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NASA Quiet Short-Haul Research Aircraft Experimenters' Handbook

Robert C. McCracken

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NASA Quiet Short-Haul Research Aircraft Experimenters' Handbook

Robert C. McCracken, Ames Research Center, Moffett Field, California

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Ames Research Center
Moffett Field, California 94035

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NASA QUIET SHORT-HAUL RESEARCH AIRCRAFT:

EXPERIMENTERS' HANDBOOK

Robert C. McCracken

Ames Research Center

SUMMARY

A summary of guidelines and particulars concerning the use of the NASA-Ames Research Center Quiet Short-Haul Research Aircraft for applicable flight experiments is presented. Included are procedures for submitting experiment proposals, guidelines for experimenter packages, an outline of experiment selection processes, a brief aircraft description, and additional information regarding support at Ames.

1. INTRODUCTION

NASA's Quiet Short-Haul Research Aircraft (QSRA), shown in figure 1, is used as a flight-test facility for advanced flight experiments in terminal-area operations. The QSRA is in no sense a prototype; it was specifically designed to serve as a research vehicle. In terms of both configuration and systems the aircraft is optimized for low-speed operation; for example, the wing leading-edge flap and landing gear are fixed in the low-speed position. In this configuration, the QSRA cannot achieve usual transport airplane cruise velocities. The fuselage and empennage are from the deHavilland C-8A Buffalo, and the wing is a new design, utilizing upper surface blowing to achieve high lift. The airplane was delivered to Ames Research Center (ARC) in August 1978.

NASA is vigorously pursuing a program to improve the QSRA and to conduct research in a number of areas (flight dynamics, handling qualities, control criteria, certification criteria, validation of prediction methods, operating systems, performance, acoustics, vortex measurement). A modest guest-pilot evaluation effort is also planned.

It is recognized that other NASA centers, as well as various organizations outside of NASA, may have research requirements that are compatible with QSRA capabilities. Consequently, this handbook has been prepared to acquaint potential QSRA experimenters with the various procedures associated with submitting proposed experiments, what the proposals should contain, and the manner in which proposed experiments will be evaluated and selected. In addition, the QSRA is briefly described; equipment requirements and installations are discussed; and support facilities and personnel, available at Ames Research Center, for QSRA-related research, are identified.

2. PROPOSAL PROCEDURES

2.1 General Comments

Experiments involving the QSRA can be divided into two broad classes: operational experiments and configuration-oriented experiments.

Operational experiments utilize the airplane in its normal configuration. Designed to explore operating techniques or systems, these experiments require no modifications to the airplane that would alter its present configuration; however, they might require some additional data collection that would require changes in the airborne data system. Examples of operational experiments would include measurement of wake vortex, evaluation of noise abatement procedures and studies of multiple-segment approaches.

Configuration change experiments, on the other hand, require modifications to the airplane; thus, they may affect aircraft performance in some way. This would include changes to the control system, such as spoiler scheduling or modifications to the leading-edge shape.

2.2 Submitting Proposals

Proposals for QSRA experiments by sources outside Ames Research Center are to be submitted in the manner described below. Preliminary inquiries about the suitability of experiments should be sent to the following address:

NASA Ames Research Center
Quiet Short-Haul Aircraft Office
Code FVQ, M/S 237-10
Attention: Experiments Manager
Moffett Field, California 94035

Inquiries may also be made by calling the QSRA Experiments Manager, 965-6093 (FTS 448-6093).

Formal applications require that a QSAO FORM FVQ-1 (see appendix) be completed and submitted to the above address.

2.3 Proposal Evaluations and Selection

All proposed experiments will be reviewed by a committee composed of experts selected from ARC Aeronautics and Flight Systems Directorate. The intent is to ensure that selected experiments are compatible with QSRA capabilities and that their subject matter and objectives are appropriate and significant. In the event that more experiments are proposed than can be handled, the relative importance of the experiments will be determined within the Directorate and priorities assigned accordingly.

2.4 Proposal Contents

Written proposals should be as brief as possible, consistent with clarity and completeness. Extraneous material serves principally to delay evaluation. Proposals should contain the following information.

2.4.1 Technical data— The following data will be required to determine acceptability and compatibility:

1. Scientific or engineering objectives: present state of knowledge, what can be gained by use of the QSRA, interest or application of results to science or to related technology.
2. Techniques: experimental approach, methods and procedures.
3. Logistics: flight hours and duration of flights; location (if not at Ames or Crows Landing); any unusual flight planning, such as nonstandard approach path or departure profile; unusual ground aids, such as landing guidance.
4. Experimental equipment: description of any unusual flight hardware to be installed on QSRA, including envelope, power requirements, weights, environmental constraints, and location on airplane.
5. Special instrumentation: added data acquisition parameters or data reduction, or both.

2.4.4 Management data- Names, titles, and addresses of the principal and co-investigators should be included in the proposal. In some cases, resumes of the investigators might aid in the evaluation of the proposal.

A cost proposal should be submitted if NASA financial support is requested. The proposal should not include costs for operating the airplane (funded internally by NASA).

In general, NASA provides engineering coordination, material handling (such as cranes and operators), a nominal amount of mechanical and electrical technician support for installation of equipment, and relevant data (expressed in engineering units).

2.5 Procedure After Acceptance of Proposal

If a proposal is approved, the Quiet Short-Haul Aircraft Office (QSAO) assumes responsibility for implementing the experiment. An engineer, assigned to the experiment, will contact the experimenter (in some cases, an assigned engineer may contact the experimenter before the proposed experiment is approved). He will be the point of contact between the Office and the experimenter with regard to all details of the experiment.

2.6 Airworthiness Assurance

All experimental hardware to be flown on the QSRA must be approved by the Ames Airworthiness Assurance Office prior to installation. If nonstandard flight regimes or techniques are to be used, they too are subject to review. The assigned QSAO engineer will assist the experiment proposer in obtaining this approval.

3. AIRCRAFT DESCRIPTION

3.1 Basic Aircraft

The QSRA, a four-engined aircraft, has a gross weight at takeoff between 50,000 and 60,000 lb. It is generally similar to other turbine-powered aircraft except that is uses engine thrust, turned by the upper surface blowing (USB) flaps, to provide lift augmentation. It is a research vehicle, and as such is fixed in the approach configuration with nonretractable leading-edge flaps and fixed landing gear. This limits its maximum speed to 160 knots (190 knots maximum dive speed). The crew is limited to two: a pilot and copilot. The airplane is described in considerable detail in TM-81149; a three-view drawing is provided in figure 2.

3.2 Recent Aircraft Modifications

Some changes have been made to the QSRA since TM-81149 was written. Auxiliary fuel tanks have been added; combined with the main tanks, they provide 15,669 lb of usable fuel. This fuel capacity allows research flight times of about 2.25 hr, with reserves.

The lateral stability and control augmentation system has been modified to provide roll-angle hold; roll rate is proportional to wheel force. A change in horizontal tail angle of incidence to reduce the elevator required for nose-up motion has been incorporated, thereby reducing the stick movement requirement to offset nose-down pitching moments generated by flow-turning at high power settings and a low speed on approach. The aerodynamic properties may have been affected by this modification, but the extent of any such changes has not yet been documented.

3.3 Aft Cabin Space

Addition of the auxiliary fuel tanks has reduced available floor space in the fuselage. Although the tanks are removable, with difficulty, their removal reduces the QSRA fuel capacity by 5,200 lb. A sketch showing the available space in the cabin is shown in figure 3.

As it is difficult to locate any additional equipment near the airplane center of gravity, experimental packages of any significant weight change the aircraft c.g., thus requiring that ballast be added to or deleted from the aft fuselage. Appropriate provisions have been made in the form of bolt-on weights that attach to stiffeners on the fuselage skin near the tail. The center of gravity under normal conditions is near body station 370.

4. EQUIPMENT CONSTRUCTION AND INSTALLATION

4.1 General

If experiments require the use of investigator-furnished equipment, it is necessary that the equipment be designed to meet standards set forth by the Airworthiness Assurance Office. The means by which the experiment packages are installed in the airplane, the power they use, and their construction must be approved by the Airworthiness Assurance Office, as mentioned earlier. The requirements set forth in the following sections are usually strictly enforced.

4.2 General Arrangement

The area available for installation is shown in figure 3. Care should be taken to ensure that an aisle is kept open down the center of the cargo floor. Figure 3 also shows the locations of available tie-down rings and existing installations within the cabin. Instrumentation pallets are permanently installed, but the fuel tanks can be removed (with some difficulty) if required.

1. The cabin, which extends from Arm 161.45 to Arm 538.63, has a volume of 1,510 ft. The width at the floor is about 90 in.; it widens to 103 in. about 1 ft above the floor. There is a cargo door, aft of the cabin. It consists of a large door hinged at the rear which opens up into the fuselage; a ramp door, which is hinged at its forward edge and opens downward, serves as a ramp to the cabin floor. The horizontal arm locations, stenciled on the cabin walls above window level at 20-in. intervals, aid in locating experiment centers of gravity.
2. The cabin floor is constructed of aluminum alloy skin over balsa. The overall loading limit is 200 lb/ft^2. The local footprint pressure of individual load items must not exceed 1,000 lb/ft^2, or at the same time 1,500 lb per running foot.
3. Weight added forward of the aircraft c.g. must be compensated for by ballast at the rear of the airplane. If the experiment package can be located aft of the center of gravity, ballast can be reduced. (The QSRA c.g. is near body station 370.)

4.3 Load Factors

All equipment intended for use on the QSRA must be designed to meet the load conditions listed below. These design load factors, when applied one at a time, must not produce a stress in any element of the equipment beyond the yield point for the material. These requirements are for structural design; it is not necessary that alignment, calibration, or operation be maintained under these load conditions.

Load direction	Design load factors
Forward	9.0 g
Upward	2.0 g
Sideward	2.0 g
Downward	4.5 g

4.4 Construction Guidelines

Guidelines to be used in the construction of experimenter-built equipment are provided in the following sections. Table 1 lists specifications and standards to be used as guidelines.

4.4.1 Materials- Structural materials should be used in the design of experimental packages. Aluminums, such as 2024-T3, 6061-T4, and 6061-T6 are readily available for this purpose. (Note that the dash-number, e.g., -T3, specifies the heat threatment and strength properties of the material.) The experimenter is not, of course, limited to these materials.

Experimenters must avoid using flammable materials or materials that give off toxic fumes when heated, in the design of equipment. Cabling external to commercial electronic components should have self-extinguishing insulation, such as polyvinyl chloride (PVC), Teflon, or Kapton; existing cables can be sleeved with PVC, for example, to avoid rebuilding them. Accessories, such as cable ties, clamps, or identification sleeves, should be of a similar material (e.g., Teflon).

Corrosive liquids should not be used in an experiment (e.g., in cooling systems or battery power supplies). Approval to use other types of batteries must be obtained in advance from the Ames Airworthiness Assurance Office.

4.4.2 Welding- Welding of structural members of experiment equipment is acceptable, although bolting or riveting is preferred. Welding must be performed by a welder currently certified to the MIL-T-5021C specification; and the assembly should then be heat-treated, if full joint strength is required.

4.4.3 Fasteners- Aircraft structural fasteners (MS or NAS, or equivalent) must be used for all structural members, and they must be secured by self-locking nuts, lock washers, or safety wire. A listing of some preferred fasteners is given in Tables 2 and 3.

4.4.4 Hydraulic or pneumatic systems- Lines and fittings should be of aircraft quality or equivalent. Hydraulic fluids should be nonflammable and noncorrosive. The aircraft hydraulic systems use fluid per MIL-H-5606.

4.4.5 Aircraft vibration- Vibration frequencies and amplitudes imparted to experimental equipment cannot be specified with accuracy because of the widely varying contributions of different mounting structures. However, in-flight vibrations are generally not a problem for experiments. Experimenters should consider that the most severe vibration (other than air turbulence) occurs during takeoff and landing. For example, on rough runways, printed circuit cards and connectors can become dislodged; because in-flight repair is impossible, they should be mechanically supported by clamps or brackets.

5. ELECTRICAL POWER

5.1 General Specifications

The QSRA is equipped with 115 V, 400 cycle ac, and 28 V dc electrical systems for airplane use. A limited amount of 26 V, 400-cycle ac power is also generated for instrument power. No specific power distribution system is provided for experimenters; however, power supply capability exceeds QSRA needs in both the 115 V ac and 28 V dc systems and excess power will be made available. Requirements should be made known to the QSAO staff as soon as possible so that necessary wiring and circuit breakers can be incorporated.

5.2 Power Sources

Each of the four engines of the QSRA drives a 15 kVA 115/200 V 400 Hz three-phase generator through a constant-speed drive, providing power to 4 ac buses, which operate independently. Various automatic and manual switching possibilities allow operation (with reduced load capability) with one or more generators inoperative. Transformers on the 115 V ac buses provide 26 V ac single-phase power. Transformer-rectifier units furnish 28 V dc to a left and right bus.

The following table indicates existing loads on various buses:

Source	Rating	Load	Available
Left			
115 V, 400 Hz, 3Ø wye	30 kVA	15 kVA	15 kVA
115 V, 400 Hz, 3Ø delta	750 VA	240 VA	510 VA
26 V, 400 Hz, 1Ø	1 kVA	300 VA	700 VA
28 V dc	200 A	50 A	150 A
Right			
115 V, 400 Hz, 3Ø wye	30 kVA	15 kVA	15 kVA
115 V, 400 Hz, 3Ø delta	750 VA	140 VA	610 VA
26 V, 400 Hz, 1Ø	1 kVA	200 VA	800 VA
28 V dc	200 A	50 A	150 A

External power (115/200 V ac, 400 Hz) is available on the ground from a cart; an external power plug permits ground operation of aircraft electrical systems when the aircraft's engines are shut down. A 34-A-hr battery is provided on the airplane as an alternative dc source.

Both the ac and dc systems use the aircraft structure for ground.

5.3 Electromagnetic Interference (EMI)

The airplane power grounding system minimizes the likelihood of generating ground loops within the airplane structure. In addition, functional testing of all airplane systems was performed on the QSRA prior to flight to ascertain that no EMI present was sufficient to influence flight operations. It is nevertheless incumbent upon the experimenter to ensure that minor voltage transients such as those usually present in aircraft power systems will not adversely affect experimental equipment. In addition, it must be ensured that normal operation of experimental packages cannot adversely affect other experiments or airplane systems.

Experimenters are reminded that airplane transmitters, such as VHF and UHF communications, radar transponders, and telemetry transmitters, will be operating during flight. Also, equipment within experimental packages must not interfere with aircraft receivers; outputs of such packages must be limited to 100 mW.

It is suggested that signals to the FTIS be shielded twisted pairs. Signal wiring should not be located close to power leads. Any high-impedance detector leads may pick up noise from rf fields existing in the airplane.

If the experimental package utilizes signals from any airplane system, such as electronic control outputs or airspeed transducers, these signal inputs must be buffered to preclude signal contamination being reflected back into the airplane systems. The QSAO engineers can provide limited advice in these areas.

6. FLIGHT TEST INSTRUMENTATION SYSTEM

6.1 General Description

The QSRA is equipped with a high-speed data system that comprises transducers, signal conditioning equipment, a telemetry transmitter, and a tape recorder. This system measures, transmits, and records significant airplane parameters for real-time or after-the-fact analysis.

The flight-test instrumentation system (FTIS) operates as follows: Data from the transducers are transmitted to analog and digital signal conditioning systems. The signals then go to one of two remote multiplexer-digitizer units (RMDU). The signals are then recorded along with a time code, generated on board by a time code generator. The data from one of the two RMDU outputs are also telemetered to a ground station for real-time data monitoring. A more detailed description of system components is presented in the following sections.

6.2 Sensors and Transducers

Numerous sensors and transducers, such as thermocouples, pressure transducers, strain gauges, servos, potentiometers, and accelerometers are installed on the QSRA to measure parameters of interest.

6.3 Tape Recorder

The tape recorder is an Astro-Science (Bell and Howell) airborne wide-band FM recorder model MARS-144 (LT)-3D. The unit, a 14-track analog recorder, uses a 10-in. reel of magnetic tape. A PCM data bit stream from each RMDU and the time-code generator output are recorded on separate tracks. The tape recorder is the limiting component in the FTIS due to its bit-packing density limitation as related to amount of tape available, speed of running, and length of record required for flight data recording during test. The recorder is operated at 7.5 in./sec, which allows about 1.5 hr of full-time data recording; this is generally sufficient to cover one data flight.

6.4 Time-Code Generator

The time-code generator, a Datametrics Model SP-375 Airborne Synchronized Generator, produces an IRIG B output for recording on the tape recorder. The unit will be synchronized with the ground time-code generator for flight tests and can be synchronized with radio station WWV. It can also be synchronized with the ground station while flying, through a radio link.

6.5 Remote Multiplexer-Digitizer Units

These devices accept signals from the active network panels, adjust the gains to appropriate levels, provide analog to digital conversion where required, and encode the data into a pulse code modulated serial bit stream.

6.6 Active Network Panels

The analog and digital active network panels process the transducer signals to make them compatible with the RMDU's. They also contain a Tecnetics power supply module, which provides ±5 V dc for transducer excitation.

6.7 Parameter List

The FTIS currently records the parameters listed in tables 4 and 5. There is limited capability to add additional parameters for specific experiments. RMDU "A" currently has 10 spare analog inputs; RMDU "B" has 7.

APPENDIX

QUIET SHORT-HAUL RESEARCH AIRCRAFT:

EXPERIMENT PROPOSAL

The NASA Ames Research Center Quiet Short-Haul Aircraft Office Form FVQ-1 is reproduced in this appendix. Copies of the form are available at the address given in Part I below.

LOG NO.

QUIET SHORT-HAUL RESEARCH AIRCRAFT
EXPERIMENT PROPOSAL

PART I   Experimenter Complete

Experiment Title:

Principal Investigator(s):	Company or Agency:
Name ____________ Address ____________ ____________ Phone ____________	

Brief Description of Investigation:

NASA Complete	Questions regarding experiments on QSRA should be addressed to:
ARC Contact ____________ Time Frame ____________ Cost Estimate Requester ____________ NASA ____________	NASA Ames Research Center Quiet Short-Haul Aircraft Office M/S 237-10 Moffett Field, CA 94035 Telephone (415) 965-6093 (FTS 448-6093)

QSAO FORM FVQ-1   (Sheet 1)

PART II OBJECTIVES

Describe in detail the objectives of experiment, including justification for using QSRA:

PART III BACKGROUND

Discuss relationship with previous effort and technology, or previous experiments on QSRA:

QSAO FORM FVQ-1A (Sheet 2)

PART IV OPERATIONAL REQUIREMENTS

Describe aircraft operational factors such as unusual flight profiles, maneuvers, landing field conditions, etc.:

PART V AIRPLANE MODIFICATIONS

If any modifications to QSRA (other than data acquisition system) or additional hardware are planned, list here:

QSAO FORM FVQ-1B (Sheet 3)

PART VI DATA REQUIREMENTS

Describe any special data required for the experiment. If this is not included in existing QSRA data system, list special transducers or sensors. Explain any data analysis required in real time:

TABLE 1.- AIRCRAFT WORKMANSHIP SPECIFICATIONS AND STANDARDS

Electrical-Electronic	
MIL-W-5088	Wiring, Aircraft, Selection and Installation
USAF T.O. 1-1A-14	(NAVAIR 01-1A-505) Technical Manual - Installation Practices, A/C Electronic and Electrical Wiring
MIL-STD-454	General Requirements for Electronic Equipment
MIL-E-7080	Electric Equipment, Aircraft, Selection and Installation
MIL-I-8700	Installation and Test of Electronic Equipment in A/C
MIL-E-5400	Electronic Equipment, A/C, General Spec. for
MIL-E-25399	Electrical Systems, A/C Design of, General Spec.
Hydraulic	
MIL-H-5440	Hydraulic Systems, Aircraft, Types I and II, Design and Installation Requirements
Pneumatics	
MIL-P-5518	Pneumatic Systems, Aircraft, Design Installation and Data Requirements
Systems	
MIL-F-9490	Flight Control Systems, Design Installation, and Test
Structure	
USAF T.O. 1-1A-1	General Manual for Structural Repair
USAF T.O. 1-1A-8	A/C Structural Hardware
Parts	
AHB-5328-1	Preferred Parts and Material List

TABLE 2.- PREFERRED FASTENERS FOR USE AT ARC: BOLTS AND NUTS

	STYLE	BASIC P.N.	DIAMETER					COMMENTS
			#4	#6	#8	#10	1/4	
BOLT		NAS1151-G SERIES	–	1151	1152	1153	1154	100°, torque SET
		NAS1141-G SERIES	–	1141	1142	1143	1144	PAN HEAD, torque SET
		NAS1303-G SERIES	–	–	–	1303	1304	HEX HEAD
		MS20074-( )	–	–	–	-03	-04	HEX HEAD, COARSE THD. 125 ksi, LIMITED USE
MACHINE SCREW		NAS1102--( )-L	-04	-06	-08	-3	-4	100°, torque SET
		NAS1100--( )-L	-04	-06	-08	-3	-4	PAN HEAD, torque SET
		NAS563-L SERIES	–	–	–	563		HEX HEAD (FOR RACK LOADING)
NUT		MS21042 ( )	L04	L06	L08	L3	L4	REDUCED HEX
	*	AN315-( )	–	-640	–	-3	-4	PLAIN, HEX
		H23-( )	–	–	–	-3	-3	12-POINT, HIGH TENSILE, KAYNAR MFG. CO.
NUTPLATE		MS21075 ( )	L04	L06	L08	L3	L4	0.02 FLOAT, MINIATURE
		MS21069 ( )	L04	L06	L08	L3	L4	RIGID, MINIATURE
		MS21071 ( )	L04	L06	L08	L3	L4	ONE LEG, RIGID, MINIATURE
		MS21073 ( )	L04	L06	L08	L3	L4	CORNER, RIGID, MINIATURE
WASHER		AN960( )	D4	D6	D8	D10	D416	OMIT D FOR STEEL, ADD L FOR THIN
		AN970-( )	–	–	–	-3	-4	STEEL, FOR WOOD
	*	MS35338-( )	-40	-41	-42	-43	-44	LOCK
		NAS1169-	–	-6	-8	-10	-416	100° DIMPLED

TABLE 3.- PREFERRED FASTENERS FOR USE AT ARC: RIVETS AND PINS

Protruding head Fastener[a]	Material	100° flat head Fastener[a]
MS20470AD( )	2117-T4	MS20426AD( )
MS20470B( )[b]	5056-F	MS20426B( )[b]
MS20470D( )[b]	2017-T3	MS20426D( )[b]
MS20470DD( )	2024-T31	MS20426DD( )
MS20615-( )M	Monel	MS20427M( )
	2117-T4	NAS1097AD( )[b]
	2024-T31	NAS1097DD( )[b]
RV800-( )	2017-T4	RV801-( )
RV890-( )	Monel	RV891-( )
NAS1669-( )L	Steel	NAS1670-( )L
HL20PB-( )Pin HL86-( )Collar	Steel	HL21PB-( )Pin HL86-( )Collar

[a]Fastener Code per NAS 523: HL( ) = Hi-Lok, Hi-Shear Rivet Tool Co., Torrance, Calif.; NAS1669 = Jo-Bolt, Voi-Shan Mfg. Co., Culver City, Calif.; RV( ) = Blind Rivet, Olympic Screw & Rivet Corp., Downey, Calif.

[b]Indicates limited usage.

TABLE 4.- FLIGHT-TEST INSTRUMENTATION PARAMETERS — RMDU/A

Parameter	Number of measurements	Comments
Airplane environment		
Acceleration — c.g.	3	Lateral, longitudinal, normal
Flight-path angles	3	Pitch, roll, heading
Angle of attack	1	Nose boom
Sideslip	1	Nose boom
Altitude	2	Nose boom, radio
Airspeed	2	Nose boom, J-TEK
Altitude rate	1	Radio altimeter
Total temperature	1	
Angular rates	3	Pitch, roll, yaw
Wing vertical acceleration	2	Left wing, front, and rear spar
Accelerations, stabilizer	3	Left tip chordwise, left front spar, and right front spar vertical
Accelerations, vertical stabilizer	3	Lateral: Fin tip forward and rear, midspan
Primary flight controls		
Control forces	3	Column (stick), pedal, wheel
Control positions	3	Column (stick), pedal, wheel
Surface positions	4	Elevator, aileron (2), rudder
Spoiler position	4	Left and right inboard, outboard
Flap positions	6	2 USB inboard, 2 USB center, 2 outboard
Trim actuator position	2	Elevator, rudder
Automatic flight controls		
Servo command	3	Pitch, roll, yaw
SAS actuator position	3	Pitch, roll, yaw
Fuel system		
Totalizer	4	Fuel used, engines 1, 2, 3,4
Fuel temperature	4	Engines 1, 2, 3, 4
Fuel flow	4	Engines 1, 2, 3, 4
Propulsion		
Fan speed (N_1)	4	Engines 1, 2, 3, 4
Core speed (N_1)	4	Engines 1, 2, 3, 4
Total pressure (5.4)	4	Engines 1, 2, 3, 4
Total pressure fan exit	4	Engines 1, 2, 3, 4
Total pressure fan exit	4	Engine 2, circumferential
Fuel pressure, inlet	4	Engines 1, 2, 3, 4
Total temp. IGT (4.1)	4	Engines 1, 2, 3, 4, double precision
Power lever angle	4	Engines 1, 2, 3, 4

TABLE 4.- Concluded

Parameters	Number of measurements	Comments
Boundary-layer control system		
Calibration duct dynamic pressure	4	Engines 1, 2, 3, 4
Calibration duct static pressure	4	Engines 1, 2, 3, 4
Static pressure in duct	4	2 LE, 2 aileron
Refer to copilot's static pressure		
Static pressure — BLC duct	4	LH and RH glove and between nacelle
BLC duct total temperature	4	Engines 1, 2, 3, 4
Miscellaneous		
Landing gear oleos	3	Right and left main, nose
Event marker	1	Pilot's wheel
Time — IRIG B	1	

TABLE 5.- FLIGHT-TEST INSTRUMENTATION PARAMETERS — RMDU/B

Parameters	Number of measurements	Comments
Airplane environment		
Acceleration, pilot's seat	2	Normal, lateral
Acceleration, aft body	2	Vertical, lateral
Temperature, wing rear spar	1	Aft of engine No. 3
Temperature, heat shield	1	Aft of engine No. 3
Temperature, wing skin	1	Aft of engine No. 3
Temperature, trailing-edge panel	3	Wing station 105, 110, 115
Flight controls		
Flap position	6	All surfaces
Spoiler position	4	All surfaces
Flap actuator pressure feedback	6	
Flap handle position	2	Outboard, USB
Column force (CAS)	1	To SAS
Speedbrake handle position	1	
Wheel position (CAS)	1	
Lateral flight-control actuator pressure	1	
Hydraulic system		
Hydraulic pressure	2	Systems A and B
Pump pressure	2	Engines 1 and 2
Suction pressure	1	System A
Case drain temperature	1	System C
Propulsion		
Throttle positions	4	Engines 1, 2, 3, 4
Miscellaneous		
Fuel tank pressure	1	
ECS bleed air pressure	1	
USB beep switch	2	Retract/extend - discrete
USB flap handle 100°	1	
USB flap handle not 0	1	
Outboard flap handle not 0	1	
DLC selected	1	
Elevator out of trim	1	
Throttle lever 81%	4	Engines 1, 2, 3, 4

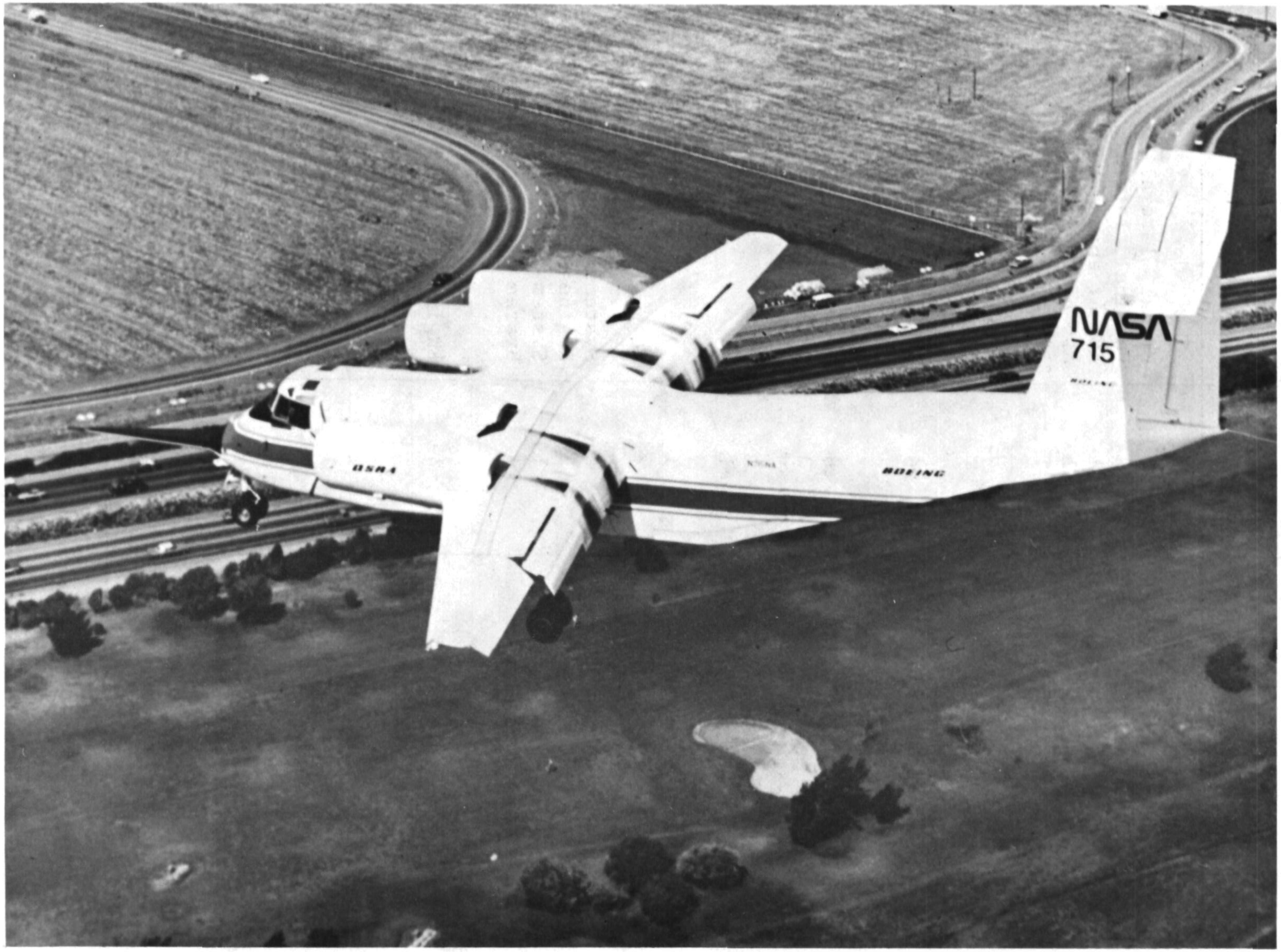


Figure 1.- Quiet Short-Haul Research Aircraft.

AERODYNAMIC DATA

	WING	HORIZ	VERT
AREA (TRAP), ft^2	600.0	233.0	152.0
SPAN, ft	73.5	32.0	14.0
ASPECT RATIO	9.0	4.4	1.22
TAPER RATIO	0.30	0.75	0.60
SWEEP C/4, deg	15.0	3.0	18.0
M.A.C. in.	107.4	88.0	137.0
CHORD ROOT, in.	150.7	100.0	168.0
CHORD TIP, in.	45.2	75.0	100.0
T/C BODY SIDE, %	18.54	14	14
T/C TIP, %	15.12	12	14
INCIDENCE, deg	4.5	–	–
DIHEDRAL, deg	0.0	–	–
TAIL ARM, in.	–	525.0 in.	488.0 in.
VOL COEFF V	–	1.898	0.1402

CONTROL SURFACES

ft^2/APL		BLOWN
AILERON	32.2	BLC
FLAPS INBD	79.0°	USB
FLAPS OUTBD	39.6°	NONE
SPOILERS	32.8	NONE
L.E. FLAPS	51.6	NONE
ELEVATOR	81.6	NONE
RUDDER	60.8	NONE

PROPULSION

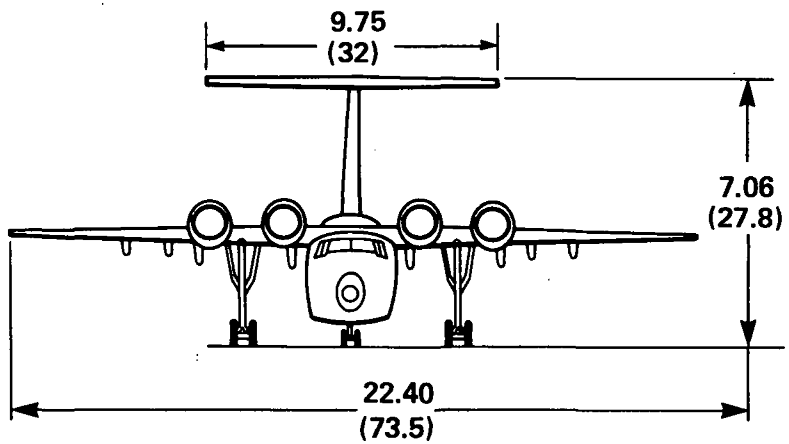
ENGINE	LYCOMING YF-102
STATIC THRUST	33139N (7450 lb)
FAN P.R.	1.45
BY-PASS RATIO	6.0

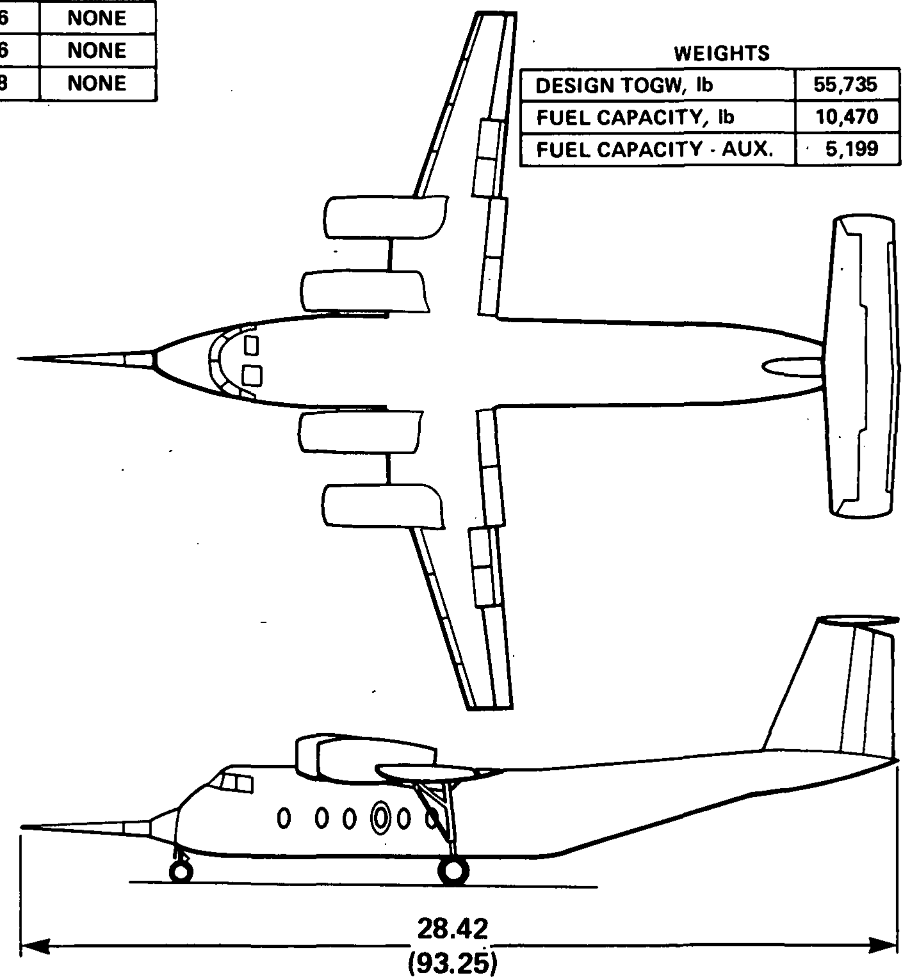
WEIGHTS

DESIGN TOGW, lb	55,735
FUEL CAPACITY, lb	10,470
FUEL CAPACITY - AUX.	5,199

LANDING GEAR

GEAR	STROKE	TIRE	TIRE O.D.	ROLLING R.
MLG, in.	21.0	11.5-15 NEW DESIGN	32.0	13.5
NLG, in.	17.5	8.90-12.50 TYPE III	27.5	12.0





DIMENSIONS IN m(ft)

Figure 2.- QSRA general arrangement and dimensions.

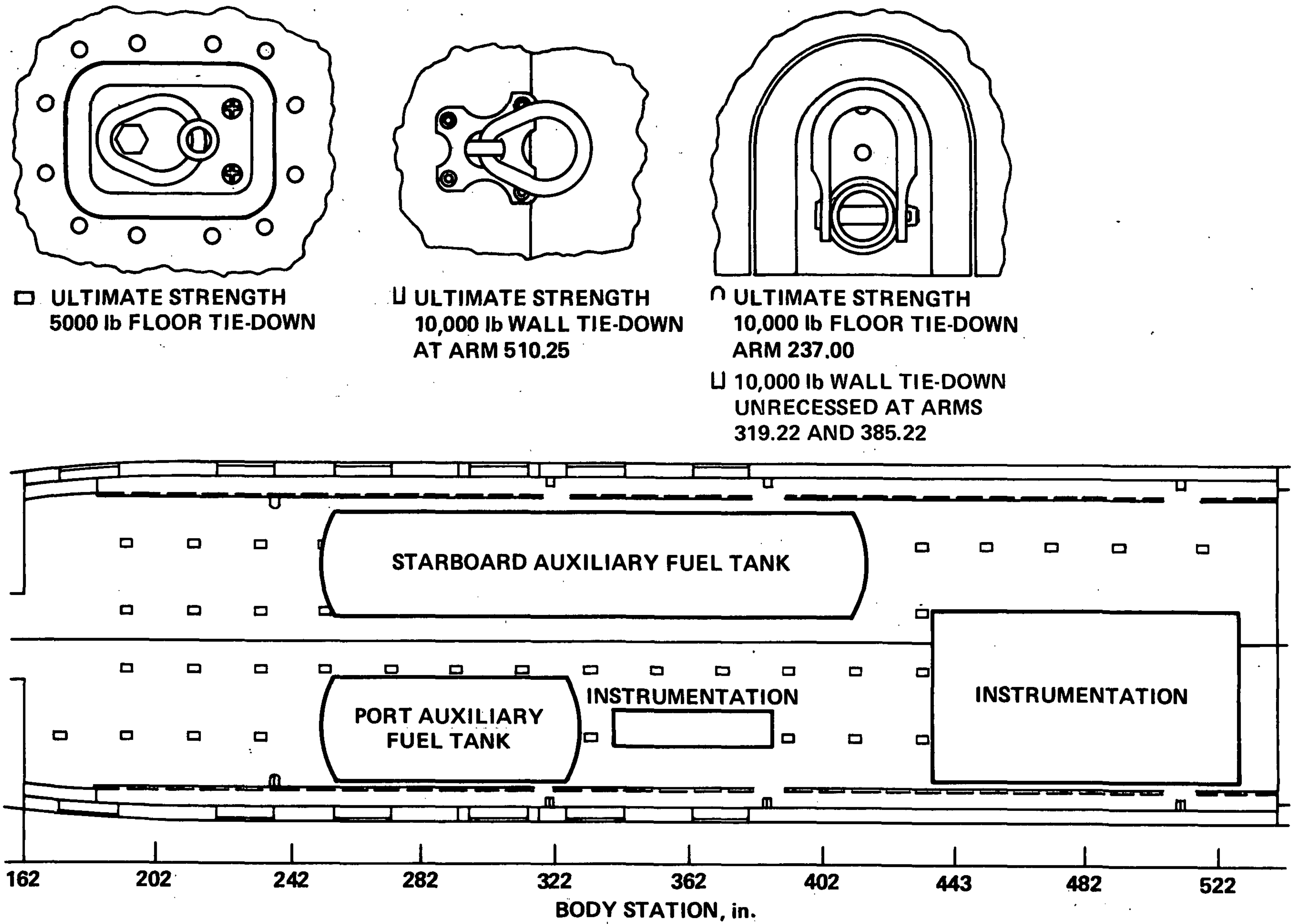


Figure 3.- QSRA cargo compartment layout.

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16. Abstract

A summary of guidelines and particulars concerning the use of the NASA-Ames Research Center Quiet Short-Haul Research Aircraft for applicable flight experiments is presented. Included are procedures for submitting experiment proposals, guidelines for experimenter packages, an outline of experiment selection processes, a brief aircraft description, and additional information regarding support at Ames.

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