

The carbon-monoxide measurement is made with an infrared 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 $C^{12}O^{16}$ and $C^{13}O^{16}$. 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 deg 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 5 V 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 2 V 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 to 900 ppbv. Calibrations using the diluted NBS/SRM are estimated to be accurate to within ± 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 in an aircraft. A check on this calibration is performed on 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. The GASP CO measurement is described in detail in reference 49.

Carbon monoxide data are processed according to the following:

$$CO = 0.25(RHOR)(COv-COz) \qquad (3)$$

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 two 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 a chilled mirror dew/frost-point hygrometer. The hygrometer consists of an electronics package (power/control unit, PCU), and a thermoelectrically cooled mirror sensor remotely mounted at the aircraft skin. The hygrometer operated on the principle of a condensate formation on the mirror surface as the mirror is cooled to the dew/frost point temperature (DFPT) of the air sample. As the condensate forms, an optical bridge circuit detects the change in mirror reflectance and provides a proportional control signal to a thermoelectric cooler control circuit. The balance of the optical bridge occurs when a thin film of condensate is maintained on the mirror surface. Changes in DFPT are tracked by increasing or decreasing the cooler current in proportion to the thickness of the condensate. The ability to track DFPT change is about 1.5 deg C per second.

Mirror temperature is determined by a platinum resistance thermometer (PRT) embedded in the mirror. The PRT is part of a bridge network in a resistance-to-voltage circuit that provides a linear 0 to 5 volt output corresponding to a DFPT range of +20 to -80 deg C.

The sensor is bolted, inside the aircraft, to the aircraft skin. Sample air is brought in through a de-iced airscoop of the type used on B747 aircraft for measurement of air temperature. The air sample is directed through a constricted flow tube to limit flow rate to about 1 standard liter per minute, across the mirror surface, and exhausted through ports in the downstream side of the airscoop. Sample pressure closely approximates altitude pressure.

In addition to DFPT data, the hygrometer was periodically operated in three operation check modes; namely an automatic balance check (ABC), a thermoelectric cooler depression check (MAX COOL), and a DFPT-readout calibration check (PCU CAL) The ABC, activated once per hour, compensates for contamination buildup on the mirror surface and for ambient temperature effects on the sensor optical components. In the ABC mode the mirror is heated to drive off any condensation and the optical-control bridge circuit is balanced to null out any change in dry mirror reflectance. In the MAX COOL mode, maximum cooling current is applied to the thermoelectric cooler to determine cooling capability (depression) or the lowest measureable DFPT at that particular flight condition. Depression is dependent on aircraft skin temperature. In the PCU CAL mode a known fixed-value precision resistor is substituted in place of the mirror PRT to provide a known output to serve as a check on the accuracy and stability of the mirror temperature measuring circuitry. The MAX COOL and PCU CAL modes were activated once per flight.

Water vapor data are reported as both dew-frost point temperature (DFPTA) and water vapor mixing ratio (WVMRA, in ppmw) in the DATA records (see table A-II). Whenever the indicated DFPT was equal to or less than 10 percent greater (warmer) than the static air temperature (SAT), DFPTAGA = 'S' to indicate saturation. Data have been edited out whenever the indicated DFPT was more than 10 percent warmer than SAT on the grounds that this would exceed maximum physically realistic supersaturated values (P. D. Falconer, private communication).

As noted previously, a measure of the cooling capibility of the hygrometer is obtained by MAX COOL depression checks performed once per flight. These MAX COOL DFPT data and their corresponding SAT values, have been used in a linear regression analysis to obtain the mean (DELT) and standard deviation (SD) of the depression as a function of SAT for each sensor. A 'K' tag has been applied to all DFPTA data values for which DFPT = -80 deg C or DFPTA < (SAT-DELT + SD) to indicate that the data is at or near the maximum cooling capability of the instrument. One would expect this to occur most frequently during stratospheric flight where dry air is expected along with warming temperatures.

Condensation-type hygrometers provide a fundamental measurement of water vapor. The accuracy of the measurement technique is surpassed only by the National Bureau of Standards' Gravimetric Train and the Calibrated Two-Pressure Generator. Cooled-mirror dew point indicators are frequently used as laboratory standards for hygrometer calibrations. The readout accuracy of the GASP hygrometer was determined by comparison of readings to the output of two distinct laboratory-standard cooled-mirror hygrometers. One of these has a mirror microscope to permit visual observation of mirror control. The accuracy of the resistance-to-voltage circuitry of the laboratory standards was periodically checked by substitution of precion resistors in place of the mirror temperature sensors. Adjustments are made to comply with sensor temperature-resistance tables supplied by each manufacturer.

The measurement error of the GASP hygrometers is of the same order as the two laboratory-standard hygrometers. Therefore for DFPT readout calibration, the average of the three DFPT readings is used as the true DFPT. The uncertainty of the GASP water vapor measurement is taken as the deviation of the hygrometer readout from the average. Based on a total of 21 calibrations performed on eight hygrometers over a two year period, the standard deviation of the hygrometer readout is 1.2 deg C. The DFPT level for calibrations ranged from -68 to +17 deg C. For the data reported herein, no change was detected in the standard deviation for a calibration performed on the hygrometer prior to its installation and upon its removal from an aircraft.

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 > 0, 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 were not reported prior to tape VL0009 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 micrometers 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 > 0.45, >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 among 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 B747'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 prerecording 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, fluorides, and ^{7}Be 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 2 hours, although shorter exposures may occur if the aircraft descends to an altitude less than 9.6 kilometers before 2 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 constitutent data are reported. The data from the laboratory analysis are divided by the integrated filter flow rate (in ambient cubic meters), and data are reported as micrograms (or pico Curies)/ambient cubic meter.

Multifilter apparatus. - The multifilter 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 diam) and expanded in the sampling duct (67 mm diam).

Filter preparation. - All filter exposures 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 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. 50). A semiautomatic 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 clean 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 rebagged and carefully repackaged for return shipment and analysis.

Filter analysis. - Prior to analysis, each filter was cut into four equal segments for separate constituent analysis, if necessary, and for comparative repeat analyses. Sulfate, nitrate, chloride, and fluoride ion concentrations were determined by ion chromatography. The basics of this analysis technique are described in references 51 to 53. 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 was 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 was calibrated using solutions with known concentrations of the various anions in the extractant. Calculations of the anion concentration were 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 VL0014 is provided in table IV. Additional information, including analyses of GASP filter data, is provided in reference 54.

Analysis for ^7Be. - GASP filter samples have been analysed for ^7Be since early 1978 at the Lewis Research Center. The filters have also been analysed for ^7Be at the New York State Department of Health, Division of Laboratories and Research and ^7Be/ozone ratios reported in reference 55. The ^7Be activities reported herein have been back calculated to the exposure date and reported as a concentration based an the integrated flow rate of air through the filter during the exposure period.

The interaction of cosmic rays with nitrogen, oxygen, and argon produces a large number of radioactive isotopes. Most of this production occurs in the stratosphere. Production rates have been estimated by Lai and Peters (ref. 56). The nuclides are easily oxidized and may be attached to small aerosol particles. ^7Be with a half life of 53.28 days has been demonstrated to be a useful natural radioactive tracer to identify stratospheric air (ref. 57). Although a significant amount can be produced in the upper troposphere, the much higher removal rates of aerosols from the troposphere compared to the stratosphere maintains a high specific activity ratio between stratosphere and troposphere (ref. 58).

GASP filter samples were assayed for ^7Be by counting the 477 keV gamma-rays emitted from the ^7Be decay. Prior to March 1979 a Camberra "5%" Ge(Li) detector was used, and after that date a Princeton Gamma Tech "15%" Ge(Li) detector was used. The 5% and 15% designations are the detection efficiency values relative to a 7.62x7.62 cm NaI(Tl) detector.

Samples were normally counted for a period of 24 hours. There were exceptions: (1) the countings of some samples of relatively high ^7Be activities were stopped after about 8 hours of counting, and (2) some samples were counted over the weekend for as long as 72 hours.

Average errors based on counting statistics only are

±20% for samples > 0.1 nCi ^{7}Be

±30% for samples < 0.1 nCi ^{7}Be

In addition, systematic errors, including the uncertainty in the detection efficiency, may be ±10%.

Condensation Nuclei

The condensation nuclei measurement is made with a modified commercial monitor purchased from Environment/One Corporation of Schenectady, N.Y. (ref. 59). Sample air, at a rate of 5 standard liters per minute, is brought from the GASP inlet probe to the monitor thru an 8 meter length of 17 mm I.D. stainless steel tubing. The sample is pressurized to cabin pressure in the monitor and then passes thru the monitor's detector system. The sample leaves the monitor and is exhausted from the aircraft thru the GASP system static overboard exhaust port.

The sample is pressurized to cabin pressure by use of a NASA designed and installed "Air Piston" type pressurization system. In this system, the sample is drawn into a length of tubing. The tubing is then backfilled with filtered cabin air, thereby trapping the sample at one end of the tube at cabin pressure. The trapped sample is drawn into the detector system for the actual measurement.

In the detector system, the pressurized sample first passes thru a humidifier and then into a cloud chamber. An adiabatic expansion process is caused to occur in the cloud chamber. This creates conditions such that the particles act as nucleation sites for the formation of a water droplet cloud. The density of the cloud, assumed to be proportional to the number of particles present, is measured by use of a light attenuation measurement technique. The relationship between particle concentration and light attenuation is obtained thru calibration.

The sensitivity of the monitor detector system is set to 600 (particles/cm^3)/Volt which results in an approximate full scale range of 1000 particles/cm^3 at typical GASP flight conditions. (The data system has a 5 V full scale range.) Repeated calibrations indicate that the output is linear with concentration and repeatable to within 10% of reading. The overall accuracy of a concentration measurement when including the pressurization system is estimated to be better than ±10% of a reading at concentrations greater than 100 particles/cm^3 for a given type of particle. Noise level on the monitor's output signal is equivalent to less than ±10 particles/cm^3 at flight conditions. The time constant (63% change) for a step change in inlet concentrations is 6 seconds and is primarily a function of electronic filtering.

A Pollak counter is used as the standard against which the condensation nuclei monitors are calibrated. Combustion products from the burning of cotton string are used as a source of particles for calibration. The monitor has been tested with other types of particles and has shown sensitivity shifts of as much as 25% dependent on particle type. In these tests, particles obtained from heated nichrome wire, atomized 1% NaCl solution and room airborne particles were used. More detailed information on the condensation nuclei measurement can be found in reference 59.

Reported condensation nuclei data, like the ozone and carbon monoxide data, are corrected for variations in the instrument zero by subtracting the most current zero level. For the CN instrument, these occur on all even cal cycles, and are reported in millivolts and are identified in the DATA records with a 'Z' tag. Full scale data readings are identified by a 'P' tag.

Four condensation nuclei data values are reported for each DATA record. CNC is the local value at the time of the recording: AVA is the average value over the 240 seconds prior to the recording; ATKMAX is the maximum, and ATKMIN is the minimum of the 12 descrete values used in calculating AVA. All condensation nuclei data values are tagged independently. For continuous recordings (MODE = 10, or TYPE = 'L', or 'C'), AVA, ATKMAX, ATKMIN are set equal to zero, and their respective tags are set equal to 'M'.

The published data obtained from the GASP condensation nuclei measurement system is corrected for the ratio of ambient to cabin air density (DENS in the DATA records) and is therefore the actual particle concentration external to the aircraft. Calculations indicate that diffusion losses which may occur in the 8 meter length of inlet tubing could amount to as much a 3%, 7%, and 45% of the particles present with diameters of 0.02, 0.01, and 0.002 micrometers respectively. No measurement of the actual losses occuring in the aircraft systems have been made and since the diameter composition of the particles being measured is unknown, no corrections for diffusion losses or sensitivity shifts are applied to the published data.

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 1 minute. These limits were 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. 60). 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 deg 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 six 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 two-hemisphere arrays are determined by means of the Flattery global analysis method (ref. 61). 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 to 15).

SUMMARY OF RESULTS

Atmospheric constituent data and related flight and meteorological data obtained during flights of GASP-equipped aircraft N533PA, N4711U, N655PA, and VH-EBE from October 3, 1977 through January 5, 1978 are now available. These data may be obtained on GASP tape VL0014 from the National Climatic Center, Federal Building, Asheville, North Carolina 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 VL0001-VL0014

Tape	File	Aircraft	Dates	FLHT*	DATA+	Data**	Ref
VL0001	1	N655PA	3/11/75- 3/30/75	43	1919	O	31
VL0002	1	N4711U	3/23/75-10/21/75	159	7274	O,W1	32
VL0003	1	N655PA	5/02/75- 5/30/75	49	2173	O	33
VL0004	1	N4711U	12/26/75- 3/07/76	73	3572	O,W1,F	34
"	2	N655PA	1/22/76- 3/25/76	66	3757	O,F,B	21
VL0005	1	N4711U	3/29/76- 5/29/76	100	4892	O,W1	35
"	2	N655PA	3/25/76- 5/13/76	86	4716	O,B	35
"	3	N533PA	4/13/76- 6/13/76	28	2640	O,B	35
VL0006	1	N655PA	7/11/76- 9/26/76	131	8724	O,F,B	36
"	2	N533PA	7/08/76- 9/14/76	45	3594	O,B	36
"	3	VH-EBE	7/13/76- 8/31/76	69	3977	O	36
VL0007	1	N712NA	10/28/76-11/18/76	14	3481	O	37
"	2	N4711U	11/37/76-12/30/76	75	3756	O,F	24
"	3	N533PA	9/30/76- 1/02/77	146	13773	O,W1	37
VL0008	1	N655PA	10/15/76- 1/10/77	165	10122	F	37
"	2	VH-EBE	9/26/76- 1/09/77	286	15525		37
VL0009	1	N533PA	10/28/77-10/29/77	1	9162	O,C,A,P,Z	40
"	2	N533PA	10/29/77-10/29/77	1	8890	O,C,A,P,Z	40
"	3	N533PA	10/29/77-10/30/77	1	11487	O,C,A,P,Z	40
"	4	N533PA	10/30/77-10/31/77	1	9640	O,C,A,P,Z	40
VL0010	1	N533PA	1/21/77- 4/ 3/77	66	6586	O,W1,P	38
"	2	N533PA	4/ 6/77- 5/31/77	99	7355	O,C,P,Z	38
"	3	N533PA	6/ 1/77- 6/ 2/77	2	3633	O,C,P,Z	38
"	4	N533PA	6/ 3/77- 8/12/77	96	10643	O,C,P,Z	38
"	5	N533PA	8/13/77-10/ 4/77	73	7875	O,C,P	38
VL0011	1	VH-EBE	1/10/77- 2/28/77	127	6314	O,P	39
"	2	VH-EBE	3/15/77- 4/23/77	120	6807	O,C	39
"	3	VH-EBE	4/24/77- 6/18/77	144	6381	O,C	39
"	4	VH-EBE	6/18/77- 8/12/77	131	6264	O,C	39
"	5	VH-EBE	8/15/77-10/ 2/77	124	6094	O,C	39
VL0012	1	N4711U	1/ 3/77- 3/25/77	49	2181	O,F	38
"	2	N4711U	3/26/77- 6/13/77	102	4669	O,C,Z,F	38
"	3	N4711U	6/14/77- 7/26/77	93	4418	C,Z	38
"	4	N4711U	7/27/77- 9/20/77	110	4394	F	38
VL0013	1	N655PA	2/22/77- 4/ 9/77	84	4058		39
"	2	N655PA	4/15/77- 6/14/77	126	6084	O,C	39
"	3	N655PA	6/14/77- 7/ 8/77	73	3321	O	39
"	4	N655PA	7/ 8/77- 9/ 1/77	119	5555	F	39
"	5	N655PA	9/ 2/77-10/ 5/77	74	3273	F	39
VL0014	1	N533PA	10/ 4/77- 1/ 3/78	109	9718	O,W2,C,P,A,Z	
"	2	N4711U	11/ 6/77- 1/ 5/78	138	5836	C,A,Z,F	
"	3	N655PA	10/ 5/77-12/18/77	99	4824	O,C,P,F	
"	4	VH-EBE	10/ 3/77-11/19/77	96	4334	O,C	
"	5	VH-EBE	11/20/77- 1/ 4/78	120	5931	O,W2,C	
				3913	269622		

* Number of flights
\+ Number of DATA records
** Constituent measurements:
- O - Ozone
- W1 - Water vapor, aluminum oxide hygrometer
- W2 - Water vapor, cooled mirror hygrometer
- F - Filter data
- B - Sample bottle data
- C - Carbon monoxide
- A - Condensation nuclei
- P - Particles and/or clouds
- Z - Cabin ozone
- F - Filter exposure

TABLE II - GASP FLIGHTS ON TAPE VL0014

A) FILE 1 (PANAM -N533PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *				
1	GP0289	LAX-SFO	10/ 4/77	2030-2105	8	O		C	
2	"	SFO-HND	10/ 4/77	2115-0653	122	O		C	
3	"	HND-JFK	10/ 5/77	0955-2115	129	O		C	
4	"	JFK-LHR	10/ 6/77	2341-0505	64	O		C	
5	"	LHR-BOS	10/ 7/77	1114-1719	83	O		C	
6	"	BOS-DTW	10/ 7/77	1923-2022	26	O		C	
7	"	DTW-BOS	10/ 7/77	2229-2319	20	O			
8	"	BOS-LHR	10/ 8/77	0308-0823	62	O		C	
9	"	LHR-BOS	10/ 8/77	1151-1756	69	O		C	
10	"	BOS-DTW	10/ 8/77	2013-2122	28	O		C	
11	"	DTW-BOS	10/ 8/77	2320-0005	8			C	
12	"	BOS-LHR	10/ 9/77	0142-0726	69	O		C	
13	"	LHR-BOS	10/ 9/77	1043-1653	71	O		C	
14	"	BOS-LHR	10/10/77	0057-0602	58	O		C	
15	"	LHR-BOS	10/10/77	1020-1658	104	O		C	
16	"	BOS-DTW	10/10/77	1853-1958	14	O		C	
17	"	DTW-BOS	10/10/77	2215-2300	19	O		C	
18	"	BOS-LHR	10/11/77	0120-0613	57	O		C	
19	"	LHR-BOS	10/11/77	1029-1629	69	O		C	
20	"	BOS-DTW	10/11/77	1918-2023	12	O		C	
21	"	DTW-BOS	10/11/77	2203-2248	9	O		C	
22	"	BOS-LHR	10/12/77	0108-0613	60	O		C	
23	"	LHR-JFK	10/12/77	1320-2015	77	O		C	
24	"	JFK-SFO	10/12/77	2312-0352	55	O		C	
25	"	SFO-AKL	10/13/77	0637-1811	241	O		C	
26	"	AKL-SYD	10/13/77	2035-2250	27	O		C	
27	"	SYD-AKL	10/14/77	0449-0654	14	O		C	
28	"	AKL-SFO	10/14/77	1046-2203	117	O		C	
29	GP0290	SFO-AKL	10/15/77	0950-2134	130	O		C	
30	"	AKL-SYD	10/15/77	2335-0210	29	O		C	
31	"	SYD-SFO	10/16/77	0838-2103	138	O		C	
32	"	SFO-JFK	10/17/77	0127-0551	52	O		C	
33	GP0294	JFK-HND	10/17/77	1744-0653	146	O		C	P
34	"	HND-LAX	10/18/77	1001-1811	78	O		C	P
35	"	LAX-HND	10/18/77	2055-0745	123	O		C	P
36	"	HND-LAX	10/19/77	0956-1749	173	O		C	P
37	"	LAX-HND	10/19/77	2023-0719	135	O		C	P
38	"	HND-JFK	10/20/77	0948-2048	131	O		C	P
39	GP0298	SFO-JFK	10/31/77	0547-0954	49	O			P
40	"	JFK-HND	10/31/77	1658-0533	139	O	W		P
41	"	HND-LAX	11/ 1/77	0817-1644	99	O			P
42	"	LAX-HND	11/ 1/77	2032-0727	122	O	W		P
43	"	HND-JFK	11/ 2/77	1046-2129	124	O			P
44	GP0310	JFK-FAI	11/15/77	1636-2301	73				
45	"	FAI-HND	11/16/77	0210-0845	75				
46	GP0310	HND-LAX	11/16/77	1115-1945	79				
47	"	LAX-HND	11/16/77	2223-0932	130				
48	"	HND-JFK	11/17/77	1218-2352	134				
49	"	JFK-HND	11/18/77	1645-0549	142				
50	"	HND-LAX	11/19/77	0814-1549	86				
51	"	LAX-HND	11/19/77	2030-0700	122				
52	"	HND-JFK	11/20/77	1216-2333	124				
53	"	JFK-HND	11/21/77	1811-0521	131				
54	"	HND-LAX	11/22/77	0901-1636	91				
55	"	LAX-HND	11/22/77	2037-0659	116				
56	"	HND-JFK	11/23/77	1319-0049	126				

TABLE II - A) VL0014 FILE 1 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *		
57	"	LAX-AKL	11/25/77	0819-1954	124		
58	"	AKL-SYD	11/25/77	2218-0028	24		
59	"	SYD-MEL	11/26/77	0223-0248	6		
60	"	MEL-SYD	11/26/77	0426-0456	5		
61	"	SYD-LAX	11/26/77	0742-2020	135		
62	"	LAX-AKL	11/27/77	0848-1648	59		
63	GP0317	SFO-AKL	12/ 1/77	0647-1759	127		
64	"	AKL-SYD	12/ 1/77	2020-2235	27		
65	"	SYD-LAX	12/ 2/77	2229-2329	13		
66	"	LAX-AKL	12/ 3/77	0827-2002	130		
67	"	AKL-SYD	12/ 3/77	2205-0030	28		
68	"	SYD-MEL	12/ 4/77	0339-0354	4		
69	"	MEL-SYD	12/ 4/77	0622-0647	5		
70	"	SYD-LAX	12/ 4/77	1237-2243	117		
71	"	LAX-JFK	12/ 5/77	1243-1559	34		
72	GP0331	JFK-LAX	12/ 8/77	1239-1708	52	O	C
73	"	SFO-HKG	12/ 9/77	2337-1327	163	O	C
74	"	HKG-SIN	12/10/77	1533-1833	35	O	C
75	"	SIN-HKG	12/11/77	0114-0403	50	O	C
76	"	LAX-HND	12/14/77	2327-0701	87	O	C
77	"	HND-JFK	12/15/77	1033-2228	154	O	C
78	"	JFK-HND	12/16/77	1702-0630	145	O	C
79	"	HND-LAX	12/17/77	0824-1649	99	O	C
80	"	LAX-HND	12/17/77	2037-0735	130	O	C
81	"	HND-IAD	12/18/77	1138-2322	136	O	C
82	"	JFK-HND	12/19/77	1624-0509	150	O	C
83	"	HND-LAX	12/20/77	0827-1734	123	O	
84	"	LAX-HND	12/20/77	2030-0634	135	O	C
85	"	HND-JFK	12/21/77	1024-2214	138	O	C
86	GP0322	JFK-LAX	12/22/77	2345-0504	87		
87	"	LAX-AKL	12/23/77	0829-2120	178		
88	"	AKL-SYD	12/23/77	2327-0147	29		
89	"	SYD-LAX	12/24/77	0629-1843	158		
90	"	LAX-AKL	12/25/77	0702-1940	208		
91	GP0322	AKL-SYD	12/25/77	2137-0012	31		
92	"	SYD-AKL	12/26/77	0519-0720	25		
93	"	AKL-LAX	12/26/77	0941-2027	181		
94	"	LAX-AKL	12/27/77	0742-2023	147		
95	"	AKL-SYD	12/27/77	2245-0113	54		
96	"	SYD-AKL	12/28/77	0523-0722	25		
97	"	AKL-LAX	12/28/77	0937-2012	142		
98	"	LAX-SFO	12/28/77	2239-2302	22		
99	"	SFO-AKL	12/29/77	0656-1911	192		
100	"	AKL-SYD	12/29/77	2110-2336	45		
101	"	SYD-AKL	12/30/77	0529-0726	38		
102	"	AKL-LAX	12/30/77	0925-2034	152		
103	"	LAX-AKL	12/31/77	0702-1927	251		
104	"	AKL-SYD	12/31/77	2138-0003	30		
105	"	SYD-MEL	1/ 1/78	0200-0235	8		
106	"	MEL-SYD	1/ 1/78	0402-0436	22		
107	"	SYD-LAX	1/ 1/78	1125-2358	245		
108	"	LAX-JFK	1/ 2/78	0305-0643	95		
109	"	JFK-BAH	1/ 3/78	0013-1107	129		

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* Number of DATA records in flight
O - OZONE
W - WATER VAPOR
C - CARBON MONOXIDE
P - PARTICLES AND/OR CLOUDS

TABLE II - GASP FLIGHTS ON TAPE VL0014

B) FILE 2 (UAL-N4711U)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *		
1	GP0305	SFO-LAX	11/ 6/77	0356-0401	2		
2	"	LAX-JFK	11/ 9/77	2043-0038	44		
3	"	JFK-LAX	11/10/77	0444-0922	56		
4	"	LAX-HNL	11/10/77	1802-2252	58		
5	"	HNL-SFO	11/11/77	0056-0439	43		
6	"	SFO-JFK	11/11/77	2056-0100	50	F	
7	"	JFK-ORD	11/12/77	0329-0444	16		
8	"	ORD-LAX	11/12/77	1457-1802	37		
9	"	LAX-ITO	11/12/77	2038-0113	52		
10	"	ITO-LAX	11/13/77	0258-0638	43		
11	"	LAX-ORD	11/13/77	0851-1136	34		
12	"	ORD-PIT	11/13/77	1359-1424	4		
13	"	PIT-ORD	11/13/77	1655-1730	8		
14	"	ORD-LAX	11/13/77	1935-2250	40		
15	"	LAX-HNL	11/14/77	0036-0447	46	F	
16	"	HNL-SFO	11/14/77	2010-0011	46		
17	GP0309	SFO-LAX	11/17/77	1835-1835	1		
18	"	LAX-JFK	11/17/77	2030-0136	116		C
19	"	JFK-LAX	11/18/77	0537-1047	59		C
20	"	LAX-HNL	11/18/77	1804-2244	53		C
21	"	HNL-SFO	11/19/77	0056-0452	46		C
22	"	SFO-HNL	11/19/77	1726-2141	49		C
23	"	HNL-LAX	11/20/77	0006-0419	49		C
24	"	LAX-JFK	11/20/77	0656-1034	55		C
25	"	JFK-LAX	11/20/77	1725-2220	74		C
26	"	LAX-HNL	11/21/77	0039-0524	57		C
27	"	HNL-LAX	11/21/77	1926-2321	45		C
28	"	LAX-DEN	11/22/77	0147-0302	16		C
29	"	DEN-ORD	11/22/77	0443-0557	15		C
30	"	ORD-HNL	11/22/77	2238-0238	48		C
31	GP0313	SFO-SEA	11/24/77	0204-0308	45		C
32	"	SEA-SFO	11/24/77	0458-0559	29		C
33	"	SFO-JFK	11/24/77	2024-0029	84		C
34	"	JFK-ORD	11/25/77	0318-0438	16		C
35	"	ORD-JFK	11/25/77	1336-1426	11		C
36	"	JFK-SFO	11/25/77	1554-2044	55		C
37	"	SFO-HNL	11/25/77	2236-0251	50		C
38	"	HNL-LAX	11/26/77	1931-2336	50		C
39	"	LAX-DEN	11/27/77	0204-0319	36		C
40	"	DEN-ORD	11/27/77	0440-0555	16		C
41	"	ORD-DEN	11/27/77	1456-1630	35		C
42	"	DEN-LAX	11/27/77	1813-1944	50		C
43	"	LAX-HNL	11/27/77	2138-0159	68		C
44	"	HNL-ORD	11/28/77	0435-1115	80		C
45	"	ORD-HNL	11/28/77	2021-0357	89		C
46	GP0313	HNL-LAX	11/29/77	1935-2355	52		C
47	"	LAX-DEN	11/30/77	0146-0309	48		C
48	"	DEN-ORD	11/30/77	0444-0559	14		C
49	"	ORD-DEN	11/30/77	1440-1615	20		C
50	"	DEN-LAX	11/30/77	1756-1916	17		C
51	"	LAX-HNL	11/30/77	2258-0323	52		C
52	"	HNL-SFO	12/ 1/77	2003-2353	46		C
53	"	SFO-ORD	12/ 2/77	1936-2226	34		C
54	"	ORD-JFK	12/ 3/77	0052-0142	11		C
55	"	JFK-SFO	12/ 3/77	1537-2042	58		C

TABLE II - B) VL0014 FILE 2 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *	
56	"	SFO-HNL	12/ 3/77	2247-0257	48	C
57	"	HNL-LAS	12/ 4/77	0934-1404	54	C
58	"	LAS-LAX	12/ 4/77	1709-1719	3	C
59	"	LAX-ITO	12/ 4/77	2032-0049	81	C
60	"	ITO-LAX	12/ 5/77	0252-0647	46	C
61	"	LAX-ORD	12/ 5/77	0913-1147	31	C
62	"	ORD-PIT	12/ 5/77	1356-1426	21	C
63	"	PIT-ORD	12/ 5/77	1659-1734	8	C
64	"	ORD-LAX	12/ 5/77	1929-2239	37	C
65	"	LAX-HNL	12/ 8/77	1811-2251	56	C
66	"	HNL-SFO	12/ 9/77	0113-0503	44	C
67	GP0319	SFO-ORD	12/ 9/77	1837-2122	34	C
68	"	ORD-JFK	12/10/77	0043-0123	8	C
69	"	JFK-SFO	12/10/77	1600-2107	71	C
70	"	SFO-HNL	12/10/77	2259-0329	54	C
71	"	HNL-LAX	12/11/77	1929-2338	53	C
72	"	LAX-DEN	12/12/77	0151-0311	16	C
73	"	DEN-ORD	12/12/77	0433-0547	46	C
74	"	ORD-DEN	12/12/77	1441-1626	38	C
75	"	DEN-LAX	12/12/77	1803-1924	17	C
76	"	LAX-HNL	12/12/77	2136-0203	54	C
77	"	HNL-LAX	12/13/77	1936-2351	48	C
78	"	LAX-DEN	12/14/77	0151-0311	17	C
79	"	DEN-ORD	12/14/77	0457-0612	16	C
80	"	ORD-LAX	12/14/77	1523-1837	125	C
81	"	LAX-ITO	12/14/77	2102-0122	52	C
82	"	ITO-LAX	12/15/77	0325-0710	43	C
83	"	LAX-ORD	12/15/77	0912-1152	32	C
84	"	ORD-PIT	12/15/77	1359-1424	6	
85	"	PIT-ORD	12/15/77	1653-1733	24	
86	"	ORD-LAX	12/15/77	1951-2306	38	C
87	"	LAX-JFK	12/16/77	0716-1104	64	C
88	"	JFK-LAX	12/16/77	1728-2208	56	C
89	"	LAX-HNL	12/17/77	0041-0546	62	C
90	"	HNL-LAX	12/17/77	0938-1318	44	C
91	GP0319	LAX-ORD	12/17/77	1638-1908	31	C
92	"	ORD-SFO	12/17/77	2232-0158	97	C
93	"	SFO-HNL	12/18/77	0402-0853	72	C
94	"	HNL-SFO	12/18/77	1956-2328	58	C
95	"	SFO-HNL	12/19/77	0827-1337	60	C
96	"	HNL-LAX	12/19/77	1931-2311	44	C
97	"	LAX-DEN	12/20/77	0146-0256	15	C
98	"	DEN-ORD	12/20/77	0437-0552	15	C
99	"	ORD-HNL	12/20/77	1837-0224	125	C
100	"	HNL-ORD	12/21/77	0432-1106	81	
101	"	ORD-PIT	12/22/77	1433-1453	5	
102	"	PIT-ORD	12/22/77	1721-1756	7	
103	"	ORD-LAX	12/22/77	2039-0022	43	
104	"	LAX-HNL	12/23/77	1829-2334	61	
105	"	HNL-LAX	12/24/77	2121-0111	46	
106	"	LAX-HNL	12/25/77	0420-0915	59	
107	"	HNL-LAX	12/25/77	2131-0126	48	
108	"	LAX-HNL	12/26/77	0443-0930	59	
109	"	HNL-LAX	12/26/77	1929-2319	47	
110	"	LAX-DEN	12/27/77	0226-0331	14	
111	"	DEN-ORD	12/27/77	0504-0614	15	
112	"	ORD-LAX	12/27/77	1508-1828	38	

TABLE II - B) VL0014 FILE 2 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *	
113	"	LAX-ITO	12/27/77	2125-0201	53	
114	"	ITO-LAX	12/28/77	0419-0756	44	
115	"	SFO-HNL	12/29/77	1844-2159	38	
116	"	HNL-LAX	12/30/77	0021-0406	44	
117	"	LAX-JFK	12/30/77	0702-1052	46	
118	"	JFK-LAX	12/30/77	1728-2213	57	C
119	"	LAX-HNL	12/31/77	0028-0528	60	C
120	"	HNL-LAX	12/31/77	0939-1324	45	
121	"	LAX-ORD	12/31/77	1625-1850	30	
122	"	ORD-SFO	12/31/77	2336-0301	41	
123	"	SFO-HNL	1/ 1/78	0443-0927	56	
124	"	HNL-LAX	1/ 1/78	1952-2335	44	
125	"	LAX-DEN	1/ 2/78	0244-0353	15	
126	"	DEN-ORD	1/ 2/78	0537-0647	15	
127	"	ORD-LAX	1/ 2/78	1522-1832	37	C
128	"	LAX-ITO	1/ 2/78	2028-0138	61	C
129	"	ITO-LAX	1/ 3/78	0347-0712	42	C
130	"	LAX-ORD	1/ 3/78	0936-1221	32	C
131	"	ORD-PIT	1/ 3/78	1429-1454	6	
132	"	PIT-ORD	1/ 3/78	1740-1815	8	
133	"	ORD-LAX	1/ 3/78	2016-2341	41	C
134	"	LAX-LAS	1/ 4/78	0342-0357	4	C
135	"	LAS-DEN	1/ 4/78	0507-0557	10	
136	GP0319	DEN-LAX	1/ 4/78	0728-0903	20	C
137	"	LAX-HNL	1/ 4/78	1919-0016	126	C
138	"	HNL-SFO	1/ 5/78	0217-0602	46	C

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* Number of DATA records in flight
F - FILTER EXPOSURE
C - CARBON MONOXIDE

TABLE II - GASP FLIGHTS ON TAPE VL0014

C) FILE 3 (PANAM -N655PA)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *				
1	GP0303	SFO-YVR	10/ 5/77	2237-2357	17			C	P
2	"	YVR-HND	10/ 6/77	1908-0438	107		F	C	P
3	"	HND-SFO	10/ 7/77	0819-1613	90			C	P
4	"	SFO-HND	10/ 7/77	2222-0752	113			C	P
5	"	HND-HKG	10/ 8/77	1100-1410	38			C	P
6	"	HKG-BKK	10/ 8/77	1552-1827	31			C	P
7	"	BKK-KHI	10/ 8/77	2023-0013	43			C	P
8	"	KHI-THR	10/ 9/77	0207-0403	24		F	C	P
9	"	THR-FRA	10/ 9/77	0648-1058	50			C	P
10	"	FRA-LHR	10/ 9/77	1415-1440	6				P
11	"	LHR-JFK	10/ 9/77	1708-0013	82			C	P
12	"	JFK-LHR	10/11/77	0241-0849	69			C	P
13	"	LHR-FRA	10/11/77	1245-1310	6				P
14	"	FRA-THR	10/11/77	1528-1923	46			C	P
15	"	THR-DEL	10/11/77	2123-2343	27			C	P
16	"	DEL-BKK	10/12/77	0127-0418	32		F	C	P
17	"	BKK-HKG	10/12/77	0611-0901	35			C	P
18	"	HKG-HND	10/13/77	0123-0413	29			C	P
19	"	HND-SFO	10/13/77	0653-1447	154			C	P
20	GP0306	SFO-HND	10/13/77	2213-0738	108			C	
21	"	HND-HKG	10/14/77	1027-1342	37			C	
22	"	HKG-BKK	10/14/77	1524-1814	33			C	
23	"	BKK-HKG	10/15/77	0434-0713	30		F	C	
24	"	HKG-HND	10/16/77	0000-0000	32			C	
25	"	HND-SFO	10/16/77	0654-1444	87			C	
26	"	SFO-LHR	10/17/77	0452-1417	102			C	
27	"	LHR-JFK	10/17/77	1812-0030	73			C	
28	"	JFK-LHR	10/18/77	0801-1318	61		F	C	
29	"	LHR-FRA	10/18/77	1644-1704	5			C	
30	"	FRA-THR	10/18/77	1913-2313	48			C	
31	"	THR-DEL	10/19/77	0128-0358	31			C	
32	"	DEL-BKK	10/19/77	0524-0759	30			C	
33	"	BKK-HKG	10/19/77	0947-1237	35			C	
34	"	HKG-HND	10/20/77	0134-0409	29			C	
35	"	HND-SFO	10/20/77	0651-1356	82			C	
36	"	SFO-HND	10/20/77	2222-0847	113	O		C	
37	"	HND-HKG	10/21/77	1049-1418	41	O	F	C	
38	"	HKG-BKK	10/21/77	1551-1846	36	O		C	
39	"	BKK-DEL	10/21/77	2133-0023	34	O		C	
40	"	DEL-THR	10/22/77	0213-0508	35	O		C	
41	"	THR-FRA	10/22/77	0601-1126	51	O		C	
42	"	FRA-LHR	10/22/77	1448-1519	18	O		C	
43	"	LHR-JFK	10/22/77	1644-0014	72	O		C	
44	"	JFK-LHR	10/24/77	0000-0000	67	O	F	C	
45	"	LHR-FRA	10/24/77	0914-0942	7	O		C	
46	GP0306	FRA-THR	10/24/77	0000-0000	45	O		C	
47	"	THR-DEL	10/24/77	0000-0000	27	O		C	
48	"	DEL-BKK	10/24/77	0000-0000	30	O		C	
49	"	BKK-HKG	10/25/77	0000-0000	24			C	
50	"	HKG-MNL	10/25/77	0000-0000	12			C	
51	"	MNL-GUM	10/25/77	0000-0000	27	O		C	
52	"	GUM-HNL	10/25/77	0000-0000	67	O		C	
53	"	HNL-SFO	10/26/77	0000-0000	40	O		C	
54	"	SFO-HND	10/26/77	0000-0000	115	O		C	
55	"	HND-HKG	10/27/77	0000-0000	34	O		C	

TABLE II - C) VL0014 FILE 3 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *			
56	"	HKG-BKK	10/27/77	1549-1839	29	O	C	
57	"	BKK-DEL	10/27/77	2027-2327	32	O	C	
58	"	DEL-THR	10/28/77	0050-0340	34		C	
59	"	THR-FRA	10/28/77	0000-0000	49	O	C	
60	"	FRA-LHR	10/28/77	0000-0000	8	O	C	
61	"	LHR-JFK	10/29/77	0000-0000	6	O	C	
62	GP0312	JFK-LHR	11/21/77	1543-2143	73	O	C	P
63	"	LHR-BRU	11/21/77	2312-2322	3	O		P
64	"	BRU-LHR	11/22/77	0858-0904	2	O		P
65	"	LHR-IAD	11/22/77	1224-1919	77	O	C	P
66	"	IAD-LHR	11/23/77	0212-0802	66	O	C	P
67	"	LHR-FRA	11/23/77	1057-1122	5	O		P
68	"	FRA-THR	11/23/77	1356-1741	44	O	C	P
69	"	THR-FRA	11/24/77	0822-0000	62	O	C	P
70	GP0315	SFO-SEA	12/ 7/77	1927-2034	29	O	C	P
71	"	SEA-LHR	12/ 7/77	2235-0648	98	O	C	P
72	"	LHR-SEA	12/ 8/77	1429-2251	100	O	C	P
73	"	SEA-SFO	12/ 9/77	0128-0228	12	O	C	P
74	"	SFO-SEA	12/ 9/77	1921-2021	12	O	C	P
75	"	SEA-LHR	12/ 9/77	2242-0658	96	O	C	P
76	"	LHR-SEA	12/10/77	1431-2300	102	O	C	P
77	"	SEA-SFO	12/11/77	0145-0249	13	O	C	P
78	"	SFO-LAX	12/11/77	0537-0602	6	O		P
79	"	LAX-PPT	12/11/77	0819-1523	119	O	C	P
80	"	PPT-PPG	12/12/77	0926-1201	30	O	C	P
81	"	PPG-HNL	12/12/77	1356-1816	51	O	C	P
82	"	HNL-SEA	12/12/77	2204-0208	101	O	C	P
83	"	SEA-FAI	12/13/77	0604-0834	30	O	C	P
84	"	FAI-SEA	12/13/77	1205-1435	44	O	C	P
85	"	SEA-HNL	12/13/77	2029-0159	124	O	C	P
86	"	HNL-LAX	12/14/77	2109-0109	46	O	C	P
87	"	LAX-HNL	12/15/77	0445-0924	56	O	C	P
88	"	HNL-NAN	12/15/77	1149-1700	85	O	C	P
89	"	NAN-SYD	12/15/77	1908-2233	42	O	C	P
90	"	SYD-MEL	12/16/77	0055-0134	39	O		P
91	GP0315	MEL-SYD	12/16/77	0507-0534	7	O		P
92	"	SYD-NAN	12/16/77	0750-1045	34	O	C	P
93	"	NAN-HNL	12/16/77	1231-1754	65	O	C	P
94	"	HNL-LAX	12/16/77	2110-0052	57	O	C	P
95	"	LAX-HNL	12/17/77	0458-1003	62	O	C	P
96	"	HNL-PPG	12/17/77	1659-2109	47	O	C	P
97	"	PPG-PPT	12/17/77	2317-0117	25	O	C	P
98	"	PPT-LAX	12/18/77	1323-1948	77	O	C	P
99	"	LAX-SFO	12/18/77	2155-2227	8	O		P

* Number of DATA records in flight
O - OZONE
F - FILTER EXPOSURE
C - CARBON MONOXIDE
P - PARTICLES AND/OR CLOUDS

TABLE II - GASP FLIGHTS ON TAPE VL0014

D) FILE 4 (QANTAS VH-EBE)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *		
1	GP0293	SYD-NAN	10/ 3/77	0922-1222	35	O	
2	"	NAN-HNL	10/ 3/77	1409-1929	64	O	C
3	"	HNL-SFO	10/ 3/77	2149-0139	45	O	C
4	"	SFO-HNL	10/ 4/77	0424-0839	49	O	C
5	"	HNL-NAN	10/ 4/77	1056-1608	77	O	C
6	"	NAN-SYD	10/ 4/77	1808-2158	43	O	C
7	"	SYD-AKL	10/ 5/77	0100-0253	51	O	
8	"	AKL-SYD	10/ 5/77	0505-0740	29	O	C
9	"	SYD-HNL	10/ 5/77	1124-1924	88	O	C
10	"	HNL-SFO	10/ 5/77	2156-0151	37	O	C
11	"	SFO-HNL	10/ 6/77	0427-0837	48	O	C
12	"	HNL-SYD	10/ 7/77	1625-0030	48	O	C
13	"	SYD-HNL	10/ 9/77	0605-1444	133	O	C
14	"	HNL-SFO	10/ 9/77	1643-2038	47	O	C
15	"	SFO-YVR	10/ 9/77	2215-2335	16	O	
16	"	YVR-SFO	10/10/77	0125-0235	14	O	
17	"	SFO-HNL	10/10/77	0424-0844	53	O	C
18	"	HNL-SYD	10/10/77	1117-2016	107	O	C
19	"	SYD-HKG	10/11/77	0237-1021	102	O	C
20	"	HKG-MNL	10/11/77	1300-1355	12	O	
21	"	MNL-SYD	10/11/77	1551-2231	75	O	C
22	"	SYD-NOU	10/12/77	0135-0320	22	O	
23	"	NOU-SYD	10/12/77	0546-0750	25	O	C
24	"	SYD-MEL	10/13/77	0304-0339	8	O	
25	"	MEL-SIN	10/13/77	0540-1235	77	O	C
26	"	SIN-BAH	10/13/77	1437-2112	71	O	C
27	"	BAH-FCO	10/13/77	2327-0357	52	O	C
28	"	FCO-FRA	10/14/77	0618-0713	12	O	
29	"	FRA-FCO	10/14/77	1719-1809	11	O	
30	"	FCO-BAH	10/14/77	2036-0041	46	O	C
31	"	BAH-SIN	10/15/77	0239-0904	74		C
32	"	SIN-MEL	10/15/77	1201-1801	69	O	C
33	"	MEL-SYD	10/15/77	1959-2029	7	O	
34	"	SYD-SIN	10/16/77	0602-1312	73	O	C
35	"	SIN-BAH	10/16/77	1839-2319	41	O	C
36	"	BAH-FRA	10/17/77	0120-0640	41	O	C
37	"	LHR-ORY	10/17/77	1928-1928	1		
38	"	ORY-DAM	10/17/77	2118-0043	39	O	C
39	"	DAM-BAH	10/18/77	0227-0352	16	O	C
40	"	BAH-KUL	10/18/77	0552-1207	71	O	C
41	"	KUL-SIN	10/18/77	1411-1421	3		
42	"	SIN-SYD	10/18/77	1624-2239	70	O	C
43	"	SYD-NOU	10/19/77	0146-0331	20	O	C
44	"	NOU-SYD	10/19/77	0544-0754	25	O	C
45	GP0301	SYD-BKK	10/20/77	0141-1008	101	O	C
46	GP0301	SYD-MEL	10/23/77	0410-0435	6	O	
47	"	MEL-PER	10/23/77	0618-0913	35	O	C
48	"	PER-BOM	10/23/77	1116-1857	133	O	C
49	"	BOM-LHR	10/23/77	2059-0539	101		
50	"	LHR-BOM	10/24/77	1244-2009	84		
51	"	BOM-PER	10/24/77	2215-0527	80		
52	"	PER-MEL	10/25/77	0716-0956	32		
53	"	MEL-SYD	10/25/77	1113-1143	6		
54	"	MEL-PER	10/26/77	0617-0912	30	O	C
55	"	PER-BOM	10/26/77	1235-1258	5	O	

TABLE II - D) VL0014 FILE 4 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *		
56	GP0307	SYD-SIN	11/ 6/77	0711-1354	78	O	C
57	"	SIN-KUL	11/ 6/77	1557-1557	1		
58	"	KUL-BAH	11/ 6/77	1758-0014	72	O	C
59	"	BAH-AMS	11/ 7/77	0215-0750	75	O	C
60	"	AMS-LHR	11/ 7/77	0959-1009	3	O	
61	"	LHR-ORY	11/ 7/77	1725-1730	2		
62	"	ORY-DAM	11/ 7/77	1929-2304	41	O	C
63	"	DAM-BAH	11/ 8/77	0045-0215	18	O	C
64	"	BAH-KUL	11/ 8/77	0420-1030	72	O	C
65	"	KUL-SIN	11/ 8/77	1215-1220	2		
66	"	SIN-SYD	11/ 8/77	1444-2114	71	O	C
67	"	SYD-MEL	11/ 9/77	0449-0521	17		
68	"	MEL-PER	11/ 9/77	0658-1013	45		
69	"	PER-BOM	11/ 9/77	1156-1946	83		
70	"	BOM-BAH	11/10/77	0716-0936	27		
71	"	BAH-LHR	11/10/77	1243-1853	73		
72	"	LHR-AMS	11/10/77	2212-2222	2		
73	"	AMS-BAH	11/11/77	0014-0514	61		
74	"	BAH-KUL	11/11/77	0728-1340	96		
75	"	KUL-SIN	11/11/77	1514-1519	2		
76	"	SIN-SYD	11/11/77	1724-2343	70		
77	"	SYD-MEL	11/12/77	0318-0348	7		
78	"	MEL-SIN	11/12/77	0545-1220	78		
79	"	SIN-BKK	11/12/77	1416-1526	12		
80	"	BKK-ATH	11/12/77	1739-0309	105		
81	"	ATH-FCO	11/13/77	0507-0612	13		
82	"	FCO-ATH	11/13/77	1916-2011	12		
83	"	ATH-BKK	11/13/77	2213-0611	95		
84	"	BKK-PER	11/14/77	0838-1353	61		
85	"	PER-MEL	11/14/77	1554-1824	26		
86	"	MEL-SYD	11/14/77	2005-2030	6		
87	"	SYD-SIN	11/16/77	0606-1308	82		
88	"	SIN-KUL	11/16/77	1457-1457	1		
89	"	KUL-BAH	11/16/77	1720-2359	79		
90	"	BAH-AMS	11/17/77	0146-0742	66		
91	GP0307	AMS-LHR	11/17/77	0922-0926	4		
92	"	LHR-AMS	11/17/77	1924-1934	3		
93	"	AMS-BAH	11/17/77	2139-0219	54		
94	"	BAH-SYD	11/18/77	0436-2032	45		
95	"	SYD-MEL	11/18/77	2325-0000	8		
96	"	MEL-SYD	11/19/77	0319-0349	6		

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* Number of DATA records in flight
O - OZONE
C - CARBON MONOXIDE

TABLE II - GASP FLIGHTS ON TAPE VL0014

E) FILE 5 (QANTAS VH-EBE)

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *			
1	GP0311	SYD-MEL	11/20/77	0407-0442	7			
2	"	MEL-PER	11/20/77	0613-0900	46			
3	"	PER-BOM	11/20/77	1107-1847	92			
4	"	BOM-LHR	11/20/77	2055-0605	102			
5	"	LHR-BOM	11/21/77	1044-1823	103	O		
6	"	BOM-PER	11/21/77	2016-0350	105			
7	"	PER-MEL	11/22/77	0537-0817	31			
8	"	MEL-SYD	11/22/77	0943-1012	5			
9	"	SYD-MEL	11/23/77	0011-0036	4			
10	"	MEL-SYD	11/23/77	0317-0347	5			
11	"	SYD-SIN	11/23/77	0611-1251	68			
12	"	KUL-BAH	11/23/77	1733-2338	58			
13	"	BAH-AMS	11/24/77	0310-0908	82			
14	"	AMS-LHR	11/24/77	1113-1123	3			
15	"	AMS-BAH	11/24/77	2031-0116	56			
16	"	BAH-KUL	11/25/77	0328-0938	70			
17	"	KUL-SIN	11/25/77	1111-1116	2			
18	"	SIN-SYD	11/25/77	1349-2019	70			
19	"	SYD-MEL	11/25/77	2242-2312	7			
20	"	MEL-SYD	11/26/77	0328-0358	7			
21	"	SYD-SYD	11/27/77	0736-0946	22	O		
22	"	SYD-AKL	11/28/77	0228-0438	24	O		
23	"	AKL-SYD	11/28/77	0657-0857	24	O		C
24	"	SYD-HKG	11/29/77	0229-1034	90	O		C
25	"	HKG-MNL	11/29/77	1309-1404	12	O		
26	"	MNL-SYD	11/29/77	1620-2240	69	O		C
27	"	SYD-NOU	11/30/77	0205-0355	23	O		C
28	"	NOU-SYD	11/30/77	0605-0800	21	O		
29	"	SYD-SYD	11/30/77	2301-0905	97	O		C
30	GP0316	SYD-MEL	12/ 2/77	0421-0456	23	O		
31	"	MEL-PER	12/ 2/77	0634-0943	53	O		C
32	"	PER-BOM	12/ 2/77	1137-1912	87	O		C
33	"	BOM-LHR	12/ 2/77	2122-0621	108	O		C
34	"	LHR-BOM	12/ 3/77	1053-1829	89	O		C
35	"	BOM-PER	12/ 3/77	2052-0424	105	O		C
36	"	PER-MEL	12/ 4/77	0615-0850	31			
37	"	MEL-SYD	12/ 4/77	1010-1040	7			
38	"	SYD-MEL	12/ 7/77	1052-1127	8		W	
39	"	MEL-BKK	12/ 7/77	1319-2121	128		W	
40	"	BKK-ATH	12/ 7/77	2338-0957	122		W	
41	"	ATH-BEG	12/ 8/77	1200-1248	41		W	
42	"	BEG-ATH	12/ 8/77	1943-2018	8		W	
43	"	ATH-BKK	12/ 8/77	2224-0559	85		W	
44	"	BKK-MEL	12/ 9/77	0907-1657	90		W	
45	"	MEL-SYD	12/ 9/77	1902-1934	18		W	
46	GP0316	SYD-NAN	12/10/77	0012-0307	35		W	
47	"	NAN-SYD	12/10/77	0508-0840	76		W	
48	"	SYD-SIN	12/11/77	0603-1249	77		W	
49	"	SIN-KUL	12/11/77	1451-1456	2		W	
50	"	KUL-BAH	12/11/77	1638-2313	79		W	
51	"	BAH-AMS	12/12/77	0121-0646	64		W	
52	"	AMS-LHR	12/12/77	0843-0854	3		W	
53	"	LHR-ORY	12/12/77	1659-1704	2			
54	"	ORY-DAM	12/12/77	1906-2234	43		W	
55	"	DAM-BAH	12/13/77	0022-0157	98			

TABLE II - E) VL0014 FILE 5 CONTINUED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *	
56	"	BAH-KUL	12/13/77	0343-0943	71	W
57	"	KUL-SIN	12/13/77	1122-1126	2	W
58	"	SIN-SYD	12/13/77	1412-2027	75	W
59	"	SYD-NOU	12/14/77	0142-0332	22	W
60	"	NOU-SYD	12/14/77	0550-0800	27	W
61	"	SYD-MEL	12/14/77	1103-1133	7	W
62	"	MEL-BKK	12/14/77	1337-2143	93	W
63	"	BKK-ATH	12/14/77	2338-0929	114	W
64	"	ATH-ATH	12/15/77	1129-1208	7	
65	"	ATH-BEG	12/17/77	0844-0914	7	W
66	"	BEG-ATH	12/17/77	1109-1144	8	W
67	"	ATH-BKK	12/17/77	1344-2142	94	W
68	"	BKK-MEL	12/17/77	2323-0708	89	W
69	"	MEL-SYD	12/18/77	0907-0937	7	W
70	GP0320	SYD-CHC	12/18/77	0821-1006	22	W
71	"	CHC-MEL	12/18/77	1920-2220	37	W
72	"	MEL-CHC	12/19/77	0048-0253	26	W
73	"	CHC-SYD	12/19/77	0504-0739	30	W
74	"	SYD-MEL	12/20/77	0315-0355	8	W
75	"	MEL-SIN	12/20/77	0536-1206	109	W
76	"	SIN-BAH	12/20/77	1417-2131	96	W
77	"	BAH-ATH	12/20/77	2332-0259	78	W
78	"	ATH-VIE	12/21/77	0452-0617	17	W
79	"	VIE-FRA	12/21/77	0803-0828	6	W
80	"	FRA-ATH	12/21/77	1913-2104	88	W
81	"	ATH-BAH	12/21/77	2248-0130	48	W
82	"	BAH-SIN	12/22/77	0351-0956	72	W
83	"	SIN-MEL	12/22/77	1208-1818	69	W
84	"	MEL-SYD	12/22/77	2012-2042	7	W
85	"	SYD-AKL	12/23/77	2232-0032	22	W
86	"	AKL-MEL	12/24/77	0254-0549	36	W
87	"	MEL-AKL	12/24/77	0812-1037	29	W
88	"	AKL-BNE	12/24/77	2234-0054	29	W
89	"	BNE-AKL	12/25/77	0351-0601	24	W
90	"	AKL-SYD	12/25/77	0816-1031	27	W
91	GP0320	SYD-MEL	12/26/77	0410-0443	24	W
92	"	MEL-PER	12/26/77	0619-0914	35	W
93	"	PER-BKK	12/26/77	1124-1704	68	W
94	"	BKK-ATH	12/26/77	1913-0543	124	W
95	"	ATH-FCO	12/27/77	0732-0842	13	W
96	"	FCO-ATH	12/27/77	1945-2040	12	W
97	"	ATH-BKK	12/27/77	2226-0552	102	W
98	"	BKK-SIN	12/28/77	0818-0938	16	W
99	"	SIN-MEL	12/28/77	1155-1804	68	W
100	"	MEL-SYD	12/28/77	1958-2029	12	W
101	"	SYD-SIN	12/29/77	0604-1244	95	W
102	"	SIN-BAH	12/29/77	1451-2151	77	W
103	"	BAH-LHR	12/29/77	2359-0623	75	W
104	"	LHR-BAH	12/30/77	2114-0219	59	W
105	"	BAH-SIN	12/31/77	0443-1113	75	W
106	"	SIN-SYD	12/31/77	1335-2014	79	W
107	"	SYD-MEL	12/31/77	2237-2312	8	W
108	"	MEL-SYD	1/ 1/78	0337-0407	7	W
109	"	SYD-SIN	1/ 1/78	0626-1300	77	W
110	"	SIN-KUL	1/ 1/78	1440-1440	1	W
111	"	KUL-BAH	1/ 1/78	1651-2315	75	W
112	"	BAH-AMS	1/ 2/78	0126-0651	62	W

TABLE II - E) VL0014 FILE 5 CONCLUDED....

		FLIGHT ROUTE	DEPARTURE DATE	DATA TIME INTVL(GMT)	DATA *	
113	"	AMS-LHR	1/ 2/78	0850-0900	3	W
114	"	LHR-ORY	1/ 2/78	1652-1657	2	W
115	"	ORY-DAM	1/ 2/78	1903-2235	42	W
116	"	DAM-BAH	1/ 3/78	0016-0147	19	W
117	"	BAH-KUL	1/ 3/78	0341-0941	72	W
118	"	SIN-SYD	1/ 3/78	1347-2003	74	W
119	"	SYD-MEL	1/ 3/78	2232-2302	6	W
120	"	MEL-SYD	1/ 4/78	0322-0356	8	W

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* Number of DATA records in flight
O - OZONE
W - WATER VAPOR
C - CARBON MONOXIDE

TABLE III - OZONE "L" TAG DETAILS

Measurement: Cabin Ozone (O33)

Aircraft: N533PA, VL0014, File 1

Flights	Dates	Tape	Inst ID	Recal date	Results
39-43	10/31/77- 11/ 2/77	GP298	024	1/4/78	30% low
44-62	11/15/77- 11/27/77	GP310	"	"	"
63-71	11/30/77- 12/ 5/77	GP317	"	"	"
72-85	12/ 8/77- 12/21/77	GP331	"	"	"
86-98	12/22/77- 1/ 3/78	GP322	"	"	"

TABLE IV - FILTER DATA ON TAPE VL0014

Exposure Data			
Filter no.	202-1	202-2	202-3
File,Flight	3,2	3,8	3,16
Route	YVR-HND	KHI-THR	DEL-BKK
Date	10/6/77	10/9/77	10/12/77
Time,GMT	2000-2200	0213-0406	0133-0333
Latitude, deg	48-45N	26-35N	27-18N
Longitude, deg	135-155W	65-52E	79-95E
Altitude, km	9.9-10.1	9.7-9.5	9.8-11.3
Region **	T	T	T
Constituent Data			
$SO_4^=$, ug/m3	.018	.015	.013
NO_3^-, "	.003	.009	.015
CL^-, "	.005	.004	.002
F^- "	.002	.000	.003
^7Be, pCi/m3	.117	.251	.135

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

TABLE IV - FILTER DATA ON TAPE VL0014, CONTINUED

Exposure Data

Filter no.	202-5	202-6	202-7	202-8
File,Flight	3,23	3,28	3,37	3,44
Route	BKK-HKG	JFK-LHR	HND-HKG	JFK-LHR
Date	10/15/77	10/18/77	10/21/77	10/24/77
Time,GMT	0447-0647	0813-1012	1102-1303	--------
Latitude,deg	11-18N	42-51N	34-27N	41-48N
Longitude,deg	102-112E	70-46W	138-124E	70-48W
Altitude,km	9.7-10.1	9.7-10.1	10.2-10.7	9.6-11.2
Region **	T	M	T	M

Constituent Data

$SO_4^=$,ugm/m3	.017	.047	.021	.049
NO_3^-, "	.055	.031	.025	.038
CL^-, "	.015	.000	.003	.001
F^-, "	.000	.000	.002	.002
^7Be,pCi/m3	.114	1.62	.598	1.69

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

TABLE IV - FILTER DATA ON TAPE VL0014, CONCLUDED

Exposure data		
Filter no.	402-4	402-5
File,Flight	2,6	2,15
Route	SFO-JFK	LAX-HNL
Date	11/11/77	11/14/77
Time,GMT	2105-2305	0047-0247
Latitude,deg	39-42N	33-28N
Longitude,deg	120-98W	121-139W
Altitude,km	9.8-11.3	9.8-11.9
Region **	T	T
Constituent Data		
SO4=,ug/m3	.017	.037
NO3-, "	.011	.030
CL-, "	.002	.000
F-, "	.003	.000
^{7}Be,PCi/m3	.381	.488

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

APPENDIX A - Specifications for GASP Archive Tapes (VLXXXX)

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 < VL0009 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 P P 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	NBLOCK	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
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	FLONON	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	FLONOF	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)
220-229	FCOMP1	A10	Filter constituent 1 (name)
230-239	FCOMP2	A10	Filter constituent 2 "
240-249	FCOMP3	A10	Filter constituent 3 "

Table A-I Completed

Bytes	Fortran Name	Fortran Format	Parameter Description, Units, and Comments
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**
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	O3 destruction constant (see eq. 1)
490-494	b	F5.3	O3 destruction constant (see eq. 1)
495-499	c	F5.1	O3 destruction constant (see eq. 1)
500-507	d	E8.2	O3 destruction constant (see eq. 1)
508	OVRFLO	I1	If OVRFLO>0, NDATA=NDATA+OVRFLO*7992, and NBLOCK=NBLOCK+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 VL0004, 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'
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+
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='T', TRPRHM from TRPRMB assuming std. atm. If ALTAG='T', 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	O33TAG	A1	Tag for O33
442-446	CDENS	F5.3	Density ratio correction used in processing O33 data - see text
447-452	RPFLOM	F6.2	Conversion from particle counts to particle density
453-456	BLDGND	I4	15th stage bleed indicator--VL0010 only
457-460	BLDFLT	I4	15th stage bleed indicator--VL0010 only
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.

\- Water vapor instrument changed to chilled-mirror type beginning with VL0014 - see text

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16. Abstract

This report is the eleventh 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 atmsopheric ozone, cabin ozine, carbon monoxide, water vapor, particles, dlouds, condensation nuclei, filter samples and related meteorological and flight information obtained during 562 flights of aircraft N533PA, N4711U, N655PA, and VH-EBE from October 3, 1977 through January 5, 1978 are 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.

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