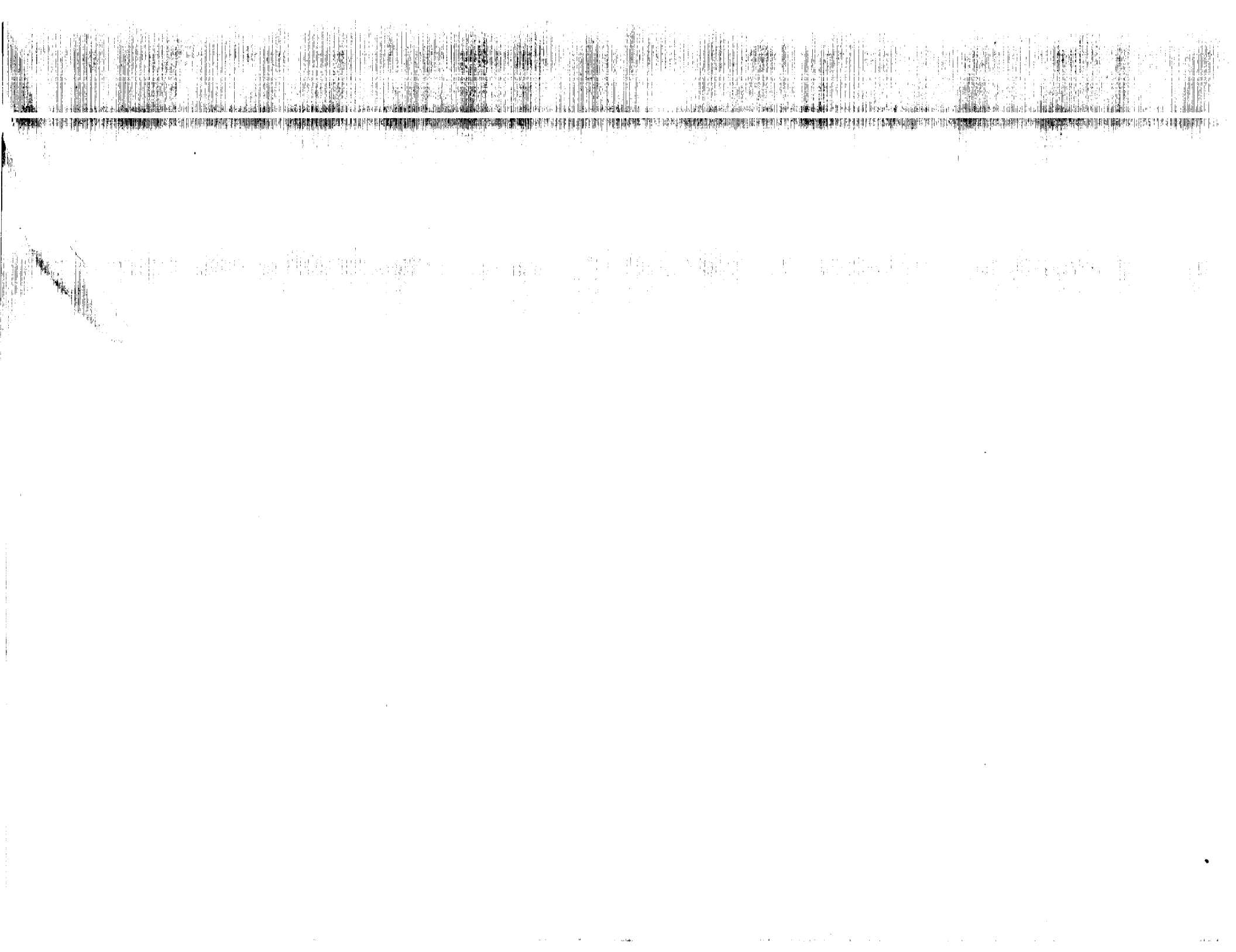
# NASA Reference Publication 1282

August 1992



**NASA Reference Publication 1282**

1992

# Facilities and Capabilities Catalog for Landing and Escape Systems

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NASA
National Aeronautics and Space Administration
Office of Management
Scientific and Technical Information Program

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# ACKNOWLEDGEMENTS

The editor wishes to thank all of the contributors in the various government laboratories, industry, and academia for their cooperation and assistance in the development of this document. Special thanks go to Lori Williams of Barrios Technology, Inc. for assistance with typing, graphics, and layout of the document. Additional thanks go to the members of the National Parachute Technology Council (NPTC) and the AIAA Aerodynamic Decelerator Systems Technical Committee (ADSTC), members of which had the difficult task of reviewing and verifying the information in this catalog.

# SUMMARY

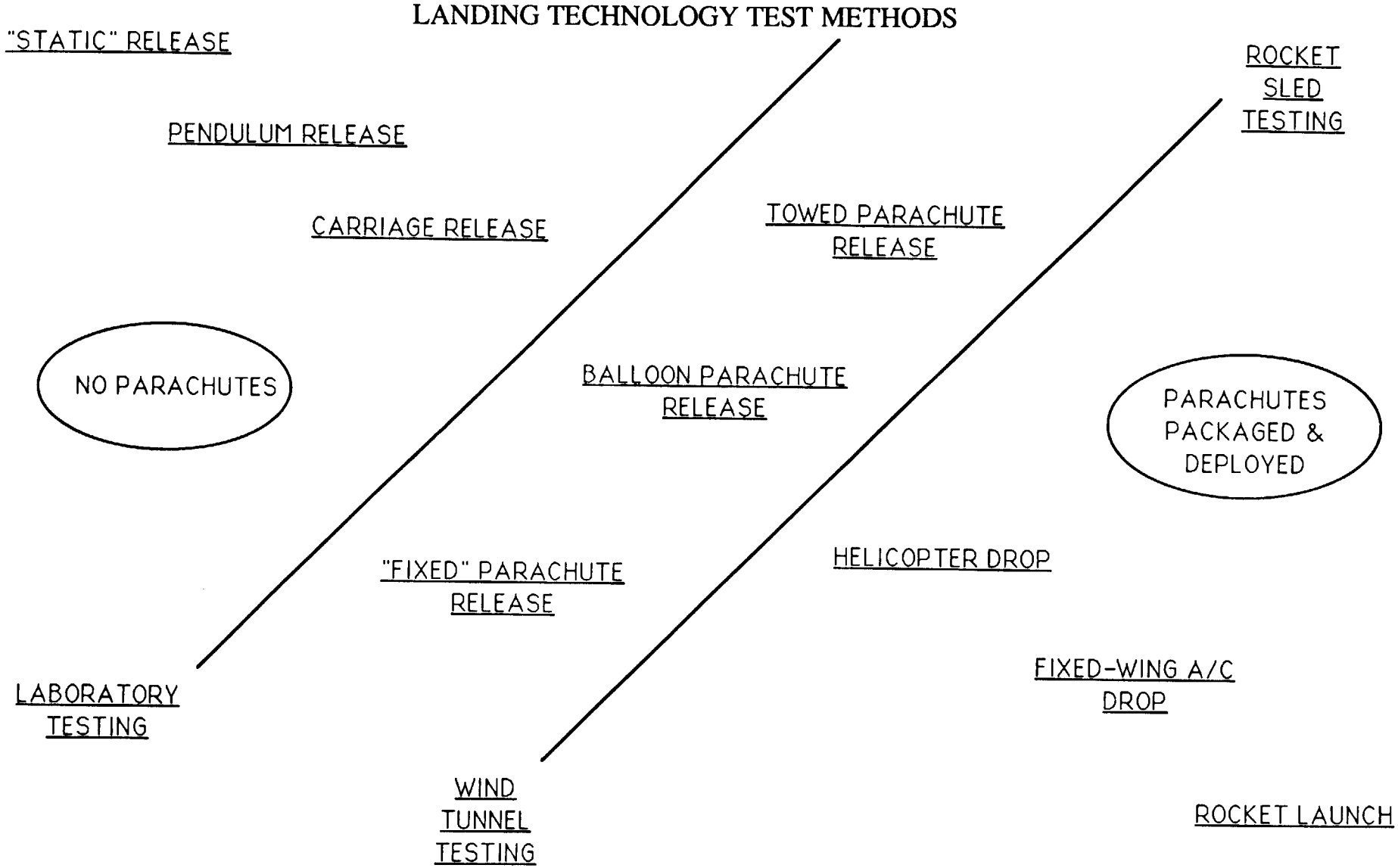
This catalog is the first ever attempt to develop a database of facilities and design tools which are applicable to the development of landing and escape systems. These facilities include wind tunnels, drop zones, test aircraft, and rocket sled tracks, among others. Only U.S. facilities have been included in this volume.

The National Aeronautics and Space Administration took on the task of developing this catalog as a member of the National Parachute Technology Council. A catalog of this nature will serve as a tool for assessing the capabilities of the nation in the development of landing and escape systems for future spacecraft, aircraft, weapons, and airdrop systems. This catalog will also serve as a single source document to assist engineers designing test programs in the future.

All of the information in this volume has been provided by the facility owners or operators. In developing this catalog, a suitable format for each chapter was developed based on that used in NASA Reference Publication 1132 "Aeronautical Facilities Catalogue." These datasheets were sent to over 60 organizations with a request for information on their facilities and references to other organizations which should be included. Datasheets were sent to these additional organizations in a second mailing. Since this was a first ever survey of this type, some facilities may have been left out.

The identification of comparable facilities in this catalog is included to give the user a list of possible alternatives. In some cases, however, these facilities may be comparable only in mission, not in performance.

The editor regrets any undetected errors or omissions and welcomes any corrections, additions, comments, or suggestions for improving future versions of this catalog.


LANDING TECHNOLOGY TEST METHODS
"STATIC" RELEASE
PENDULUM RELEASE
CARRIAGE RELEASE
NO PARACHUTES
LABORATORY TESTING
"FIXED" PARACHUTE RELEASE
BALLOON PARACHUTE RELEASE
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WIND TUNNEL TESTING
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Figure 1

# INTRODUCTION

This catalog serves as a single source reference for designers of landing and escape systems for spacecraft, aircraft, weapons and airdrop systems. It includes those facilities which may be required by a system designer in planning a development test program. The catalog is divided into six chapters and the information is presented in the following order:

- Wind Tunnels
- Drop Zones
- Test Aircraft
- Fabrication Facilities
- Design Tools
- Miscellaneous Facilities

Figure 1 lists the types of facilities used in the development of these systems.

This catalog has been produced in conjunction with the National Parachute Technology Council (NPTC), a group of parachute users and developers from government, industry, and academia interested in the advancement of parachute technology. The objective of this catalog is to provide a means for identifying critical facilities within the U.S. which can be used for the development of landing and escape systems. The chapter on design tools is included to showcase the emerging capability in the area of computer analysis of these systems.

A second objective of this catalog is to provide a useful tool to the system designer for picking and choosing facilities and capabilities. In developing this catalog, a request for input was circulated to over 60 organizations around the U.S. It is believed that there are still many facilities available which are not included, but can support this type of activity in some way. These organizations either did not respond to the request for information or were not contacted. References have been made where the editor believes information is still lacking.

The format of this catalog is similar to NASA Reference Publication (RP) 1132, "Aeronautical Facilities Catalog." The datasheet format is used to provide a quick-look reference for facility performance and support capability. A local contact is provided for further information. This volume includes a different datasheet format for each chapter and an explanation of the format for each datasheet is included. If supplied, facility drawings and performance curves are included on the page facing the datasheet. It should also be noted that the information provided by respondents was not, in general, independently verified for accuracy. It is left to the user to verify critical information directly with the specific facility.

# WIND TUNNELS

Wind Tunnels are used in the design of landing and escape systems to provide aerodynamic characteristics of parachutes, parachute/payload systems, ejection seats, crew modules, and other related systems. They can be used to measure parameters during steady state such as aerodynamic drag, surface pressure, and flow velocity, as well as dynamic events. Measured data can be used to perform preliminary sizing of a system prior to flight test or to better understand detailed characteristics of an operational system.

There are over 100 wind tunnels in the United States ranging in size from one inch to 120 feet and speeds ranging from Mach 0.01 to Mach 10. Requirements for deployable landing and escape systems, however, are essentially limited to speeds ranging from zero to Mach 3.0. This catalog is limited to subsonic, transonic, and supersonic wind tunnels of a size suitable for testing of parachute systems. Facilities in this catalog have been used in the design and development of systems such as the Apollo Ringsail parachute, the F-111 Crew Module parachute, as well as a number of more mainstream applications. Some tunnels of a smaller size located in industry and at universities are included because of their significant research capability with aerodynamic decelerators. Unique facilities such as vertical wind tunnels and water tunnels are also included in this chapter. No formal criteria was developed to determine whether a facility should or should not be included. The reader should refer to NASA RP-1132 "Aeronautical Facilities Catalogue" for a complete survey of wind tunnel facilities of all sizes and speed ranges.

Comparable facilities are identified based on groupings similar to those used in NASA RP-1132 and are included in the Comparable Wind Tunnels Index. Group E (Unique Facilities) includes smaller facilities which are used primarily for research. Supersonic and Transonic facilities have been included in a single group of high speed test facilities (Group F) for simplicity.

# WIND TUNNELS

| | | | |
|---|---|---|---|
| COMPANY:<br><br>LOCATION: ① | TEST SECTION SIZE: | SPEED RANGE:<br>(Mach#) | COMPARABLE FACILITIES |
| | DATE BUILT/UPGRADED: | TEMP. RANGE: | |
| | OPERATIONAL STATUS: | REYNOLDS NO:<br>(Per ft X $10^{-6}$ ) | |
| TYPE:<br><br>② | DESCRIPTION: | DYNAMIC PRES:<br>($lb/ft^2$ ) | |
| | | STAGNATION PRES:<br>(psia) | |
| | | TURBULENCE LEVEL: (%): | |

TESTING CAPABILITIES:

DATA ACQUISITION:

PAST APPLICATIONS:

PLANNED IMPROVEMENTS:

LOCAL INFORMATION CONTACT:

EXPLANATION OF WIND TUNNEL DATA SHEETS

(1) Name of the Installation where the facility is located, and when not evident, the name of the owner and city.

(2) Proper or generic name of the facility, with additional qualifiers or identifiers as appropriate. When the size of a tunnel is included, the units are those by which the tunnel is best known.

*Test Section Size:* The dimensions of the test section are included as Height (H) by Width (W) by Length (L) unless the cross section diameter is given and indicated by (dia.).

*Date Built/Upgraded:* Self Explanatory.

*Operational Status:* An indication of the facility's current work load. A "backlog" indicates an overflow of work beyond normal operations. The facility operators should be contacted directly to determine the extent of the backlog. When a facility is currently inactive or on standby, it is so indicated, as is operations on a "demand" basis only.

*Description:* Space available for supplementary information on the performance range or special conditions of the facility.

*Performance Parameters:*

*Speed Range:* Listed in Mach number with feet per sec (ft/sec) or knots included where indicated. Several speed ranges may be included in concert with different size test sections or Unitary Plan facilities.
*Temp. Range:* Stagnation temperature in units indicated. "Ambient" is included for atmospheric facilities.
*Reynolds No:* Reynolds number range in millions per foot.
*Dynamic Pres:* Dynamic pressure range given in pounds per square foot (psf).
*Stagnation Pres:* Stagnation pressure in units indicated.
*Turbulence Level:* Turbulence level in % or turbulence factor where indicated.

*Testing Capabilities:* Detailed information about the facility. Unique features, instrumentation, and performance capabilities are discussed.

*Data Acquisition:* Describes the type of systems used for data gathering, number of channels available, and the form of output.

*Past Applications:* Lists past landing/escape systems programs which have been conducted in this facility.

*Planned Improvements:* Describes major improvements, rehabilitations, and modifications being made or planned.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the facility.

# WIND TUNNEL INDEX

# WIND TUNNEL INDEX

# WIND TUNNEL INDEX

# COMPARABLE WIND TUNNELS

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group A ( > 30 ft )** | |
| 1-20 | 80 x 120 ft Low Speed Wind Tunnel | NASA Ames Research Center |
| 1-23 | 40 x 80 ft Low Speed Wind Tunnel | " |
| 1-27 | 30 x 60 ft Wind Tunnel | NASA - Langley Research Center |
| | **Group B ( 12 - 30 ft )** | |
| 1-15 | 30 x 26 and 16 x 23 ft Wind Tunnels | Lockheed Aeronautical Systems Company |
| 1-19 | 12 ft Pressure tunnel | NASA Ames Research Center |
| 1-25 | 14 x 22 ft Subsonic Tunnel | NASA - Langley Research Center |
| 1-30 | 9 x 15 ft Low Speed Propulsion Wind Tunnel | NASA - Lewis Research Center |
| 1-38 | Large Subsonic Wind Tunnel | United Technologies Research Center |
| | **Group C ( 7 x 10-12 ft )** | |
| 1-14 | 8 x 12 Subsonic Wind Tunnel | General Dynamics Corporation |
| 1-17 | 7 x 10 (15 x 20) ft Low Speed Wind Tunnel | LTV Aerospace and Defense Company |
| 1-21 | 7 x 10 ft Low Speed Wind Tunnel | NASA Ames Research Center |
| 1-33 | 7 x 10 ft Low Speed Wind Tunnel | Texas A&M University |
| 1-37 | 8 x 10 Low Speed Wind Tunnel | U. S. Navy, David Taylor Research Center |
| 1-40 | Atmospheric Wind Tunnel | University of Maryland |
| | **Group D (Vertical Wind Tunnels)** | |
| 1-26 | 20 ft Vertical Spin Tunnel | NASA - Langley Research Center |
| 1-34 | Vertical Wind Tunnel | U.S. Air Force |
| 1-36 | Vertical Wind Tunnel | U.S. Army Chemical Res., Dev., and Engineering Ctr. |

# COMPARABLE WIND TUNNELS

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group E (Unique Facilities)** | |
| 1-9 | 30 x 30 in. Low speed wind tunnel | Alliant Techsystems, Inc. |
| 1-19 | 12 ft Pressure tunnel | NASA Ames Research Center |
| 1-31 | 4 x 4 ft Wind Tunnel | Naval Air Development Center |
| 1-32 | Low Speed Water Tunnel | Syracuse University |
| 1-39 | Eiffel-type Wind Tunnel | University of Lowell |
| 1-41 | Open and Closed Return Wind Tunnels | University of Minnesota |
| 1-35 | Transonic Wind Tunnel | U.S. Army Chemical Res., Dev., and Engineering Ctr. |
| | **Group F (Supersonic/Transonic)** | |
| 1-10 | 16 ft Supersonic Tunnel (16S) | Arnold Engineering Development Center |
| 1-11 | 16 ft Transonic Tunnel (16T) | " |
| 1-12 | 4 ft Transonic Tunnel (4T) | " |
| 1-13 | Von Karman Facility, Tunnel A | " |
| 1-16 | 4 x 4 ft High Speed Wind Tunnel | LTV Aerospace and Defense Company |
| 1-18 | 11 x 11 ft Transonic Wind Tunnel | NASA Ames Research Center |
| 1-24 | 9 x 7 ft Supersonic Wind Tunnel | " |
| 1-22 | 8 x 7 ft Supersonic Wind Tunnel | " |
| 1-28 | 7 x 10 ft High Speed Wind Tunnel | NASA - Langley Research Center |
| 1-29 | Transonic Dynamics Tunnel (TDT) | " |

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** Alliant Techsystems, Inc.<br><br>**LOCATION:** 5901 Lincoln Dr. Edina, MN 55436 | **TEST SECTION SIZE:** 30" X 30" X 60" | **SPEED RANGE:** (Mach#) 0 - 0.50 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1969/1990 | **TEMP. RANGE:** 0 - 160°F | Group E |
| | **OPERATIONAL STATUS:** Fully operational, normally 1 shift per day | **REYNOLDS NO:** (Per ft X $10^{-6}$) 0.6 - 3.4 | |
| **TYPE:** 30 X 30 in. Low Speed Wind Tunnel | **DESCRIPTION:** Horizontal, atmospheric return flow facility, powered by a 700 H.P. electric motor. Velocity is varied by hydraulically changing fan blade pitch. | **DYNAMIC PRES:** ($lb/ft^2$) 0 - 300 | |
| | | **STAGNATION PRES:** (psia) 14.10 | |
| | | **TURBULENCE LEVEL: (%):** ± 1.0 | |

**TESTING CAPABILITIES:**
Static stability data, dynamic magnus data, dynamic pitch damping and dynamic events. Sting mounts with 6 component balance (range -10° to +90° pitch), floor mounting and wall mounting.

**DATA ACQUISITION:**
Up to 90,000 samples/second. Uses Hewlett Packard HP3852 based data acquisition system. Easily programmable and changeable to fit many applications. Immediate output in the form of printed data and comprehensive data plots.

**PAST APPLICATIONS:**
Low speed ballistics, munitions dispensers, aerodynamic decelerators, gliders, infantry weapons, cluster munitions.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Todd Van Slyke - (612) 939-2371

# WIND TUNNELS

| COMPANY: Arnold Engineering Development Center<br>LOCATION: Arnold AFB, TN. 37389 | TEST SECTION SIZE: 16 ft x 16 ft x 40 ft | SPEED RANGE: (Mach#) 1.6 - 3.4 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1954 | TEMP. RANGE: 120 - 200 | Group F |
| | OPERATIONAL STATUS: Active | REYNOLDS NO: (Per ft X $10^{-6}$) 0.2 - 2.6 | |
| TYPE: 16 ft Supersonic Tunnel (16S) | DESCRIPTION: Closed Circuit continuous flow. Single return, variable density. | DYNAMIC PRES: ($lb/ft^2$) 30 - 580 | |
| | | STAGNATION PRES: (psia) 200 - 1800 | |
| | | TURBULENCE LEVEL: (%): 0.2 - 0.3% | |

**TESTING CAPABILITIES:**
Testing of large-scale aerodynamic models and full-scale air-breathing or rocket propulsion systems is possible at the conditions above and at altitudes from 50,000 to 90,000 ft. Tunnel 16S is adaptable to testing many full-scale decelerator devices. Parachutes and decelerators up to five feet in diameter have been deployed without any appreciable change in tunnel conditions. Larger parachutes can be tested; however, the available ranges of tunnel parameters may be compromised. Numerous support system hardware and instrumentation systems are available to accommodate test program peculiar requirements.

**DATA ACQUISITION:**
Automatic data processing and model control. Analog data recording, electro-optical flow visualization techniques and photographic coverage. Instrumentation systems include: Digital Equipment Corp. VAX 8650, DEC PDP11/73, digital multiplexor & control system, digital pressure system, and automated model positioning and control. Microvax III or Masscomp systems used for dynamic data acquisition.

**PAST APPLICATIONS:**
During the last 20 years, numerous decelerator and ejection seat systems have been tested in Tunnel 16S. Tests are described in: AEDC-TR-70-161, AEDC-TR-72-78, AEDC-TR-72-90 and AEDC-TSR-87-P19.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** David E.A. Reichenau, M.S.600, (615) 454-6672, FAX: (615) 454-6759.

# WIND TUNNELS

| COMPANY: Arnold Engineering Development Center<br>LOCATION: Arnold AFB, TN. 37389 | TEST SECTION SIZE: 16 ft x 16 ft x 40 ft | SPEED RANGE: (Mach#) 0.06 - 1.6 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1952 | TEMP. RANGE: 60 - 150 | Group F |
| | OPERATIONAL STATUS: Active | REYNOLDS NO: (Per ft X $10^{-6}$) 0.1 - 5.5 | |
| TYPE: 16 ft Transonic Tunnel (16T) | DESCRIPTION: Closed Circuit continuous flow. Single return, variable density. Porous wall (60 deg. incl) Test Section | DYNAMIC PRES: (lb/$ft^2$) 1 - 1000 | |
| | | STAGNATION PRES: (psia) 200 - 4000 | |
| | | TURBULENCE LEVEL: (%): 0.4% | |

**TESTING CAPABILITIES:**
Testing of large-scale aerodynamic models and full-scale air-breathing or rocket propulsion systems is possible at the conditions above and at altitudes from sea level to 90,000 ft. Tunnel 16T is adaptable to testing many full-scale decelerator devices. Parachutes and decelerators up to five feet in diameter have been deployed without any appreciable change in tunnel conditions. Larger parachutes can be tested; however, the available ranges of tunnel parameters may be compromised. Numerous support system hardware and instrumentation systems are available to accommodate test program peculiar requirements.

**DATA ACQUISITION:**
Automatic data processing and model control. Analog data recording, electro-optical flow visualization techniques and photographic coverage. Instrumentation systems include: Digital Equipment Corp. VAX 8650, DEC PDP11/73, digital multiplexor & control system, digital pressure system, and automated model positioning and control. Microvax III or Masscomp systems used for dynamic data acquisition.

**PAST APPLICATIONS:**
During the last 20 years, numerous decelerator and ejection seat systems have been tested in Tunnel 16T. Tests are described in: AEDC-TR-70-61, AEDC-TR-71-30, AEDC-TR-72-78, AEDC-TR-76-21, and AEDC-TR-77-36, AEDC-TSR-80-P17, AEDC-TSR-81-P52, AEDC-TR-87-16, AEDC-TSR-87-P19.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** David E.A. Reichenau, M.S.600, (615) 454-6672, FAX: (615) 454-6759.

# WIND TUNNELS

| COMPANY: Arnold Engineering Development Center<br>LOCATION: Arnold AFB, TN. 37389 | TEST SECTION SIZE: 4 ft x 4 ft x 12.5 ft | SPEED RANGE: (Mach#) 0.2 - 2.0 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1968 | TEMP. RANGE: 90 - 135 | Group F |
| | OPERATIONAL STATUS: Active | REYNOLDS NO: (Per ft X $10^{-6}$) 6.5 | |
| TYPE: 4 ft Transonic Tunnel (4T) | DESCRIPTION: Closed Circuit continuous flow. Single return, variable density. Porous wall (1 to 10% var.) Test Section | DYNAMIC PRES: (lb/$ft^2$) 20 - 1400 | |
| | | STAGNATION PRES: (psia) 200 - 3400 | |
| | | TURBULENCE LEVEL: (%): 0.8 - 1.2% | |

**TESTING CAPABILITIES:**
Well suited for highly specialized testing techniques such as captive trajectory and store separation testing. Numerous support system hardware and instrumentation systems are available to accommodate test program peculiar requirements.

**DATA ACQUISITION:**
Automatic data processing and model control. Analog data recording, electro-optical flow visualization techniques and photographic coverage. Instrumentation systems include: Digital Equipment Corp. VAX 8650, DEC PDP11/73, digital multiplexor & control system, digital pressure system, and automated model positioning and control. Microvax III or Masscomp systems used for dynamic data acquisition.

**PAST APPLICATIONS:**
During the last 20 years, numerous decelerator and ejection seat systems have been tested in Tunnel 16T. Tests are described in: AEDC-TR-71-123, AEDC-TR-72-18, AEDC-TR-73-27, AEDC-TR-75-149, AEDC-TSR-83-P30.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** David E.A. Reichenau, M.S.600, (615) 454-6672, FAX: (615) 454-6759.

# WIND TUNNELS

| COMPANY: Arnold Engineering Development Center<br>LOCATION: Arnold AFB, TN. 37389 | TEST SECTION SIZE: 3.3 ft x 3.3 ft x 7 ft | SPEED RANGE: (Mach#) 1.5 - 5.5 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1954 | TEMP. RANGE: 90 - 240 | Group F |
| | OPERATIONAL STATUS: Active | REYNOLDS NO: (Per ft X $10^{-6}$) 0.3 - 9.2 | |
| TYPE: Von Karman Facility Tunnel A | DESCRIPTION: Closed Circuit continuous flow. Variable density. | DYNAMIC PRES: ($lb/ft^2$) 60 - 1800 | |
| | | STAGNATION PRES: (psia) 864 - 21,312 | |
| | | TURBULENCE LEVEL: (%): 0.03 - 0.1% | |

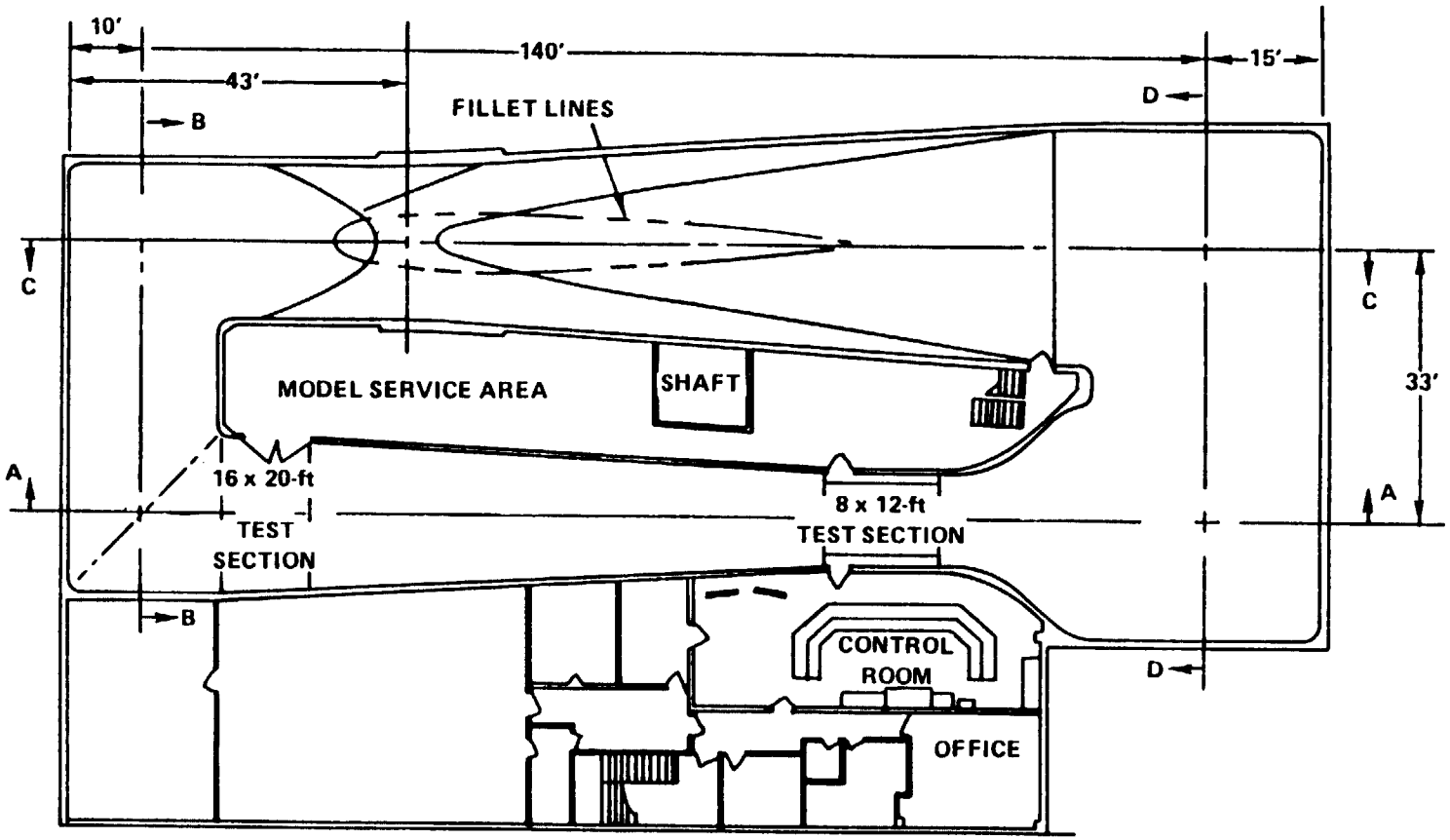
**TESTING CAPABILITIES:**
Well suited for force and moment, pressure, heat transfer, dynamic stability, hot/cold flow jet effects, and free flight tests. Tunnel A also provides highly specialized testing techniques such as captive trajectory, and store separation. The Tunnel A Aerospace Rig Mechanism is exclusively for simulating escape system separation. Numerous support system hardware and instrumentation systems are available to accommodate test program peculiar requirements.

**DATA ACQUISITION:**
Force, pressure, and temperature measurements. The data acquisition system can accept 142 digital signals (incl. constants) and 80 analog signals. Instrumentation systems include: Digital Equipment Corp. VAX 8650, DEC PDP11/73, digital multiplexor & control system, digital pressure system, and automated model positioning and control. Microvax III or Masscomp systems used for dynamic data acquisition.

**PAST APPLICATIONS:**
The following references describe some of the ejection seat and decelerator test completed in Tunnel A: AEDC-TR-65-110, AEDC-TR-65-218, AEDC-TR-67-93, AEDC-TR-67-224, AEDC-TR-69-263, AEDC-TR-72-171.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Bill Strike, M.S. 400, (615) 454-3270.


10'
140'
15'
43'
B
FILLET LINES
D
C
C
33'
MODEL SERVICE AREA
SHAFT
A
16 x 20-ft
TEST
SECTION
8 x 12-ft
TEST SECTION
A
B
CONTROL
ROOM
D
OFFICE

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** General Dynamics Corporation<br>**LOCATION:** San Diego, CA | **TEST SECTION SIZE:** 8 x 12 x 15 | **SPEED RANGE:** (Mach#) 0.01 - 0.37 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1947/1961 | **TEMP. RANGE:** Ambient | Group C |
| | **OPERATIONAL STATUS:** 1 Shift per day, Capable of extended shifts. | **REYNOLDS NO:** (Per ft X $10^{-6}$) 0.25 - 2.5 | |
| **TYPE:** 8 x 12 Subsonic Wind Tunnel | **DESCRIPTION:** Closed circuit, single return, continuous flow, tandem V/STOL. | **DYNAMIC PRES:** ($lb/ft^2$) 2 - 200 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** 0.05 - 0.3, qbar | |

**TESTING CAPABILITIES:**
Six-component force data of decelerator models are obtained from internal or external balances using strut, sting, or cable supports. High speed photographic equipment to analyze aircraft escape systems.

**DATA ACQUISITION:**
Forty analog input channels can be recorded and processed on a tunnel dedicated computer system.

**PAST APPLICATIONS:**
Measurement of drag and stability characteristics of several parachute configurations.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Ed. A. Collinge, (619) 542-2358; Richard S. Crooks, (619) 542-2356.

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| Lockheed Aeronautical Systems Company<br>**LOCATION:**<br>Marietta, GA | 30x26x63 ft with tandem 16.25x23.25x43 ft | **(Mach#)** 0.13, 0.26 (146, 293 ft/sec) | Group B |
| | **DATE BUILT/UPGRADED:**<br>1967/1985-91 | **TEMP. RANGE:**<br>Ambient | |
| | **OPERATIONAL STATUS:**<br>1 - 1.5 shifts per day | **REYNOLDS NO:**<br>**(Per ft X $10^{-6}$ )** 0-1; 0-2 | |
| **TYPE:**<br>30 x 26 and 16 x 23 ft Wind Tunnels | **DESCRIPTION:**<br>Closed circuit, single return, continuous flow, closed throat, tandem test section. 9000 Hp electric motor directly coupled to a fixed-pitch, 6-bladed fan of 39-ft diameter | **DYNAMIC PRES:**<br>**(lb/$ft^2$ )** 0.5-25; 2-100 | |
| | | **STAGNATION PRES:**<br>**(psia)** Atmospheric | |
| | | **TURBULENCE LEVEL: (%):**<br>0.07% (sphere) 0.3% Hot Wire | |

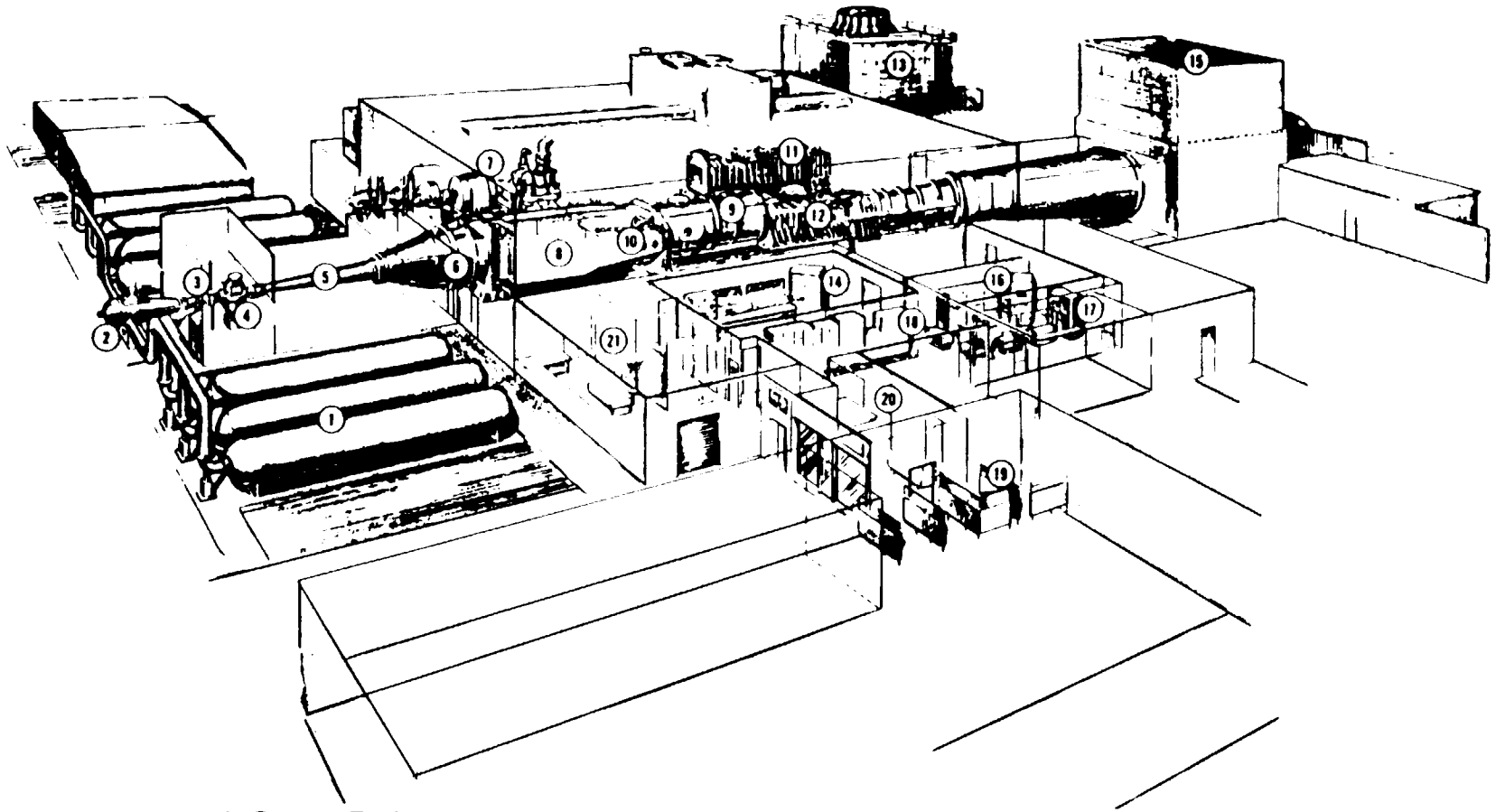
**TESTING CAPABILITIES:**
A 6-component external balance is installed under each of the test sections. Several model support systems available. Two 600-Hp M.G sets with output frequencies from 60 to 400 Hz and a volts per cycle ratio from 0.4 to 2.0. Additionally, 4500 Hp air compressor can supply 20 lb/sec at 300 psi to the model. Automated, high-productivity facility.

**DATA ACQUISITION:**
On line, Real Time Data Acquisition, Reduction, Analysis and Presentation Capability.

**PAST APPLICATIONS:**
Aerodynamics, stability and control and propulsion integration for aircraft, automotive, parachute, and research models. Automotive acoustic, radiator/underhood flows, and wake traverse measurements.

**PLANNED IMPROVEMENTS:**
Continuous improvement program including data systems, model supports, test techniques, and productivity.

**LOCAL INFORMATION CONTACT:** Gerald Pounds, (404) 494-4158, FAX: (404) 494-4790



1. Storage Tank
2. Mixing Header
3. Gate Valve
4. Control Valve
5. Entrance Cone
6. Stilling Chamber
7. Air Compressor Room
8. Variable Nozzle
9. Transonic Test Section
10. Supersonic Test Section
11. Supersonic Diffuser
12. Subsonic Diffuser
13. Cooling Tower
14. Control Room
15. Exhaust Muffler
16. Computer Room
17. Data Reduction Room
18. Office
19. Customer Offices
20. Lobby
21. Model Room

LTV High Speed Wind Tunnel

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** LTV Aerospace and Defense Company<br>**LOCATION:** P.O. Box 655907 Dallas, TX 75265-5907 | **TEST SECTION SIZE:** 4 ft x 4 ft | **SPEED RANGE:** (Mach#) 0.4 - 5.0 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1958/1991 | **TEMP. RANGE:** 80 - 120° F | Group F |
| | **OPERATIONAL STATUS:** Two 8-hour shifts; can extend to three 8-hour | **REYNOLDS NO:** (Per ft X $10^{-6}$) 2 - 38 | |
| **TYPE:** 4 X 4 ft High Speed Wind Tunnel | **DESCRIPTION:** Blow down to atmosphere with interchangeable transonic (M=0.4 to 1.8, 22% normal hole) and supersonic (M=1.4 to 5.0) test sections. 40K cubic feet air storage at 515 psia with run times up to 2.5 minutes as a function of Mach #. | **DYNAMIC PRES:** (lb/$ft^2$) 150 - 5000 | |
| | | **STAGNATION PRES:** (psia) 20 - 350 | |
| | | **TURBULENCE LEVEL: (%):** 2 (nominal) | |

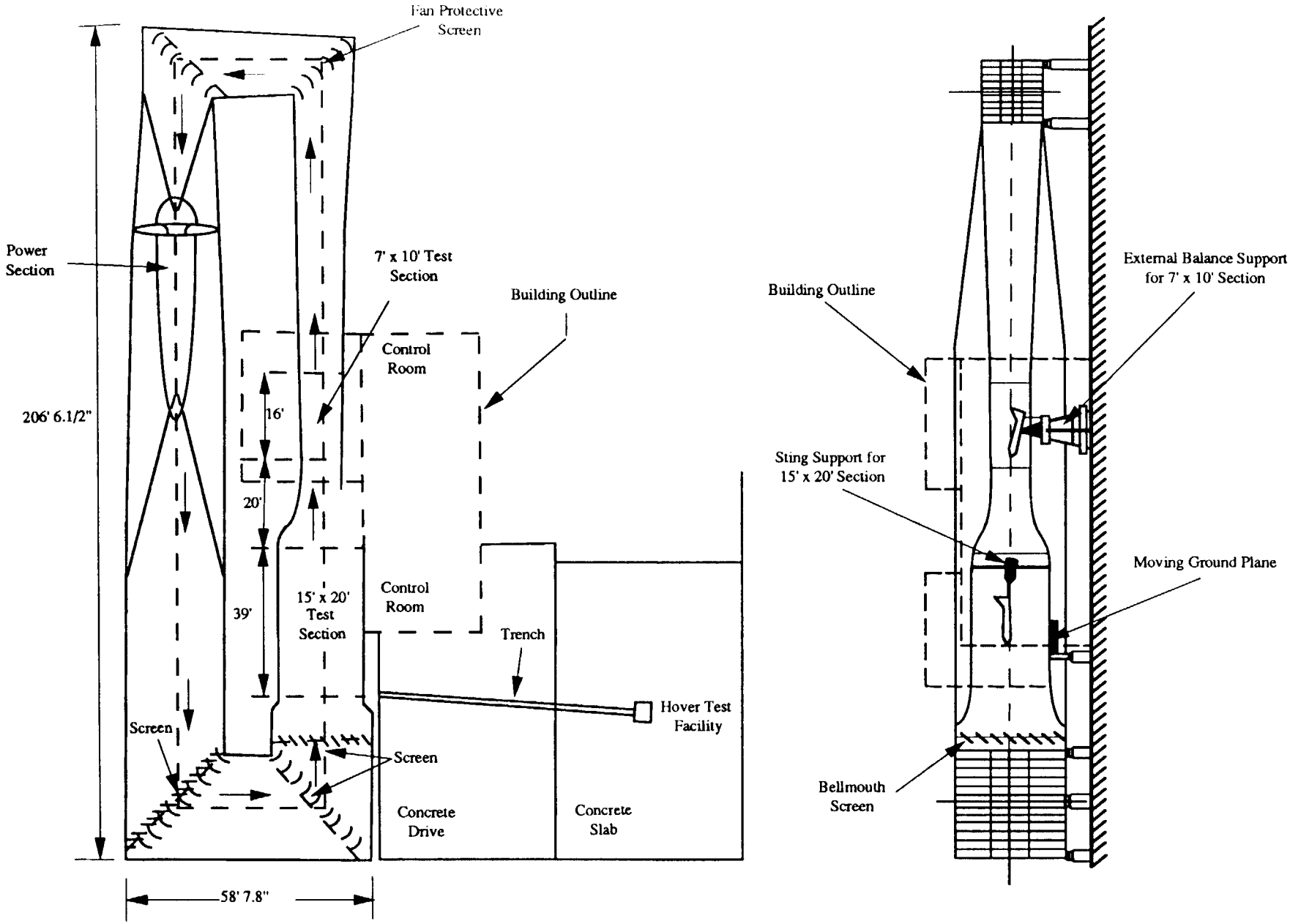
**TESTING CAPABILITIES:**
Basic Aerodynamic Components, Internal Flow, Heat Transfer, Pressure Distribution, Jet Exhaust Effects, Photographic Observation, Free-Store Ejection, Dynamic Stability, Flutter, Inlet Testing, Rocket Propulsion, Captive Store Separation, Cold Jet Simulation and Roll Damping.

**DATA ACQUISITION:**
500 KHz Analog-to-Digital Converter, 120-Channel System Controlled with a Hewlett Packard 1000 Series 700 Digital Computer, Standard and High Speed Video.

**PAST APPLICATIONS:**
High Speed Aerodynamic Characteristics Tests on Parachutes, Aircraft, Missiles, Store Separation Characteristics and parts thereof.

**PLANNED IMPROVEMENTS:**
Recently increased air storage capacity, upgraded Static Flow Facility maximum flow rate to 60 lbs/sec. of air, added high pressure N2 facility.

**LOCAL INFORMATION CONTACT:** Wind Tunnel Lab. Manager - (214) 266-2751 or 8461 FAX: (214) 266-5466




LTV Low Speed Wind Tunnel Circuit Arrangement

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| LTV Aerospace and Defense Company<br>**LOCATION:**<br>P.O. Box 655907<br>Dallas, TX 75265-5907 | 7 x 10 x 16 ft; (15 x 20 x 39 ft) | **(Mach#)** 0.01 - 0.06 | Group C |
| | **DATE BUILT/UPGRADED:** 1954/1987 | **TEMP. RANGE:** 500 - 565° R | |
| | **OPERATIONAL STATUS:** Single 8-hour shift; can extend to two 8-hour shifts | **REYNOLDS NO:** **(Per ft X $10^{-6}$ )** 0.06 - 0.47 | |
| **TYPE:** 7 X 10 (15 X 20) ft Low Speed Wind Tunnel | **DESCRIPTION:** Closed circuit, single return, continuous flow facility with tandem 7 x 10 and 15 x 20-ft test sections. | **DYNAMIC PRES:** **(lb/$ft^2$ )** 0.2 - 6.0 | |
| | | **STAGNATION PRES:** **(psia)** Dynamic Plus | |
| | | **TURBULENCE LEVEL: (%):** T.F. = 1.01 (1.40) | |

**TESTING CAPABILITIES:**
This facility is equipped for force measurements with external or internal balances on Powered Models, Jet Simulation, Ground Effects, Automotive and Wind Loads on buildings and other structures. Models supported on strut mount, sting support, or cables. Auxiliary model power sources include two 50 Kw variable frequency generator sets, a 90 GPM, 5000 psi hydraulic system and 500 psi heated air at rates of up to 200 lb./sec.

**DATA ACQUISITION:**
Sixty-four low level analog data channels may be recorded with 16-bit resolution and processed by an on-line, on-site digital computer and plotter system. Six 5-digit external balance channels and four 5-digit frequency counters can also be recorded by direct digital entry into the computer. Also available are standard and high speed video recording systems, oscilloscopes, FM analog tape recorder, and spectrum analyzer.

**PAST APPLICATIONS:**
Wind turbine and parachute testing, low speed aerodynamic characteristics of aircraft, missiles, helicopters, automobiles, buildings and other structures, aircraft store separation.

**PLANNED IMPROVEMENTS:**
Increase tunnel speed to M = 0.4, fabricate 3-axis flow survey apparatus.

**LOCAL INFORMATION CONTACT:** Wind Tunnel Manager - (214) 266-2751 or 2130 FAX: (214) 266-5466

# WIND TUNNELS

| COMPANY: NASA Ames Research Center<br>LOCATION: Moffett Field, CA | TEST SECTION SIZE: 11' x 11' | SPEED RANGE: (Mach#) 0.5 - 1.4 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1958 | TEMP. RANGE: 80->120°F | Group F |
| | OPERATIONAL STATUS: Operational - 3 shifts/day | REYNOLDS NO: (Per ft X $10^{-6}$) 1.5 - 8.0 | |
| TYPE: 11 x 11 ft Transonic Wind Tunnel | DESCRIPTION: Part of the Unitary Plan Wind Tunnels. Single drive, Continuous flow 0.5 < Pt < 2.0 ATM | DYNAMIC PRES: ($lb/ft^2$) 100 - 2000 | |
| | | STAGNATION PRES: (psia) 0.5 - 2.0 | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**
Sting supports, floor support.

**DATA ACQUISITION:**
Centralized, facility support system.

**PAST APPLICATIONS:**
Commercial and military aircraft development, Shuttle development, SST research, and NASA research.

**PLANNED IMPROVEMENTS:**
Major automation planned for 1995 and 1996.

**LOCAL INFORMATION CONTACT:** Mr Dave Banducci, (415) 604-6698

# WIND TUNNELS

| COMPANY: NASA Ames Research Center<br>LOCATION: Moffett Field, CA | TEST SECTION SIZE: 12 x 12 | SPEED RANGE: (Mach#) 0 - 0.6 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1945, upgrade 1995 | TEMP. RANGE: 120°F | Group B & E |
| | OPERATIONAL STATUS: Under renovation, operational - 1995 | REYNOLDS NO: (Per ft X $10^{-6}$) ≤ 9 | |
| TYPE: 12 ft Pressure tunnel | DESCRIPTION: Pressurized, low turbulence, continuous flow | DYNAMIC PRES: ($lb/ft^2$) ≤ 600 | |
| | | STAGNATION PRES: (psia) 6 - 90 | |
| | | TURBULENCE LEVEL: (%): < 0.05% | |

**TESTING CAPABILITIES:**
Sting support - Pitch-Roll, Semi span, Hi Alpha, and Thru support

**DATA ACQUISITION:**
Centralized, facility supported data acquisition and reduction system.

**PAST APPLICATIONS:**
Hi lift for commercial and military aircraft, Hi alpha for military aircraft, and Fluid dynamic research

**PLANNED IMPROVEMENTS:**
Major renovation underway, planned operational capability - 1995

**LOCAL INFORMATION CONTACT:** Mr Dave Banducci, (415) 604-6698

# WIND TUNNELS

| COMPANY: NASA Ames Research Center<br>LOCATION: Moffett Field, CA | TEST SECTION SIZE: 80 X 120 X 190 ft | SPEED RANGE: (Mach#) 100 knots | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1985 | TEMP. RANGE: Ambient | Group A |
| | OPERATIONAL STATUS: Currently operational | REYNOLDS NO: (Per ft X $10^{-6}$) 1.5 | |
| TYPE: 80 X 120 ft Low Speed Wind Tunnel | DESCRIPTION: Part of the National Full-Scale Aerodynamics Complex. Uses same fan drive as the 40 x 80-ft Wind Tunnel. Solid wall. Open Return. Rectangular cross section. | DYNAMIC PRES: (lb/$ft^2$) 33 | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): 0.7% | |

**TESTING CAPABILITIES:**
Wind-tunnel balance limits in pounds: ±150,000 lift, ±25,000 drag, ±30,000 side force. Load cell balances can also be used. 2-D laser velocimeter, multiple channels of hot-wire annemometry, and laser light sheet flow visualization. 3-strut mounting system is standard but other mounts can be accomodated.

**DATA ACQUISITION:**
VAX-based data system with 14-bit A/D front end. 6-component force and moments measured by external wind-tunnel balance system. Load-cell balances may be used as well. Electronically scanned pressure measuring system is available. Dynamic data can be acquired.

**PAST APPLICATIONS:**
Large ram-air inflated wings (20' by 60'), large- or full-scale aircraft and models.

**PLANNED IMPROVEMENTS:**
Modern data acquisition system (Unix based) with increased data rates and storage capacity.

**LOCAL INFORMATION CONTACT:** Jerry Kirk - (415) 604-5045

# WIND TUNNELS

| COMPANY: NASA Ames Research Center<br>LOCATION: Moffett Field, CA | TEST SECTION SIZE: 7 X 10 X 14.7 ft | SPEED RANGE: (Mach#) 0.30 (220 knots) | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1940 | TEMP. RANGE: Ambient | Group C |
| | OPERATIONAL STATUS: Currently operational | REYNOLDS NO: (Per ft X $10^{-6}$) 2.3 | |
| TYPE: 7 X 10 ft Low Speed Wind Tunnel | DESCRIPTION: Test section is rectangular. Closed Return. Can be also be run as an open jet. | DYNAMIC PRES: (lb/$ft^2$) 160 psf | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): 1% | |

**TESTING CAPABILITIES:**
Wind-tunnel balance limits in pounds: ±4400 lift, ±500 drag, ±2500 side force. Can also accomodate internal model balances. 3-D laser velocimeter, multiple channels of hot-wire annemometry, flow survey traverse system, and laser light sheet flow visualization.

**DATA ACQUISITION:**
VAX-based data system with 14-bit A/D front end. 6-component force and moments measured by external wind-tunnel balance system. Internal balances may be used as well. Electronically scanned pressure measuring system is available. Dynamic data can be acquired.

**PAST APPLICATIONS:**
Small-scale ram-air inflated wings, wake turbulence measurements.

**PLANNED IMPROVEMENTS:**
Modern data acquisition system (Unix based) with increased data rates and storage capacity

**LOCAL INFORMATION CONTACT:** Jerry Kirk - (415) 604-5045

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| NASA Ames Research Center<br>**LOCATION:**<br>Moffett Field, CA | 8' x 7' | (Mach#) 2.5 - 3.5 | Group F |
| | **DATE BUILT/UPGRADED:** 1958 | **TEMP. RANGE:** 80 ->120°F | |
| | **OPERATIONAL STATUS:** Operational - 3 shifts/day | **REYNOLDS NO:** (Per ft X $10^{-6}$) 1.5 - 8.0 | |
| **TYPE:** 8 x 7 ft Supersonic Wind Tunnel | **DESCRIPTION:** Part of the Unitary Plan Wind Tunnels. Single drive, Continuous flow $0.5 < Pt < 2.0$ ATM | **DYNAMIC PRES:** (lb/$ft^2$) 100 - 2000 | |
| | | **STAGNATION PRES:** (psia) 0.5 - 2.0 | |
| | | **TURBULENCE LEVEL: (%):** N/A | |

**TESTING CAPABILITIES:**
Wall mounted fixtures.

**DATA ACQUISITION:**
Centralized, facility support system.

**PAST APPLICATIONS:**
Commercial and military aircraft development, Shuttle development, SST research, and NASA research.

**PLANNED IMPROVEMENTS:**
Major automation planned for 1995 and 1996.

**LOCAL INFORMATION CONTACT:** Mr Dave Banducci, (415) 604-6698

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** NASA Ames Research Center<br>**LOCATION:** Moffett Field, CA | **TEST SECTION SIZE:** 40 X 80 ft | **SPEED RANGE:** (Mach#) 0.45 (300 knots) | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1985 | **TEMP. RANGE:** Ambient to 150°F | Group A |
| | **OPERATIONAL STATUS:** Currently operational | **REYNOLDS NO:** (Per ft X $10^{-6}$) 3.2 | |
| **TYPE:** 40 X 80 ft Low Speed Wind Tunnel | **DESCRIPTION:** Part of the National Full-Scale Aerodynamics Complex. Uses same fan drive as the 80 x 120-ft. Wind Tunnel. Solid wall. Closed Return. Square center of cross- section with semi-circular side walls. Test section is 80 feet long. | **DYNAMIC PRES:** (lb/$ft^2$) 260 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** 0.7% | |

**TESTING CAPABILITIES:**
Wind-tunnel balance limits in pounds: ±50,000 lift, ±8,000 drag, ±8,000 side force. Load cell balances can also be used. 2-D laser velocimeter, multiple channels of hot-wire anemometry, and laser light sheet flow visualization. 3-strut mounting system is standard but other mounts can be accomodated.

**DATA ACQUISITION:**
VAX-based data system with 14-bit A/D front end. 6-component force and moments measured by external wind-tunnel balance system. Internal balances may be used as well. Electronically scanned pressure measuring system is available. Dynamic data can be acquired.

**PAST APPLICATIONS:**
Depoyments studies of several types of parachutes at up to 200 knots, wake turbulence measurements, large-scale fixed- and rotary-wing aircraft.

**PLANNED IMPROVEMENTS:**
Modern data acquisition system (Unix based) with increased data rates and storage capacity. Improved acoustic lining to decrease reverberent noise in test section.

**LOCAL INFORMATION CONTACT:** Jerry Kirk - (415) 604-5045

# WIND TUNNELS

| COMPANY: NASA Ames Research Center<br>LOCATION: Moffett Field, CA | TEST SECTION SIZE: 9' x 7' | SPEED RANGE: (Mach#) 1.55 - 2.5 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1958 | TEMP. RANGE: 80->120°F | Group F |
| | OPERATIONAL STATUS: Operational - 3 shifts/day | REYNOLDS NO: (Per ft X $10^{-6}$) 1.5 - 8.0 | |
| TYPE: 9 x 7 ft Supersonic Wind Tunnel | DESCRIPTION: Part of the Unitary Plan Wind Tunnels. Single drive, Continuous flow 0.5 < Pt < 2.0 ATM | DYNAMIC PRES: ($lb/ft^2$) 100 - 2000 | |
| | | STAGNATION PRES: (psia) 0.5 - 2.0 | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**
Wall mounted fixtures.

**DATA ACQUISITION:**
Centralized, facility support system.

**PAST APPLICATIONS:**
Commercial and military aircraft development, Shuttle development, SST research, and NASA research.

**PLANNED IMPROVEMENTS:**
Major automation planned for 1995 and 1996.

**LOCAL INFORMATION CONTACT:** Mr Dave Banducci, (415) 604-6698

# WIND TUNNELS

| COMPANY: NASA - Langley Research Center<br>LOCATION: Hampton, VA 23665 | TEST SECTION SIZE: 14.5 x 21.8 x 20 ft | SPEED RANGE: (Mach#) 0 - 0.28 (318 ft/sec) | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1970/1984 | TEMP. RANGE: 490° - 620° R | Group B |
| | OPERATIONAL STATUS: 2 shifts per day (backlog) | REYNOLDS NO: (Per ft X $10^{-6}$) 0 - 2.1 | |
| TYPE: 14 x 22 ft Subsonic Tunnel | DESCRIPTION: Boundary-layer suction, moving-belt ground board, closed or open throat, single return, test-section size permits use of optimum-size power models. | DYNAMIC PRES: ($lb/ft^2$) 0 - 120 | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**

Used for force, moment, and pressure studies of full-span and semispan powered and unpowered advanced fighter aircraft. For ground effect tests, a moving-belt ground board with boundary-layer suction and variable-speed capabilities for operation at test-section flow velocities can be installed. A universal model support system uses a three-joint rotary sting. This system is mounted on a horizontal turntable with ±165° of rotation. Models can be powered with either high-pressure air or variable frequency electric systems.

**DATA ACQUISITION:**

Two duplicate systems. Each system is capable of reading 96 analog channels, 16 digital channels, and 1024 pressure scanner ports and controlling up to 10 scanivalve steppers. Each system uses a computer to control the acquisition process, to record the data on magnetic tape and disk, and to print or display computed parameters. Dynamic data can be recorded on a 72 channel Zonic 7000 system with a sampling frequency of 20 kHz at 90 D6.

**PAST APPLICATIONS:**

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Frank Quinto; (804) 864-5068, FAX: 864-8192

# WIND TUNNELS

| COMPANY: NASA - Langley Research Center<br>LOCATION: Hampton, VA 23665 | TEST SECTION SIZE: 20 ft dia. x 25 ft height | SPEED RANGE: (Mach#) 0.08 (90 ft/sec) | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1940/1984 | TEMP. RANGE: Ambient | Group D |
| | OPERATIONAL STATUS: 2.5 shifts per day (backlog) | REYNOLDS NO: (Per ft X $10^{-6}$) 0 - 0.62 | |
| TYPE: 20 ft Vertical Spin Tunnel | DESCRIPTION: Acceleration capability: 15-ft per sec(squared) Test Medium: Air<br>Deceleration capability: 25-ft per sec(squared)<br>Vertical annular return, continuous flow, closed throat | DYNAMIC PRES: ($lb/ft^2$) 0 - 10 | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**

Used to investigate spinning and tumbling characteristics of airplanes. Free-spinning and free-tumbling tests are conducted on dynamically scaled models with remotely actuated control surfaces. Recoveries by aerodynamic controls and by emergency parachute are evaluated. One degree-of-freedom tumbling tests use a free-to pitch rig. Force and moment and pressure tests under spinning conditions are performed using a boom-mounted rotary balance system permitting angles of attach through 360-degrees.

**DATA ACQUISITION:**

High-resolution CCD color video for free-spinning and tumbling tests. HP 9816 computer for rotary balance tests.

**PAST APPLICATIONS:**

Free-spinning and tumbling tests of airplane models. Rotary balance tests. Sizing of emergency spin recovery parachutes for airplanes. Static and dynamic tests of aerodynamic decelerators. Other tests requiring vertical airflow.

**PLANNED IMPROVEMENTS:**

Fiscal Year 1992: New fan, motor, power distribution, and rotary balance. Automation of video tracker. Video image analysis data acquisition system.

**LOCAL INFORMATION CONTACT:** Raymond D. Whipple, Flight Dynamics Branch; (804) 864-1194, FAX: 864-7722

# WIND TUNNELS

| COMPANY: NASA - Langley Research Center<br>LOCATION: Hampton, VA 23665 | TEST SECTION SIZE: 30 x 60 x 56 ft | SPEED RANGE: (Mach#) 0.03 - 0.11 (38 - 132 ft/sec) | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1930/1984 | TEMP. RANGE: Ambient | Group A |
| | OPERATIONAL STATUS: 2 shifts per day (backlog) | REYNOLDS NO: (Per ft X $10^{-6}$) 0-1 | |
| TYPE: 30 x 60 ft Wind Tunnel | DESCRIPTION: Closed circuit, double return, continuous flow, open throat. Model size: Span - 40-ft, weight - 15,000 lbs. | DYNAMIC PRES: ($lb/ft^2$) 0-30 | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**

Equipped for free-flight model test, the tunnel has shielded struts for the 6-component scale balance used for large-scale tests. There are a variety of smaller model mounts for use with small models having internal balances. Auxiliary equipment consists of 1000- and 500-hp dc motors for power supply to models, as well as 2 lb/sec at 500 psi and 15 lb/sec at 300 psi compressed-air supplies. The facility will accommodate models with a wing span of up to 40 ft and weight of 20,000 lbs. This facility is powered by two 4-bladed, 35.5-ft diameter fans, each driven by a 4000-hp electric motor.

**DATA ACQUISITION:**

65 channels of information of data can be recorded on the data acquisition system and reduced off-site.

**PAST APPLICATIONS:**

**PLANNED IMPROVEMENTS:**

In 1992, the high-pressure air supply will be upgraded to 10 lbs/sec. at 800 psi and the test section survey equipment will be rehabilitated and upgraded.

**LOCAL INFORMATION CONTACT:** Frank Jordan; (804) 864-1153, FAX: 864-7722

# WIND TUNNELS

| COMPANY: NASA - Langley Research Center<br>LOCATION: Hampton, VA 23665 | TEST SECTION SIZE: 6.6 x 9.6 x 10 ft | SPEED RANGE: (Mach#) 0.2 - 0.9 (224 - 1008 ft/sec) | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1945 | TEMP. RANGE: 490° - 620°R | Group F |
| | OPERATIONAL STATUS: 1 shift per day (backlog) | REYNOLDS NO: (Per ft X $10^{-6}$) 0.1 - 3.2 | |
| TYPE: 7 x 10 ft High-Speed Wind Tunnel | DESCRIPTION: Closed circuit, single return, continuous flow, closed throat. Model Size: Span - 5 ft | DYNAMIC PRES: (lb/$ft^2$) Variable | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): N/A | |

**TESTING CAPABILITIES:**
Used for static and dynamic studies of aerodynamic characteristics of aircraft and spacecraft models. Model mounting consists of a low to moderate angle-of-attack performance sting system, a low to high angle-of-attack combines pitch-roll stability sting system, a sidewall turntable, forced oscillation apparatus, and other specialized systems. Powered by a 1400 hp electric maindrive motor.

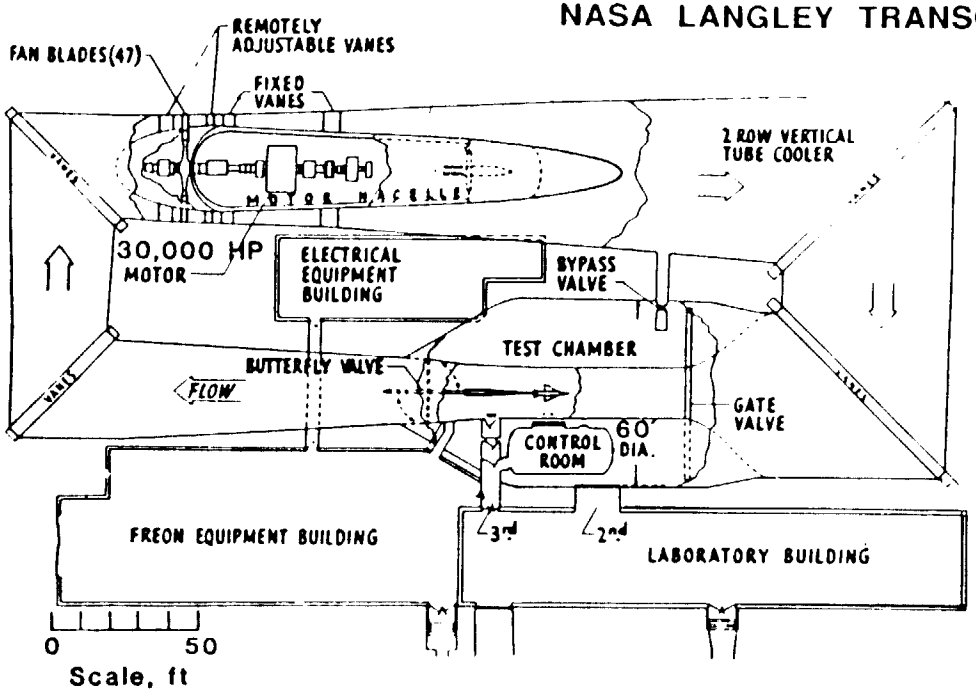
**DATA ACQUISITION:**
Equipped with a digital acquisition, display, and control system operated by a dedicated on-site Xerox Sigma 3 computer. Data reduction is accomplished in real time on-site as well as in batch mode off-site.

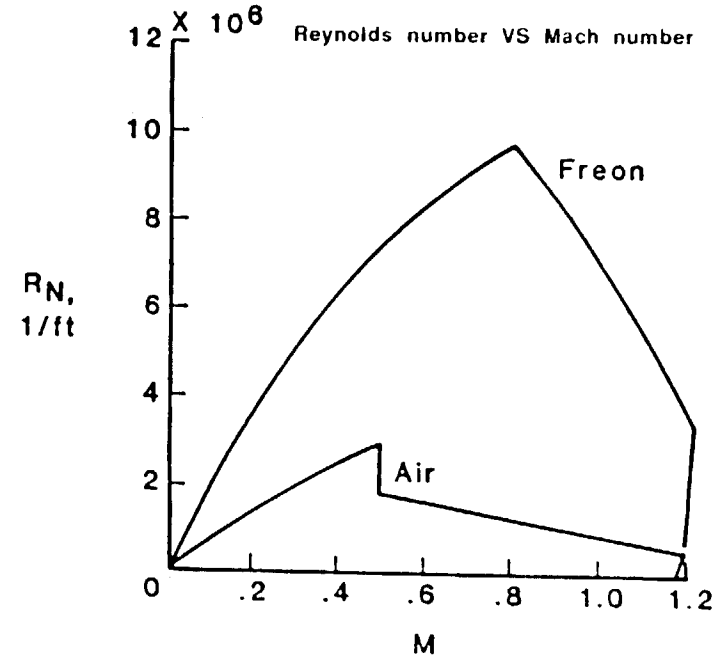
**PAST APPLICATIONS:**

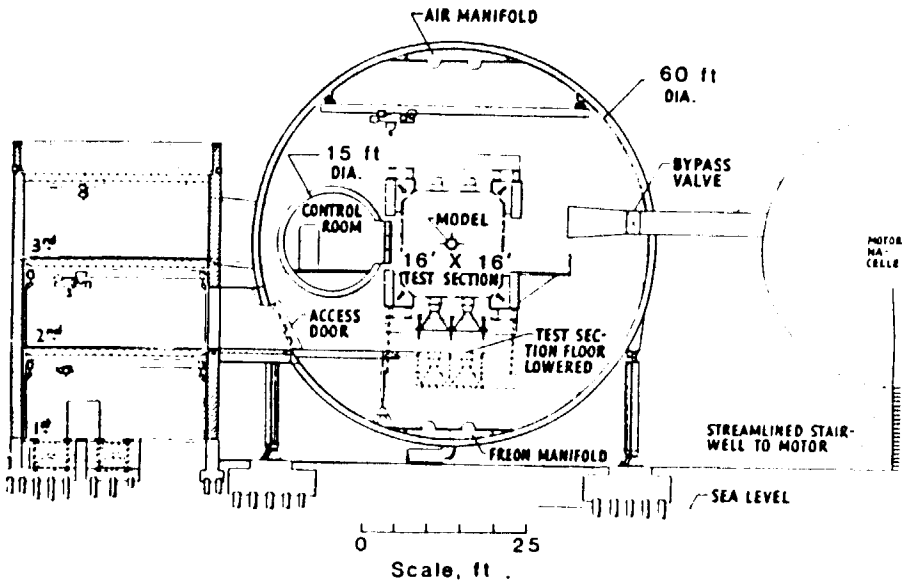
**PLANNED IMPROVEMENTS:**

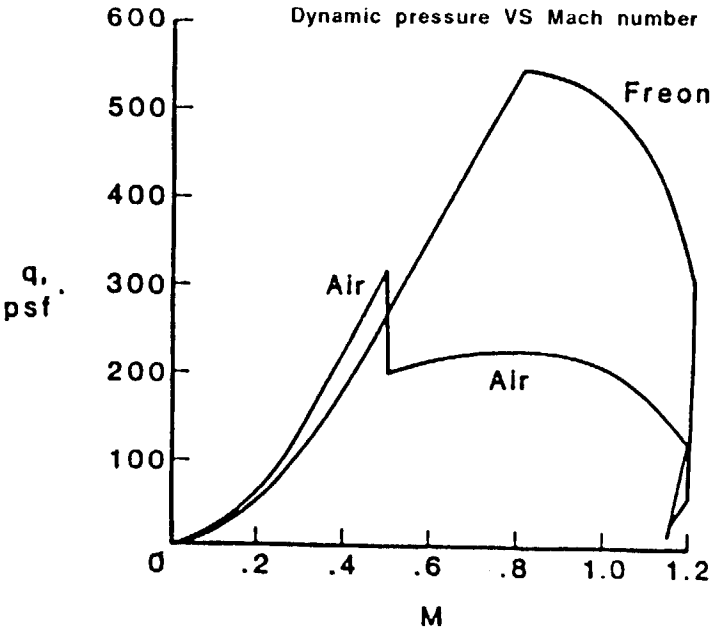
**LOCAL INFORMATION CONTACT:** Charles Fox; (804) 864-4906, FAX: 864-8192

# NASA LANGLEY TRANSONIC DYNAMICS TUNNEL



# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** NASA - Langley Research Center<br>**LOCATION:** Hampton, VA 23665 | **TEST SECTION SIZE:** 16 x 16 x 30 ft | **SPEED RANGE:** (Mach#) 0 - 1.2 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1959/1991 | **TEMP. RANGE:** Ambient - 590° | Group F |
| | **OPERATIONAL STATUS:** 2 shifts per day (5-year backlog) | **REYNOLDS NO:** (Per ft X $10^{-6}$) (Air) 3 (Freon 12) 10 | |
| **TYPE:** Transonic Dynamics Tunnel (TDT) | **DESCRIPTION:** Test medium: Freon 12 or air. Continuous flow, closed circuit, variable density pressure, free flight capability, low dynamic pressure per unit Rn, slotted throat, single return | **DYNAMIC PRES:** ($lb/ft^2$) 0 - 550 | |
| | | **STAGNATION PRES:** (psia) 0.3 - 14.7 | |
| | | **TURBULENCE LEVEL: (%):** N/A | |

**TESTING CAPABILITIES:**
Dedicated to aeroelasticity research, the TDT can test cable mounted, sidewall mounted, sting mounted or floor mounted models. Using any of the four basic model support systems, it is capable of testing dynamic models of sufficient size to allow simulation of important structural properties of airplanes, rotorcraft, and spacecraft. The tunnel has gust simulation capability.

**DATA ACQUISITION:**
An on-site data acquisition system with 328 channels of input enhances the dynamic aspect of the facility by providing near real-time data acquisition and data reduction.

**PAST APPLICATIONS:**
Commercial Transports, Military Aircraft, rotorcraft, NASP, active controls.

**PLANNED IMPROVEMENTS:**
Fiscal Year 1996 - Modify heavy gas reclamation system to use SF6 as a test medium.

**LOCAL INFORMATION CONTACT:** Rodney H. Ricketts; (804) 864-1207, Bryce Kepley 864-1244

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** NASA - Lewis Research Center<br>**LOCATION:** Cleveland, Ohio | **TEST SECTION SIZE:** 9 ft x 15 ft x 28 ft | **SPEED RANGE:** (Mach#) 0 - 0.2 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1968/1992 | **TEMP. RANGE:** Ambient | Group B |
| | **OPERATIONAL STATUS:** Two shift operation with backlog of 2 yrs. | **REYNOLDS NO:** (Per ft X $10^{-6}$) 0 - 1.4 | |
| **TYPE:** 9 X 15 ft Low Speed Propulsion Wind Tunnel | **DESCRIPTION:** Continuous flow, Acoustic, atmospheric Wind Tunnel located in return leg of 8x6 Transonic Wind Tunnel | **DYNAMIC PRES:** (lb/$ft^2$) 0 - 72 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** .75% rms | |

**TESTING CAPABILITIES:**
Used for low subsonic testing of propulsion system components at high angles of attack. Heavy emphasis is placed on the testing of components used in VTOL propulsion systems. The tunnel is used extensively for testing the noise characteristics of inlets. The Test facility is controlled and operated by a distributed control system, using alarm and color graphic CRT displays. The Facility is also equipped with a Test Matrix Sequencer that can automatically sequence model variables and associated facility parameters following a preprogrammed test matrix to increase test productivity.

**DATA ACQUISITION:**
The facility is equipped with both steady-state and dynamic instrumentation systems. Data are recorded and processed by a dedicated data acquisition system in the facility. This system provides on-line computation and display of test data with a once-a-second update rate. Alphanumeric and graphic displays can be tailored to the user's requirements.

**PAST APPLICATIONS:**
Parachute Blockage Effects Test for Sandia National Laboratories

**PLANNED IMPROVEMENTS:**
Flow quality improvement devised, laser seeding system, gaseous hydrogen system model preparation and calibration area.

**LOCAL INFORMATION CONTACT:** Osvaldo Rivera, Facility Manager (216) 433-5699

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** Naval Air Development Center<br>**LOCATION:** Warminster, PA 18974-5000 | **TEST SECTION SIZE:** 4 x 4 x 8 ft | **SPEED RANGE:** (Mach#) 0.18 (200 ft/sec) | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 10/91 | **TEMP. RANGE:** Atmospheric | Group E |
| | **OPERATIONAL STATUS:** Online Spring of 1992 | **REYNOLDS NO:** (Per ft X $10^{-6}$) 1.27 | |
| **TYPE:** 4 X 4 ft Wind Tunnel | **DESCRIPTION:** Indraft, open return wind tunnel. The facility conducts high-quality aerodynamic research with a wide variety of instrumentation (i.e., pressure probes velocimetry and force/moment balances.) | **DYNAMIC PRES:** ($lb/ft^2$) 47.56 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** N/A | |

**TESTING CAPABILITIES:**
Force and Moment measurements can be conducted on a 3-component platform balance (175 lb Lift, 30 lb Drag, 30 ft lb Pitching Moment) or three sting balances ranging from 15 lb to 300 lb of Normal force. Flow Field measurements can be conducted with pressure probes, hot wire anemometry and laser doppler velocimetry.

**DATA ACQUISITION:**
A Pressure Systems Inc. 8400 processor is used to digitize 224 pressures and force/moment signals. Pressure data rates are 20,000 channels/sec and 20,000 channels/sec for force/moment measurements. Wind Tunnel speed and model position may be set and measured either manually or by a computer.

**PAST APPLICATIONS:**
New Facility.

**PLANNED IMPROVEMENTS:**
Upgrade data acquisition in order to sample unsteady phenomena.

**LOCAL INFORMATION CONTACT:** Hugo Gonzalez, Code 6051, (215) 441-1738; Marvin Walters, 441-2928

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| Syracuse University | 24 x 24 x 96 inches, Total length = 30'8" | (Mach#) 0 - 1 m/sec | |
| **LOCATION:** Dept. of Mechanical and Aerospace Engineering Syracuse, NY 13244 | **DATE BUILT/UPGRADED:** June 1991 | **TEMP. RANGE:** N/A | Group E |
| | **OPERATIONAL STATUS:** Fully Operational | **REYNOLDS NO:** (Per ft X $10^{-6}$) N/A | |
| **TYPE:** Low Speed Water Tunnel | **DESCRIPTION:** Closed circuit, continuous flow | **DYNAMIC PRES:** (lb/$ft^2$) N/A | |
| | | **STAGNATION PRES:** (psia) N/A | |
| | | **TURBULENCE LEVEL: (%):** < 0.8% | |

**TESTING CAPABILITIES:**
Detailed flow field survey behind models using Laser Doppler Anemometer, Hot Film Anemometer, Laser light sheet and laser induced fluorescent technique. Balance, Computer controlled towing mechanism, Real time digital motion image capture system

**DATA ACQUISITION:**
Fully micro-computer controlled

**PAST APPLICATIONS:**
New Facility

**PLANNED IMPROVEMENTS:**
6-component balance, towing system for finite mass simulation

**LOCAL INFORMATION CONTACT:** Prof. H. Higuchi, (315) 443-4369, FAX: (315) 443-9099

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** Texas A&M University<br>**LOCATION:** College Station, TX | **TEST SECTION SIZE:** 7 X 10 X 12 ft | **SPEED RANGE:** (Mach#) 0 - 0.25 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1960/1983 | **TEMP. RANGE:** ± 10° F from ambient | Group C |
| | **OPERATIONAL STATUS:** Fully operational | **REYNOLDS NO:** (Per ft X $10^{-6}$) 0 - 1.9 | |
| **TYPE:** 7 X 10 ft Low Speed Wind Tunnel | **DESCRIPTION:** Closed circuit, atmospheric wind tunnel with a six component external balance | **DYNAMIC PRES:** ($lb/ft^2$) 0 - 100 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** Factor 1.1, Intensity .3-1.2% | |

**TESTING CAPABILITIES:**
Force and moment, pressure, and flowfield measurements using internal and external balance systems, pressure scanners, and hot wire anemometer/pressure probe systems.

**DATA ACQUISITION:**
Perkin Elmer 3210 digital computer, PSI 8400 Pressure Measurement System (48 ports), 16-bit 312 K Analog-to-Digital Converter System, 100-2000 Gain Signal Amplifiers.

**PAST APPLICATIONS:**
Orbiter drag chute deployment studies using high speed film, Deployable wing tests for booster recovery

**PLANNED IMPROVEMENTS:**
Upgrade to Perkin Elmer 3242
Increase number of available ports for PSI 8400 System

**LOCAL INFORMATION CONTACT:** Oran W. Nicks/Jorge Martinez - (409) 845-1028, FAX: (409) 845-8191

# WIND TUNNELS

| COMPANY: U.S. Air Force<br>LOCATION: Wright-Patterson AFB, OH | TEST SECTION SIZE: 12 ft dia. X 15 ft high | SPEED RANGE: (Mach#) 0 - 0.14 | COMPARABLE FACILITIES |
|---|---|---|---|
| | DATE BUILT/UPGRADED: 1943 | TEMP. RANGE: Atmospheric | Group D |
| | OPERATIONAL STATUS: Operational/Active | REYNOLDS NO: (Per ft X $10^{-6}$) 1 | |
| TYPE: Vertical Wind Tunnel | DESCRIPTION: 16 sided polygon with open throat test section. Contraction ratio is 9.86 to 1 and power is provided by 1000 hp electric motor. Annular return. | DYNAMIC PRES: ($lb/ft^2$) 25 | |
| | | STAGNATION PRES: (psia) Atmospheric | |
| | | TURBULENCE LEVEL: (%): Varies, less than 2% w/o net | |

**TESTING CAPABILITIES:**
Sting mounts for models and nose cones, etc. Decelerators can be deployed in the tunnel. Balance capacity is 200 lbs. for parachute drag (vertical) and 100 lbs for side force.

**DATA ACQUISITION:**
Video and high speed film. Electronic data gathering of aerodynamic forces. Current set-up can handle up to 24 channels (more channels can be added, depending on the type of data required).

**PAST APPLICATIONS:**
Aircraft model spin testing, parachute and decelerator testing (models up to 6' diameter), rotary wing characteristics, ejection seat stabilization testing, and free fall training of military sky divers.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Russ Osborne, WL/Fimm - (513) 255-3876; John Tinapple, Exp. Engineering - 255-6317

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| U.S. Army Chemical Res., Dev., and Engineering Ctr.<br>**LOCATION:**<br>Aberdeen Proving Ground<br>MD 21010-5423 | 1.6 x 1.6 x 5.9 ft | (Mach#) 0.45 - 1.2 | Group E |
| | **DATE BUILT/UPGRADED:**<br>1969 | **TEMP. RANGE:**<br>Ambient | |
| | **OPERATIONAL STATUS:**<br>Available | **REYNOLDS NO:**<br>(Per ft X $10^{-6}$) 322 - 859 | |
| **TYPE:**<br>Transonic Wind Tunnel | **DESCRIPTION:**<br>Open circuit, blowdown, transonic wind tunnel | **DYNAMIC PRES:**<br>($lb/ft^2$) 300 - 2131 | |
| | | **STAGNATION PRES:**<br>(psia) 5 - 20 psig | |
| | | **TURBULENCE LEVEL: (%):**<br>N/A | |

**TESTING CAPABILITIES:**

Determines aerodynamic characteristics of chemical and conventional ordnance devices such as grenades, mortars, artillery projectiles, bomb, submunitions, etc. Blowdown tunnel providing 10-14 second of run time using air from high pressure tanks. Open circuit design.

**DATA ACQUISITION:**

Range of internal strain gage balances for static force and moment measurements. Internal and external dynamic stability rigs for pitch damping tests. Various fixtures to duplicate spinning motion in flight. High speed films and videos for item motion analysis.

**PAST APPLICATIONS:**

Triangular Ram Air Decelerator for M75 submunition and Artillery Delivered Expendable Jammer; BLU 27 Decelerator; M74 MLRS ribbon stabilizer; Ram Air Inflatable Decelerator for Sensor Delivery system, etc.

**PLANNED IMPROVEMENTS:**

None.

**LOCAL INFORMATION CONTACT:** Miles C. Miller, SMCCR-RSP-A, (410) 671-2186.

# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| U.S. Army Chemical Res., Dev., and Engineering Ctr.<br>**LOCATION:**<br>Aberdeen Proving Ground<br>MD 21010-5423 | 2.5 x 2.5 x 7.9 ft (L), 1.5 x 1.5 x 5.9 ft (U) | **(Mach#)** 0 - 102 fps (L), 0 - 400 fps (U) | Group D |
| | **DATE BUILT/UPGRADED:** 1971 | **TEMP. RANGE:** Ambient | |
| | **OPERATIONAL STATUS:** Available | **REYNOLDS NO:** **(Per ft X $10^{-6}$ )** 64 (L), 256 (U) | |
| **TYPE:** Vertical Wind Tunnel | **DESCRIPTION:** Subsonic vertical wind tunnel with two tandem test sections (lower and upper). | **DYNAMIC PRES:** **(lb/$ft^2$ )** 12 (L), 190 (U) | |
| | | **STAGNATION PRES:** **(psia)** 14.7 | |
| | | **TURBULENCE LEVEL: (%):** N/A | |

**TESTING CAPABILITIES:**
Designed to study the free flight motion of ordinance devices. Continuous flow, open circuit tunnel, exhausting to the atmosphere. Both test sections include 360 degree transparent windows for viewing during tests. Inexpensive and easy to operate.

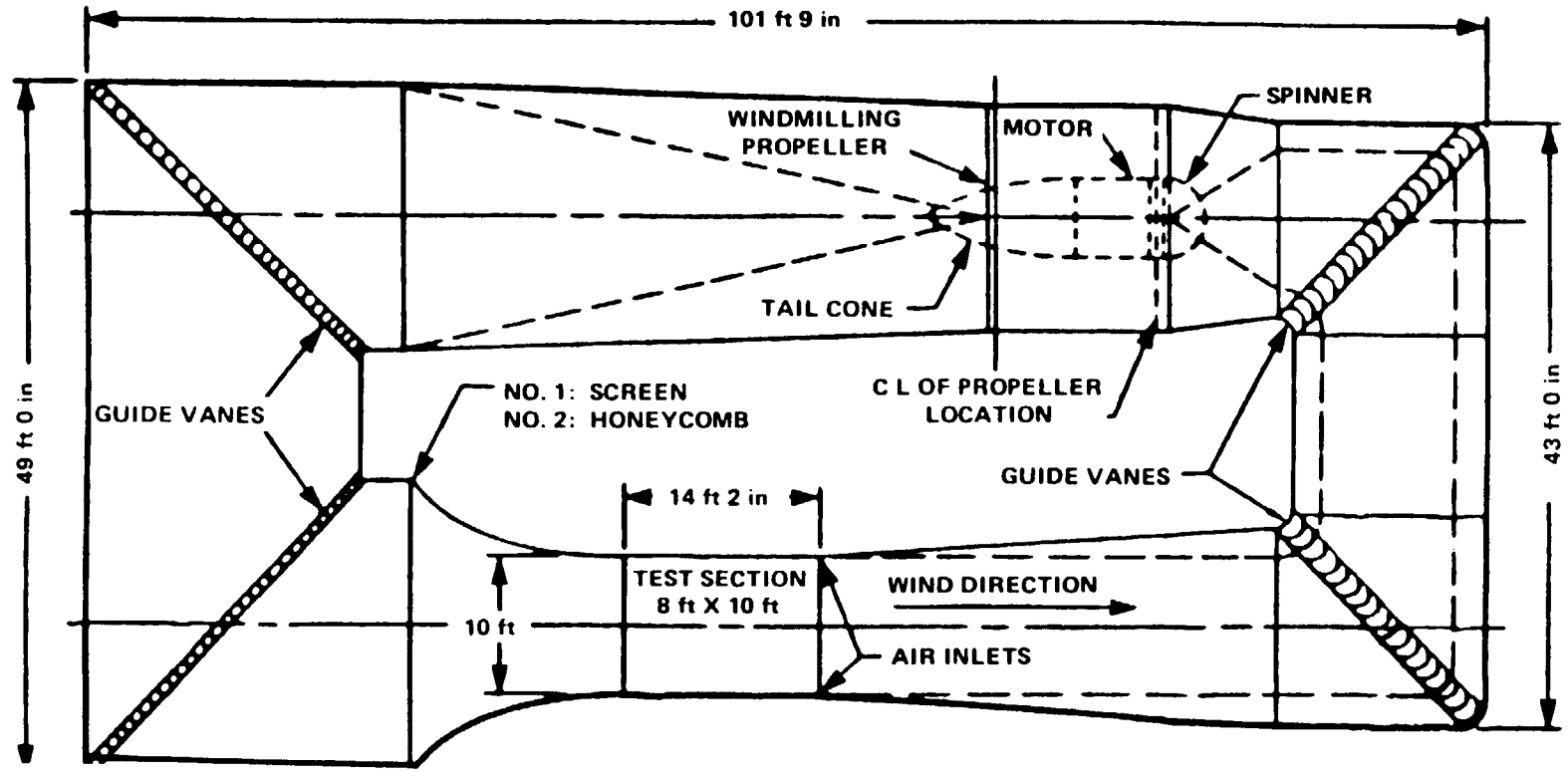
**DATA ACQUISITION:**
Velocity measuring instrumentation to determine drag coefficient. High speed films and videos for item motion analysis.

**PAST APPLICATIONS:**
Triangular Ram Air Decelerator (TRAD) for M75 submunition and Artillery Delivered Expendable Jammer; BLU 27 Decelerator; M74 MLRS ribbon stabilizer; Ram Air Inflatable Decelerator for Sensor Delivery sys., MK 82 bomb, Air Force 800 lb. Modular Bomb and 2000 lb. Fuel Air Explosive Bomb, etc.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Miles C. Miller, SMCCR-RSP-A (410) 671-2186

NOTE: DASHED LINES SHOW RADII TANGENCIES AND TRANSITION LINES



# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| U. S. Navy, David Taylor Research Center<br>**LOCATION:**<br>Bethesda, MD 20084-5000 | 8 x 10 x 14 ft | (Mach#) 0.02 - 0.25 | Group C |
| | **DATE BUILT/UPGRADED:**<br>1943/1953/1983 | **TEMP. RANGE:**<br>550°R | |
| | **OPERATIONAL STATUS:**<br>No backlog. Available to gov't. & industry. | **REYNOLDS NO:**<br>(Per ft X $10^{-6}$) 0 | |
| **TYPE:**<br>8 x 10 Low Speed Wind Tunnel | **DESCRIPTION:**<br>Two separate, nearly identical general purpose wind tunnels. Closed circuit, single return, closed test section (both Tunnel Nos. 1 & 2). | **DYNAMIC PRES:**<br>(lb/$ft^2$) 0 - 90 | |
| | | **STAGNATION PRES:**<br>(psia) Atmospheric (+) | |
| | | **TURBULENCE LEVEL: (%):**<br>N/A | |

**TESTING CAPABILITIES:**
Force, moment, and pressure measurements. External balance (strut mount) or internal balances. Adjustable height ground plane. Two dimensional inserts for Tunnel No. 2 produces test section 8 ft x 3 ft x 10 ft Full width turntable (floor and ceiling) in Tunnel No. 1.

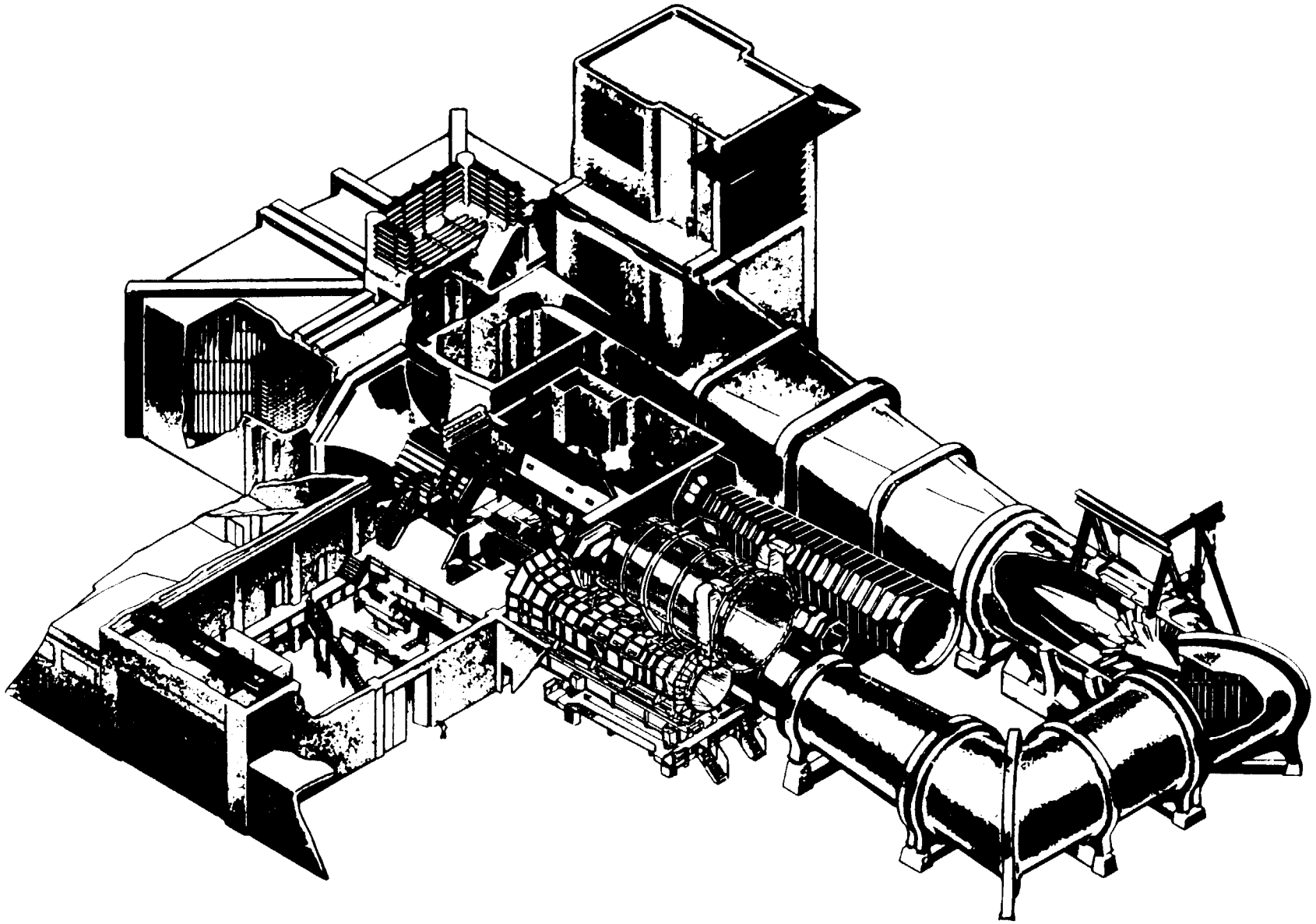
**DATA ACQUISITION:**
Sixty-four channels of data; 250,000 (total) samples per second. Tabulated reduced data and computer generated plots at end of each run.

**PAST APPLICATIONS:**
Parachute drag and opening tests; extraction chute behavior behind powered cargo aircraft; performance of AERCAB escape vehicles.

**PLANNED IMPROVEMENTS:**
On-line data reduction and plots.

**LOCAL INFORMATION CONTACT:** Arthur E. Johnson, Code 1270: (301) 227-1478

# UTRC LARGE SUBSONIC WIND TUNNEL



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# WIND TUNNELS

| COMPANY: | TEST SECTION SIZE: | SPEED RANGE: | COMPARABLE FACILITIES |
|---|---|---|---|
| United Technologies Research Center<br>**LOCATION:**<br>East Hartford, CT 06108 | Interchangeable Test Sections | **(Mach#)** 0 - .26, 0 - .42, 0 - .95 | Group B |
| | **DATE BUILT/UPGRADED:**<br>1946/1984 | **TEMP. RANGE:**<br>500° - 590°R | |
| | **OPERATIONAL STATUS:**<br>1 Shift per day extended as required | **REYNOLDS NO:**<br>**(Per ft X $10^{-6}$ )** 0 - 4.5 | |
| **TYPE:**<br>Large Subsonic Wind Tunnel | **DESCRIPTION:**<br>Closed circuit, single return, continuous flow tunnel with interchangeable test sections (18 octagonal X 40 ft long, 8 octagonal x 16 ft long, 10 x 15 x 20 ft). Tunnel powered by 9000 hp constant speed motor driving a 26-bladed 20-ft diameter fan through eddy current clutch. | **DYNAMIC PRES:**<br>**($lb/ft^2$ )** 0 - 709 | |
| | | **STAGNATION PRES:**<br>**(psia)** Atmospheric | |
| | | **TURBULENCE LEVEL: (%):**<br>0.3 - 1.0 | |

**TESTING CAPABILITIES:**

Equipped for a variety of low-speed and high-subsonic speed programs in the interchangeable 18 X 8-ft and 10 X 15-ft test sections. Conventional full-model airplane and helicopter tests conducted with models mounted to external 6-component balance providing remote pitch/yaw control. Aerodynamic model components such as inlets, nozzles, rotors also tested. Variety of variable frequency electric power, pressure/vacuum pneumatic, and other services available. Full range of flow visualization tests conducted.

**DATA ACQUISITION:**

Forty channels of steady information (pressure/temperature scanners) with individual channel amplifiers and signal conditioners plus 14 digital channels. Computer-controlled data scanning matrix for multiple sampling. Various on-line hard copy and displays. Data records tape and fixed disks for off-line reprocessing.

**PAST APPLICATIONS:**

General-purpose subsonic testing for large variety and type of models.

**PLANNED IMPROVEMENTS:**

Studying acoustic testing in 18-ft. test section.

**LOCAL INFORMATION CONTACT:** Anthony Fasano - (203) 727-7275

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** University of Lowell<br><br>**LOCATION:** Mechanical Eng. One University Ave. Lowell, MA 01854 | **TEST SECTION SIZE:** 25 x 36 x 48 inches | **SPEED RANGE:** (Mach#) 15 - 205 mph | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1987 | **TEMP. RANGE:** Ambient | Group E |
| | **OPERATIONAL STATUS:** Operational | **REYNOLDS NO:** (Per ft X $10^{-6}$) 1.9 | |
| **TYPE:** Eiffel-type Wind Tunnel | **DESCRIPTION:** Open circuit tunnel of 2' x 3' test section, plexiglass sides for test section to allow photography. Airspeed continuously variable from 15 mph to 205 mph. | **DYNAMIC PRES:** (lb/$ft^2$) 102 psf | |
| | | **STAGNATION PRES:** (psia) Ambient (14.7 psia) | |
| | | **TURBULENCE LEVEL: (%):** 0.02% | |

**TESTING CAPABILITIES:**
Force and pressure testing of parachutes, crew equipment, etc.

**DATA ACQUISITION:**
Load cells and pressure transducers attached to Digital Data Acquisition System, Hewlett Packard Signal Analyzer, and Personal Computers for data processing.

**PAST APPLICATIONS:**
Small scale model parachutes, and paratrooper helmet impact protection retention in aircraft slipstream.

**PLANNED IMPROVEMENTS:**
Variable frequency speed control and 6 component balance.

**LOCAL INFORMATION CONTACT:** Prof. Eugene E. Niemi, Jr., (508) 934-2977 or 534-4169

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** University of Maryland<br>**LOCATION:** College Pk., MD 20742 | **TEST SECTION SIZE:** 7.5 X 11.04 X 12 ft | **SPEED RANGE:** (Mach#) 0 - 0.3 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1949 | **TEMP. RANGE:** Ambient | Group C |
| | **OPERATIONAL STATUS:** Available | **REYNOLDS NO:** (Per ft X $10^{-6}$) 0 - 2.2 | |
| **TYPE:** Atmospheric Wind Tunnel | **DESCRIPTION:** Closed Circuit | **DYNAMIC PRES:** ($lb/ft^2$) 0 - 132 | |
| | | **STAGNATION PRES:** (psia) 0 - 2249 | |
| | | **TURBULENCE LEVEL: (%):** Factor 1.05 | |

**TESTING CAPABILITIES:**
Force and Moment, Pressure, and Flowfield Measurements. Flow Visualization.

**DATA ACQUISITION:**
External wind tunnel balances, electronic recording of data from recording devices through in-house computer facilities.

**PAST APPLICATIONS:**
Numerous applications including airplanes, missiles, mines, parachutes and other inflatable devices, rotors, and helicopters.

**PLANNED IMPROVEMENTS:**
Upgrade computing facilities.

**LOCAL INFORMATION CONTACT:** Dr. Jewel Barlow - (301) 405-6861

# WIND TUNNELS

| | | | |
|---|---|---|---|
| **COMPANY:** University of Minnesota<br><br>**LOCATION:** Dept. of Aerospace Eng. University of Minnesota Minneapolis, MN | **TEST SECTION SIZE:** 60 x 60 in. (38 x 54 in.) closed, 12 x 17 in. open | **SPEED RANGE:** (Mach#) 0 - 0.15; 0 - 0.25 | **COMPARABLE FACILITIES** |
| | **DATE BUILT/UPGRADED:** 1981 (closed)1989 (open) | **TEMP. RANGE:** Ambient | Group E |
| | **OPERATIONAL STATUS:** Available | **REYNOLDS NO:** (Per ft X $10^{-6}$) N/A | |
| **TYPE:** Open and Closed return Wind Tunnels | **DESCRIPTION:** Low speed, open and closed return subsonic wind tunnels | **DYNAMIC PRES:** ($lb/ft^2$) 9.0 (30.0)/100 | |
| | | **STAGNATION PRES:** (psia) Atmospheric | |
| | | **TURBULENCE LEVEL: (%):** 2 % | |

**TESTING CAPABILITIES:**
3 component mean velocity (5 hole probe) over transverse planes, 2 axis probe traverser (open return)
1-2 component hot wire anemometer (open return)

**DATA ACQUISITION:**
Caps based data acquisition/control of traverse (open return)

**PAST APPLICATIONS:**
Model parachutes of all types, drag measurements, opening force measurements, moment coefficient measurements, L/D measurements.

**PLANNED IMPROVEMENTS:**
3 component force balance (open return); 6 component force balance (closed return)

**LOCAL INFORMATION CONTACT:** Dr. William L. Garrard - (612) 625-9002, FAX: 626-1558

# DROP ZONES

Drop zones are used to perform flight and impact testing of parachutes, parachute/payload systems, and other landing and escape systems. A drop zone normally consists of a large open area of varying terrain with the range and tracking data systems necessary for measuring vehicle performance. In many cases, aircraft are available at the drop zone for performing and supporting drop tests. All aircraft are included in the following chapter entitled "TEST AIRCRAFT." In any given system development program, a certain number of successful drop tests will be required to qualify a system for operational use.

The drop zones included in this chapter are those of a size and capability suitable for the testing of landing and escape systems. There are numerous airports which are capable of dropping small payloads operated by small skydiving clubs. These facilities alone have not been included in this volume. Several small companies which provide drop test services out of these small airports are included under "MISCELLANEOUS FACILITIES."

Since Drop Zones vary widely in terrain, size, and support capability, no attempt has been made to present a listing of comparable facilities for this chapter.

# DROP ZONES

| COMPANY: | SITE SIZE: | SUPPORT AVAILABLE: |
|---|---|---|
| LOCATION: ① | | ☐ Engineering<br>☐ Instrumentation<br>☐ Tracking<br>☐ Photographs<br>☐ Fabrication/Build-up<br>☐ Drop Aircraft<br>☐ Chase Aircraft |
| TYPE: ② | OPERATIONAL STATUS: | |

**DATA ACQUISITION:**

**AVAILABILITY:**

**PAST APPLICATIONS:**

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:**

EXPLANATION OF DROP ZONE DATA SHEETS

(1) Name of the Installation where the facility is located, and when not evident, the name of the owner and city.

(2) Proper or generic name of the facility, with additional qualifiers or identifiers as appropriate.

*Site Size:* The dimensions of the drop zone and airspace available.

*Operational Status:* An indication of the facility's current work load. A "backlog" indicates an overflow of work beyond normal operations. The facility operators should be contacted directly to determine the extent of the backlog. When a facility is currently inactive or on standby, it is so indicated, as is operations on a "demand" basis only.

*Support Available:* Self Explanatory.

*Data Acquisition:* Describes the type of systems used for data gathering, the number of channels available, and the form of output.

*Availability:* Indicates whether the facility is available to government or industry or both.

*Past Applications:* Lists past landing/escape systems programs which have been conducted at this facility.

*General Comments:* Space available for additional information about the facility including a description of the terrain, where applicable.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the facility.

# DROP ZONE INDEX

# DROP ZONE INDEX

# DROP ZONES

**COMPANY:** Avtel Flight Test, Inc.

**LOCATION:** Hangar 77
Mojave Airport
Mojave, CA 93501

**SITE SIZE:**
1/4 section (1750 x 3500 ft)

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**TYPE:**

Inert Ordinance Parachute Testing Range

**OPERATIONAL STATUS:**

Normal active workload

**DATA ACQUISITION:**
Ground station with 32 channels available, 16 channels of strip chart expandable to 32 channels.

**AVAILABILITY:**
Available to both government and commercial industry.

**PAST APPLICATIONS:**
All types of inert munitions/ordinance, parachute testing.

**GENERAL COMMENTS:**
Range is located approximately 2 miles due east of Mojave Airport. Range is surrounded by a minimum of 5 square sections of uninhabited land, all desert. Owned and operated by Avtel Flight Test, Inc.

**LOCAL INFORMATION CONTACT:** Hal Belles or Bill Hickle - (805) 824-9381

# DROP ZONES

**COMPANY:** NASA Ames/Dryden Flight Research Facility

**LOCATION:** Edwards AFB, CA

**SITE SIZE:**
60 X 80 miles

**TYPE:**
Open Desert - Optical and radar tracking

**OPERATIONAL STATUS:**
Available with scheduling

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Radar & optical space position recording, telemetering, receiving, processing and data recording.

**AVAILABILITY:**
Available with scheduling.

**PAST APPLICATIONS:**
Various parachute tests have been conducted on the Edwards range.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Edward T. Schneider (805) 258-3215, Marvin R. Barber 258-2275

# DROP ZONES

**COMPANY:** NASA Goddard Space Flight Center - Wallops Flight Facility

**LOCATION:** Wallops Island, VA

**SITE SIZE:**
Essentially unlimited. Limited area for photo and chase plane coverage.

**TYPE:**
Water Drop Zone

**OPERATIONAL STATUS:**
On request availability

**SUPPORT AVAILABLE:**

- ☐ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☐ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**

Telemetry: VHF (217.55 MHz/219.45 MHz), S-Band (2205.5 MHz-2295.5 MHz), uplink command available FM/FM, PCM, and FM/PCM system can be accommodated.
Radar: S-Band and C-Band radars are available.
Photographic: Video downlink available, airborn and ground based motion pictures and stills available.

**AVAILABILITY:**

Available to government, university, and industry upon approval of Director, SPOD.

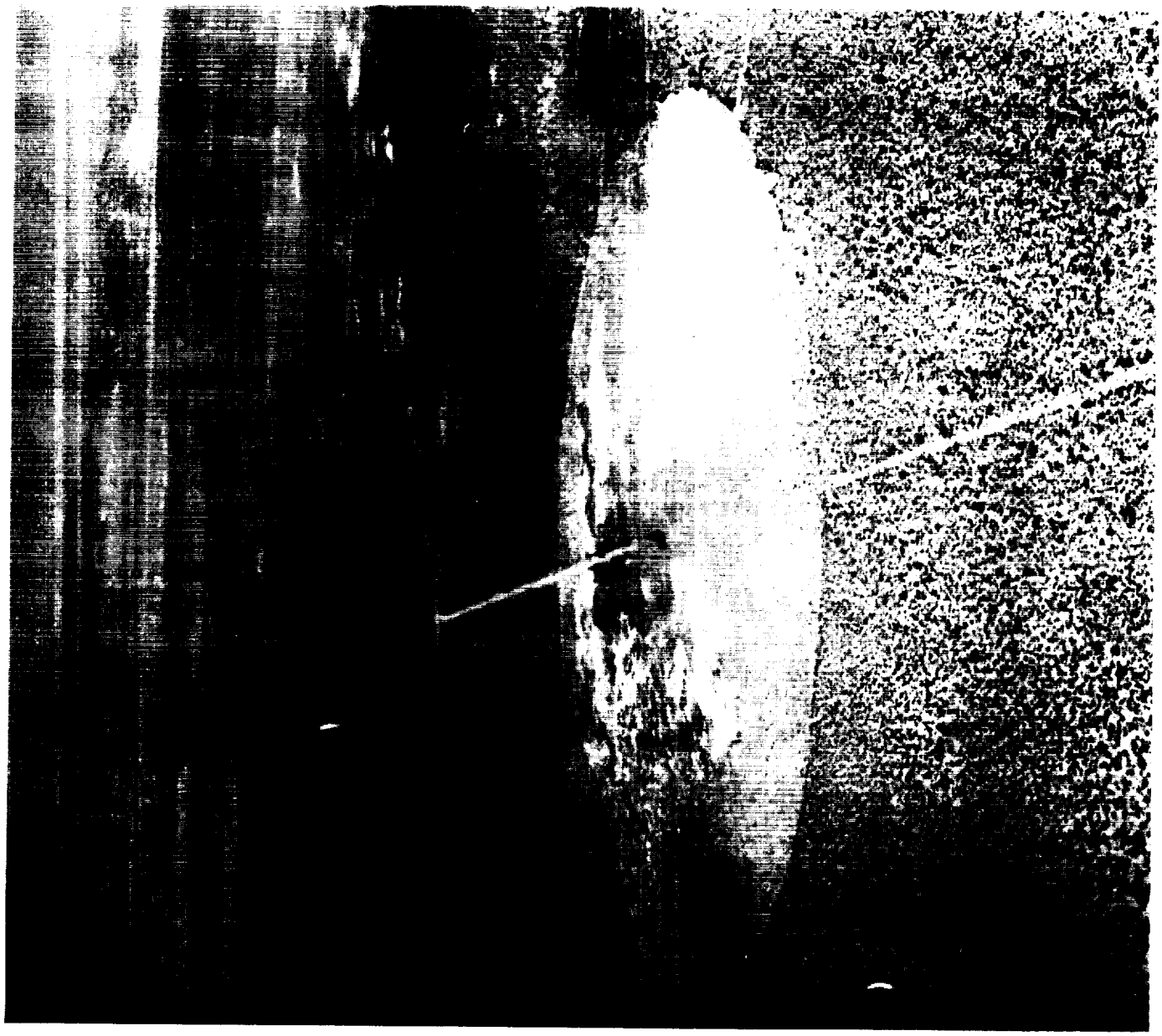
**PAST APPLICATIONS:**

Sounding rocket flights, drop tests, air retrieval tests, water impact tests.

**GENERAL COMMENTS:**

Drop zone for ground based photo coverage limited to five mile by three mile area. Chase aircraft available for expanding zone. Deployment aircraft can be based within five miles of drop zone at Wallops Flight Facility Airport. Low level drops over land could be conducted over the airfield. Aircraft vectoring available.

**LOCAL INFORMATION CONTACT:** Bob Long - (804) 824-1354, Bill Burns - (804) 824-1462



2-8A

# DROP ZONES

**COMPANY:** Naval Air Warfare Center
Weapons Division

**LOCATION:** China Lake, CA 93555

**SITE SIZE:**
1 mile dia. cleared & disked in center of 4 mile x 6 mile test range.

**TYPE:**
Open Drop Zone

**OPERATIONAL STATUS:**
Fully Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Solid State and Telemetry data recording. Video, photographic, laser, and radar tracking with IRIG timing.

**AVAILABILITY:**
All

**PAST APPLICATIONS:**
Live Navy test parachutist, test and evaluation of various personnel and emergency escape parachute systems. Drop testing of various test vehicles emergency escape aircrew capsules and other drop test items including the 48,000 pound space shuttle solid rocket booster decelerator subsystem.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008

# DROP ZONES

**COMPANY:** Para-Flite, Inc.

**LOCATION:** 5800 Magnolia Ave.
Pennsauken, NJ 08109

**SITE SIZE:**
200 acre area up to 8,000 ft altitude

**TYPE:**
Low altitude, low speed Drop Zone

**OPERATIONAL STATUS:**
Demand

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☐ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Real time in-flight recording, 4 channels, ASCII file.

**AVAILABILITY:**
Both government and industry.

**PAST APPLICATIONS:**
Design and Development testing of personnel and light cargo, < 3,000 lbs parachutes.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Troy Loney - (609)-663-1275; FAX: 663-3028

# DROP ZONES

**COMPANY:** Sandia National Laboratories

**LOCATION:** Albuquerque, NM

**SITE SIZE:**
300 x 300 ft
3,500 ft AGL - Ceiling

**TYPE:**
Helicopter Drop Zone with catch net

**OPERATIONAL STATUS:**
On demand

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☐ Chase Aircraft

**DATA ACQUISITION:**
We can receive and reduce many channels of L, S and P band telemetry. Sandia's laser trackers can provide x, y, z, time and velocity trajectory information and high-speed film and video.

**AVAILABILITY:**
Facility is available to government agencies and private industry.

**PAST APPLICATIONS:**
Low-speed deployment tests of the F-111 parachute system.

**GENERAL COMMENTS:**
Helicopters are used as a platform to carry 100-lb test units to 3,500 ft AGL. Test units are dropped and free fall to desired parachute deployment velocities.

**LOCAL INFORMATION CONTACT:** Dave Bickel: (505) 845-3179

# DROP ZONES

**COMPANY:** Sandia National Laboratories

**LOCATION:** Tonopah Test Range, NV

**SITE SIZE:**
26 x 24 miles

**TYPE:**

Optical Range with dry lakes, desert turf, and 750 ft diameter concrete slab targets.

**OPERATIONAL STATUS:**

Some excess capacity

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☐ Fabrication/Build-up
- ☒ Drop Aircraft
- ☐ Chase Aircraft

**DATA ACQUISITION:**

6 monopulse and conical scan radars (200 kW to 1 mW), 9 mobile cinetheodolites, 7 mobile tracking telescopes with high speed cameras, assorted fixed cameras and video systems (including high speed video), real-time computer and graphics display, 2 fixed and 2 mobile telemetry ground stations, and full data reduction capability.

**AVAILABILITY:**

Available to government and government-sponsored projects.

**PAST APPLICATIONS:**

All types of parachute drops have been performed ranging from F-111 escape module development to weapon compatibility drops from various military aircraft.

**GENERAL COMMENTS:**

Can usually accommodate short time frame scheduling on a priority basis.

**LOCAL INFORMATION CONTACT:** Tonopah Test Range Test Directors: (702) 295-8107

# DROP ZONES

**COMPANY:** U.S. Air Force Flight Test Center

**LOCATION:** Edwards AFB, CA

**SITE SIZE:**
1 mi x 1/2 mi

**TYPE:**
FARM - Fully instrumented personnel and cargo drop range

**OPERATIONAL STATUS:**
Fully Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Radar tracking, portable photo cameras, still photo, weather data, Telemetry.

**AVAILABILITY:**
On daily schedule basis.

**PAST APPLICATIONS:**
Wide variety of airdrops: Sticks of 40 paratroopers, 50,000 ft drops from supersonic aircraft, cargo airdrops.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Michael Wuest - (805) 277-4820

# DROP ZONES

**COMPANY:** U.S. Air Force Flight Test Center

**LOCATION:** Edwards AFB, CA

**SITE SIZE:**
1 1/4 x 1 1/4 mi

**TYPE:**
PB-8 - Fully instrumented personnel and cargo drop range

**OPERATIONAL STATUS:**
Fully Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Radar and cine theodolite tracking; permanent and portable photo cameras (35 mm, 16 mm, video), still photo, weather data, Telemetry.

**AVAILABILITY:**
On daily schedule basis.

**PAST APPLICATIONS:**
Wide variety of airdrops: Sticks of 40 paratroopers, 50,000 ft drops from supersonic aircraft, cargo airdrops.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Michael Wuest - (805) 277-4820

# DROP ZONES

**COMPANY:** U.S. Army Aeromedical Research Laboratory

**LOCATION:** Fort Rucker, AL

**SITE SIZE:**
Various sites and sizes available

**TYPE:**
Army airfields

**OPERATIONAL STATUS:**
Currently operational as helicopter training fields - can be scheduled to be clear for use as parachute drop zones.

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
Installed as required.

**AVAILABILITY:**
Drop zones are available, but require advance scheduling to ensure local air traffic is rerouted.

**PAST APPLICATIONS:**
Used as drop zones on weekends by the local parachute club.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
4570 ft diameter
altitude 80,000 ft

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**TYPE:**

Los Angeles Drop Zone - High altitude cargo drops

**OPERATIONAL STATUS:**

Operational

**DATA ACQUISITION:**

A wide range of systems are available including sensors to measure accelerations, rates, strain, and temperature data; tracking systems including telemetry, laser, radar, FM/PCM, and cinetheodolite (film and video); and photographic equipment including air-to-air, ground-to-air, and on-board. Meteorological data is available from surface to 2200 meters.

**AVAILABILITY:**

Government
Industry (under special conditions)

**PAST APPLICATIONS:**

Large variety of airdropped payloads

**GENERAL COMMENTS:**

Can be used for other personnel or non-hazardous cargo drops.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
2218 x 3800 ft

**TYPE:**
Phillips Drop Zone - Personnel Drop Zone

**OPERATIONAL STATUS:**
Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
A wide range of systems are available including sensors to measure accelerations, rates, strain, and temperature data; tracking systems including telemetry, laser, radar, FM/PCM, and cinetheodolite (film and video); and photographic equipment including air-to-air, ground-to-air, and on-board. Meteorological data is available from surface to 2200 meters.

**AVAILABILITY:**
Government
Industry (under special conditions)

**PAST APPLICATIONS:**
Wide range of uses.

**GENERAL COMMENTS:**
Flat disced drop zone used for personnel parachute testing.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
3000 x 6726 ft
altitude 80,000 ft

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**TYPE:**

Roadrunner Drop Zone - Hazardous Cargo

**OPERATIONAL STATUS:**

Operational

**DATA ACQUISITION:**

A wide range of systems are available including sensors to measure accelerations, rates, strain, and temperature data; tracking systems including telemetry, laser, radar, FM/PCM, and cinetheodolite (film and video); and photographic equipment including air-to-air, ground-to-air, and on-board. Meteorological data is available from surface to 2200 meters.

**AVAILABILITY:**

Government
Industry (under special conditions)

**PAST APPLICATIONS:**

Large variety of airdropped payloads

**GENERAL COMMENTS:**

High and low velocity. Rated for DU ammo

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
100 x 1000 ft

**TYPE:**
Roadrunner Drop Zone - LAPE loads

**OPERATIONAL STATUS:**
Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☐ Chase Aircraft

**DATA ACQUISITION:**
A wide range of systems are available including sensors to measure accelerations, rates, strain, and temperature data; tracking systems including telemetry, laser, radar, FM/PCM, and cinetheodolite (film and video); and photographic equipment including air-to-air, ground-to-air, and on-board. Meteorological data is available from surface to 2200 meters.

**AVAILABILITY:**
Government
Industry (under special conditions)

**PAST APPLICATIONS:**
All LAPE loads and hazardous payloads

**GENERAL COMMENTS:**
Flat level drop zone

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
Altitude up to 2,000 ft

**TYPE:**
Senator Wash Drop Zone - Water Zone for personnel jumps

**OPERATIONAL STATUS:**
Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☐ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
By mobile equipment only

**AVAILABILITY:**
Government
Industry (under special conditions)

**PAST APPLICATIONS:**
Training

**GENERAL COMMENTS:**
Exit from rotary wing aircraft

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
2610 x 7210 ft
altitude 80,000 ft

**TYPE:**
Sidewinder Drop Zone

**OPERATIONAL STATUS:**
Operational

**SUPPORT AVAILABLE:**

- ☒ Engineering
- ☒ Instrumentation
- ☒ Tracking
- ☒ Photographs
- ☒ Fabrication/Build-up
- ☒ Drop Aircraft
- ☒ Chase Aircraft

**DATA ACQUISITION:**
A wide range of systems are available including sensors to measure accelerations, rates, strain, and temperature data; tracking systems including telemetry, laser, radar, FM/PCM, and cinetheodolite (film and video); and photographic equipment including air-to-air, ground-to-air, and on-board. Meteorological data is available from surface to 2200 meters.

**AVAILABILITY:**
Government
Industry (under special conditions)

**PAST APPLICATIONS:**
Large variety of airdropped payloads

**GENERAL COMMENTS:**
Non-hazardous material at low and high velocity. Usually used for low altitude work.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DROP ZONES

**COMPANY:** U.S. Army Yuma Proving Ground

**LOCATION:** Yuma, AZ

**SITE SIZE:**
2400 x 3600 ft
altitude 80,000 ft

**SUPPORT AVAILABLE:**

- ☐ Engineering
- ☐ Instrumentation
- ☐ Tracking
- ☐ Photographs
- ☐ Fabrication/Build-up
- ☐ Drop Aircraft
- ☐ Chase Aircraft

**TYPE:**

Tyson Drop Zone - HAHO personnel drop zone

**OPERATIONAL STATUS:**

Operational

**DATA ACQUISITION:**

Systems include Telemetry, Radar, and meteorological data

**AVAILABILITY:**

Government
Industry (under special conditions)

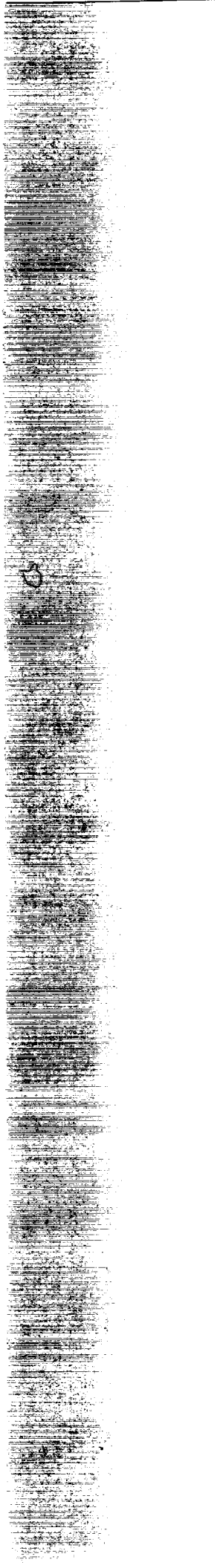
**PAST APPLICATIONS:**

Variety of square parachutes.

**GENERAL COMMENTS:**

Used mostly for long distance run-in.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116



# TEST AIRCRAFT

Test aircraft are used to provide suitable flight conditions for development testing of landing and escape systems. These aircraft can include airplanes, helicopters, and remotely piloted ultralight aircraft. A test article can be transported to a suitable altitude and then released to provide the required initial conditions for decelerator system deployment. Other types of tests include taxi tests, in which a parachute is deployed behind an airplane traveling on a runway. Drop Test facilities which provide a specified impact condition upon touchdown are available and are included in the chapter entitled "MISCELLANEOUS FACILITIES."

A wide range of aircraft are available for testing and the test engineer must consider maximum payload weight, payload size, and altitude/speed range to best match the flight conditions required. While this information is included in the data sheets, all combinations of altitude, speed, and payload may not always be available. The engineer must also consider airplane availability in choosing an aircraft. Another item of interest is the point on the aircraft at which the test article is attached. For example, the NASA B-52, located at Dryden Flight Research Facility, is capable of deploying a test article from the wing pylon, bomb bay, or drag chute compartment. While the data included in this volume will give an idea about the range of capabilities available, the facility should be contacted for detailed information about a specific test program.

Comparable aircraft have been identified and grouped by configuration (fixed or rotary wing) and payload capability.

# TEST AIRCRAFT

| COMPANY: ① LOCATION: | DATE BUILT: | SPEED RANGE: (Mach#) | COMPARABLE AIRCRAFT |
|---|---|---|---|
| | OPERATIONAL STATUS: | MAX. ALTITUDE: (ft) | |
| | EXTRACTION FROM: | PAYLOAD WT.: (lb) | |
| TYPE: ② | ☐ WING PYLON<br>☐ BOMB BAY<br>☐ REAR DOOR<br>☐ SIDE DOOR<br>☐ OTHER _____ | OTHER: | |
| | | BACKUP AIRCRAFT AVAILABLE? O YES O NO | |

**DATA ACQUISITION:**

**AVAILABILITY:**

**PAST APPLICATIONS:**

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:**

EXPLANATION OF TEST AIRCRAFT DATA SHEETS

(1) Name of the Installation where the aircraft is located, and when not evident, the name of the owner and city.

(2) Maker and proper or generic name of the aircraft, with additional qualifiers or identifiers as appropriate.

*Date Built:* Self Explanatory.

*Operational Status:* An indication of the aircraft's current work load. A "backlog" indicates an overflow of work beyond normal operations. The operators should be contacted directly to determine the extent of the backlog. When an aircraft is currently inactive or on standby, it is so indicated, as is operations on a "demand" basis only.

*Extraction From:* Indicates the type of extraction available for the test article. More than one box may be checked.

*Speed Range:* Listed in Mach number unless indicated. NOTE: Aircraft and payload must be known to insure that a given aircraft can meet specified test conditions. Contact the aircraft operator for specifics about a given test.

*Max Altitude:* Listed in feet unless indicated. NOTE: Aircraft and payload must be known to insure that a given aircraft can meet specified test conditions. Contact the aircraft operator for specifics about a given test.

*Payload Wt:* Listed in pounds unless indicated. NOTE: Aircraft and payload must be known to insure that a given aircraft can meet specified test conditions. Contact the aircraft operator for specifics about a given test.

*Other:* Other performance parameters of interest to the user.

*Data Acquisition:* Describes the type of systems used for data gathering, the number of channels available, and the form of output. These operations are normally handled by the drop zone but are included here where available.

*Availability:* Indicates whether the aircraft is available to government, industry, or both.

*Past Applications:* Lists past landing/escape systems programs or types of testing which have been conducted with this aircraft.

*Planned Improvements:* Describes major improvements, rehabilitations, and modifications being made or being planned to the aircraft.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the aircraft.

# TEST AIRCRAFT INDEX

| Page Number | Company / Make and Aircraft Name | Speed (Mach #) | Max. Altitude (ft.) | Payload Wt. (lb.) |
|---|---|---|---|---|
| | **Avtel Services, Inc.** | | | |
| 3-8 | DC 130A | 125 - 250 knots | 25,000 | 25,000 |
| 3-9 | F-4D | 2.0 | 50,000 | 10,000 |
| 3-10 | T-33 MK3 | 0.73 | 42,000 | 3,500 |
| | **Lockheed Aeronautical Systems Company** | | | |
| 3-11 | L100-20 (C-130, commercial version) | 235 knots | 32,000 | 30,000 |
| | **NASA Ames/Dryden Flight Research Facility** | | | |
| 3-12 | 180 HP Piper Super Cub | 45 - 100 mph | 12,000 | 100 |
| 3-13 | B-52A Bomber | 0.3 - 0.80 | 50,000 | 48,000 |
| 3-14 | "Better Duck" remotely piloted ultralight aircraft | 65 - 100 mph | 16,000 | 500 |
| 3-15 | F-18 | 0.2 - 0.85 | 50,000 | 2,000 |
| 3-16 | "Mothership" Remotely Piloted Vehicle | 25 - 90 mph | 10,000 MSL | 20 |
| | **NASA Goddard Space Flight Center - Wallops Flight Facility** | | | |
| 3-17 | Bell Aircraft UH1D Utility, Helicopter N415NA | 150 - 350 KEAS | 15,000 | 3,600 |
| 3-18 | Lockheed P3B (Heavy) Anti-submarine aircraft N426NA | 150 - 350 KEAS | 25,000 | 15,000 |
| 3-19 | Short Brothers and Harland SC-7 "Flying Boxcar" configuration. | 80 - 140 KEAS | 15,000 | 2,000 |
| | **Naval Air Warfare Center Weapons Division** | | | |
| 3-20 | A-6 | 250 - 550 KIAS | 45,000 MSL | 2,400 |
| 3-21 | UC-8 | 80 - 140 KIAS | 30,000 MSL | 2,000 |
| 3-22 | UH-1, HHIN Helicopters | 0 - 120 KIAS | 10,000 MSL | 1,800 |
| 3-23 | YF-4J | 140 - 750 KIAS | 50,000 MSL | 4,300 centerline |

# TEST AIRCRAFT INDEX

| Page Number | Company / Make and Aircraft Name | Speed (Mach #) | Max. Altitude (ft.) | Payload Wt. (lb.) |
|---|---|---|---|---|
| | Niemi Enterprises | | | |
| 3-24 | Piper PA 28-161, Warrior II | 120 knots | 11,000 | 25 |
| | Para-Flite, Inc. | | | |
| 3-25 | Cessna 185 and Beechcraft H-18 | 70-200 mph | 12,500 | 650 |
| | Sandia National Laboratories | | | |
| 3-26 | Dehaviland DCH-6, Twin Otter (STOL) | 0.14 - 0.20 | 25,000 | 1000 centerline; 400 each wing |
| | Strong Enterprises | | | |
| 3-27 | Cessna 180 | 60 - 140 mph | 13,000 | 600 |
| | U.S. Air Force Flight Test Center | | | |
| 3-28 | C-130 | 0.7 | 25,000 | 42,000 |
| 3-29 | F-4 | 2.0 | 50,000 | 2500 |
| | U.S. Army Aeromedical Research Laboratory | | | |
| 3-30 | OH-58A | 0 - 110 knots | 10,000 | 1000 |
| 3-31 | U-21G | 90 - 190 knots | 10,000 + | 1500 |
| 3-32 | UH-1H | 0 - 115 knots | 10,000 | 2000 cabin, 4000 cargo hook |
| 3-33 | UH-60A | 0 - 170 knots | 10,000 + | 5000 cabin, 8000 cargo hook |
| | U.S. Army Natick RD&E Center | | | |
| 3-34 | Remote-controlled ultra-lite aircraft | 20-75 mph | 2000 | 400 |
| | U.S. Army Yuma Proving Ground | | | |
| 3-35 | UH-1 | 40 - 80 KEAS | 10,000 | 2800 max |

# COMPARABLE AIRCRAFT

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group G Fixed Wing ( > 20K lbs)** | |
| 3-8 | DC 130A | Avtel Services, Inc. |
| 3-11 | L100-20 (C-130, commercial version) | Lockheed Aeronautical Systems Company |
| 3-13 | B-52A Bomber | NASA Ames/Dryden Flight Research Facility |
| 3-28 | C-130 | U.S. Air Force Flight Test Center |
| | **Group H Fixed Wing (10 - 20K lbs)** | |
| 3-9 | F-4D | Avtel Services, Inc. |
| 3-18 | Lockheed P3B (Heavy) Anti-submarine aircraft N426NA | NASA Goddard Space Flight Center - Wallops Flight Facility |
| | **Group I Fixed Wing (1 - 10K lbs)** | |
| 3-10 | T-33 MK3 | Avtel Services, Inc. |
| 3-15 | F-18 | NASA Ames/Dryden Flight Research Facility |
| 3-19 | Short Brothers and Harland SC-7 "Flying Boxcar" configuration. | NASA Goddard Space Flight Center - Wallops Flight Facility |
| 3-20 | A-6 | Naval Air Warfare Center Weapons Division |
| 3-21 | UC-8 | " |
| 3-23 | YF-4J | " |
| 3-29 | F-4 | U.S. Air Force Flight Test Center |
| 3-31 | U-21G | U.S. Army Aeromedical Research Laboratory |

# COMPARABLE AIRCRAFT

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group J Fixed Wing (< 1K lbs)** | |
| 3-12 | 180 HP Piper Super Cub | NASA Ames/Dryden Flight Research Facility |
| 3-14 | "Better Duck" remotely piloted ultralight aircraft | " |
| 3-16 | "Mothership" Remotely Piloted Vehicle | " |
| 3-24 | Piper PA 28-161 Warrior II | Niemi Enterprises |
| 3-25 | Cessna 185 and Beechcraft H-18 | Para-Flite, Inc. |
| 3-26 | Dehaviland DCH-6 Twin Otter (STOL) | Sandia National Laboratories |
| 3-27 | Cessna 180 | Strong Enterprises |
| 3-34 | Remote-controlled ultra-lite aircraft | U.S. Army Natick RD&E Center |
| | **Group K (Helicopters)** | |
| 3-17 | Bell Aircraft UH1D Utility, Helicopter N415NA | NASA Goddard Space Flight Center - Wallops Flight Facility |
| 3-22 | UH-1, HHIN Helicopters | Naval Air Warfare Center Weapons Division |
| 3-30 | OH-58A | U.S. Army Aeromedical Research Laboratory |
| 3-32 | UH-1H | " |
| 3-33 | UH-60A | " |
| 3-35 | UH-1 | U.S. Army Yuma Proving Ground |

# TEST AIRCRAFT

**COMPANY:**
Avtel Services, Inc.

**LOCATION:**
Hangar 77
Mojave Airport
Mojave, CA 93501

**TYPE:**
DC 130A

**DATE BUILT:**
1957

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 125-250 knots

**MAX. ALTITUDE:**
(ft) 25,000

**PAYLOAD WT.:**
(lb) 25,000

**OTHER:**
Cargo capability and launch platform

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group G

**DATA ACQUISITION:**
N/A

**AVAILABILITY:**
Available through U.S. Navy.

**PAST APPLICATIONS:**
Target launch BQM 34 series and BQM 74 series drones and parachute drops with personnel and cargo.

**GENERAL COMMENTS:**
U.S. Navy aircraft contractor maintained and operated.

**LOCAL INFORMATION CONTACT:** Boyd L. Chisholm - (805) 824-2443

# TEST AIRCRAFT

**COMPANY:**
Avtel Services, Inc.

**LOCATION:**
Hangar 77
Mojave Airport
Mojave, CA 93501

**TYPE:**
F-4D

**DATE BUILT:**
1966

**OPERATIONAL STATUS:**
Normal Workload

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Center Line Pylon

**SPEED RANGE:**
(Mach#) 2.0

**MAX. ALTITUDE:**
(ft) 50,000

**PAYLOAD WT.:**
(lb) 10,000

**OTHER:**
Max Wt. Single Station Store
4000 lbs

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group H

**DATA ACQUISITION:**
Ground station with 32 channels available, 16 channels of strip chart expandable to 32 channels.

**AVAILABILITY:**
Available through both Government and Commercial industry.

**PAST APPLICATIONS:**
Munition/ordinance drops, captive carry testing, any kind of flight testing within the parameters of the aircraft.

**GENERAL COMMENTS:**
The F-4D is a two place (tandem) supersonic, long-range, all weather fighter-bomber built by McDonnell Douglas.

**LOCAL INFORMATION CONTACT:** Hal Belles or Bill Hickle - (805) 824-9381

# TEST AIRCRAFT

**COMPANY:**
Avtel Services, Inc.

**LOCATION:**
Hangar 77
Mojave Airport
Mojave, CA 93501

**TYPE:**
T-33 MK3

**DATE BUILT:**
1957

**OPERATIONAL STATUS:**
Normal Workload

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Center Line Pylon

**SPEED RANGE:**
(Mach#) 0.73

**MAX. ALTITUDE:**
(ft) 42,000

**PAYLOAD WT.:**
(lb) 3500

**OTHER:**
Max Wt Single Station Store
1000 lbs

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
Ground station with 32 channels available, 16 channels of strip chart expandable to 32 channels.

**AVAILABILITY:**
Available through both Government and Commercial industry.

**PAST APPLICATIONS:**
Munition/ordinance drops, captive carry testing, any kind of flight testing within the parameters of the aircraft.

**GENERAL COMMENTS:**
The T-33 MK3 is a two place (tandem) subsonic pilot trainer or armament trainer.

**LOCAL INFORMATION CONTACT:** Hal Belles or Bill Hickle - (805) 824-9381

# TEST AIRCRAFT

**COMPANY:**
Lockheed Aeronautical Systems Company

**LOCATION:**
Marietta, GA

**TYPE:**
L100-20 (C-130, commercial version)

**DATE BUILT:**
1974, mod. '85-'86

**OPERATIONAL STATUS:**
Active

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☒ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 235 knots

**MAX. ALTITUDE:**
(ft) 32,000

**PAYLOAD WT.:**
(lb) 30,000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group G

**DATA ACQUISITION:**
1000 Channels of POM and FM with capability for real time and/or recorded data. Telemetry is also available.

**AVAILABILITY:**
Can be scheduled depending on program requirements for dedicated time or time share.

**PAST APPLICATIONS:**
Quiet Knight Demonstrations, STOL Development, HUD-FLIR Demos, STOL Demos. Two world records in the "time to climb" category for transport aircraft.

**GENERAL COMMENTS:**
This aircraft is an Engineering tool for developing/proving new technologies. The on-board instrumentation package and available hardware mounting structure can accommodate many programs concurrently - some with little or no modification to the airplane.

**LOCAL INFORMATION CONTACT:** R.A. Brogdon (404) 494-5253

# TEST AIRCRAFT

**COMPANY:**
NASA Ames/Dryden Flight Research Facility

**LOCATION:**
Edwards AFB, CA

**TYPE:**
180 HP Piper Super Cub

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Available (Is leased from local soaring school)

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Launch fixture on rt. wing strut

**SPEED RANGE:**
(Mach#) 45 - 100 mph

**MAX. ALTITUDE:**
(ft) 12,000

**PAYLOAD WT.:**
(lb) 100

**OTHER:**
Wing strut launch rack is quickly installed requiring no modifications to the aircraft

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Launch aircraft may double as photo plane because of low speed maneuverability.

**AVAILABILITY:**
Available weekdays & some weekends.

**PAST APPLICATIONS:**
Used to launch 100 pound models for spacecraft cruise missiles - using both parachute and horizontal landing recoveries.

**GENERAL COMMENTS:**
Quick response and low cost for testing models up to 100 pounds.

**LOCAL INFORMATION CONTACT:** Alexander G. Sim (805) 258-3714, R. Dale Reed 258-2171

# TEST AIRCRAFT

**COMPANY:**
NASA Ames/Dryden Flight Research Facility

**LOCATION:**
Edwards AFB, CA

**TYPE:**
B-52A Bomber

**DATE BUILT:**
1952

**OPERATIONAL STATUS:**
Current

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☒ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 0.3 - 0.80

**MAX. ALTITUDE:**
(ft) 50,000

**PAYLOAD WT.:**
(lb) 48,000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group G

**DATA ACQUISITION:**
Aircraft has on-board volume and power available for number of data systems.

**AVAILABILITY:**
Is kept in continuous operational status.

**PAST APPLICATIONS:**
Was used originally as X-15 launcher, later for lifting bodies, a number of RPV's, and parachute test specimens.

**GENERAL COMMENTS:**
Has proven to be an excellent launch platform especially for very large specimens.

**LOCAL INFORMATION CONTACT:** Edward T. Schneider (805) 258-3215, Marvin R. Barber (805) 258-2275

# TEST AIRCRAFT

**COMPANY:**
NASA Ames/Dryden Flight Research Facility

**LOCATION:**
Edwards AFB, CA

**TYPE:**
"Better Duck" remotely piloted ultralight aircraft

**DATE BUILT:**
1992

**OPERATIONAL STATUS:**
Flight Tests scheduled for Feb. 1992

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER External from belly

**SPEED RANGE:**
(Mach#) 65 - 100 mph

**MAX. ALTITUDE:**
(ft) 16,000

**PAYLOAD WT.:**
(lb) 500

**OTHER:**
Has autopilot and can be flown IFR with radar beacon tracking.

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Data & TV systems may be installed in launch aircraft.

**AVAILABILITY:**
Is projected to be operational after January 1992.

**PAST APPLICATIONS:**
None - Begin operations in 1992 for launching 120 to 300-lb spacecraft/parachute models.

**GENERAL COMMENTS:**
This RPV is designed for low-cost, simplicity and portability. Is quick deployable from enclosed trailer and operated by 2-man crew.

**LOCAL INFORMATION CONTACT:** Alexander G. Sim (805) 258-3714, R. Dale Reed 258-2171.

# TEST AIRCRAFT

**COMPANY:**
NASA Ames/Dryden Flight Research Facility

**LOCATION:**
Edwards AFB, CA

**TYPE:**
F-18

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER External centerline store position

**SPEED RANGE:**
(Mach#) 0.2 - 0.85

**MAX. ALTITUDE:**
(ft) 50,000

**PAYLOAD WT.:**
(lb) 2,000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
Aircraft has on-board volume and power available for a number of data systems.

**AVAILABILITY:**
3 F-18 support aircraft are usually operational and available and all have the centerline 2000 pound store capability.

**PAST APPLICATIONS:**
These 3 aircraft are used in support and chase aircraft roles for other aircraft committed to research projects.

**GENERAL COMMENTS:**
If the parachute test specimen can be configured into the standard F-18 store shape, engineering and development costs may be held to a minimum.

**LOCAL INFORMATION CONTACT:** Edward T. Schneider (805) 258-3215, Marvin R. Barber (805) 258-2275

# TEST AIRCRAFT

**COMPANY:**
NASA Ames/Dryden Flight Research Facility

**LOCATION:**
Edwards AFB, CA

**TYPE:**
"Mothership" Remotely Piloted Vehicle

**DATE BUILT:**
1976

**OPERATIONAL STATUS:**
Currently Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Belly External

**SPEED RANGE:**
(Mach#) 25 - 90 mph

**MAX. ALTITUDE:**
(ft) 10,000 MSL

**PAYLOAD WT.:**
(lb) 20

**OTHER:**
Payload wt. is the total of launched vehicle or any special equipment such as TV system & radar transponder. 10 or 14 ft wingspan with twin engines.

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
On-board downward looking TV installed in mothership for imaging parachute deployments or other variable geometry deployments.

**AVAILABILITY:**
Available - Is used intermittently to launch various research aircraft, spacecraft, and parachute models.

**PAST APPLICATIONS:**
Has launched lifting body models, various spacecraft configurations, hypersonic aircraft configurations, and parachute test models.

**GENERAL COMMENTS:**
This launch method is particularly suited for quick low-cost flight tests of conceptual model configurations. Mothership is currently operating with a highly reliable autopilot and can be flown with a radar transponder to altitudes near 10,000 feet if needed.

**LOCAL INFORMATION CONTACT:** Alexander G. Sim (805) 258-3714, R. Dale Reed 258-2171

# TEST AIRCRAFT

**COMPANY:**
NASA Goddard Space Flight Center - Wallops Flight Facility

**LOCATION:**
Wallops Island, VA

**TYPE:**
Bell Aircraft UH1D Utility, Helicopter N415NA

**DATE BUILT:**
1965

**OPERATIONAL STATUS:**
On request availability

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☒ OTHER Hell hole hook

**SPEED RANGE:**
(Mach#) 150-350 KEAS

**MAX. ALTITUDE:**
(ft) 15,000

**PAYLOAD WT.:**
(lb) 3,600

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**
None

**AVAILABILITY:**
Available to government, university, and industry upon approval of Director, SPOD

**PAST APPLICATIONS:**
Drop tests of parachutes and drop bodies with decelerator parachutes.

**GENERAL COMMENTS:**
Helicopter drops have been requested when precise drop point geometry is desired, or when minimal forward speed deployment is desired.

**LOCAL INFORMATION CONTACT:** Roger Navarro (804) 824-1448, Doug Young 824-1443, Bob Long 824-1354

# TEST AIRCRAFT

**COMPANY:**
NASA Goddard Space Flight Center - Wallops Flight Facility

**LOCATION:**
Wallops Island, VA

**TYPE:**
Lockheed P3B (Heavy)
Anti-submarine aircraft N426NA

**DATE BUILT:**
1966

**OPERATIONAL STATUS:**
On request availability

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☒ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 150-350 KEAS

**MAX. ALTITUDE:**
(ft) 25,000

**PAYLOAD WT.:**
(lb) 15,000

**OTHER:**
Bomb Bay capacity is 140 inches in length and ~ 4,000 lb capacity

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group H

**DATA ACQUISITION:**
The P3B has an extensive data acquisition system using a digital Arinc-429 data bus.

**AVAILABILITY:**
Available to government, university, and industry upon approval of Director, SPOD

**PAST APPLICATIONS:**
Drop tests of inert bodies, bodies with decelerator parachutes, and experimental parachutes.

**GENERAL COMMENTS:**
N426NA has 4,000 mile range and could perform deployment tasks remote from WFF.

**LOCAL INFORMATION CONTACT:** Roger Navarro (804) 824-1448, Doug Young 824-1443, Bob Long 824-1354

# TEST AIRCRAFT

**COMPANY:**
NASA Goddard Space Flight Center - Wallops Flight Facility

**LOCATION:**
Wallops Island, VA

**TYPE:**
Short Brothers and Harland SC-7 "Flying Boxcar" configuration.

**DATE BUILT:**
1967

**OPERATIONAL STATUS:**
On request availability

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☒ REAR DOOR
- ☐ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 80-140 KEAS

**MAX. ALTITUDE:**
(ft) 15,000

**PAYLOAD WT.:**
(lb) 2,000

**OTHER:**
Recovery weight ~250 lbs

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
Retrieval winch loads are measured and telemetered to a ground station. Retrieval payloads normally incorporate an accelerometer into their telemetry. Onboard film cameras and video cameras are carried, primarily to provide feedback to the pilots on their accuracy in flying the skyvan over a target parachute.

**AVAILABILITY:**
Available to government, university, and industry upon approval of Director, SPOD

**PAST APPLICATIONS:**
(1) Drop test of inert bodies, inert bodies with decelerator parachutes, and parachute deployment tests
(2) Mid-air retrieval of parachute borne payloads from 5-250 lbs.

**GENERAL COMMENTS:**
Aft cargo door facilitates deployment tests.

**LOCAL INFORMATION CONTACT:** Doug Young - (804) 824-1443, Roger Navarro 824-1448, Bob Long 824-1354

# TEST AIRCRAFT

| COMPANY: | DATE BUILT: | SPEED RANGE: | COMPARABLE AIRCRAFT |
|---|---|---|---|
| Naval Air Warfare Center<br>Weapons Division<br>**LOCATION:**<br>China Lake, CA 93555 | 1968<br>**OPERATIONAL STATUS:**<br>Fully Operational | (Mach#) 250 - 550 KIAS<br>**MAX. ALTITUDE:**<br>(ft) 45,000 MSL<br>**PAYLOAD WT.:**<br>(lb) 2,400 | Group I |
| **TYPE:**<br>A-6 | **EXTRACTION FROM:**<br>☒ WING PYLON<br>☐ BOMB BAY<br>☐ REAR DOOR<br>☐ SIDE DOOR<br>☒ OTHER Centerline Pylon | **OTHER:**<br>**BACKUP AIRCRAFT AVAILABLE?**<br>◉ YES ○ NO | |

C-2

**DATA ACQUISITION:**
Solid State and Telemetry data recording. Video, photographic, laser, and radar tracking with IRIG timing.

**AVAILABILITY:**
All

**PAST APPLICATIONS:**
Test and evaluation of various personnel, missile recovery, and test vehicle parachute systems.

**GENERAL COMMENTS:**
Normal usage is for moderate to high speed air drop testing of cylindrical test vehicles.

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008

3-20A

# TEST AIRCRAFT

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
UC-8

**DATE BUILT:**
1966

**OPERATIONAL STATUS:**
Fully Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☒ REAR DOOR
- ☐ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 80 - 140 KIAS

**MAX. ALTITUDE:**
(ft) 30,000 MSL

**PAYLOAD WT.:**
(lb) 2,000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group I

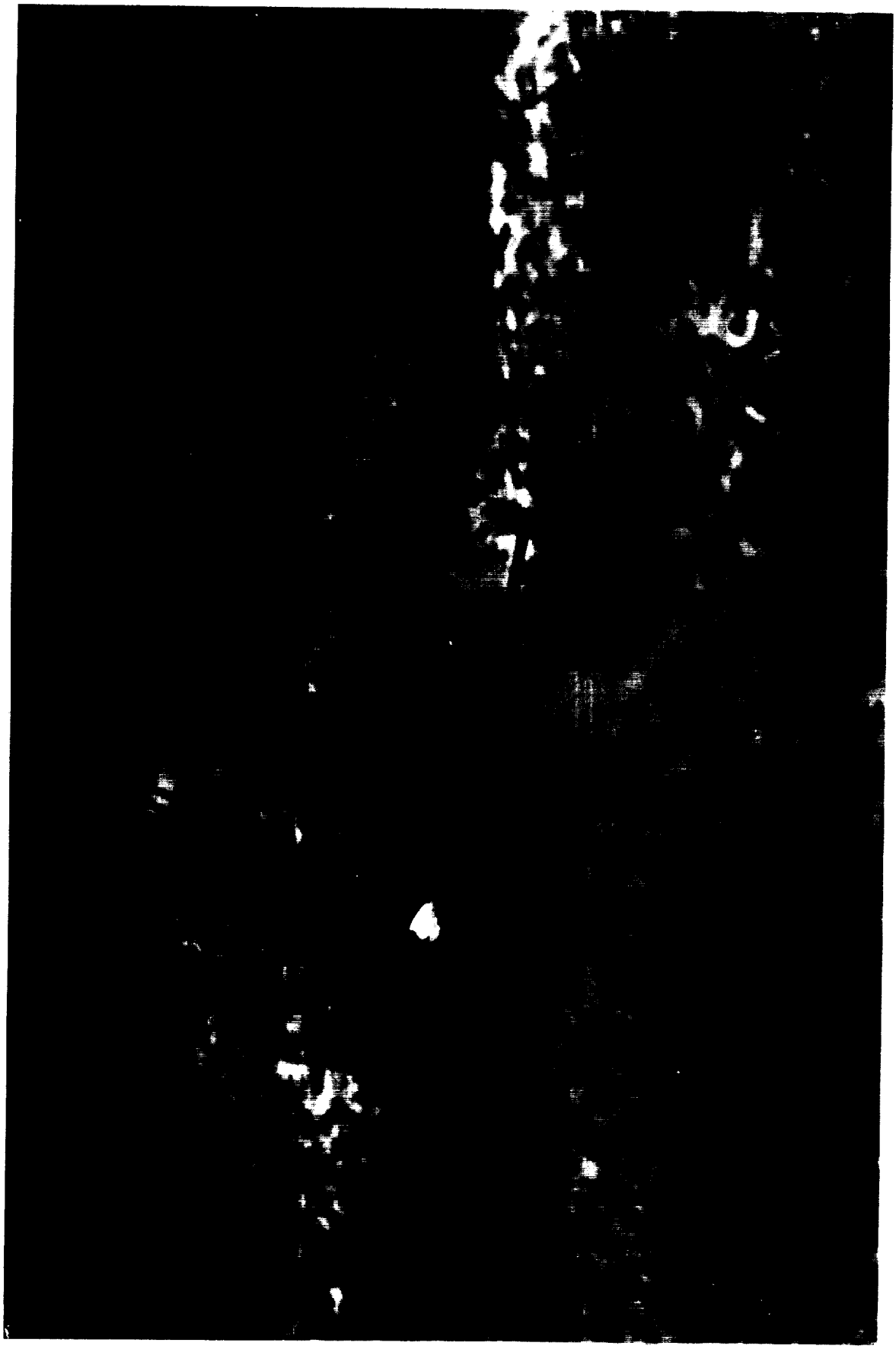
**DATA ACQUISITION:**
Solid State and Telemetry data recording. Video, photographic, laser, and radar tracking with IRIG timing.

**AVAILABILITY:**
All

**PAST APPLICATIONS:**
Live Navy test parachutist jumping, torso dummy and other drop test vehicles.

**GENERAL COMMENTS:**
Access to Marine or Navy C-130's is usually available for backup.

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008



3-21A

# TEST AIRCRAFT

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
UH-1, HHIN
Helicopters

**DATE BUILT:**
1974

**OPERATIONAL STATUS:**
Fully Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 0 - 120 KIAS

**MAX. ALTITUDE:**
(ft) 10,000 MSL

**PAYLOAD WT.:**
(lb) 1,800

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**
Solid State and Telemetry data recording. Video, photographic, laser, and radar tracking with IRIG timing.

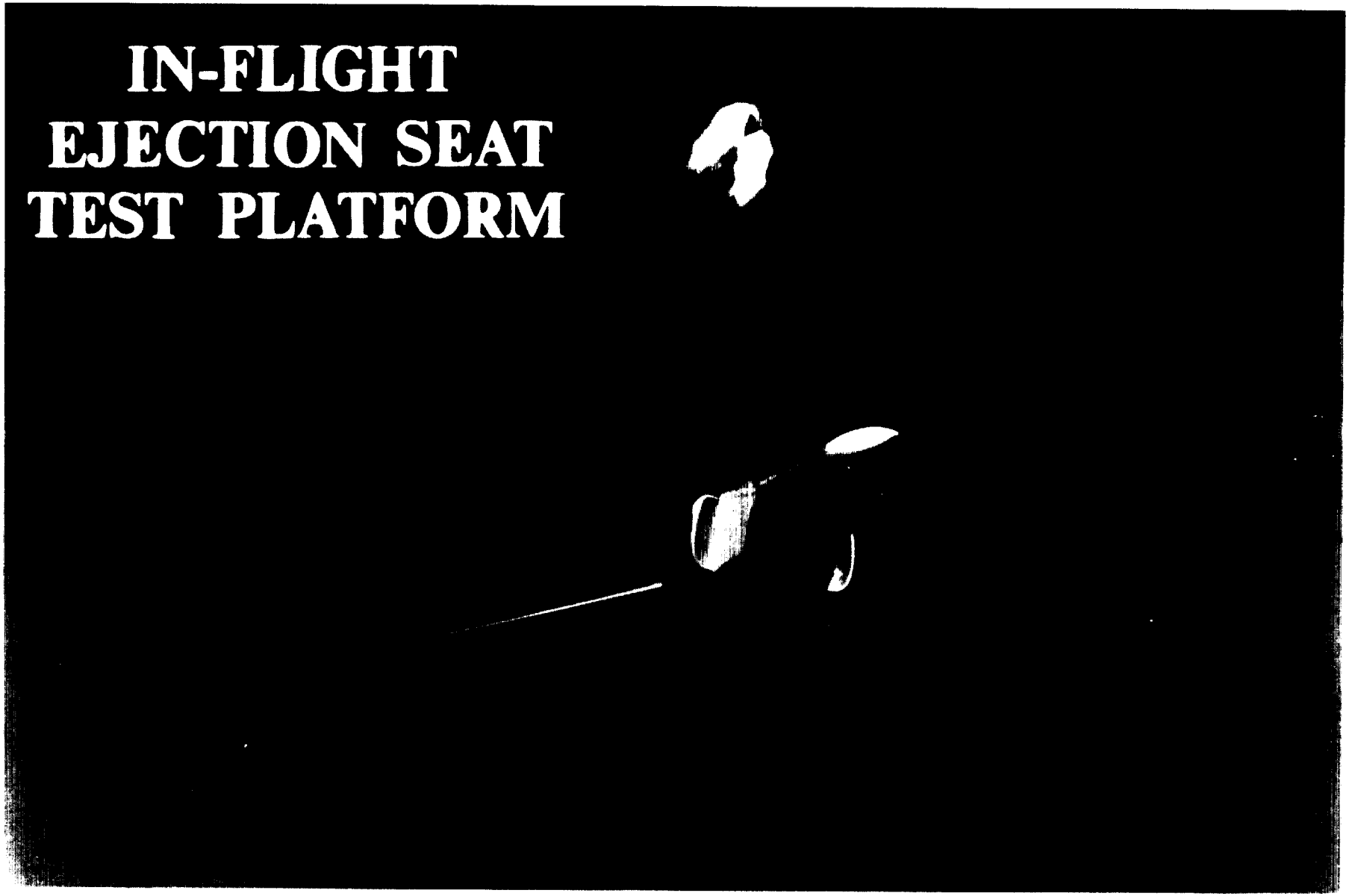
**AVAILABILITY:**
All

**PAST APPLICATIONS:**
Live Navy test parachutist jumping, free fall drops of torso dummies and other drop test vehicles.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008

# IN-FLIGHT EJECTION SEAT TEST PLATFORM



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# TEST AIRCRAFT

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
YF-4J

**DATE BUILT:**
1964

**OPERATIONAL STATUS:**
Fully Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Ejection seat & Centerline Pylon

**SPEED RANGE:**
(Mach#) 140 -750 KIAS

**MAX. ALTITUDE:**
(ft) 50,000 MSL

**PAYLOAD WT.:**
(lb) 4,300 centerline

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
Solid State and Telemetry data recording. Video, photographic, laser, and radar tracking with IRIG timing.

**AVAILABILITY:**
All

**PAST APPLICATIONS:**
Navy and Air Force in-flight ejection seat tests.

**GENERAL COMMENTS:**
Primary usage is for high speed ejection seat testing and centerline air drops of cylindrical test vehicles.

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008

# TEST AIRCRAFT

**COMPANY:**
Niemi Enterprises

**LOCATION:**
1340 Lancaster Ave.
Lunenburg, MA 01462

**TYPE:**
Piper PA 28-161
Warrior II

**DATE BUILT:**
1978

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☒ OTHER Window

**SPEED RANGE:**
(Mach#) 120 knots

**MAX. ALTITUDE:**
(ft) 11,000

**PAYLOAD WT.:**
(lb) 25

**OTHER:**
None

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Rustrak Ranger Recorder for recording data from four channels during drop testing. Videocamera for opening characteristics.

**AVAILABILITY:**
On reasonable prior notice.

**PAST APPLICATIONS:**
Flight training only.

**GENERAL COMMENTS:**
Suitable for drop testing of small scale parachutes.

**LOCAL INFORMATION CONTACT:** Eugene E. Niemi, Jr., Ph.D., P.E. (508) 534-4169 or 934-2977

# TEST AIRCRAFT

**COMPANY:**
Para-Flite, Inc.

**LOCATION:**
5800 Magnolia Ave.
Pennsauken, NJ 08109

**TYPE:**
Cessna 185 and Beechcraft H-18

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Available on 2-3 days notice

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER N/A

**SPEED RANGE:**
(Mach#) 70-200 mph

**MAX. ALTITUDE:**
(ft) 12,500

**PAYLOAD WT.:**
(lb) 650

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
In-flight only: Airspeed (2 components) and inclination. 4-channels available with ASCII output

**AVAILABILITY:**
Both government and industry.

**PAST APPLICATIONS:**
MC-4, MC-5, Arabs, Commercial

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Troy Loney - (609)-663-1275; FAX: 663-3028

# TEST AIRCRAFT

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
Tonopah Test Range, NV

**TYPE:**
Dehaviland DCH-6
Twin Otter (STOL)

**DATE BUILT:**
1974

**OPERATIONAL STATUS:**
Some excess capacity available

**EXTRACTION FROM:**

- ☒ WING PYLON
- ☒ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Fuselage

**SPEED RANGE:**
(Mach#) 0.14 - 0.20

**MAX. ALTITUDE:**
(ft) 25,000

**PAYLOAD WT.:**
(lb) 1000 centerline; 400 each wing

**OTHER:**
Not pressurized

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Power panel available - 300 amps DC with AC inverters for 120 VAC equipment.

**AVAILABILITY:**
Available to government and government-sponsored projects.

**PAST APPLICATIONS:**
SAINT Instrumentation System Development; SWERVE/TFS real-time SAR development and testing; NDB, B-61, and SDSID drop tests.

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Tonopah Test Range Test Directors: (702) 295-8107

# TEST AIRCRAFT

**COMPANY:**
Strong Enterprises

**LOCATION:**
Orlando, FL 32837

**TYPE:**
Cessna 180

**DATE BUILT:**
1956

**OPERATIONAL STATUS:**
On Demand

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 60 - 140 mph

**MAX. ALTITUDE:**
(ft) 13,000

**PAYLOAD WT.:**
(lb) 600

**OTHER:**
In-flight door

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Video, photo

**AVAILABILITY:**
By prior arrangement.

**PAST APPLICATIONS:**
Live and dummy drops using door exit with and without exit slide.

**GENERAL COMMENTS:**
In-flight door, jump step.

**LOCAL INFORMATION CONTACT:** Ted Strong (407) 859-9317 FAX: (407) 850-6978

# TEST AIRCRAFT

**COMPANY:**
U.S. Air Force Flight Test Center

**LOCATION:**
Edwards AFB

**TYPE:**
C-130

**DATE BUILT:**
1970's

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Centerline

**SPEED RANGE:**
(Mach#) 0.7

**MAX. ALTITUDE:**
(ft) 25,000

**PAYLOAD WT.:**
(lb) 42,000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group G

**DATA ACQUISITION:**
N/A

**AVAILABILITY:**
Available to government and industry on a daily schedule basis.

**PAST APPLICATIONS:**

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** Michael Wuest - (805) 277-4820

# TEST AIRCRAFT

**COMPANY:**
U.S. Air Force Flight Test Center

**LOCATION:**
Edwards AFB, CA

**TYPE:**
F-4

**DATE BUILT:**
1970's

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☒ OTHER Centerline

**SPEED RANGE:**
(Mach#) 2.0

**MAX. ALTITUDE:**
(ft) 50,000

**PAYLOAD WT.:**
(lb) 2500

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
N/A

**AVAILABILITY:**
Available to government and industry on a daily schedule basis.

**PAST APPLICATIONS:**

**GENERAL COMMENTS:**
Plan to replace F-4's with F-16's in near future.

**LOCAL INFORMATION CONTACT:** Michael Wuest - (805) 277-4820

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
OH-58A

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
On demand

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 0 - 110 knots

**MAX. ALTITUDE:**
(ft) 10,000

**PAYLOAD WT.:**
(lb) 1000

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**
Installed as required.

**AVAILABILITY:**
Government

**PAST APPLICATIONS:**
None

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
U-21G

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
On demand

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 90 - 190 knots

**MAX. ALTITUDE:**
(ft) 10,000 +

**PAYLOAD WT.:**
(lb) 1500

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group I

**DATA ACQUISITION:**
Installed as required.

**AVAILABILITY:**
Government

**PAST APPLICATIONS:**
None

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
UH-1H

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
On demand

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☒ OTHER Cargo Hook

**SPEED RANGE:**
(Mach#) 0 - 115 knots

**MAX. ALTITUDE:**
(ft) 10,000

**PAYLOAD WT.:**
(lb) 2000 cabin, 4000 cargo hook

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**
Installed as required.

**AVAILABILITY:**
Government

**PAST APPLICATIONS:**
None

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
UH-60A

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
On demand

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☒ OTHER Cargo hook

**SPEED RANGE:**
(Mach#) 0 - 170 knots

**MAX. ALTITUDE:**
(ft) 10,000 +

**PAYLOAD WT.:**
(lb) 5000 cabin, 8000 cargo hook

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**
Installed as required.

**AVAILABILITY:**
Government

**PAST APPLICATIONS:**
None

**GENERAL COMMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Natick RD&E Center
Experimental Analysis Branch

**LOCATION:**
Natick, MA 01760-5017

**TYPE:**
Remote-controlled ultra-lite aircraft

**DATE BUILT:**
1965

**OPERATIONAL STATUS:**
Operational and Available

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☐ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 20-75 mph

**MAX. ALTITUDE:**
(ft) 2000

**PAYLOAD WT.:**
(lb) 400

**OTHER:**

**BACKUP AIRCRAFT AVAILABLE?**
○ YES ◉ NO

**COMPARABLE AIRCRAFT**
Group J

**DATA ACQUISITION:**
Remote-controlled ultra-lite airplane, hand-made miniature, self-powered data acquisition devices (up to 25 cu. in.) that power multiple transducers, measure forces and other phenomena during airdrop, and provide same day down load and display of data using PC.

**AVAILABILITY:**
Available to government agencies.

**PAST APPLICATIONS:**
Cluster Parachute studies, low speed opening study, high speed opening study, night opening study, T-10 slider study, 1/4 scale canopy study, fabric stiffness, IR detection.

**GENERAL COMMENTS:**
Considering acquisition of higher performance ultra-lite aircraft.

**LOCAL INFORMATION CONTACT:** Jack Buckley, Model Maker or Bruce Buckland, Chief, Experimental Analysis Br. - (508) 651-4799

# TEST AIRCRAFT

**COMPANY:**
U.S. Army Yuma Proving Ground

**LOCATION:**
Air Delivery Division
Yuma, AZ

**TYPE:**
UH-1

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Operational

**EXTRACTION FROM:**

- ☐ WING PYLON
- ☐ BOMB BAY
- ☐ REAR DOOR
- ☒ SIDE DOOR
- ☐ OTHER _____

**SPEED RANGE:**
(Mach#) 40 - 80 KEAS

**MAX. ALTITUDE:**
(ft) 10,000

**PAYLOAD WT.:**
(lb) 2800 max.

**OTHER:**
Max payload 1400 lbs @ 4000 ft

**BACKUP AIRCRAFT AVAILABLE?**
◉ YES ○ NO

**COMPARABLE AIRCRAFT**
Group K

**DATA ACQUISITION:**

**AVAILABILITY:**
Government Only

**PAST APPLICATIONS:**
Variety

**GENERAL COMMENTS:**
Most YPG testing is performed using Air Force A/C.
Internal transport and sling loads.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# FABRICATION FACILITIES

Fabrication facilities are those which are capable of building parachutes, other decelerators, and parachute/payload systems. There are a large number of manufacturers of parachutes in the U.S., a majority of them committed to the sport parachute market. This catalog includes only those organizations which are capable of producing systems for landing, escape, airdrop, and weapons systems. The objective of this chapter is to provide a summary of the types of facilities available around the nation, not to provide a complete survey. The reader is referred to The Parachute Manual (from Para Publishing) for a complete survey of sport parachute manufacturers.

There are two types of facilities represented in this volume, those which build production hardware, and those which build prototype systems. Production facilities are normally operated by industry, employ a large number of people, and are capable of developing a large number of systems. Prototype shops are normally operated by government agencies and are much smaller in size. In choosing a fabrication facility, the engineer must consider past experience and the capability of the shop in producing the specific type of system required.

# FABRICATION FACILITIES

| NAME OF COMPANY ① | # OF EMPLOYEES<br>○ 1-25 ○ 25-100 ○ 100-250<br>○ 250-500 ○ Over 500 |
|---|---|
| LOCATION: ② | DESIGN SUPPORT AVAILABLE?<br>○ YES ○ NO<br>BUILD TO PRINT?<br>○ YES ○ NO |

**TYPE OF EQUIPMENT MANUFACTURED:**

- ☐ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☐ Personnel Parachutes - Military
- ☐ Cargo Parachutes
- ☐ Aircraft Spin and Brake Parachutes
- ☐ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**

**PAST PROGRAMS:**

**LOCAL INFORMATION CONTACT:** **TECHNICAL:**

**COST:**

EXPLANATION OF FABRICATION FACILITIES DATA SHEETS

(1) Name of the Installation where the facility is located, and when not evident, the name of the owner and city.

(2) Proper or generic name of the facility, with additional qualifiers or identifiers as appropriate.

*# of Employees:* Self Explanatory.

*Design Support Available?:* Indicates whether technical support is available in the design and development of systems.

*Build to Print?:* Indicates whether the facility will build to a set of existing drawings.

*Type of Equipment Manufactured:* Self Explanatory.

*General Comments:* Includes other information of interest to the user.

*Past Applications:* Lists past landing/escape systems programs which have been supported by this facility.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the facility. Contacts for both technical information and costing are included.

# FABRICATION FACILITIES INDEX

| Page Number | Company | Location | Type Facility |
|---|---|---|---|
| 4-6 | Ballistic Recovery Systems, Inc. | 9905 Hayward Way.<br>S. El Monte, CA 91733 | Production |
| 4-7 | Butler Parachute Systems, Inc. | 6399 Lindbergh Blvd.<br>California City, CA 93505-6012 | Production |
| 4-8 | Frost Engineering Development Corp. | 3910 S. Kalamath St.<br>P.O. Box 1294<br>Englewood, CO 80150 | Production |
| 4-9 | FXC Corporation/Guardian Parachute Co. | 3410 South Susan St.<br>Santa Ana, CA 92704 | Production |
| 4-10 | Irvin Industries, Inc. | Santa Ana, CA; Other shops in North Carolina, England, Canada, & Italy | Production |
| 4-11 | Mills Manufacturing Corp. | P.O. Box 8100<br>Asheville, NC 28814 | Production |
| 4-12 | NASA Ames/Dryden Flight Research Facility | Edwards AFB, CA | Prototype |
| 4-13 | North American Aerodynamics | 107-110 Carver Dr.<br>Roxboro, NC 27573 | Production |
| 4-14 | Para-Flite, Inc. | 5800 Magnolia Ave.<br>Pennsauken, NJ 08109 | Production |
| 4-15 | Pioneer Aerospace Corp. | Man. & Purch.: Columbia, MS<br>Admin., Eng. & Prototype:<br>South Windsor, CT<br>Engineering: Melbourne, FL | Production |

# FABRICATION FACILITIES INDEX

## FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Ballistic Recovery Systems, Inc. | ○ 1-25 ◉ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 9905 Hayward Way. S. El Monte, CA 91733 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

**TYPE OF EQUIPMENT MANUFACTURED:**

- ☒ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☐ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**

**PAST PROGRAMS:**
Producers of decelerators for the Navy MK 46 Topper, Aircraft Recovery, RPV and UAV Recovery, Munitions decelerators, Suborbital Payload Recovery, Sonobuoy Deceleration.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Boris Popov (612) 436-7642

**COST:**

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Butler Parachute Systems, Inc. | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 6399 Lindbergh Blvd. California City, CA 93505-6012 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
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- ☒ Personnel Parachutes - Military
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- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Wide variety of commercial products. No sport equipment programs. Extensive experience in aircrew emergency equipment.

**PAST PROGRAMS:**
Aircrew Gliding Escape System, "Rarebear" World Record Holder, Coast Guard E2C & R68A , Voyager World Flight, GROB Egret

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Manley C. Butler, Jr. - (619) 373-4991, FAX: 373-2730

**COST:**

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Frost Engineering Development Corp. | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 3910 S. Kalamath St. P.O. Box 1294 Englewood, CO 80150 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☐ Parachute Systems
- ☒ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☐ Personnel Parachutes - Military
- ☐ Cargo Parachutes
- ☐ Aircraft Spin and Brake Parachutes
- ☐ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**
Design and manufacture cargo parachute releases (M-1, M-2), force transfer devices, and cargo towplate systems including modifications for special applications.
Design and manufacture personnel parachute releases, controlled dis-reefing systems, and energy absorbers.

**PAST PROGRAMS:**
Development of M-1 and M-2 cargo parachute releases, development of "Frost" personnel parachute release, development of energy absorbers and dis-reefing controllers for US Army and US Navy, development of combination parachute and restraint harnesses for US Air Force.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** H.M. Varner or E.L. Stech (303)761-1010

**COST:** J. Limbach or E.L. Stech

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| FXC Corporation/Guardian Parachute Co. | ○ 1-25 ◉ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 3410 South Susan St. Santa Ana, CA 92704 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
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- ☒ Personnel Parachutes - Military
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- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Parachutes, oxygen systems, parachute automatic openers/releases, speed sensors, ejection seat sub-components, gliding parachutes, etc.

**PAST PROGRAMS:**
Aces II Ejection Seat, Mach III-Alpha Tactical Gliding Parachute, NASA Escape Systems, Cargo Releases, Lapes, Halo, HAHO Systems

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Michael Jackson (714) 557-8032 FAX (714) 641-5093

**COST:** Mingo Caballero (714) 557-8032

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Irvin Industries, Inc. | ○ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ◉ Over 500 |
| **LOCATION:** Santa Ana, CA; Other shops in North Carolina, England, Canada, & Italy | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
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- ☒ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Development of Bomb Retarder Fins (AAR Inflatable Retarders)

**PAST PROGRAMS:**
Aircraft Spin and brake (C-17; C-5a; Orbiter Brake Chute; F-16; SR-71), Escape (F-111 Crew module, SR-71, TR-1), RPV Recovery (ALCM, SLAT, MQM-107, Auqilla), Cargo (G-12D), and Others, including SRB Recovery and Special Weapons Chutes.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Phil Delurgio/Robert Lawrence - (714) 662-1400

**COST:** Paul Collivar/Robert Kirk

## FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Mills Manufacturing Corp. | ○ 1-25 ○ 25-100 ○ 100-250<br>◉ 250-500 ○ Over 500 |
| **LOCATION:**<br>P.O. Box 8100<br>Asheville, NC 28814 | **DESIGN SUPPORT AVAILABLE?**<br>○ YES ◉ NO<br>**BUILD TO PRINT?**<br>◉ YES ○ NO |

### TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☒ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**
Manufacturer of military parachutes since WWII. American owned, woman owned, labor surplus area, small business. On QPL List since 1956.

**PAST PROGRAMS:**
Prime contractor on Government contracts.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** C. Joseph Keller, V.P. Engineering & Q.C. - (704) 645-3061, FAX: 645-3065

**COST:** James W. Turner, President

## FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| NASA Ames/Dryden Flight Research Facility | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** Edwards AFB, CA | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO<br>**BUILD TO PRINT?** ◉ YES ○ NO |

**TYPE OF EQUIPMENT MANUFACTURED:**

- ☐ Parachute Systems
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- ☐ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**
The Dryden Fabrication Facilities are primarily set up for support of experimental aircraft, however, the mechanical portions of parachute systems have been fabricated for spin recovery systems and model chute system.

**PAST PROGRAMS:**
X-29, F-19, and F-18 Spin Chutes, RPV Chute Recovery Systems, and spacecraft model chute systems.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Thomas C. McMurtry (805) 258-3212

**COST:**

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| North American Aerodynamics | ○ 1-25 ○ 25-100 ◉ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 107-110 Carver Dr. Roxboro, NC 27573 | **DESIGN SUPPORT AVAILABLE?** ○ YES ◉ NO **BUILD TO PRINT?** ◉ YES ○ NO |

**TYPE OF EQUIPMENT MANUFACTURED:**

- ☒ Parachute Systems
- ☒ Parachute Systems, includes metal components and ordinance
- ☒ Personnel Parachutes - Commercial
- ☒ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
None

**PAST PROGRAMS:**

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Jim Barker or John Higgins (919) 599-9266, FAX: (919) 599-7810

**COST:** Same as above

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Para-Flite, Inc. | ○ 1-25 ○ 25-100 ◉ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 5800 Magnolia Ave. Pennsauken, NJ 08109 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO<br>**BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
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- ☒ Personnel Parachutes - Military
- ☒ Cargo Parachutes
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- ☒ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Para-Flite produces primarily high-glide parachutes.

**PAST PROGRAMS:**
MC-4, MC-5, ARABS

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Troy Loney - (609)-663-1275; FAX: 663-3028

**COST:** Bill Bruno

## FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Pioneer Aerospace Corp. | ○ 1-25 ○ 25-100 ○ 100-250<br>◉ 250-500 ○ Over 500 |
| **LOCATION:**<br>Man. & Purch.: Columbia, MS<br>Admin., Eng. & Prototype:<br>South Windsor, CT<br>Engineering: Melbourne, FL | **DESIGN SUPPORT AVAILABLE?**<br>◉ YES ○ NO<br>**BUILD TO PRINT?**<br>◉ YES ○ NO |

### TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
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- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Supplier to U.S. Government and Foreign Governments, do not sell to commercial or sport market. Florida Engineering office dedicated primarily to Advanced Space Vehicle Recovery Systems. Columbia facility engaged in large scale production contracts.

**PAST PROGRAMS:**
Drag Chute for F-117A Stealth Fighter
B-1 Bomber Crew Escape Module Recovery
Parachute Recovery System for Space Shuttle Solid Rocker Boosters
Parachute for Jupiter Probe (Galileo) Descent Module

**LOCAL INFORMATION CONTACT:**
**TECHNICAL:** CT: William Everett (203) 528-0092, FAX 528-8122;
FL: William Wailes (407) 676-4604
**COST:** Michael Eldredge (203) 528-0092

## FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Sandia National Laboratories | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** Albuquerque, NM 87185-5800 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO<br>**BUILD TO PRINT?** ◉ YES ○ NO |

**TYPE OF EQUIPMENT MANUFACTURED:**

- ☒ Parachute Systems
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- ☐ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☒ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☒ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Specialize in prototype design and development. Availability only to government programs and with direct government funding.

**PAST PROGRAMS:**
Primarily high performance ribbon parachutes for nuclear weapon delivery. Parachutes for underwater missile recovery. Sounding rocket recovery systems. Reentry vehicle recovery systems.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Larry D. Whinery - (505) 844-5239; FAX 844-8251

**COST:** Same

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| Strong Enterprises | ○ 1-25 ◉ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** 11236 Satellite Blvd. Orlando, FL 32837 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
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- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Established 1960. FAA TSO approved manufacturer since 1971. MIL-I-45208. Small quantity specialists. Complete capability to manufacture harness, pack, round and "square" canopies, pilot chutes, ripcords and all related components for personnel assemblies.

**PAST PROGRAMS:**
4-inch to 66-foot diameter canopies. Gov't. prime and sub-contracts. 165 to 520 sq. foot RAM airs.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Ted Strong (407) 859-9317 FAX: (407) 850-6978

**COST:** Ted Strong

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| U.S. Army Natick RD&E Center | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** Parachute Prototype Branch, Airdrop Systems Division, Natick, MA 01760-5017 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO<br>**BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
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- ☐ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Specialize in prototype design/development and manufacture of parachutes & airdrop components.
Limited production of systems/components for test.
Expedited fabrication/support in emergency situations (maintain reasonable stocks).
Ongoing evaluation of advanced fabrication & repair equipment & procedures.

**PAST PROGRAMS:**
C-5 Extraction Systems; Desert Storm support (e.g., "Daisy Cutter" Parachute System, special OPS missions)
Low Altitude Retro-Rocket System support (proto. extraction parachutes, slings, deployment bags)
Prototype Tactical Assault Personnel Parachutes

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Peter Stalker - (508) 651-4400; FAX: 651-5000

**COST:** John Greendale - (508) 651-4282; FAX: 651-5000

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| U.S. Army Proving Ground | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** Air Delivery Division Yuma, AZ | **DESIGN SUPPORT AVAILABLE?** ○ YES ◉ NO **BUILD TO PRINT?** ○ YES ◉ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
- ☒ Parachute Systems, includes metal components and ordinance
- ☒ Personnel Parachutes - Commercial
- ☒ Personnel Parachutes - Military
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- ☒ Munitions and Submunitions Parachutes
- ☒ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☒ Gliding Parachutes

**GENERAL COMMENTS:**
Limited fabrication facilities available to support technical testing at Yuma Proving Ground.

**PAST PROGRAMS:**

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Jim Stewart (602) 328-3116

**COST:** Same

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| U.S. Naval Surface Warfare Center | ◉ 1-25 ○ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** White Oak, Silver Spring, MD 20903-5000 | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO<br>**BUILD TO PRINT?** ○ YES ◉ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☐ Parachute Systems
- ☐ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☐ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☐ Aircraft Spin and Brake Parachutes
- ☒ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**
We maintain a small model shop to build first article parachutes, systems, etc. Quantities of parachutes are procured on commercial contracts to drawings developed in-house.

**PAST PROGRAMS:**
Mines, bombs, torpedoes, Supersonic and Subsonic Faze Recovery, Depth Charges, Nuclear weapons, high altitude (200K-250K) retardation systems, cargo delivery systems, special applications, decoys, sonobuoys.

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** W.D. Ludtke/Code U13 - (301) 394-1705

**COST:** Not available for non DOD programs.

# FABRICATION FACILITIES

| NAME OF COMPANY | # OF EMPLOYEES |
|---|---|
| United Technologies Corp. USBI | ○ 1-25 ◉ 25-100 ○ 100-250 ○ 250-500 ○ Over 500 |
| **LOCATION:** Parachute Refurbishment Facility Kennedy Space Center, FL | **DESIGN SUPPORT AVAILABLE?** ◉ YES ○ NO **BUILD TO PRINT?** ◉ YES ○ NO |

## TYPE OF EQUIPMENT MANUFACTURED:

- ☒ Parachute Systems
- ☒ Parachute Systems, includes metal components and ordinance
- ☐ Personnel Parachutes - Commercial
- ☐ Personnel Parachutes - Military
- ☒ Cargo Parachutes
- ☐ Aircraft Spin and Brake Parachutes
- ☐ Munitions and Submunitions Parachutes
- ☐ Aerial Delivery Components
- ☐ Supersonic Parachutes
- ☐ Gliding Parachutes

**GENERAL COMMENTS:**
USBI operates the 30,000 sq. ft Parachute Refurbishment Facility at Kennedy Space Center under a contract with Marshall Space Flight Center. This facility assembles and refurbishes the parachutes used to recover the Space Shuttle Solid Rocket Boosters. Modification and fabrication of parachutes and supporting fabric elements is also performed at this facility.

**PAST PROGRAMS:**

**LOCAL INFORMATION CONTACT:** **TECHNICAL:** Bruce A. Rutledge, Mgr. Parachute Ops; FAX: (407) 867-7190

**COST:**

# DESIGN TOOLS

The design of parachutes and landing/escape systems has primarily depended on empirical methods and "cut and try" testing. The "Recovery Systems Design Guide" (or Parachute Handbook) is the standard manual for the parachute industry and includes practical details on construction techniques and performance data for recovery systems. A combination of empirical techniques, testing, and the practical experience of a good "parachute engineer" have combined to produce successful programs in the past.

More recently, however, rising costs of experimental testing and improvements in computational capability have led to the development of analysis codes which better describe the behavior of these types of systems. A number of design tools are being used for the design and analysis of landing and escape systems. These include tools for structural analysis of parachute canopies, ground impact analysis, trajectory analysis, and flowfields around parachutes and vehicles. Computational Fluid Dynamics techniques are beginning to be applied to parachute systems but are not yet considered design tools. Proprietary codes within industry are available under contract and are not included here, requests for this information should be directed toward the individual parachute manufacturer.

In addition to the tools listed here, there are many applicable tools available in the COmputer Software Management and Information Center (COSMIC), a NASA facility located at the University of Georgia. Computer codes developed within NASA or under government contract are available for a fee and abstracts are included in a catalog available from:

COSMIC
The University of Georgia
382 East Broad Street
Athens, GA 30602
(404) 542 - 3265

A sample of the applicable programs available through COSMIC are listed below:

| | |
|---|---|
| PMARC | Panel method, Ames Research Center |
| POST3D & POST6D | 3 & 6 degree of freedom trajectory optimization program |
| AGFATL | Active Gear Flexible Aircraft Takeoff and Landing Analysis |
| SWIRL | Solid Rocket Booster Rigid Body Water Impact Loads Analysis |
| APAS | Aerodynamic Preliminary Analysis System |

# DESIGN TOOLS

| | | |
|---|---|---|
| COMPANY:<br><br>LOCATION: ① | PROGRAM LANGUAGE: | COMPARABLE TOOLS |
| | TYPE OF COMPUTER: | |
| | WHEN WRITTEN: | |
| PROGRAM TITLE:<br>② | PUBLICLY AVAILABLE?<br>O YES O NO<br><br>DOCUMENTATION AVAILABLE?<br>O YES O NO | |

PROGRAM DESCRIPTION:

PAST APPLICATIONS:

PLANNED IMPROVEMENTS:

LOCAL INFORMATION CONTACT:

EXPLANATION OF DESIGN TOOLS DATA SHEETS

(1) Name of the Installation where the design tool was developed, and when not evident, the name of the owner and city.

(2) Commonly used name of the design tool, with additional qualifiers or identifiers as appropriate.

*Program Language:* Computer language in which the program is written.

*Type of Computer:* Type of computer(s) for which the program is written.

*When Written:* Self Explanatory.

*Program Description:* Brief description of the program capabilities and types of input and output required.

*Past Applications:* Lists past landing/escape systems programs or types of problems which have been analyzed with this tool.

*Planned Improvements:* Describes major improvements being planned or made to this tool.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the tool.

# DESIGN TOOLS INDEX

# DESIGN TOOLS

**COMPANY:**
NASA - Langley Research Center

**LOCATION:**
Hampton, VA 23665-5225

**PROGRAM LANGUAGE:** FORTRAN

**TYPE OF COMPUTER:** CRAY, CDC, MicroVax

**WHEN WRITTEN:** 1987

**COMPARABLE TOOLS**

DYNA 3D
KRASH 89

**PROGRAM TITLE:**
DYCAST

**PUBLICLY AVAILABLE?**
◉ YES ○ NO

**DOCUMENTATION AVAILABLE?**
◉ YES ○ NO

**PROGRAM DESCRIPTION:**
DYCAST is a finite element program developed for structural code analysis. Has the capability to perform nonlinear structural dynamic finite element analysis using beams, plates, and spring elements.

**PAST APPLICATIONS:**
GA Crash Dynamic of Aircraft Structures. CID (B720) Crash Program - Helicopter Crash Analysis.

**PLANNED IMPROVEMENTS:**
Composite (linear) and (nonlinear) beam elements, composite plate elements.

**LOCAL INFORMATION CONTACT:** Martha P. Robinson (804) 864-4149

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** Para-Flite, Inc.<br><br>**LOCATION:** 5800 Magnolia Ave. Pennsauken, NJ 08109 | **PROGRAM LANGUAGE:** Fortran<br>**TYPE OF COMPUTER:** Macintosh II FX<br>**WHEN WRITTEN:** 1990 | **COMPARABLE TOOLS** |
| **PROGRAM TITLE:** PARA3D | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

**PROGRAM DESCRIPTION:**
Iterative finite element analysis and vortex lattice method 3 dimensional aerodynamic analysis tool for parachute design.

**PAST APPLICATIONS:**
Commercial products.

**PLANNED IMPROVEMENTS:**
Update to include separated flow effects.

**LOCAL INFORMATION CONTACT:** Elek Puskas - (609)-663-1275; FAX: 663-3028

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** Rockwell International Space Systems Division | **PROGRAM LANGUAGE:** FORTRAN | **COMPARABLE TOOLS** |
| **LOCATION:** 12214 Lakewood Blvd. Downey, CA 90241 | **TYPE OF COMPUTER:** IBM | |
| | **WHEN WRITTEN:** 1978 | |
| **PROGRAM TITLE:** Ejection seat trajectory code | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

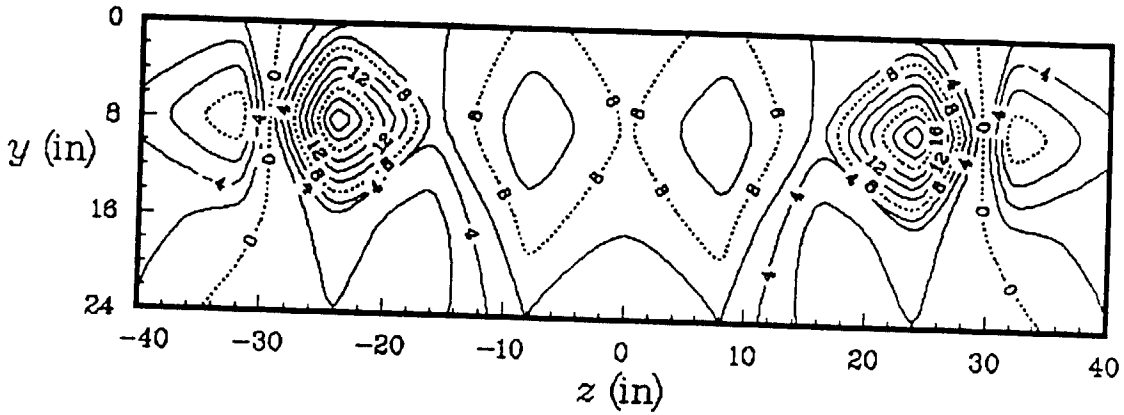
**PROGRAM DESCRIPTION:**
A computer simulation method was refined to accommodate the orbiter Approach & Landing Test (ALT)/Orbital Flight Test (OFT) Crew Escape System (CES) performance characteristics. It is based on the STS booster separation program and was updated to include the ejection seat and seat/man aerodynamics, orbiter proximity effects, and ejector space-time-acceleration relationships. Documented in Flight Certification reports.

**PAST APPLICATIONS:**
Used to analyze ejectee trajectories and recovery performance during the ALT profile and OFT powered ascent/OFT gliding descent. It was utilized to supplement the static test (0/0) and the 4 dynamic sled tests and was the primary analysis tool to define safe escape envelopes for contingency usage. Developed for use in B-1 escape capsule development.

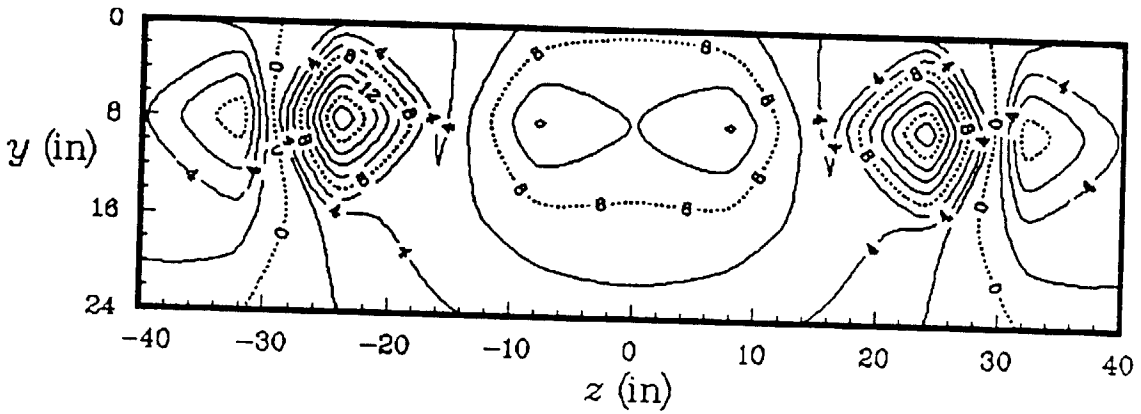
**PLANNED IMPROVEMENTS:**
Could be utilized for any free-body trajectory analysis to determine parameters prior to recovery decelerator deployment.

**LOCAL INFORMATION CONTACT:** Don Morris/Mail Code AB93 - (310) 922-1557

# Vertical Velocity Contours in the Wake of a 6% Scale B1-B Model




**NASA tunnel data**




AIVEL-PW prediction

# DESIGN TOOLS

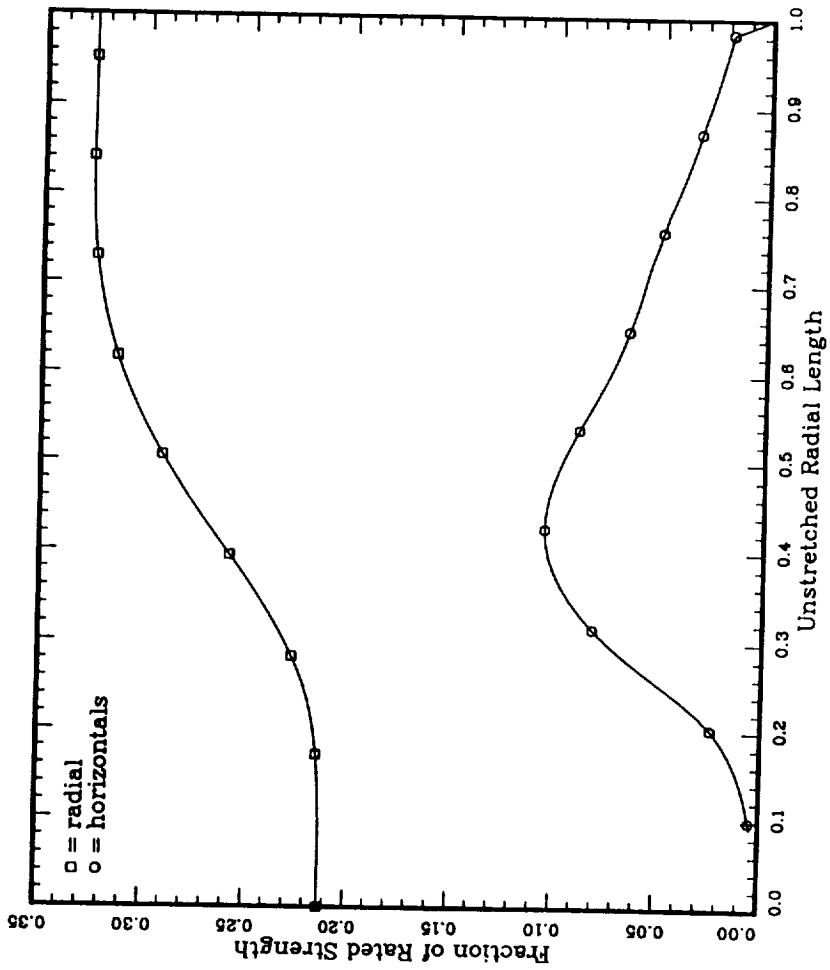
| | | |
|---|---|---|
| **COMPANY:** Sandia National Laboratories<br><br>**LOCATION:** Albuquerque, NM 87185-5800 | **PROGRAM LANGUAGE:** FORTRAN 77<br>**TYPE OF COMPUTER:** IBM PC, DEC VAX, SUN<br>**WHEN WRITTEN:** 1989 | **COMPARABLE TOOLS** |
| **PROGRAM TITLE:** AIVEL | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

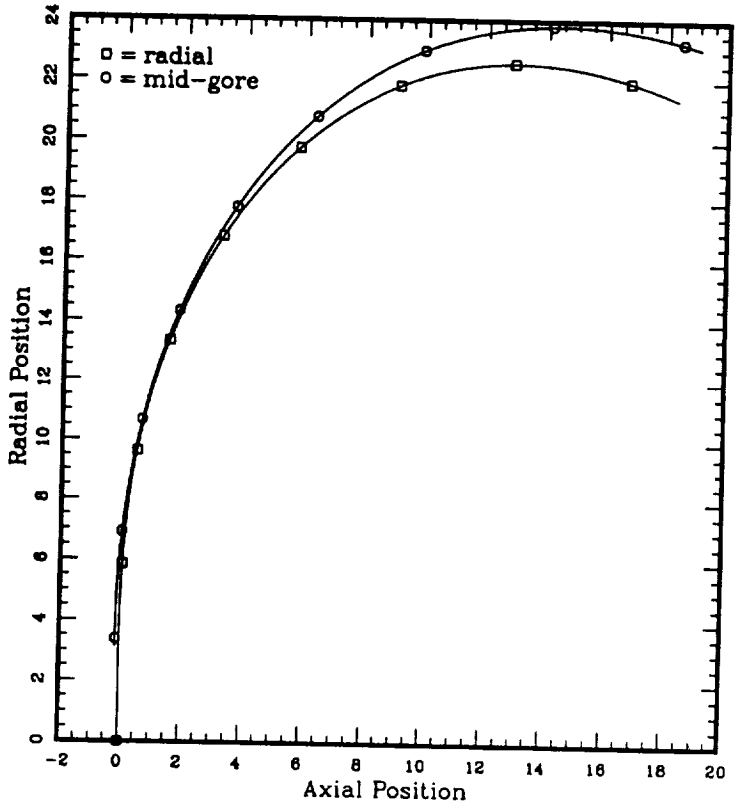
**PROGRAM DESCRIPTION:**
This code allows one to obtain estimates of the fluid velocities produced by an aircraft flying through otherwise still air. The aircraft is allowed to move along a selected trajectory specified by its range and altitude. Three component fluid velocities (with respect to the ground) are calculated at selected locations in the flow field. The aircraft wing and its wake are modeled by a set of vortex panels.

**PAST APPLICATIONS:**
Effect of aircraft on parachute performance.

**PLANNED IMPROVEMENTS:**
Include additional wing planforms & document.

**LOCAL INFORMATION CONTACT:** James H. Strickland, Parachute Systems Division, (505) 844-8421.


□ = radial
○ = horizontals
Fraction of Rated Strength
Unstretched Radial Length
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0


□ = radial
○ = mid-gore
Radial Position
Axial Position
0
2
4
6
8
10
12
14
16
18
20
22
24
-2
0
2
4
6
8
10
12
14
16
18
20

5-8A

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** Sandia National Laboratories<br><br>**LOCATION:** Albuquerque, NM 87185-5800 | **PROGRAM LANGUAGE:** FORTRAN - 77<br>**TYPE OF COMPUTER:** SUN SPARC, DEC VAX, IBM PC<br>**WHEN WRITTEN:** 1986 | **COMPARABLE TOOLS**<br>CANO |
| **PROGRAM TITLE:** Canopy Loads Analysis (CALA) | **PUBLICLY AVAILABLE?** ◉ YES ○ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**
From user input pressure distribution, constructed geometric shape, and material properties, the inflated canopy shape and stresses/loads are calculated for a symmetric parachute in steady state. The parachute can be reefed, the dynamic pressure to match a specified load can be calculated, and a vent pulldown line can be indirectly modeled. Gore material strength parallel to the radial members is ignored.

**PAST APPLICATIONS:**
Load/Stress analysis of several solid, ring slot, ring sail and ribbon parachutes has been performed.

**PLANNED IMPROVEMENTS:**
Equations for including gore material strength parallel to the radial members have been derived but not implemented into CALA.

**LOCAL INFORMATION CONTACT:** Dr. Donald D. McBride (505) 844-6957, FAX 846-8278; W. David Sundberg (505) 844 5234 (technical)

# DESIGN TOOLS

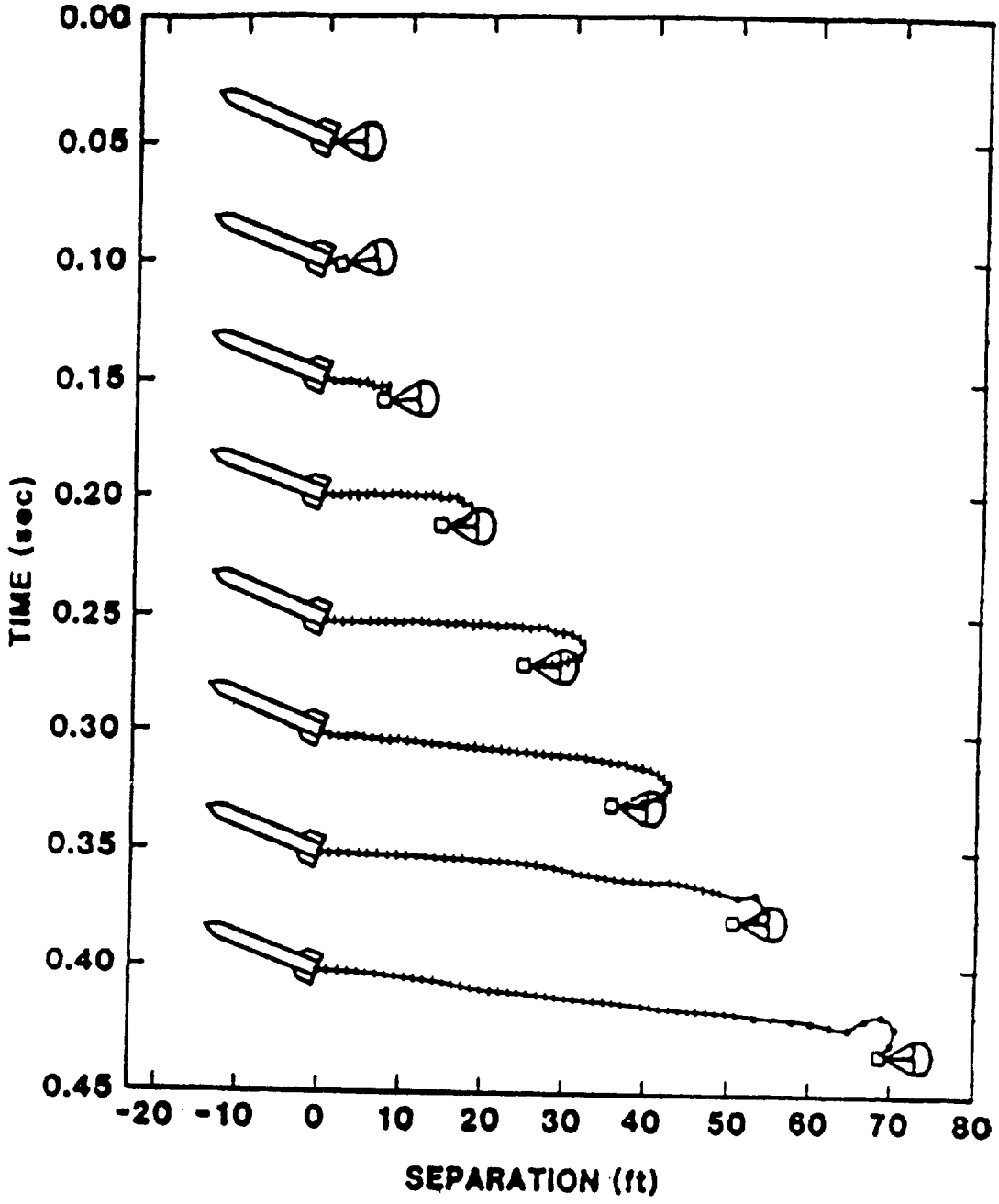
| | | |
|---|---|---|
| **COMPANY:** Sandia National Laboratories<br><br>**LOCATION:** Albuquerque, NM 87185-5800 | **PROGRAM LANGUAGE:** FORTRAN<br>**TYPE OF COMPUTER:** IBM PC<br>**WHEN WRITTEN:** November, 1985 | **COMPARABLE TOOLS** |
| **PROGRAM TITLE:** Conical Ribbon Parachute Design Code (CONRIB) | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

**PROGRAM DESCRIPTION:**
The conical ribbon parachute design code provides output of dimensions necessary for the construction of the parachute, such as ribbon lengths, radial lengths, vent diameter and pattern length, given user inputs of constructed diameter, number of gores and ribbon data. It also calculates geometric posority. Referenced in AIAA 86-2486 "Computer Design Code for Conical Ribbon Parachutes" by D.E. Waye, October 1986.

**PAST APPLICATIONS:**
Sandia designed conical Ribbon Parachutes.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Don Waye, Parachute Systems Division 1552, (505) 844-1167


0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
TIME (sec)
-20
-10
0
10
20
30
40
50
60
70
80
SEPARATION (ft)

# DESIGN TOOLS

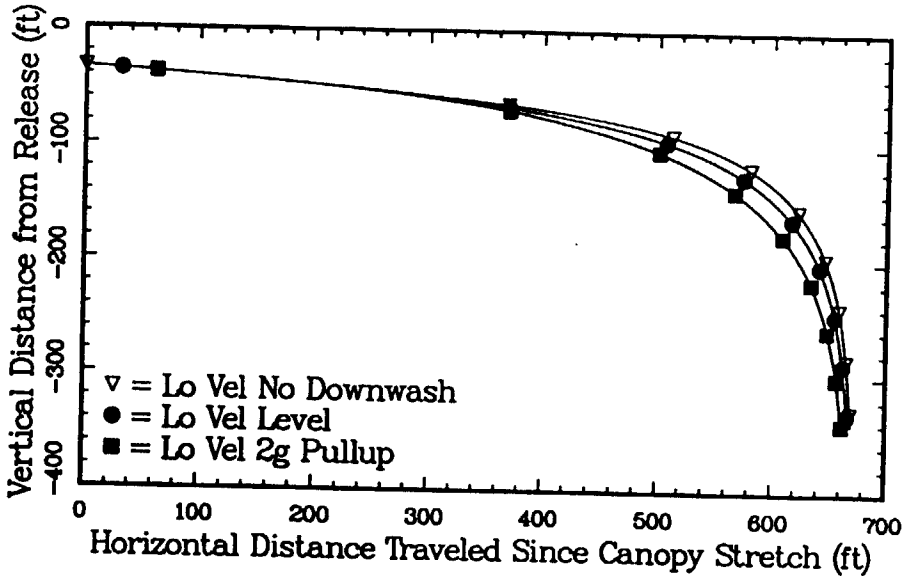
| | | |
|---|---|---|
| **COMPANY:** Sandia National Laboratories<br><br>**LOCATION:** Albuquerque, NM 87185-5800 | **PROGRAM LANGUAGE:** FORTRAN<br>**TYPE OF COMPUTER:** Personal Computer<br>**WHEN WRITTEN:** 1983 | **COMPARABLE TOOLS**<br>None |
| **PROGRAM TITLE:** LINESAIL | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

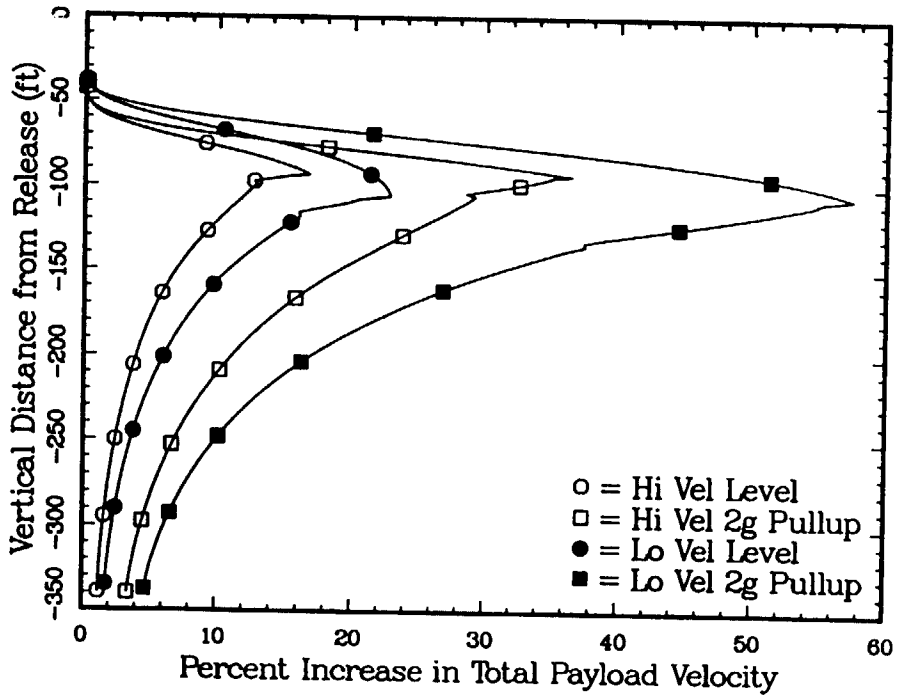
**PROGRAM DESCRIPTION:**
A numerical deployment simulation of a lines-first parachute deployment with the capability to predict aerodynamically-induced line sail. The model includes all aspects of the deployment problem, such as suspension line aerodynamics, line ties, and canopy/deployment bag friction. The analysis is reported in the following reference: Purvis, J.W., "Improved Prediction of Parachute Line Sail During Lines-first Deployment," AIAA 84-0786, April, 1984.

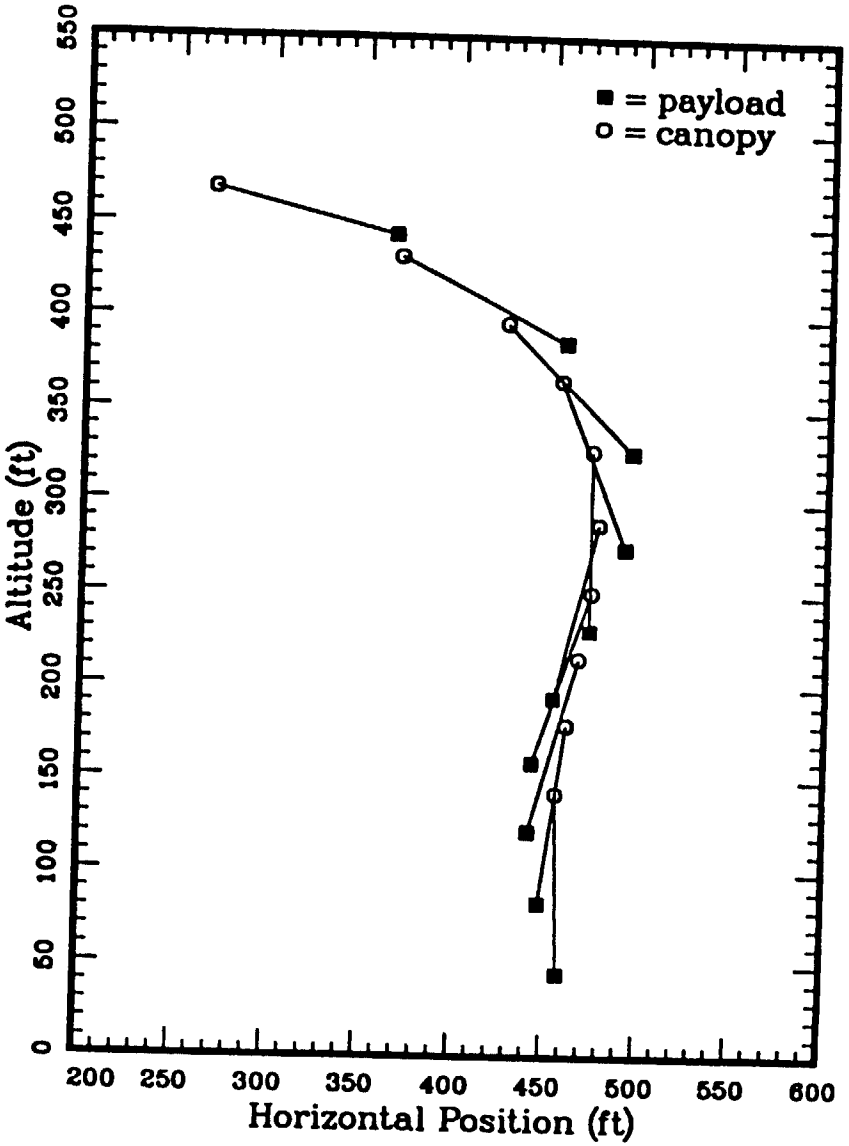
**PAST APPLICATIONS:**
B83 Nuclear Bomb Parachute, F111 Crew Escape Module Recovery System.

**PLANNED IMPROVEMENTS:**
None at present.

**LOCAL INFORMATION CONTACT:** Donald D. McBride, Supervisor, Parachute Systems Division; (505) 844-6957.


Vertical Distance from Release (ft)
0
-100
-200
-300
-400
▽ = Lo Vel No Downwash
● = Lo Vel Level
■ = Lo Vel 2g Pullup
0
100
200
300
400
500
600
700
Horizontal Distance Traveled Since Canopy Stretch (ft)


Vertical Distance from Release (ft)
-50
-100
-150
-200
-250
-300
-350
○ = Hi Vel Level
□ = Hi Vel 2g Pullup
● = Lo Vel Level
■ = Lo Vel 2g Pullup
0
10
20
30
40
50
60
Percent Increase in Total Payload Velocity


Altitude (ft)
0
50
100
150
200
250
300
350
400
450
500
550
■ = payload
○ = canopy
200
250
300
350
400
450
500
550
600
Horizontal Position (ft)

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** Sandia National Laboratories | **PROGRAM LANGUAGE:** FORTRAN-77 | **COMPARABLE TOOLS** |
| **LOCATION:** Albuquerque, NM 87185-5800 | **TYPE OF COMPUTER:** SUN, SPARC, IBM PC | |
| | **WHEN WRITTEN:** 1991 | |
| **PROGRAM TITLE:** Two Body Trajectory (TWOBDY) | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ○ YES ◉ NO | |

**PROGRAM DESCRIPTION:**
The trajectory of two point masses (parachute and payload) connected by an elastic line are calculated. Downwash velocity from a delivery aircraft can be calculated from a paneled-wing model of the aircraft and this effect included in the trajectory. The orientation of both bodies is determined from the connecting line, and normal and axial aerodynamic forces are treated independently. Apparent mass terms for the parachute can be included and their derivatives are calculated. Code is not yet ready for public release; Sandia can perform computations.

**PAST APPLICATIONS:**
Effects of delivery aircraft Downwash on payload trajectory from a high speed, low altitude release. Trajectory turnover and impact conditions for low altitude cargo (11,000 lb) delivery.

**PLANNED IMPROVEMENTS:**
This code will become part of the Sandia Parachute System Simulations code which will include deployment and inflation modules as well as a six degree of freedom trajectory simulation.

**LOCAL INFORMATION CONTACT:** Mr. W. David Sundberg (505) 844-5234, FAX 846-8278

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** U.S. Naval Surface Warfare Center | **PROGRAM LANGUAGE:** Fortran IV | **COMPARABLE TOOLS** |
| **LOCATION:** White Oak, Silver Spring, MD 20903-5000 | **TYPE OF COMPUTER:** VAX 780 | |
| | **WHEN WRITTEN:** 1988 | |
| **PROGRAM TITLE:** Parachute Program | **PUBLICLY AVAILABLE?** ◉ YES ○ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**

Program calculates inflation time, and performance profiles (shock force, velocity, drag area) during inflation for solid cloth parachutes deployed at arbitrary altitudes, velocities, and trajectory angles to the horizon. Inflation analysis is provided for other types of parachutes, but requires the inflation time as input data. Program is published in NSWC TR 88-6, "Notes on a parachute opening force analysis applied to a general trajectory".

**PAST APPLICATIONS:**

Various Navy programs including inflation of T-10 parachutes in rarefied atmosphere.

**PLANNED IMPROVEMENTS:**

None

**LOCAL INFORMATION CONTACT:** W.P. Ludtke/Code U13 - (301) 394-1705

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** U. S. Navy, David Taylor Research Center<br><br>**LOCATION:** Bethesda, MD 20084-5000 | **PROGRAM LANGUAGE:** FORTRAN<br>**TYPE OF COMPUTER:** VAX<br>**WHEN WRITTEN:** 1984 | **COMPARABLE TOOLS**<br>SCORS |
| **PROGRAM TITLE:** Ship Motion Program (SMR) | **PUBLICLY AVAILABLE?** ◉ YES ○ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**
The program uses linear strip theory to produce the 6-degree of freedom rigid body motions of a ship in irregular waves. The input includes the geometry and weight distribution of the ship and the ship speeds and sea conditions of interest. The output consists of tables of motions, velocities and accelerations in all D.O.F. Motions can also be obtained at user specified locations on the ship.

**PAST APPLICATIONS:**
Ship Motion predictions for Commercial and Navy ships in irregular waves. The results are used to assess the performance of the existing ships, and new ship designs and to assess the effects of design changes on ship motions.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** University of Lowell | **PROGRAM LANGUAGE:** Fortran | **COMPARABLE TOOLS** |
| **LOCATION:** Mechanical Engineering Dept. One University Ave. Lowell, MA 01854 | **TYPE OF COMPUTER:** VAX or IBM PC | |
| | **WHEN WRITTEN:** 1990 | |
| **PROGRAM TITLE:** DROPTO | **PUBLICLY AVAILABLE?** ○ YES ◉ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**
Program calculates the opening dynamics of solid flat circular parachute canopies, considering elasticity and damping of suspension lines, and porosity of parachute fabric. Canopy and payload are treated as two separate point masses. A prescribed opening shape representative of this type of canopy is assumed. Opening force and velocity versus time histories are printed out, together with relevant other geometric parameters.

**PAST APPLICATIONS:**
Correlation studies with U.S. Army Natick Labs drop tests as part of parachute scaling studies.

**PLANNED IMPROVEMENTS:**
Variation of canopy permeability with dynamic pressure to be added to program.

**LOCAL INFORMATION CONTACT:** Prof. Eugene E. Niemi, Jr. - (509) 934-2977 or 534-4169

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** University of Minnesota | **PROGRAM LANGUAGE:** Fortran/Basic | **COMPARABLE TOOLS** |
| **LOCATION:** Dept. of Aerospace Engineering, University of Minnesota, Minneapolis, MN 55455 | **TYPE OF COMPUTER:** IBM PC/MacIntosh | CALA |
| | **WHEN WRITTEN:** 1986-1991 | |
| **PROGRAM TITLE:** CANO | **PUBLICLY AVAILABLE?** ◉ YES ○ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**
Stress Analysis Program used for calculation of canopy stress distribution and suspension line force and runs on IBM PC. Current versions of CANO are available for both solid and slotted parachutes.

**PAST APPLICATIONS:**
CANO has been used for a wide variety of parachute designs.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Dr. William L. Garrard - (612) 625-9002, FAX: 626-1558

# DESIGN TOOLS

| | | |
|---|---|---|
| **COMPANY:** University of Minnesota | **PROGRAM LANGUAGE:** FORTRAN/BASIC | **COMPARABLE TOOLS** |
| **LOCATION:** Dept. of Aerospace Engineering, University of Minnesota, Minneapolis, MN 55455 | **TYPE OF COMPUTER:** IBM PC/Macintosh | |
| | **WHEN WRITTEN:** 1986-1991 | |
| **PROGRAM TITLE:** Trajectory Analysis | **PUBLICLY AVAILABLE?** ◉ YES ○ NO<br>**DOCUMENTATION AVAILABLE?** ◉ YES ○ NO | |

**PROGRAM DESCRIPTION:**

Trajectory/opening force analysis program runs on both IBM PC and Macintosh and are based on Drag Area vs. Time theory. An extensive multi-body simulation with forebody aerodynamics and elastic interconnections is not available to the public but is available on a contract basis. This program is IBM PC based.

**PAST APPLICATIONS:**

Conceptual design studies and various operational systems.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Dr. William L. Garrard - (612) 625-9002 FAX: 626-1558

# MISCELLANEOUS FACILITIES

The final chapter includes a wide variety of facilities which can also be used for the testing of landing and escape systems. These types of facilities could not support a chapter of their own but still have a large part in the development of many types of systems. A list of the major types of facilities included in this chapter are listed below:

Rocket Sled Tracks - Rocket Sled facilities are used in development and verification of ejection seat systems and parachutes. They can achieve a test condition by use of a sled attached to a rail which is propelled by a rocket. Facilities included in this volume can accelerate various payloads to Mach 6.0 and some have the capability to propel the payload into free-flight at the end of the run.

Impact Facilities - Impact facilities are used to simulate impact with ground or water and range in complexity from swing rigs which can deliver a highly accurate vertical and horizontal impact condition to a vertical cable strung between two towers.

Dynamic Test Facilities - Dynamic Test facilities can be used to accelerate or decelerate ejection seats and other payloads to test human factors characteristics, impact attenuation systems, and other vehicle characteristics.

Water Dynamics Facilities - Water Dynamics facilities are used to measure the dynamic characteristics of vehicles and payloads during steady cruise, under tow, or following water impact.

Many of the remaining facilities in this chapter did not fit into one of the major categories listed above. These facilities perform a wide range of functions including environmental testing of components, rigs to simulate airdrop extraction, test parachutists, biodynamic manikins, and support services for drop testing. As with all facilities listed in this volume, the user is directed toward the local contact at the specific facility for more detailed information.

# MISCELLANEOUS FACILITIES

| | | | |
|---|---|---|---|
| COMPANY:<br>LOCATION: ① | SIZE:<br>DATE BUILT:<br>OPERATIONAL STATUS: | PERFORMANCE: | COMPARABLE FACILITIES |
| TYPE: ② | DESCRIPTION: | | |

TESTING CAPABILITIES:

DATA ACQUISITION:

PAST APPLICATIONS:

PLANNED IMPROVEMENTS:

LOCAL INFORMATION CONTACT:

EXPLANATION OF MISCELLANEOUS FACILITIES DATA SHEETS

(1) Name of the Installation where the facility is located, and when not evident, the name of the owner and city.

(2) Proper or generic name of the facility, with additional qualifiers or identifiers as appropriate.

*Size:* Key dimensions of the facility and defined as necessary.

*Date Built/Upgraded:* Self Explanatory.

*Operational Status:* An indication of the facility's current work load. A "backlog" indicates an overflow of work beyond normal operations. The facility operators should be contacted directly to determine the extent of the backlog. When a facility is currently inactive or on standby, it is so indicated, as is operations on a "demand" basis only.

*Description:* Space available for supplementary information on the performance range or special conditions of the facility.

*Performance:* Performance parameters pertaining to this facility with applicable units.

*Testing Capabilities:* Provides detailed information about the facility. Unique features and special instrumentation are discussed as well as performance capabilities.

*Data Acquisition:* Describes the type of systems used for data gathering, the number of channels available, and the form of output.

*Past Applications:* Lists past landing/escape systems programs which have been conducted in this facility.

*Planned Improvements:* Describes major improvements, rehabilitations, and modifications being made or being planned on the facility.

*Local Information Contact:* Includes the name, title, phone number, and FAX number of the person to contact for additional information about the facility.

# MISCELLANEOUS FACILITIES INDEX

# MISCELLANEOUS FACILITIES INDEX

# MISCELLANEOUS FACILITIES INDEX

# COMPARABLE MISCELLANEOUS FACILITIES

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group L (Rocket Sled Tracks)** | |
| 6-13 | High Speed Test Track | Holloman Air Force Base |
| 6-25 | G-4 Terminal Ballistics Track | Naval Air Warfare Center Weapons Division |
| 6-27 | Supersonic Navy Ordinance Research Track (SNORT) | " |
| 6-37 | Rocket Sled Track Facility | Sandia National Laboratories |
| 6-54 | Supersonic Test Track Facility | Universal Propulsion Company |
| | **Group M (Impact Facilities)** | |
| 6-10 | Pendulum Drop Test Facility with Custom 4-Bar Linkage | Boeing Defense & Space Group |
| 6-15 | Impact Dynamics Research Facility | NASA - Langley Research Center |
| 6-22 | Drop Tower | Naval Air Warfare Center Weapons Division |
| 6-23 | Drop Tower | " |
| 6-38 | Water Impact Facility | Sandia National Laboratories |
| 6-42 | Impact tower | U.S. Army Aeromedical Research Laboratory |
| | **Group N (Dynamic Testing)** | |
| 6-17 | Crash Pulse Simulation Facility, Horizontal Accelerator | Naval Air Development Center |
| 6-20 | Pyrotechnic Aircraft Escape System Testing Facility | " |
| 6-28 | Horizontal Impact Accelerator | Naval Biodynamics Laboratory |
| 6-30 | Vertical Impact Accelerator | " |
| 6-35 | Horizontal Actuator | Sandia National Laboratories |
| 6-41 | Dynamic impact tester | U.S. Army Aeromedical Research Laboratory |

# COMPARABLE MISCELLANEOUS FACILITIES

| Page Number | Facility Name | Company Name |
|---|---|---|
| | **Group O (Water Dynamics)** | |
| 6-31 | Deep water multi-directional wave model basin | Offshore Technology Research Center |
| 6-47 | Circulating Water Channel | U. S. Navy, David Taylor Research Center |
| 6-48 | Deep Water Towing Basin with Wavemaker & 20-knot Towing Carriage ( #2). | " |
| 6-49 | High Speed Towing Basin with Wavemaker & 32-knot Towing Carriage (#3). | " |
| 6-50 | High Speed Towing Basin with Wavemaker & 50-knot Towing Carriage (#5). | " |
| 6-51 | Large Cavitation Channel | " |
| 6-52 | Maneuvering and Seakeeping Basin with 15-knot manned Towing Carriage, Wavemaker, & Wind Generator. | " |
| | **Group P (Drop Test Services)** | |
| 6-9 | Drop Test Services | Ballistic Recovery Systems, Inc. |
| 6-12 | Drop Test Services | Butler Parachute Systems, Inc. |
| 6-39 | Drop Test Services | Strong Enterprises |
| 6-55 | Drop Test Services | Vertigo, Inc. |

# MISCELLANEOUS FACILITIES

**COMPANY:**
Ballistic Recovery Systems, Inc.

**LOCATION:**
1) St. Paul, MN
2) Perris, CA

**TYPE:**
Drop Test Services

**SIZE:** See "Performance"

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Standby

**PERFORMANCE:**
2 Drop Zones available
1) Airport (private)- 640 acres
2) Airport (public)- 2 sq miles

**COMPARABLE FACILITIES**

Group P

**DESCRIPTION:**
Low cost drop testing capability using microlight aircraft, also higher weight/speed conventional aircraft.

**TESTING CAPABILITIES:**
Support available includes Engineering, Instrumentation, Photographs, Fabrication/build-up, Drop Aircraft, and Chase Aircraft.

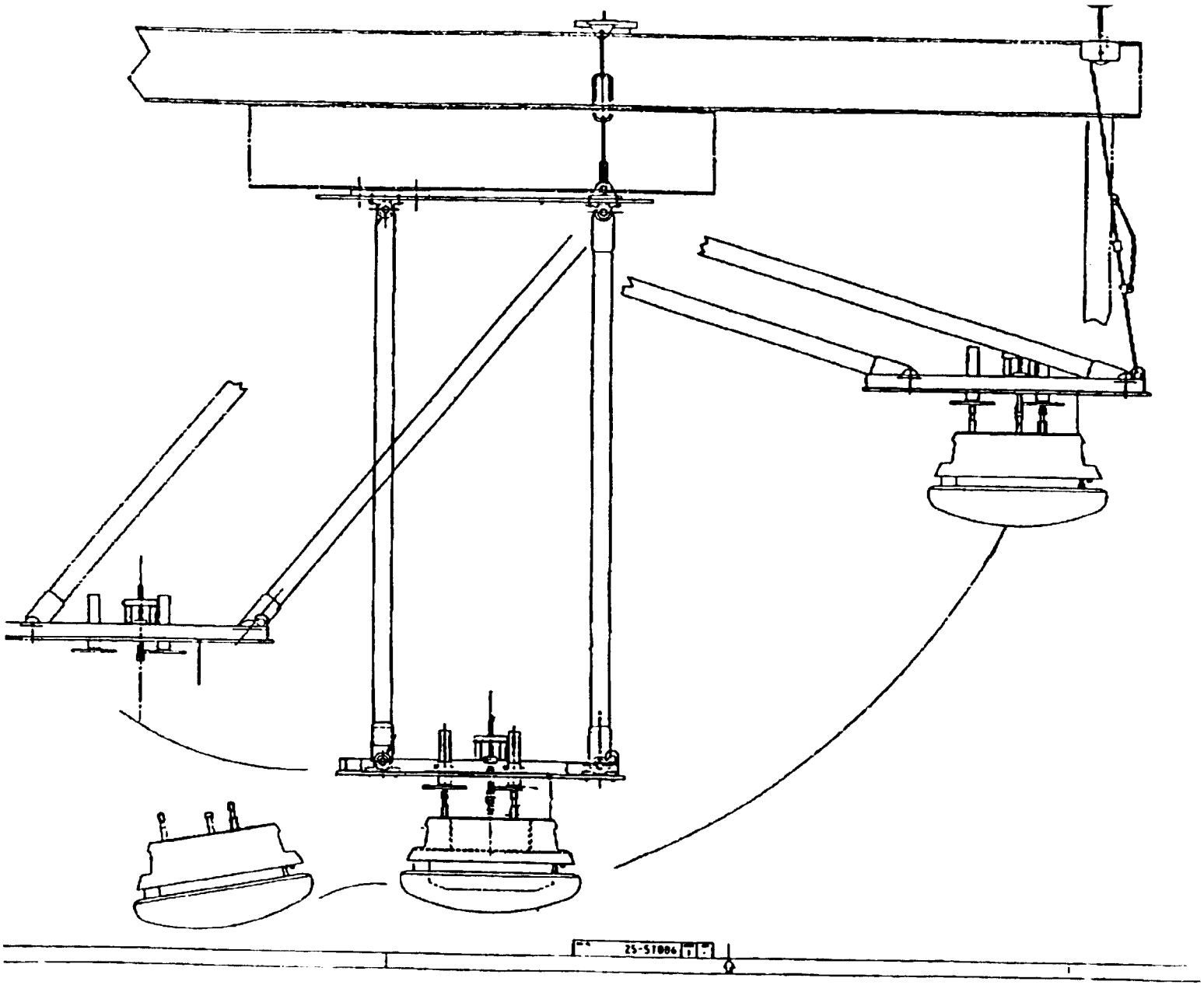
**DATA ACQUISITION:**
Available systems include Digital Data Loggers, Birnell Testers, Accelerometers, and Radar

**PAST APPLICATIONS:**
Parachute testing up to 1700 lbs at 160 mph, Munitions decelerator testing, and RPV/UAV testing

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Ballistic Recovery Systems (612) 436-7642

BOEING PENDULUM DROP TEST FACILITY



# MISCELLANEOUS FACILITIES

**COMPANY:**
Boeing Defense & Space Group

**LOCATION:**
Tulalip, Washington
(located inside the Cathedral building)

**TYPE:**
Pendulum Drop Test Facility with Custom 4-Bar Linkage

**SIZE:** Drop area, 34 x 10, test article 80" above ground plane

**DATE BUILT:**
October 1989

**OPERATIONAL STATUS:**
"Standby" mode. No backlog of test activity. Upgrades currently in work.

**PERFORMANCE:**
Max. test article wt = 2500 lb
Max. vert. velocity = 15 ft/s
Max. hor. velocity = 25 ft/s

**DESCRIPTION:**
Includes 3 parallel, 17 ft pendulum arms attached to a ceiling plate on the upper end and a mounting plate on the lower end, which provides 3-axis orientation of test article and a solenoid-actuated release pin system.

**COMPARABLE FACILITIES**

Group M

**TESTING CAPABILITIES:**
Provides for accurate orientation of the test article in 3 degrees of freedom (pitch, roll and yaw) prior to impact. Video coverage and high speed movies are available for analysis of test article response during impact. A wide variety of impact surface conditions are easily simulated by changing the composition and characteristics of the drop area.

**DATA ACQUISITION:**
Include the Masscomp 5550 and a 40 channel Pacific Instruments Transient Data Recorder (TDRs) system. The Masscomp system is a 32 channel system with an aggregate sample rate of 1 mHz. The TDRs are individual A/D converters with programmable, 500 kHz sample rate capability. Test data may be stored/presented in virtually any format required by the customer.

**PAST APPLICATIONS:**
BD&SG ALS P/A Module was tested in June, 1990.

**PLANNED IMPROVEMENTS:**
An 18 in. deep soil bed is under development which will provide for evaluation of the effect of a wide variety of soils and compaction parameters. The available pitch, yaw and roll ranges are being increased, and provisions are being made to accommodate reduced a drop height. A 50 ft high structure exists which, if developed, could be used for test articles weighing up to 25,000 lb and provide vertical and horizontal velocities up to 40 ft/s.

**LOCAL INFORMATION CONTACT:** Larry C. Shrout (206) 773-8208, Steven T. Durick (206) 342-8213

# MISCELLANEOUS FACILITIES

**COMPANY:**
Boeing Defense & Space Group

**LOCATION:**
Tulalip, Washington

**TYPE:**
Transonic Windblast Generator

**SIZE:** 18 x 18 ft & 63 x 63 ft nozzles

**DATE BUILT:**
1988

**OPERATIONAL STATUS:**
Standby

**PERFORMANCE:**
Up to 800 knots with 3 ft x 6 ft nozzle.

Up to 500 knots with 8.75 ft dia. nozzle.

**DESCRIPTION:**
Open jet blowdown

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Dynamic response of large systems to sea level transonic environments. Windblast effects on crew escape and life support systems under ejection conditions.

**DATA ACQUISITION:**
Assembled as required. Example: Masscomp 5550 with 32 channels and 1 MHZ aggregate
Sample rate: 40 channel pacific instruments transient data recorder with 500 KHZ sample rate: High speed photography.

**PAST APPLICATIONS:**
Full scale crest ejection seat testing including drogue chute deployment. Subscale sea lance payload shroud deployment.

**PLANNED IMPROVEMENTS:**
None.

**LOCAL INFORMATION CONTACT:** Larry Shrout (206) 773-8208; Steven Durick (206) 342-8213.

# MISCELLANEOUS FACILITIES

**COMPANY:**
Butler Parachute Systems, Inc.

**LOCATION:**
6399 Lindbergh Blvd.
California City, CA 93505-6012

**TYPE:**
Drop Test Services

**SIZE:** 1 sq. mile

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Operational up to 7 days/week

**PERFORMANCE:**
Open Desert Drop Zone available.

**DESCRIPTION:**
Drop zone operated by California Skydiving Club.

**COMPARABLE FACILITIES**

Group P

**TESTING CAPABILITIES:**
Support available includes; Engineering, Tracking, Photographs, Fabrication/build-up, Drop Aircraft, and Chase Aircraft.

**DATA ACQUISITION:**
Video coverage from aircraft (ground to air, air to air, chase).

**PAST APPLICATIONS:**
TSO C23 Tests, Various recovery systems

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Manley C. Butler, Jr. - (619) 373-4991; FAX: 373-2730

# MISCELLANEOUS FACILITIES

**COMPANY:**
Holloman Air Force Base

**LOCATION:**
6585 TESTG/TK
Holloman AFB, NM 88330

**TYPE:**
High Speed Test Track

**SIZE:** 50,788 ft in length

**DATE BUILT:**
1956/1974

**OPERATIONAL STATUS:**
Fully operational with large inventory of rocket sleds and instrumentation.

**PERFORMANCE:**
Velocities up to 9,000 ft/sec with payloads in the order of 50 lbs.

Velocities up to 3,000 ft/sec with payloads on the order of 3,000 lbs and much larger payloads at lower velocities.

**COMPARABLE FACILITIES**

Group L

**DESCRIPTION:**
50,788 ft of continuously welded dual (171 lb/yd crane) rails at 7 ft gauge with a third rail on the last 15,000 ft with a 26 5/16 inch gauge.

**TESTING CAPABILITIES:**
Parachute (on special available test vehicle). Velocities 1700-3000 fps; max. dia. parachute 5-23 ft; steady state loads 100k-150k lbs.; max. dyn.. load 150k-225k lbs. Stabilization and other drag producing devices can also be tested. Sled vehicles are available for ejection seats and dummies with parachute deployment.

**DATA ACQUISITION:**
Load cells for measuring both dynamic and steady state forces. Accelerometers, rate gyros, etc. Telemetry Systems FM/FM, PCM/FM, on-board recorders. Photo Optical-High Frame rate both trackside and on-board, stop motion (i.e., syncroballistic cameras)

**PAST APPLICATIONS:**
Parachute, ballutes, stabilization devices, ejection seats.

**PLANNED IMPROVEMENTS:**
Shuttered Video, automated processing of digital telemetry data.

**LOCAL INFORMATION CONTACT:** Dave Cummings (505) 679-2766; FAX: (505) 679-2906

# MISCELLANEOUS FACILITIES

**COMPANY:**
NASA - Langley Research Center

**LOCATION:**
Hampton, VA 23665-5225

**TYPE:**
Aircraft Landing Dynamics Facility

**SIZE:** 1,800 ft test track

**DATE BUILT:**
1956, 1985.

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
Speeds up to 225 kts.

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Landing Gear and Tire Testing - Outdoor. Located at Building 1262.

**TESTING CAPABILITIES:**
Up to 60,000 lbs vertical load on tire and/or landing gear - touchdown velocities up to 18 fps - yaw angle variable.

**DATA ACQUISITION:**
28 data channels T/M to control facility.

**PAST APPLICATIONS:**
Shuttle tire testing - spin-up and wear tests with and without brake.

**PLANNED IMPROVEMENTS:**
Added high pressure water pump to shorten turnaround time and therefore more tests per day.

**LOCAL INFORMATION CONTACT:** Granville L. Webb (804) 864-1303

# MISCELLANEOUS FACILITIES

**COMPANY:**
NASA - Langley Research Center

**LOCATION:**
Hampton, VA 23665-5225

**TYPE:**
Impact Dynamics Research Facility

**SIZE:** 240 ft tall, 400 ft wide

**DATE BUILT:**
1965

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
Impact Velocity up to 65 mph
Payload wts up to 30,000 lb

**DESCRIPTION:**
Crash and Impact Testing located in Building 1297

**COMPARABLE FACILITIES**

Group M

**TESTING CAPABILITIES:**
Maximum allowable weight - 30,000 lbs - impact angles (pitch, roll, and yaw) controllable - impact velocity up to 65 mph.

**DATA ACQUISITION:**
96 channel hardware to data room (PC and tape data system) ground, on-board, and overhead photographic coverage - data output - hard copy and film/video.

**PAST APPLICATIONS:**
Originally used for lunar landing research and training. General aviation airplane crash program. Army helicopter crash tests. Air Force F-111 Crew Escape Module impact tests.

**PLANNED IMPROVEMENTS:**
Data acquisition upgrade to 120 channels.

**LOCAL INFORMATION CONTACT:** Granville L. Webb (804) 864-1303

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA

**TYPE:**
Controllable dual gimballed centrifuge

**SIZE:** Arm: 50 ft radius, Gondola: 9'6" usable diameter

**DATE BUILT:**
1949/1964

**OPERATIONAL STATUS:**
Active, manned, schedule in advance 6 months.

**PERFORMANCE:**
Max g: 40 g @1,000 lb. payload
Onset Rate: 10 gz/sec. average from 2 to 10 Gz.
g Duration: N/A
Payload Wt.: 40,000 g-lb

**DESCRIPTION:**
Hypobaric simulation to 100,000; environmental control (temperature, pressure) g-vector can be dynamically controlled in any direction.

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Open-loop; closed loop; some aircraft simulation, pilot-initiated open loop. Ramp, G-haversine, W-haversine onsets and offsets; decay offset, limited open-loop air combat maneuvering simulation.

**DATA ACQUISITION:**
Acceleration in 5 axes; Gimbal position in 2 axes; Biomedical feedback including EKG, Heart Rate, and other types provided by Project Officers. Equipment must withstand g-forces up to 1.5 times the maximum experimental G-level in all axes.

**PAST APPLICATIONS:**
G-suit testing; G-tolerance improvement training; Physiological effects of acceleration stress; helmet, mask testing; helmet-mounted vision systems testing; seat-restraint systems testing; effect of body position on G-induced loss of consciousness.

**PLANNED IMPROVEMENTS:**
Digital control system, solid-state power generation.

**LOCAL INFORMATION CONTACT:** Jacob Eyth, NADC, Code 6035, (215) 441-2891

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA 18974-5000

**TYPE:**
Crash Pulse Simulation Facility
Horizontal Accelerator

**SIZE:** 110 ft Tracks
12 inch Hyge Actuator

**DATE BUILT:**
1982

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
MAX g: 50 g's
Onset Rate: Up to 2500 g/sec
8 ft Stroke
Payload Wt: Up to 1800 lbs

**DESCRIPTION:**
Performance envelope exists, above are maximums.

**COMPARABLE FACILITIES**

Group N

**TESTING CAPABILITIES:**
Payload limit to 2000 lb including fixture, testing involving pure material testing, manikin, or cadaver type payloads. No live subject testing.

**DATA ACQUISITION:**
1) 20 channel FM tape Data Acquisition System
2) 32 channel SVERDRUP Data Acquisition System
3) High speed film and video (400, 1000 fps film, 200, 400, 1000 FTS video)

**PAST APPLICATIONS:**

**PLANNED IMPROVEMENTS:**
The facility will be re-rated for work involving Hero Rated Ordinance. Upgrades to photographic and electronic data acquisition are planned.

**LOCAL INFORMATION CONTACT:** Carl Pierce, NADC, Code 6035, (215) 441-2666

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA

**TYPE:**
Environmental Chamber

**SIZE:** 22' W x 25" D x 14" H

**DATE BUILT:**
1990

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
Temp. range: -30°F - +160°F
Rel. humidity: 5% - 95% @ 80°F
Water Temp.: 1° - 16°C

**DESCRIPTION:**

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Cold water immersion, dry cold, heat stress, exercise physiology, pulmonary function testing, intra-airway temperature measurement, mathematical modeling.

**DATA ACQUISITION:**
128 channels of data digitized and collected on PDP 11/73 computer (temperature, heat flux, ECG, respirator gas concentration).

**PAST APPLICATIONS:**
1) Cold water immersion studies for anti-exposure suits, hypothermia rewarming techniques.
2) Heat stress testing of chemical defense ensembles.

**PLANNED IMPROVEMENTS:**
Upgrade data acquisition, enhance temperature measurement system.

**LOCAL INFORMATION CONTACT:** Jonathan Kaufman, (215) 441-2565

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA

**SIZE:** 20 x 25 ft (burn area)

**DATE BUILT:**
1966

**OPERATIONAL STATUS:**
Annual operations from April to October

**PERFORMANCE:**

**COMPARABLE FACILITIES**

Unique

**TYPE:**
Fuel Fire Test Facility

**DESCRIPTION:**
Manikin testing only.

**TESTING CAPABILITIES:**
Fuel scale manikin testing of garments, exposure to open pit jet fuel fire (JP4).

**DATA ACQUISITION:**
Skin temperature measurements to provide percent body burn data. Heat flux measurement.

**PAST APPLICATIONS:**
Testing of protective garments for all branches of armed services, as well as private industry and the U.S. Coast Guard.

**PLANNED IMPROVEMENTS:**
Addition of flame temperature measurement capabilities. Enhanced data acquisition.

**LOCAL INFORMATION CONTACT:** John Vannaccone, NADC, Code 6035, (215) 441-1873

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA 18974-5000

**SIZE:** 150 ft inclined

**DATE BUILT:**
1946/1952

**OPERATIONAL STATUS:**
Man-rated (1989)

**PERFORMANCE:**
MAX g: 30g/600 lbs (total wt)
Onset Rate: Up to 250 g/sec
g Duration: ~ 150 msec.
Payload Wt.: 350 lbs max

**COMPARABLE FACILITIES**

Group N

**TYPE:**
Pyrotechnic Aircraft Escape System Testing Facility

**DESCRIPTION:**
Cockpit designs are evaluated for subject emergency egress.

**TESTING CAPABILITIES:**
Used to qualify Aircraft Ejection Seats to structural loads and to certify the seats during live testing to the physiological aspects. (Anthropomorphic & Live Subjects)

**DATA ACQUISITION:**
32 channels Honeywell HTMS-3000 system.

**PAST APPLICATIONS:**
Evaluated F-18 Seat; F-14 NACES Seat and various cockpit designs. Also Airforce and Navy pilot protective gear for germ warfare which includes B-52, B1-B, F-16, F4, A1 and various other pilot equipment.

**PLANNED IMPROVEMENTS:**
Improved data acquisition.

**LOCAL INFORMATION CONTACT:** John Swan, NADC, Code 60353, (215) 441-2053/1101

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Development Center

**LOCATION:**
Warminster, PA 18974-5000

**SIZE:** N/A

**DATE BUILT:**

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
The simulator is intended for general flying qualities and flight controls research. This requires a simulator with easy access, quick model turn around time, and high flexibility. High fidelity simulation is not the primary concern.

**COMPARABLE FACILITIES**

Unique

**TYPE:**
Real time, Fixed-base, single-seat, single projection screen simulator.

**DESCRIPTION:**
FASTER is a generic fixed-base manned flight simulator. Computer generated, projection visual system. Generic fixed-wing cockpit with head-up and head-down displays and analog instruments.

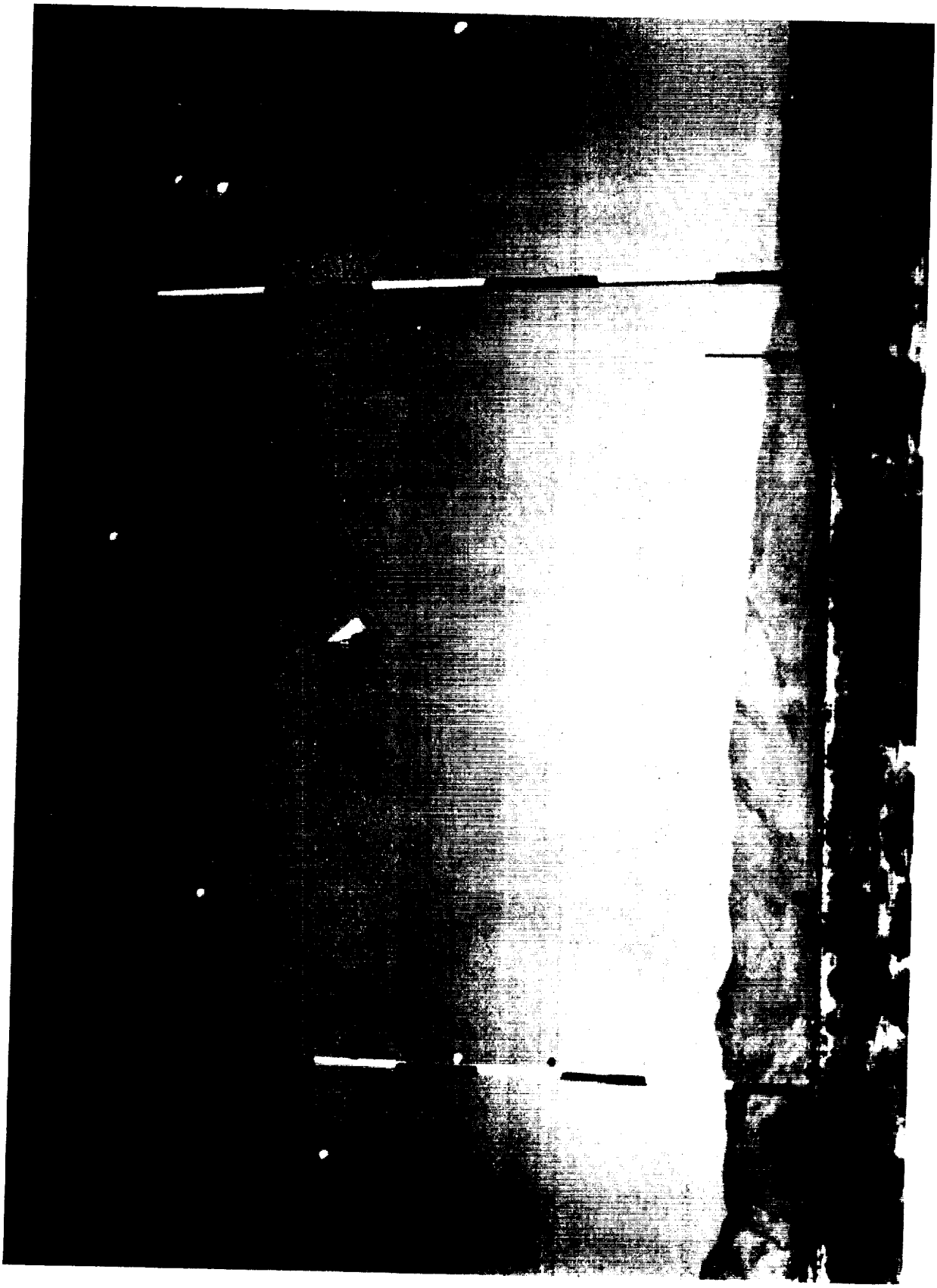
**TESTING CAPABILITIES:**
Both real time and non real time simulations of aircraft and flight control system models are conducted. Inputs can be provided either through manual cockpit controls or preprogrammed computer controls.

**DATA ACQUISITION:**
Data can be transmitted to strip chart recorders or stored on magnetic tape.

**PAST APPLICATIONS:**
1) Display time delay effects on flying qualities.
2) Fluidic flight control law evaluation.

**PLANNED IMPROVEMENTS:**
1) Collective throttle quadrant for helicopter simulation.
2) Wheel controller for large aircraft/transport simulations.

**LOCAL INFORMATION CONTACT:** Robert Mackrell (215) 441-3335 or Robert Palmer (215) 441-2137



6-21A

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
Drop Tower

**SIZE:** 270 ft

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
N/A

**DESCRIPTION:**
Cable suspended between two 350 ft poles approx. 100 ft apart.

**COMPARABLE FACILITIES**

Group M

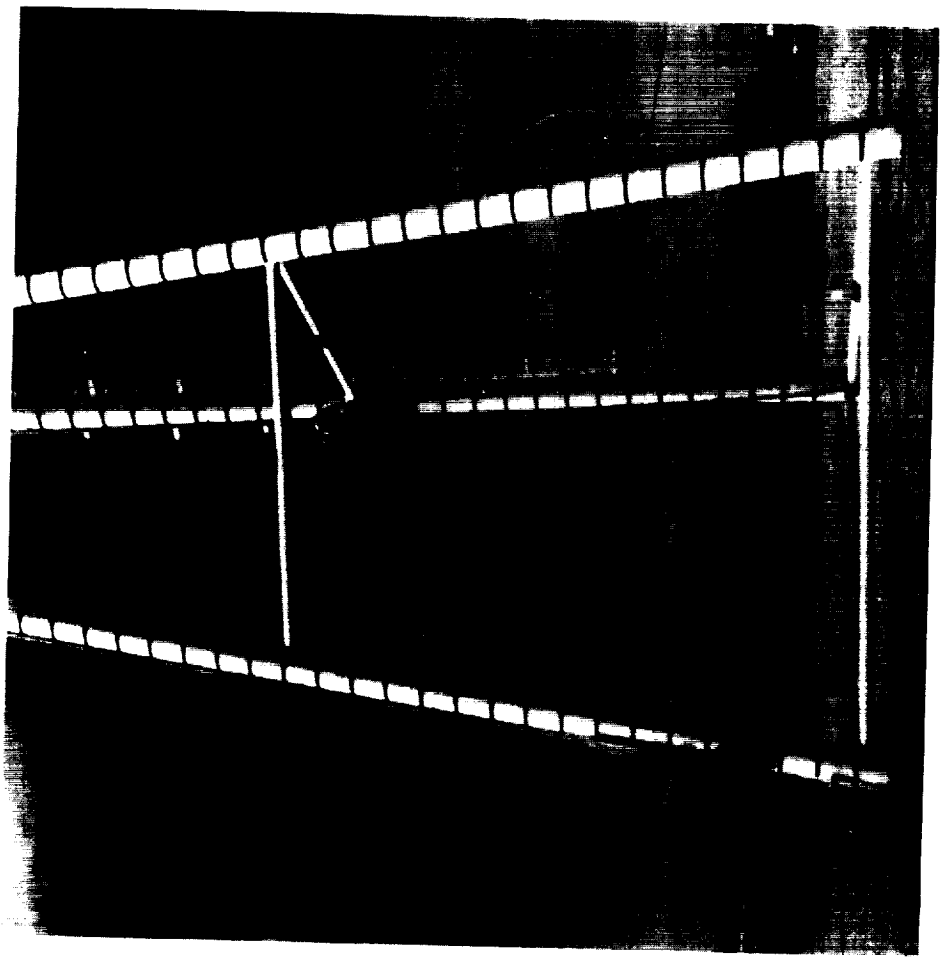
**TESTING CAPABILITIES:**
Provide a low cost method to determine rate of descent of parachutes. Max suspended height of cable in center of span is 270 ft above ground.

**DATA ACQUISITION:**
Laser tracking, video and photographic coverage.

**PAST APPLICATIONS:**
Various personnel parachute systems.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008



6-22A

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**SIZE:** 35 ft

**DATE BUILT:**
1950's

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
N/A

**COMPARABLE FACILITIES**
Group M

**TYPE:**
Drop Tower

**DESCRIPTION:**
Steel tripod tower with a steel cable attached to the apex to suspend/snub test item above the ground.

**TESTING CAPABILITIES:**
Provide a low cost method to conduct impact testing and structural strength testing of parachute related hardware. Limit of the lifting hoist is 4,000 pounds.

**DATA ACQUISITION:**
Solid state and telemetry data recording as well as hardwire monitoring. Video and photographic coverage is available.

**PAST APPLICATIONS:**
Impact shock testing of Navy torso harnesses, cargo release systems, ejection seats and test vehicle hardware.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Huibert deHaan: Code 6414 (C3243), (619) 927-1338, FAX: (619) 939-3008

6-23A

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**SIZE:** 4 x 4 ft up to 10 x 10 ft

**DATE BUILT:**
1975/1991

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
Speeds up to:
550 knots over 18 sq ft
200 knots over 80 sq ft
120 knots over 100 sq ft

**COMPARABLE FACILITIES**

Unique

**TYPE:**
Ducted Airflow

**DESCRIPTION:**
Airflow provided as bypass air from 4 TF33-P11 engines ducted into single or dual nozzles or diffusers. (Temps 0-50°F above ambient)

**TESTING CAPABILITIES:**
Provide airflow over parts of aircraft or over entire weapons systems. Construction of custom test fixtures. Parachute deployment. Canopy ejection. Stores release. Small arms bullet impact. Small warhead detonations.

**DATA ACQUISITION:**
Air speed, forces on chutes, strain gauge, temp, pressures. Total of 120 data channels. Photographic coverage on Video or High speed film.

**PAST APPLICATIONS:**
Opening drogue chutes; airflow over aircraft, weapons, ejection seats; deploying chutes from air targets; stores release

**PLANNED IMPROVEMENTS:**
Flow straighteners; reduction of turbulence; dump gate to provide instantaneous air flow.

**LOCAL INFORMATION CONTACT:** Jay Kovar, Code 3182 (C1182); (619) 939-6401 FAX: (619) 939-6213

6-24A

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
G-4 Terminal Ballistics Track

**SIZE:** 3,000 ft long

**DATE BUILT:**
Late 1950's

**OPERATIONAL STATUS:**
Fully operational. Most tests can be planned/conducted within 60-180 days.

**PERFORMANCE:**
Velocity up to Mach 4.0.
The muzzle end overlooks a desert sink 500 ft deep.

**DESCRIPTION:**
Terminal Ballistic dual rail test track.

**COMPARABLE FACILITIES**

Group L

**TESTING CAPABILITIES:**
The track facility is essentially a terminal ballistic track, seldom used to obtain straight track-run data. Offers a wide variety of sled structure and propulsion techniques in addition to sledborne electronics instrumentation and close-in photographs. The capability exists for performing sled design and fabrication for static and dynamic tests.

**DATA ACQUISITION:**
FM/FM, PCM, and PAM telemetry systems are available. The number of data channels are determined by the number of telemetry packages used. It is not unusual to have more than 60 channels of data on the more complex test articles. A wide selection of motion picture cameras are available, as well as lower speed data cameras used for obtaining time-space positioning information.

**PAST APPLICATIONS:**
Warhead impact tests. Submunition dispense tests. Flare deployment and parachute deployment tests.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Surface Test Mgt. Office; Code 62C2 (C32052), (619) 939-4325, FAX (619) 939-4339

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
Navy Test Parachutists

**SIZE:** 13 men and women

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Fully Operational

**PERFORMANCE:**
N/A

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Live jump personnel for evaluation of parachute systems.

**TESTING CAPABILITIES:**
Live jump evaluation of personnel parachute systems and life support equipment. Determine physiological limitations of the personnel parachute environment.

**DATA ACQUISITION:**
Solid state and telemetry data recording. Video, photographic, laser, radar tracking. Subjective evaluations.

**PAST APPLICATIONS:**
All Navy emergency escape systems, NASA Shuttle Crew Escape System, Marine Personnel Parachute Systesm, various physiological studies.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** PRMC Al Burton Code 6412 (C3242), (619) 939-2162

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6-26A

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Air Warfare Center
Weapons Division

**LOCATION:**
China Lake, CA 93555

**TYPE:**
Supersonic Navy Ordinance
Research Track (SNORT)

**SIZE:** 21,600 ft long

**DATE BUILT:**
1953

**OPERATIONAL STATUS:**
Fully operational. Most tests can be planned/conducted within 60-180 days.

**PERFORMANCE:**
Velocity up to Mach 5.0.
Sled size up to 150 ft long and 12 ft wide. Sled weight up to 80,000 lbs

**DESCRIPTION:**
High speed dual rail test track

**COMPARABLE FACILITIES**

Group L

**TESTING CAPABILITIES:**
The track facilities offer a wide variety of sled structure and propulsion techniques in addition to a broad range of sledborne and close-in photographic and electronics instrumentation. The capability exists for performing sled design and fabrication for static and dynamic tests, data acquisition, data assessment, and final documentation.

**DATA ACQUISITION:**
FM/FM, PCM, and PAM telemetry systems are available. The number of data channels are determined by the number of telemetry packages used. It is not unusual to have more than sixty channels of data on the more complex test articles. A wide selection of motion picture cameras are available, as well as lower speed data cameras used for obtaining time-space positioning information.

**PAST APPLICATIONS:**
Static and dynamic ejection seat testing. Warhead impact tests. Fuze tests. Submunition dispense tests. Flare deployment and parachute deployment tests. Bird strike and rain tests. Vehicle barrier tests. Motor performance tests. Aerodynamic heating and other dynamic performance tests.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Surface Test Mgt. Office; Code 62C2 (C32052), (619) 939-4325, FAX: (619) 939-4339

## MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Biodynamics Lab.

**LOCATION:**
13800 Old Gentilly Rd.
Bldg. 420, P.O. Box 29407
New Orleans, LA 70189

**TYPE:**
Horizontal Impact Accelerator

**SIZE:** 12 inch Diameter, 72 inch Stroke

**DATE BUILT:**
1974 (Man-rated)

**OPERATIONAL STATUS:**
25-75% committed (seasonal)

**PERFORMANCE:**
225,000 lb thrust
700 ft enclosed track

**DESCRIPTION:**
Electro/Pneumatic, enclosed accelerator

**COMPARABLE FACILITIES**

Group N

**TESTING CAPABILITIES:**
Simulated crash impacts up to 35g's and 50 mph for large payloads (less than 5000 lb). Up to 180 g's and 90 mph for small (less than 1000 lb) payloads.

**DATA ACQUISITION:**
72 channels, 12 Bit analog to digital converter, H.P. 9000 Host data acquisition system.

**PAST APPLICATIONS:**
Human and human surrogate impact tests, shuttle escape system tests, post-challenger icicle penetration tests of shuttle tank.

**PLANNED IMPROVEMENTS:**
New generation inertial instrumentation.

**LOCAL INFORMATION CONTACT:** Gil Willems, Head, Technology Dept., (504) 257-3892, FAX (504) 257-5456

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Biodynamics Lab.

**LOCATION:**
13800 Old Gentilly Rd.
Bldg. 420, P.O. Box 29407
New Orleans, LA 70189

**TYPE:**
Ship Motion Simulator

**SIZE:** 8 x 8 x 8 ft cab

**DATE BUILT:**
1985 (Man-rated)

**OPERATIONAL STATUS:**
20-50% committed (seasonal)

**PERFORMANCE:**
± 11 ft Heave,
± 15 deg/sec pitch & roll
Simulates up to sea state 5.

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Electrohydraulic, capable of duplicating ship motion on 3-axes.

**TESTING CAPABILITIES:**
Simulation of living and work spaces and tasks onboard ships.

**DATA ACQUISITION:**
Up to 48 channels, pc-based data acquisition systems.

**PAST APPLICATIONS:**
Motion sickness studies, studies of performance degradation at sea.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Gil Willems, Head, Technology Dept., (504) 257-3892, FAX (504) 257-5456

# MISCELLANEOUS FACILITIES

**COMPANY:**
Naval Biodynamics Lab.

**LOCATION:**
13800 Old Gentilly Rd.
Bldg. 420, P.O. Box 29407
New Orleans, LA 70189

**TYPE:**
Vertical Impact Accelerator

**SIZE:** 6 inch Diameter, 36 inch Stroke

**DATE BUILT:**
1989 (Man-rated)

**OPERATIONAL STATUS:**
25-75% committed (seasonal)

**PERFORMANCE:**
40,000 lb thrust
40 ft tower

**DESCRIPTION:**

**COMPARABLE FACILITIES**

Group N

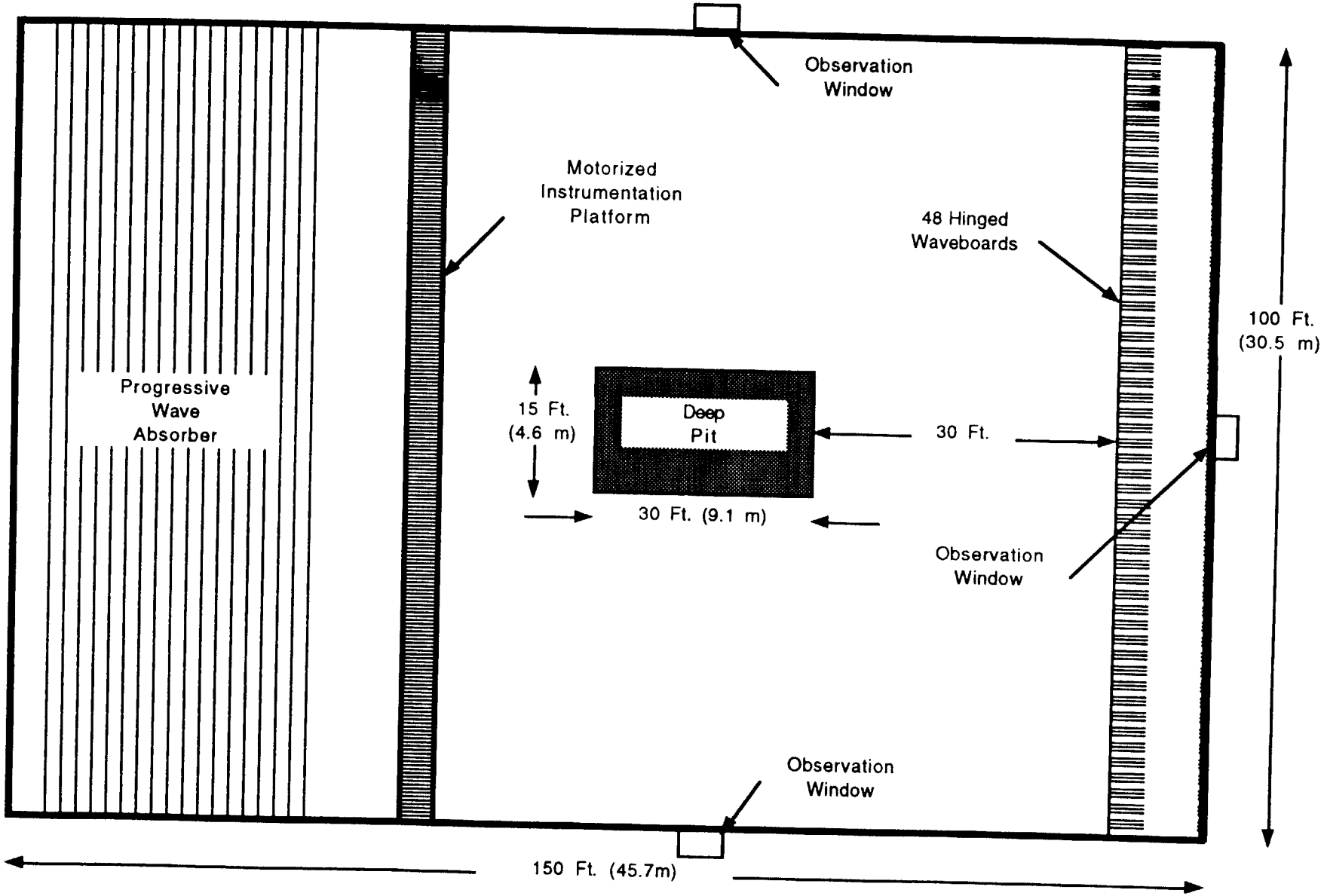
**TESTING CAPABILITIES:**
Simulated crash or ejection profiles of up to 20 g's with human payloads, 80 g's with small payloads.

**DATA ACQUISITION:**
72 channels, 12 Bit analog to digital converter, H.P. 9000 Host data acquisition system.

**PAST APPLICATIONS:**
Human and human surrogate impact tests, ejection simulation with and without added head mass. (Simulated night vision devices)

**PLANNED IMPROVEMENTS:**
New generation instrumentation.

**LOCAL INFORMATION CONTACT:** Gil Willems, Head, Technology Dept., (504) 257-3892, FAX (504) 257-5456




**OTRC Multi-Directional Wave Basin**

# MISCELLANEOUS FACILITIES

**COMPANY:**
Offshore Technology Research Center

**LOCATION:**
1200 Mariner Drive
College Station, TX 77845-3400

**TYPE:**
Deep water multi-directional wave model basin

**SIZE:** 150 ft L x 100 ft W x 19 ft deep

**DATE BUILT:**
October, 1990

**OPERATIONAL STATUS:**
On a "demand" basis for students, industry, and government agencies.

**PERFORMANCE:**
Max. wave height = 33 "
Wave period range = 0.5 - 6.0 seconds
Regular & random waves straight, oblique and multi-dimensional

**DESCRIPTION:**
A test tank to study ocean waves and their effect on vessels and structures. Utilizes a computer controlled segmented wavemaker.

**COMPARABLE FACILITIES**

Group O

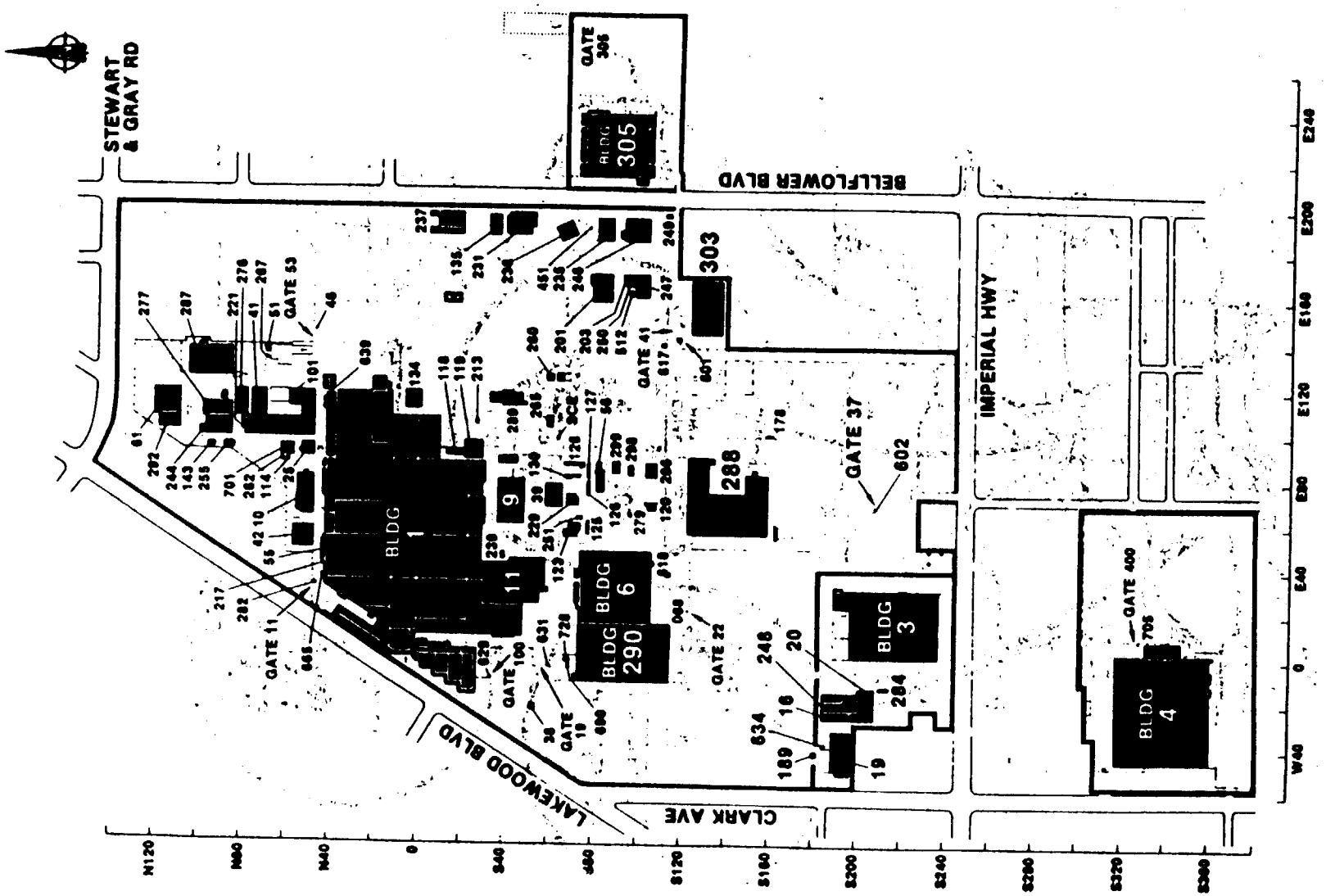
**TESTING CAPABILITIES:**
The wave basin can be used to examine the seakeeping characteristics of capsules and re-entry modules in waves. Motions, loads, moments, pressures, wave heights and run-up may be measured. The facility can handle both sub-scale and full-scale models.

**DATA ACQUISITION:**
The system is based upon a DEC VAX station 3500 and NEFF System 620. There are 32 channels of analog data with a maximum sample rate of 1 kHz/channel. Data is stored to hard disk. Output and analysis products may be displayed to a CRT or printed on a laserprinter.

**PAST APPLICATIONS:**
New Facility. Upcoming tests include April, 1992, seakeeping tests of Assured Crew Return Vehicle (ACRV) for NASA.

**PLANNED IMPROVEMENTS:**
Increase number of data acquisition channels. Upgrade wave absorber. Add side wave absorber. Acquire additional instruments. Add current generation. Add wind generation. Expand data analysis capabilities.

**LOCAL INFORMATION CONTACT:** R.P. Johnson, Facility Manager - (409) 845-1753, FAX: (409) 845-9273




Rockwell/Downey

# MISCELLANEOUS FACILITIES

**COMPANY:**
Rockwell International Space Systems Division

**LOCATION:**
12214 Lakewood Blvd.
Downey, CA 90241

**TYPE:**
Enclosed High Bay Facility (Building 290)

**SIZE:** 390 ft L X 80 ft W X 55 ft H

**DATE BUILT:**
Early 1960's

**OPERATIONAL STATUS:**
Semi-active currently on orbiter modifications. Area/Volume not fully utilized.

**PERFORMANCE:**
Facility has high-bay traverse cranes and may have semi-clean room environment.

**DESCRIPTION:**
Fully walled with access through large sliding doors. Normal shop & checkout services with some office space. This is a government building.

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Potential capabilities for pre- and post-test inspection and/or check-out of recovery systems and payloads. Area/Volume large and compatible with manned vehicle parachutes (large gliding or conventional canopies). The facility has electrical service and overhead office space.

**DATA ACQUISITION:**
N/A

**PAST APPLICATIONS:**
Apollo Command Service Module assembly and checkout, STS Orbiter crew module/forward fuselage assembly.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** D.B. Morris/Mail Code AB93 - (310) 922-1557

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
1515 Eubank SE
Albuquerque, NM 87123

**TYPE:**
Gun Site Facility

**SIZE:** .17 Caliber to 8-inch bore

**DATE BUILT:**
Various

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
Velocities to 9,000 fps

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
A general purpose R&D test facility involving gun type systems of various sizes and applications.

**TESTING CAPABILITIES:**
Smoothbore and rifled guns from .17 caliber to 8-inch bore. Custom special purpose gun design. Custom propellant charge development and assembly. Sabot design.

**DATA ACQUISITION:**
High speed photography, flash x-ray, on-board instrumentation systems, telemetry, and hardwire instrumentation.

**PAST APPLICATIONS:**
155MM recovery parachute development, drogue gun prototyping and charge development.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Dave Schafer - (505) 845-3153; Mike Skaggs - (505) 845-3018

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
1515 Eubank SE
Albuquerque, NM 87123

**TYPE:**
High-speed and ultra-high speed photography

**SIZE:** N/A

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Fully operational and mobile capability.

**PERFORMANCE:**
N/A

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Pin-registered cameras to 400 frames/second.
Rotating-prism cameras to 10,000 frames/second.
Rotating-mirror cameras to 26 million frames/second.

**TESTING CAPABILITIES:**
High-speed photography of Wind Tunnel tests of high-performance parachutes. High speed photography of parachute deployment in the field environment.

**DATA ACQUISITION:**
16 mm/35 mm/70 mm film, SVHS Video, film-to-video conversions.

**PAST APPLICATIONS:**
Remote capability including tests at NASA Ames and Langley Research Centers.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Gary Phipps, (505) 845-8269

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
P.O. Box 5800
Albuquerque, NM 87185-5800

**TYPE:**
Horizontal Actuator

**SIZE:** 18 inch diameter; 90 ft track

**DATE BUILT:**
1960

**OPERATIONAL STATUS:**
Operational - Facility in use for shock testing.

**PERFORMANCE:**
Will propel 110 lb sled to 140 ft/sec.

**COMPARABLE FACILITIES**

Group N

**DESCRIPTION:**
The pneumatically driven actuator propels sleds down a 90 ft track to confirm performance of parachute cord prior to use in a wind tunnel.

**TESTING CAPABILITIES:**
The 18-inch actuator provides the capability for dynamic testing of parachute cord designs under controlled conditions prior to use in wind tunnels where failure is not acceptable.

**DATA ACQUISITION:**
Force measured on cord. Acceleration measured on sled. High speed photography provides velocity data.

**PAST APPLICATIONS:**
System was used to verify performance of parachute tear-ply cord developed by Sandia for the F111 Crew Escape Module in 1989.

**PLANNED IMPROVEMENTS:**
None.

**LOCAL INFORMATION CONTACT:** Thomas J. Baca, Division 2741: (505) 844-8686

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
1515 Eubank SE
Albuquerque, NM 87123

**TYPE:**
Large Centrifuge

**SIZE:** 29 and 35 ft radius centrifuges

**DATE BUILT:**
Rebuilt 1985

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
1.6 million G-lbs. on a 29-ft system.

450 thousand G-lbs. on 35-ft system.

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Two large centrifuges. A 29-ft radius system is enclosed in a building. A 35-ft radius system is located outdoors in an open enclosure.

**TESTING CAPABILITIES:**
16,000 lbs to 100 g's or lighter weights to nearly 300 g's on 29 foot system. 4500 lbs. to 100 g's on 35 foot system. Explosives can be tested on 35 foot system. Six foot spacing between arms for fixture/unit mounting. Hi bay, cranes, forklift support. Equipped for simultaneous combined vibration/acceleration testing.

**DATA ACQUISITION:**
Multiple data, video and power slip rings. Multiplexing and telemetry systems available. Digital and analog recording systems.

**PAST APPLICATIONS:**
Vehicle flight qualification, structural integrity verification, releasing items for impact or free flight tests, aircraft ejection seat functioning under g loading.

**PLANNED IMPROVEMENTS:**
Programmable control system.

**LOCAL INFORMATION CONTACT:** Dave Schafer - (505) 845-3153; Doug Cotter - (505) 845-3017

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
Albuquerque, NM 87185

**TYPE:**
Rocket Sled Track Facility

**SIZE:** 15,000 ft L x 2,500 ft W with 3,000 ft AGL ceiling

**DATE BUILT:**
1965/1983

**OPERATIONAL STATUS:**
Currently moderate workload schedule on demand.

**PERFORMANCE:**
Max. sled velocity = 6,500 ft/s

Max. sled wt = 50,000 lbs

**COMPARABLE FACILITIES**

Group L

**DESCRIPTION:**
10,000-ft long, dual rail track with a 22-inch gauge used for recoverable and non-recoverable sled tests. Also use three sizes of launch rails for free flight rocket tests.

**TESTING CAPABILITIES:**
Extensive parachute development test experience using Sandia's ejector sleds and free flight booster technology. Ejector sleds capable of placing 3,000-lb test unit into ballistic trajectory at 1,700 ft/s and 200-ft apogee or 100-lb test unit into ballistic trajectory at 3,000 ft/s and 80-ft. apogee. Free flight rockets used to carry 100-lb. test unit into ballistic trajectory at 1,700 ft/s and 2,500-ft apogee. Site has a small machine ship and welding facilities.

**DATA ACQUISITION:**
Sandia's laser trackers can provide x, y, z, time, velocity trajectory information as well as close-up high-speed film and video of the test unit in flight. We have 4-channel telemetry, 4-channel timer/fire channels of L, S and P band telemetry.

**PAST APPLICATIONS:**
Conducted tests of NASA's SRB Pilot Parachute.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Dave Bickel: (505) 845-3179

# MISCELLANEOUS FACILITIES

**COMPANY:**
Sandia National Laboratories

**LOCATION:**
1515 Eubank SE
Albuquerque, NM 87123

**TYPE:**
Water Impact Facility

**SIZE:** 120 x 190 x 50 ft deep

**DATE BUILT:**
1983

**OPERATIONAL STATUS:**
Operational

**PERFORMANCE:**
650 lb vehicles to impact velocities greater than 600 fps. Impact angles from 15 to 90 degrees from horizontal.

**COMPARABLE FACILITIES**

Group M

**DESCRIPTION:**
Fifty-foot deep body of water at the base of a 300-foot tower. A rocket sled attached to the test item via cables accelerates the item to speed. The cables are cut free just before impact.

**TESTING CAPABILITIES:**
Vehicles up to 650 lbs can be delivered at impact velocities greater than 600 fps with impact angles from 15 to 90 degrees from horizontal. On-site SCUBA technicians. Soft underwater catch. Adjacent 30 ton crane for recovery. A descriptive video is available.

**DATA ACQUISITION:**
Underwater and above surface high speed photography. Mobile instrumentation trailer with signal conditioning and recording capability for multiple trailing wire data channels and types. On-board recording data systems also available.

**PAST APPLICATIONS:**
Sonobuoy/parachute interaction with water entry and cavity effect studies.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Dave Schafer - (505) 845-3153; Doug Cotter - (505) 845-3017

# MISCELLANEOUS FACILITIES

**COMPANY:**
Strong Enterprises

**LOCATION:**
Orlando, FL 32837

**TYPE:**
Drop Test Services

**SIZE:** 1-25 sq. miles

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
Open daily

**PERFORMANCE:**
Utilize 2 of 7 drop zones within a 3-hour drive of our facility. Torso dummies available.

**DESCRIPTION:**
Commercial Sport Parachute Operation

**COMPARABLE FACILITIES**

Group P

**TESTING CAPABILITIES:**
Support Available includes; Photographs, Fabrication/build-up, Drop Aircraft, and Chase Aircraft.

**DATA ACQUISITION:**
Video, photo

**PAST APPLICATIONS:**
Live & dummy drops for FAA TSO Testing.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Ted Strong- (407) 859-9317, FAX (407) 850-6978

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
Biodynamic Manikin

**SIZE:** 50th Percentile

**DATE BUILT:**
1991

**OPERATIONAL STATUS:**
On demand

**PERFORMANCE:**
N/A

**DESCRIPTION:**
Test manikin with internal power, sensors, data acquisition, and storage electronics

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Used for testing personnel parachute systems.

**DATA ACQUISITION:**
Up to 21 channels reading head accelerations, neck forces and moments, thoracic accelerations, and lumbar forces and accelerations

**PAST APPLICATIONS:**
Newly developed for testing of seat crashworthiness and personnel parachute systems.

**PLANNED IMPROVEMENTS:**
Development of a 95th percentile and 5th percentile manikin

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
Dynamic impact tester

**SIZE:** N/A

**DATE BUILT:**
1984

**OPERATIONAL STATUS:**
On demand

**PERFORMANCE:**
14.5 in stroke
45 fps velocity max.

**DESCRIPTION:**
Variable rate dynamic impact tester in either tension or compression

**COMPARABLE FACILITIES**

Group N

**TESTING CAPABILITIES:**
Breaking strength of parachute riser and shroud lines.

**DATA ACQUISITION:**
Records Ram displacement and transmitted load.

**PAST APPLICATIONS:**
Restraint webbing and energy attenuating tubes.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Aeromedical Research Laboratory

**LOCATION:**
Fort Rucker, AL

**TYPE:**
Impact tower

**SIZE:** 12 ft vertical monorail

**DATE BUILT:**
1982

**OPERATIONAL STATUS:**
On demand

**PERFORMANCE:**
Variable drop heights up to 12 ft

**DESCRIPTION:**
12 ft vertical free fall drop tower typically used for evaluations of protective headgear.

**COMPARABLE FACILITIES**

Group M

**TESTING CAPABILITIES:**
Protective helmets

**DATA ACQUISITION:**
Headform accelerations and transmitted loads. Electronics are tied in to a Zenith 286 PC for data acquisition and analysis.

**PAST APPLICATIONS:**
Aviation helmets

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** B. Joseph McEntire (205) 255-6896, FAX: (205) 255-6937, Autovon 558-6937

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Chemical Res., Dev., and Engineering Ctr.

**LOCATION:**
Aberdeen Proving Ground
MD 21010-5423

**TYPE:**
Spinning Barrel Air Gun

**SIZE:** .5 ft Diameter, 8.2 ft Length

**DATE BUILT:**
1985

**OPERATIONAL STATUS:**
Available

**PERFORMANCE:**
Muzzle velocities up to 1200 fps for masses up to 29.7 lb
Spin rates from 0 to 100 hz.
Oversize items can be launched using spigot sabot.

**DESCRIPTION:**
Nitrogen actuated air gun with spinning barrel mounted on mobile trailer.

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Designed to fire 9.9 lb items at transonic velocities. Can launch lighter items at higher speeds and heavier items at lower speeds. Quick opening, reusable valve included in gun. Standard bottled nitrogen gas utilized. Entire barrel spins by high pressure air turbine mechanism. Launch items at any spin rate independent of muzzle velocity. Item deployment and opening events can occur close to ground at known location for max. observation.

**DATA ACQUISITION:**
Radar tracking for velocity decay, drag coefficient, etc. measurements. High speed and sequential film coverage.

**PAST APPLICATIONS:**
Triangular Ram Air Decelerator for Artillery Delivered Expendable Jammer; Bomb/Projectile Fragment Flight Motion for FragHaz program.

**PLANNED IMPROVEMENTS:**
Increase spin rate to 200 hz.

**LOCAL INFORMATION CONTACT:** Miles C. Miller, SMCCR-RSP-A, (410) 671-2186.

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Natick RD&E Center

**LOCATION:**
Experimental Analysis Branch
Natick, MA 01760-5017

**TYPE:**
Materials Testing

**SIZE:** N/A

**DATE BUILT:**
1975

**OPERATIONAL STATUS:**
Operates year round

**PERFORMANCE:**
See Below

**COMPARABLE FACILITIES**
Unique

**DESCRIPTION:**
Test energy dissipating characteristics of airdrop materials used on airdrop platforms during rigging. Test tensile/compression characteristics of airdrop components.

**TESTING CAPABILITIES:**
Horizontal Impact Tester delivers up to 7,500 lbs/sq. ft. at impact velocities up to 40 ft/sec to airdrop cushioning materials and measures energy dissipated. Universal Testing Machine, Instron Model 1128 has 112,500 lb capacity with a 9 ft max. JAW separation, Instron Model 1125 has 22,500 lb. capacity with a 5 ft. max. JAW separation. Both machines have a max. headspeed of 500 mm/min.

**DATA ACQUISITION:**
Strip chart read outs.

**PAST APPLICATIONS:**
Army Airdrop Programs.

**PLANNED IMPROVEMENTS:**
May obtain a 500,000 lb. Universal Testing Machine.

**LOCAL INFORMATION CONTACT:** Bruce Buckland, Chief, Experimental Analysis Branch - (508) 651-4799

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Natick RD&E Center

**LOCATION:**
Experimental Analysis Branch
Natick, MA 01760-5017

**TYPE:**
Roller Test Facility + Drop Tower

**SIZE:** 1/4 Acre

**DATE BUILT:**
1970

**OPERATIONAL STATUS:**
Operates year round

**PERFORMANCE:**
Data acquisition system capable of reading Roller data to ± 2 lbs per roller over + 0 to 3000 lb range.

**DESCRIPTION:**
Facility simulates a C-141 Aircraft Roller Bed with up to 100,000 lbs of extraction force. Drop tower capable of lifting and releasing instrumented loads.

**COMPARABLE FACILITIES**

Unique

**TESTING CAPABILITIES:**
Facility includes 136 instrumented rollers which are able to measure point loading of cargo within an aircraft. The 45 foot high Drop Tower is capable of lifting and releasing instrumented airdrop loads up to 100,000 pounds.

**DATA ACQUISITION:**
Some of the data acquisition systems available include Masscomp model 5520, HP 3497 Strain Gauge System, 3655E Yokogawa Analyzing Record, Data Translation 2800 Series PC circuit board plug-in cords, Keithly 575 PC based measurement system and strip chart recorders.

**PAST APPLICATIONS:**
Facility certifies air worthiness of air cargo for air transport and airdrop as well as external air transport with helicopters.

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Jack Lanza, Eng. Technician or Bruce Buckland, Chief, Experimental Analysis Br. - (508) 651-4799

# MISCELLANEOUS FACILITIES

**COMPANY:**
U.S. Army Yuma Proving Ground

**LOCATION:**
Air Delivery Division Yuma, AZ

**TYPE:**
Air Delivery Complex

**SIZE:** See description

**DATE BUILT:**
April 1992

**OPERATIONAL STATUS:**
Operational in 4/92

**PERFORMANCE:**
N/A

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Complex consisting of: 1) Main building (47,000 sq ft), 2) Hazard building (3,600 sq ft), 3) Drying tower (130 ft high x 1,600 sq ft), 4) Taxiway (3,000 ft), 5) Loading apron (17,000 sq yds)

**TESTING CAPABILITIES:**
Capabilities include: test engineering, hazard material rigging, parachute packing, parachute maintenance, cargo rigging, and data acquisition.

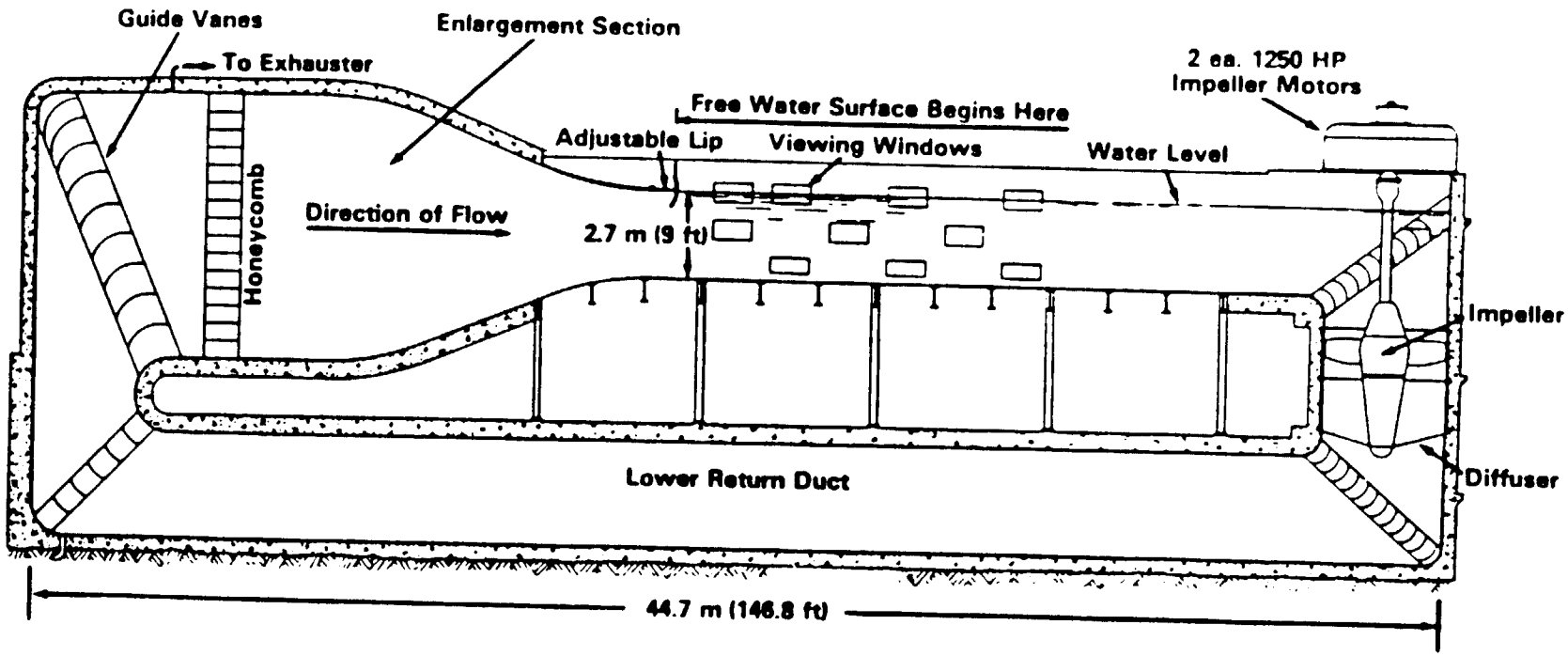
**DATA ACQUISITION:**
N/A

**PAST APPLICATIONS:**
N/A

**PLANNED IMPROVEMENTS:**
New complex which is replacing 12 other separated facilities at YPG.

**LOCAL INFORMATION CONTACT:** Jim Stewart (602) 328-3116

# DAVID TAYLOR RESEARCH CENTER
# CIRCULATING WATER CHANNEL (1944)




Approx. Length of water circuit measured around the centerlines = 99 m (325 ft)

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**TYPE:**
Circulating Water Channel

**SIZE:** 60 ft L X 22 ft W X 9 ft deep (Working Section)

**DATE BUILT:**
1944

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Working Section Maximum Velocity = 5.1 m/s (10-knots).

**COMPARABLE FACILITIES**

Group O

**DESCRIPTION:**
670,000 gallon vertical plane, closed recirculating water circuit, variable speed channel with an open to the atmosphere test section with a free surface. The Channel possesses a rectangular cross-sectional shape.

**TESTING CAPABILITIES:**
This large size Circulating Water Channel is unique within the Navy, and is used for stack gas flow studies over ship superstructures at various headings, towed body evaluations, and high accuracy flow visualization experiments on Navy ship hulls, rudders, fairings, struts, bilge keels, and other appendages. Facility also has been used to enhance the performance of commercial fishing trawl nets.

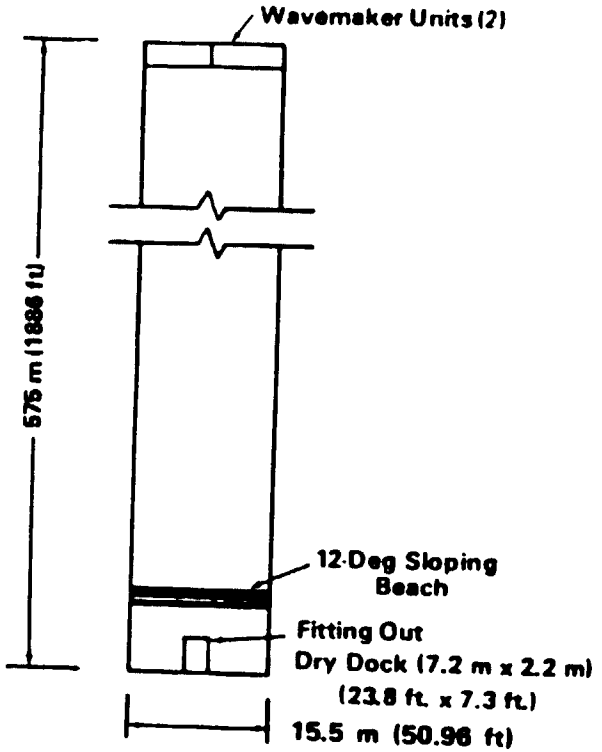
**DATA ACQUISITION:**
Dye injection system for flow visualization experiments, pressure sensors, force measuring dynamometers, high speed video system, and model motor power supplies. Ten large viewing/photo windows at different elevations on both sides of the test section, and nine viewing windows in the bottom of the test section. Computers available for data collection and analysis.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES."

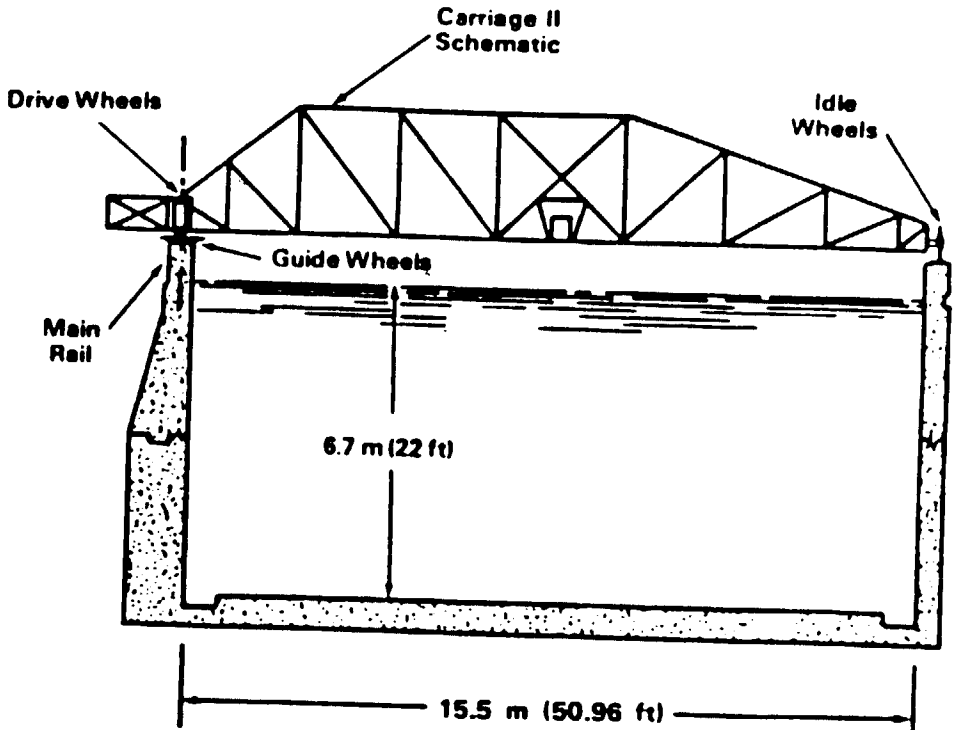
**PLANNED IMPROVEMENTS:**
Upgrades to speed control system.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DAVID TAYLOR RESEARCH CENTER
# TOWING CARRIAGE NO. 2 (1947)




Schematic Plan View of Basin
(Carriage Not Shown)




Elevation View of Deep Water Basin
& Carriage II

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**TYPE:**
Deep Water Towing Basin with Wavemaker & 20-knot Towing Carriage ( #2).

**SIZE:** 1886 ft L x 51 ft W x 22 ft deep

**DATE BUILT:**
1947

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Towing Carriage #2 has a maximum speed of 10.3 m/s (20-knots). Carriage can maintain test speeds in either direction within a few hundredths of a knot. Regular wave length = 5 to 40 ft with corresponding max. heights of 4 to 24 in.

**COMPARABLE FACILITIES**

Group O

**DESCRIPTION:**
15,820,000 gallon rectangular concrete fresh water basin with a pneumatic wavemaker located at one end and a wave absorbing beach at the other. Computers aboard the Carriage are used for data collection & analysis.

**TESTING CAPABILITIES:**
Towing Carriage #2 in the Deep Water Towing Basin is used for a wide variety of hydrodynamic tests including: propulsion and resistance measurements; seakeeping & propulsion evaluations in head or following waves; hydrodynamic forces on submerged bodies; planar motion experiments; open water propeller characterizations; wake surveys; knot-meter calibrations; and towed body experiments.

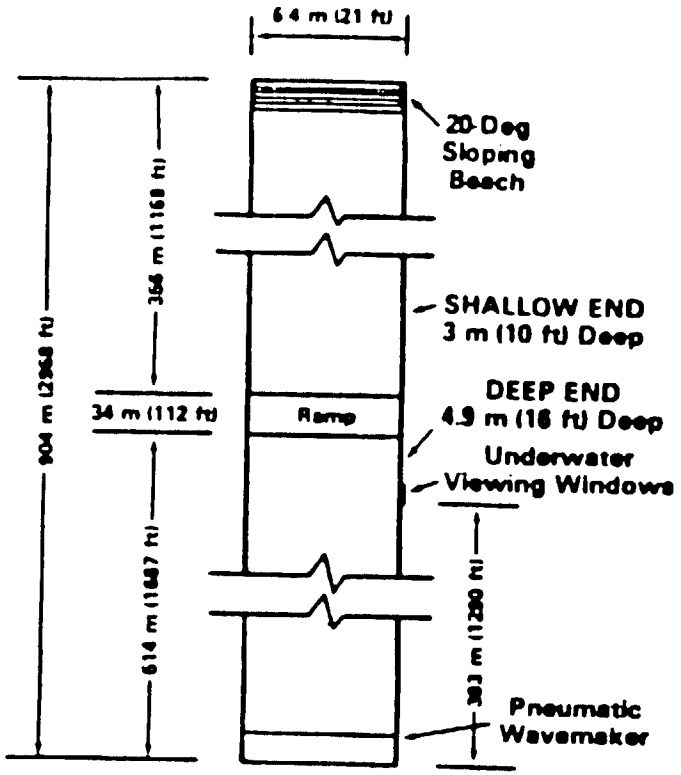
**DATA ACQUISITION:**
A microwave/fiber optic data link system creates a unique capability for conducting long straight line free running radio controlled submarine model tests, in head or following seas, under real time computer control. Pneumatic type wavemaker is capable of generating regular waves, and irregular waves with a spectrum resembling typical ocean wave patterns with appropriate scale reductions.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES."

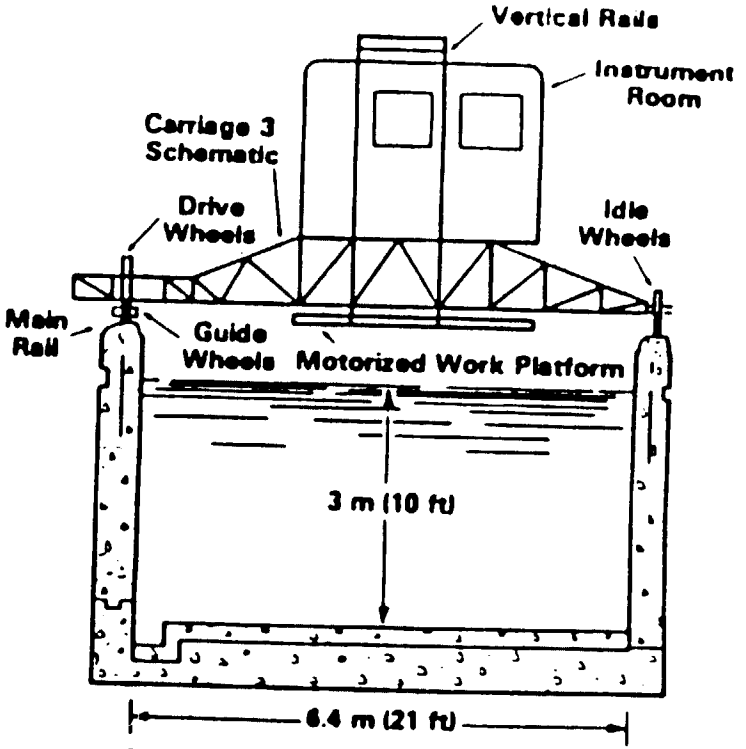
**PLANNED IMPROVEMENTS:**
Upgrade of wavemaker.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DAVID TAYLOR RESEARCH CENTER
## TOWING CARRIAGE NO. 3 (1941) - MODIFIED 1973-74




Schematic Plan View of High Speed Basin
(Carriage Not Shown)




Elevation View of Shallow End of
High Speed Basin & Carriage III

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**TYPE:**
High Speed Towing Basin with Wavemaker & 32-knot Towing Carriage (#3).

**SIZE:** 2968 ft L x 21 ft W x10 & 16 ft deep

**DATE BUILT:**
1941 & 1973-74

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Towing Carriage #3 has a maximum speed of 16.5 m/s (32-knots). Speed can be maintained in either direction within a few hundredths of a knot. Acceleration - (0.07 g maximum in either direction) Regular wave length = 3 to 40 ft with corresponding max. heights of 2.5 to 24 in.

**COMPARABLE FACILITIES**

Group O

**DESCRIPTION:**
6,310,000 gallon rectangular concrete fresh water basin with a pneumatic wavemaker located at one end and a wave absorbing beach at the other. Computers aboard the Carriage are used for data collection & analysis.

**TESTING CAPABILITIES:**
Towing Carriage #3 in the High Speed Basin is used for a wide variety of hydrodynamic tests including: resistance, self-propulsion, & static stability in calm water; seakeeping & propulsion evaluations in head or following waves; and planar motion experiments. This test facility is equipped with special force balance dynamometers and instrumentation for experiments on surface effect ships and air cushion vehicles.

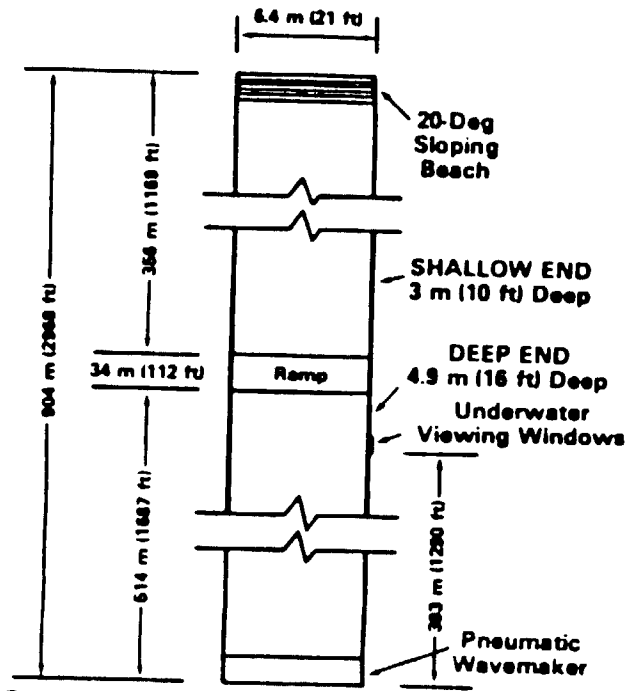
**DATA ACQUISITION:**
Three large underwater viewing windows at different elevations are set into the wall about mid-length of the Basin to facilitate collection of underwater photographic & video records. Carriage has special observation/camera platform. Pneumatic type wavemaker is capable of generating regular waves, and irregular waves with a spectrum resembling typical ocean wave patterns with appropriate scale reductions.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES."

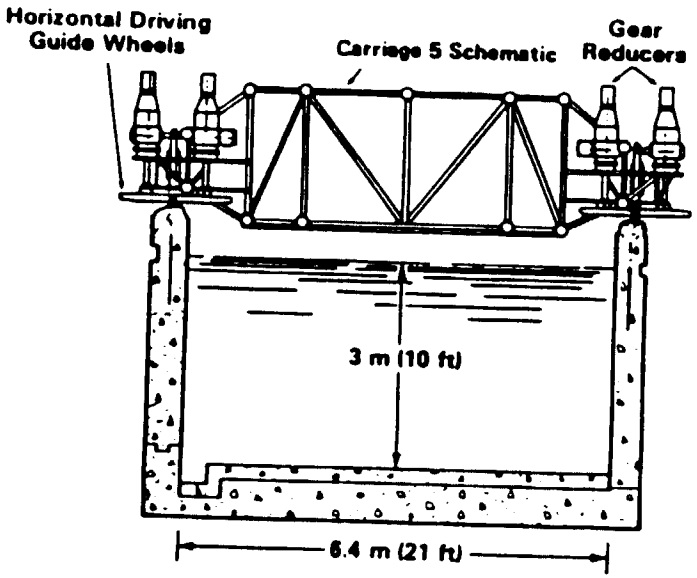
**PLANNED IMPROVEMENTS:**
Upgrade of wavemaker.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DAVID TAYLOR RESEARCH CENTER
# TOWING CARRIAGE NO. 5 (1947)




Schematic Plan View of High Speed Basin
(Carriage Not Shown)




Elevation View of Shallow End of High Speed Basin
& Carriage V

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**TYPE:**
High Speed Towing Basin with Wavemaker & 50-knot Towing Carriage (#5).

**SIZE:** 2968 ft L x 21 ft W x 10 & 16 ft deep

**DATE BUILT:**
1947 & 1991

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Towing Carriage #5 has a maximum speed of 25.7 m/s (50-knots). Acceleration (0.2 g maximum), deceleration, & speed of Carriage are computer controlled. Regular wave length = 3 to 40 ft with corresponding max. heights of 2.5 to 24 in.

**COMPARABLE FACILITIES**

Group O

**DESCRIPTION:**
6,310,000 gallon rectangular concrete fresh water basin with a pneumatic wavemaker located at one end and a wave absorbing beach at the other. Computers aboard the Carriage are used for data collection & analysis.

**TESTING CAPABILITIES:**
Towing Carriage #5 in the High Speed Basin is used for a wide variety of hydrodynamic tests including: measurement of hydrodynamic forces on submerged bodies, towed bodies, hydrofoils, planing boats, and other high speed craft operating in calm water or in waves; unsteady propeller blade force measurements; wake surveys; and knot-meter calibrations under simulated dynamic conditions.

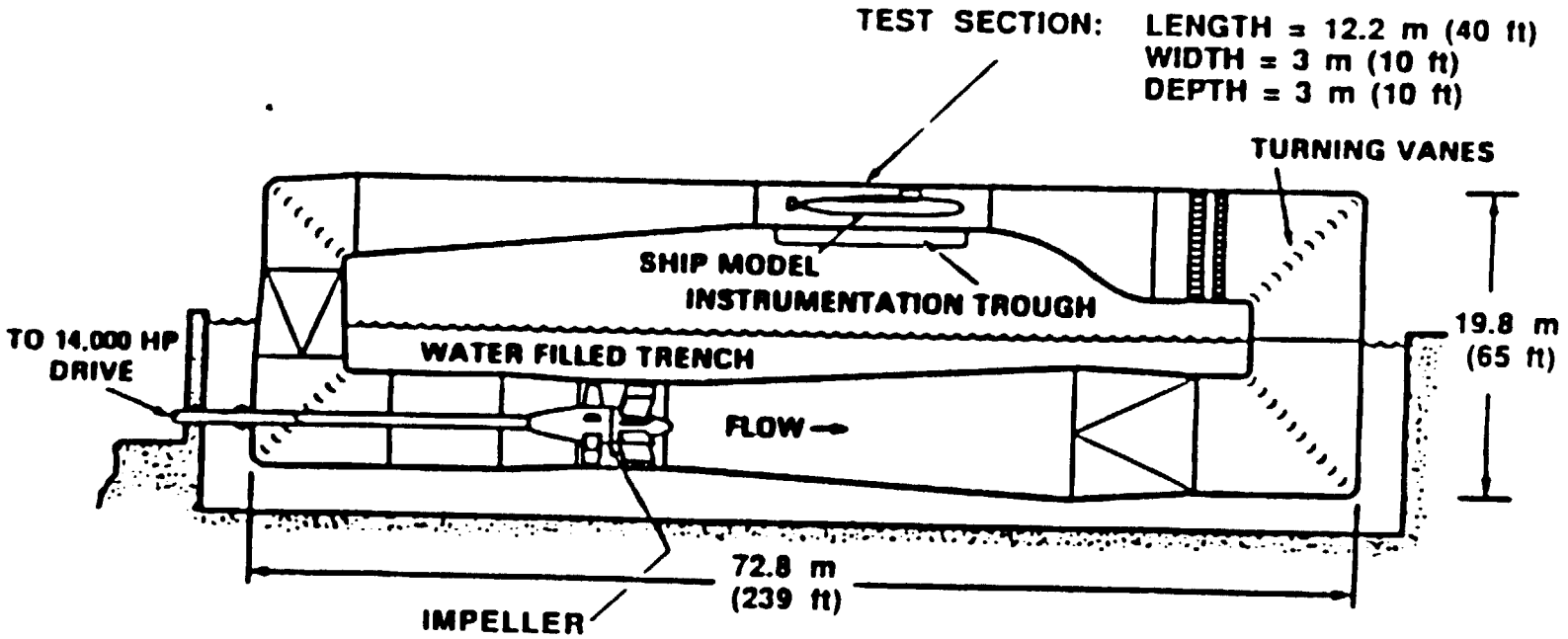
**DATA ACQUISITION:**
Three large underwater viewing windows at different elevations are set into the wall about mid-length of the Basin to facilitate collection of underwater photographic & video records. The pneumatic type wavemaker is capable of generating regular waves, and irregular waves with a spectrum resembling typical ocean wave patterns with appropriate scale reductions. Thrust, torque, and force measuring capability.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES."

**PLANNED IMPROVEMENTS:**
Upgrade of wavemaker.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DAVID TAYLOR RESEARCH CENTER
# LARGE CAVITATION CHANNEL (1991)




Approx. Length of water circuit measured around the centerlines = 162 m (532 ft)

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
2700 Channel Ave.
Presidents Island
Memphis, TN 38113-0428

**TYPE:**
Large Cavitation Channel

**SIZE:** Working Section: L = 43 ft, Width = 10 ft, Depth = 10 ft

**DATE BUILT:**
1990-91

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Working Section Maximum Velocity = 15.4 m/s (30 kts)
Absolute Pressures:
Maximum = 414 kPa (60 psia),
Minimum = 3.5 kPa (0.5 psia).
Minimum Cavitation Number:
Sigma = 0.02 (0.5 psia & 30-knots). Low turbulence (0.1%).

**COMPARABLE FACILITIES**
Group O

**DESCRIPTION:**
1.4 million gallon vertical plane, closed recirculating water circuit, variable speed, variable pressure, channel with lower half submerged in 2.5 million gallon water filled trench as acoustic treatment. 6:1 contraction ratio.

**TESTING CAPABILITIES:**
The Large Cavitation Channel (LCC) is the world's largest and quietest high-speed, variable-pressure water channel. Facility is capable of performing tests involving cavitation, force measurement, flow visualization and noise on complete hull-appendage-propulsor models, bodies of revolution, surface ships, submarines, and torpedoes; and open water propeller tests requiring low background noise levels.

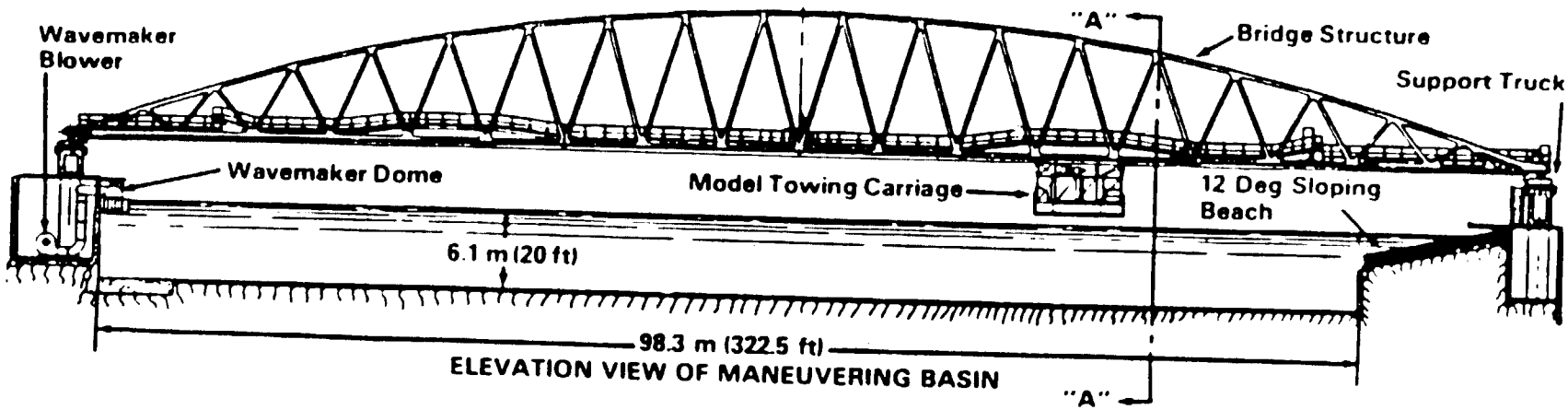
**DATA ACQUISITION:**
Propeller dynamometers and drive motors internal to flooded hull models or pod-strut (future), pressure sensors, hydrophones, nested hydrophone array in trough beneath test section floor, computerized data collection systems, high speed photographic system, 3-component LDV, particle or bubble size & distribution analyzer. Many large viewing/photo windows in sides, top, & bottom of test sect.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES."

**PLANNED IMPROVEMENTS:**
Upgrades to dynamometry and instrumentation.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# DAVID TAYLOR RESEARCH CENTER
# MANEUVERING AND SEAKEEPING BASIN (1961)




ELEVATION VIEW OF MANEUVERING BASIN

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**TYPE:**
Maneuvering and Seakeeping Basin with 15-knot manned Towing Carriage, Wavemaker, & Wind Generator.

**SIZE:** 360 ft L x 240 ft W x 20 ft & 35 ft deep

**DATE BUILT:**
1961

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**PERFORMANCE:**
Towing Carriage has a max. speed of 7.7 m/s (15-knots). Regular wave length = 3 to 40 ft with corresponding max. heights of 4 to 24 in. Irregular waves simulating the ocean up to sea state 9. Models can be towed in head or following seas at any angle from 0 to 90 degrees. Wind to 20 knots.

**COMPARABLE FACILITIES**

Group O

**DESCRIPTION:**
12,210,000 gallon rectangular concrete fresh water basin with pneumatic wavemakers located on two adjacent sides & wind generator on one side. Movable 376 ft bridge structure spans Basin & supports Towing Carriage.

**TESTING CAPABILITIES:**
The Maneuvering and Seakeeping Basin is unique within the Navy, and is used to model & evaluate the full scale motions of ships, platforms, and mooring systems in waves; the maneuverability, propulsion, & dynamic stability and control of free running radio controlled surface ships & submarines in waves and smooth water at various headings. Facility is also used for capsizing tests & slamming studies.

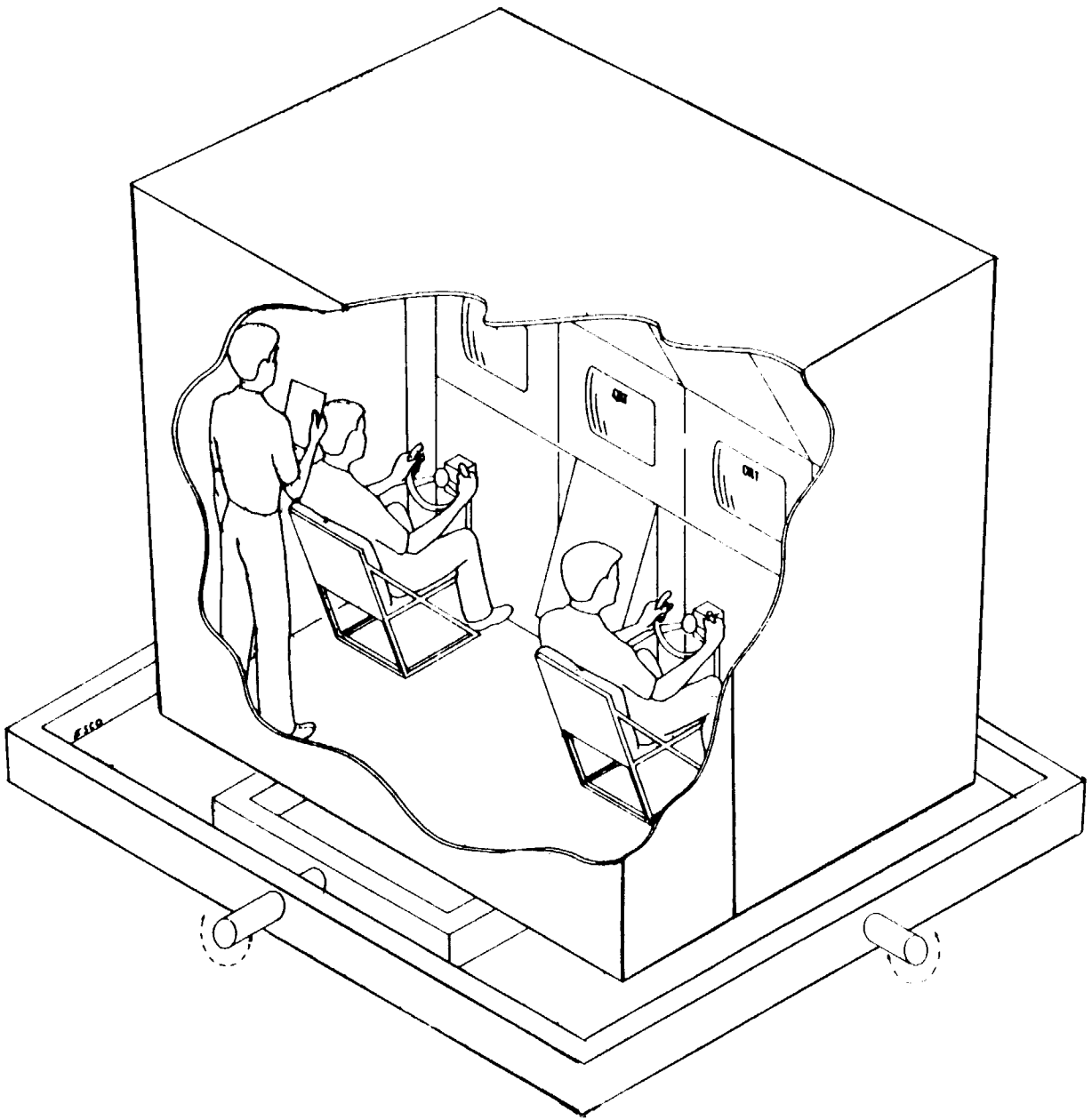
**DATA ACQUISITION:**
Heave measuring apparatus, pitch-yaw-roll measuring gyros, force balance dynamometers, model propeller torque and thrust transmission dynamometers, ultrasonic transducers for measuring wave amplitudes and model motions (heave, surge, sway), computerized data collection & digitizing systems, and model motor power supplies. Underwater viewing & photo windows in basin wall.

**PAST APPLICATIONS:**
Same as those items listed above under "TESTING CAPABILITIES," including MIDWAY motions improvement, T-AGOS 19 design evaluation, and SSN-21 Submarine design and evaluation.

**PLANNED IMPROVEMENTS:**
Upgrades to wavemaker and data collection equipment.

**LOCAL INFORMATION CONTACT:** Dr. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

DAVID TAYLOR RESEARCH CENTER
MOTION BASE SIMULATOR CAB ASSEMBLY



6-52A

# MISCELLANEOUS FACILITIES

**COMPANY:**
U. S. Navy, David Taylor Research Center

**LOCATION:**
Bethesda, MD 20084-5000

**SIZE:** Simulator Crew Cabin, 81 in. H x 91 in. W x 73 in. L

**DATE BUILT:**
1955 & 1985

**OPERATIONAL STATUS:**
Fully operational & available to both government and industry.

**TYPE:**
Submarine Simulator

**PERFORMANCE:**
Max g: 0.016

Onset Rate: 0.016 g/s

G. Duration: 1 second

Payload Wt.: 1000 lbs

**COMPARABLE FACILITIES**

Unique

**DESCRIPTION:**
Mounted on gimbals to allow computer controlled pitch and roll movements.

**TESTING CAPABILITIES:**
The Submarine Simulator has the capability to simulate submarine motions and controls. This facility is unique within the Navy, and is used to evaluate new display concepts and overall maneuvering performance. The controls & computer responses can be programmed for any submarine for which the appropriate data are available. Controls, instrumentation, & displays arranged as they would be on a submarine.

**DATA ACQUISITION:**
Software - implemented display changes for human factor studies of: display arrangements; display types; reduced manning; illumination; control appendages, etc. Motion responses & computer signals serve as inputs to the display instruments. Duplicate sets of controls inside simulator allow two-person use of the facility.

**PAST APPLICATIONS:**
SSN 21 control appendage design, SSN 688 full scale trial agenda review

**PLANNED IMPROVEMENTS:**
None, near term.

**LOCAL INFORMATION CONTACT:** D.. William B. Morgan, Code 15: (301) 227-1578, FAX: 227-3679

# MISCELLANEOUS FACILITIES

**COMPANY:**
Universal Propulsion Co.

**LOCATION:**
Hurricane Mesa
Hurricane, Utah

**TYPE:**
Supersonic Test Track Facility

**SIZE:** 6000 acres

**DATE BUILT:**
1955

**OPERATIONAL STATUS:**
Active

**PERFORMANCE:**
Mach 2 class track
15,000 lb payload

**COMPARABLE FACILITIES**
Group L

**DESCRIPTION:**
A completely self-sufficient high speed testing complex with extensive capabilities. The track is 12000 ft long and is located at an elevation of 5100 ft MSL terminating at a 500 ft vertical cliff.

**TESTING CAPABILITIES:**
Facility is capable of testing ejection seat systems, escape capsules, canopies, hatches; scale models of rockets, missiles, and aircraft; aerodynamic drag devices, submunition dispense, RPV's, and Low Altitude parachute delivery systems. A 2,800 ft water brake system and hydro-mechanical arresting gear provide for vehicle deceleration.

**DATA ACQUISITION:**
Complete photographic and telemetry coverage. Real time readout and data collection is provided for each test parameter.

**PAST APPLICATIONS:**
Douglas-Mini PAC & ACES II Ejection Seats/ Boeing-AIWS & Sea Lance Missile Systems/ UPCO-SIIIS, S4S & Ranger Escape Systems/ E Systems-Egrett Escape System/ Plus many more

**PLANNED IMPROVEMENTS:**

**LOCAL INFORMATION CONTACT:** Ron Chase - (801) 635-9629 or 635-4488

# MISCELLANEOUS FACILITIES

**COMPANY:**
Vertigo, Inc.

**LOCATION:**
P.O. Box 117
Lake Elsiore, CA 92531-0117

**TYPE:**
Drop Test Services

**SIZE:** N/A

**DATE BUILT:**
N/A

**OPERATIONAL STATUS:**
On Demand

**PERFORMANCE:**
Speeds: 80 KIAS up to Mach 2
Weight: 175 - 2500 lbs

**DESCRIPTION:**
Complete low cost drop test services, including rigging, instrumented weights and coordination of aircraft services.

**COMPARABLE FACILITIES**

Group P

**TESTING CAPABILITIES:**
Aircraft can be made available (C206, Twin Otter, Casa 212, F-4) for drop testing of instrumented systems.

**DATA ACQUISITION:**
Digital Recorder with 8 Analog Channels and PC Interface
Load cells, airspeed, and altitude measurement.

**PAST APPLICATIONS:**
Parachute and Parafoil testing in support of UAV, personnel and submunition recovery systems.

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Glen Brown, (714) 676-0604

# MISCELLANEOUS FACILITIES

**COMPANY:**
Vertigo, Inc.

**LOCATION:**
P.O. Box 117
Lake Elsiore, CA 92531-0117

**TYPE:**
Instrumented Test Vehicle

**SIZE:** N/A

**DATE BUILT:**
1988

**OPERATIONAL STATUS:**
On Demand

**PERFORMANCE:**
Speeds: 0-90 mph
Payload: 2000 lbs

**COMPARABLE FACILITIES**
Unique

**DESCRIPTION:**
Flat bed truck equipped and instrumented for parafoil and parachute testing.

**TESTING CAPABILITIES:**
Typical applications include measurement of parafoil Lift-to-Drag ratio and pilot chute force coefficients; optimization of parafoil trim; launch of test vehicles.

**DATA ACQUISITION:**
Digital Recorder with 8 Analog Channels and PC Interface
Load cells, airspeed, and altitude measurement

**PAST APPLICATIONS:**
UAV-MR - Parafoil Mars alternate recovery system
UAV-SR - Parafoil recovery system

**PLANNED IMPROVEMENTS:**
None

**LOCAL INFORMATION CONTACT:** Glen Brown, (714) 676-0604

# REPORT DOCUMENTATION PAGE

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**13. ABSTRACT (Maximum 200 words)**

This catalog serves as a single source reference for designers of landing and escape systems for spacecraft, aircraft, weapons, and airdrop system. It includes those facilities which may be required by a system designer in planning a development test program for many applications. The primary objective of this catalog is to provide a means for identifying critical facilities withj the U.S. which can be used for the development of landing and escape systems. A secondary objective is to provide a useful tool to the system designer for picking and choosing facilioties and capabilities. The six chapters in this volume include wind tunnels, drop zones, test aircraft, facrication facilities, design tools, and other misccellaneous facilities. A differenct data sheet format is used for each of the chapters which provides information on performance, location, special capabilities, and a local point of contact. All inpouts were solicitedfrom the individual facilities and have not been independently verified for accuracy.

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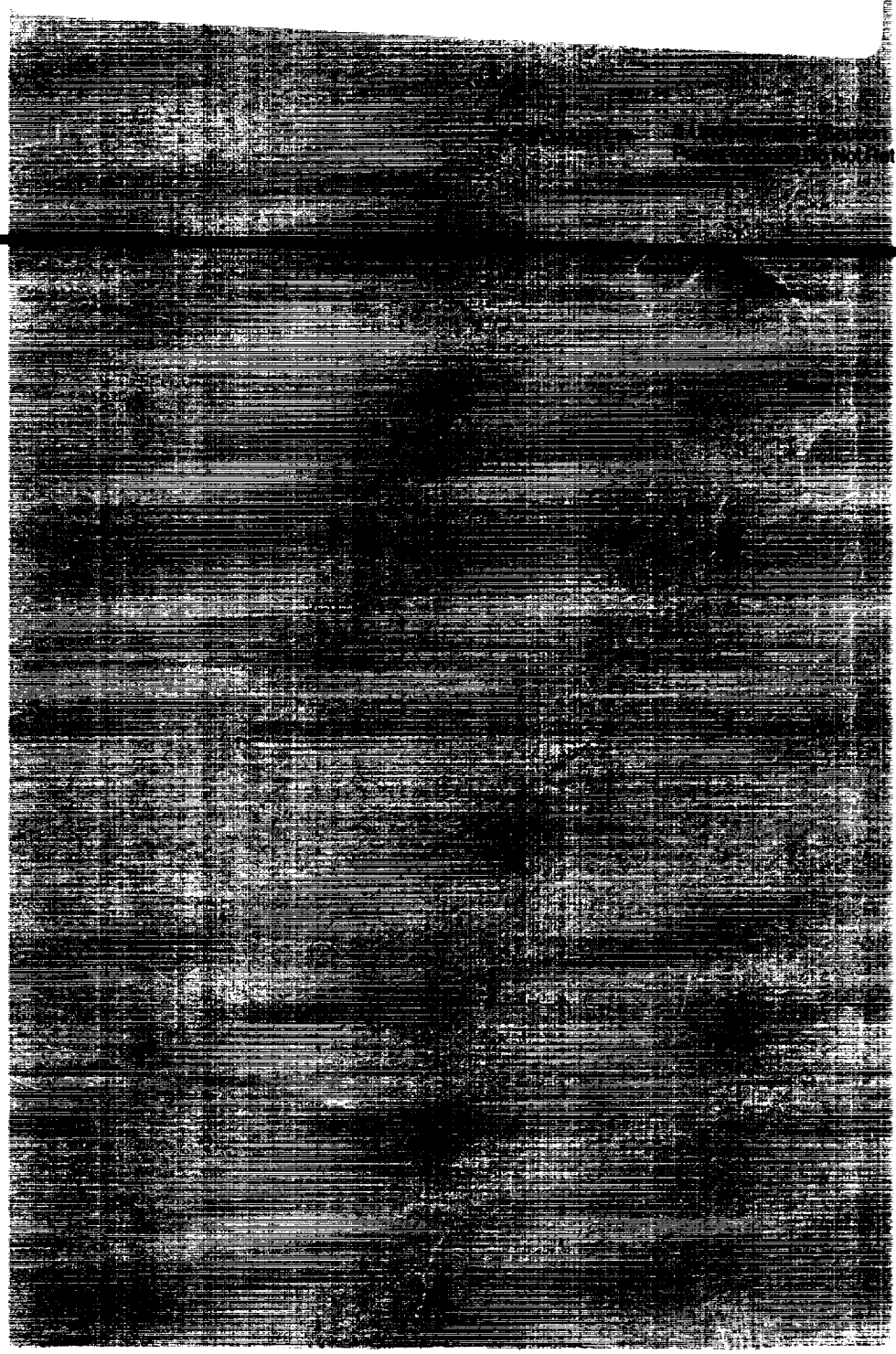

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