02382

NCAR MO1A

NCAR-TN-6 (revised) 402B

Aircraft and Instrumentation In Atmospheric Research

301

aircraft
instrumentation
atmospheric research

FACILITIES LABORATORY

October 1970 P200 subj. 301

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NCAR shares with other atmospheric research groups four interrelated, long-range objectives that provide justification for major expenditures of public and private funds:

- To ascertain the feasibility of controlling weather and climate, to develop the techniques for control, and to bring about the beneficial application of this knowledge;
- To bring about improved description and prediction of astrophysical influences on the atmosphere and the space environment of our planet;
- To bring about improved description and prediction of atmospheric processes and the forecasting of weather and climate;
- To improve our understanding of the sources of air contamination and to bring about the application of better practices of air conservation.

The research and facilities operation of NCAR are conducted in four organizational entities:

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The High Altitude Observatory
The Facilities Laboratory
The Advanced Study Program

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University of Miami
University of Michigan
University of Minnesota
University of Missouri
New York University
University of Oklahoma
Pennsylvania State University
Saint Louis University
Texas A & M University
University of Texas
University of Utah
University of Washington
University of Wisconsin

PREFACE

The purpose of this catalog is to provide convenient and reasonably comprehensive information on aircraft and associated instrumentation used for atmospheric research in the United States. The catalog should make possible more efficient access to, and use of, such aircraft by interested research scientists.

The information presented here was originally compiled by E. Bollay Associates, Inc., under subcontract to the NCAR Research Aviation Facility. The Facility, established in March 1964 within the Facilities Laboratory of the National Center for Atmospheric Research (NCAR), is intended for joint use by NCAR staff members, and university and other research scientists not with NCAR. The Facility provides aviation services to a variety of atmospheric research programs and, in addition, has been designated by the Interdepartmental Committee for the Atmospheric Sciences (a committee of the Federal Council for Science and Technology) to serve as a nationwide center for collecting and disseminating information on atmospheric research aircraft, and their instrumentation. This catalog was prepared as part of the Facility's information-exchange program.

The Facility supports flight research, provides technical assistance in developing aircraft instrumentation and data recording and reduction systems, serves as a liaison between the scientific community and Federal regulatory bodies, and trains scientific and technical workers in the use of aircraft for research.

This loose-leaf catalog will be updated by replacing obsolete sections, or by issuing additional pages to include new data. Catalog holders will receive such correction sheets as soon as they are issued.

The organizations listed in the catalog are the primary sources of the data presented, and are thanked for their cooperation. The future value of the catalog will depend on continued cooperation, and all persons connected with research aviation are urged to send corrections, new information, suggestions, and requests for information on aircraft or instrumentation availability to:

Manager
NCAR Research Aviation Facility
National Center for Atmospheric Research
Boulder, Colorado 80302

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AVIATION TERMS AND ABBREVIATIONS

ADF	Automatic Direction Finding
DME	Distance Measuring Equipment
IAS	Indicated Airspeed
LORAN	Long-Range Aid to Navigation
PPI	Plan-Position Indicator
TACAN	Tactical Air Navigation (system); UHF navigational facility; direction and distance information
TAS	True Airspeed
VGH	Velocity, Acceleration, Heading
VOR	Very High Frequency Omnirange
VORTAC	VOR and TACAN systems combined

STATUS AND TRENDS IN RESEARCH AIRCRAFT INSTRUMENTATION

The basic parts of an aircraft research instrumentation system are: sensors, amplifiers and recorders, a power source, and the necessary controls and switching. The preparation of an airborne instrumented platform is a systems engineering problem; factors of flight profile, sensor type and exposure, aircraft characteristics, recording media, power, installation of equipment, and reduction of the recorded data to usable form must all be considered. In practice, system components are often selected because they happen to be available; the problem then becomes one of integrating the items into a usable system. Any research instrumentation system merits a careful analysis, from sensor to data analysis procedures, to ensure that data produced will justify the time and money expended.

SENSORS

In most research systems, more effort is devoted to the development of sensors than to any other part of the system because of the unknown factors that are involved. New, untried sensors and/or techniques must be tested to determine their ability for gathering atmospheric data.

If the aircraft platform is available only on a part-time or shared basis, the "in and out" requirement and lack of freedom to modify the aircraft structure impose severe constraints in mounting the equipment. Some of the new innovations of sensor installation involve extra removable nose sections, doors, and wing tips or tip tanks. An example is the use of a rack installation to carry an external package. Generally, only sensors would be carried in the external package; the aircraft platform would provide the "universal" control, recording, and power facilities. It is conceivable that all necessary instrumentation, including sensor, recorder, and power, could be carried as a self-contained unit.

Many sensors useful in meteorological research are available commercially. Requirements of users of meteorological sensors have created a trend toward faster response rates, easier calibration, and digital outputs for these instruments. However, the catalog data indicate that a large number of sensors are developed in-house, in contrast to other portions of research instrumentation systems, which are generally proven instruments developed for other uses, but which satisfy the requirements of meteorological research projects.

Similarly, some of the sensors used for atmospheric research were originally developed for other purposes and later adapted for atmospheric research use. The spectrometer, radiometer, and stable platforms are examples. Although use of these sensors will continue, new concepts are being applied directly to the field of atmospheric research,

as in the development of laser instrumentation specifically to study particulates and clear air turbulence, to determine aircraft altitude, and to determine sea state or snow surface roughness.

Within the near future, major advances in sensing appear imminent in two categories: particulate measurement, and the indirect observation of many parameters by means of their inherent emissions. Particulate measurement includes the collection or detection of the atmosphere's most miniscule particles at altitudes from the surface to the greatest heights that aircraft can reach. It includes trapping these particles in filters, on films, or in containers, and analyzing their composition at ground laboratories. It also includes sampling their composition and concentration, in real time, within the aircraft. For real-time sampling, sensors will select some physical, chemical, or electrical property of the particles, such as mass, phosphorescence, or nucleating propensity. Ground analysis will also be performed using these techniques, together with electron microscope techniques, and activation analysis.

Emission measurements depend on the fact that all solids, liquids, and gases emit energy on a scale and at wavelengths related to their thermal condition and thermal properties. Their emissions are greatest at a frequency determined by their temperature, and extend in both directions from the peak in a known manner. Some emissions are essentially blackbody (e.g., the ground surface), while others (the gases) have a distinctly banded structure.

Ground or sea water temperature can now be sensed remotely with relatively simple radiometers. More complicated, but still air transportable, radiometers and spectrometers can measure cloud top temperatures, and vertical profiles of temperature and water vapor content when clouds are absent. Semiactive techniques to measure atmospheric dust properties are feasible, using the sun as the source of radiant energy.

Microwave radiometry is being applied to certain large-scale radiation mapping projects. The techniques in the microwave region are completely different from those in other regions of the spectrum. Problems of antenna design, cryogenic cooling, and elaborate signal processing take the place of the optical and detector problems associated with visual and IR wavelength radiometry. At still lower frequencies, electromagnetic radiations by clouds and variations in the electrical properties of the atmosphere will undoubtedly receive more study and will require very sensitive and stable detectors to operate at frequencies ranging from essentially direct current to hundreds of megacycles.

Still another sensor development appears to be necessary: the evolution of better directional stabilization for primary sensors when directionally precise observations from aircraft are required. Aircraft observations of the sun, for instance, will require rough leveling by the aircraft autopilot or an inertial platform, and fine pointing by a precise sun-follower. The space age has given us the tools for this job; it is only a matter of adapting these tools to the aircraft environment

to achieve usable accuracies (1 arc min or less). A primary design problem is the mass that must be stabilized. It is easy to design an instrument whose sheer bulk will preclude aircraft use. On the other hand, when aircraft flight is an initial goal, it is also relatively easy to limit the mass that must be pointed to a single mirror, lens, or detector. Thus, coordination between the scientist and the instrumentation engineer, and detailed knowledge of the aircraft platform are essential from the very beginning of a project.

RECORDING METHODS

Great freedom of choice is possible in the selection of data recording equipment. System requirements may dictate one or several recording methods. The most widely used methods are analog chart and photographic recordings. Continuous analog records are popular because of their ready access, comparison, and preliminary evaluation by visual examination. Most chart recorders in use are older laboratory-type instruments that also perform well in the aircraft environment, if space and weight are not a problem. Newer instruments offer improved portability, smaller size, and many options on sensitivity, response, and power requirements.

If more than a few parameters are processed, the data reduction effort required with analog chart inputs becomes a serious problem. Several facilities utilize semiautomatic chart readers to convert recorder deflections to digital form for further processing by a computer. Fully automatic chart digitizing devices are now available and should be considered if large volumes of analog chart data are to be processed.

For visible parameters (i.e., clouds, radar scopes, and the positions of dials, switches, or indicators), cameras are popular recording devices. Photo recording systems are usually simple and inexpensive, and are often used for a backup record or for parameters not requiring high resolution and accuracy. However, the analysis of film records is time-consuming and tedius when considerable information is required.

Analog records can also be made on magnetic tape. Large, laboratory-type recorders have been used in aircraft of transport size, but small portable recorders are availabble. Magnetic tape is a reliable recording medium and offers a much higher frequency response than chart recorders. The analog input must be converted to a frequency-modulated signal to retain amplitude accuracy, and subsequent playback requires additional equipment to return the signal to its analog form and make a visible record. During playback, it is possible to use an analog-to-digital converter and obtain a digital record suitable for computer processing.

A disadvantage of magnetic tape recording, whether analog or digital, is the lack of a visible record in real time. Therefore, the usual instrumentation system includes the parallel metering or charting of a few selected parameters to allow real-time evaluation.

Digital magnetic tape recorders of the computer type are found only in larger aircraft systems where a tremendous volume of data makes the added size and complexity of this type of equipment worthwhile. Digital data systems have two definite advantages: first, the sensed data are converted to a numeric value before recording, and retain their accuracy from this point on; second, once recorded, the data can be processed readily with ground-based computer systems.

A recent innovation in the recorder field, the incremental digital magnetic tape recorder, promises to make digital recording more attractive for use in all sizes of airborne data systems. Unlike computer tape transports, which require constant data rate and fixed tape speed, incremental (stepper) recorders record asynchronously (a character at a time) to maintain constant packing density. Steppers advance the tape only on receipt of a digital character, and record information received at any rate (fixed or variable) from 1 to 300 Hz. There are now many different incremental magnetic recorders on the market, with their advantages of digital recording, tape reusability, high information packing density, and reliability at high data rates. Many of these recorders are small, compact units suited for aircraft installation or portable use. Some incremental magnetic recorders can record directly in computer-compatible format, thereby eliminating secondary conversion. Other less expensive recorders are not directly compatible.

INSTRUMENTATION POWER

Most instrumentation systems require some form of on-board electrical power, since the power required by research instruments usually differs from the normal aircraft electrical power system. The standard private aircraft power system is 12 V dc; larger twin- and multi-engine aircraft use 28 V dc. Military aircraft have a combination of 28 V dc and 400 Hz ac power, with 400 Hz ac becoming the primary power system. In contrast, most readily available electronic equipment requires standard household 115 V, 60 Hz ac power. For many years, rotary inverters have been used to bridge the gap between the dc power sources and the ac power requirements of instruments. More recently, solid state inverters have been developed which offer many advantages in size, weight, efficiency, and reliability. Conversion from dc to ac is the normal requirement for airborne instrumentation, but other conversions are also occasionally necessary.

All aircraft are limited in the amount of electrical power they can supply for instrument use, and instrumentation installations are often power-limited before they are space- or weight-limited. Batteries, additional aircraft-engine-driven generators, and self-contained auxiliary power units are some of the means adopted to provide supplementary power. Some of the systems described on the following pages use gas turbine, 400 Hz alternator auxiliary power units. One suggested possibility for auxiliary power generation is a fan-driven alternator mounted in the aircraft slipstream.

AIRCRAFT POSITION AND ATTITUDE

Most research projects need information about the location, attitude, and relative motion of the sensor platform. The basic aircraft instruments provide indications of altitude, airspeed, heading, attitude, and time. Common additional requirements are such specialized inputs as angle of attack, acceleration, rate of climb, altitude above ground level, roll, pitch, and yaw position and/or rates.

The most elementary way to determine the geographic location of the platform is by visual reference to the ground. Such visual navigation is quite adequate for much of the low-level and local flying. If radio navigation is needed, the VOR/DME system available in the U.S. seems to offer the most utility to the average user. Accuracy obtainable depends more on local conditions and the condition of receiving and transmitting equipment than on the initial equipment cost. Accuracy can vary from ± 1 to ± 4° in bearing, and from 1 to 2% in distance. Other radio navigation systems such as LORAN and CONSOLAN (long-range navigation) and Decca (short-range navigation) could be useful in some applications.

Doppler and inertial navigation systems are being used by the military and by commercial airlines, and are found in a few research aircraft platforms, but the cost and complexity of available equipment limit their use. The typical inertial guidance system provides continuous recordable outputs of aircraft pitch, roll, and true heading; aircraft ground track and ground track velocity; north-south and east-west velocity; aircraft present position in latitude and longitude; and autopilot command outputs.

Ground-based radar is a useful tool for determining aircraft position and track, although its use restricts the aircraft to a fixed volume of space which is limited by the range and accuracy capabilities of the ground-based radar (or radars). A particular advantage of ground-based radar in cloud physics and rainstorm research is the possibility of a common reference for aircraft and "weather" radar track information, which greatly facilitates data reduction.

Methods to record aircraft position must be selected with the overall data reduction problem in mind. Manual recording is adequate in many situations, using paper chart records, a voice record, or magnetic tape. The pilot or equipment operator is the link between the aircraft instruments, visual observation, or navigation equipment readouts, and the physical record. Greater accuracy and reliability are possible by the use of normal photographic techniques to obtain a record of aircraft instrument readings at times of interest. In addition, photographs of the atmosphere surrounding the aircraft, or of the surface underneath, are a useful source of data for many experiments. In some experiments it is necessary to obtain a continuous record of aircraft position and

altitude to accompany the other sensed data. A few aircraft instruments have electrical outputs suitable for recording, but in most cases the instruments must be modified. If they cannot be modified, it is simplest to provide separate sensors whose outputs can be recorded directly.

THE UNIVERSITY OF CHICAGO
Department of the Geophysical Sciences
5723 University Avenue
Chicago, Illinois 60637

Source: Roscoe R. Braham, Jr.
Professor of Meteorology

Date: 9/10/70

PROJECT SUMMARY

Aircraft and ground-based radar will be used to determine the general features of precipitating volumes in the flight area.

The aircraft will operate out of Bemidji, Minnesota, during the summer months of June, July, and August. During the winter months, flights will be made on a nonscheduled basis for experimental studies in supercooled stratus clouds.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4/6/65
REVISED	9/10/70

FACILITY: University of Chicago, Cloud Physics Lab
Department of the Geophysical Sciences

ADDRESS: 5730 South Ellis Avenue
Chicago, Illinois 60637

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Precipitation Physics - R. R. Braham, Jr. (NSF) 2. Cloud Particle Sampling - R. N. Knollenberg (NASA)	Lockheed Lodestar

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Data reader	Benson-Lehner	Strip chart	Punched cards	

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4/6/65
REVISED 9/10/70

FACILITY: University of Chicago (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Lockheed Lodestar	N9980F						

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Precipitation Physics: Roscoe R. Braham, Jr.
2. Cloud Particle Sampling: Robert G. Knollenberg

NAVIGATION SENSORS AND RECORDERS

POSITION: Dual omni, transponder, DME, dual UHF, dual ADF
ALTITUDE: See below
HEADING: C-4 compass-gyrosyn to photobox
AIRSPEED: See below

AIRCRAFT ELECTRIC POWER	Two 250 A, 28 V dc generators; two 60 Hz, 115 V, 20 A generators; two 400 Hz, 115 V, 40 A generators

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Radar echo	Radar	Bendix RDR-1	Operate on 5 mi			#1	5 A, 28 V dc	Horizontal axis scan
B. Precipitation particles	Foil sampler (drops indent lead foil)	Developed in-house	H_2O: 200 μ; snow pellets and small ice crystals: 3 to 4 mm	H_2O: ± 50 μ; pellets and crystals: ± 250 μ	1/2 in./sec		110 V, 400 Hz, 0.5 A, 28 V dc, 5 A	Calibrated in laboratory
C. Cloud droplets and precipitation particles	Fiber optic particle measuring systems (2)	Developed in-house and at NCAR	5 μ, 1 cm	Cloud droplets: ± 2.5 μ; precipitation: ± 100 μ	10^{-7} sec	#2	8 A, 28 V dc	
D. Particles	Auto-replicator 16-mm tape	Developed in-house	Cloud particles and small ice crystals	To ± 2 μ ideal conditions			100 V, 60 Hz, 100 W	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 16-mm camera	Multidata III	1 ft/2 sec		A	28 V dc	Triggered by antenna scan
2. Magnetic tape recorder	Ampex	3-3/4 and 7-1/2 in./sec	4 tracks	C	110 V, 60 Hz	
3. Oscillograph	Visicorder	1/2 in./sec	24	E - K, L	110 V, 60 Hz, 60 A	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4/6/65
REVISED 9/10/70

FACILITY: University of Chicago (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Lockheed Lodestar	N9980F (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
E. Liquid water content	Hot wire	Johnson-Williams Model LWH	0 to 6 gm/m^3	~ ± 20%	0.5 sec	#3 and 4	110 V, 400 Hz 0.8 A, 28 V dc @ 15 A	Accurate calibration not available
F. Liquid water content	Paper tape (measure electric conductivity)	Built in-house	Up to 9 gm/m^3 above 32°F	± 25% as usually calibrated	1.8 sec delay	"	28 V, 45 W	Accurate calibration not available
G. Temperature, humidity	Dry and wet bulb (platinum elements)	Developed in-house	Adjustable; each range = 8°C	T = ± 0.1°C	~ 0.2 sec DB; ~ 2 sec WB	"	Battery	
H. Temperature	Stagnation	Rosemount Engr. Co.				"		
I. Dew point	Thermoelectric dew point hygrometer	Bendix Corp. DHAA-IP	-60 to +40°C	± 0.5°C @ 30°C; ± 2°C @ -50°C	1 sec	"	110 V, 400 Hz, 100 W, 28 V dc, 4 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
4. Magnetic tape recorder	In-house (duplicate of NCAR ARIS II) Pemco Recorder		7 tracks multi-channel	C-M	28 V dc	
5. Photobox (16-mm camera)	Developed in-house	1 ft/4 sec		L,M, attitude dual VOR, heading		
6. Magnetic tape recorder	Uher 4000S	Voice actuated	1	Voice	Battery	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4/6/65
REVISED	9/10/70

FACILITY: University of Chicago (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Lockheed Lodestar	N9980F (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
J. Pressure altimeter	Variable reluctance transducer	Pace Engr. Co. P1 and CD-32	0 to 35,000 ft	1% full scale		#3, 4, and 5	20 mA, 28 V dc	
K. Airspeed	Variable reluctance transducer	Pace Engr. Co. P1 and CD-32	0 to 300 mph	1% full scale		#3, 4, and 5	20 mA, 28 V dc	
L. Rate of climb	Instantaneous vertical speed indicator		0 to 3000 ft/min			#5		
M. Time	Crystal controlled oscillator	Developed in-house		1 part/10^7		#2, 3, 4, and 5		
N. VOR distance	Standard A/C DME							
O. VOR radial	Standard A/C VOR					#5		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

COLORADO STATE UNIVERSITY
Atmospheric Science Department
Fort Collins, Colorado 80521

Source: Peter C. Sinclair
Associate Professor of
Atmospheric Science

Date: 9/5/70

PROJECT SUMMARY

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair. The Mark III, T-33, SNJ-4, and LK10A aircraft are being used to investigate the sub-cloud and in-cloud temperature, humidity, and wind structure. In particular, the investigation is designed to acquire knowledge of the mass, momentum, heat, and moisture flux that takes place during the development, maturity, and dissipation stages of large thunderstorms and hailstorms. This information is being used to formulate descriptive and quantitative models of hailstorm initiation, growth, and dissipation.

2. Joint Hail Suppression Research -- Airborne Rocket Seeding Project: P. C. Sinclair. The Mark III, T-33 is being used to test the airborne seeding rocket which has been developed by CSU in cooperation with commercial rocket and flight test companies. The rocket system is designed to deliver up to 500 gm of nucleating material directly into the supercooled cloud droplet region of incipient hailstorms. The rocket is fired from a horizontal stand-off position outside of the cloud and travels 3-5 mi before the nucleating payload is explosively detonated. The T-33 provides the necessary reaction time and mobility required for proper timing of the seeding experiment. In addition, the aircraft is equipped with an instrumentation system for monitoring storm behavior before and after the seeding application.

3. Atmospheric Limitations to Remote Sensing: W. E. Marlatt. NASA's CV990 and CSU's Aero Commander 500B were used to obtain measurements of aerosols, air temperature, humidity, incoming solar radiation, albedo and sea surface temperature in support of the BOMEX project. This data will be analyzed to evaluate the role of atmospheric aerosols in radiation transfer and to aid in the development of an atmospheric radiation transfer model.

4. Instrumentation Development for Research Aircraft: W. E. Marlatt. This project is to aid NASA in procuring, assembling and installing a central recording system aboard the NASA CV990 research aircraft. Control programs applicable to operation of the central recording system for recording and processing of aircraft data will be developed.

5. Measurement and Interpretation of the Sea Surface and Air Temperature Gradients in the Sub-Cloud Layer in the Barbados Island Region in Association with the BOMEX Project: W. E. Marlatt and W. M. Gray. A micro- and mesoscale investigation of the variations of sea surface and sub-cloud layer horizontal and vertical temperature gradients was conducted using the CSU Aero Commander during the BOMEX project. This data will be analyzed in relation to the frictional veering of the wind in the sub-cloud layer to determine if this is a mechanism in the generation of the mesoscale "cloud blob" areas.

6. The Role of Liquid and Solid Particulate Matter in the Transfer of Radiation through the Atmosphere: W. E. Marlatt. The CSU Aero Commander will be used to investigate the role of semitransparent and opaque layers on the transfer of visible and infrared radiation through the atmosphere. A field program will be conducted to obtain simultaneous profile measurements of aerosols; incoming, reflected, and emitted spectral visible and infrared radiation; air temperature and water vapor content; and cloud droplet concentration and size distribution. These profile measurements will be made under different air mass conditions and different geographical regions.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University
Atmospheric Science Department

ADDRESS: Fort Collins, Colorado 80521

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair
2. Joint Hail Suppression Research -- Airborne Rocket Seeding Project: P. C. Sinclair
3. Atmospheric Limitations to Remote Sensing: W. E. Marlatt
4. Instrumentation for Research Aircraft: W. E. Marlatt
5. Measurement and Interpretation of Sea Surface and Air Temperature Gradients in the Sub-Cloud Layer: W. E. Marlatt, W. M. Gray
6. The Role of Liquid and Solid Particulate Matter in the Transfer of Radiation through the Atmosphere: W. E. Marlatt

A/C TYPES

Canadair Mark III, T-33
North American SNJ-4
Cessna 180
Laister Kauffmann 10A
Aero Commander 500 B
NASA CV990

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Digital computer	Control Data Corp. 6400	Card and tape	Card, tape, and printer	University owned
Digital computer	Digital Equipment Corp. PDP-8S	Paper tape and teletype	Paper tape and teletype	"
A/D converter and computer	Redcor	Magnetic and paper tape	Tape and teletype	"
A/D converter	Dymec	Magnetic tape, graphic reader	Card, paper tape, and typewriter	Department owned

SPECIAL FACILITIES

1. M-33 ground radar
2. FPS-6 and FPS-8 aircraft control radar
3. VHF air/ground communications
4. Private university airport and hangar facilities

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Aero Commander 500B	6212X	150 kt	30,000 ft	1000 mi	Christman Field Fort Collins	All year	Colorado State University

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Atmospheric Limitations to Remote Sensing: W. E. Marlatt
2. Sea Surface Temperatures: W. E. Marlatt, W. M. Gray
3. The Role of Particulate Matter on Radiation Transfer: W. E. Marlatt

NAVIGATION SENSORS AND RECORDERS

POSITION	16-mm, downward-looking camera and visual navigation
ALTITUDE	Standard A/C instruments
HEADING	Read and recorded by observer
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 110 V, 60 Hz rotary inverter; 110 V, 400 Hz rotary inverter

AIRBORNE INSTRUMENTATION

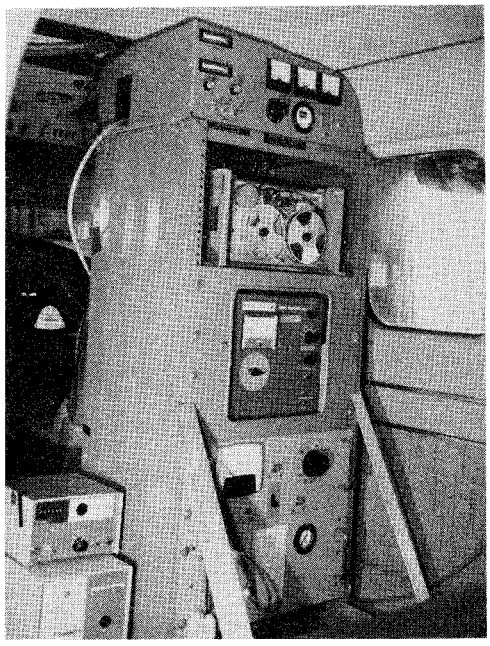
PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Air temperature wet bulb	Diode bridge	Developed in-house	-50 to +50°C	± 0.3°C	0.1 sec 5 sec	#1 or 2 "	110 V, 60 Hz	
B. IR up flux	PRT-5, IT-3	Barnes Engr. Co.	-40 to +70°C	± 0.1°C		"	Internal 110 V, 60 Hz	
C. Solar and sky radiation	Eppley Sol-a-meter; Filter wedge spectro-radiometer	The Eppley Laboratory, Inc., NASA in-house				"		
D. Reflected radiation	Eppley Sol-a-meter	The Eppley Laboratory, Inc.						
E. Aerosol counter	Light scattering	Bausch & Lomb						
F. Cloud drops	Impactor	Developed in-house						
G. Refractive index	Refractometer	ESSA	0 to 999 N unit		1 sec	#1 and 2	28 V dc	
H. Condensation Nuclei (continuous)	Light scattering	General Electric						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital data acquisition system	A-D in-house Kennedy	20 samples/sec	6	20	110 V, 60 Hz	#1 and 2 are not used at the same time
2. Analog magnetic tape recorder	Pemco	15/16 in./sec	7	7	110 V, 60 Hz	
3.16-mm movie camera	Bolex	Adjustable		2	28 V dc	Time-imaged on film with picture
4. Strip chart recorder	Moseley 680	Adjustable	1	1	110 V, 60 Hz	Used for monitoring
5. Oscilloscope	Tektronix				110 V, 60 Hz	Used for monitoring

CSU's Aero Commander 500B research aircraft. This aircraft is equipped with turbocharged engines permitting altitudes in excess of 30,000 ft and has upward and downward viewports for remote sensing devices.

A typical equipment installation in CSU's research aircraft. The plane is equipped with 19 in. equipment racks, 115 V, 60 Hz; 115 V, 400 Hz; and 28 V dc power. Various methods for data recording have also been utilized (i.e., strip chart, analog magnetic tape, digital magnetic tape).



ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Laister Kauffmann 10A	N50894	60 mph	45,000 ft	~ 200 mi	Christman Field Fort Collins	All year	P. C. Sinclair

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair
2. Joint Hail Suppression Research - Airborne Rocket Seeding Project: P. C. Sinclair

NAVIGATION SENSORS AND RECORDERS

POSITION: Visual and ground radar

ALTITUDE:

HEADING: Standard A/C instruments

AIRSPEED:

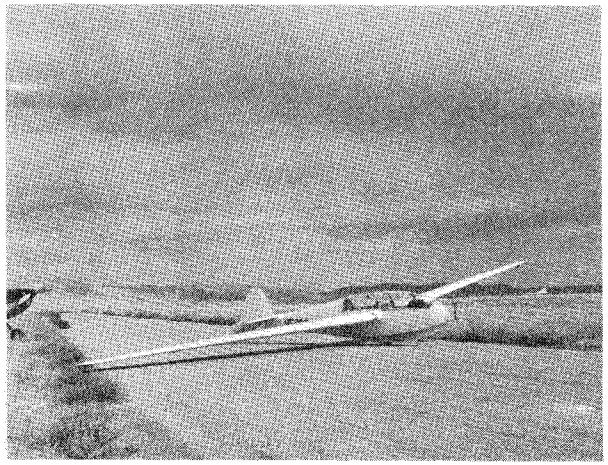
AIRCRAFT ELECTRIC POWER	6 to 24 V dc battery packs

AIRBORNE INSTRUMENTATION

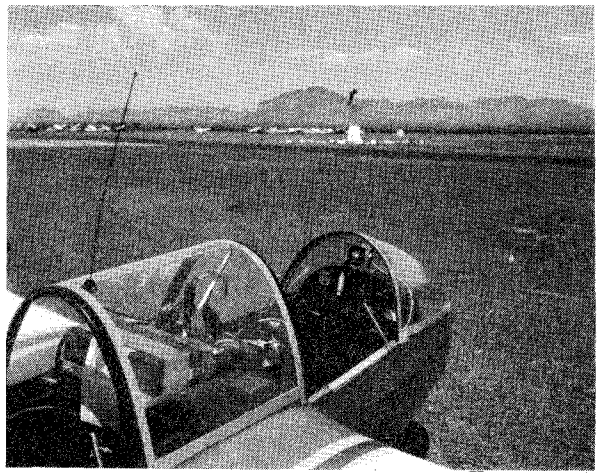
PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Pressure altitude	Aircraft altimeter	Kollsman Instrument Corp.	0 to 50,000 ft	± 100 ft	0.5 sec	#1		
B. Airspeed		Bendix Aviation Corp.	0 to 120 mph	± 1 mph	0.3 sec	"		
C. Total air temperature	Resistance wire	Developed in-house	-30 to +30°C	± 0.3°C	0.5 sec	"	24 V dc	
D. Rate-of-climb	Sailplane variometer with total energy	Badin Instrument Co.	0 to 2000 ft/min	± 50 ft/min	0.3 sec	"		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

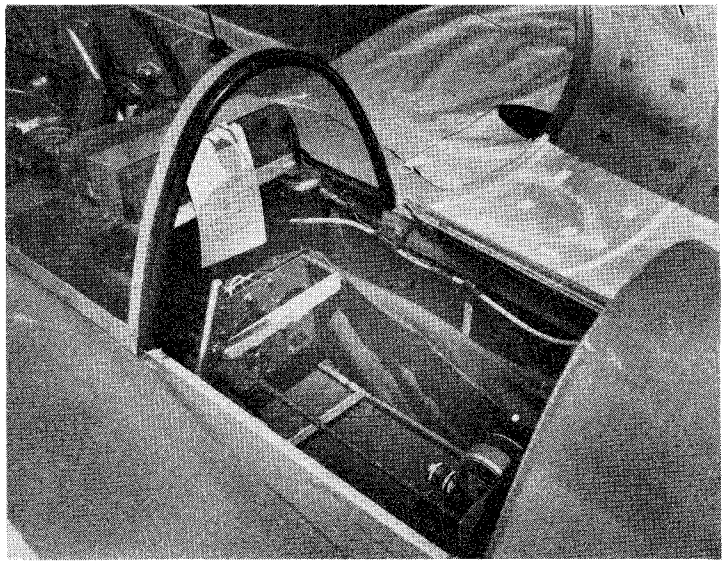
RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 16-mm, time-lapse, movie camera	Keystone Model A-9	Framing rate 0.1 to 10 sec (variable by pilot control)		A/D	6 V dc	The Airborne Atmospheric Data System (AADS-1A) is now being converted to electronic analog sensors and magnetic tape recording.



CSU's Laister Kauffmann research sailplane.



Flight and AADS-1A monitoring controls in the front cockpit of the Laister Kauffmann sailplane.



The AADS-1A instrument package in the rear cockpit of the Laister Kauffmann sailplane.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	North American SNJ-4	N90650	160 mph	18,000 ft	1000 mi	Fort Collins, Colorado	All year	VIP Aviation (instrumentation by CSU)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair
2. Joint Hail Suppression Research - Airborne Rocket Seeding Project: P. C. Sinclair

NAVIGATION SENSORS AND RECORDERS

POSITION: VOR and ground radar

ALTITUDE:

HEADING: Standard A/C instruments (see also airborne instrumentation)

AIRSPEED:

AIRCRAFT ELECTRIC POWER	28 V dc generator; 110 V, 400 Hz, 3-phase, solid state inverter; and ± 15 V dc supply for instrumentation package.

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Pressure altitude (coarse)	Variable reluctance	Pace Engr. Co. CP60	0 to 15 psi	± 0.5% full scale	0 to 10^3 kHz frequency response	#1	25 to 30 V dc @ 20 mA	Note: all errors listed refer to system error; i.e., sensor, demodulator, signal conditioning, and tape recorder errors.
B. Pressure altitude (fine)	Potentiometer	Rahm, PT-71-2	± 1 psid	± 1% full scale	0.1 sec	"	28 V dc	
C. Airspeed	Variable reluctance	Tavis/Edcliff 4-504	± 3 psid	0.5% full scale	0 to 10^3 kHz frequency response	"	"	
D. Total air temperature	Platinum wire	Rosemount Engr. Co. Model 102E2AL	-50 to +100°C	± 1% full scale	0.1 to 0.02 sec	"	"	
E. Angle of attack and yaw	Vane synchro system	Developed in-house	± 15°	± 0.05°	0.1 sec	"	"	
F. Pitch	Vertical gyro	Kearfott Co., Inc.	± 15°	0.1° rms	"	"	26 V, 400 Hz, 1-phase	
G. Roll	"	"	± 20°	"	"	"	26 V, 400 Hz, 1-phase	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Analog tape recorder	Ampex AR 200	1-7/8 to 60 in./sec	14	A-M	28 V dc	Prior to recording, sensor outputs are demodulated (if necessary) and passed through FM amplifiers. All components are temperature controlled to laboratory calibration standards.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	North American SNJ-4	N90650 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
H. Pitch rate	Rate gyro	Whittaker, R170	± 10°/sec	± 0.1°/sec	< 0.1 sec	#1	115 V, 400 Hz, 3-phase	
I. Roll rate	"	Whittaker, R170	± 15°/sec	"	"	"	"	
J. Yaw rate	"	Honeywell, JRS101A2	± 10°/sec	"	"	"	"	
K. Vertical acceleration	Linear servo accelerometer	Donner Systron Co. Model 4310	± 5 g	± 0.005 g	0.05 sec	"	28 V dc	
L. Lateral acceleration	"	"	± 1 g	± 0.001 g	"	"	"	
M. Longitudinal acceleration	"	"	"	"	"	"	"	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

North American SNJ-4 hailstorm research aircraft. The AADS-2A-6 system is contained in a modified T-33 wing-tip tank and is mounted on a quick-disconnect pylon below the right wing. The AADS-1A is a self-contained package used for recording atmospheric variables and pertinent aircraft parameters. It can be quickly removed for laboratory check-out, calibration, or installation on another aircraft.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Canadair Mark III T-33	N156X	0.7M (400 KCAS)	45,000 ft	1300 n mi	Long Beach, California	All year	Flight Test Research, Inc. (instrumentation by CSU)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair
2. Joint Hail Suppression Research -- Airborne Rocket Seeding Project: P. C. Sinclair

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR/DME ground radar
ALTITUDE	
HEADING	Standard A/C instruments (see also airborne instrumentation)
AIRSPEED	

AIRCRAFT ELECTRIC POWER	24 V dc generator; 110 V, 400 Hz, 3-phase solid state inverter and ± 15 V dc supply for instrumentation package.

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Pressure altitude (course)	Capicitance pressure transducer	Rosemount Engr. Co. Model 830J9	0 to 15 psi absolute	± 0.5% full scale	0.025 sec	#1	28 V dc ± 10%	Note: all errors listed refer to system error; i.e., they include sensor, demodulator, signal conditioning, and tape recorder errors.
B. Pressure altitude (fine)	Potentiometer pressure transducer	Giannini Controls Corp., Model 45176DR-D	0 to 0.15 psi differential	± 1% full scale	0.1 sec	"	28 V dc	
C. Airspeed	Capacitance pressure transducer and pitot-static tube	Rosemount Engr. Co. Model 831L15 Model 850A	0 to 6 psi differential	± 0.5% full scale	0.025 sec	"	28 V dc ± 10%	
D. Total air temperature	Platinum wire	Rosemount Engr. Co. Model 102CS2CA	-75 to +45°C	± 1% full scale	0.7 to 2 sec	"	28 ± 4 V dc, 25 mA, 115 V dc de-icing heater	
E. Angle of attack and yaw	Vane synchro system	Developed in-house	± 10°, ± 20°	± 0.05°	0.1 sec	"	28 V dc	
F. Pitch	Vertical gyro	Kearfott Co., Inc.	± 82°	0.1° rms	0.1 sec	"	26 V, 400 Hz, 1-phase	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital, incremental, magnetic tape recorder	Incre-Data Inc. Mark II	1000 char./sec 200 BPI	20	A-M	28 V dc	Prior to recording, sensor outputs are demodulated and passed through eighth-order Butterworth filters. All components are temperature controlled to laboratory calibration standards.
2. Oscilloscope monitor	Tektronix, Type 323		22 inputs	A-N	28 V dc or 110 V ac	Used in pre-flight and in-flight monitoring of system noise levels and voltage inputs to tape recorder.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Canadair Mark III T-33	N156X (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. Roll	Vertical gyro	Kearfott Co., Inc.	± 360°	0.1° rms	0.1 sec	#1	26 V, 400 Hz, 1-phase	
H. Heading	Directional gyro; roll stabilized	Kearfott Co., Inc.	± 90°	< 1°	0.5 sec	"	115 V, 400 Hz, 3-phase	
I. Pitch rate	Rate gyro	Smith's Aviation Division Model 304RGS/3	± 10°/sec	± 0.1°/sec	0.1 sec	"	26 V, 400 Hz, 1-phase, 115 V, 400 Hz, 3-phase	
J. Yaw rate	Rate gyro	Smith's Aviation Division, Model 304RGS	± 10°/sec	± 0.1°/sec	0.1 sec	"	26 V, 400 Hz, 1-phase, 115 V, 400 Hz, 3-phase	
K. Vertical acceleration	Linear servo accelerometer	Donner Systron Co. Model 431F-S-AG Model 4310-2	± 5 g ± 2 g	± 0.025 g ± 0.012 g	0.05 sec 0.05 sec	"	± 15 V dc 28 V dc	
L. Lateral acceleration	Linear servo accelerometer	Donner Systron Co. Model 4310-1-AG	± 1 g	± 0.005 g	0.05 sec	"	28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Canadair Mark III T-33	N156X (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

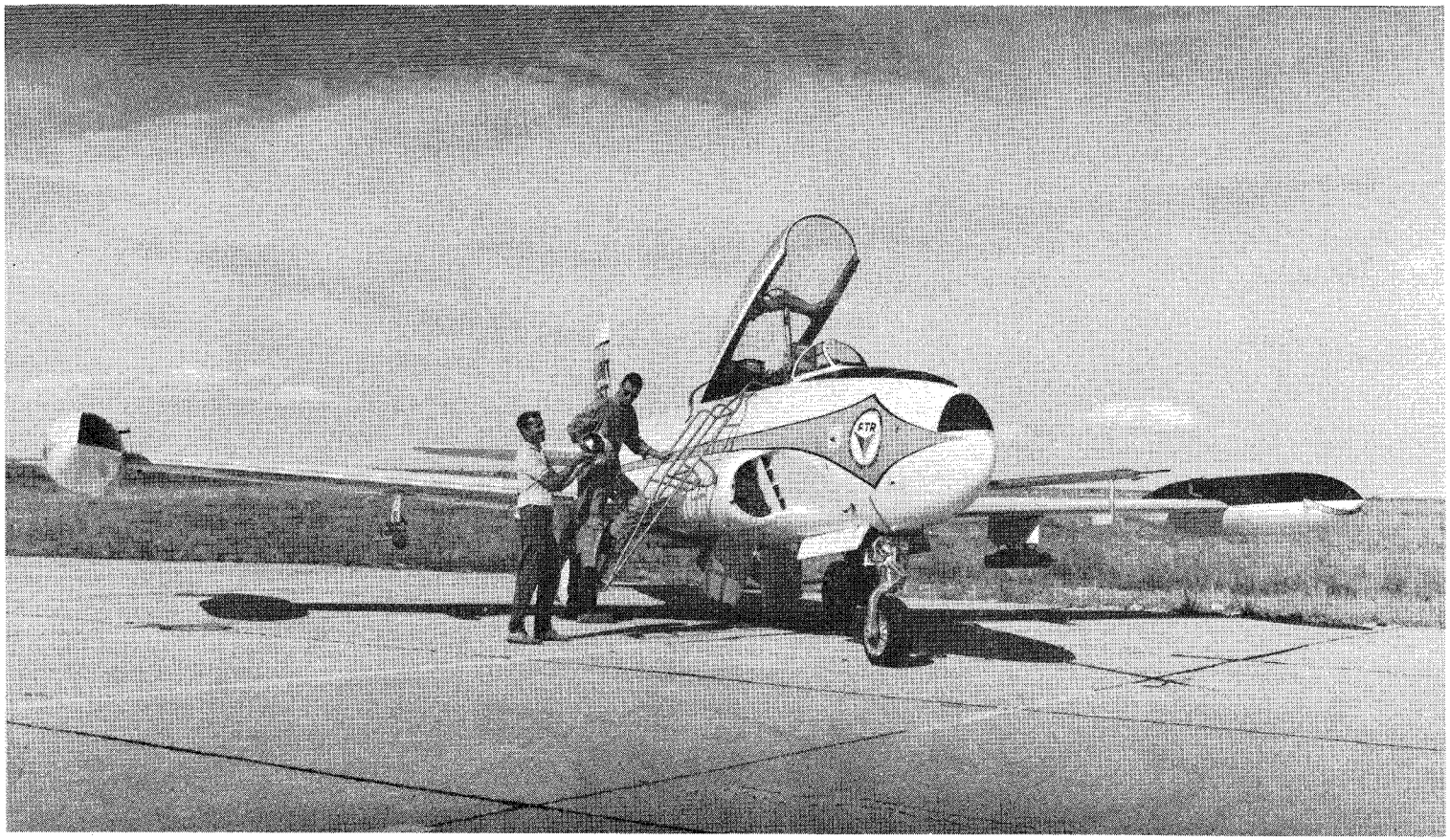
AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

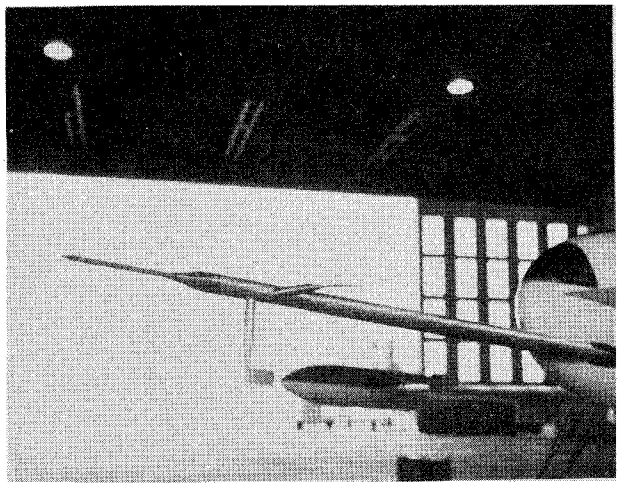
PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
M. Longitudinal accelerometer	Linear servo accelerometer	Donner Systron Co. Model 4310-1	± 1 g	± 0.005 g	0.05 sec	#1	28 V dc	
N. Boom vertical and latitudinal bending	Temperature compensated wire strain gage system	Micro-measurements ED-DY-250BG-350	± 1200 μstrain	± 1%	0.01 sec	#2	28 V dc	
O. Cloud seeding	CSU rocket delivery system							A/C carries 2 prototype launchers which hold 7 rockets each.

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

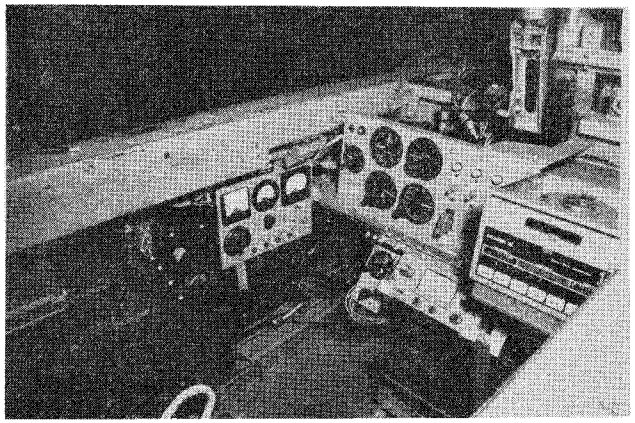
RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS



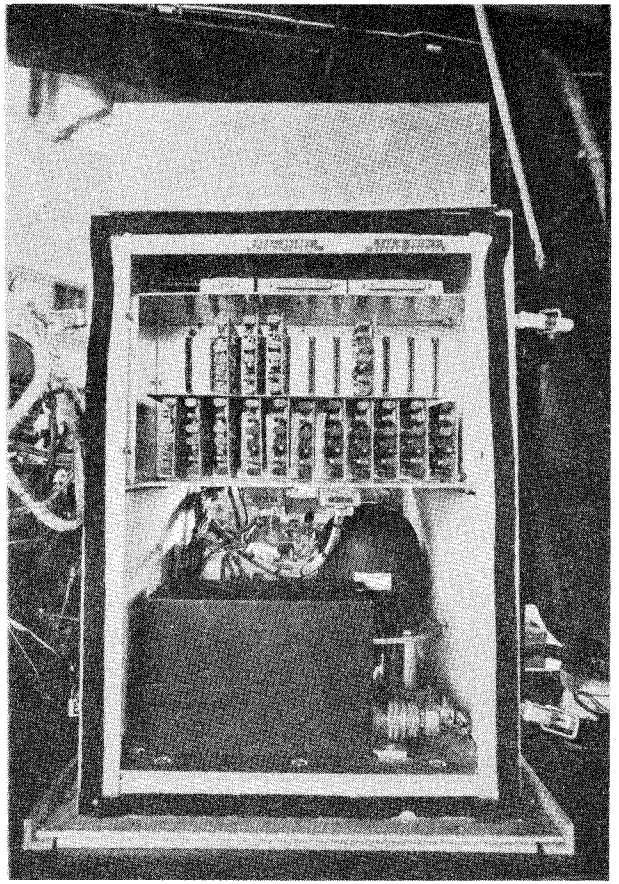
Rocket firing and severe storms measurement aircraft. The Canadair T-33 jet aircraft performs a dual function in acting as the delivery platform for the hailstorm seeding rockets and as the measurement platform for the AADS-3B-33 system which is used in the severe storm measurement program. The loaded rocket launchers are located on the pylons below each wing, and the AADS-3B-33 boom system positions the gust vane and pressure sensing probes well ahead of the aircraft to minimize adverse flow characteristics. During the present testing phases of the rocket program, two prototype launchers are carried with a total capacity of 14 rockets. New launcher designs are available with a total capacity of 100 rockets per flight.



Canadair T-33 boom and gust-vane system (AADS-3B-33).



Recording and monitoring units in rear cockpit of Canadair T-33.



Nose compartment of Canadair T-33. Temperature controlled gyro reference, signal conditioning, and filter section of the AADS-3B-33 system.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-26-69
REVISED	9-5-70

FACILITY: Colorado State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Cessna 180	N2707X	130 mph	19,000 ft	500 mi	Christman Field Fort Collins	All year	VIP Aviation (instrumentation by CSU)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Design of Descriptive and Theoretical Hailstorm Models: P. C. Sinclair
2. Joint Hail Suppression Research - Airborne Rocket Seeding Project: P. C. Sinclair

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR and ground radar
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	12 V dc generator 24 V dc battery pack

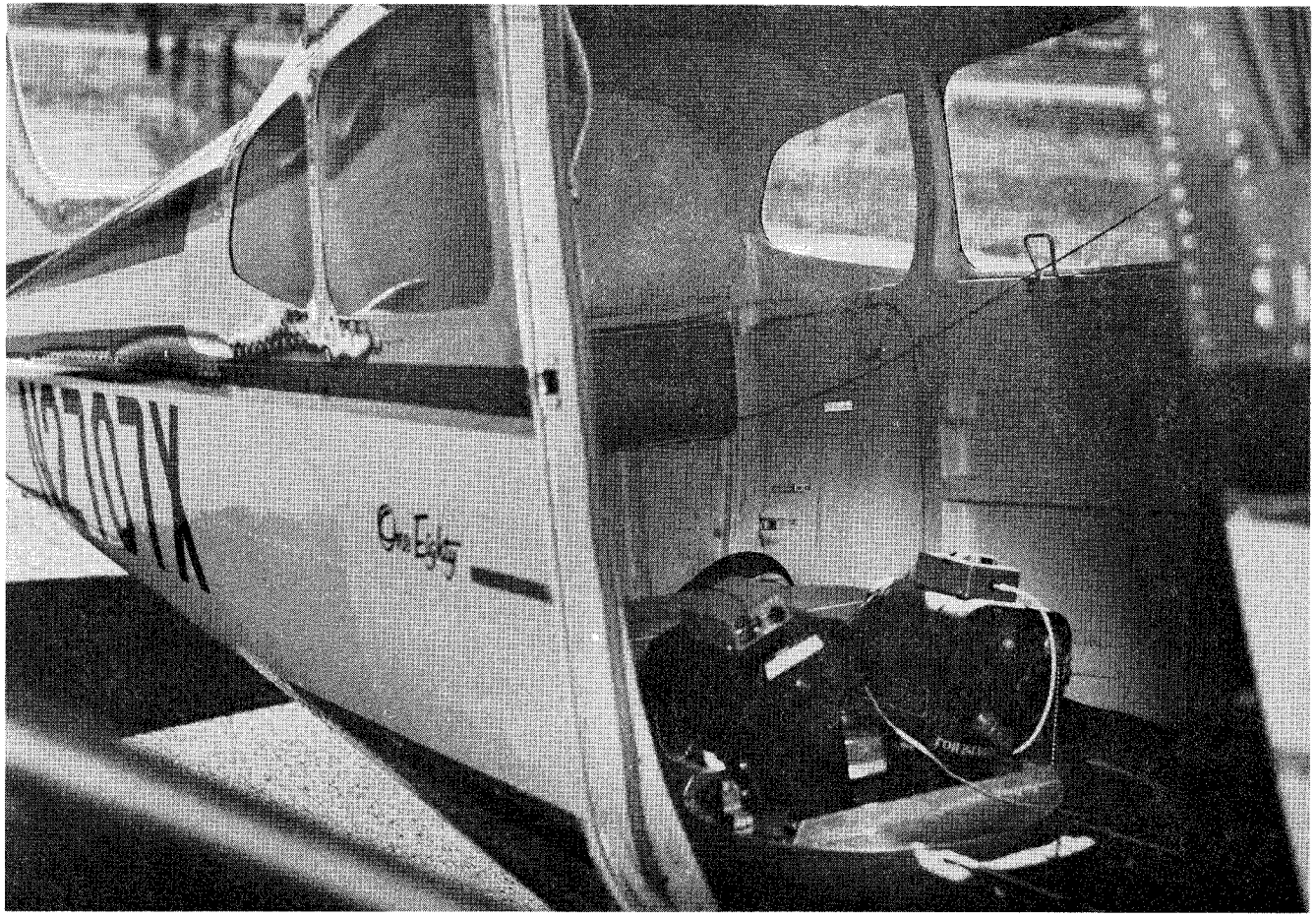
AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
Aerial photographic (IR and visible) mapping of hailfall ground coverage	Aerial cameras (overlapping coverage)	4 × 5 in. aircraft camera, Folmer Graflex Corp. Type K-25B	Unlimited		Framing rate: 0.1 to 10 sec		24 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

CSU's Cessna 180 used for hailswath mapping.



Hailswath camera system installed in the Cessna 180. Two K-25B aerial cameras are used to photograph the hailswath as the aircraft flies parallel to the storm movement. Two cameras provide a two-mile lateral coverage of the hailswath from cloud base altitudes. Hailswaths exceeding this two-mile limit can be photographed using different flight plans.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	9-10-70
REVISED	

FACILITY: Desert Research Institute
University of Nevada

ADDRESS: STEAD Facility, Reno, Nevada

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Sierra Storm Studies and Modification Program (winter): Dr. E. X. Berry, Flight Facility Director 2. Alberta Hail Studies Program: Dr. Peter W. Summers, Field Coordinator 3. Flagstaff, Arizona Storm Studies: Meteorological Research, Inc. 4. Storms over Cascade Mountains: Dr. P. V. Hobbs, University of Washington 5. Project Skywater Seeding Program: Prof. J. Warburton 6. Project Skywater Evaluation Program: Dr. E. X. Berry	Douglas B-26

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Dataplexer and telemetry PAM/FM receiver	Sierra Research, Inc.	Sensor outputs including computer valves	Meter display magnetic tape or PDP-8 computer	Portable unit used to display actual flight data on the ground for real-time evaluation
PDP-8 computer	Digital Equipment Corporation	Magnetic tape or telemetry output	Teletype and calcomb plotter	Additional information can be stored on punch cards or magnetic tape
X-Y plotters (2)	Tektronix, Inc. Variplotter 50 × 50 in.	X-Y position		

SPECIAL FACILITIES

Two ground-based radars, type M-33, are located in the vicinity of the Desert Research Institute. These radars are used in the winter field-study programs carried out in the Sierra Nevada Mountains near Reno and Lake Tahoe. The aircraft sensors and seeding mechanisms are in instrumentation pods located beneath each wing. The pods can be replaced by other special instrumentation pods if desired by other users of the aircraft. The signal conditioning equipment and recording devices are located in the aircraft cabin and can be interfaced to instrumentation pods with little or no modification.*

*Technical Report No. 8, Desert Research Institute, Reno, Nevada, 1969.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	9-10-70
REVISED	

FACILITY: Desert Research Institute (continued) ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
8-channel analog tape Digital tape	Honeywell 8100 Precision Instrument	Dataplexer output, aircraft radar and aircraft track sensors.	Computer-generated display on a storage scope and teletype output.	

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9-10-70
REVISED

FACILITY: Desert Research Institute
University of Nevada (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	B-26	N4204A	240 kt	25,000 ft	1450 n mi No res.	Reno, Nevada	All year	Des. Research Inst. University of Nevada

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR/DME X-Y plotter
ALTITUDE	Standard all-weather aircraft instruments including Lear Siegler L-S Autopilot
HEADING	
AIRSPEED	

AIRCRAFT ELECTRIC POWER	Two 300 A, 28 V dc generators; one 500 W, one 650 W, 60 Hz, 115 V ac inverter; two 2.5 kVA, 400 Hz, 115 V ac inverter

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Temperature-total	Platinum resistance wire (bridge)	Rosemount Engr. Co. Model 120	-30 to +20°C -50 to +10°C	± 0.1°C	0.01 sec	#1, 2, 3	110 V ac, 50 to 400 Hz	Heated probe
B. Pressure altitude	Linear potentiometer	Computer Instrument Corp. 7000	0 to 30,000 ft	± 45 ft	0.02 sec	"	"	Regulated 10 V dc input
C. Indicated airspeed	Linear potentiometer	Computer Instrument Corp. 7000	100 to 350 kt	± 0.4 kt	0.02 sec	"	"	Regulated 10 V dc input
D. Absolute pressure	Strain-gauge transducer	Consolidated Electrodynamics Corp. 4-312	0 to 15 psi	± 0.23% full scale	< 0.1 sec	"	5 V dc	5 V dc supply-calibrate each flight
E. Liquid water content	Heated wire resistance	Johnson-Williams	0 to 1.5 gm/m^3 0 to 3 gm/m^3	± 20% full scale	1 sec	"	115 V ac, 400 Hz	Heated probe
F. Ice rate and liquid water content	Vibrating tube	Rosemount Engr. Co. Model 871BDI	0.15 sec of ice	± 10% full scale		"	28 V dc	Regulated supply

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape, analog	Honeywell 8100 analog tape	4 speeds	8	Dataplexer radar and aircraft position	115 V ac, 60 Hz	Records radar picture as well as sensor data
2. Oscillograph, strip chart	Honeywell, 1012 Hieland Division	160 in. (max.)	24		115 V ac, 400 Hz, 28 V dc	Used as an option to the magnetic tape
3. Multiplexed data PAM/FM telemetry transmitter	Sierra Research Model 6622	40 Hz, 400 Hz, or 40 kHz clock	14	Sensors and aircraft position	115 V ac, 60 Hz, 12 V dc	Used in conjunction with the ground-based radar and telemetry receiving station (portable)

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9-10-70
REVISED

FACILITY: Desert Research Institute
University of Nevada (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	B-26	N4204A (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. Rate of climb			0 to 10 m/sec	± 1%	> 1 sec	#1, 2, 3	12 V dc	
H. Time	Tuning fork	Hornig Variometer Accutron	1 sec, 1 min, 1 hr	± 0.3 sec		#1, 2, 3	Battery	
I. Angle of attack	Vane torque transmitter	Cornell Aeronautic Laboratories	± 45 min	± 0.1%		Analog computer	115 V dc, 400 Hz	
J. Vertical accelerometer	Force coil	Kistter Instruments Model 305T	± 5 *g*	± 0.5 full scale	0.001 sec	Analog computer		
K. Turbulence	Pressure transducer	Meteorology Research, Inc. Model 1120	0 to 10 units	± 10%	3 ± 0.5 sec	#1, 2, 3	28 V dc	
L. Potential gradient	Field mill (rotating)	Meteorology Research, Inc. Model 619	0 to ± 100 kV/m	± 10%		#1, 2, 3	115 V ac, 60 Hz	Calibration flight planned late 1970

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
Position plotter X-Y ground reference	Hewlett-Packard 7005	Variable	X-Y	Vortac DME X-Y	115 V ac, 60 Hz	Gives continuous plot of aircraft path on maps
Position display X-Y radar and A/C track	Tektronix 611 CRT display			Vortac DME X-Y and radar	115 V ac, 60 Hz	Superimposes the signal from the aircraft, now earth-referenced, on a ground map and the aircraft path trace
Time-lapse camera pictures of storage scope	Bolex H16M	1/min		Scope 611	28 V dc, 115 VA, 60 Hz	Record of storage scope

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9-10-70
REVISED

FACILITY: Desert Research Institute
University of Nevada (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	B-26	N4204A (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
M. Ice nucleus counter	Photoelectric cell	Meteorology Research, Inc. Model 1511	0 to 10,000/ℓ			Nixie tube display	28 V dc	
N. Particle sampler	Continuous precoated Formvar technique	Developed in-house	0 to 400 μ			Film record	115 V ac, 60 Hz, 28 V dc	
O. X-Band radar	Weather radar	Bendix RDR-1	0 to 100 mi				Ground-referenced storage scope	
P. Pyrotechnic dispenser	Rack	Developed in-house	24 flares					
Q. Chaff dispenser		Developed in-house						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9-10-70
REVISED

FACILITY: Desert Research Institute
University of Nevada (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	B-26	N4204A (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

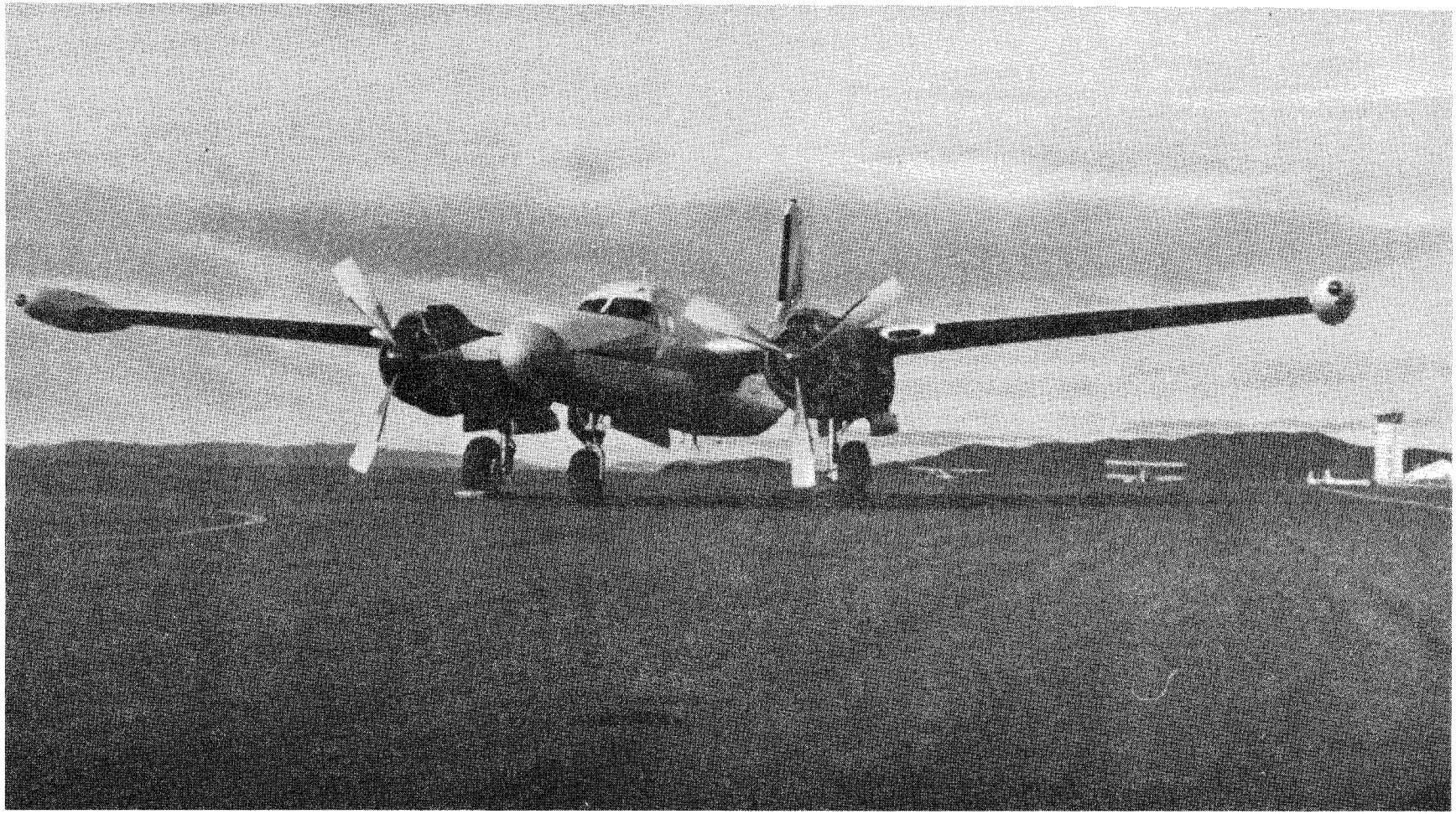
AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
R. X-Y plotter	DME Vortac-Sin-Cos computer	Developed in-house		± 5% @ 80 mi	5 sec	Hewlett-Packard X-Y plotter and magnetic tape	115 V ac, 60 Hz	
COMPUTED DATA								
A. True airspeed	Analog computer built in-house	"	100 to 350 kt	< 1%	< 1 sec	#1, 2, 3	115 V ac, 60 Hz, or 115 V ac, 400 Hz	Installed and calibrated
B. True static temperature	"	"	-80 to + 20°C	"	"	"		
C. Mach number	"	"	0 to 0.5	"	"	"	115 V ac, 60 Hz, or 115 V ac, 400 Hz	Installed and calibrated

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS



Desert Research Institute's B-26 research aircraft.

THE PENNSYLVANIA STATE UNIVERSITY
College of Earth and Mineral Sciences
Department of Meteorology
503 Deike Building
University Park, Pennsylvania 16802

Source: Charles L. Hosler, Dean

Date: 8/27/70

PROJECT SUMMARY

1. An Investigation of the Dynamics and Microphysics of Clouds: Aircraft and surface networks are employed to obtain coordinated observations of the microphysics, dynamics, and environmental properties of shower situations which are compared to numerical models of precipitation processes. Definitive experiments are being performed, both in the field and laboratory, to aid in the assessment of the consequences of artificial modification of clouds. Data derived from these programs are ultimately used to relate changes in the formation of precipitation as predicted by numerical calculations.

2. Atmospheric Turbulence: The properties and structure of atmospheric turbulence are being studied with data obtained from measurement programs utilizing tower and aircraft instrumentation.

INSTRUMENTATION SUMMARY

The Aero Commander 680E is equipped with a complete cloud physics instrumentation package. The instrument sensors primarily associated with in-cloud measurements are mounted in a removable pod under the right wing. The sensors for standard meteorological measurements are fuselage-mounted to increase the operational flexibility of the aircraft. An identical pod under the left wing may be set up to carry two types of pyrotechnic seeding devices

or a continuous gelatin cloud-particle sampler. The removable sampling tube for the high-speed hydrometeor sampler projects through the roof of the fuselage. The camera is mounted at the rear of the cabin. Cabinets containing the data acquisition system and sensor signal conditioning electronics are mounted to the floor behind the copilot position. The data system is equipped with a crystal-controlled time base, programable gain and format switching, plus various event marks and manual data entries. Systems programming has been developed for the PSU IBM 360/67 computer to automatically reduce and output the data in various user-selectable formats.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4/12/65
REVISED	8/27/70

FACILITY: The Pennsylvania State University
Department of Meteorology

ADDRESS: 503 Deike Building
University Park, Pennsylvania 16802

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Microphysics and Dynamics of Clouds: R.L. Lavoie, J. Pena, R. Pena, C.L. Hosler (NSF) 2. Atmospheric Turbulence: J.A. Dutton, H.A. Panofsky, A.K. Blackadar (USAF,NSF)	Aero Commander 680E

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Digital computer	IBM 360/67	Cards, magnetic and punched tape, disc pack	Same as imput plus high-speed printer, Calcomp 564 plotter and IBM 2250 CRT display	Remote job entry (RJE) available. MVT operating system under HASP expected to be operational early in 1970
Digital computer	IBM 1401	Cards, magnetic tape	Cards, magnetic tape, printer	
Hybrid computer	EAI 680 plus DEC PDP 10/40 w/EAI 693 interface	Analog tape, punched tape, key-board, dectape	Same as input plus X-Y plotter and CRT display	Time sharing Fortran available on PDP 10/40

SPECIAL FACILITIES

Three M-33 radar systems with 403 MHz and ATC transponder capability.
APQ-13 radar system.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4/12/65
REVISED	8/27/70

FACILITY: The Pennsylvania State University (continued) ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Graphic digitizer	Calma 302	Analog graphs, strip charts	7-track BCD magnetic tape of readings taken every 0.01 in.	Serial-to-parallel conversion of multi-channel strip charts software available
Analog digital computer	Universal Comptronics, Inc.	± 1.41 V dc analog single channel	Three digits + sign on punched paper or 7-track magnetic tape	Designed for use with Ampex SP-300 recorder; maximum scan rate using magnetic tape output: 70 scans/sec.

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4/12/65
REVISED	8/27/70

FACILITY: The Pennsylvania State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Aero Commander 680E	6297B	200 mph @ 10,000 ft	25,000 ft	900 stat. @ rated speed	University Park Airport	All year	Pennsylvania State University

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Microphysics and Dynamics of Clouds: R. L. Lavoie, J. Pena, R. Pena, C. L. Hosler
2. Atmospheric Turbulence: J. A. Dutton, H. A. Panofsky, A. K. Blackadar

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR, DME, ADF, transponders (ATC and 403 MHz). Doppler radar
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 200 A maximum; 115 V ac, 60 Hz, 750 VA; 115 V ac, 400 Hz, 670 VA;

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Static Pressure	Capacitive pressure transducer	Rosemount Engr. Co. 830 BA	1034 to 300 mb	± 1 mb	20 msec	#1	28 V dc, 0.1 A	
B. Total temperature	Platinum resistance with linear bridge network	Rosemount Engr. Co. 102DL2U	-40 to +40°C	± 0.1°C	5 sec	"		De-iced
C. Total temperature	Butt-welded thermocouple reverse-flow housing	Developed in-house	-40 to +40°C	± 0.5°C	0.1 sec	"	115 V ac, 60 Hz	Electronic reference junction
D. Wet bulb depression	Dry/wet bulb thermopile referenced together	Developed in-house	0 to 20°C	≃ 0.05°C	0.1 sec	"	115 V ac, 60 Hz	
E. Dew point	Thermoelectric hygrometer	Cambridge Systems 137-C3-S3-P	-50 to +50°C	± 0.5°C above 0°C, ± 1.0°C below 0°C	3°C/sec	"	115 V ac, 60 Hz, 20 W	
F. Differential pressure (indicated airspeed)	Capacitive pressure transducer	Rosemount Engr. Co. 831A4	0 to 1 psid 0 to 237 mph	± 0.35 mph	25 msec	"	28 V dc, 0.05 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital data acquisition system	CEC Model 123.4	0.5 scans/sec to 1 scan/hr	40 analog 5 digital	A-P as required	110 V, 60 Hz, 4.8 A	Digi-Data Model 1457 digital recorder
2. Analog magnetic tape	Ampex SP-300	1-7/8 to 15 in./sec	7	As required	110 V, 60 Hz, 2.7 A	May be used in place of either #1 or 3
3. Oscillograph recorder	Consolidated Electrodynamics Corp. 5-124	1/4 to 64 in./min	18	As required	110 V, 60 Hz, 350 W	May be used in place of either #1 or 2

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4/12/65
REVISED 8/27/70

FACILITY: The Pennsylvania State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Aero Commander 680E	6297B (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. A/C heading	Gyro compass	Sperry Gyroscope Co. C-4	0 to 360°	± 2°	≈ 1 sec	#1	± 15 V dc, 100 mA	Compass synchro output converted to ± 1 V dc sin-cos θ
H. VOR distance	DME receiver	Collins 860-1				"	115 V, 400 Hz, 250 VA	
I. VOR heading	VOR receiver	Collins and ARC	0 to 360°	± 3°		"		Converted to digital input with shaft encoder
J. Ground speed/drift angle	Doppler navigation radar	Singer-General Precision, GPK 1000	0 to 200 kt ± 40°	0.75 kt 0.17° (averaged over 10 n mi)	1 sec	"	115 V, 400 Hz, 425 VA	
K. Liquid water content	Hot wire	Johnson-Williams, Model LWH	0 to 6 gm/m^3		0.65 sec	"	110 V, 400 Hz, 80 W, 28 V dc, 15 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
4. Voice recorder	IBM 224		1		Battery	
5. 35-mm camera	Praktina	Adjustable				Downward-looking
6. 16-mm camera	Bell & Howell Co.					Time-lapse

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4/12/65
REVISED 8/27/70

FACILITY: The Pennsylvania State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Aero Commander 680E	6297B (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
L. Surface or cloud temperature	IR radiometer (8 to 14 μ band) 3° field	Barnes Engr. Co. IT-3	-40 to 65°C	2° (above 0°C) 4° (below 0°C)	0.05 sec or 0.5 sec	#1	110 V ac, 60 Hz, 25 W	Downward-looking
M. Horizontal and vertical electric field components	Field mill	Meteorology Research, Inc.	0 to 100 kV/m			"	110 V ac, 60 Hz, 10 W	
N. Hydrometeor charge	Coaxial Faraday cage	Meteorology Research, Inc.	0 to 1000 pCb/V			"	110 V ac, 60 Hz, 20 W	
O. SO_2 concentration		Sign-X Labs 603D				"	115 V ac, 60 Hz, 0.5 A	
P. Turbulence	Δp transducer, with accelerometer and gyro	Giannini Controls Corp., gust probe	± 120 cm/sec	± 15 cm/sec	0.053 to 26.4 Hz	#1 or 2	28 V dc, 20 W, 110 V, 400 Hz, 30 W	On loan from University of Wisconsin

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4/12/65
REVISED	8/27/70

FACILITY: The Pennsylvania State University (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Aero Commander 680E	6297B (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

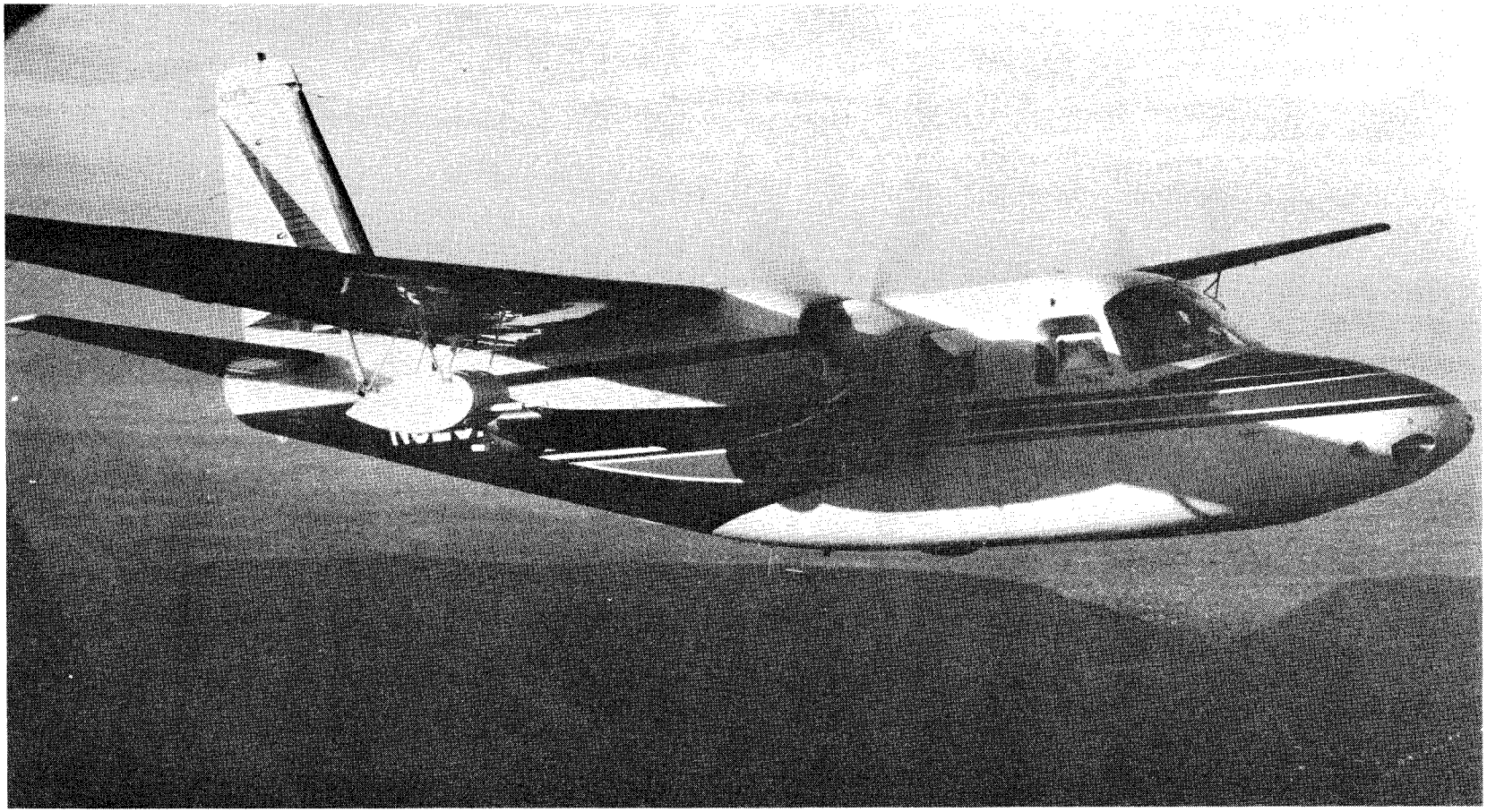
AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
Q. Hydrometeor spectrum	High-speed, rotating-prism motion picture camera, "shadowgraph" principle	Developed in-house	300 μ (min)	< ± 10%, D > 0.7 mm < ± 5%, D > 1.2 mm	0.8 μsec (strobe duration)	Self-recording, event mark on #1	28 V dc, 5 A (max.), 115 V ac, 50 to 400 Hz, 15 W	Uses Fairchild HS-401 camera
R. Cloud particle spectrum	Gelatin coated, continuous 16-mm film sampler	Developed in-house	0 to 1 gm/m^3 cloud liquid water content			Self-recording, event mark on # 1	100 V ac	
S. Aerosol concentration	Cascade impactor	Unico Model 1600-10	1/2 to 20 μ diam in four stages		Determined by desired spectral range	Microscope slide	None	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS



The Pennsylvania State University, Department of Meteorology, Aero Commander 680E.

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
Institute of Atmospheric Sciences
Rapid City, South Dakota

Source: Richard A. Schleusener, Director

Date: 9/10/70

INSTRUMENTATION SUMMARY

The instrumentation on the North American T-28 is used in studies of the physical properties of cumulonimbus clouds and of the mean structure of clouds, including dimensions, updrafts, liquid water content, and ice particle concentration.

A Beech Baron is used to seed cumulus clouds with silver iodide and salt as well as to determine the environmental conditions in the vicinity of the seeding aircraft. Three methods are used for dispersing seeding materials: acetone generators, pyrotechnic flares, and a salt hopper with spreader.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4/12/65
REVISED	9/10/70

FACILITY: South Dakota School of Mines and Technology
Institute of Atmospheric Sciences

ADDRESS: Rapid City, South Dakota

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Cloud Climatology: R. A. Schleusener, J. H. Hirsch 2. Microphysics of Hailstorms (including cloud seeding studies): R. A. Schleusener	North American T-28 Beech A-55 (Baron)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Computer	IBM 1130	Cards, paper tape	Cards/printout	16,000, 3 disk drives
Computer	PDP-8	Analog, paper tape	Paper tape/printout	8,000, 3 magnetic tape, CRT display
Digitizer	Auto-Trol 3600	Strip charts	Cards	X-Y readout

SPECIAL FACILITIES

1. Two dual-wavelength Nike-Ajax radar systems; acquires weather data and tracks aircraft. Five PPI displays; one for 3-cm, time-lapse photography, four for visual study. Four 3-cm radars; two aircraft trackers, one multiple-range gate, one for PPI photography.
2. Two IFF (L-band) radars for aircraft identification.
3. One FPS-6 height finder 10-cm radar with remote display for photography.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9/10/70
REVISED

FACILITY: South Dakota School of Mines and Technology (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	North American T-28	510 MH	240 kt	25,000 ft	850 n mi	Rapid City, S.D.	April-Sept.	SDSM&T

PROJECTS AND PRINCIPAL INVESTIGATOR

Microphysics of Hailstorms: R. A. Schleusener

NAVIGATION SENSORS AND RECORDERS

POSITION: VOR, DME, L-band and X-band transponders

ALTITUDE, HEADING, AIRSPEED: See Instrumentation

AIRCRAFT ELECTRIC POWER	28 V, 200 A generator, 110 V, 400 Hz, 500 W, 110 V, 60 Hz, 500 W, ± 15 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Pressure altitude	Pressure transducer	Ball EX-210-B	-200 to 30,000 ft	± 1%		#1 and 2	28 V dc	
B. Pressure altitude	Pressure transducer	CIC 7000	0 to 30,000 ft	± 100 ft		"	"	MetroData TVH 26
C. Airspeed	Transducer	CIC 7100	0 to 350 kt	± 2 kt		"	"	"
D. Temperature	Thermistor	TS 22	-30 to +30°C	± 0.2°C		"	"	"
E. Rate of climb	Variometer	Ball 101A	-3000 to +6000	± 2%	0.5 sec	"	"	
F. Temperature	Platinum resistance	Rosemount 102	-40 to +80°C	± 0.5°C	0.025 sec	"	"	
G. Liquid water content	Hot wire	Johnson-Williams	0 to 6 gm/m^3	20%	0.5 sec	"	110 V, 400 Hz	2 scales
H. Position	VOR, DME	Aircraft Nav-Aids	0 to 100 n mi			"	28 V dc	MetroData VT21

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape - digital	MetroData DL 620	48 channels/sec	20	All	110 V, 60 Hz	
2. Oscillograph	Consolidated Electrodynamics Corp. 5-124	4 in./min	18	All	110 V, 60 Hz	To be discontinued FY 1971
3. Audio tape	Aiwa	1-7/8 in./sec	2	Intercom, hail impact	9 V dc	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9/10/70
REVISED

FACILITY: South Dakota School of Mines and Technology (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	North American T-28 (cont.)	510 MH						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

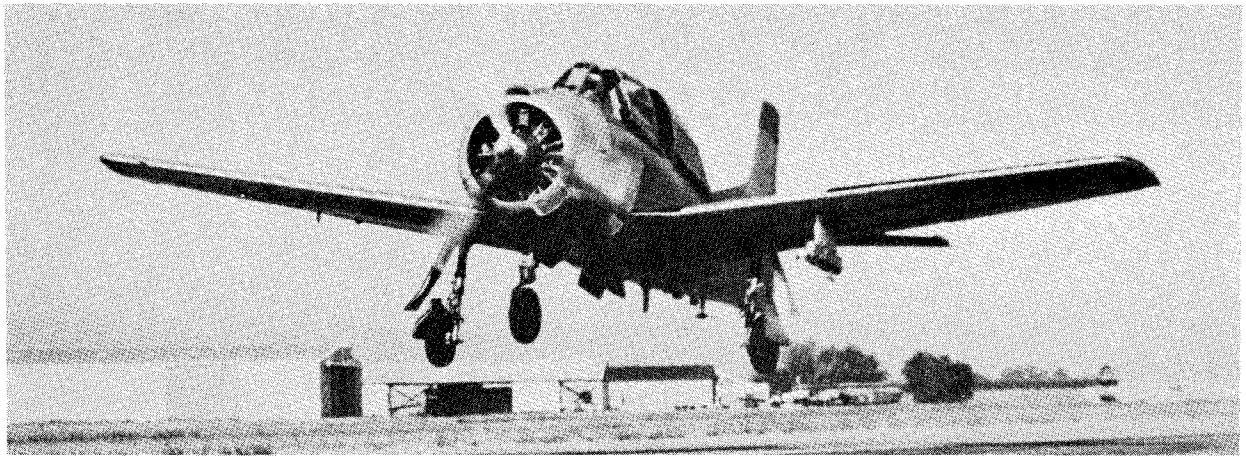
AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

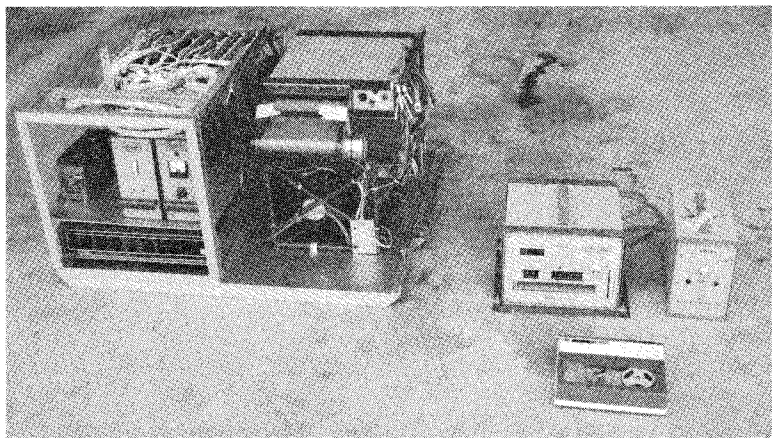
PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
I. Raindrop spectrometer	Piezoelectric force	MetroData RR40	0.35 to > 4 mm		0.42 sec	#1	28 V dc	9 raindrop classes
J. Time	Clock	Bulova Accutron	24 hr			#1	28 V dc	
K. Event-condition	Pulse	MetroData	0 to 9 events			#1 and 2	15 V dc	
L. Spar strain	Strain gage	BLH model SR-4	40,000 to 60,000 psi	± 1%		#2	5 V dc	8 in place on spar
M. Vertical acceleration	Accelerometer	Statham A-45	± 15 *g*			#1 and 2	12 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

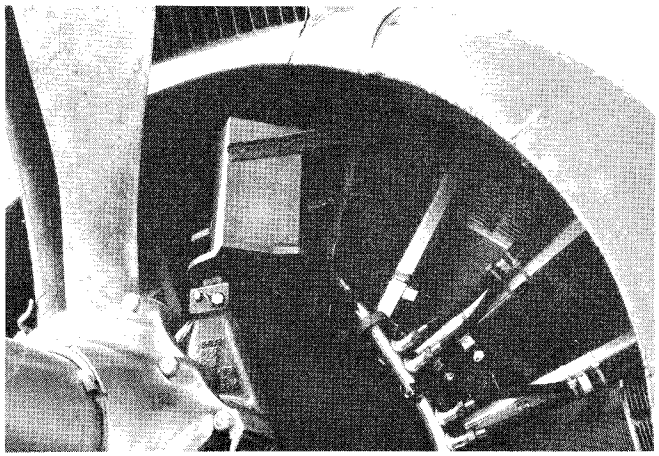
RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS



South Dakota School of Mines and Technology North American T-28.



Instrumentation for T-28.



Protector shields and armor plate on engine and wings enable the T-28 to fly into hailstorms.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4/12/65
REVISED 9/10/70

FACILITY: South Dakota School of Mines & Technology (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beech A-55	107 BA	210 kt	22,000 ft	1000 mi	Rapid City Municipal Airport	May-Aug	Snedigar Flying Service

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Cloud Seeding: A. Koscielski

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR, X-band, L-band, DME transponders
ALTITUDE, HEADING, AIRSPEED	Standard A/C instruments

AIRCRAFT ELECTRIC POWER	24 V, 35 A generators; 110 V, 60 Hz, 500 W

AIRBORNE INSTRUMENTATION

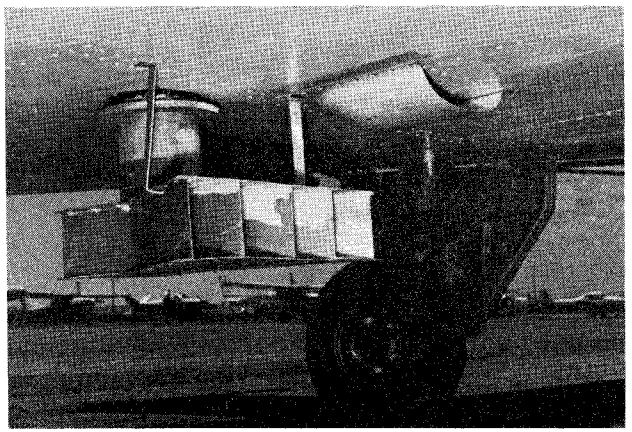
PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Pressure altitude	Altimeter with light follower	Meteorology Research, Inc.	0 to 50,000 ft	Same as A/C altimeter	0.01 sec	#1 and dial	12 V	
B. Rate of climb	Variometer	Crossfell	0 to 30 ft/sec	± 1 ft/sec	0.7 sec	#1 and dial	12 V	
C. True airspeed and turbulence	Universal turbulence indicator	Meteorology Research, Inc.	0 to 200 kt 0 to 10 units	± 1 kt	0.1 sec	#1 and meter	Batteries	
D. Temperature	Thermocouple	Weather Science, Inc.	-30 to +30°C	Sensitivity 5°C/in.	0.1 sec	#1	None	2 scales, reverse flow housing
E. Wet bulb depression	Thermopile	Weather Science, Inc.	0 to 12°C	0.05°C	0.2 sec	#1	None	Reverse flow housing
F. Manifold pressure	Pressure transducer	Humphrey, Inc.	0 to 15 psi			#1 and dial	5 V dc	
G. Cloud seeding	Silver iodide flares and burners	Lohse-Wilson						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Oscillograph	Consolidated Electro-dynamics Corp. 5-124	1/4 to 64 in./min	18	All	110 V, 60 Hz	
2. Audio tape recorder	Concord	1-7/8 to 3-3/4 variable	1	Intercom, events	9 V dc	Voice actuated
3. Event and condition marker	Weather Science, Inc.				1.5 V dc	Manual; 10-event, 3-condition

South Dakota School of Mines and Technology Beech Baron.

Seeding equipment on Beech Baron includes AgI acetone generators, pyrotechnic flare racks, and salt dispensing systems.



Salt spreader under Beech Baron.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED 7/15/69
REVISED

FACILITY: Natural Resources Research Institute
College of Engineering
University of Wyoming

ADDRESS: P. O. Box 3038, University Station
Laramie, Wyoming 82070

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Investigations of the Modification of Orographic Clouds for the Augmentation of Water Supply. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal. 2. Cloud Physics and Dynamics of Hailstorms on the Higher Plains. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal. 3. Cloud Physics and Dynamics of Hailstorms of Central Alberta. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal. 4. Orographic Cloud Census of the Higher Mountains of Wyoming. Principal investigator: A.H. Auer, Jr.	C45H (modified)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Digital computer	Philco 2000 Model 211	Cards and magnetic tape	Magnetic tape and printout	
Digital computer	SDS Sigma V	Cards and magnetic tape	Magnetic tape and printout	

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 7/15/69
REVISED

FACILITY: Natural Resources Research Institute (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C45H	N-600-UW	175 kt	17,000 ft	800 n mi	Laramie, Wyoming	Winter and Summer	Natural Resources Research Institute

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Investigations of the Modification of Orographic Clouds for the Augmentation of Water Supply. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal.
2. Cloud Physics and Dynamics of Hailstorms on the Higher Plains. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal.
3. Cloud Physics and Dynamics of Hailstorms of Central Alberta. Principal investigators: A.H. Auer, Jr., J.D. Marwitz, and D.L. Veal.

NAVIGATION SENSORS AND RECORDERS

POSITION	Dual VOR and DME, King KNR 660 VOR with Theta Instrument Decitrak converter.
ALTITUDE	Ball Bros. Research Corp. altitude transducer
HEADING	King KPI 550 slave gyro magnetic compass with Decitrak converter.
AIRSPEED	Ball Bros. Research Corp. transducer

AIRCRAFT ELECTRIC POWER	Dual 1100 W, 60 Hz inverters; one 400 Hz inverter.

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Temperature		Rosemount Engr. Co. Model 102 de-iced temperature probe	-50 to +50°C			Digi-Data Model DRS-1420-V-200 magnetic tape stepping recorder		
B. Humidity		Cambridge Systems dew point hygrometer	-50 to +50°C			"		
C. Heading		King KPI 550 slave gyro magnetic compass; Theta Instrument Decitrak decoder	0 to 360°			"		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape	Digi-Data Model DRS-1420-V-200	100 char./sec	20	20		
2. Digital display	Built in-house		20	20		
3. Analog meter display	Built in-house		12	12		
4. Rustrak recorder			12	12		

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 7/15/69
REVISED

FACILITY: Natural Resources Research Institute (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C45H	N-600-UW (cont.)						

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

PROJECTS AND PRINCIPAL INVESTIGATOR

4. Orographic Cloud Census of the Higher Mountains of Wyoming. Principal investigator: A.H. Auer, Jr.

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
D. VOR		King KNR 660 VOR; Theta Instruments Decitrak decoder	0 to 360°			Diti-Data Model DRS-1420-V-200 magnetic tape stepping recorder		
E. DME		King KDM 700 DME and KFS 560 channel selector	0 to 100 n mi			"		
F. Altitude		Ball Bros. Research Corp.	0 to 20,000 ft			"		
G. Indicated airspeed		Ball Bros. Research Corp.	0 to 250 kt			"		
H. Manifold pressure		Computer Instrument Co.	15 to 30 in. Hg			"		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 7/15/69
REVISED

FACILITY: Natural Resources Research Institute (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C45H	N-600-UW (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
I. Vertical acceleration		Giannini Controls Corp.	-3.5 to +3.5 g			Digi-Data Model DRS-1420-V-200 magnetic tape stepping recorder		
J. Time		NRRI	0 to 24 hr			"		
K. Ice nuclei		Bollay Ice Nucleus Counter	1 to 10,000 cm/min			"		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERICS INCORPORATED
4981 East Dakota
Fresno, California 93727

Source: Thomas J. Henderson

Date: 8/27/70

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-3-65
REVISED	8-27-70

FACILITY: Atmospherics Incorporated

ADDRESS: 4981 East Dakota Avenue
Fresno, California 93727

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Project ITREX: Thunderstorm air inflow and precipitation studies involving the use of tracer elements; central Illinois: T. J. Henderson
2. Project Shawnee Hills: Atmospheric data acquisition for precipitation studies over hills of southern Illinois. T. J. Henderson
3. Hail Suppression and Associated Studies, Kenya, Africa: T. J. Henderson
4. Project Air Sample: Nuclei sampling and photographic observation over U.S.: T. J. Henderson

A/C TYPES

Piper Aztec "D" (turbocharged)	(1)
Piper Twin Comanche "B" (turbocharged)	(3)
Piper Twin Comanche "C" (turbocharged)	(2)
Cessna TU-206 (turbocharged)	(1)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

Mobile weather radar facility (50 kW and 200 mi range). Aztec "D" is equipped for all-weather flying and a wide variety of nuclei dispensers, including pyrotechnic devices, explosive bundle drop and dropsonde capabilities. Twin Comanches and Cessna are equipped with wing racks for pyrotechnic seeding.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-3-65
REVISED	8-27-70

FACILITY: Atmospherics Incorporated (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Aztec "D"	178A	140 kt	30,000 ft	600 mi	Fresno, Calif.	All year	Atmospherics, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION Full panel of navigational aids plus appropriate instruments for all-weather flying. Aircraft equipped with turbo-chargers and de-icing equipment.

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	12 V dc, 28 V dc, 117 V ac, 60 Hz, 117 V ac, 400 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Temperature		Atkins Technical, Inc.	-50 to +50°C	2%				
B. Ice nuclei	Cold box	Meteorology Research, Inc.	0 to 10^4/cm^3	10%				
C. Condensation nuclei	Small particle detector	Gardner	0 to 10^7/cm^3	10%				
D.	Silver iodide dispensers	Developed in-house	Several rates					
E.	Dry ice dispensers	Developed in-house	1 to 60 lb/min					
F. Position	Dual omni, ADF, DME	National Aero Corp., Bendix	60 mi	2%				
G. Altitude	Altimeter	Standard A/C						
H. Attitude	Gyro horizon	Standard A/C						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Still cameras	Rolleicord					Both sides of aircraft
2. Movie camera	Kodak K-100 Bollex Model H-16	16 to 48 ft/sec plus time lapse				Both sides of aircraft
3. Tape recorder	Concord	3-3/4 in./sec	1	Voice		Observer comments
4. Executary	IBM		1	Voice		Observer comments

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-3-65
REVISED	8-27-70

FACILITY: Atmospherics Incorporated (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Aztec "D"	178A (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
I. Heading	Gyro compass	Standard A/C						
J. Time	8-day clock, recording stop watch	"						
K. Vertical speed	Inertial vertical speed indicator	"	0 to 6000 ft/min					
L. Liquid water content		Johnson-Williams Model LWH	0 to 6 gm/m^3				117 V ac, 400 Hz, 12 V dc	
M. Hydrometeor sampling	Continuous hydrometeor foil impactor	Meteorology Research, Inc. Model 1220					28 V dc	
N. Temperature ΔT $(T - T_w)$	Electronic psychrometer	MEE Industries Model 501		± 2% RH			115 V, 60 Hz or 12 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-3-65
REVISED	8-27-70

FACILITY: Atmospherics Incorporated (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Aztec "D"	178A (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
O. Ice nuclei	Acoustical counter	E. Bollay Assoc.					115 V, 60 Hz	
P. Condensation nuclei	Small particle detector (continuous)	Environment One	$10^3 - 10^5$ nuclei/cm^3				115 V, 60 Hz	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

BATTELLE MEMORIAL INSTITUTE
Battelle-Northwest Division
P. O. Box 999
Richland, Washington 99352

(Operator of Hanford Laboratories for the U.S. Atomic Energy Commission)

Source: C. L. Simpson, Manager
Atmospheric Resources Department

Date: 8/31/70

PROJECT SUMMARY

The Atmospheric Resources Department, Environmental and Life Sciences Division, at Hanford is engaged in research designed to provide a better understanding of the fundamental nature of: diffusion, transport, and deposition of airborne pollutant material; removal of airborne material by precipitation processes and; turbulent character of the atmosphere. These studies are being conducted on the Hanford Reservation and at other off-site locations. Aircraft are used to extend and supplement ground-based instrumentation grids and atmospheric parameter measurement systems.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-12-65
REVISED	8-31-70

FACILITY: Battelle Memorial Institute
Pacific Northwest Laboratory
(Hanford Laboratories for AEC)

ADDRESS: P. O. Box 999
Richland, Washington 99352

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Radioactive Fallout Rates and Mechanisms: L. C. Schwendiman 2. Atmosphere Diffusion, Deposition, and Transport: C. E. Elderkin 3. Atmospheric Scavenging Processes: W. G. N. Slinn 4. Atmospheric Turbulence: C. E. Elderkin	Cessna-01A (L-19) Various rental aircraft (typical: Cessna 172)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Rankin counter	Developed in-house		Digital visual display	Used to analyze filters
Digital computer	Univac 1108 SEL 840A			
Magnetic tape recorder	Ampex FR 1300	Sensor signals plus control data	To analog and hybrid computer	
Digital tape recorder	MetroData Systems, Inc. DL620A	Sensor signals plus control data	To digital computer (SEL 840A)	

SPECIAL FACILITIES

Two ground-based atmospheric diffusion grids extending to 16 mi. Both time-integrated and real-time diffusion data may be developed.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-12-65
REVISED	8-31-70

FACILITY: Battelle Memorial Institute
Pacific Northwest Laboratory (continued)

ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Analog and hybrid computer facilities		Sensor data	Processed data	There are several analog/hybrid computers available that may be used in various combinations to process large volumes of sensor data

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4-12-65
REVISED 8-31-70

FACILITY: Battelle Memorial Institute (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Cessna-01A (L19)	3302T	90 kt	10,000 ft	300 mi	Richland Airport	All year	U.S. Atomic Energy Commission

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Environmental Studies and Evaluation: W. C. Horton
2. Fallout Phenomenology: C. E. Elderkin
3. Atmospheric Diffusion: C. E. Elderkin
4. Precipitation Scavenging: W. G. N. Slinn
5. Atmospheric Turbulence: C. E. Elderkin

NAVIGATION SENSORS AND RECORDERS

POSITION: Visual navigation over prescribed patterns
ALTITUDE:
HEADING: A/C instruments
AIRSPEED:

AIRCRAFT ELECTRIC POWER	12 V, 12 V dc (both convertible to 115 V ac)

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
Project No. 1								
A. Radiation	Scintillator (5 × 3 in. NaI crystal)	Developed in-house	0 to 10^4, 10^5, 10^6 counts/min	Sensitivity: 0.5 μc I_{131}/m^2 on ground		#1	12 V battery	120° cone of response
Project Nos. 2 and 3								
B. Fluorescent particles	Atomatic bulk sampler	"	1 to 10 μ particles				115 V ac	In development
C. Fluorescent particles	Real-time sampler	"	1 to 10 μ particles				115 V ac	
Project No. 4								
Turbulence	Air motion	"					12 V dc	In development
Project No. 5								
Infrared temperature measurements	Remote sensing	Barnes Engr. Co.						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Strip chart recorder	Esterline-Angus Instrument Co.	Adjustable		A	Spring-driven	
2 & 3. Strip chart recorder	Texas Instruments, Inc.	"			115 V ac	
4 & 5. Magnetic tape	Ampex FR 1300	"			115 V ac	

FLIGHT TEST RESEARCH, INC.
2680 East Wardlow Road
Long Beach, California 90807

DATE: 11/5/69

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	11-5-69
REVISED	

FACILITY: Flight Test Research, Inc. **ADDRESS:** 2680 East Wardlow Road, Long Beach, California 90807

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	T-33 (4)	N156X N157X N109X N144M	390 KCAS	45,000 ft	1300 n mi	Long Beach, California	All year	Flight Test Research, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

These aircraft are available for research application under contract.

Instrumentation payload capability is approximately 1500 lb.

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR, DME, ADF transponder (4096)
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 400 A, 750 VA, 115 V, 3-phase (400 Hz), 250 VA, 115 V, 3-phase (400 Hz)

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	11-5-69
REVISED	

FACILITY: Flight Test Research, Inc. (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	F-86	N186F	440 KCAS	50,000 ft +	1250 n mi	Long Beach, California	All year	Flight Test Research, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

This aircraft is available for research application under contract.
Instrumentation payload capability is approximately 1500 lb.

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR, DME, ADF transponder (4096)
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 400 A 1500 VA, 115 V, 1-phase (400 Hz), 115 VA, 3-phase (400 Hz)

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
NCAR Research Aviation Facility
1420 30th Street
Boulder, Colorado 80302

Source: John W. Hinkelman, Jr., Manager

Date: 4/1/70

The NCAR Research Aviation Facility is an operating element within the Facilities Laboratory of the National Center for Atmospheric Research whose purpose is to provide:

1. An operating flight group designed to support the internal needs of NCAR programs and the expanding needs of the scientific community in general.

2. A systematic exchange within the scientific community of information concerning the aircraft and instrumentation being used in atmospheric research, and assistance in arranging for the cooperative use of available aircraft flight time and payload space.

3. Technical assistance to the scientific community in developing aircraft instrumentation and data recording/reduction systems.

4. Liaison between the scientific community and federal regulatory bodies (such as FAA and FCC) emphasizing the needs of scientists in a time of growing restrictions on airspace and frequency usage.

5. Cooperative training programs providing a locale and facilities for summer programs in which graduate students in the atmospheric sciences may participate.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility

ADDRESS: 1420 30th Street
Boulder, Colorado 80302

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beechcraft Queen Air A80	304D	175 kt @10,000 ft	29,000 ft	1050 n mi @ stated speed	Jefferson County Airport	All year	NCAR

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR; DME; ADF; transponder; doppler radar
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 125 A or 115 V, 60 Hz, 1000 VA; and 115 V, 400 Hz, 1-phase, 100 VA; and 28 V dc, 45 A or combination

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Air temperature	Platinum-reverse	Minco Products, Inc.	-60 to +40°C	± 0.5°C	0.1 sec	* ARIS		* Aircraft Research Instrumentation System
B. Air temperature	Total temperature	Rosemount Engr. Co.	-70 to +30°C	± 0.5°C	0.1 sec	"	28 V dc	
C. Dew point	Thermoelectric hygrometer	Bendix Corp.	-50 to +50°C	± 2°C @ -50°C	2 sec @ +30°C 10 sec @ -50°C	"	115 V, 400 Hz	
D. Wet bulb temperature	Wick type	Trans-sonics, Inc.	0 to +25°C	undetermined	Est. 2-5 sec	"		
E. Liquid water content	Hot wire	Johnson-Williams	0 to 5 gm/m^3	± 20%	0.1 sec	"	115 V, 400 Hz	
F. Pressure altitude	Servo altitude	Bulova Watch Co.	0 to 65,000 ft	50 ft @ 40,000 ft	0.5 sec	"	115 V, 400 Hz, 28 V dc	
G. Pressure altitude	Variable reluctance transducer	Pace Engr. Co.	1100 to 300 mb	± 4 mb	0.5 sec	"	115 V, 400 Hz	
H. Airspeed	Variable reluctance transducer	Pace Engr. Co.	0 to 300 kt	± 1 kt	0.5 sec	"	115 V, 400 Hz	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Oscillograph recorder	Consolidated Electro-dynamics Corp. 5-124	0.25, 1, 4, 16, 64 in./min	18	As required	115 V, 60 Hz, 350 VA; 28 V dc, 7 A	
2. Oscillograph recorder	Century Electronics & Instrument Div. 444	0.1, 0.5, 1, 5 in./min	6	As required	28 V dc, 6 A	
3. Audio recorder	Uher 4000 S (Germany)	Voice actuated	1	Voice	Battery	
4. Rustrak recorder	Rustrak Instrument Co. #91		2		115 V, 60 Hz	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beechcraft Queen Air A80	304D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
I. Radiation thermometer	PRT-5	Barnes Engr. Co. #127	-50 to +50°C	± 0.5°C		ARIS	115 V, 60 Hz or battery	
J. Ground speed	APN-153 doppler radar	Singer-General Precision Co.	0 to 999 kt	undetermined		"	115 V, 400 Hz, 28 V dc	
K. Drift angle	APN-153 doppler radar	Singer-General Precision Co.	0 to 40°	undetermined		"	115 V, 400 Hz, 28 V dc	
L. Heading	C-4 repeater	Sperry Gyroscope Co.	360°	± 4°		"		
M. Heading	N-1 compass system	Sperry Gyroscope Co.	360°	± 1°		"	115 V, 400 Hz, 3-phase	
N. Longitude and latitude	ASN-41 navigational computer	Singer-General Precision Co.					115 V, 400 Hz	
O. Radar altitude	APN-22	Raytheon Mfg. Co.	0 to 10,000 ft	± 5%		ARIS	115 V, 400 Hz, 28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
5. Magnetic tape recorder (ARIS)	Developed in-house	1-7/8 to 60 in./sec	45 analog, 145 digital, 1 voice	As required	28 V dc, < 10 A	
6. Oscillograph recorders (2)	Consolidated Electrodynamics Corp. 5-124	0.24 in./sec	36 possible, 11 used	S-U	115 V, 60 Hz	5 channels: 0 to 5000 Hz/sec, 6 channels: 0 to 180 Hz/sec
7. Oscilloscope	California Instrument Corp.	Variable	7	V-X	110 V, 60 Hz	One used at a time

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beechcraft Queen Air A80	304D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
P. Radar altitude	APN-155	Radio Corp. of America	0 to 5000 ft			ARIS	115 V, 400 Hz, 28 V dc	
Q. Weather radar	AVQ-55 X band	Radio Corp. of America	0 to 45 mi			0 to 15 camera		
R. Weather radar	APS-113 Ku band	Bendix Corp. RDR-100	0 to 40 mi			0 to 15 camera	115 V, 400 Hz	
S. Camera	16-mm time lapse	Giannini Controls Corp. Scientific #111B					28 V dc	
T. Camera	35-mm time lapse	Automax #G-1					"	
U. Camera control	Intervalometer	Developed in-house	1, 2, 4, 8, 16, 30, 60 ft/min				"	
V. Precipitation particle sampler	Lead foil	University of Chicago	150-1000 μ diam				"	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
8. Oscilloscope	Developed in-house	Variable	6	V-X	110 V, 60 Hz	
9. Strip chart recorder	Westronics		1	DD, EE	115 V, 60 Hz, 50 W	
10. 16-mm time-lapse cameras (2)		1 ft/sec	100 ft rolls	Cloud pictures	28 V dc	Forward- and side-looking
11. 16-mm time-lapse cameras (2)		1 ft/sec, 1 ft/4 sec				

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beechcraft Queen Air A80	304D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
W. Precipitation particle sampler		Developed in-house						
X. Incident and reflected light	Fiber Optics pyranometers	The Eppley Laboratory, Inc. Model #2	-30 to +30°C					
Y. Air sampling intakes		Developed in-house	30 ft^3/min					
Z. Time								
1. Nose boom								
2. Chemical dispenser								
3. Dropsonde dispenser	Chute tupe	Developed in-house						
4. Communication	FM air to ground	Airtron	50 mi				115 V, 60 Hz, 12 V dc	
5. Communication	HF radio	Collins Radio Corp.					115 V, 60 Hz	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

NCAR's Queen Air A80 N304D.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabreliner	307D	430 kt	45,000 ft	1400 n mi	Jefferson County Airport	All year	NCAR

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION: VOR; DME; ADF; transponder; doppler radar

ALTITUDE:

HEADING: Standard A/C instruments

AIRSPEED:

AIRCRAFT ELECTRIC POWER	100 A, 28 V dc, 2500 VA, 1-phase 400 Hz, 115 V ac, 750 VA, 3-phase, 400 Hz, 115 V ac (wye or delta), 2000 VA, 1-phase, 60 Hz, 115 V ac

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Air temperature	Total temperature	Rosemount Engr. Co.	-70 to +30°C	± 0.5°C	0.1 sec	ARIS	28 V dc	
B. Dew point	Thermoelectric hygrometer	Cambridge Instruments, Inc.	-50 to +50°C	± 1°C	3°C/sec	"	115 V, 400 Hz	
C. Pressure altitude	Servo altitude	Bulova Watch Co.	0 to 65,000 ft	50 ft @ 40,000 ft	0.5 sec	"	115 V, 400 Hz, 28 V dc	
D. Pressure altitude	Variable reluctance transducer	Pace Engr. Co.	1100 to 50 mb	± 4 mb	0.5 sec	"	115 V, 400 Hz	
E. Airspeed	Variable reluctance transducer	Pace Engr. Co.	0 to 450 kt	± 1 kt	0.5 sec	"	115 V, 400 Hz	
F. Ground speed	APN-153 doppler radar	Singer-General Precision Co.	0 to 999 kt	undetermined		"	115 V, 400 Hz, 28 V dc	
G. Drift angle	APN-153 doppler radar	Singer-General Precision Co.	0 to 40°	undetermined		"	115 V, 400 Hz, 28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape recorder (ARIS)	Developed in-house	1-7/8 to 60 in./sec	45 analog, 145 digital, 1 voice	As required	28 V dc, < 10 A	
2. Strip chart recorder	Hewlett Packard #7100 B		2		115 V, 60 Hz	
3. Rustrak recorder	Rustrak Instrument Co. #91		2		115 V, 60 Hz	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 6-20-65
REVISED 4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabreliner	307D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
H. Longitude and latitude	ASN-41 navigational computer	Singer-General Precision Co.				ARIS	115 V, 400 Hz	
I. Weather radar	AVQ-55 X band	Radio Corp. of America	0 to 45 mi			16-mm time-lapse camera		
J. Weather radar	APS-113 Ku band	Bendix Corp. RDR-100	0 to 40 mi				115 V, 400 Hz, 28 V dc	
K. True airspeed	Computer	Servo Mechanisms, Inc. #ACC 602-1	0 to 1000 kt			ARIS		
L. Camera	16-mm time lapse	Giannini Controls Corp. Scientific #111B					28 V dc	
M. Camera	35-mm time lapse	Automax #G-1					"	
N. Camera control	Intervalometer	Developed in-house	1,2,4,8,16,30, 60 ft/min				"	
O. Time		Developed in-house						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabreliner	307D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
P. Nose boom	Air sampling	North American Rockwell						
Q. Pod-external store	Dropsonde application	Fairchild-Hiller					28 V dc	
R. Communication	FM air to ground	Airtron	50 mi				115 V, 60 Hz, 12 V dc	
S. Communication	HF radio	Collins Radio Corp.					115 V, 60 Hz	
T. Heading	Compass	Sperry Gyroscope Co.	360°	± 0.75°		ARIS		
U. Heading	Compass	Sperry Gyroscope Co.	360°	± 0.75°		ARIS		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

NCAR's North American Rockwell Sabreliner N307D.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	de Havilland Buffalo	326D	200 kt	25,000 ft	1400 n mi	Jefferson County Airport	All year	NCAR

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Mountain Lee Waves
2. Great Lakes Air Mass Modification
3. Eastern Pacific Stratus and Fog
4. Wallops Island
5. Frontal Area and Clear Air Convection

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR; DME; ADF; transponder; doppler radar
ALTITUDE	
HEADING	Standard A/C instruments
AIRSPEED	

AIRCRAFT ELECTRIC POWER	300 A dc or 2500 VA, 3-phase, 400 Hz, 115 VAL (wye), 500 VA, 1-phase, 400 Hz, 115 VAL, 750 VA, 3-phase, 400 Hz, 115 VAL (delta)

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Dew point	Thermoelectric hygrometer	Bendix Corp.	-50 to +50°C	± 2°C @ -50°C	2 sec @ +30°C 10 sec @ -50°C	ARIS	115 V, 400 Hz	
B. Pressure altitude	Variable reluctance transducer	Pace Engr. Co.	1100 to 300 mb	± 4 mb	0.5 sec	"	"	
C. Airspeed	Variable reluctance transducer	Pace Engr. Co.	0 to 300 kt	± 1 kt	0.5 sec	"	"	
D. Ground speed	APN-153 doppler radar	Singer-General Precision Co.	0 to 999 kt	undetermined		"	115 V, 400 Hz, 28 V dc	
E. Drift angle	APN-153 doppler radar	Singer-General Precision Co.	0 to 40°	undetermined		"	115 V, 400 Hz, 28 V dc	
F. Heading	N-1 compass system	Sperry Gyroscope Co.	360°	± 1°		"	115 V, 400 Hz, 3-phase	
G. Radar altitude	APN-22	Raytheon Mfg. Co.	0 to 10,000 ft	± 5%		"	115 V, 400 Hz, 28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape recorder (ARIS II)	Developed in-house	1-7/8 to 60 in./sec	45 analog, 145 digital, 1 voice	As required	28 V dc, < 10 A	Data transfer both to and from computers
2. Magnetic tape recorder, digital	Ampex ATM-13591	75 or 36 in./sec	9 track	Navigational and data processor computers through digital interface	208 V, 400 Hz, 1.025 KVA normal; 1.500 KVA worst case; 1.700 KVA surge-2 ms or less	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	de Havilland Buffalo	326D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
H. Camera	16-mm time lapse	Giannini Controls Corp. Scientific #111B					28 V dc	
I. Time								
J. Nose boom	Research instrumentation	Developed in-house						
K. Air temperature	Platinum resistance total temperature probe	Rosemount Engr. Co. 102E2AL	-100 to +50°C	0.3°C	0.05 sec	ARIS	5 V dc, < 1 A	Mounted on nose boom
L. Air temperature	Tungsten resistance wire	Built in-house	-100 to +50°C	1°C	0.01 sec	"	"	Element is exposed and subject to strain and breakage; mounted on nose boom
M. Attack and sideslip angles	Nonrotating force-sensing vanes	Lockheed	± 8°	0.5°	0.03 sec	"	"	Vanes modified to provide better damping; mounted on nose boom

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
3. Chart recorder	Consolidated Electrodynamics Corp. Model 5-133	0.1 to 16 in./sec	36	Analog and converted digital	105 to 125 V, 60 Hz, 1.05 kW	
4. Digital interface	DRI design and construction	3.8 MHz byte transfer rate (8 bit)	Up to 32 bit words, parallel and serial-byte transfer	Navigational and data processor computers; May-tape recorder	75 W	To be expanded to include analog to digital input

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	6-20-65
REVISED	4-1-70

FACILITY: National Center for Atmospheric Research
NCAR Research Aviation Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	de Havilland Buffalo	326D (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

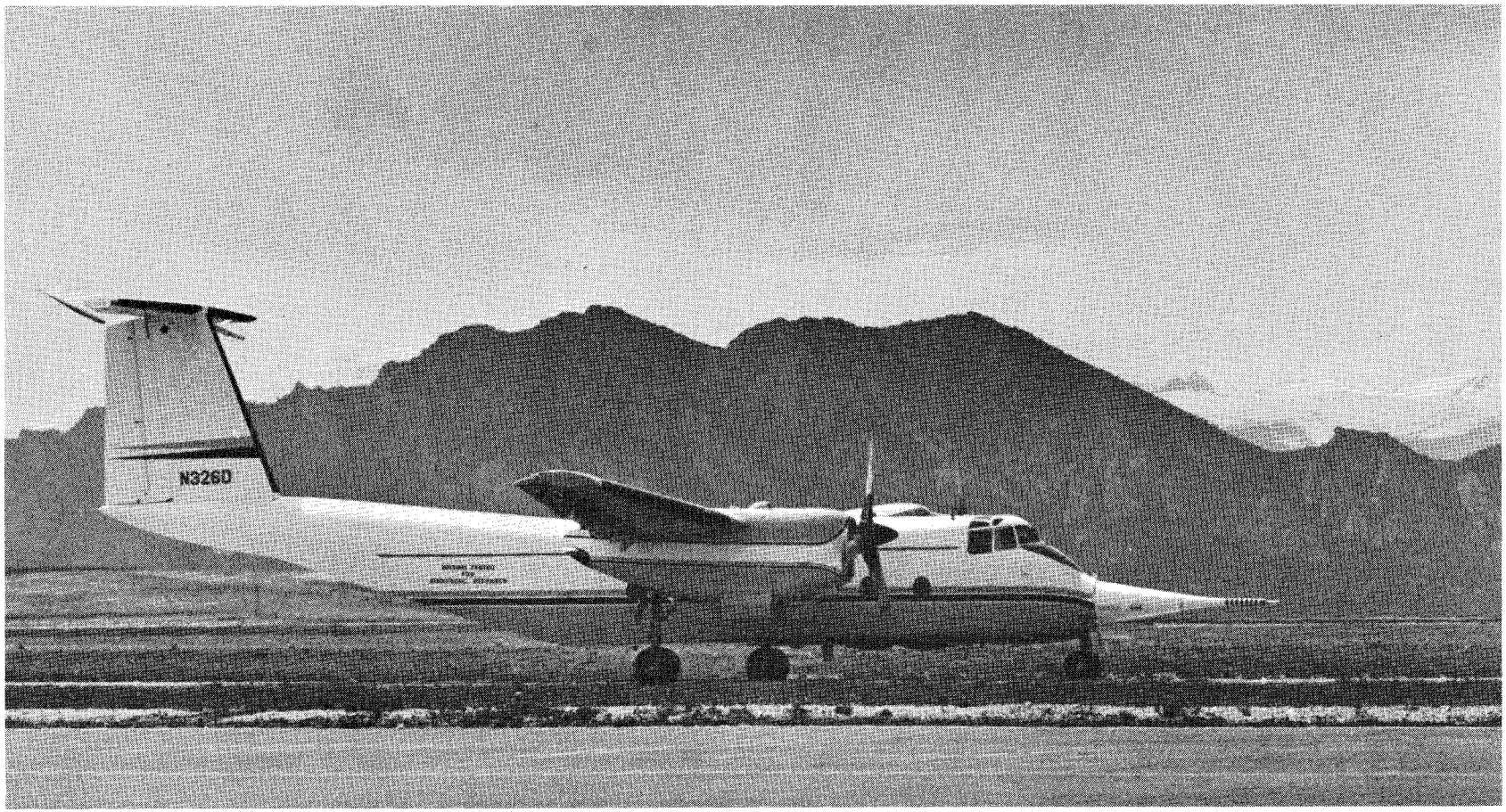
AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
N. Airspeed	Strain gage pressure transducer	Statham	0 to 70 mb	2% full scale	0.02 sec	ARIS	5 V dc, < 1 A	Mounted on nose boom
O. Rate of pressure change	Differential pressure sensor	Ball Bros. Research Corp.	± 3000 ft/min			"	"	Mounted on nose boom
P. Attack angle	Rotating vane	Built in-house	± 10°	0.5	0.03 sec	"	"	Uses a rotary variable differential transformer; mounted on nose boom
Q. Wet bulb depression	Wet and dry thermistor	Built in-house	10°C	0.1°C	0.1 sec	"	"	Temperature difference between two thermistors is measured; mounted on nose boom
R. Airplane attitude angles (pitch, roll and azimuth)	Inertial navigation system	Litton LN-15G	0 to 360°	0.05°				
S. Airplane velocity (along all 3 axes)	Inertial navigation system	Litton LN-15G		10 cm/sec				

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
5. Analog multiplexer to navigational computer	DRI design and construction; software controlled	1 MHz switching rate	8	Baro-altitude; 7 unspecified; all in 0 to 5 V range	0.25 W	



NCAR's de Havilland Buffalo N326D.

NORTH AMERICAN ROCKWELL CORPORATION
Autonetics Division
Sabreliner Project Office
Department 523-31, Building 74
3370 Miraloma Avenue
Anaheim, California 92803

Source: R. L. Gorham
Sabreliner Project Manager
Research & Engineering Division

Date: 12/1/68

PROJECT SUMMARY

1. Gust Loads Instrumentation: The objectives of the program are to develop accurate mathematical descriptions of gust frequencies and amplitudes. This information will in turn be used to develop a suitable transfer function for the aircraft, hopefully suitable for extrapolation to other aircraft.

2. Radar Research (PENRAD); and 3. Laser Development (ALIRATS): Projects 2 and 3 are for the purpose of testing avionics equipment and, in general, require only enough atmospheric data to describe the environment.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division

ADDRESS: 3370 Miraloma Avenue
Anaheim, California 92803

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Gust Loads Instrumentation 2. Radar Research (PENRAD): D. Bushong 3. Laser Development (ALIRATS): C. Weiss	North American Rockwell (NAR) Sabreliner Beech D-18S

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
All North American Rockwell ground facilities are available when required. These include four IBM 360 computers and associated equipment. The processing of film is contracted with various groups in the motion picture industry.				

SPECIAL FACILITIES

1. Ground-based radar is used for aircraft positioning when required.
2. Nearby military installations can be made available for tactical target detections, laser firing, and release of external stores.
3. X-band or Ku-band radomes available and interchangeable.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

4. Removable (or jettison) pod for the installation of precision gimbaled optics systems. The following viewing windows are available for installation in the pod.

   a. Ordinary window glass (green tint)
   b. Window glass (colorless) coated with high-efficiency antireflection coating
   c. Arsenic trisulfide windows.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

5. Four-station external stores racks (manual and automatic release capability).
6. Provisions for installing a 10-in. diam luneberg radar reflector lens, or a 12-in. diam trihedral radar corner reflector are available on the aircraft tail cone.
7. Nose boom (185 in. total, 85 in. removable) 5 pressure transducers, 2 accelerometers.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

8. CO_2 closed circuit cooling system for avionics systems cooling.

9. An inertial navigation system (Autonetics N16) suitable for high-precision, earth-coordinate instrumentation.

NOTE: Items 3-9 apply to the Sabreliner.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabre-liner	N287NA	505 kt	45,000 ft	1800 n mi	Los Angeles California	All year	North American Rockwell Corp.

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Gust Loads Instrumentation
2. Radar Research (PENRAD): D. Bushong
3. Laser Development (ALIRATS): C. Weiss

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR/DME; ground radar when required
ALTITUDE	
HEADING	Standard A/C instruments, radar altimeter
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 400 A each engine; 400 Hz, 10 kVA alternator; 60 Hz, 1 kVA inverter, solid state

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude	Radio altimeter	Honeywell DHG 9050B	0 to 5000 ft	1% ± 5 ft		#3, 4, 9, and 11	100 VA	
B. Airstream direction	Vane	Servomechanisms, Type TR-671	+12°; -15° pitch	1%		#3	26 V ac, 0.4 W	
C. Attitude	Vertical gyro	Kearfott Co., Inc. C70-4101-003	360° roll; ± 80° pitch	± 6 arc min pickoff error		#3 and 5	40 VA	
D. Acceleration 3 axes	Accelerometers	Statham	± 5 g			#11		
E. Structural load	Bonded strain gages at 23 points (total 46 gages)	Developed in-house				#11		
F. Control surface position	Strain gage/beam	Developed in-house				#3		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 70-mm camera	F-95 Vinten (England)	Up to 8 frames/sec		Aircraft positioning	50 VA dc	70-mm; 500 exposures (vertical-pointing)
2. Video recorder with audio (2 in. tape)	Sony Model PV-120U	4.24 in./sec	Video; audio		350 W, 60 Hz	TV or radar video (85 min)
3. Oscillograph	Consolidated Electrodynamics Corp. 5-114-PE or 5-119-P3	Up to 115 in./sec or 100 in./sec	18 or 36 plus dynamic	A, B, I, and as required	600 W dc (max)	7 in. × 200 ft paper or 12 in. × 475 ft paper

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-16-65
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FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabre-liner	N287NA (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. Remote airstream direction	Gust probe	Developed in-house				#3		Located in nose boom
H. Pitch rate	Inertial sensor	Developed in-house				#4		
I. Control surface hinge moments	Strain gages					#3		
J. Angular rate	Rate gyro	Honeywell, Doelcam Division				#3		
K. Flight profile	Flight analyzer	Midwestern						3 channels; airspeed, altitude, vertical acceleration (time based)
L. Angular acceleration	Angular accelerometers	Statham	± 6_2 rad/sec			#11		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
4. Hot-stylus chart recorder	Sanborn Co., Model 299	1 or 10 mm/sec	1 plus correlating	A	50 VA, 60 Hz	
5. Photo panel	Developed in-house			As required		6 parameters
6. 16-mm cameras (5)	Flight Test Research, Inc. Model III-B	Up to 40 frames/sec			50 VA ac, 30 W dc	16-mm, magazine load; cabin displays and photo panel
7. 16-mm camera	Milliken DBM-5P	4, 8, 24 frames/sec			50 W dc	16-mm, 400 ft roll load; forward-pointing

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-16-65
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FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabre-liner	N287NA (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
M. Low ambient light measurement	Dual detectors	Developed in-house	Up to 0.025 ft candles			#6	50 VA ac	Night use only (incident light)
N. Aircraft or sensor pointing	Gunsight	K-14 (modified in-house)					28 V dc	Fixed sight; boresighted as required
O. Audio tone generator	Oscillator 1000 Hz	Developed in-house				#6, 9, and 11 to interphone	28 V dc	VHF and UHF transmission capability
P. Correlation	Electromagnetic counters	Veender-Root	10,000 count @ 1 pulse/sec			#1, 3, 6, 7, 8, 9, 10, 11, and 12	5 VA/counter	In-house timer; pulse generator
Q. Altitude profile	Baro/servo summing circuit	Developed in-house	500 ft from reference			#4	Internal batteries (1.35 V dc plus 28 V dc)	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
8. 35-mm camera	Flight Test Research, Inc.	Up to 40 frames/sec			50 VA ac, 20 W dc	35-mm, 100 ft roll load; oscilloscope displays
9. Digital tape recorder (1 in. tape)	Leach MTR-3200	Up to 60 in./sec	16	As required	80 W dc	Space available in A/C for either digital or FM
10. Oscilloscopes	Tektronix 321, 422, 453		As required	"	50 VA	Installed as required
11. FM/FM tape recorder (1 in. tape)	Leach MTE-3200	Up to 60 in./sec		"	80 W dc	Space available in A/C for either digital or FM

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NAR Sabre-liner	N287NA (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
R. Temperature monitor	Thermocouples	Developed in-house	-50 to +350°C		2 sec/position	#6	100 W ac, 50 W dc	Monitor avionics hardware and/or ambient air
S. Baro altitude	Transducer	Computer Instrument Corp.	0 to 30,000 ft					For systems input (two 100 K pots, one 30 K pot)
T. Indicated airspeed	Transducer	Computer Instrument Corp.	85 to 450 kt					For systems input (2 K pot)
U. Simulated temperature	Calibrated voltage	Developed in-house	0 to 200°F				5 V dc	For systems input
V. Aircraft stick forces	Strain gage instrumented pilot's control wheel	Developed in-house	0 to 100 lb			#3		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
12. TV displays (2)	Sony 5 in. Model PJV-3030			As required	75 W, 60 Hz	Installed in cockpit and test engineer's stations
13. 16-mm camera	Veender-Root 5	200 frames/sec			100 W dc	16-mm, 100 ft roll load; located under left-hand wing tip
14. 2¼ × 3¼ camera	Developed in-house		4 magazines (6 points/mag)	A/C angle of attack	2 to 1.35 V dc batteries	Zero-lift bubble camera

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-16-65
REVISED	12-1-68

FACILITY: North American Rockwell Corporation
Autonetics Division (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Beech D-18S	N5804C	170 kt	10,000 ft*	650 n mi	Los Angeles, California	All year	North American Rockwell Corp.

*15,000 with oxygen

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION	VOR/DME; ground radar when required
ALTITUDE	M-H 9050 radar altimeter and standard A/C instruments
HEADING	
AIRSPEED	

AIRCRAFT ELECTRIC POWER	28 V dc, 100 A each engine; 400 Hz, 115 to 200 V, 3-phase, 1500 VA; 60 Hz, 115 V, 1-phase, 500 VA

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Radiation temperature	K-band radiometer	Developed in-house	77 to 323.5°K	~ 1%	0.1, 0.3, 1, 3 sec (selectable in flight)	#1	115 V, 60 Hz	
B. Visible spectrum radiation	Aerial mapping camera	Maurer P-2	4600 Å, 5400 Å, 6500 Å, and 7900 Å			Self-contained	+28 V dc, 115 V, 400 Hz	Also records aircraft position
C. Visible spectrum radiation	TV (4 cameras multiplexed to recorder)	Panasonic	4600 Å, 5400 Å, and 6400 Å			#2 and 3	115 V, 60 Hz	
D. IR radiation	Thermal mapper	Bendix CCC-1	8 to 14 μsec			Self-contained 70-mm film	+28 V dc, 115 V, 400 Hz, 1-phase	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Strip chart recorder	Sanborn 35	100, 20, 5, and 1 mm/sec (selectable in flight)	2	A	115 V, 60 Hz	
2. Video recorder	Panasonic Video Master		1 video 1 audio	C	"	
3. Video monitor	Panasonic TR205			C	"	

TRAVELERS RESEARCH CORPORATION
Field Facilities Division
250 Constitution Plaza
Hartford, Connecticut 06103

Source: Max F. Scoggins, Director

Date: 9/3/69

PROJECT SUMMARY

1. Connecticut Air Pollution Simulation Model: A program was conducted to verify a previously developed air pollution simulation model in Connecticut. Measurements of sulfur dioxide and suspended particulates were obtained at 30 locations in the state. Two-hour averages of SO_2 data were obtained for 24 hr. Particulates were sampled for 24-hr periods using standard techniques with additional information available from 2-hour paper tape samples. Four mobile samplers on the ground and one aircraft obtained SO_2 data for 8-12 hr periods. Data were collected on 25 days during the period of September 1968 to April 1969.

An instrument package was developed which could be placed in the rear seat of a Cessna 172; the air probe was inserted into the wing root ventilator. The package can be installed in any Cessna 172 in a matter of minutes. It measures and records ambient air temperature, altitude, and SO_2 sulphur dioxide concentrations.

2. The Pilgrim Atomic Power Plant Project: The instrument package was used to measure temperature profiles in order to define the depth of the mixing layer. The SO_2 analyzer was replaced with a Barnes infrared radiometer which was used to map the water temperature of Cape Cod Bay.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	9-4-69
REVISED	

FACILITY: Travelers Research Corporation

ADDRESS: 250 Constitution Plaza
Hartford, Connecticut 06103

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Connecticut Air Pollution Simulation Model: Dr. G. R. Hilst 2. Pilgrim Atomic Power Plant Project: G. F. Collins	Cessna 172

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Strip chart	Beckman Instrumatic 3-channel Model 2550			Can be installed in any Cessna 172 within minutes.

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 9-4-69
REVISED

FACILITY: Travelers Research Corporation (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Cessna 172	Any	120 mph			Hartford, Conn.	All year	Any lesee

PROJECTS AND PRINCIPAL INVESTIGATOR

Connecticut Air Pollution Simulation Model: Dr. G. R. Hilst

Pilgrim Atomic Power Plant Project: G. F. Collins

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	12 V dc, 50 A

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Air temperature	Bead thermistor	Fenwal	-20 to 0°C -10 to +10°C 0 to 20°C 10 to 30°C 20 to 40°C	< 1/2°C	< 1 sec	3-channel Beckman		
B. Altitude	Strain gage pressure sensor	Statham	0 to 1500 ft 0 to 4500 ft	± 10 ft	< 1 sec	"		
C. Sulphur dioxide	Conductivity in H_2O	Sinex	0 to 1 ppm		3 sec	"		
D. Surface temperature		Barnes Engr. Co.	-20 to +15°C -10 to +45°C	± 1°C	30 Hz/sec	"	Total: 15 A 12 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
Strip chart	Beckman Model 2550	3/4 in./hr 1-1/2 in./hr 3 in./hr	3	3	39 VA	Response 1 sec full scale

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED 8-30-70
REVISED

FACILITY: Weather Science, Inc. (WSI)

ADDRESS: P. O. Box FF (1225 West Main)
Norman, Oklahoma 73069

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Raindrop Spectrum Measurements: D. R. Booker (WSI)	Piper Aztec
2. Cloud Physics Studies: D. R. Booker (WSI)	Piper Apache
3. Remote Balloon Launching: L. W. Cooper (WSI)	Piper Twin Comanche
4. Updraft Mapping Studies: L. W. Cooper and J. L. Sutherland (WSI)	Cessna 401
5. Stereophotography	
6. Ice Nucleus Tracer Studies (WSI)	
7. Pyrotechnic Cloud Seeding (WSI)	
8. Warm Cloud Seeding (WSI)	

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Digital computer	Raytheon 703	Punched cards or magnetic tape	Plotter, line printer or tape	Can use either 1/2 in. tape or MetroData Systems, Inc. 1/4 in. tape.
Digital tape recorders and readers	MetroData Systems Inc., Models DL620A and DL622A	Analog or digital signals	1/4 in. magnetic tape gives BCD direct to computer	Completely portable.

SPECIAL FACILITIES

Wide variety of digital and analog data recording and processing equipment.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 8-30-70
REVISED

FACILITY: Weather Science, Inc. (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Aztec	N6272Y	180 kt	30,000 ft	970 n mi	Norman, Okla.	All year	Weather Science, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION MetroData Systems, Inc. Model M8

ALTITUDE Altitude transducers

HEADING MetroData Systems, Inc. Model M8

AIRSPEED Airspeed transducers

AIRCRAFT ELECTRIC POWER	14 V dc, 28 V dc, 115 V ac, 60 Hz, 115 V ac, 400 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude, airspeed, temperature, VOR bearing (2), DME, compass heading, humidity	8-parameter module Signal transducer Standard A/C Gyro stabilized compass Carbon strip	MetroData Systems, Inc. Model M8	0 to 30,000 ft 0 to 350 ft -50 to +50°C 0 to 360° 0 to 100 n mi 0 to 360° 40 to 95%	30 ft 1 kt 0.5°C 1° (M8 only) 0.5 n mi 2° 5%	0.1 sec 0.1 sec 0.5 sec 1 sec " " "	#1 or 2	60 to 400 Hz, 15 W	All 8 variables contained in a single 5 in. module
B. Dew point	Mirror type	Cambridge Systems	-50 to +50°C	0.5°C	"	"	60 Hz, 50 W	
C. Rain rate and size	Impact transducer	MetroData Systems, Inc. Model RR40	0.5 to 7 mm drop size, 0 to 30 in./hr	5%	100 μsec	"	60 to 400 Hz, 25 W	
D. Liquid water content	Hot wire	Johnson-Williams	0 to 6 gm/m^3	10%	< 0.1 sec	"		
E. Ice nuclei	NCAR type	EG&G, Inc.	0 to 1000/ℓ	20%		"	60 Hz, 500 W	
F. Ice rate	Vibrating rod	Rosemount Engr. Co.	0 to 10 gm/m^3	10%	10 sec	"	400 Hz, 40 W	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital tape recorder	MetroData Systems, Inc. Model DL620A	50 channels/ sec	20	Analog or digital	60 to 400 Hz, 35 W	Completely portable, digital clock included
2. Oscillograph	CEC 5-124	1/4 to 64 in./min	18	Analog	60 Hz, 250 W	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 8-30-70
REVISED

FACILITY: Weather Science, Inc. (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Twin Comanche	N8396Y	180 kt	30,000 ft	1230 n mi	Norman, Okla.	All year	Weather Science, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION	MetroData Systems, Inc. Model M8
ALTITUDE	Altitude transducers
HEADING	MetroData Systems, Inc. Model M8
AIRSPEED	Airspeed transducers

AIRCRAFT ELECTRIC POWER	14 V dc, 28 V dc, 115 V ac, 60 Hz, 115 V ac, 400 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude, airspeed, temperature, VOR bearing (2), DME, compass heading, humidity	8-parameter module Signal transducer Standard A/C Gyro stabilized compass Carbon strip	MetroData Systems, Inc. Model M8	0 to 30,000 ft 0 to 350 ft -50 to +50°C 0 to 360° 0 to 100 n mi 0 to 360° 40 to 95%	30 ft 1 kt 0.5°C 1° (M8 only) 0.5 n mi 2° 5%	0.1 sec 0.1 sec 0.5 sec 1 sec " " "	#1 or 2	60 to 400 Hz, 15 W	All 8 modules contained in a single 5 in. module
B. Dew point	Mirror type	Cambridge Systems	-50 to +50°C	0.5°C	"	"	60 Hz, 50 W	
C. Rain rate and size	Impact transducer	MetroData Systems, Inc. RR40	0.5 to 7 mm drop size, 0 to 30 in./hr	5%	100 μsec	"	60 to 400 Hz, 25 W	
D. Liquid water content	Hot wire	Johnson-Williams	0 to 6 gm/m^3	10%	< 0.1 sec	"		
E. Ice rate	Vibrating rod	Rosemount Engr. Co.	0 to 10 gm/m^3	10%	10 sec	"	400 Hz, 40 W	
F. Yaw angle	Pressure sensor	Giannini Controls Corp.	0 to 10°	0.1°	0.01 sec	"	400 Hz, 40 W	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital tape recorder	MetroData Systems, Inc. DL620A	50 channels/sec	20	Analog or digital	60 to 400 Hz, 35 W	Completely portable, digital clock included
2. Oscillograph	CEC 5-124	1/4 to 64 in./min	18	Analog	60 Hz, 250 W	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 8-30-70
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FACILITY: Weather Science, Inc. (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Cessna 401	N3221Q	190 kt	30,000 ft	900 n mi	Inyokern, Calif.	All year	Weather Science, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION	MetroData Systems, Inc. Model VT22, which records VOR bearings and DME
ALTITUDE	Altitude transducers
HEADING	MetroData Systems, Inc. Model CH23
AIRSPEED	Airspeed transducers

AIRCRAFT ELECTRIC POWER	14 V dc, 115 V ac, 60 Hz, 115 V ac, 400 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude, airspeed, temperature, VOR bearing (2), DME, compass heading, humidity	8-parameter module Signal transducer Standard A/C Gyro stabilized compass Carbon strip	MetroData Systems, Inc. Model M8	0 to 30,000 ft 0 to 350 ft -50 to +50°C 0 to 360° 0 to 100 n mi 0 to 360° 40 to 95%	30 ft 1 kt 0.5°C 1° (M8 only) 0.5 n mi 2° 5%	0.1 sec 0.1 sec 0.5 sec 1 sec " " "	#1 or 2	60 to 400 Hz 15 W	All 8 modules contained in a single 5 in. module
B. Dew point	Mirror type	Cambridge Systems	-50 to +50°C	0.5°C	"	"	60 Hz, 50 W	
C. Rain rate and size	Impact transducer	MetroData Systems, Inc. Model RR40	0.5 to 7 mm drop size, 0 to 30 in./hr	5%	100 μsec	"	60 to 400 Hz, 25 W	
D. Liquid water content	Hot wire	Johnson-Williams	0 to 6 gm/m^3	10%	< 0.1 sec	"		
E. Ice nuclei	NCAR type	EG&G, Inc.	0 to 1000/ℓ	20%		"	60 Hz, 500 W	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital tape recorder	MetroData Systems, Inc. DL620A	50 channels/sec	20	Analog or digital	60 to 400 Hz	Completely portable, digital clock included
2. Oscillograph	CEC 5-124	1/4 to 64 in./min	18	Analog	60 Hz, 250 W	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	8-30-70
REVISED	

FACILITY: Weather Science, Inc. (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Piper Apache	N4485P	145 kt	30,000 ft	870 n mi	Norman, Okla.	All year	Weather Science, Inc.

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION	MetroData Systems, Inc. Model M8
ALTITUDE	Altitude transducers
HEADING	MetroData Systems, Inc. Model M8
AIRSPEED	Airspeed transducers

AIRCRAFT ELECTRIC POWER	14 V dc, 115 V ac, 60 Hz 115 V ac, 400 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude, airspeed, temperature, VOR bearing (2), DME, compass heading, humidity	8-parameter module Signal transducer Standard A/C Gyro stabilized compass Carbon strip	MetroData Systems, Inc. Model M8	0 to 30,000 ft 0 to 350 ft -50 to +50°C 0 to 360° 0 to 100 n mi 0 to 360° 40 to 95%	30 ft 1 kt 0.5°C 1° (M8 only) 0.5 n mi 2° 5%	0.1 sec 0.1 sec 0.5 sec 1 sec " " "	#1 or 2	60 to 400 Hz, 15 W	All 8 modules contained in a single 5 in. module
B. Dew point	Mirror type	Cambridge Systems	-50 to +50°C	0.5°C	"	"	60 Hz, 50 W	
C. Rain rate and size	Impact transducer	MetroData Systems, Inc. Model RR40	0.5 to 7 mm drop size, 0 to 30 in./hr	5%	100 μsec	"	60 to 400 Hz, 25 W	
D. Liquid water content	Hot wire	Johnson-Williams	0 to 6 gm/m^3	10%	< 0.1 sec	"		
E. Ice nuclei	NCAR type	EG&G, Inc.	0 to 1000/ℓ	20%		"	60 Hz, 500 W	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Digital tape recorder	MetroData Systems, Inc. Model DL620A	50 channels/sec	20	Analog or digital	60 to 400 Hz, 35 W	Completely portable, digital clock included
2. Oscillograph	CEC 5-124	1/4 to 64 in./min	18	Analog	60 Hz, 250 W	

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: Air Force Cambridge Research Laboratories (AFCRL)

ADDRESS: L. G. Hanscom Field, Bedford, Mass. 01730

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Cloud Physics: R. M. Cunningham 2. Atmospheric Electricity: D. Fitzgerald 3. Weather Modification: R. M. Cunningham 4. Aircraft Met Sensors and Techniques: Lt. Col. J. Church 5. Atmospheric Optics: Dr. R. Fenn 6. Remote Sensing: Dr. R. Williams 7. Optical/IR Effects: H. P. Gauvin 8. Infrared Non-Equilibrium Radiative Mechanisms: A. T. Stair 9. Airborne Ionospheric Studies: Dr. G. J. Gassmann 10. Airborne Ionospheric Observations: Maj. A. H. Sizoo 11. Aurora and Airglow: T. Markham	C-130 A (2) RC-130 A (1) NKC-135 A (2)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Curve digitizer	Edwin Industries Corp. PF10A	Analog charts	Paper tape	*
Tape reader	Metro-Data Systems, Inc. DL622	1/4 in. tape	Reformated data	*
Computer	DECPDP-81	Paper tape teletype	Paper tape teletype	*
Tape recorder	Cipher 70	Reformated data	1/2 in. tape	*

* All outputs can be processed through the AFCRL Computation Center

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL (continued) ADDRESS:

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Digital magnetic tape recorder/reproducer	Ampex TM-7	Digital tape	Digital tape	
Analog 14-channel magnetic tape recorder/reproducer	Ampex CP-100	Digital tape	Reformated tape for computer system	
7-channel 1/4 in. magnetic tape recorder/reproducer	Ampex SP-300	Analog tape	Analog photographic film	
A-D conversion and processing system	Cutler & Hammer	Analog tape	Digital tape	

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: Air Force Cambridge Research Laboratories, Optical Physics Laboratory **ADDRESS:** L. G. Hanscom Field, Bedford, Mass. 01730

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NKC-135A	53120	450 kt	40,000 ft	5,000 n mi	Hanscom Field	All year	USAF (AFSC/ESD)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Optical/IR Effects: H. P. Gauvin
2. Infrared Non-Equilibrium Radiative Mechanisms: A. T. Stair

NAVIGATION SENSORS AND RECORDERS

POSITION	Radar, VOR, TACAN, LORAN Periscopic sextant
ALTITUDE	Radio altimeter, altimeter
HEADING	Compass: M-1, J-4 syst. mag.
AIRSPEED	Indicated airspeed, true airspeed and ground speed

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Solar spectral irradiance	Interferometer spectrometer	AFCRL II - 1	1.3 to 3 μ	-	2 scans/sec	1	115 V, 400 Hz	Liquid N_2 cooled detector; trainable elev. +15 - +80°; resolution element $\Delta\nu \approx 10\ cm^{-1}$.
	"	AFCRL II - 2	3 to 7.5 μ	-	2 scans/sec	"		
B. Atmospheric spectral radiance	"	AFCRL III - 1	1 to 3 μ	-	15 sec/scan	"		Liquid N_2 cooled detector; fixed overhead mount; radiation reference is external liquid N_2 cooled chopper; resolution element $\approx 2\ cm^{-1}$.
		AFCRL III - 2	3 to 5.2 μ	-	"	"		
		AFCRL III - 3	5 to 15 μ	-	"	"		
	"	BLOCK 296/A	0.65 to 1.1 μ	-		"		Trainable elev. +15 -80°
	Radiometer	Utah State University	1 to 2.5 μ		10 sec	"		Narrowband filters
	Radiometer	AFCRL	1 to 2.5 μ		10 sec	"		Narrowband filters
	Multi-filter photometer	Photometrics, Inc.	0.4 to 0.7 μ		2 sec	"		Several narrowband filters

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Recorder magnetic tape	Ampex CP-100	1-7/8, 60 in./sec	14	A and B	115 V, 400 Hz	5 recorders on board
2. Oscilloscope	Tektronix			A and B	115 V, 400 Hz, 28 V dc	6 scopes, various types
3. All-sky camera	Flight Research 16 mm					
4. Timing standard	Astro Data Model 7400 -113				115 V, 400 Hz	Master time reference recorded on CP 100s
5. Time code generator	S.I.R. TCG-24				115 V, 400 Hz	Time code on film

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Atmospheric Optics Laboratory **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	55022	295 kt	35,000 ft	2000 mi	Hanscom Field	All year	USAF (AFSC/ESD)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Atmospheric Optics: Dr. Robert Fenn

NAVIGATION SENSORS AND RECORDERS

POSITION: Radar, TACAN, LORAN, driftmeter, VOR, ADF

ALTITUDE: Altimeter, radio altimeter, radar altimeter

HEADING: Fluxgate compass; magnetic compass

AIRSPEED: Indicated airspeed; true airspeed and ground speed

AIRCRAFT ELECTRIC POWER	110 V, 400 Hz, 110 V, 60 Hz 28 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Total upwelling and downwelling irradiance	Irradiometers	UCSD Vis Lab	5 decade	-	-	1	28 V dc	
B. Terrain radiance	Telephotometer	"	"	-	-	"	28 V dc	
C. Upper and lower hemisphere	2 π scanners	"	"	-	-	"	28 V dc; 115 V ac, 400 Hz	
D. Equilibrium radiance	Equilibrium radiance telephotometer	"	"	-	-		28 V dc; 115 V ac, 400 Hz	
E. Horizontal path function	Horizontal path function telephotometer	"	"	-	-	"	28 V dc	
F. Total scattering coefficient	Integrating nephelometer	"	"	-	-	"	28 V dc; 115 V ac, 60 Hz	
G. Size distribution of atmospheric aerosol particles	Royco system	"	"	-	-	"	115 V ac, 60 Hz	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Magnetic tape datalogger	Honeywell		42		115 V ac, 60 Hz	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Atmospheric Optics Laboratory (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	55022 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
H. Temperature, pressure and relative humidity	AMQ-17 aerograph	Mfgr. #02387	+50 to +90°C 15% to 90% RH 50/1050 mb	-	-	1	115 V ac, 400 Hz, 28 V dc	
I. Humidity	Cambridge dew point hygrometer	Cambridge Systems, Inc. Model 137-C3	-50 to +50°C	-	-	"	115 V ac, 60 Hz	
J. Pressure altitude	Ambient pressure transducer	Bourns, 5 k PN 2004308005	0 to 15 psia	-	-	"	1 V dc	
K. Air velocity	Airspeed tranducer	Bourns, 7.5 k PN 509116-0-5-752	0 to 7.5 psia	-	-	"	1 V dc	
L. Distance of the atmospheric aerosol particles	Goetz aerosol spectrometer	Zimmey Corp. Model F-M SN112	-	-	-	"	115 V ac, 60 Hz	
	Wing tip and Nadir cameras	Automax G-10 Maurer KS-67A Model 24611	35 mm 70 mm	-	-	"	28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Terrestrial Sciences Laboratory **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	RC-130 A	57518	295 kt	28,000 ft	2000 mi	Hanscom Field	All year	USAF(AFSC/ESD)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Remote Sensing: Dr. Richard Williams

NAVIGATION SENSORS AND RECORDERS

POSITION	Radar, TACAN, LORAN, driftmeter, VOR, ADF
ALTITUDE	Altimeter, radio altimeter, radar altimeter
HEADING	Fluxgate compass; magnetic compass
AIRSPEED	Indicated airspeed; true airspeed and ground speed

AIRCRAFT ELECTRIC POWER	110 V, 400 Hz, 110 V, 60 Hz, 28 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Terrain thermal conditions	Infrared scanner	University of Michigan M1A1	3 to 5.5 8 to 14	-	-	1	110 V, 400 Hz	
	Radiometer (IR)	Barnes Engr. Co. PRT-14	8 to 14	-	-	1, 3	110 V, 60 Hz	
B. Terrain visible reflectance	3 aerial cameras KC-1BK-17 1 - lens multispectral		0.4 to 0.9	-	-	-	28 V dc	
C. Terrain ultra-violet reflectance	Conversion kit for infrared scanner	University of Michigan	0.25 to 0.4	-	-	1, 2	110 V, 400 Hz	
D. Photographic control	Gyrostabilized aerial camera mounts	Aeroflex A-28		-	-	-	28 V dc	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 8-Channel tape recorder (70 mm) for infrared scanner	Ampex FR-1300	-	-	-	110 V, 400 Hz	
2. CRT scope camera (70 mm) for infrared scanner	-	-	-	-	110 V, 400 Hz	
3. Dual-pen chart recorder for radiometer	Sanborn	-	-	-	110 V, 60 Hz	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133	295 kt	32,000 ft	2400 mi	Hanscom Field	All year	USAF (AFSC/ESD)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Cloud Physics: R. M. Cunningham
2. Atmospheric Electricity: D. Fitzgerald
3. Weather Modification: R. M. Cunningham
4. Aircraft Met Sensors and Techniques: Lt. Col. J. Church

NAVIGATION SENSORS AND RECORDERS

POSITION RADAR, LORAN, drift meter, VOR, ADF

ALTITUDE Altimeter, radio altimeter, radar altimeter

HEADING Fluxgate compass, magnetic compass

AIRSPEED Indicated airspeed, true airspeed and ground speed

AIRCRAFT ELECTRIC POWER	28 V dc, 115 to 200 V; 400 Hz, 115 V, 60 Hz

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude	Radio altimeter	SCR-718C						
B. Acceleration	Accelerometer	Schaeritz Engr. LSB	± 2 g	Total 0.2% full scale	0.003 sec	1, 2, 3	30 V, 10 MHz	
C. Airspeed	Aerograph	Kollsman KS4	50 to 650 kt			4	130 W dc, 166 VA ac	
D. Airspeed	Diaphram, Co. 1	Pace Engr. Co. CP51	2 psi	1%	0.003 sec	1, 2	28 V, 20 MHz	
E. Bearing	TACAN-direction from station	Lab fabricated adapted to AN/ARN 21	360°	-	-	1, 2		
F. Cloud density	"dc" output of item M	Lab fabricated				1, 3		Presently being constructed
G. Cloud - down	Phototube down view	Lab fabricated				1		
H. Cloud - up	Phototube up view	Lab fabricated				1		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Oscillograph	CEC-5-119P3	0.1 to 1 in./sec	50	B,D,E,F,G,H,J, K,L,S,T,U,V,X, Y,Z,AA,BB,EE, FF,GG,JJ,KK, LL,NN,00	28 V dc 13 A	Other speeds available

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
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FACILITY: AFCRL Meteorology Laboratory (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
I. Conductivity (electric)	Gerdieu tubes	Lab fabricated	2×10^{-14} to 1×10^{-9} A ±			3		Air and small ion content automatic range change being fabricated
J. Distance	TACAN	Lab fabricated adapted to AN/ARN 21	195 n mi			1, 2		
K. Dew point	Mirror, thermoelectric	Cambridge Systems, Inc. 108A	+35 to -35°C	0.5°	4°/sec	1, 2		Range limited by particular installation. Microscope used to view mirror
L. Drift angle	Doppler	GPL, APN 144	± 40°	± 1/2°	> 15 sec	1, 2		
M. Drop size	90° scatter, pulse per drop	Techops, Singco, and lab fabricated	200 μ to 5 mm			3		Being fabricated for left wing pod. Samples 1 m^3/sec

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
2. 1/4 in. magnetic tape digital	Metro-Data Systems, Inc. DL-620A	Continuous: each channel every 0.4 sec	20	B,D,E,J,K,L,T, U,V,X,Y,Z,BB, EE,FF,JJ,KK, NN	35 W, 115 V ac	Can also sample every 10 sec, 1 min, 10 min, 1 hr. Time and refractive index on two channels each

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
N. Drop size and type	Photo of wind screen	Lab fabricated	> 1 mm	approx	1 photo/sec	11, nose		
O. Drop size and type	Single shot lead foil	Lab fabricated	> 150 diam					Foil retained and photographed
P. Drop charge	Induction ring	Cornell Aero, Singco, and lab fabricated	*			3		*Range: 4×10^5 to 2.5×10^9 e per drop > 100 μ diam being fabricated. To be installed in right wing pod.
Q. Electric charge on aircraft	Derived from 2 elec. field mills	Lab fabricated	3×10^{-8} to 2×10^{-4}C		0.01 sec	3		
R. Electric field X, Y, 3	Derived from 4 field mills	Lab fabricated	10 V/m to 5×10^4 V/M			3		
S. Elevator position	Linear, motor transducer operated from a cam	Lab fabricated	± 15°			1, 2		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
3. Analog tape	Ampex AR-200	1-7/8, 60 in./sec	14 track 1 in. tape	B,F,I,M,P,Q,R, T,Z,BB,GG,II, JJ,NN,OO	24 V dc 10 A	
4. Aerograph, analog tape	Kollsman KS-4		7	C,T,V,W,CC, MM,NN	130 W dc, 166 VA ac	
5. Analog tape	Rustrak - A	60 in/hr	1	FF	4 W	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
T. Event rain, snow cloud, etc.	6 manual switches	Lab fabricated				1, 2, 3		
U. Ground speed	Doppler	GPL, APN 144	70 to 1000 Kt	± 0.6% + 1 kt		1, 2		
V. Heading	Fluxgate compass and adaptor	N-1 system and lab fabricated	360°			1, 2		
W. Humidity	Carbon strip	Kollsman KS-4	> 15, > 100%			4	130 W dc, 166 VA ac	Also derived from dew point and refractive index measurement
X. Icing rate	Rotating thin disk	Lab fabricated	> 0.001"/6 sec		~ 6 sec	1, 2		
Y. Liquid water	Paper tape	CSRIO (Australia)	> 0.2 gm/m^3			1, 2		
Z. Liquid water	Hot wire	Johnson Williams	0 to 3 gm/m^3			1, 2, 3		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
6. X-Y tape	Mosley #4		X-Y	DD,FF,JJ	100 V, 60 Hz, 1.2 A	Records an in-flight sonding of refractive index and temperature
7. Analog	HP/7100B		2 + 2 marking pens	*	110 V, 60 Hz, 0.35 A	*Variables to be recorded for in-flight look can be changed depending on requirements of the moment
8. Scope camera	Fairchild 0-15					For use with APS-42 radar

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
AA. Ozone	Chemiluminescent	Regener and lab fabricated	0 to 1000 γ		~ 15 sec	1	28 V, 1 A	
BB. Pitch	Vertical gyro	Kearfott Co., Inc. T 2108	± 82°	± 1/4°	Erecting rate 2-1/2°/min	1, 2, 3	115 V, 400 Hz, 3-phase, 26 V, 400 Hz	
CC. Pressure	Aerograph	Kollsman KS-4	150 to 1060 mb	25 mb		4	130 W dc, 166 VA ac	
DD. Pressure	Diaphram	Pace Engr. Co. CP 51	0 to 15 psi	1%	0.003 sec	6	28 V, 20 mA	
EE. Pressure	Bellows, differential transformer - Sycro	Giannini Control Corp. 55 T9-1	0 to 15 psi course 0.6 psi fine	± 0.01 psi	15 sec full scale	1, 2	0.15 V, 0.1 A, 400 Hz	
FF. Refractive index (microwave)	Refractometer	University of Texas and lab fabricated	0 to 400 N		0.01 sec	1, 2, 7		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
9. Voice tape	Staneil Hoffman R70	15/16 in./sec	4	NN, 2 intercoms, VHF, UHF	60 Hz, 1.5 A	
10. T-11 cameras (3)	Fairchild				28 V, 4 A per camera intermittent	9 x 9 in. photo, left, right, down. Time of exposure recorded on #1.
11. 16-mm cameras (4)	Industrial camera K4DR	Time lapse 1, 3 or 10 sec/frame			28 V, 0.2 A	Left, right, nose, tail. Time of exposure recorded on #1

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
GG. Roll	Vertical gyro	Kearfott Co., Inc. T2108	± 90°	± 1/4°	Erecting rate 2-1/2°/min	1, 2, 3	15 V, 400 Hz 30 26 V, 400 Hz	
HH. Radar return	3 cm radar	AN/APS 42 and Isoecho mod.	5,10,30,100, 200 n mi			8		
II. Sferics	Radio receivers	ARN-6, SR 7-1, and National HRO500	SKHz to 30 MHz			3	115 V, 400 Hz, 2 A	
JJ. Temperature	Large tangential vortex	Lab fabricated Rosemount sensor	+50 to -70°C		~ 0.02 sec	1, 2, 3, 7		Open wire Rosemount sensor # 149AT
KK. Temperature	Total temperature	Rosemount 102 CL2AZ	-70 to +50°C		~ 0.02 sec	1, 2	115 V, 270 W	De-iced type
LL. Temperature	90° flow "DUCT"	Rosemount and lab fabricated	-70 to +50°C		~ 0.02 sec	1	115 V, 400 Hz, 2 A	Sensor Rosemount 1350
MM. Temperature	Reverse flow, thermometer	Kollsman lab modified			~ 1 sec	4		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Meteorology Laboratory (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	C-130 A	533133 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
NN. Time generator	Electronic, crystal control	Hyperion #150	Hr, min, sec	< 1 sec/day		1,2,3,4,7,9	115 V, 60 Hz, 1.4 A	
OO. Time absolute	WWV receiver	Specific Products SR 7-1	WWV frequencies			1,3		Also can record range time

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Ionospheric Physics Laboratory **ADDRESS:** L. G. Hanscom Field, Bedford, Mass. 01731

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NKC-135 A	53131	450 kt	40,000 ft	5,000	Hanscom Field	All year	USAF(AFSC/ESD)

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Airborne Ionospheric Studies: Dr. George J. Gassmann
2. Airborne Ionospheric Observations: Maj. Antoine H. Sizoo
3. Aurora and Airglow: Thomas Markham

NAVIGATION SENSORS AND RECORDERS

POSITION	RADAR, VOR, TACAN, LORAN, periscopic sextant
ALTITUDE	Radio altimeter, altimeter
HEADING	Compass: M-1, J-4 Syst. Mag.
AIRSPEED	Indicated airspeed, true and ground airspeed

AIRCRAFT ELECTRIC POWER	111/5200 V, 400 Hz; 115 V, 60 Hz; 28 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Vertical heights vs frequency	Ionospheric sounder	Granger 3705-1	2.025 to 32 MHz	-	-	1, 2, 3, 4	208 V, 400 Hz, 3-phase	
B. Vertical heights vs frequency	Digisonde	LTIRF 12.8	0.5 to 16 MHz	-	-	2, 3, 4	115 V, 400 Hz, 1-phase	
C. High frequency propagation	High frequency receivers	R-390	0.5 to 30 MHz	-	-	1, 2	115 V, 60 to 400 Hz, 1-phase	
D. Low frequency propagation	LORAN receiver	Lab fabricated	0.1 to 1.9 MHz	-	-	1, 5	"	
E. Very low frequency and low frequency propagation	Loop antennas and receivers	Pickard & Burns	18.6 to 100 KHz	-	-	2	"	
F. Data/time announcements	Audicron	Audicron, Inc.	24 hr clock	-	-	-	"	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Tape recorder	Precision instrument Co.	33 to 60 in./sec	14	F,H	115 V, 60 Hz, 1-phase	
2. Paper recorder (chart)	Offner Div., Beckman	1 to 250 mm/sec	8	H,G	115 V, 60 to 400 Hz, 1-phase	
3. Magnetic tape recorder	Ampex CP-100	1-7/8, 60 in./sec	14	A,C,D,F,G	"	
4. Magnetic tape recorder	Ampex 350C	1-7/8, 65 in/sec	2	A,F,G	115 V, 60 Hz, 1-phase	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	5-28-65
REVISED	5-25-70

FACILITY: AFCRL Ionospheric Physics Laboratory (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	NKC-135 A	53131 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. Time	Time code generator	EECO	24 hr clock	1×10^{-8}	-	2	115 V, 400 Hz, 1-phase	
H. Amplitude at 4 wavelengths	Photometer	AS&E	5577, 4278, 6300, 4861 A	-	0.01 to 30 sec	1,2	115 V, 60 to 400 Hz, 1-phase	
I. Gamma rays	Gamma ray monitor	AS&E	0.005-15 MeV	-	10^6 cntg rate	2	115 V, 400 Hz, 3-phase	
J. Visible radiations	Visible spectrometer (2)	Lab fabricated	3000 to 7000 A	± 1 A	0.25 to 1 sec	8	115 V, 60 Hz, 1-phase	
K. Infrared radiations	IR spectrometer	Lab fabricated	1 to 3 μ	± 2 A	0.25 to 1 sec	8	"	
L. Adds spectroscans	Memory unit	Technical Instruments Inst.	400 channel	-	-	9	"	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
5. 35-mm all-sky camera	Automax G-2	F 1, 5	-	G	28 V dc	
6. Oscilloscope (2 ea) photo data	Tektronix RM 561	-	-	A	115 V, 60 Hz, 1-phase	One scope records on 35 mm; one on 16 mm
7. 35-mm pulse camera	Flight Research, Inc.	F 1	-	None	115 V, 400 Hz, 1-phase	
8. Chart recorder (2)	Sanborn Co.	1 to 25 mm/sec	2	J,K	115 V, 60 Hz, 1-phase	
9. X-Y recorder	Hewlett-Packard	-	1	L	115 V, 60 Hz, 1-phase	

U.S. ARMY ATMOSPHERIC SCIENCES LABORATORY
U.S. Army Electronics Command
White Sands Missile Range, New Mexico 88002

Source: E. Alex Blomerth, Jr., Chief
Atmospheric Physics Technical Area

Date: 9/18/70

PROJECT SUMMARY

1. Atmospheric Modification Models: The Army requires a capability to modify fog and clouds for tactical purposes. This work unit will provide descriptions of the initial and future states of the atmosphere. Research results will be used to evaluate and delineate weather modification techniques and requirements.

2. Warm Fog/Cloud Modification Techniques: The technical objective of this series of experiments is to provide quantitative evaluation of various techniques of fog dissipation such as helicopter downwash, hygroscopic spray, sized salt particles, polyelectrolytes, etc.

3. Cold Fog/Cloud Modification Techniques: To determine methods for dissipation of supercooled fogs, gain understanding of the physical conditions under which such dissipation occurs, and provide knowledge for the establishment of operational systems.

4. Investigations of Atmospheric Particulates: To investigate the constituency, absorptive properties, concentration, and size distribution of atmospheric particulates near the earth's surface. Results will provide inputs for predicting electromagnetic attenuation and for design and evaluation of weather modification studies.

5. Atmospheric Electrical Studies Near Clouds: Information on the electrical properties of the atmosphere is required by the Army for use in aircraft operations. This work unit will provide knowledge concerning the electrical characteristics of the atmosphere in the vicinity of cumulus clouds.

6. Warm Fog/Cloud Studies: This work unit will conduct an investigation of various physical and chemical processes in the formation and growth of clouds and fogs. Knowledge gained will lead to the development of artificial modification techniques.

7. Measurements of Aerosols: To investigate aerosols less than 1 μ in diameter, and to investigate freezing nuclei which determine to a large degree the precipitation dynamics of supercooled clouds and warm intermediate level clouds with tops.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-9-65
REVISED	9-18-70

FACILITY: U.S. Army Atmospheric Sciences Laboratory
Hq., U.S. Army Electronics Command

ADDRESS: Attn: AMSEL-BL-WS-A(B)
White Sands Missile Range, New Mexico 88002

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Atmospheric Modification Models: W. S. Nordquist 2. Warm Fog/Cloud Modification Techniques: R. B. Loveland 3. Cold Fog/Cloud Modification Techniques: E. Alex Blomerth 4. Investigation of Atmospheric Particulates: G. B. Hoidale 5. Atmospheric Electrical Studies Near Clouds: R. B. Loveland 6. Warm Fog/Cloud Studies: R. D. H. Low 7. Measurement of Aerosols: H. E. Gerber	CH-47, CH-54 helicopters UH-1, and L-19 fixed wing

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Time-sharing system	UNIVAC 1108	Cards, tape	Cards, tape, printout	2 complete systems available
Digital field data collection facility	Geospace 1703	Analog data	Tape and printout	Raytheon 703 computer, automatic gain ranging equipment, and peripheral equipment
Analog system	Ampex and Comcor	Analog data	X, Y plot, tapes, strip charts	Comcor CI-150 computers (2), all types of Ampex equipment, and peripheral associated analog equipment and telemetry

SPECIAL FACILITIES

Two Nike Ajax ground-based radars (3 and 10 cm) for tracking aircraft and PPI scope display of storms.
One M33 radar and four rubidium vapor magnetometers and various field measuring devices.
Two mountain-top observatories for cumulus cloud studies and investigations of aerosols.
One cloud physics laboratory housing chemical research equipment for cloud physics studies and a thermal diffusion chamber.
One complete atmospheric particulate laboratory.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-9-65
REVISED	9-18-70

FACILITY: U.S. Army Electronics Command (continued) **ADDRESS:**

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Temperature	Platinum resistance thermometer	Rosemount Engr. Co.	-40 to +40°C	± 0.2	0.1 sec	CP-100 capability for telemetry	28 V dc	Detachable pod
B. Pressure	Barometer with electric readout	Rosemount Engr. Co.	0 to 1086 mb	± 7 mb	0.2 sec			
C. Liquid water	Hot wire bridge	Johnson-Williams	0 to 3 gm/m^3	± 15% estimated	0.5 sec estimated			

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
Analog tape	Ampex CP-100	1-7/8 to 60 in./sec	14	A, B, C	110 V, 60 Hz, 28 V dc	

DESERET TEST CENTER
Fort Douglas, Utah 84113

Source: Dr. M. A. Rothenberg,
Scientific Director

Date: 8/25/70

INSTRUMENTATION SUMMARY

1. Portable Radiation Thermometer: This radiometer will be used in aircraft which traverse the Deseret Test Center area in an effort to map the horizontal profiles of surface temperature primarily during nighttime hours. An attempt will be made to correlate this horizontal gradient of surface temperature with the generation and decay of local small-scale adiabatic and katabatic wind flow patterns.

2. Temperature Indicator: This is a rapid-response, temperature-indicating instrument which is mounted on aircraft in a stagnation type probe. Primary approaches include traverses with the aircraft and the thermistor at various altitudes to determine the vertical distribution of temperature. The data output is then converted to a format for input to diffusion modeling. This device is used on a continuing basis to obtain vertical soundings of temperature for support to various tests at the Deseret Test Center.

3. Fluorescent Pigment Disseminator: This device is aircraft-mounted and is flown to produce an aerosol of known dimensions which can be studied in terms of rates of vertical diffusion. Specific study projects are portions of the meteorological research program in which the fluorescent pigment is employed as an inert safe tracer material.

4. Universal Turbulence Indicator with Vortex Thermometer: This sensor is to be flown on various Deseret field tests, including meteorological research projects. The output provides an indication of the horizontal turbulence along the flight path of the aircraft. This, in turn, can be related to the vertical turbulence structure which is important in determining the rates of vertical diffusion from elevated releases of tracer materials.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-29-65
REVISED	8-25-70

FACILITY: Deseret Test Center ADDRESS: Fort Douglas, Utah 84113

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Technology and Technical Support: Dr. C. Grant Ash, Director
2. Testing of Biological and Chemical Materials and Atmospheric Diffusion Studies: F. L. Horning, Chief, Meteorological Division

A/C TYPES

DeHavilland U-6A; Beech U-8D

Note: These aircraft cannot be made available to other users. Joint effort is conducted with other DOD organizations; however, due to the classified nature of much of this work, joint effort with agencies other than DOD is not feasible. Some of the data from these activities may be made available to users upon appropriate arrangements. For further information, write: Commanding General, Deseret Test Center, ATTN: STEP-LD-AV(D), Building 103, Soldier's Circle, Fort Douglas, Utah 84113.

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
Graph reader	Benson-Lehner	Analog chart	Punched cards	
Computer	IBM 360/40	Punched cards, magnetic tape	Punched cards, magnetic tape	

SPECIAL FACILITIES

1. Collection system for temperature, temperature gradient, dew point, pressure, and wind data at levels up to 8 m at selected points telemetered by hard wire into a central location.
2. Computer operated data acquisition system using RF link for command, measurement, computation, display, and recording of information from test sites.
3. Low-level meteorological rocketsonde for wind data up to 3000 ft tied into the RF link (being developed).

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4-29-65
REVISED 8-25-70

FACILITY: Deseret Test Center (continued) ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	U-6A U-8D		105 kt 140 kt	19,000 ft 25,500 ft	530 n mi 1600 n mi	Fort Douglas, Utah	All year	Army-owned

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION: Visual and photographic

ALTITUDE, HEADING, AIRSPEED: Standard A/C instruments plus Universal turbulence indicator

AIRCRAFT ELECTRIC POWER	110 V, 60 Hz inverter; 24 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Surface temperature	Portable radiation thermometer	Barnes Engr. Co. Model PRT-4	-32 to +55°C	± 1.5°C	50 msec	Dial plus strip chart	110 V, 60 Hz	FOV 2°, 8 to 14 μ
B. Temperature	Thermistor element	Beckman & Whitley, Inc. #197	-30 to +130°F	± 1°F	50 msec	Dial plus strip chart	Batteries	
C.	Fluorescent pigment disseminator	Model D	1 to 5 lb/mi at 150 kt	* ± 0.1 lb/mi		Control dials	A/C power supply (24 V dc)	* Post-flight analysis correctable to ± 10 gm of total output
D. Turbulence	Universal turbulence indicator	Meteorology Research, Inc. Model 2009	Minimum significant to maximum A/C limit			Dial plus strip chart	Battery	
E. Temperature	Vortex thermometer	"	-35 to +45°C			Dial indicator	Battery	
F. True airspeed	Universal turbulence indicator	"	0 to 250 kt	± 1 kt		Dial plus strip chart	Internal battery	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Strip chart recorder	Hewlett-Packard Model 7100B	0.1 to 2 in./sec, 0.1 to 2 in./min 1 and 2 in./hr	2	A, B, C, D, F	110 V ac, 60 Hz	Any two outputs A,B,C,D,F can be recorded simultaneously on the U-8D aircraft. Above instrumentation is primarily installed on the U-8D, but can be mounted on the U-6A when desired.

U.S. DEPARTMENT OF COMMERCE
Environmental Science Services Administration
ESSA Research Laboratories
Research Flight Facility
P.O. Box 197 IAB
Miami, Florida 33148
305-350-4139 (FTS)

Source: Howard A. Friedman,
Project Coordinator/Meteorologist, RFF

Date: 8/25/70

The Research Flight Facility (RFF) has, for the past decade, demonstrated its capability of melding together the aircraft and instrumentation systems necessary to make significant atmospheric measurements and provide data processing services for a wide range of scientific projects.

Objectives: To meet the requirements of the ESSA Research Laboratories and other groups, to the extent possible, for environmental measurements from aircraft.

Functions: The RFF maintains and operates aircraft specially instrumented for environmental research, and develops instrumentation to obtain these measurements.

Position (DC-6 A/B): Position information is obtained on these RFF aircraft with the following systems: AN/APN-82 doppler radar, AN/APN-153 doppler radar, and the OMEGA navigation system. In addition, radar, LORAN, visual, celestial, and other standard navigation aids (VOR, DME) are available for position determination. Digital recording in a binary-coded-decimal (BCD) form on magnetic tape is available for the doppler parameters (ground speed and drift angle) in the case of the AN/APN-153; the doppler parameters and aircraft position (latitude/longitude) are digitized and recorded similarly from the AN/APN-82 doppler system. The OMEGA output is recorded in digitized form on the magnetic (flight) tape on one of the DC-6 A/B aircraft, and in analog (strip chart) form on the other DC-6 A/B aircraft. Photo panel and manual data recording are also accomplished in flight for backup purposes and operational use, respectively. Real-time display of all systems in flight is available.

B-57A: This RFF aircraft presently employs the AN/APN-102 and the AN/APN-153 doppler radar systems. In addition, the OMEGA navigation system and other standard navigation aids are available. Doppler information is recorded on magnetic tape in BCD form, and the OMEGA data is recorded in analog form. Real-time display of all systems in flight is available.

The RFF is currently updating its aircraft by retiring the C-54 (DC-4) and obtaining a WC-130B (scheduled for September 1970). The WC-130B will initially employ an AN/APN-147 doppler radar system and other standard navigation aids for position determination. The installation of the AN/APN-102 doppler radar, OMEGA navigation system, and possibly an inertial platform for navigation and wind data is being considered.

Altitude: Pressure altitude is measured with conventional sensitive altimeters (Kollsman). In addition, pressure altitude from a dedicated pitot-static source is obtained with Giannini pressure transducer systems. These data are recorded on the magnetic tape in BCD form (DC-6 A/Bs and B-57A). The WC-130B will, for the present time, use the standard aircraft pitot-static system and altimeter readout for pressure altitude information. Real-time data display is available on all aircraft. The absolute (radar) altitude is measured with the APN-159 radar altimeter on the DC-6 A/B and B-57A aircraft. This information is recorded on magnetic tape in BCD form. The WC-130B aircraft will employ an APN-42 radar altimeter for the absolute altitude data. Real-time display available on all aircraft.

Heading: This information is obtained with the N-1 compass system (all aircraft). These data are digitized and recorded on magnetic tape in BCD form (DC-6 A/B and B-57A). Real-time data display is available on all aircraft.

Airspeed: Indicated airspeed information is provided on all aircraft by standard pitot-static systems. The DC-6 A/B and B-57A aircraft also use dedicated pitot-static systems and Giannini pressure transducers to obtain differential pressure data. This information can then be converted into indicated airspeed or true airspeed information, independent of the true airspeed transmitters (see below) also employed on the aircraft. The differential pressure data is recorded on the magnetic tape in BCD form. True airspeed information is provided by the Kollsman A-2 True Air Speed Transmitter (DC-6 A/B and B-57A). The M1-A True Air Speed Indicator is used for the WC-130B. These systems essentially couple pitot-static information with flush-bulb temperature to obtain the true airspeed.

TABLE 1a

RFF AIRCRAFT OPERATIONAL CAPABILITIES

	DC-6 A/B	C-54 (DC-4)	B-57A
Registration number	N6539C N6540C	N91282	N1005
Number of aircraft	2	1	1
Takeoff runway length required (max gross weight)	6000 ft	4300 ft	6500 ft
Landing distance required (over a 50 ft obstacle at landing weight)	3200 ft	2800 ft	6500 ft
Long-range endurance (at optimum altitude with reserve)	12 hr	17 hr	4 hr 50 min
Practical service ceiling	18,000 ft	18,000 ft (oxygen required above 10,000 ft)	43,000 ft
Maximum mission radius (no time on station)	1300 n mi	1350 n mi	950 n mi
Maximum range (with reserve)	2600 n mi	2700 n mi	1900 n mi
Rate of climb	600 ft/min	600 ft/min	1500 ft/min
Climb time (from sea level)	45 min (to 18,000 ft)	45 min (to 18,000 ft)	30 min (to 40,000 ft)
Maximum cruise speed	248 kt (TAS)	217 kt (IAS)	350 kt (IAS)
Maximum fuel capacity	5512 gal	3540 gal	3440 gal

The RFF is scheduled to receive a WC-130B from the U.S. Air Force in September 1970. Following are lists indicating operational capabilities and navigational systems for that aircraft.

TABLE 1b

OPERATIONAL INFORMATION ON WC-130B

Critical field length at gross weight and 90°F (135,000 lb max gross weight; max landing gross weight - 118,000 lbs)	4000 ft (6000 ft)*	Service ceiling @ 130,000 lbs @ 100,000 lbs	21,000 ft 28,000 ft (18-20,000 ft)*
Time to climb to 21,000 ft (cruise ceiling)	30 min (45 min to 18,000)*	Maximum mission radius at sea level, standard day, 20°C with reserve	740 n mi
Distance to climb to 21,000 ft	100 n mi		
Fuel to climb to cruise ceiling	2650 lb	Maximum mission radius at 15,000 ft, standard day 20°C with reserve	850 n mi (1300 n mi)*
Total fuel available after takeoff	44,000 lb		
Cruise speed	290 kt - TAS (248 kt)*	Maximum mission radius at 20,000 ft. standard day 20°C with reserve	1115 n mi
Long range endurance @ 20,000 ft (4 eng) @ 25,000 ft (4 eng)	 7.6 hr 7.7 hr (12 hr)	Maximum range at gross weight, standard day, 20°C with reserve	2350 n mi (2600 n mi)*

*DC-6 A/B value.

INSTRUMENTATION SYSTEMS FOR C-130B

AMQ-19 total temperature system

M1-A true airspeed indicator

Modified AN/AMT-13 dropsonde system

APN-59 navigational radar

APN-147 doppler radar

ASN-35 navigational computer

618T-2 HF/SSB communications system

APN-42 radar altimeter

N-1 compass system

Formvar replicator

Foil impactor

Johnson-Williams liquid water content probe

Infrared hygrometer

MA-1 chute

12A foil sampler

Thermocouple vortex temperature system

TABLE 2

RFF AIRBORNE INSTRUMENTATION SYSTEMS

PARAMETER	INSTRUMENT/MFGR	RANGE	ERROR	AIRCRAFT 39C	40C	282	05	TC
Latitude	(a) Doppler APN-153 GPL Division, General Precision, Inc.	90° N/S		x	x	x	x	
	(b) Doppler APN-82 GPL Division, General Precision, Inc.	90° N/S		x	x	x		
Longitude	(a) Doppler APN-153	180° E/W		x	x	x	x	
	(b) Doppler APN-82	180° E/W		x	x	x		
Absolute position	OMEGA navigation system, Tracor Corp.	90° N/S 180° E/W			x			
Ground speed	(a) Doppler APN-153	60 to 1000 kt	(0.2 ± 0.35%)	x	x	x	x	
	(b) Doppler APN-82	70 to 700 kt	± 2.1 kt or ± 0.3% GS	x	x	x		300 Hz ~ 14 kt/sec
Solar radiation	Eppley precision spectral pyranometer	λ: 285 to 2800 nm T: -20 to +50°C		x	x	x		1 sec; sensitivity 5 mv/cm^2 min
Radar systems	APS-20E 10.4 cm PPI	200 n mi		x	x			
	WP-101 5.6 cm PPI	150 n mi		x	x			
	RDR-1D 3.2 cm X	20 n mi		x	x			
	RDR-1D 3.2 cm PPI	150 n mi					x	
	APS-42A 3.2 cm PPI	200 n mi				x		

TABLE 2 (cont.)

PARAMETER	INSTRUMENT/MFGR	RANGE	ERROR	AIRCRAFT 39C	40C	282	05	TC
Radiation detection	FI-2A, 2 with B200 90 GM foil assembly	0 to 200,000		x	x	x	x	
Atmospheric turbulence	See Table 3			x				
Drift angle	(a) Doppler APN-153	± 40°	± 0.17°	x	x	x	x	
	(b) Doppler APN-82	± 45°	± 0.15°	x	x	x		
Wind direction (DDD)	(a) Doppler APN-153	360°	± 0.4 + 105°/FFF	x	x	x		Response 2.6°/sec TC = ~ 35 sec
	(b) Doppler APN-82	360°						
Wind speed (FFF)	(a) Doppler APN-153 (b) Doppler APN-82	0 to 240 kt	± 3 kt for FFF < 150 kt, ± 0.02 FFF for FFF ⩾ 150 kt					
Distance travel count (DTC)	Doppler APN-82	0 to 999.999 n mi	~ 1% (ΔDTC)	x	x			
Pitch/roll angle	Doppler APN-81	± 30° (pitch)	± 0.1°	x	x			36°/sec
	Antenna, C-1160 gyro	± 45° (roll)	± 0.1°	x	x			36°/sec
Magnetic heading	N-1 flux gate compass; C-2 transmitter mil-type	360°	± 0.2°	x	x	x	x	36°/sec
Magnetic variable	Manual setting	180° E/W		x	x	x	x	

TABLE 2 (cont.)

PARAMETER	INSTRUMENT/MFGR	RANGE	ERROR	AIRCRAFT 39C	40C	282	05	TC
Ambient pressure	Pressure transducer Giannini 555TI	1050 to 50 mb	± 0.5 mb	x	x	*	x	10 mb/sec
Differential pressure	Pressure transducer Giannini 555T2	0 to 200 mb	± 0.5 mb	x	x	*	x	10 mb/sec
Indicated airspeed	(a) Pressure transducer Giannini 555T2	50 to 400 kt	± 5 kt	x	x	*	x	
	(b) IAS meter Kollsman	50 to 400 kt	± 5 kt	x	x	x	x	
True airspeed	TAS transducer Kollsman A-2	50 to 700 kt	± 5 kt	x	x	x	x	80 kt/sec
Pressure altitude	(a) Kollsman altimeter	0 to 50,000 ft		x	x	x	x	
	(b) Giannini 555TI	0 to 50,000 ft	± 15 ft	x	x	*	x	
Radar altitude	APN-159 Stewart-Warner	Classified	± 8 ft or 1%	x	x	x	x	500 ft/sec
Ambient temperature	(a) ML-471/AMQ-8 Vortex, Bendix	-80 to +50°C	± 1°C	x	x	x	x	10 sec
	(b) RFF model AMQ-8	0 to 400,000	± 1°C	x	x	x		< 5 sec
Sea-surface temperature	(a) Barnes PRT-5 IR	-40 to +40°C	± 0.5°C	x	x	x		50 msec
	(b) Te radiometer	-20 to +45°C	± 0.5°C	x	x	x		2 sec

*RFF C-54 (DC-4) employs copilots pitot-static system source for this information.

TABLE 2 (cont.)

PARAMETER	INSTRUMENT/MFGR	RANGE	ERROR	AIRCRAFT 39C	40C	282	05	TC
Total temperature	Rosemount system	-60 to +40°C	± 1°C	x	x		x	1/e = ~ 20 msec
Liquid Water content	(a) Levine hot-wire	0 to 10 gm/m^3	30 to 50%	x	x			4 sec
	(b) Johnson-Williams	0 to 6 gm/m^3	Within 30%	x	x			< 5 sec
Absolute humidity	RFF IRH system	0 to 20 gm/m^3	5%	x	x	x		0-10 sec (90% chg)
Dew (frost) point temperature	Hygrometer Cambridge system	-50 to +50°C	Within ± 2°C of IRH	x	x			10 sec
Ice detector	Pressure differential cyclic			x	x		x	
Aitken Nucleus C+	APCL			x	x			
Vertical acceleration	Statham AJ-43	0 to ± 3 *g*	10%	x	x	x		
Refractive index	Microwave ref, WPL			x				
Vertical velocity	See Table 3			x				
WVF	See Table 3			x				

TABLE 3

RFF AIRBORNE TURBULENCE MEASURING SYSTEM

MEASUREMENT	INSTRUMENT TYPE	LOCATION	MANUFACTURER	MODEL	NATURAL FREQ (Hz)	RANGE INST/MEAS	SYSTEM RESOULTION
Vane force	Vane	Probe-boom	Lockheed	FT3809	155	± 12 lb ± 2 lb	0.004 lb
Probe normal acceleration	Accelerometer	Probe-boom	Statham	AJ43-2-350		± 2 *g* ± 1 *g*	0.0036 *g*
Airspeed	Differential pressure	Probe-boom	Statham	PL283TC	3600	0-1 psid 0-200 kt	0.2 kt
Temperature	Thermistor	Probe-boom	Fenwall	KIC 26			
Pressure altitude	Pressure transducer	Boom	Rosemount	830A		0-16 psi	0.01% full scale
Vertical acceleration	Stable platform	A/C CG	Litton	LN 3A		1 ± 8 *g* 1 ± 0.5 *g*	
Roll angle	Stable platform	A/C CG	Litton	LN 3A			
Pitch angle	Stable platform	A/C CG	Litton	LN 3A			
Roll rate	Gyro	Nose	R. C. Allen	F2880-045	15	± 10°/sec ± 10°/sec	0.02°/sec
Pitch rate	Gyro	Nose	R. C. Allen	F2880-045	15	± 10°/sec ± 10°/sec	0.02°/sec
Elevator position	Potentiometer	Tail				± 2.5° ± 2.5°	

TABLE 4

RFF AIRBORNE RECORDING SYSTEMS

RECORDER/DISPLAY	MANUFACTURER/MODEL	SPEED	CHANNELS	AIRCRAFT 39C	40C	282	05	REMARKS
Digital (magnetic tape) recorder	ESS-GEE Co. modified by RFF	See (6)	7-BCD	x	x		x	See (1)
Digital (magnetic tape) recorder	Radiation Inc.	See (6)	7-BCD 20 FM analog			x		See (2)
FM (IRIG) analog recorder	Sangamo series 3560	Variable	14	x				See (3)
Strip chart recorder (6 & 8 in.)	Honeywell Visicorder	Variable Variable	14 28	x x	x x	x x		 See (4)
Strip chart recorder	Hewlett-Packard		2	x	x	x		See (5)
Cloud camera, slide mounted, 35 mm	Automax G-2	1 frame/ 5 sec	1	x	x	x		Mounted left/right
Cloud camera, forward looking, 16 mm	Milliken DBM-5C	1 frame/ 2 sec	1	x	x	x	x	
Photo-panel camera, 35 mm	Automax G-1	1 frame/ 5 sec	1	x	x	x		
Radar camera 35 mm	Fairchild 0-15	Variable	1	x	x	x	x	All A/C radars

(1) Tape moves at 76 cm/sec. Recording capacity 4500 BCD characters/sec with bit density of 200 bits/in. Original system modified by RFF.

(2) Capability of recording 50 complete samples/sec. System can also be used to record 20 channels of analog (FM) data.

(3) Used to record individual components of the water vapor flux system.

(4) Light beam galvanometer type. Used to continuously record output of special instruments.

(5) E[illegible]static recorder used for IR and solar radiation measurement recording.

(6) R[illegible], are each 150 BCD characters in length.

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ADDRESS: P.O. Box 197 IAB, Miami, Florida 33148

PROJECTS AND PRINCIPAL INVESTIGATOR

Projects for which RFF Provides Observational and Data Processing Support

1. Air Resources Laboratory: Dr. L. Machta
2. Argonne National Laboratory: Dr. J. Kastner
3. Army Signal Corps
4. Atmospheric Physics and Chemistry Laboratory: Dr. H. Weickmann
5. Atomic Energy Commission: Mr. P. Raft, Dr. T. Crawford
6. Barbados Oceanographic and Meteorological Experiment (BOMEX); Barbados Oceanographic and Meteorological Analysis Project (BOMAP): Dr. J. Kuettner, Dr. J. Holland, Dr. J. Charney
7. CABRIOLET: Dr. T. Crawford
8. Cloud Physics Research: Dr. J. Simpson, Dr. W. Woodley, Dr. R. C. Gentry
9. Cold Low Study: Dr. N. Frank

A/C TYPES

DC-6 A/B (2); B-57A; DC-4; WC-130B

The RFF leases hangar and ramp areas at Butler Aviation, Inc. (formerly Air International, Inc.), Miami International Airport, Florida. Aircraft crews are Department of Commerce employees. Additional contract services are obtained through the contractor.

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
1. Digital computer	IBM 1401	Magnetic tape generated by A/C digital system; data cards	Magnetic tape generated by computer; printout	Time rented as required
2. Digital computers (3)	IBM 7040, IBM 360, Control Data Corp. 6600	Magnetic tape generated by A/C digital system and other digital computer systems	Magnetic tape generated by computer; printout; plot out	Time rented as required

SPECIAL FACILITIES

The RFF DC-6 A/B aircraft are equipped with the Collins 618T-3 and KWM-2 transceivers for long-range, HF single side band (SSB) communications. The 618T-3 provides 28,000 channels in 1 kHz increments in the 2-30 MHz band, with 400 W power output. The 618-S is a 144-channel crystal controlled AM transceiver providing approximately 100 W of output power.

All RFF aircraft are equipped with both VHF and UHF transmitter/receivers for shorter range communications.

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PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
10. Colorado Lee Wave Project: Dr. J. Kuettner 11. Colorado State University: Dr. H. Riehl, Dr. W. Gray 12. Department of the Interior: Dr. A. Kahan 13. Eastern Caribbean Cooperative Reconnaissance Organization: Dr. R. C. Gentry 14. EQUALANT: Dr. H. Johnson 15. Florida State University: Dr. C. Jordan 16. Global Atmospheric Research Program (GARP) 17. International Indian Ocean Expedition: Dr. C. Ramage 18. Jet Stream Project: Dr. H. Riehl 19. Lake Effect Snow Project: Dr. H. Weickmann 20. Mountain Wave Project: Dr. J. Kuettner 21. National Hurricane Research Laboratory: Dr. R. C. Gentry 22. National Severe Storms Laboratory: Dr. E. Kessler 23. New York University: Dr. J. Spar	

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS
3. Digital X-Y plotter	California Computer Products	Magnetic tape generated by computer systems	X-Y data plotout	Time rented as required
4. Other systems as required and/or available (if practicable)				Time rented as required

SPECIAL FACILITIES

In addition, the RFF maintains a portable ground air communications station with the Collins 32-S transmitter and the Collins 75-S receiver for SSB communications.

Additional facilities are available for VHF communications from the portable ground air station.

The WC-130B aircraft will also have HF/SSB communications capabilities compatible with the other RFF aircraft.

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PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
24. Operational Missions: National Hurricane Center - Dr. R. H. Simpson Eastern Region Weather Bureau - Mr. S. Simplicio 25. Project Mercury: Mr. J. Gulick 26. Project Stormfury: Dr. R. C. Gentry 27. Research Flight Facility: Mr. H. J. Mason, Jr. 28. Sea Air Interaction Laboratory: Mr. F. Ostapoff 29. Sea Breeze: Dr. N. Frank 30. Sea Breeze (part of IIOE): Mr. J. Nicholson 31. Snow Project (East Coast Winter Storms): Dr. J. Spar 32. Storm Cloud: Dr. E. P. McClain 33. Sub-cloud (mixing layer) Investigation: Dr. H. Riehl 34. USAF (Research and Development Program) 35. University of Chicago: Dr. T. Fujita	

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

External pods for collection of special project data can be mounted on the DC-6 A/B, DC-4, and the B57A. (WC-130B aircraft capabilities will be evaluated and developed.)

The RFF DC-6s and B-57A have cloud seeding (delivery) capability. This is accomplished with an RFF developed steady-state flame-type generator (DC-6 A/B), and a pyrotechnic flare delivery system (DC-6 A/B, B-57A).

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PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
36. University of Miami: Dr. G. Ostlund 37. University of Stockholm: Mr. W. Bischof 38. University of Washington: Dr. R. Fleagle	

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

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PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
Projects Within the RFF 1. Liquid Water Content Measurements: Dr. G. Conrad 2. Thermocouple Vortex Temperature Measurements: Dr. G. Conrad 3. Small-scale Atmospheric Turbulence: U. O. Lappe, H. J. Mason, Jr. 4. Flight Evaluation of Dew Point/Frost Point Hygrometer Systems: H. J. Mason, Jr., Dr. G. Conrad 5. IR Radiation Thermometer: Dr. G. Conrad, Dr. J. McFadden 6. Accuracy of Doppler Radar-Derived Wind Measurements: H. W. Davis 7. Special Data Reduction: M. Ahrens 8. Cloud Seeding Installations: B. Patten, H. J. Mason, Jr. 9. External Pod Installations: B. Patten, J. Rembisz 10. RFF Systems Manual: H. A. Friedman, Dr. G. Conrad 11. Expendable Bathythermograph: Dr. J. McFadden	

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4-7-65
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FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2);	N6539C N6540C	220 kt	20,000 ft	2600 n mi	Miami International Airport	All year	U.S. Dept. of Commerce (ESSA)
	B-57;	N1005	430 kt	45,000 ft	1500 n mi			
	DC-4;	N91282	200 kt	25,000 ft	2880 n mi			
	WC-130B	N6541C	290 kt	28,000 ft	2350 n mi			

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	115 V, 400 Hz, 3-phase 30 kVA; standard A/C power

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
1. Latitude (LAT)	AN/APN-82 doppler radar AN/APN-153 doppler radar AN/APN-102 doppler radar OMEGA navigation system	General Precision Co. Tracor	90° N/S	*		#3, 6, 7, and manual #6, 11, and manual		*Computed from doppler measured parameters, magnetic heading, variation, and true airspeed data using the principle of "dead-reckoning"; measured on all A/C.
2. Longitude (LONG)	"	"	180° E/W	*		#3, 6, and manual		(See note above)
3. Ground speed (GS)	AN/APN-153 doppler radar AN/APN-102 doppler radar AN/APN-82 doppler radar	General Precision Co. " "	60 to 1000 kt 70 to 700 kt	0.2% ± 0.35 ± 2.1 kt or ± 0.3% of top speed†	Effective rate at which doppler frequency is tracked is 300 Hz which corresponds to ~ 14 kt/sec	#3		†Manufacturer's statement of probable error; RFF experience has shown that the accuracy of the GS (or DTC) is on the order of 1% of the DTC; measured on DC-6 A/B aircraft.

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 35-mm cloud cameras	Automax G-2	Optional	2*			Clouds photographed; data chamber; DC-6 only. *Port and starboard sides
2. 16-mm cloud cameras	Milliken DBM-5C(PD)	"	1			Clouds photographed; data chamber; DC-6 and B-57 only; forward-looking
3. 35-mm photo-panel camera	Automax G-1	"	"			All A/C
4. 70-mm vertical camera	Maurer Model P-2	"	"			Ground-mapping, sea-surface, etc.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

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REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

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NAVIGATION SENSORS AND RECORDERS

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AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
4. Drift angle (DA)	AN/APN-153 doppler radar AN/APN-102 doppler radar AN/APN-82 doppler radar	General Precision Co.	± 40° ± 45°	± 0.17° ± 0.15°		#3, 6, 7, and manual		Measured on DC-6 A/B. APN-153 also on B-57A. APN-102 on WC-130B aircraft
5. Wind direction (DDD)	APN-82 doppler radar	"	360°	Vector	Max. response of wind angle servo is 2.6°/sec; TC ≈ 35 sec	"		DDD/FFF computed by analog (ASN-6) on-board computer by solving the wind triangle, $\vec{W} = \vec{GS} - \vec{TAS}$. Direction error given as: ± 0.4 + 150°/FFF; measured on DC-6 A/B aircraft.
6. Wind speed (FFF)	APN-82 doppler radar	"	0 to 240 kt		Max. rate of wind speed change is 7.2 kt/sec; TC ≈ 22 sec	"		See above. Speed error given as: ± 3 kt for FFF ≤ 150 kt; ± 0.02 (FFF) for FFF > 150 kt. Measured on DC-6 A/B; TC defined as degrees error/degrees/sec toward alignment.

Note: APN-153 and APN-102 systems provide only GS, DA information (not presently hooked up to computer for DDD/FFF in flight).

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
5. 35-mm radar cameras	Fairchild 0-15	Variable	1			APS-20E, WP-101, RDR-1D, APS-42A, radar scopes are photographed
6. Digital recorder (magnetic tape)	ESS-GEE Co.; in-house modified Ampex FR-400	*	7 BCD			*Records: 150 char. long; tape moves at 76 cm/sec; recording capacity: 4500 BCD char./sec; bit density: 200/in.
7. Digital recorder (magnetic tape)	Radiation, Inc.	Variable	7 BCD, 20 analog	Optional		

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

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ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

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NAVIGATION SENSORS AND RECORDERS

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AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
7. Distance traveled count (DTC)	AN/APN-82 doppler radar	General Precision Co.	0 to 999.999 n mi	~ 1% of DTC		#6, 7		DC-6 A/B; DTC cycles to "0" after 999.999
8. Pitch/roll angle	C-1160 Gyro AN/APN-81 antenna	General Precision Co.	± 30° (pitch) ± 45° (roll)	± 0.1° ± 0.1°	36°/sec 36°/sec	#3, 6, 7		DC-6 A/B
9. Aircraft heading	N-1 flux gate	N-1 military type	360°	± 0.2°	36°/sec	#3, 6, 7, and manual		Measured on all A/C
10. Ambient pressure (P)	Pressure transducer	Giannini Controls Corp. 555T1	1050 to 50 mb	± 0.5 mb	10 mb/sec	#3, 6, 7		DC-6 A/B and B-57A; resolution (digital encoder) is 0.05 mb
11. Differential pressure (DP)	"	Giannini Controls Corp. 555T2	0 to 200 mb 0 to 400 mb	± 0.5 mb	10 mb/sec	#3, 6, 7		0 to 200 mb on DC-6 A/B 0 to 400 mb on B-57A
12. Indicated airspeed (IAS)	"	Giannini Controls Corp. 555T2	~ 50 to 400 kt	~ ± 5 kt		#3		DC-6 A/B and B-57A

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
8. Strip chart recorders (6 and 8 in.)	Honeywell Visicorder	Variable	14 and 28, respectively	Special instruments		Light beam galvonometer type
9. Strip chart recorder	Hewlett-Packard	"	2	Optional		Electrostatic recording
10. FM tape recorder	Honeywell	"	8	Optional		
11. Strip chart recorder	Rustrak Co.					

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

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Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

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NAVIGATION SENSORS AND RECORDERS

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AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
13. Indicated airspeed (IAS)	Conventional meter	Kollsman	~ 50 to 400 kt	~ ± 5 kt		#3		DC-4, DC-6 A/B, and B-57A, WC-130B use these for cockpit indicators
14. True airspeed (TAS)	True airspeed transducer	Kollsman A-2; M1-A (WC-130B)	50 to 700 kt	~ ± 5 kt	80 kt/sec	#3, 6, 7		Measured on all A/C
15. Pressure altitude (PA)	Sensitive pressure altimeter	Kollsman	0 to 50,000 ft	*		#3		*Bench check calibrated; measured on all A/C
16. Pressure altitude (PA)	Pressure transducer	Giannini Controls Corp. 555T1	0 to 50,000 ft	± 15 to 20 ft		#3		DC-6 and B-57; computed from ambient pressure
17. Ice detector	Pressure difference cyclic sensor				60 ± 10 sec	#3, 6, 7		DC-6 A/B and B-57; Ice/No-Ice cyclic sensor
18. Absolute altitude (RA)	Radar altimeter	Stewart-Warner AN/APN-159; APN-42 (WC-130B)	Classified	± 8 ft or 1% of altitude	500 ft/sec	"		Digital resolution: 1 BPF

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED 4-7-65
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ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

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NAVIGATION SENSORS AND RECORDERS

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AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
19. Ambient temperature (T_V)	Vortex thermometer	Bendix Corp. ML-471/AMQ-8	-80 to +50°C	± 1°C	10 sec	#3, 6, 7		Measured on DC-6 A/B and B-57A
20. Ambient temperature (T_V)	Thermocouple vortex thermometer	AMQ-8 modified in-house	0 to 400°K	≤ ± 1°	< 5 sec	#6, 7, and manual		Developmental
21. Liquid water content (LWC)	Hot wire	Johnson-Williams	0 to 6 gm/m^3	Within 30%*	< 5 sec	#3, 6, 7		*DC-6 A/B; sample check in small wind tunnel at RFF
22. Absolute humidity	IR hygrometer	USWB, modified in-house	0 to 20+ gm/m^3	5%	0 to 10 sec for 90% change	#3, 6, 7		DC-6 A/B and WC-130B
23. Dew point temperature (T_d)	Dew point hygrometer	Cambridge Systems, Inc. 137-C3-S3-P	-50 to +50°C	Within ± 2°C of values obtained with IRH system	~ 10 sec	#6, 7, 8		DC-6 A/B; 35°C drop from 20°C; 20°C drop from -20°C heat sink

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

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ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

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AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
24. Total temperature (T_t)	Total temperature system	Rosemount Engr. Co.	-70 to +30°C	± 1°C	1/e time is 20 msec	#3, 6, 7		All A/C
25. Sea surface/ cloud temperature	IR temperature system	Barnes PRT-5	-40 to +40°C	Resolution of 0.2°C, absolute accuracy of 0.5°C	50 msec	#9 and manual		As required
		Te radiometer	-20 to +45°C	± 0.5°C	2 sec			
26. Cloud seeding devices	AgI (flare type)	Olin Mathieson			Selectable ejection rate	Manual, notes		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
27. Cloud seeding devices	Steady-state flame type nucleus generator	Developed in-house				Manual, notes		Can be installed on all A/C; effective nucleus output of system at -20°C is 7.3×10^{15} (number of crystals of AgI produced/gm AgI/min) at -8°C; rating is 5.5×10^{12}
28. Radiation detector	Air sampler and radiation counter	FI-2B military type				Manual		All A/C; fittings and instrumentation for radioactive counting
29. Nucleus counter	Special chamber	Bigg-Warner (built for RFF)				Manual, photo		On DC-6 A/B assigned to high-level flights

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
30. Temperature, pressure, humidity	Dropsonde	AN/AMT-3 military type	-80 to +60°C, 1060 to 250 mb, 15 to 100%	*		Manual		*DC-6 A/B; each unit has individual calibration and baseline check data; accuracy comparable to standard radiosonde; temperature elements on E and F models have ~ 10 sec lag; on A-D models lag is ~ 1.5 min
31. Time	24 kHz crystal oscillator	ESS-GEE Co. (modified in-house)	24 hr	Probably < 1 sec/day				DC-6 A/B and B-57A; checked in flight with standard WWV
32. Time	Clock	Bulova Accutron; Wakkmann	24 hr	**				**All A/C; checked against 24 kHz crystal oscillator time; log of time differences kept during flights
33. Total elapsed time count	1 sec digital system pulse	Developed in-house	0 to 9999 (count)					DC-6 A/B and B-57A

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
34. Liquid water content	Hot-wire probe	Levine	0 to 10 gm/m^3	30 to 50%	4 sec	#8		DC-6 A/B; also gives volume median drop size
35. Engine power	BMEP indicator					#3		DC-6 A/B; monitors for constant power setting profiles
36. Vertical acceleration (integrated)	Accelerometer	Statham AJ-43	0 to ± 3 g			Manual		All A/C; never properly calibrated; assume ~ 10% error
37. Vertical velocity	Vertical velocimeter	Developed in-house	0 to 10 m/sec		On the order of seconds	#7, 8		Can also go to integral multiples of 10 m/sec; can be installed on all A/C
38. Magnetic variation	Manually set-in		± 180°		#6, 7, and manual			All A/C; manually put into AN/APN-82 system to obtain true heading

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57;	N6539C N6540C N1005						
	DC-4; WC-130B (cont.)	N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
39. Radar system	Pulse radar	APS-20E military type	250 n mi		1 sweep/ 10 sec	Photo		DC-6 A/B; 10 cm; PPI scope; data chamber
40. "	"	Collins Radio Corp. WP-101	150 n mi		1 sweep/ 4 sec	"		DC-6 A/B; 5.6 cm; PPI scope; data chamber
41. "	"	Bendix Corp. RDR-1D	150 n mi		"	"		3.2 cm; PPI scope (B-57A); cross-section presentation (DC-6 A/B); data chamber
42. "	"	Bendix Corp. APS-42A APN-59 navigation radar	200 n mi		"	"		DC-4; 3.2 cm; PPI scope; data chamber
43. Systems status/ event indicators	Automatic and/or manual switch settings					#3, 6, 7		All A/C
44. Water sample collection								DC-6 A/B; collected in water sample bottles

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-7-65
REVISED	8-25-70

FACILITY: U.S. Department of Commerce
Research Flight Facility (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	DC-6 A/B (2); B-57; DC-4; WC-130B (cont.)	N6539C N6540C N1005 N91282 N6541C						

PROJECTS AND PRINCIPAL INVESTIGATOR

See Facility Sheet

NAVIGATION SENSORS AND RECORDERS

POSITION See page II C-26

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
45. External pod capability								All A/C; data collection packages can be mounted on external pods
46. Cloud physics and other measurements	Formvar replicator foil replicator total water content (Lyman-α)							From time to time special instrumentation is installed on all RFF A/C to meet the needs of individual scientific programs
47. Incoming and reflected solar radiation	Eppley precision spectral pyranometer	The Eppley Laboratory, Inc.			1 sec	#8, 9		All A/C; mounted at the ends of specially designed pylons on top and bottom of A/C
48. Turbulence		Lockheed/RFF turbulence measurement system						

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

The RFF B-57A aircraft (N1005) is a high-altitude, twin jet research/reconnaissance aircraft, equipped with standard navigation/communications facilities and doppler radar.

The RFF DC-6 A/B aircraft (N6539C, N6540C) are long-range, pressurized, four-engine (reciprocating type) land planes. Considered the workhorses of the RFF, the DC-6s are equipped with standard navigation aids, doppler radar, and highly flexible communications systems.

The RFF DC-4 aircraft (N91282) is a long-range, unpressurized, four-engine (reciprocating type) land plane. In addition to its uses for operational/research missions, the aircraft serves as a test-bed for developmental instrumentation and logistics support. The aircraft is equipped with standard navigation aids, doppler radar, and a highly flexible communications system. This aircraft is being retired from service and being replaced by a WC-130B aircraft.

FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF SPORT FISHERIES AND WILDLIFE
Tiburon Marine Laboratory
P.O. Box 98
Tiburon, California 94920

Source: James L. Squire, Jr., Assistant Director

Date: 8/30/70

BUREAU OF SPORT FISHERIES AND WILDLIFE
Sandy Hook Marine Laboratory
P.O. Box 482
Highlands, New Jersey 07732

Source: John R. Clark

Date: 8/30/70

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	11-6-64
REVISED	8-30-70

FACILITY: Fish and Wildlife Service
U.S. Department of the Interior

ADDRESS: Tiburon, California
Highlands, New Jersey

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Continental Shelf Sea Surface Temperature Survey (Tiburon Marine Laboratory): J. L. Squire, Jr. 2. Atlantic Shelf Sea Surface Temperature Survey (Sandy Hook Marine Laboratory): J. R. Clark	Grumman HU-16-E Albatross

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	11-6-64
REVISED	8-30-70

FACILITY: Fish and Wildlife Service
U.S. Department of the Interior

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Grumman HU-16-E		~ 150 mph	Operate @ 500 ft			All year	U.S. Coast Guard, used once/mo

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Continental Shelf Sea Surface Temperature Survey (Tiburon Marine Laboratory): J. L. Squire, Jr.
2. Atlantic Shelf Sea Surface Temperature Survey (Sandy Hook Marine Laboratory): J. R. Clark

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	110 V, 60 Hz rotary inverter; 27 V dc

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
Project No. 1								
A. Sea surface temperature	IR radiometer	Barnes Engr. Co. Model IT-2			50 or 500 msec	#2	110 V, 60 Hz, 25 W	8 to 13 μ band pass
B. Sea surface temperature	IR radiometer	Barnes Engr. Co. Model 14-312		± 1°F		#2		
Project No. 2								
C. Sea surface temperature	IR radiometer	Barnes Engr. Co. Model IT-1			2.8 msec	#3		8 to 13 μ band pass, 2° × 2° FOV

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Strip chart recorder	Varian Assoc. G-11	½ to 2 in./min	1	A	110 V, 60 Hz, < 10 A	
2. Strip chart recorder	Varian Assoc. G-14			B, C		
3. Recorder				D		

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
Intermountain Forest and Range Experiment Station
Northern Forest Fire Laboratory
Missoula, Montana

Source: Donald Fuquay

Date: 8/26/70

PROJECT SUMMARY

1. Lightning Fire Research (Project Sky Fire).

2. Fire Detection and Mapping (Project Fire Scan). This project, directed by S. N. Hirsch, is also conducted by the Fire Laboratory. A King Air and an Aero Commander are each equipped with infrared scanning devices and photographic printers and displays.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	7-29-64
REVISED	8-26-70

FACILITY: Forest Service, U.S. Department of Agriculture
Northern Forest Fire Laboratory

ADDRESS: Intermountain Forest and Range Experiment Station,
Missoula, Montana

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
1. Lightning Fire Research (Project Sky Fire): D. Fuquay	Cessna 180 Cessna 182 Cessna 205 Cessna 207

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

1. Aircraft-to-ground communication available on Forest Service VHF equipment.
2. Two modified SO-12 (3 cm) mobile radar (ground based) used for precipitation cell location.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	7-29-64
REVISED	8-26-70

FACILITY: Forest Service, U.S. Department of Agriculture, Northern Forest Fire Laboratory **ADDRESS:** Intermountain Forest and Range Experiment Station, Missoula, Montana

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	Cessna 180, 182, 205, 207		~ 130 mph	~ 20,000 ft		Johnson-Bell Field		Contracted from commercial operator

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Lightning Fire Research (Project Sky Fire): D. Fuquay

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE Standard A/C instruments

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Temperature	Thermistor bridge	Developed in-house	-20 to +20°C; 0 to +40°C	± 0.25°C	< 1 sec	Meter	Battery	
B. Altitude	Altimeter					Meter		
C.	Silver iodide detector (cold box, 0 to -25°C)	Meteorology Research, Inc.						
D.	Silver iodide smoke generator	Developed in-house	4 to 8 gallons AgI/NaI solution/hr				12 V dc, 2 A	Uses up to 10% AgI solution
E. Field, field changes, VHF, and luminosity	Solid state detectors and VHF receivers	Developed in-house				14-channel tape recorder	12 V dc, 40 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Ames Research Center
Moffett Field, California 94035

Source: Earl V. Petersen, Research Scientist

Date: 9/17/70

NASA LEAR JET AIRBORNE LABORATORY

NASA has available a Lear Jet aircraft for research. The aircraft is based at NASA Ames Research Center, Moffett Field, California. Because of logistics support problems, strong justification is required to operate the aircraft other than from Moffett Field. Where range or endurance is important to a mission, however, other airports can be used for refueling before returning to Moffett Field. Space for experimentation is available in response to proposals by investigators. Details of proposal procedures are included in *NASA Lear Jet Airborne Laboratory Experimenter's Handbook*, which is available to interested experimenters from the Airborne Science Office, NASA Ames Research Center, Moffett Field, California 94035. These procedures are also included in *Opportunities for Participation in Space Flight Investigations*, NHB 8030.1A.

The Lear Jet is a six-passenger, twin-engine aircraft with a maximum operating range of ~ 1700 n mi, a total flight endurance in excess of 3 hr, and a practical operating ceiling of 45,000 ft.

Dimensions of cabin and luggage compartment are: 4 ft wide, 12.25 ft long. With maximum fuel, the aircraft can carry up to 300 lb of observation equipment and two observers.

Two special hatches (which replace the starboard, over-wing emergency exit hatch) are provided for upward viewing. Each hatch has a maximum circular clear aperture of 14.75 in. One hatch has the equipment mounting flange at an elevation angle of 22°; the flange on the other hatch is at a 45° elevation. Optical windows or open-port pressure vessels (which can contain telescopes, etc.) up to the 14.75 in. aperture may be attached to the flanges. In addition to the special hatch, there is one 24 in. long by 17 in. high Plexiglas window on each side of the cabin. There are currently no convenient nadir ports, but provisions for these are currently being studied. A gyro-stabilized mirror providing a line-of-sight stability of better than 10 arc sec is available for astronomy or geophysics experiments. Approximately 1 KVA of 60 Hz or 400 Hz, 115 V ac, and 30 A of 28 V dc are available for the experimenter.

NASA CV-990 AIRBORNE LABORATORY

NASA currently operates a Convair 990 aircraft for research. This is a four-engine, high-altitude, medium-range, subsonic jet transport. It is a manned laboratory capable of carrying scientific personnel with instruments and equipment for making airborne scientific observations and performing space science and aeronautical research. The aircraft is based at the NASA Ames Research Center, Moffett Field, California, and is capable of operation from any airport which normally serves four-engine jet aircraft. Space for experimentation is available in response to proposals by investigators. Details of proposal procedures are included in *NASA CV-990 Airborne Laboratory Experimenters' Handbook*, which is available to interested experimenters, from the Airborne Science Office, NASA Ames Research Center, Moffett Field, California 94035. These procedures are also included in *Opportunities for Participation in Space Science Flight Investigations*, NHB 8030.1A.

The approximate cabin dimensions are: 92 ft long, 10.5 ft wide, and 7 ft high. A photographic darkroom in the rear of the cabin can be used for changing, but not for processing, film. A maximum of 44 seats can be installed for the convenience and safety of the experimenters.

The maximum cruising speed is 540 kt. The cabin is pressurized to ~ 8000 ft when the aircraft is at 40,000 ft altitude. The payload capability is about 20,000 lb, and the maximum range is 3300 n mi at altitudes above 35,000 ft. For those missions not requiring heavier payloads, the aircraft can accommodate 14,000 lb at 40,000 ft for periods up to 2 hr.

A specially tuned autopilot provides a ± 15 arc min stability for each axis in smooth air. Special inputs can be made for flying smooth predetermined curved paths. Navigation is accomplished by celestial, Loran, and doppler radar, and by inertial navigation system (Litton LTN-51).

There are 89 passenger windows, each ~ 10 in. wide and 14 in. high, at an elevation angle of 14°. These windows are untinted double Plexiglas for which transmissivity curves are available. Nine of these passenger window apertures have been modified to accept optical glass. Windows of soda-lime glass, antireflection coated, flat to 4 fringes, and parallel to 0.001 in. are available for experimenters' use. Quartz windows are also available. In addition, there are 13 special viewing windows, 12 in. wide and 14 in. high, at an elevation angle of 65°. Windows with the same optical specifications as stated above are standard equipment. In addition to 65° ports, two zenith ports and six nadir ports have been installed. These ports have the same approximate dimensions as the 65° ports and are also designed to accept optical quality glass.

There are 16 electrical wall outlets, each with two AN connectors--one for 400 Hz, 110/220 V, 3-phase power, and one for 60 Hz (± 0.25%), 115 V (± 1%) power. A maximum of 2.5 kVA of 400 Hz power and 2 kW of 60 Hz power is available from any one outlet. Special wiring is required for additional amounts of power. Twenty-eight volts dc is supplied through transformer-rectifier units. Acid type batteries are not permitted. There are 25 electronics equipment racks, specially designed for the CV-990, available for use by experimenters. Each rack has 70 in. of available panel space and can accommodate up to 400 lb of equipment.

An experimenter's coordination console is used to control power distribution to various experiment stations in the main cabin. In addition, a timing system synchronized with WWV (National Bureau of Standards' radio) provides timing signals to the individual experiments. An interphone system connects each experiment station to the coordinator's console. The console can, in turn, communicate to the navigators and the cockpit and transmit to the ground.

U. S. NAVAL RESEARCH LABORATORY
Atmospheric Physics Branch
Code 8320
Washington, D. C. 20390

Source: J. E. Dinger

Date: 5/1/70

PROJECT SUMMARY

Atmospheric Physics Branch

1. The aircraft phases of cloud physics studies are directed primarily toward an experimental investigation of precipitation processes in clouds. This includes measurements of the ice and water budget in supercooled clouds, relation of number of cloud nuclei to cloud droplets, worldwide distribution of cloud nuclei, and studies of composition of cloud nuclei.

2. Airborne atmospheric electricity research includes studies of ionic mobilities, and fair-weather conduction-current-densities as related to the worldwide variations in these current densities.

ATMOSPHERIC RESEARCH FACILITY

ORIGINALLY ISSUED	4-2-65
REVISED	5-1-70

FACILITY: U. S. Naval Research Laboratory
Atmospheric Physics Branch

ADDRESS: Washington, D.C. 20390

PROJECTS AND PRINCIPAL INVESTIGATOR	A/C TYPES
Atmospheric Physics Branch 1. Cloud Physics Studies: J. E. Dinger 2. Atmospheric Electricity Studies: J. E. Dinger	S2D EC-121-Super Constellations (2)

GROUND STATION PLAYBACK AND DATA PROCESSING EQUIPMENT

TYPE	MANUFACTURER AND MODEL NUMBER	INPUT	OUTPUT	REMARKS

SPECIAL FACILITIES

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-2-65
REVISED	5-1-70

FACILITY: U. S. Naval Research Laboratory
Atmospheric Physics Branch (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	EC-121	135753	210 kt	20,000 ft	16 hr	Patuxent NATC	All year	U.S. Navy, assigned to NRL

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Cloud Physics Studies: J. E. Dinger
2. Atmospheric Electricity Studies: J. E. Dinger

NAVIGATION SENSORS AND RECORDERS

POSITION	Visual and TACAN
ALTITUDE	Readings of duplicate A/C indicators manually annotated on Brush recorder chart
HEADING	
AIRSPEED	

AIRCRAFT ELECTRIC POWER	110 V, 60 Hz, 3 kW inverters (2); 110 V, 60 Hz, 1000 kW inverters (2); 110 V, 400 Hz, 8 kW inverter; 3-phase; 110 V, var. freq., ~ 30 kW, 28 V dc, 1200 A

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Liquid and water vapor content	Ly_{α} detector and dew point sensor	Developed in-house	10% relative humidity to 4 gm/m^3 liquid	Dew point ± 0.5°C	0.1 sec	#1	110 V, 60 Hz, 24 V dc, < 1 A	
B. Electric field	Rotating shutter 3 axis system (4 units)	Developed in-house	0.5 to 0.5 × 10^6 V/m	10% absolute, 1% relative	~ 0.5 sec	"	110 V, 60 Hz, 300 W	
C. Atmospheric conductivity	Electrometer with Gerdien condenser	Applied Physics Corp. Model 33A	< 1×10^{-14} to > 50×10^{-14} mho/m	± 2%	~ 0.5 sec	"	110 V, 60 Hz, 50 W	
D.	Modified Blackwood ion mobility spectrometer	Developed in-house	0.1 to 20 cm^2/V sec	± 6%	1 spectrum/ 20 min	#2 and #3	110 V, 60 Hz, 100 W	
E. Condensation nuclei	Cloud chamber	ASR-3				Meter	Battery	
F. Temperature	Vortex thermometer	Developed in-house	-90° to +50°C	± 1°C	1 sec		110 V, 400 Hz, 1 A; 24 V dc, 2 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. Hot stylus recorders (2)	Brush Instruments		6 analog plus 2 events each	A-C, H-J, L, M	115 V, 60 Hz, 340 W	
2. Self-balanced potentiometer recorder	Varian Associates			D		
3. Frequency meter	General Radio Co.			D		
4. 16-mm cloud camera	Bell & Howell P-200	Intervalometer controlled		Cloud pictures		

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-2-65
REVISED	5-1-70

FACILITY: U. S. Naval Research Laboratory, Atmospheric Physics Branch (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	EC-121	135753 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G. Temperature, humidity, pressure	Aerograph	AMQ-13						
H. Altitude	Standard sensitive duplicate of A/C unit					#1, chart		Recorded
I. Airspeed	Standard A/C unit					"		"
J. Heading	A/C flux gate compass repeater					"		"
K. Radar echo	Radar	APS-42						
L. Time	Standard A/C clock					#1		
M. Events	4 switches to indicate significant flight events					#1		

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-2-65
REVISED	5-1-70

FACILITY: U. S. Naval Research Laboratory, Atmospheric Physics Branch (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	EC-121	135753 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

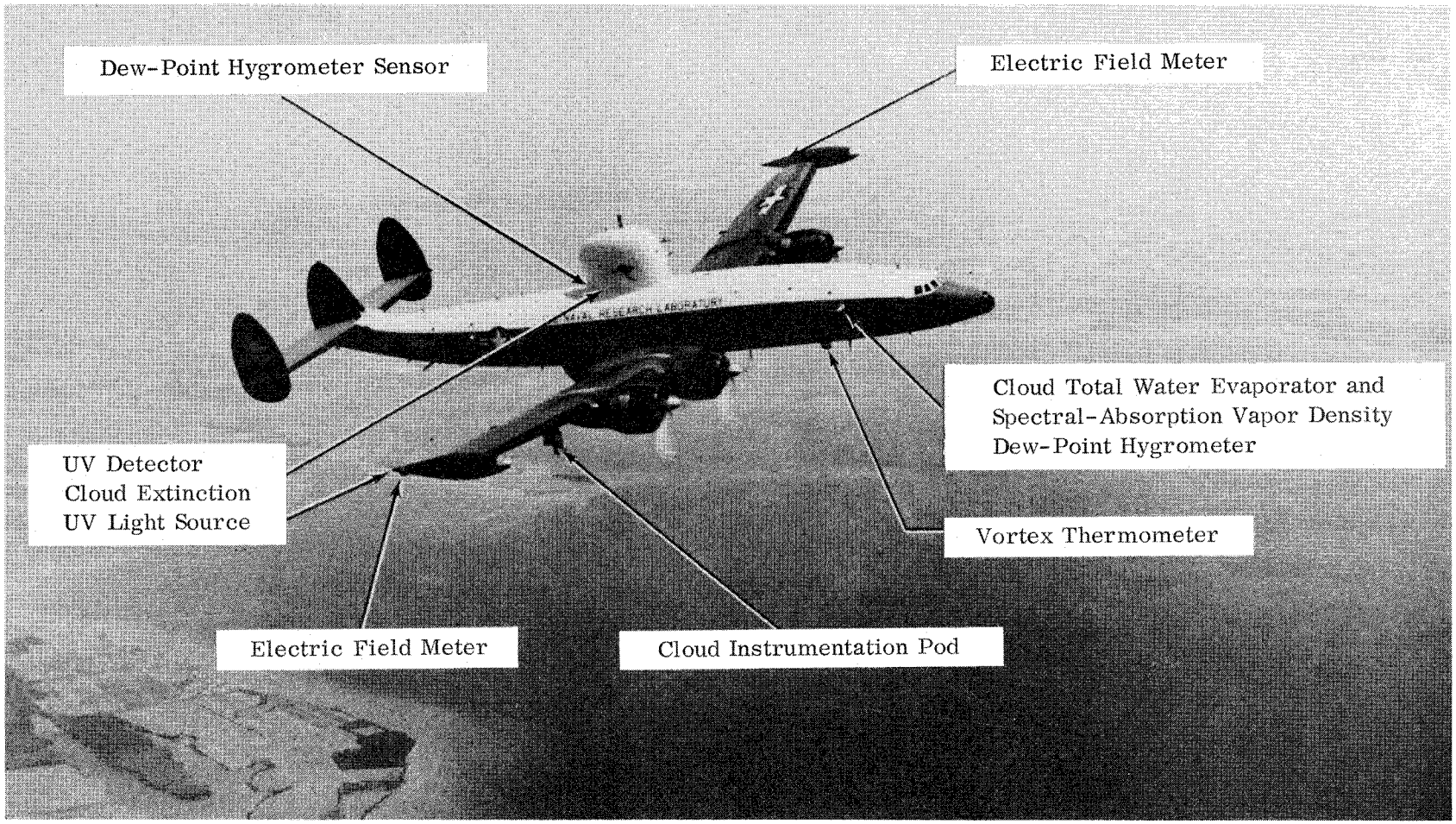
AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
N. Aircraft charge	Exhaust dischargers	Developed in-house						Grid near A/C exhaust flow controls A/C charge
O. Cloud particles	Formvar continuous replicator	"						Replica recorded on film
P. Light extinction by cloud	Light source on wing tip; sensor on fuselage	"						This measurement together with "A" gives average droplet radius
Q. Cloud nuclei	Thermal diffusion chamber	"						Manually operated and recorded

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS



The U.S. Naval Research Laboratory's EC-121 Super Constellation.

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

ORIGINALLY ISSUED	4-2-65
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FACILITY: U. S. Naval Research Laboratory, Atmospheric Physics Branch (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	S2D	149240	150 kt	18,000 ft	7 hr	NAF, Andrews AFB	All year	U.S. Navy, assigned to NRL

PROJECTS AND PRINCIPAL INVESTIGATOR

1. Cloud Physics: J. E. Dinger

NAVIGATION SENSORS AND RECORDERS

POSITION	TACAN and ADF; visual reference to areas of interest, APS-88 radar
ALTITUDE	
HEADING	See photo panel instrumentation
AIRSPEED	

AIRCRAFT ELECTRIC POWER	110 V, 400 Hz, 100 A; 24 V dc, 100 A; 110 V, 60 Hz, 175 W

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
A. Altitude	Standard A/C altimeter (duplicate)					Photo panel		
B. Airspeed	Standard A/C indicator (duplicate)					"		
C. Heading	Flux gate unit on A/C					"		
D. Vertical acceleration	Standard military unit (duplicate)		-4 to +10 g	± 0.25 g		"		
E. True air temperature	Vortex thermometer	Developed in-house	-90 to +50°C	± 1°C	1 sec or ~ 15 sec	"	110 V, 400 Hz, 1 A; 24 V dc, 2 A	
F. Liquid water content	Hot wire bridge	Johnson-Williams	0 to 4 gm/m^3	± 20%	0.6 gm/sec	"	110 V, 400 Hz, ~ 1 A; 24 V dc 20 A	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS
1. 16-mm camera	Modified Traid	4 to 16 ft/sec		Photo panel	24 V dc, 50 W	Motor driven
2. Magnetic tape recorder	Standard U.S. Navy unit UNH-1		2	Voice	100 V, 400 Hz, 25 W; 24 V dc, 75 W	
3. Strip chart recorder	Brush Instruments		2	Various channels	110 V, 60 Hz, 90 W	

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

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FACILITY: U. S. Naval Research Laboratory, Atmospheric Physics Branch (continued)

ADDRESS:

AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	S2D	149240 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
G.	Project control switches in photo panel					Photo panel		
H. Time	Standard A/C clock					"		
I. Velocity, acceleration, heading	VGH recorder	NACA-developed		± 2 kt, ± 0.05 g, ± 1°		"	110 V, 400 Hz; 24 V dc	
J.	Dropsonde chute							
K. Cloud particles	Moving tape sampler	Meteorology Research, Inc.	3 to 30 μ				24 V	Developmental instrument
L. Liquid and water vapor content	Rapid-response Ly_{α} detector	Developed in-house	10% relative humidity to 4 gm/m^3 liquid	Dew point: ± 0.5°C	0.1 sec	#3	110 V, 400 Hz; 24 V	Developmental instrument
M.	Aerosol dispenser	Developed in-house	10 gallon/10 sec				24 V	10 gallon liquid capacity

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

ATMOSPHERIC RESEARCH INSTRUMENTATION AND AIRCRAFT DATA

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AIRCRAFT	TYPE	REGIST. NO.	CRUISING SPEED	OPER'NL CEILING	RANGE	HOME BASE	OPERATING SEASON	AIRCRAFT OWNER
	S2D	149240 (cont.)						

PROJECTS AND PRINCIPAL INVESTIGATOR

NAVIGATION SENSORS AND RECORDERS

POSITION

ALTITUDE

HEADING

AIRSPEED

AIRCRAFT ELECTRIC POWER	

AIRBORNE INSTRUMENTATION

PARAMETER	INSTRUMENT TYPE	MANUFACTURER AND MODEL NUMBER	RANGE	ERROR	TIME CONSTANT	ON-BOARD RECORDER	POWER REQUIRED	REMARKS
N. Aerosols	Sampler, 8 sequential filters	Developed in-house					24 V	70 mm diam filters
O. Aerosols	Sampler, moving filter tape						"	Variable speed (1 in./sec nominal)
P. Precipitation	Moving foil	Meteorology Research, Inc.	15 min to 1 hr sampling time			Photo panel	"	
Q. Condensation nuclei	Cloud chamber	ASR-3				Photo panel	"	
R. Cloud extinction	Scattering of UV	Developed in-house					"	

ON-BOARD RECORDING AND DISPLAY EQUIPMENT

RECORDER/DISPLAY TYPE	MANUFACTURER AND MODEL NUMBER	SPEED	NUMBER OF CHANNELS	INSTRUMENT INPUTS	POWER REQUIRED	REMARKS

Aircraft and Instrumentation in Atmospheric Research - Link Page

NEXT.....PART 2.....