

Interface Control Document NASA 932 C-9B

Aircraft Operations Division

November 2007

CHANGE RECORD			
Doc. Version	Date	Process Owner/Ext.	Description
Rev B	Nov 2007	John. S. Yaniec/49211 Dominic Del Rosso/ 49113	Major revision.



National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, TX 77058

Verify that this is the correct version before use.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 2 of 25

APPROVAL AUTHORITIES

Original Signed By

John S. Yaniec
Lead, Reduced Gravity Program

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Lyndon B. Johnson Space Center
Houston, Texas

Verify that this is the correct version before use.

TABLE OF CONTENTS

CHANGE RECORD	COVER PAGE
APPROVAL AUTHORITIES	2
TABLE OF CONTENTS	3
LIST OF FIGURES	4
LIST OF TABLES	4
1.0 INTRODUCTION	5
1.1 Purpose	5
1.2 Scope	5
1.3 Reference Documents	5
1.4 List of Acronyms and Abbreviations	5
2.0 FACILITIES PROVIDED	6
2.1 Aircraft	7
2.1.1 Cabin Environment.....	8
2.1.2 Cabin Dimensions	8
2.1.3 Cabin Provisions.....	12
2.1.4 Electrical Power and Interface	12
2.1.5 Aircraft Lighting.....	15
2.1.6 High Pressure Gas System	16
2.1.7 Overboard Vent System	17
2.1.8 Aircraft G-Load Display	18
2.1.9 Accelerometer Signal	19
2.1.10 On-Board Tools.....	20
2.1.11 On-Board Storage Containers	20
2.2 Ground Facilities	21
2.2.1 Reduced Gravity Office.....	21
2.2.2 Computers, Network Access, Printers, and Phones	22
2.2.3 Normal Duty Hours	22
2.2.4 Equipment and Material Storage.....	22
2.2.5 Cryogenic Storage and Supply System	23
2.2.6 Crane and Scale	23
2.2.7 Forklift.....	23
2.2.8 Ground Tools.....	23
2.2.9 Loading Assistance Tools	24

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 4 of 25

LIST OF FIGURES

Figure 1. C-9B Aircraft.....	7
Figure 2. Parabola Diagram for Reference Only	8
Figure 3. Aircraft Floor Layout	9
Figure 4. Cross-Section of Fuselage	9
Figure 5. Cargo Door Dimensions in Inches	9
Figure 6. Cargo Door Operations.....	10
Figure 7. Floor Attachment Assembly Installed Dimension Cargo Strap and Tie Down	11
Figure 8. Cargo Strap Anchor, Tie Down 3,000 Pounds	11
Figure 9. Power Distribution Panel DC Side	12
Figure 10. MS Cannon Receptacle (Left) and Plug (Right)	13
Figure 11. 115 Vac 60 Hz Connectors (30 A and 20 A).....	14
Figure 12. 115 Vac 60 Hz 3 ph GFCI-protected Pigtail	15
Figure 13. 208 Vac 60 Hz Connector (20 A).....	15
Figure 14. Multi-User Overboard Vent	17
Figure 15. Dedicated Overboard Vent Ports.....	18
Figure 16. Signal Distribution Box.....	19
Figure 17. DB-15 Accelerometer Data Connector	19
Figure 18. Aircraft Acceleration Vectors.....	20
Figure 19. On-Aircraft Storage Containers.....	20
Figure 20. Ground Facilities	21
Figure 21. Building 993 High Bay Work Area.....	21
Figure 22. Building 993 High Bay Work Area.....	22
Figure 23. Forklift with Lifting Platform.....	23

LIST OF TABLES

Table 1. Floor Attachment Hardware	11
Table 2. Total Electrical Test Power.....	12
Table 3. Flow Rates	18
Table 4. Accelerometer Pin Designations.....	19

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 5 of 25

1.0 INTRODUCTION

The Reduced Gravity Program, operated by the National Aeronautics and Space Administration (NASA), Lyndon B. Johnson Space Center (JSC) in Houston, Texas, provides a “weightless” environment, similar to the environment of space flight.

1.1 Purpose

The purpose of this guide is to provide a guideline for existing and potential users of the Reduced Gravity Program. This document provides detailed interface definition.

1.2 Scope

This document applies to all users and potential users of the JSC Reduced Gravity Program.

1.3 Reference Documents

[AOD 33897, Experiment Design Requirements and Guidelines NASA 932 C-9B](#)
[National Electrical Manufacturers Association \(NEMA\)](#)

1.4 List of Acronyms and Abbreviations

A	Amp
AC	Alternating Current
AN	Army/Navy
AOD	Aircraft Operations Division
CST	Central Standard Time
DC	Direct Current
DIA	Diameter
DOT	Department of Transportation
F	Fahrenheit
FAA	Federal Aviation Administration
FS	Fuselage Station
GFCI	Ground Fault Circuit Interrupter
Hz	Hertz
JSC	Johnson Space Center
K	Kelvin
LED	Light Emitting Diode
MS	Military Specification
MSDS	Material Safety Data Sheet

Verify that this is the correct version before use.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 6 of 25

NASA	National Aeronautics and Space Administration
NEMA	National Electrical Manufactures Association
PH	Phase
PSI	Pounds per Square Inch
PSIA	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
RGO	Reduced Gravity Office
SCFM	Specific Cubic Feet per Minute
TBD	To Be Determined
TEDP	Test Equipment Data Package
V	Volt
VAC	Volts Alternating Current
VCR	Video Cassette Recorder
VDC	Volts Direct Current

2.0 FACILITIES PROVIDED

This section describes the NASA facilities available to reduced gravity researchers and users of the C-9B.

The reduced gravity environment is achieved by flying a modified Boeing C-9B jet through a series of parabolic maneuvers. This results in short periods of less than one “g” acceleration. The lengths of these reduced gravity periods depend on the “g” level required for the specific test. Listed below are typical lengths for various maneuvers:

Negative-g to	1/10 max	15 seconds
Zero-g	0-g	23 seconds
Lunar-g	1/6-g (.16)	30 seconds
Martian-g	1/3-g (.38)	40 seconds

These maneuvers may be flown consecutively (i.e., roller coaster fashion) or separated by enough time to alter the test setup. Each parabola is initiated with a 1.8-g pull-up and terminated with a 1.8-g pullout. Normal missions, lasting approximately two hours, consist of 40 parabolic maneuvers, and originate and terminate at Ellington Field in Houston, Texas. Changes to the normal mission profile can be made to ensure more efficient test operations. These changes include number of parabolas performed, g level adjustments (i.e., .16, .38, .1, .5), and length of breaks between parabolas or sets of parabolas. Requests for operations away from Ellington Field will be considered on an individual basis addressing the benefit to NASA, fiscal soundness, scientific merit, airspace accessibility, and overall Reduced Gravity Program schedule impact.

Verify that this is the correct version before use.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 7 of 25

The C-9B aircraft test area is equipped with electrical power, portable compressed gas racks, an overboard vent, accelerometer data, and photo lights. NASA JSC can provide photographers for still photography and video coverage. An S-band video downlink with two-way audio capability may also be requested. Limited peer to peer wireless intercom is also available upon request. Workspace is available on the ground for buildup and checkout of test equipment to ensure its operation before installation in the airplane.



DC9-603

Figure 1. C-9B Aircraft

2.1 Aircraft

The Boeing C-9B is a two-engine, swept-wing aircraft similar to the McDonnell Douglas DC-9. The United States Navy primarily operated these aircraft as transport. This particular C-9B (subsequently named NASA 932) was manufactured in January 1970. NASA obtained the current C-9B in August 2003 and modified it to support the Reduced Gravity Program. The predecessor to NASA 932, NASA 931, put in service in 1995 and retired in October 2004, flew 34,728 parabolas and is now on display at the Pima Air and Space Museum in Pima Arizona. Its predecessor, NASA 930, was obtained by NASA in 1973 and flew 58,236 parabolas before it was retired in 1995. It is now on static display at the entrance to Ellington Field.

The C-9B is operated as a public aircraft within the meaning of the Federal Aviation Act of 1958, as amended. As such, it does not require or hold a current airworthiness certificate issued by the Federal Aviation Administration (FAA). The C-9B is not operated as a common carrier or as a military transport. Consequently, any individual manifested to board the C-9B should determine before boarding whether their personal life or accident insurance provides coverage under such conditions. Also, since the aircraft will be used under test conditions, all researchers and test subjects will be fully informed of the test plans and all risks, hazards, and discomforts inherent to such tests prior to flight.

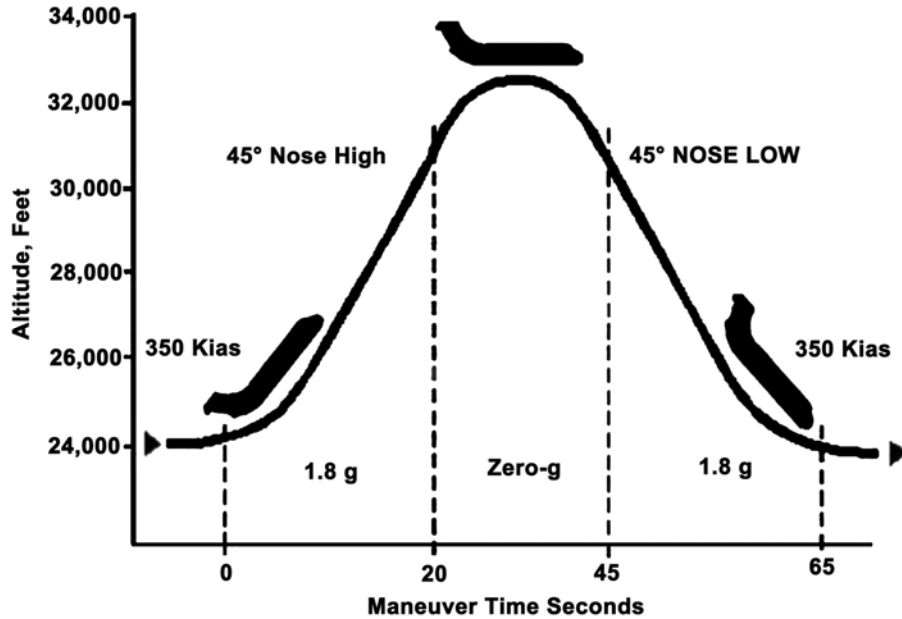


Figure 2. Parabola Diagram for Reference Only

C9-566

2.1.1 Cabin Environment

Cabin pressure is maintained at approximately pressure altitude 8,000 feet [10.9 pounds per square inch absolute (psia)] during parabolic maneuvers. Loss of cabin pressurization could result in pressure as low as 2.8 psia; a factor that must be considered in the design of test equipment.

Normally, cabin temperature varies from 50 to 80 degrees Fahrenheit (F) in flight.

The temperature in the cabin is not controlled while the airplane is on the ground; however, a portable ground air conditioner is available during preflight operations. Keep in mind that the aircraft typically sits out on the ramp during the day and overnight during a flight week. Temperature ranges inside the cabin area are uncontrolled and can be as cold as 30°F during the winter months and as hot as 120°F in the summer. Researchers should make provisions for their experiment hardware to tolerate these conditions.

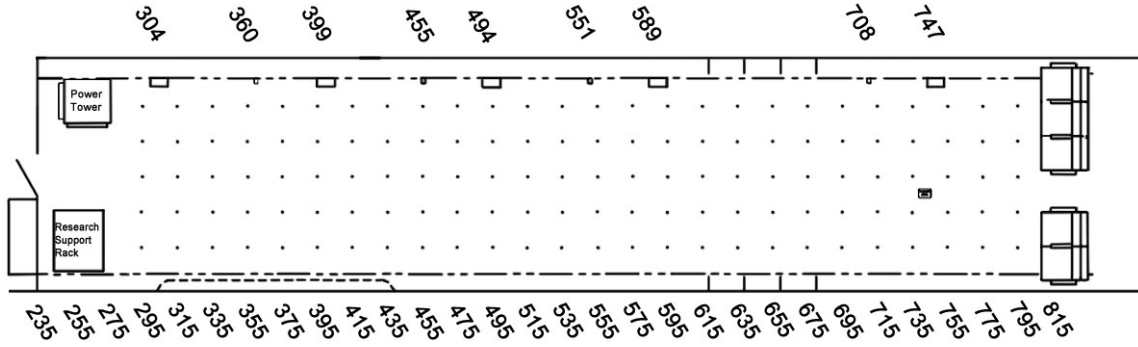
2.1.2 Cabin Dimensions

Approximately 45 feet of cabin length is available for test purposes. A floor plan schematic is shown in [Figure 3](#). A cross sectional view of the cabin is shown in [Figure 4](#). Test equipment is usually loaded through the cargo door, which is 78 inches high and 135 inches wide. Because of the door actuation mechanism, an area 6 inches tall and 10 inches wide is unusable at the top left corner of the door. A diagram of the cargo door is shown in [Figure 5](#). A photograph showing the cargo door during loading operations is shown in [Figure 6](#).

NOTE

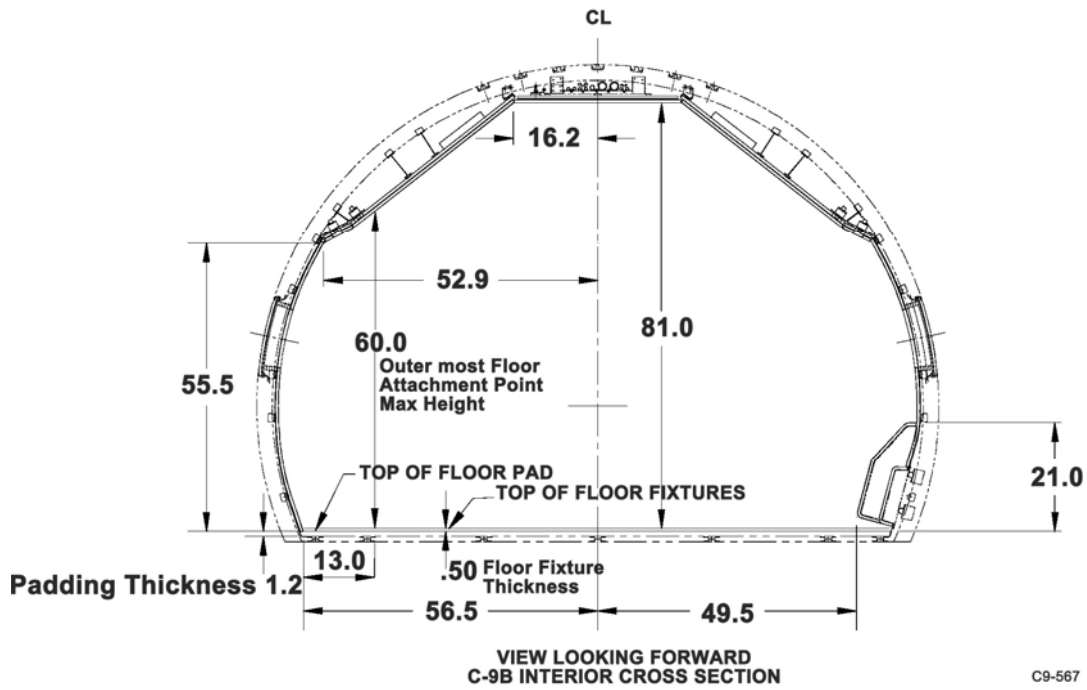
Research equipment installation is prohibited on cross-hatched areas.

Verify that this is the correct version before use.



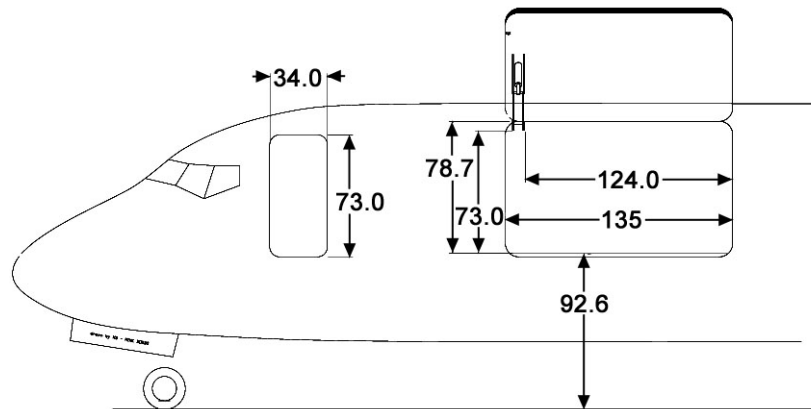
DC9-620

Figure 3. Aircraft Floor Layout



C9-567

Figure 4. Cross-Section of Fuselage



DC9-630

Figure 5. Cargo Door Dimensions in Inches

Verify that this is the correct version before use.



DC9-645

Figure 6. Cargo Door Operations

2.1.2.1 Floor Attachment Hardware/Loading

The aircraft Seat Track floor fitting interface shall not exceed the capacity of 3,000 pounds in tension or shear at anytime. These loads are not to be applied simultaneously.

Not more than four (4) anchor points may be used per station. This includes non-contiguous equipment.

Live loads shall not exceed 200 pounds per square foot during loading operations without the use of shoring, provided by the Reduced Gravity Office (RGO), and prior authorization by the Aircraft Operations Division (AOD) Engineering Branch.

Pneumatic tires should be used whenever possible when material handling on the aircraft. Use of steel or other hard wheels must be approved prior to use on the aircraft and for each specific case by the AOD Engineering Branch.

Inflight loads shall be limited to 300 pounds per square foot without the use of shoring, provided by the RGO, and prior authorization by the AOD Engineering Branch.

Table 1. Floor Attachment Hardware

Restraint	WLL	Width	Length	Fixed Length
CGU-1/B (strap)	#5000*	2 in	18 ft	12 in
S0203-0338-B (strap)	#1200	1.5 in	12 ft	14 in
104410P (strap)	#260	1 in	12 ft	8 in
AN-6 Steel Bolts	#5000*	3/8 in	1/2 to 4 in	N/A

* Individual floor fittings have a load capacity of 3,000 pounds in tension and in shear at the seat track interface; this shall be used as the limiting case.

Aluminum spacers are used in conjunction with industry standard Ancra fittings to bolt equipment directly into the aircraft floor seat track (bypassing the floor foam) and to load bolts in single shear (experiment interface) at each floor attachment location. The maximum amount of weight allowed to rest on one plate in a 1-g environment, is 200 pounds per fitting (see [Figure 7](#)).

Floor attachment holes are centered on a 20 inch \pm 0.005 inch square pattern (see [Figure 7](#)).

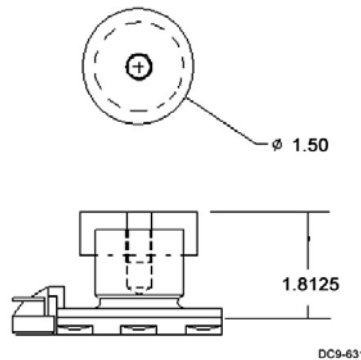


Figure 7. Floor Attachment Assembly Installed Dimension Cargo Strap and Tie Down

Allowable floor loading of 300 pounds per square foot (in-flight load case, not ground loading) without proper floor shoring (see [Figure 8](#)).

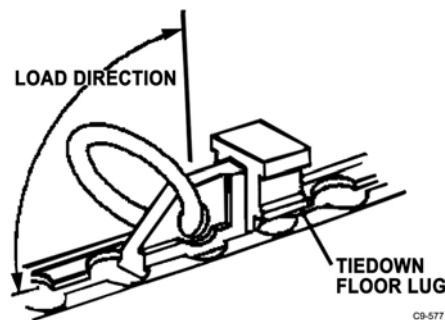


Figure 8. Cargo Strap Anchor, Tie Down 3,000 Pounds

No continuous equipment or structure greater than 8 feet in length shall be rigidly secured along the length of the aircraft deck.

Verify that this is the correct version before use.

2.1.3 Cabin Provisions

The aircraft is equipped with 20 seats aft of the test section. There is one lavatory for critical use, similar to passenger aircraft. The interior walls of the cabin are covered with foam padding for the protection of personnel and equipment.

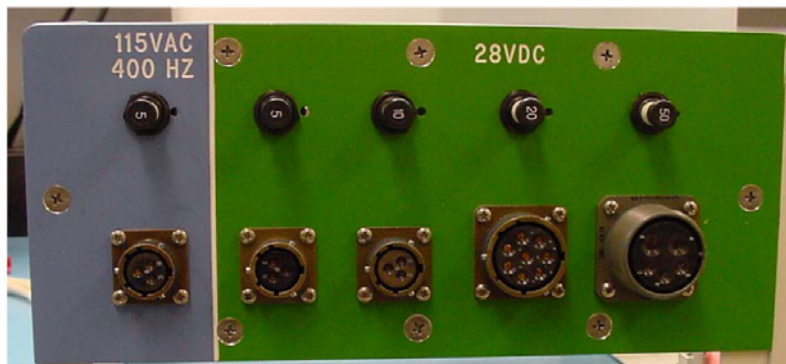
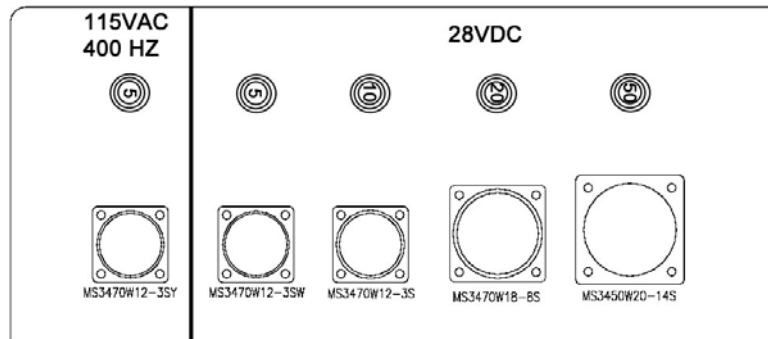
2.1.4 Electrical Power and Interface

Four types of electrical power are available, as shown in [Table 2](#). The 115 volts (v) alternating current (AC) (VAC) is distributed into two buses (A and B bus). Each experiment will be allotted a portion of the power budget at the time the aircraft is loaded. Special arrangements can be made for experiments with unusually high power requirements.

Table 2. Total Electrical Test Power

Power Type	Total Current Available
28 Volts Direct Current (Vdc)	50 Amps
115 Volt AC, 400 Hertz (Hz), Single Phase	10 Amps
115 Volt AC, 60 Hz, Three Phase	30 Amps
115 Volt AC, 60 Hz, Single Phase	60 Amps
208 Volt AC, 60 Hz, Single Phase	20 Amps

Aircraft electrical power is distributed via five power distribution panels. These panels are located along the lower sidewall of the test cabin at fuselage stations 304, 399, 494, 589, and 747. A mechanical drawing of a power distribution panel is shown in [Figure 9](#). The following sections will explain the mechanical interface to each type of electrical power.



DC9-632

Figure 9. Power Distribution Panel DC Side

Verify that this is the correct version before use.

115 Vac, 400 Hz, 1 ph

One cannon receptacle, MS3470W12-3SY (see [Figure 9](#)) supplies raw 115 Vac aircraft power at 400 Hz. This receptacle has a dedicated 5 Amp (A) circuit breaker on the local power distribution panel. Researchers may use the 400 Hz outlet when it is available; however, it is the responsibility of the researchers to protect their own equipment from electrical faults. Every electrical cable from a power distribution panel should include a current limiting device on the experiment.

Experimenters must use wire sizes in accordance with “Minimum Wire Gauges” ([AOD 33897](#), Table 2) and will find the mating cannon plug in [AOD 33897](#).

28 Vdc

Each power distribution panel provides interfaces for 5, 10, 20, and 50 Amp circuits.

All 28 Volt interfaces are standard Military Specification (MS) cannon connectors (see [Figure 10](#)).

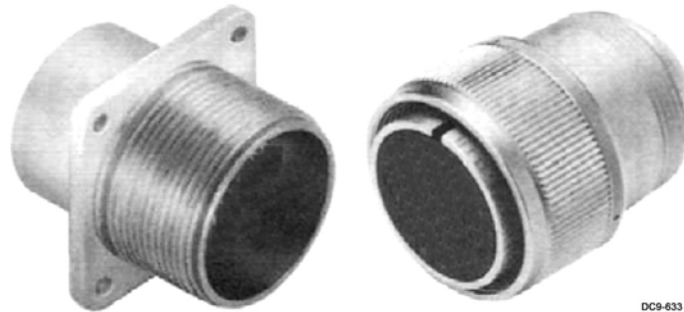


Figure 10. MS Cannon Receptacle (Left) and Plug (Right)

Power Panel 28 VDC Interfaces

One cannon receptacle (see [Figure 10](#)) supplies 28 Vdc at a maximum 5 Amps (MS3470W12-10S).

Researchers will find the mating cannon plug in [AOD 33897](#).

HOT	A
GROUND	B

Connector Pin Out

One cannon receptacle (see [Figure 10](#)) supplies 28 Vdc at a maximum 10 Amps (MS3470W12-3S).

Researchers will find the mating cannon plug in [AOD 33897](#).

HOT	A
GROUND	B

Connector Pin Out

One cannon receptacle (see [Figure 10](#)) supplies 28 Vdc at a maximum 20 Amps (MS3470W18-8S).

Researchers will find the mating cannon plug in [AOD 33897](#).

HOT	A
GROUND	B

Connector Pin Out

One cannon receptacle (see [Figure 10](#)) supplies 28 Vdc at a maximum 50 Amps (MS3450W20-14S).

Researchers will find the mating cannon plug in [AOD 33897](#).

HOT	A
GROUND	B

Connector Pin Out

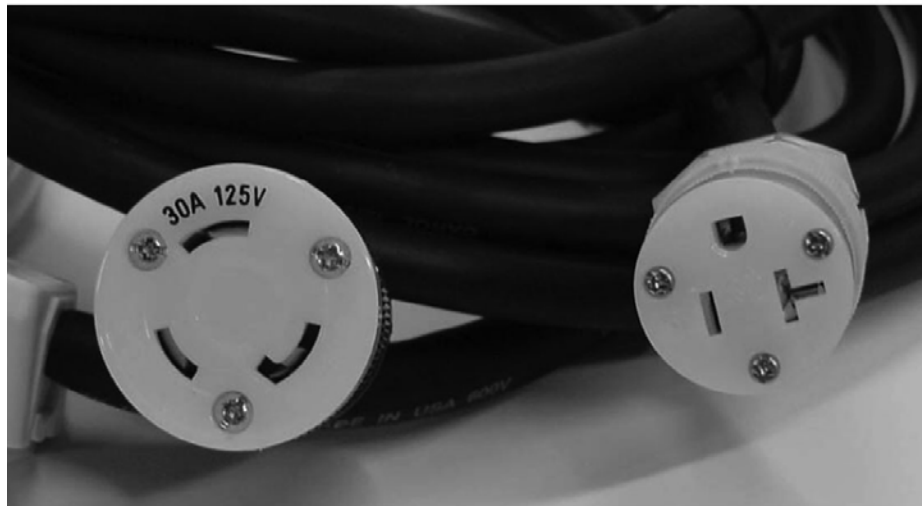
The mechanical connections are similar. The power distribution panel receptacles are female. Experimenters must provide the mating male plug connector. Experimenters must use wire sizes in accordance with “Minimum Wire Gauges” (see [Table 2](#)) and will find the mating cannon plug in [AOD 33897](#).

NOTE

Power cords used to reach this 50 Amp outlet should be 10 feet in length.

115 Vac, 60 Hz, Single Phase (ph), 30 A and 20 A

Three 115 Vac 60 Hz 20 A circuits and one 30 A circuit are provided at each power panel. Research hardware interfaces to these via 6 foot long Ground Fault Circuit Interrupter (GFCI)-protected single receptacle pigtails as shown in Figure 11, having 30 A twist loc (HUBBELL 2611, NEMA 15-30P) and 20 A flat prong (HUBBELL 53CM69C, NEMA 5-20R) standard type residential outlets.



DC9-634

Figure 11. 115 Vac 60 Hz Connectors (30 A and 20 A)

Verify that this is the correct version before use.

Experimenters must use wire sizes in accordance with “Minimum Wire Gauges” ([AOD 33897](#), Table 2) and will find the mating cannon plug in [AOD 33897](#).

115 Vac, 60 Hz, 3 ph

One outlet per panel will supply 20 A, 115 Vac, 60 Hz, 3 ph power via a GFCI-protected pigtail (see [Figure 12](#)) terminated in a single 5-pin twist loc receptacle (HUBBELL 2813, NEMA L21-30R).

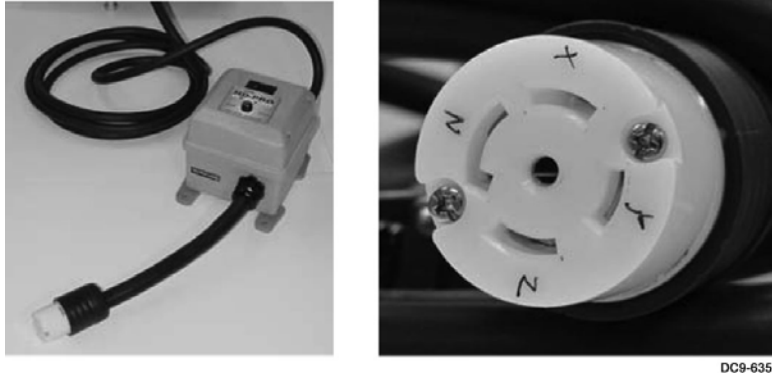


Figure 12. 115 Vac 60 Hz 3 ph GFCI-protected Pigtail

208 Vac, 60 Hz, Single ph, 20 A

One 20 A circuit is provided at each power panel. Research hardware interfaces to these via 6 foot long GFCI-protected single receptacle pigtails (as shown in [Figure 13](#)) 20 A flat prong (HUBBELL HBL5469C, NEMA 6-20R) standard type outlet.

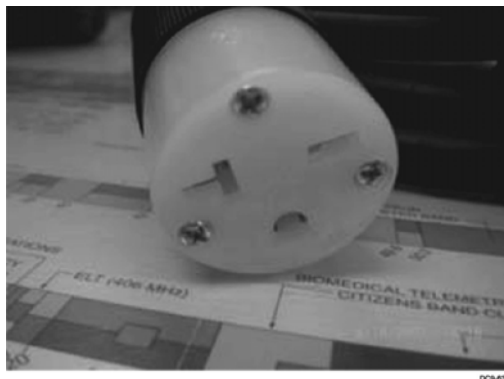


Figure 13. 208 Vac 60 Hz Connector (20 A)

2.1.5 Aircraft Lighting

The aircraft cabin contains 28 light emitting diode (LED) photo-lights (14 down each side/overhead). These lights have been specially designed to provide sunlight-quality illumination [color temp of 5,600 Kelvin (K)]. Because of the unique design of the assemblies, daylight camera film may be used in the cabin and a flashbulb is typically not required.

Verify that this is the correct version before use.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 16 of 25

A switch in the cockpit controls the intensity setting of all cabin photo lights. There are two possible illumination levels: all assemblies on and half of the assemblies on. The lights will be set to full illumination during the reduced gravity portion of the parabolas. During all other phases of flight (including takeoff, landing, parabola pull-up, and pull-out) the lights will remain at half-illumination or off.

Each of the lights may be turned off individually. When a given fixture is turned off, it will remain off during all phase of flight regardless of the cockpit switch position.

2.1.6 High Pressure Gas System

High pressure gas systems are allowed for use on the C-9B through compliance with all safety guidelines. All pressurized gas systems must receive approval through the pressure vessel certification procedure documented in this User's Guide (refer to [AOD 33897](#), Section 2.3).

Per customer request, the RGO will provide the following high pressure gas and K-bottle handling equipment.

NOTE

Bottle Racks must be included in Researcher Test Equipment Data Package (TEDP) for overall loading and configuration.

1. Nitrogen K-bottle [volume 228 ft³ at 2,200 pounds per square inch gauge (psig)]
2. Helium K-bottle (volume 212 ft³ at 2,200 psig)
3. Argon K-bottle (volume 248 ft³ at 2,200 psig)
4. Breathing air K-bottle (volume 233 ft³ at 2,200 psig)
5. K-bottle ground handling carts
6. In-flight, 9 g rated, "K-bottle" mounting rack

Researchers should ensure the gas bottles shipped to the RGO are 9 inches in diameter and 55 inches in length if RGO Bottle Racks are used.

All bottles must be Department of Transportation (DOT)-certified and current or meet pressure system requirements for a pressure vessel.

All regulators and gauges must be properly calibrated and have current certification tags.

All gas systems must have appropriate-sized relief valves installed at the regulators to prevent over-pressurization of the gas supply line and current calibration (and tagged).

The RGO does not supply regulators, relief valves, or hoses to researchers.

Any high-pressure gas equipment must be approved for use by the RGO prior to its arrival at Ellington Field (refer to [AOD 33897](#), Section 2.3).

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 17 of 25

2.1.7 Overboard Vent System

An overboard vent system is available on the aircraft for the venting of most gases. No liquid can be vented through this system due to freezing that could occur at altitude.

There are four vents: two are multi-user lines (see [Figure 14](#)) and the other two are dedicated ports for use with oxygen enriched, or reactive gases. The multi-use vent lines [1-inch diameter (DIA)] have interface locations at fuselage station (FS) 360, FS 455, FS 551, and FS 708 along the right side of the aircraft.



Figure 14. Multi-User Overboard Vent

The fittings on the multi-user vent line are male Army/Navy (AN) 16 fittings (1 inch); researchers must supply a female AN 16 fitting on the research equipment (Parker Triplelok 37 degree Flared Tube Fitting).

For experiments requiring venting of oxygen enriched gas or the requirement for a dedicated vent, there are two dedicated vent ports located at FS 918. These two vent ports (1-inch DIA) do not have permanent lines attached. It is the responsibility of the researcher to have the correct AN fittings and flexible vent line to attach to the either of the two dedicated to these vents. The distance from the vent ports to the front edge of the seats is 110 inches. The distance from the top fitting to the floor is 41 inches.

NOTE

All vent line materials must be compatible with expected vent mixtures.

When the vent line is being utilized for an oxygen enriched gas mixture, the vent line must meet the requirements for oxygen clean systems. Proper written oxygen handling procedures must be used at all times and approved before use.

The dedicated vent port has a male 1-inch AN 16 fitting. The researcher will be required to have a 90 degree AN female fitting to attach to the aircraft male AN fitting at the window plug (see [Figure 15](#)). The researcher is responsible for providing all of the appropriate fittings and hoses from the aircraft connection to their research equipment.

Verify that this is the correct version before use.



Figure 15. Dedicated Overboard Vent Ports

A simplified table of vent line flow rates is provided below:

Table 3. Flow Rates

Location	Max Flow (SCFM) 36,000'	Min Flow (SCFM) 26,000'
Fwd Manifold	TBD (total*)	TBD (total*)
Aft Manifold	TBD (total*)	TBD (total*)
Dedicated Line	TBD	TBD

* Total refers to a combination of all experiment flows at that location including all flows introduced upstream at the forward manifold.

NOTE

These rates apply at the manifold/fitting only. Line losses in researcher equipment must be considered to determine flow rate at researcher's termination point.

A complete study of the volumetric flow rates through the overboard vent system will be performed and a copy available through the RGO.

The test cabin volume is approximately 4,700 cubic feet. The cabin air exchange rate is one cabin volume per 3.5 minutes.

2.1.8 Aircraft G-Load Display

There are two display panels to show the real-time g-value and the parabola count for reference only. One display is mounted on the forward bulkhead facing aft and the other is mounted on the aft bulkhead facing forward. These values are not typically recorded in flight by the RGO.

2.1.9 Accelerometer Signal

Aircraft accelerometer signals Gx, Gy, and Gz are available for research use. The locations of the signal distribution boxes are shown in [Figure 16](#). Each signal distribution box is buffered to prevent interference with aircraft systems and other researchers.

Accelerometer signals are not typically recorded in flight by the RGO.

Each signal is filtered with a normal cutoff frequency of 100 Hz. The RGO may independently adjust the cutoff frequency of each channel upon request. Changes to any cutoff frequency will affect the corresponding signal at every signal distribution box in the test cabin.



Figure 16. Signal Distribution Box

A male DB-15 connector and 10- to 15-feet of signal cable are required to connect to a signal distribution box. Pin designations are shown in [Figure 17](#) and [Table 4](#).

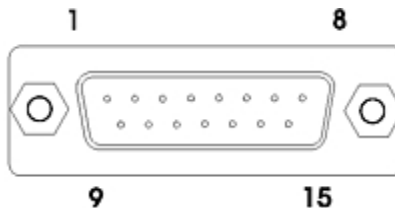


Figure 17. DB-15 Accelerometer Data Connector

Table 4. Accelerometer Pin Designations

Measurement	Pin Number	Signal Value
Gx +	5	9.8 Volts/g
Gx -	9	Signal Ground, 0 Volts
Gy +	6	9.8 Volts/g
Gy -	10	Signal Ground, 0 Volts
Gz +	4	3.6 Volts/g
Gz -	11	Signal Ground, 0 Volts

Verify that this is the correct version before use.

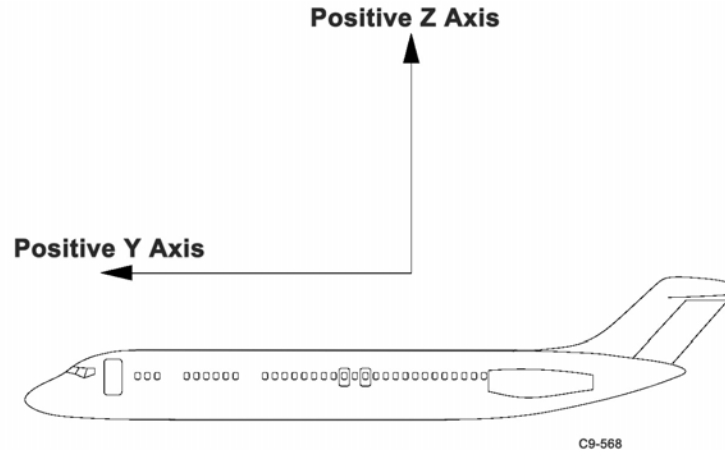


Figure 18. Aircraft Acceleration Vectors

2.1.10 On-Board Tools

The RGO maintains a toolbox with a collection of hand tools sufficient to install most test packages in the aircraft. No tools or loose equipment are allowed on the aircraft at any time without proper inventory control and specific prior authorization of RGO. The toolbox and all tools are removed prior to flight unless specifically authorized. This includes user supplied items; there are no exceptions. No tools are provided during flight. Refer to [AOD 33897](#), Section 2.10 for a description of allowed tools.

2.1.11 On-Board Storage Containers

The RGO has three storage containers for use on the aircraft by researchers upon request. Two smaller containers and one large container are shown in [Figure 19](#).



Figure 19. On-Aircraft Storage Containers

DC9-640

The interior dimensions and take-off / landing weight limits are as follows:

- Small container: 20-1/2 x 19 x 19-1/2 inches (L x W x H), 100 pounds.
- Larger container: 46-1/2 x 22-1/2 x 17-1/2 inches (L x W x H), 150 pounds.

Verify that this is the correct version before use.

2.2 Ground Facilities

This section describes the NASA ground facilities that are provided to NASA's Reduced Gravity researchers by AOD.



DC9-641

Figure 20. Ground Facilities

2.2.1 Reduced Gravity Office

Building 993 at Ellington Field provides visiting researchers with a 1,760 square foot high bay work area. This air-conditioned workspace is available for test equipment buildup and checkout.



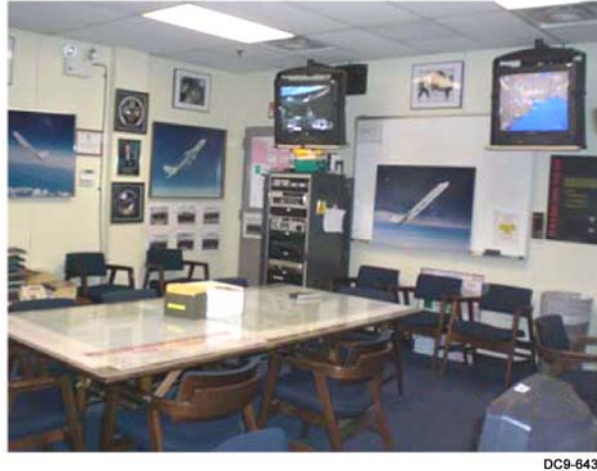
DC9-642

Figure 21. Building 993 High Bay Work Area

The high bay is equipped with:

- 5-foot, 7-foot, and 10-foot workbenches for researcher use
- One 1-ton overhead crane
- Portable Air Compressor
- Hazardous material storage
- Utility sink
- General Tool Box for researcher use
- Available electrical power includes 115 Vac, 60 Hz, 20 Amp; 115 Vac, 3 ph, 20 A, 400 HZ; 28 Vdc, 20 A
- Access to the work area includes two 12- by 12-foot roll-up doors

Verify that this is the correct version before use.



DC9-643

Figure 22. Building 993 High Bay Work Area

The building also has an adjacent conference room containing computers, telephones, a Video Cassette Recorder (VCR), 8-mm video equipment, and video monitors.

2.2.2 Computers, Network Access, Printers, and Phones

The computers and the network access are provided by the RGO for official business only. Phones are provided in the conference room. All long distance calls must be made collect or third party. Incoming calls or faxes for the researcher should be to the following numbers:

Main Office: 281-244-9874
Conference Room: 281-244-9005
Fax: 281-244-9500

2.2.3 Normal Duty Hours

The RGO operates Monday through Friday from 7:30 a.m. to 4 p.m. Central Standard Time (CST). Researcher access to the High Bay is limited to these hours unless prearranged with the RGO. Access to the aircraft is from 7:30 a.m. to 4 p.m. CST during flight days.

2.2.4 Equipment and Material Storage

Very limited storage space is available in Building 993. Requests for space must be prearranged with the RGO. All chemicals will be stored in the chemical storage locker located in the High Bay of Building 993. Any chemical stored in this locker shall be clearly marked with the name of the researcher, the date it was placed in the locker, and the experiment title. Material Safety Data Sheet (MSDS) paperwork should be given to RGO personnel for filing in a 3-ring binder located on top of the chemical storage locker.

It is the responsibility of the researcher to remove all chemicals from EFD, and notify RGO of such, after completion of an experiment.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 23 of 25

NOTE

Building 993 is not equipped with an approved vent hood for chemical mixing.

2.2.5 Cryogenic Storage and Supply System

A cryogenic storage/supply system is available to provide a source of breathing air or nitrogen. The cryogenic system has a 1/2-inch standard AN fitting with a variety of available adapters. Contact the RGO six weeks prior to flight to address any needs in this category.

2.2.6 Crane and Scale

Building 993 is equipped with an overhead crane that spans the distance between the two overhead doors. It has a capacity of 2,000 pounds. The maximum distance from the floor to the crane hook on the crane is 97 inches. Only certified JSC or Ellington Field personnel shall operate the crane.

2.2.7 Forklift

Forklifts are available for the unloading and loading of research equipment, 8,000 pound capacity at 24 inches with 177-inch lift (see [Figure 23](#)).

The forklift can be equipped with a loading platform for ease of operation when moving multiple pieces of equipment up to 2,000 pounds total load. This loading platform has a ramp on the front that enables research equipment with wheels to be rolled on and off the platform. Only certified JSC or Ellington Field personnel shall operate the forklift.



Figure 23. Forklift with Lifting Platform

2.2.8 Ground Tools

The High Bay of Building 993 provides a complete toolbox for researcher use while at the RGO. The high bay facility also includes a 20-gallon air compressor with 135 psi max [5.7 specific cubic feet per minute (SCFM) @ 90 psi / 4.9 SCFM @ 135 psi], shop vacuum, bench vice, and power available.

Verify that this is the correct version before use.

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 24 of 25

2.2.9 Loading Assistance Tools

Loading assistance tools are available for researcher use, including:

- Lift Platform (for the forklift)
- J-Bars
- Roller Pipe (schedule 40 PVC)
- Lifting Straps
- Lifting Pipe
- Furniture Dolly (24- by 44-inches)

It is the researcher's responsibility to ensure that research hardware has been designed with the proper handholds, lifting bars, and wheels (if required) to allow for safe and easy loading and unloading of the aircraft (refer to [AOD 33897](#), Section 2.10).

Aircraft Operations Division Interface Control Document NASA 932 C-9B	Doc. No.: AOD 33912	Doc. Version: Rev B
	Date: November 2007	Page 25 of 25

INDEX

115 Vac, 400 Hz, 12, 13
 115 VAC, 400 Hz, 14
 28 Vdc, 12
 Accelerometer Pin Designations, 18
 Accelerometer Signal, 18
 Aircraft, 6
 Aircraft Floor Layout, 8
 Aircraft G-Load Display, 17
 Aircraft Lighting, 14
 Building 993, 20, 21, 22
 C-9B, 5, 6, 15, 20
 Cabin Dimensions, 7
 Cabin Provisions, 11
 Computers, Network Access, Printers, and
 Phones, 21
 Crane and Scale, 22
 Cross-Section of Fuselage Station 835 to
 234, 8
 Cryogenic Storage and Supply System, 22
 DB-15 Accelerometer Data Connector, 18
 Electrical, 11
 Ellington Field, 5, 6, 16, 20, 22
 Environment. *See* Aircraft Environment
 3.1.1
 Facilities Provided, 5
 Floor Attachment Hardware, 9
 forklift, 22, 23
 Furniture Dolly (24\ by 44-inches, 23
 gas systems, 15
 Ground Facilities, 20
 Ground Tools, 22
 High Pressure Gas System, 15
 Introduction, 4
 J-Bars, 23
 K-bottle, 15
 Lifting Pipe, 23
 Lifting Straps, 23
 Loading Assistance Tools, 23
 Normal Duty Hours, 21
 On-Board Tools, 19
 Overboard Vent, 16
 Overboard Vent System, 16
 Power Distribution Panel, 11
Power Panel 28 Vdc Interfaces, 12
 Purpose, 4
 Reduced Gravity Office, 20, 22, 23
 RGO, 16, 17, 21, 22
 Roller Pipe (schedule 40 PVC), 23
 Scope, 4
 Storage (Including Chemicals), 21
 volumetric flow rates, 17