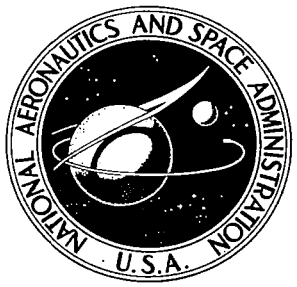

AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES

Volume III — Structural and Environmental Facilities

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16. Abstract

This Volume of the Aeronautical Ground Research Facility Inventory covers facilities in which the conditions of acceleration, environment, impact (or drop), structural shock, load, heat, vibration and noise may be imposed upon a test specimen, assembly or system. Structural and environmental testing varies widely in complexity and facility capability requirements. Simple static-load tests to evaluate strength of a single structural element or an altitude variation to check sealing qualities of a cockpit may be made with minimal equipment. Complete subsystems, or major subassemblies, however, may require much more complex testing involving simulations of combined environment and structural load. While all parameters may not be simulated at the same time it is common for a facility to provide combined simulations of more than two conditions. In limiting the number of facilities herein, total capability of a given installation is not necessarily represented, but those facilities shown are in keeping with the objective of the inventory to represent the major structural and environmental ground research capability in the United States.

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PREFACE

McDonnell Aircraft Company has conducted an inventory of Aeronautical Ground Research Facilities under contract number NAS 2-5458 (Modification 1) for NASA's Advanced Concepts and Missions Division, Office of Advanced Research and Technology (OART) located at Ames Research Center, Moffett Field, California. The inventory is intended to provide sufficient documented facility information to be used by government and industry engineers and scientific personnel for planning test programs relative to advanced aeronautical systems. The inventory is arranged by major facility category in four volumes for convenience.

Volume I - Wind Tunnels
Volume II - Airbreathing Engine Test Facilities
Volume III - Structural and Environmental Facilities
Volume IV - Engineering Flight Simulation Facilities

The primary content of each volume is a compilation of facility data pages which provide information descriptive of the general arrangement, performance, testing capability, and where available, acquisition and operating costs of each facility inventoried. Also, sufficient additional source references are provided for those requiring more detailed information. Summary tables in each volume list facilities by type and alphabetically by reporting installation along with brief data descriptive of the facility. An index of facilities is provided which is arranged alphabetically by reporting installation and functional name of each facility under that installation's cognizance.

This inventory was accomplished in five basic steps which included: (1) a literature search to identify candidate facilities, (2) formulation and distribution of appropriate questionnaire to facility operators, (3) preparation of preliminary facility data pages (based on completed questionnaires), (4) operator review of facility data pages to insure accuracy, and (5) final draft of the report.

The facilities included in this inventory do not necessarily represent the total ground research capability of each reporting installation, but rather its major capabilities. These facilities were chosen on the basis of several factors such as size, operating range, and uniqueness.

VOLUME III - ABSTRACT

STRUCTURAL AND ENVIRONMENTAL FACILITIES

This Volume of the Aeronautical Ground Research Facility Inventory covers facilities in which the conditions of acceleration, environment, impact (or drop), structural shock, load, heat, vibration and noise may be imposed upon a test specimen, assembly or system. Structural and environmental testing varies widely in complexity and facility capability requirements. Simple static-load tests to evaluate strength of a single structural element or an altitude variation to check sealing qualities of a cockpit may be made with minimal equipment. Complete subsystems, or major subassemblies, however, may require much more complex testing involving simulations of combined environment and structural load. While all parameters may not be simulated at the same time it is common for a facility to provide combined simulations of more than two conditions. In limiting the number of facilities herein, total capability of a given installation is not necessarily represented, but those facilities shown are in keeping with the objective of the inventory to represent the major structural and environmental ground research capability in the United States.

Facilities covered are grouped into seven categories and are defined as follows:

- Acceleration Facilities - are those devices which are designed to impose a linear or rotational acceleration upon a test specimen. Accordingly centrifuges and rocket powered sleds fall in this category. Centrifuges generate radial and tangential accelerations by driving the specimen on an arm about a pivot at constant or varying speed. Rocket powered sleds provide linear acceleration along a track. The test specimen is usually integral with the sled or mounted on the sled carriage. This device is used for evaluating the performance of assemblies and subsystems in the environmental conditions of low level flight.

- Environmental Chambers - are those chambers or test cells which are equipped to subject assemblies or subsystems to basic operational conditions of altitude, temperature and humidity. Other environments may include salt spray, dust, space and solar simulation, simulated aerodynamic heating, vibration, and acceleration.

- Impact and Drop Facilities - are those in which assemblies and subsystems are subjected to the impact loads of landing. Basic conditions simulated are vertical and horizontal impact velocity. Impact surfaces may vary according to the operational requirements of the system and may include concrete, sand, water, soil, asphalt or metallic surfaces.

- Shock Test Facilities - are those which employ specially designed machines or devices which impose high peak accelerations or pulse loads on assemblies or subsystems. Simulated operational load conditions include landing impact, stage or component separation, parachute opening, projectile firing, shock or blast wave propagation, target impact and rocket launching. The amplitude and period of the shock pulse generated may be a number of classic shapes including half sine, sawtooth, square and trapezoidal as well as tailored pulses depending upon the specific requirements of simulation.

- Structural Load and Fatigue Facilities - are those which provide for steady state and programmed cycled loading of structural elements, assemblies or complete full-size vehicles. Load simulations include aerodynamic, inertial, and mechanical. Conditions of aerodynamic heating and cryogenic cooling also may be simulated in some facilities in this category.

- Structural/Thermal Facilities - are those which are used for evaluation of structural assemblies and subassemblies under simulated flight conditions of load and heat produced by operational aerodynamics, plume impingement, solar radiation or nuclear blast.

- Vibration Facilities - are those which are equipped to evaluate structural assemblies and subsystems under conditions of dynamic loading. Accordingly facilities in this category include both acoustic and mechanical vibration types. Acoustic facilities provide high intensity sound for evaluation of test specimen reaction to resultant forces. Mechanical vibration facilities employ systems which shake the test specimen at frequencies and amplitudes which would be imposed by the flight environment of the vehicle.

TABLE OF CONTENTS

A. REPORTING INSTALLATION INDEX

B. SUMMARY TABLES

B.1. ACCELERATION FACILITIES, CENTRIFUGES (Government Owned)

Organization Location Facility Name GOVERNMENT OWNED	Type of Facility	Max. Specimen Size (ft) and Weight (lb)	Maximum RPM	Radius of Centrifuge Arm (ft)	Maximum Force (g-lb)	Maximum Acceleration (g)	Page
AFFDL Wright-Patterson Air Force Base, Ohio Synergistic Environmental Research Centrifuge	Combined environments centrifuge	2 ft Cube; 375	120	6	Not Available	30 (Steady-State) 50 (Sinusoidal or random)	1-2
AFRPL Edwards Air Force Base, California Centrifuge Test Facility	Combined environments centrifuge	Size not avail.; 30K (Includes vibration exciter & env. chamber)	84	13	900,000	30	1-4
AFSWC Holloman Air Force Base, New Mexico Holloman 260-Inch Precision Centrifuge	Counter-rotating platform centrifuge	4 diam x 4L; 800	116	21.7	30,000	100	1-6
NASA-Goddard Greenbelt, Maryland Launch Phase Simulator	Combined environments centrifuge	11 diam x 18L; 5000	38.3	76.5	150,000	30	1-18
NASA-MSC Houston, Texas Flight Acceleration Facility	Man-rated environmental centrifuge	12 diam; 3000	120	50	60,000	20	1-20

B.1.1. ACCELERATION FACILITIES, CENTRIFUGES (Industry Owned)

Organization Location Facility Name INDUSTRY OWNED	Type of Facility	Max. Specimen Size (ft) and Weight (lb)	Maximum RPM	Radius of Centrifuge Arm (ft)	Maximum Force (g-lb)	Maximum Acceleration (g)	Page
Bendix Aerospace Systems Division Mishawaka, Indiana Centrifuge Test Facility	Centrifuge	3x3x4.17; 600	155	7.5	36,000	88	1-8
General Dynamics Corp San Diego, California Combined Environmental, Vibration, Acceleration, & Temperature Centrifuge Facility	Combined environments centrifuge	7x10x12; 6000	120	20	600,000	100	1-10
Grumman Aerospace Corp Bethpage,L.I., N.Y. G-20 Centrifuge	Centrifuge	.032 ft^3; 2000	88	23	2,000	60	1-12
McDonnell Douglas Corp St. Louis, Missouri Acceleration Test Facility	Centrifuge	3x3 (Mounting platform); 500	315	6	20,000	200	1-14
McDonnell Douglas Corp Santa Monica, Calif. Centrifuge Test Facility (Unit 143)	Centrifuge	9.5 (Clearance to wall on $\mathcal{L}$), 4.2 (Clearance to floor on $\mathcal{L}$)-Short Arm; 9000-Short Arm	150	15.8 (Long arm)	76,000	150	1-16
North American Rockwell Corporation Los Angeles, Calif. Space Station Rotational Test Facility	Man-rated environmental centrifuge	12 diam; 20,000	9	80	40,000	2	1-22
Wyle Laboratories Norco, California Combined Environment Centrifuge Test Facility	Combined environments centrifuge	6x6 (Mounting platform size), 15,000 (Includes fixture)	105	22	150,000	42	1-24

B.1. ACCELERATION FACILITIES, SLED TEST TRACKS (Government Owned)

Organization Location Facility Name GOVERNMENT OWNED	Type of Facility	Maximum Payload (lb)	Track Length (ft)	Maximum Velocity (ft/sec)	Maximum Deceleration (g)	Maximum Acceleration (g)	Page
AFSWC Holloman Air Force Base, New Mexico Holloman Test Track Facility	Rocket powered sled test track	16,000	35,588	8200	75	200	1-26
NWC China Lake, California Supersonic Naval Ordnance Research Track (SNORT)	Rocket powered sled test track	128,000	21,550	6000	100	100	1-28
NWC China Lake, California B-4 Transonic Test Track	Rocket powered sled test track	2,000	14,560	1980	15	50	1-30

B.2. ENVIRONMENTAL CHAMBERS (Government Owned)

Organization Location Facility Name GOVERNMENT OWNED	Type of Environments Simulated	Chamber Dimensions (ft)	Man-Rated	Temperature Range (°C)	Altitude (ft)	Minimum Work Pressure (Torr)	Page
AFFDL Wright-Patterson Air Force Base, Ohio Combined Environments Research Laboratory	Altitude, Thermal	18 I.D. x 17H Max. size	Yes	-62 to +80	150,000	-	2-4
AFRPL Edwards Air Force Base, California Space Propulsion Environmental Facility	Space Simulations, Altitude, Solar Simulation, Thermal	30 diam sphere	No	-184 to +204	-	$1x10^{-6}$	2-6
AFSWC Holloman Air Force Base, New Mexico Holloman Stratosphere Chamber	Altitude, Humidity, Solar Simulation	8Wx8Hx11L 4Wx8Hx4L (Anteroom)	No	-75 to +90	200,000	-	2-8
AEDC Arnold Air Force Station, Tennessee Aerospace Environmental Chamber (Mark I)	Space Simulations, Altitude, Solar Simulation, Thermal, Vibration	Not Available	Not Available	Not Available	Not Available	Not Available	2-10
NASA-Goddard Greenbelt, Maryland Environmental Facilities	Space Simulations, Altitude, Solar Simulation, Thermal	27.5 diam x 40H (Test volume)	No	-163 to +85	-	10^{-9} to 10^{-10}	2-40
NASA-Langley Hampton, Virginia Dynamics Research Lab.	Space Simulations, Altitude, Vibration, Shock, Acceleration & Thermal	55H	Yes	23 to 149	-	$1x10^{-4}$	2-44
NASA-Langley Hampton, Virginia Altitude Control Simulator Facility	Space Simulations, Solar Simulation, Thermal	60 diam	No		-		2-46
NASA-Langley Hampton, Virginia 60-Foot and 41-Foot Space Simulators	Space Simulations	60 diam & 40 diam			-		2-48
NASA-MSC Houston, Texas Crew Systems Division Environmental Chambers	Space Simulations, Altitude	20 diam x 20H (Main chamber) 10 diam x 9H (Inner Lock)	Yes	-207 to +145	225,000	-	2-50
NASA-MSC Houston, Texas Space Environment Simulation Laboratory	Space Simulations, Solar Simulation	65 diam cylinder	Yes	To -185	-	$1x10^{-6}$	2-52
NASA-Marshall Huntsville, Alabama Ultra-High Vacuum Facility	Space Simulations	15 diam x 20H	No	To -163	-	$1x10^{-9}$	2-54

B.2. ENVIRONMENTAL CHAMBERS (Industry Owned)

Organization Location Facility Name INDUSTRY OWNED	Type of Environments Simulated	Chamber Dimensions (ft)	Man-Rated	Temperature Range (°C)	Altitude (ft)	Minimum Work Pressure (Torr)	Page
AC Electronics Milwaukee, Wisconsin Space Simulation Facility	Space Simulations, Solar Simulation, Thermal	7.5 diam x 10L	No	-196 to +93	-	$5x10^{-11}$	2-2
Bendix Aerospace Systems Division Ann Arbor, Michigan Thermal/Vacuum Lab	Space Simulations, Solar Simulation	20 diam x 27L	No	-180 to +150	-	$5x10^{-8}$	2-12
The Boeing Company Seattle, Washington Altitude Environmental Facility	Space Simulations, Altitude, Thermal	19 diam x 33L	No	Not Available	220,000	-	2-14
The Boeing Company Seattle, Washington Environmental Temperature Test Facility	Humidity, Thermal	30x30x80	Not Available	-54 to +46	Atmospheric	-	2-16
The Boeing Company Seattle, Washington Space Environment Lab	Space Simulations, Solar Simulation	39 diam x 50H	No	Not Available	-	$1x10^{-7}$	2-18
General Dynamics Corp. Fort Worth, Texas High Altitude Lab	Altitude, Humidity, Thermal, Low Temp	(2),34x50x14 (3),35x20x14	No	-73 to +205	120,000	3.3	2-20
General Electric Co. Philadelphia, Pa. Solar Thermal Vacuum Chamber & Thermal Vacuum Chambers	Space Simulations, Solar Simulation	21 diam max. specimen size	No	-179 to Ambient	-	$1x10^{-9}$	2-24
Grumman Aerospace Corp Bethpage, L.I., N.Y. Thermal/Vacuum Space Simulation Lab	Space Simulations, Altitude	15Wx20H	Not Available	-206 to +176	-	$1x10^{-7}$	2-28
Hughes Aircraft Co. Culver City, Calif. Environmental Lab	Altitude, Thermal	7x7x18	No	-75 to +180	-	Not Available	2-32
Hughes Aircraft Co. Los Angeles, Calif. Space Simulation Lab	Altitude, Thermal	15 diam x 36H	No	-195 to +135	-	$5x10^{-7}$	2-34
McDonnell Douglas Corp. Huntington Beach, Calif. Space Simulation Lab	Space Simulations	39 diam sphere	Yes	Ambient & -195	-	$1x10^{-9}$	2-36
McDonnell Douglas Corp. St. Louis, Missouri 30-Ft Diam Cylindrical Space Simulation Chamber	Space Simulations, Thermal	30 diam x 36L	Yes	-175 to +95	-	$5x10^{-9}$	2-38

B.2. ENVIRONMENTAL CHAMBERS (Industry Owned) (Continued)

Organization Location Facility Name INDUSTRY OWNED	Type of Environments Simulated	Chamber Dimensions (ft)	Man-Rated	Temperature Range (°C)	Altitude (ft)	Minimum Work Pressure (Torr)	Page
North American Rockwell Corporation McGregor, Texas Environmental Test Facility	Altitude	3.3 diam x 15L	No	-35 to +129	200,000	$5x10^{-4}$	2-56
North American Rockwell Corporation Downey, California Environmental Lab	Altitude	18 diam max. size	Yes	-185 to +315	240,000	-	2-58
RCA Princeton, New Jersey Environmental Test Center	Space Simulations, Thermal	24 diam x 20 full open	No	-175 to +120	-	$5x10^{-6}$	2-60
Wyle Laboratories Huntsville, Alabama Environmental Chambers	Thermal	10x12x33	No	Not Available	Not Available	Not Available	2-62

B.3. IMPACT AND DROP FACILITIES (Government and Industry Owned)

Organization Location Facility Name	Type of Facility	Maximum Specimen Weight (lb)	Vertical Drop Height (ft)	Horizontal Travel Length (ft)	Incline Rail Slope (degrees)	Maximum Impact Velocity (ft/sec)	Page
GOVERNMENT OWNED							
NASA-Langley Hampton, Virginia Impacting Structures Facility	Slingshot, pendulum, catapult, or monorail launch for impact tests			1100 max.		200 (Vertical) 21 (Horizontal)	3-6
NASA-Langley Hampton, Virginia Landing Loads Track	Steel and concrete track w/ drop frame	20,000		2177		18 (Vertical) 220 (Horizontal)	3-8
NASA-MSC Houston, Texas Landing and Impact Test Facility 338	Monorail w/ pneumatic catapult for launch to impact	15,000	25	100	Not Applicable	65 @ 13,000 lb 103 @ 4,900 lb	3-10
INDUSTRY OWNED							
Grumman Aerospace Corp Bethpage, L.I., N.Y. Drop Test Facilities	Drop test facility	60,000	To 33	Not Applicable	Not Applicable	24	3-2
McDonnell Douglas Corp St. Louis, Missouri Landing and Shock Simulation Facility	Drop test facility	60,000	15	Not Applicable	Not Applicable	30	3-4

B.4. SHOCK TEST FACILITIES (Government and Industry Owned)

Organization Location Facility Name	Type of Major Shock Test Machines and No. of Units	Max. Specimen Size (in) and Weight (lb)	Maximum Force (g's) or (lb)	Pulse Shape	Pulse Duration (msec)	Max. Drop Height or Travel (in)	Page
GOVERNMENT OWNED							
U.S. Naval Ordnance Laboratory Silver Spring, Md. Air Guns	26-Inch Air Gun, (1)	30x120, 9,500	5000K lbs	Not Available	Not Available	1082	4-20
INDUSTRY OWNED							
Bendix Aerospace Systems Division Mishawaka, Indiana Shock Test Facilities	Hydro-pneumatic, (1);	30x30x240, 4,000;	60g	Half-sine, Trapezoid;	25-80	72	4-2
	Free Fall, (1)	36x36x104, 1,000	500g	Half-sine Square, Saw tooth	3-30	96	
The Boeing Company Seattle, Washington Shock Test Lab	Horizontal pneumatic in pulse,(1)	48x48x60, 4,000	4,500K g-lb	Saw tooth, Half-sine, Square, Impulse	3-40	167 & 234	4-4
General Dynamics Corp. Electric Boat Division Groton, Connecticut Shock Test Facilities	Floating barge exposed to underwater explosive attack, (1)	Variable; 60,000	Per MIL-S-901	Not Available	Not Available	Not Applicable	4-6
General Dynamics Corp. Fort Worth, Texas Shock Test Facilities	Pneumatic, (1)	30x30x24, 2,000	40K lb	Half-sine	11-20	240	4-8
Hughes Aircraft Co. Culver City, Calif. Shock Test Facilities	Free Fall, (1)	36x36x60, 2,000	1000g	Half-sine, Saw tooth	3-40	84	4-10
Hughes Aircraft Co. Fullerton, California Shock Test Facilities	Mechanical, (1)	Varies w/weight and c.g.; 6,000	Per MIL-S-901	Not Available	Not Available	Per MIL-S-901	4-12
LTV Aerospace Corp. Dallas, Texas Shock Test Facilities	Free Fall, (1)	30x30x30, 450	180g	Half-sine	6.5-32	40	4-14
McDonnell Douglas Corp. St. Louis, Missouri Shock Test Facilities	Pneumatic, (1)	Not Available, 750	40K lb	Half-sine, Saw tooth	6-30	120	4-16
McDonnell Douglas Corp. Santa Monica, Calif. Shock Test Facility	Pneumatic, (1)	18 diam x 120L, 400;	40K lb	Half-sine, Saw tooth, Square	1-11	240	4-18
	Electrical, (1)	30 diam x 240, 2,000;	32K lb	Half-sine, Transient	Not Available	1.0	
	Electrical, (1)	20 diam x 144, 1,000	17.5K lb	Half-sine, Transient	Not Available	1.25	
New York Testing Laboratories Westbury, L.I., N.Y. Shock Test Facilities	Free Fall, (1)	12x12x12 100	1500 g	Half-sine, Saw tooth	5-10	24	4-22

B.4. SHOCK TEST FACILITIES (Industry Owned) (Continued)

Organization Location Facility Name INDUSTRY OWNED	Type of Major Shock Test Machines and No. of Units	Max. Specimen Size (in) and Weight (lb)	Maximum Force (g's) or (lb)	Pulse Shape	Pulse Duration (msec)	Max. Drop Height or Travel (in)	Page
Philco-Ford Corp. Aeronutronic Division Newport Beach, Calif. Shock Test Facilities	Free Fall, (1)	24x24, 1,000	2000g	Half-sine, Saw tooth	.3-30	106	4-24
Teledyne Brown Engineering Company Huntsville, Alabama Shock Test Facilities	Mechanical (Inclined Plane), (1)	Not Available, 4,000	240K lb	Half-sine, Saw tooth, Square	2-100	216	4-26
Wyle Laboratories Huntsville, Alabama Shock Test Facilities	Mechanical (Inclined Plane), (1)	144x144, 10,000		Half-sine, Saw tooth, Square	.5-200	480	4-28

B.5. STRUCTURAL LOAD AND FATIGUE FACILITIES (Government Owned)

Organization Location Facility Name GOVERNMENT OWNED	Type of Testing Capability	Typical Max. Specimen Size (ft) and Weight (lb)	No. of Load System Channels	Size of Floor Avail. For Testing (ft^2)	Test Machine Types	Radiant Heat System Capab. (kVA)	Page
AFFDL Wright-Patterson Air Force Base, Ohio	Struct. loads, struct. fatigue, thermal, cryogenic	160x230x50, 415,000	166	42,670	Static tension & compression, fatigue	50,400	5-2
NASA-Langley Hampton, Virginia Fatigue Research Laboratory	Struct. loads, struct. fatigue, shock, vibration	Not Available	Not Available	Not Available	Tension-compression, fatigue, cyclic, creep	Not Available	5-34
NASA-Langley Hampton, Virginia Structures Research Laboratory	Struct. loads, struct. fatigue, thermal	Not Available	Not Available	Not Available	Tension-compression, shear torsion, horizontal bending, fatigue	Not Available	5-36
NASA-MSC Houston, Texas Structures Test Laboratory	Struct. loads, struct. fatigue, thermal, materials	80x50x30, No Limit	21	13,700	Universal test	13,000K watts	5-38
NASA-Marshall Huntsville, Alabama Structural Static Test Facility	Struct. loads, cyclic	64 diam x 45H, 30,000,000	Not Available	Not Available	Universal test	Not Available	5-40
Naval Air Development Center Warminster, Pa. Aero Structures Test Facility	Struct. loads, struct. fatigue, thermal	100x100x30, Not Available	14	38,000	Universal test & fatigue	8,000	5-42

B.5. STRUCTURAL LOAD AND FATIGUE FACILITIES (Industry Owned)

Organization Location Facility Name INDUSTRY OWNED	Type of Testing Capability	Typical Max. Specimen Size (ft) and Weight (lb)	No. of Load System Channels	Size of Floor Avail. For Testing (ft^2)	Test Machine Types	Radiant Heat System Capab. (kVA)	Page
The Boeing Company Seattle, Washington Boeing Fracture, Static,Stress,Fatigue Analysis & Exposure Laboratories	Struct. loads, struct. fatigue impact or drop, thermal, shock vibration, cryogenic	85 High, Not Available		18,690	Static tens. or compression, fatigue cyclic		5-4
The Boeing Company Seattle, Washington Full-Scale Airplane Static and Fatigue Test Facility	Struct. loads, struct. fatigue	250x240x60, 800,000		90,000	Static, fatigue		5-8
The Boeing Company Seattle, Washington Space Center Structural Test Facility and Materials Lab.	Struct. loads, struct. fatigue, impact or drop, thermal, shock vibration, cryogenic	96x96x85, 80,000	254	9,200	Universal test & fatigue test machines	9360 kW	5-10
The Boeing Company Seattle, Washington Structural Component Test Laboratory	Struct. loads, struct. fatigue	Not Available		21,850	1000 K lb test machine, static fatigue	4000	5-12
The Boeing Company Wichita, Kansas Structural Laboratories	Struct. loads, struct. fatigue, thermal, shock, vibration, creep cryogenic	160x200x55, 600,000	64	99,585	Creep, fatigue, load rams universal test vibration	1320	5-14
Chrysler Corporation New Orleans, La. Engineering Test Laboratories	Struct. loads, struct. fatigue, impact or drop, shock, vibration, cryogenic	Not Available	60	1,743,221	Not Available	Not Available	5-16
General Dynamics Corp. San Diego, Calif. Structures Test Lab. & Cryogenic Tensile Test Laboratory	Struct. loads, struct. fatigue, impact or drop, thermal cryogenic	120x130x45, 100,000	96	33,700	Universal test	Not Available	5-18
General Dynamics Corp. Fort Worth, Texas Structural Test Facilities	Struct. loads, Struct. fatigue	40 High, Not Available	162	30,000	Not Available	Not Available	5-20
Grumman Aerospace Corp Bethpage, L.I., N.Y. Structural Test	Struct. loads, struct. fatigue, impact or drop	40x50x15, 60K (impact or drop)	20	59,000	Universal test	Not Available	5-22
LTV Aerospace Corp. Dallas, Texas Mechanical Properties Laboratory	Struct. loads, struct. fatigue, impact, thermal, hydro dynamic	12x2.5x6, 1000	15	2500	Creep, fatigue, static tension-comp.	1050	5-24

B.5. STRUCTURAL LOAD AND FATIGUE FACILITIES (Industry Owned) (Continued)

Organization Location Facility Name INDUSTRY OWNED	Type of Testing Capability	Typical Max. Specimen Size (ft) and Weight (lb)	No. of Load System Channels	Size of Floor Avail.For Testing (ft^2)	Test Machine Types	Radiant Heat System Capab. (kVA)	Page
LTV Aerospace Corp. Dallas, Texas Structures Test Laboratory	Struct. loads, struct. fatigue, impact or drop	70x68x26, 39,000	128	26,800		-60 to +2000°F	5-26
McDonnell Douglas Corp Long Beach, Calif. Engineering Development Center	Struct. loads, struct. fatigue	Not Available, 60,000	500	150,945	Not Available	Not Available	5-28
McDonnell Douglas Corp St. Louis, Missouri Structures Laboratory	Struct. loads, struct. fatigue, impact or drop, thermal, shock, vibration	Not Available	40	26,000	Fatigue, cyclic, tension-compression	See thermal section	5-30
McDonnell Douglas Corp Huntington Beach,Calif Structures Test Lab.	Struct. loads, struct. fatigue, impact or drop, thermal,pressure vibration cryogenic	50x50x70, Not Available	309	20,250	Tension-compression jacks	9000	5-32
North American Rockwell Corporation Downey, California Structural Test Laboratory	Struct. loads, struct. fatigue, impact or drop, thermal, shock, vibration	120x40x25, 20,000	Not Available	25,340	Universal test	36 channels	5-44
Wyle Laboratories Huntsville, Alabama High Force Test Facility	Struct. loads, thermal, vibration	Not Available	Not Available	8150	Not Available	Not Available	5-46

B.6. STRUCTURAL/THERMAL FACILITIES (Government and Industry Owned)

Organization Location Facility Name	Type of Facility	Maximum Heat Flux Attainable (Btu/ft^2 sec)	Maximum Temperature Attainable (°F)	No. of Power Control Channels	Power Supply Capacity (kVA)	Type of Infrared Heaters	Page
GOVERNMENT OWNED							
NASA Flight Research Center Edwards Air Force Base, California	Radiant Heat with Structural Loads & Vibration	100 (Over small areas)	3000	103	20,000	Quartz Lamps	6-6
INDUSTRY OWNED							
McDonnell Douglas Corp Huntington Beach, California Thermal Test Facility	Radiant Heat	120	3000	18	9,000	Quartz Lamps, Graphite	6-2
McDonnell Douglas Corp St. Louis, Missouri Transient Heat Facility	Radiant Heat with Structural Loads	150 (Over 1 ft^2 area) 120 (Over larger areas)	3500 3000	75	34,000	Quartz Lamps	6-4

B.7.1. VIBRATION FACILITIES, ACOUSTIC (Government and Industry Owned)

Organization Location Facility Name	Type of Facility	Chamber Volume and Inside Dimensions (ft^3), (ft)	Maximum Sound Pressure Level (dB)	Frequency Range (Hz)	Acoustic Power (watts)	Type of Generator	Page
GOVERNMENT OWNED							
AFFDL Wright-Patterson Air Force Base, Ohio Sonic Fatigue Facility	Reverberant or Progressive Wave Chamber	154,000; 70x56x42H	174 (Prog. Wave) 162 (Reverb.)	50-10,000	1000K	Pure tone sirens	7-2
NASA-MSC Houston, Texas Spacecraft Acoustic Laboratory	Progressive Wave, Prog.Wave Reverb. Fill-In, or Full Reverb.	441,000 60x70x105H	169	20-2000	160,000	Air modulators	7-20
INDUSTRY OWNED							
The Boeing Company Seattle, Washington Anechoic-Reverberant Chamber	Anechoic & Reverberant Chambers	733; 8.33x11x8 (Anechoic) 5225;7.7x22x13.5 (Reverberant)	150 (Overall)	10-10,000	2000	Electro-pneumatic	7-4
The Boeing Company Seattle, Washington Sonic Test Facility	Progressive Wave Test Cell	4680; 30x12x13	To 172	50-10,000	60,000	Ling - EPT-110	7-6
General Dynamics Corp. Convair Division San Diego, California Acoustics Laboratory	Reverberant Chamber	20,000; 35x26x22H	To 120	50-10,000	2000	Speakers	7-8
General Dynamics Corp. Electric Boat Division Groton, Connecticut Acoustic Test Facility	Reverberant Chamber	5000; 17x21.5x13.5	Not Available	Not Available	Not Available	Not Available	7-10
General Dynamics Corp. Fort Worth Division Fort Worth, Texas Acoustic Test Facility	Anechoic Chamber	432; 6x6x12	185	94-2000	Not Available	Sinusoidal Siren	7-12
LTV Aerospace Corp. Dallas, Texas Acoustic Laboratory	Reverberant Chamber	5700; 18x22x14.5H	158	50-10,000	20,000	Electro-pneumatic	7-14
Lockheed Missiles and Space Company Sunnyvale, California Large Vehicle Acoustic Test Facility (LVATF)	Reverberant Chamber	189,000; 44x50x86H	156	40-10,000	240,000	Ling EPT-200 & Wyle WAS 3000	7-16
McDonnell Douglas Corp Santa Monica, Calif. Acoustics Laboratory	Reverberant Chamber	10,000; 18x21x28	170	50-1250	80,000	Air modulators	7-18
Wyle Laboratories Huntsville, Alabama Acoustic Test Facilities	Reverberant Chamber	100,000; 40x50x60	155	Not Available	120,000	Air modulators	7-22

B.7.2. VIBRATION FACILITIES, MECHANICAL (Government Owned)

Organization Location Facility Name GOVERNMENT OWNED	Type of Major Vibration Exciters and No. of Units	Max. Specimen Size (in) and Weight (lb)	Maximum Acceleration (g)	Maximum Force Sine/ Random (lb)	Frequency Range (Hz)	Double Amplitude (in)	Page
NASA-Ames Moffett Field, Calif. Structural Dynamics Laboratory	Hydraulic, (1) Hydraulic, (4)	Not Available Not Available	50 @ 2400 lb 10	100K/- 1000K/- (4 units combined)	0-150	3 8	7-48
NASA-MSC Houston, Texas Vibration and Acoustic Test Facility (VATF)	Electrical, (1) Electrical, (8)	Not Available, 2600 @ 10g; Not Available 94 @ 10g	75 100	30K/28K 10K/-	5-2000 5-2000	1 1	7-50
NASA-Marshall Huntsville, Alabama S-V Dynamic Test Stand	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	7-54

B.7.2. VIBRATION FACILITIES, MECHANICAL (Industry Owned)

Organization Location Facility Name INDUSTRY OWNED	Type of Major Vibration Exciters and No. of Units	Max. Specimen Size (in) and Weight (lb)	Maximum Acceleration (g)	Maximum Force Sine/ Random (lb)	Frequency Range (Hz)	Double Amplitude (in)	Page
Bendix Aerospace	Hydraulic, (1)	Not Available	20	15K/-	2-500	2	7-24
Systems Division	Electrical, (1)	Not Available	100	10K/8K	5-3000	1	
Mishawaka, Indiana	Electrical, (2)*	Not Available	100	8K/14.5K	5-3000	1	
Vibration and Acoustic Test Facilities	*can be combined						
The Boeing Company	Electrical, (4)*	Not Available	75	30K/32K	5-2000	1	7-26
Kent, Washington	*can be combined						
Vibration Laboratory	Electrical, (1)	Not Available	71	25K/17.7K	5-2000	1	
Dayton T. Brown	Electrical	Not Available, 1,000;	100	10K/8K	5-3000	1	7-28
Bohemia, L.I., N.Y.	Electrical	Not Available, 5,000;	78	28K/20K	5-2000	1	
Vibration Testing Facilities	Hydraulic, (4)*	Not Available, 10,000;	10	60K/-	1-50	2.5	
	*combined						
General Dynamics Corp.	Electrical	Not Available	100	22K/18.5K	5-2000	1	7-30
Convair Division	Electrical	Not Available	100	21.5K/15K	5-2000	1	
San Diego, California	Electrical, (2)*	Not Available	44	15K/10.6K	5-2000	1	
Vibration Test Lab	*can be combined	410 @ 20g					
General Dynamics Corp.	Electrical	24x24x24, 200;	60	6.5K/4.5K	5-2000	1	7-32
Fort Worth Division Fort Worth, Texas	Electrical	60x60x60,	60	12.5K/-	5-2000	1	
Vibration Test Facilities		1,000					
General Electric Co.	Electrical, (2)*	Not Available	87	35K/35K	5-2000	1	7-34
Philadelphia, Pa.	*can be combined						
Dynamic Simulation Lab	Electrical, (1)	Not Available	175	17.5K/15K	5-3000	1	
	Electrical Array	Not Available	100	54K/36K	5-3000	1	
Grumman Aerospace Corp	Electrical	Not Available, 2,604;	75	30K/32K	5-2000	1	7-36
Bethpage, L.I., N.Y.							
Vibration Laboratory	Electrical	Not Available, 1,000	100	15K/12.5K	5-2500	1	
Hughes Aircraft Co.	Mechanical	Not Available	10g	77K/-	5-60	.125	7-38
Culver City, Calif.	Electrical	Not Available	79g	30K/30K	5-2000	1	
Vibration Test Facility							
Hughes Aircraft Co.	Hydraulic, (1)	72x72 (Approx.), 10,000;	5	50K/-	5-500	1	7-40
Fullerton, California							
Vibration Test Facility	Mechanical Reaction, (1)	60x60x60, 5,000	5	25K/-	5-60	.2	
LTV Aerospace Corp.	Electrical	Not Available	100	15K*/11K	0-5000	1	7-42
Dallas, Texas				*can be combined			
Vibration Test Facility	Electrical	Not Available	100	17.5K/13K	0-5000	1	
McDonnell Douglas Corp	Electrical	Not Available	75	30K/28K	5-2000	1	7-44
St. Louis, Missouri	Electrical	Not Available	150	17.5K/15K	5-3000	1.25	
Vibration Test Facilities	(Combined capability exists)						

B.7.2. VIBRATION FACILITIES, MECHANICAL (Industry Owned) (Continued)

Organization Location Facility Name INDUSTRY OWNED	Type of Major Vibration Exciters and No. of Units	Max. Specimen Size (in) and Weight (lb)	Maximum Acceleration (g)	Maximum Force Sine/ Random (lb)	Frequency Range (Hz)	Double Amplitude (in)	Page
McDonnell Douglas Corp Santa Monica, Calif. Vibration Test Facilities	Electrical, (2) Electrical, (4) (Combined capability exists)	216Wx240H, 1,100 @ 20g; 144H, 770 @ 20g	75 150	30K/32K 17.5K(14K)	5-2000 5-3000	1 1.2	7-46
North American Rockwell-Autonetics Anaheim, California Dual Shaker System	Electrical, (2)	Not Available	Not Available	50K/40K (Combined)	5-2000	.9	7-56
North American Rockwell Corporation Downey, California Dynamic Simulation Laboratory	Electrical, (4) Electrical, (6)	Not Available, 30,000 @ 1g; Not Available, 10,000 @ 1g	78 100	30K/32K 10K/7K	5-2000 5-2000	1 1	7-58
Wyle Laboratories Huntsville, Alabama High Force Vibration Facility	Electro-hydraulic, (8) Electrical, (1)	480 (on a side), 200,000; Not Available, 2,604 @ 1g	16 75	400K/400K (Combined) 30K/28K	2000 5-2000	1 1	7-60
Wyle Laboratories Norco, California Vibration Test Facilities	Electrical, (4)* *4 can be combined Electrical Team, (1)	Not Available Not Available Not Available	75 100 Not Available	30K/32K 22K/21K 100K/-	5-2000 5-2000 0-500	1 1 Not Available	7-62

1. ACCELERATION

AFFDL SYNERGISTIC ENVIRONMENTAL RESEARCH CENTRIFUGE

REPORTING INSTALLATION: Air Force Flight Dynamics Laboratory Wright-Patterson Air Force Base Ohio 45433	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Vehicle Equipment Division
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: J. F. Dreher Environmental Control Branch Phone: (513) 255-5195

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of an environmental chamber which houses a centrifuge and an associated vibration exciter. A test specimen can also be subjected to a thermal environment up to 1000°F. Construction of the facility was completed during the past year.

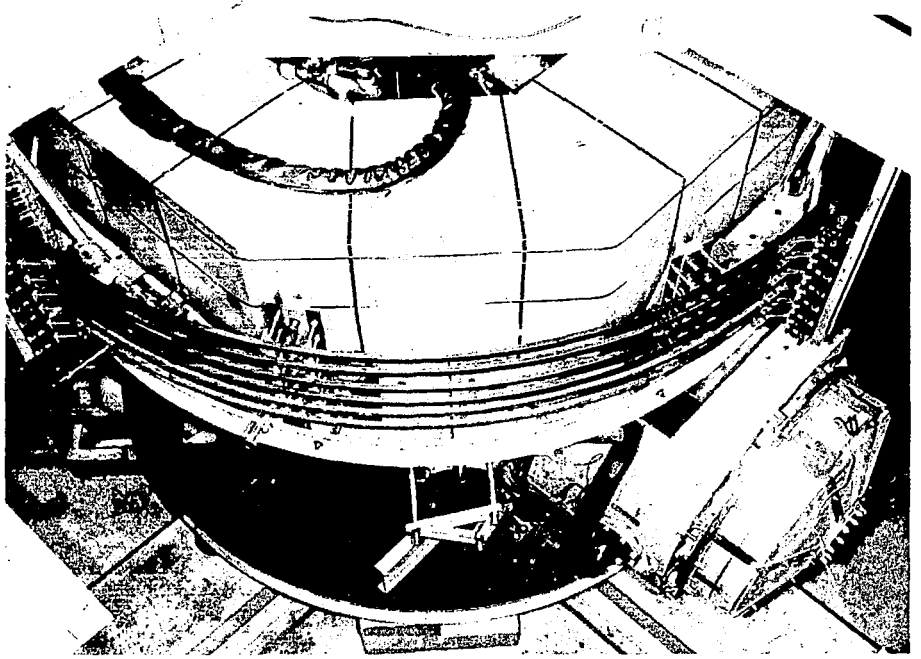
TESTING CAPABILITIES: This facility has the capability to subject specimens to combined environments of acceleration, vibration, temperature, and altitude.

FACILITY COST HISTORY

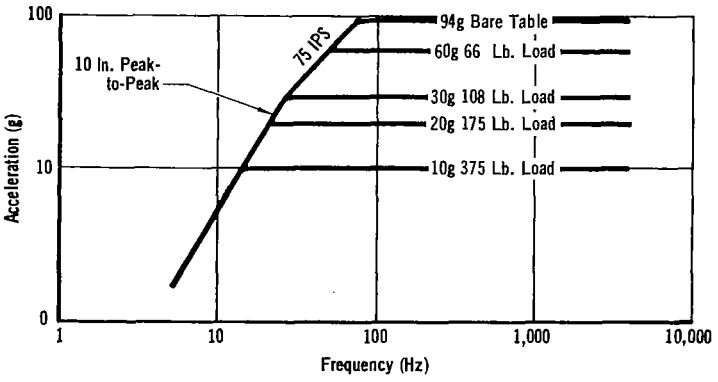
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $285	CONSTRUCTION YEAR: 1969 COST $ Not Available ESTIMATED REPLACEMENT VALUE $480,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer: AFFDL-designed

Radius of Centrifuge Arm (ft): 6

Maximum RPM: 120

Maximum Force (g-lb): Not Available

Maximum Acceleration (g): 30 (Steady-State)
50 (Sinusoidal or Random)

Maximum Specimen Weight (lb): 375

Maximum Specimen Size (feet): 2 ft cube

Number of Slip Rings: 168

Number of Hydraulic and Pneumatic Rotary Joints: 1

Temperature Range (°F): -300 to +1000
Pressure Range (Torr): 1×10^{-6}
Maximum Vibratory Motion (in): .5
Vibratory Frequency Range (Hz): 5 to 2000

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
Haines Designed Products Corp.	3794C	4.5	225	40,000	100		100	18x18x18	Closed Circuit TV

AFRPL CENTRIFUGE TEST FACILITY

REPORTING INSTALLATION: Air Force Rocket Propulsion Laboratory Edwards Air Force Base California 93523	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Test and Operations Division RPF
OTHER SOURCES OF INFORMATION: AFRPL Test Facility Brochure	LOCAL OFFICE TO CONTACT FOR INFORMATION: C. A. Notar, Branch Chief Area A (RPFA) Phone: (714) 553-2218

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility combines in one machine and at one location the potential for testing rocket and missile components under simulation of actual flight conditions. In most cases it can exceed these hypothetical conditions in order to provide a margin for reliability and for quality control testing. This facility consists of five major divisions: (1) Centrifuge machine and allied equipment; (2) Environmental chamber and humidity system; (3) Vibration exciter and support equipment; (4) Cryogenic fluid flow systems, and (5) Building and attachments. The base of the centrifuge itself is mounted in triple-reinforced 3000 lb test concrete poured directly against raw exposed granite in the foundation. This results in a predictively accurate rotational stability of the centrifuge rotor, which when fully loaded, weighs approximately 50,000 lb. The machine can be used as a simple centrifuge by removing the environmental chamber and vibration exciter normally mounted in the bucket end of the rotor arm and attaching thereto the desired test specimen. The bucket further has the capability of being rotated up to 90° from the horizontal to permit two-plane testing with one mounting. At full potential, the centrifuge has mounted on the rotor, in addition to the environmental chamber and vibration exciter, a 700 gallon liquid nitrogen tank which supplies liquid nitrogen for cooling of the environmental chamber. Also mounted on the rotor are two cryogenic tanks for helium service rated at 10 cu ft at 6000 psi, and two cylindrical tanks rated at 10 cu ft at 1000 psi for liquid nitrogen or fuel service. The counterweight frame diametrically opposed from the bucket side of the rotor contains, in addition to the counterweight, a heat exchanger and coolant circulating pump and controls necessary to maintain the vibration exciter at a constant temperature.

TESTING CAPABILITIES: During a component or assembly test using this facility, nearly all environments to which an assembly or component will be subjected during flight conditions can be simultaneously simulated. These include: (1) The centrifuge can simulate G forces, constant or variable, in one plane; (2) The environmental chamber can vary the temperatures that the tested component will see in actual use; (3) The vibration exciter can superimpose on top of these the constantly changing vibration and resulting loadings that the test component must sustain, and (4) Another feature of this facility is flow potential. Operation of valving, pumps, and other hardware used on liquid propellant rocket engines is of prime importance. This facility has the built-in equipment to supply these components with liquids or gases at either ambient temperature or elevated or depressed ranges. Temperature ranges of conditioned fluids between -320°F and +500°F are possible. The flow rates are consistent with pressures up to 6000 psig.

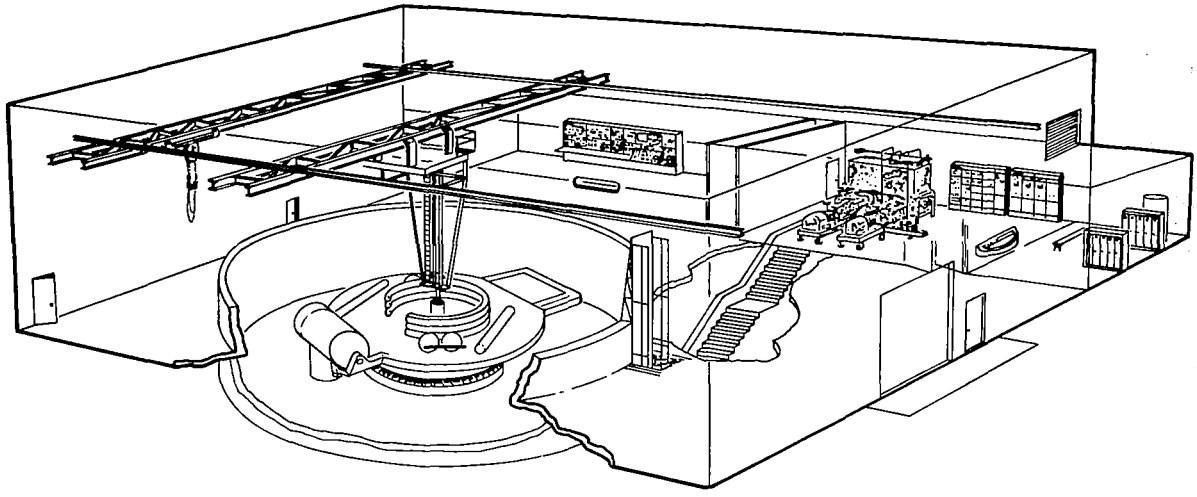
The foregoing tests can be constantly monitored with both on-board and off-board instrumentation. A multi-channel, highly accurate slip ring assembly can carry sensing devices' signals to off-board recorders for permanent records of the test run. As support, two methods of visual monitoring are available.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1963 COST $1,500,000 ESTIMATED REPLACEMENT VALUE $2,000,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Facility Operating Envelope

(Not Available)

Manufacturer: Rucker Co.

Radius of Centrifuge Arm (ft): 13

Maximum RPM: 84

Maximum Force (g-lb): 900,000

Maximum Acceleration (g): 30

Maximum Specimen Weight (lb): 30K (includes weight of vibration exciter and environmental chamber)

Maximum Specimen Size (ft): Not Available

Number of Slip Rings: 96

Number of Hydraulic and Pneumatic Rotary Joints: Not Available

Vibration Force Output (lb): 5000
Vibration Frequency Range (Hz): 5 to 3000
Temperature Range (°F): -300 to +500
Relative Humidity (%): 0-95

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
None									

AFSWC - HOLLOMAN 260-INCH PRECISION CENTRIFUGE

REPORTING INSTALLATION: Air Force Special Weapons Center Holloman Air Force Base New Mexico 88330	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: MDS
OTHER SOURCES OF INFORMATION: "Standard Laboratory Tests for Accelerometer Subsystems," MDC-TR-68-48, May 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: MDSLA Phone: (505) 573-6511, ext 5-2154

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility provides the capability for evaluating the performance of inertial guidance systems and components at sustained high acceleration environments. The counter-rotating platform will support a 30,000 g-lb payload; i.e., a 300-lb payload at the maximum acceleration of 100 g or a 600-lb payload at 50 g. Maximum rpm is 116.

TESTING CAPABILITIES: The 260-inch (radius arm) precision centrifuge is used to evaluate inertial guidance systems and components in high acceleration environments. The counter rotating platform permits gyro and systems to be tested without subjecting the instruments to the detrimental high angular rate of the centrifuge arm. The counter-rotating platform can also be operated in a fixed mode and can be remotely repositioned with the arm in motion. Sinusoidal oscillations and step inputs of up to 30° amplitude can be superimposed on either the counter-rotating or fixed mode of operation. The centrifuge can be operated in either direction of rotation.

Both analog and digital data acquisition systems are available with 64 data channels. The centrifuge has 110 slip rings for data channels. On site data reduction is accomplished with a CDC 3600 computer. The time cycle for data processing is approximately 4 days, although this can be shortened to 2 days for priority tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $1000	CONSTRUCTION YEAR: 1962-66 COST $2,728,500 ESTIMATED REPLACEMENT VALUE $3,000,000
CONTRACTOR: Genisco Systems	LOCATION: Compton, California

IMPROVEMENTS AND COSTS: (1966-70) Redesign of centrifuge (main drive and counter-rotating platform), Cost $706,500.

PLANS FOR FACILITY IMPROVEMENTS: (1) Digital Data Acquisition System for testing complete guidance systems, (2) Remotely controlled two-gimballed platform for accelerometer gyro tests, and (3) Optical measurement of test.

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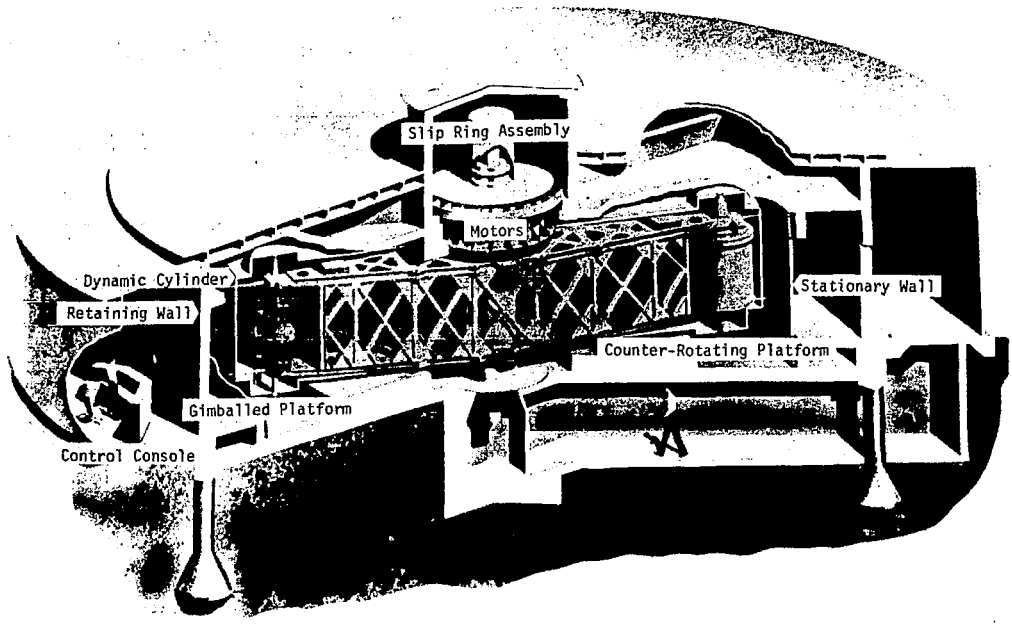
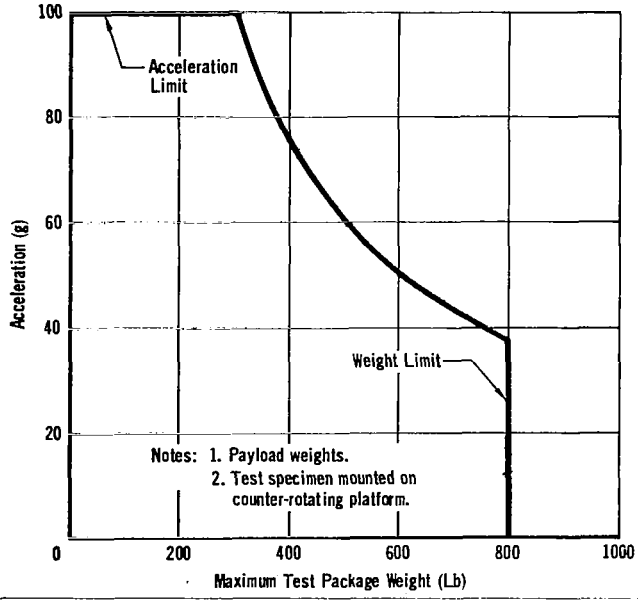


FACILITY PERFORMANCE DATA



Manufacturer: Genisco (extensively redesigned by MIT)

Radius of Centrifuge Arm (ft): 21.7 (to center of counter-rotating platform)

Maximum rpm: 116

Maximum Force (g-lb): 30,000

Maximum Acceleration (g): 100

Number of Slip Rings: 61 (at counter-rotating platform)
110 (at main spindle)

Maximum Specimen Weight (lb): 800

Maximum Specimen Size (feet): 4 Diam x 4 L

Angular Velocity Stability: Short term (4 parts/million/revolution)
Long term (1 parts/million over 50 sec. interval)

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
Genisco	G-460	8.33	105	1500	30	72	50	16x16x16	
Genisco	G-460	8.33	105	1500	30	72	50	16x16x16	
Schaevitz	P-100	3.00	400	2500	150	15	100		

BENDIX CENTRIFUGE TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Bendix Aerospace Systems Division Mishawaka Operations 400 South Beiger Street Mishawaka, Indiana 46544	COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Laboratory
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as above Phone: (219) 255-2111

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility provides the capability to subject aerospace and other components and systems to sustained acceleration environments. Test packages (weight of test specimen and fixture) up to 600 pounds can be accelerated to 36,000 g-pounds (or 60 g's). Test packages that weigh between 600 and 1200 pounds can be tested (within the g-pound rating of the machine), providing additional counterbalancing weight is fastened to the opposite end of the centrifuge arm.

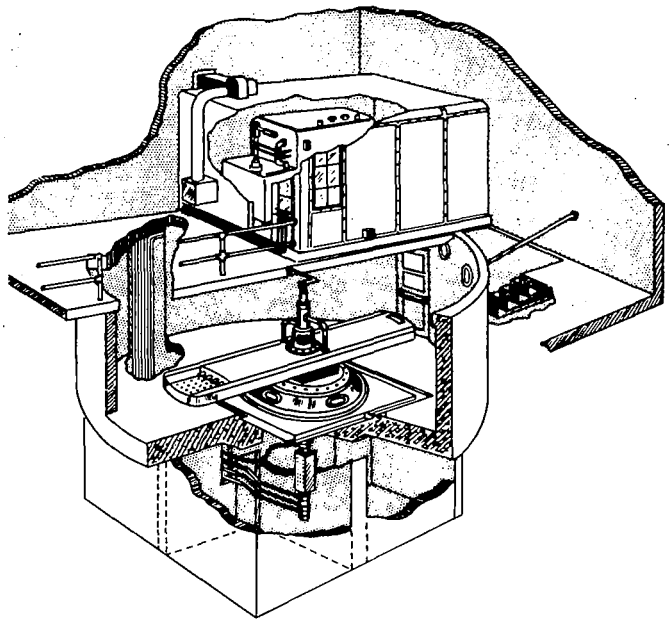
TESTING CAPABILITIES: Data recording is provided by a VHF telemetry system and a ground station for 20 data channels.

FACILITY COST HISTORY

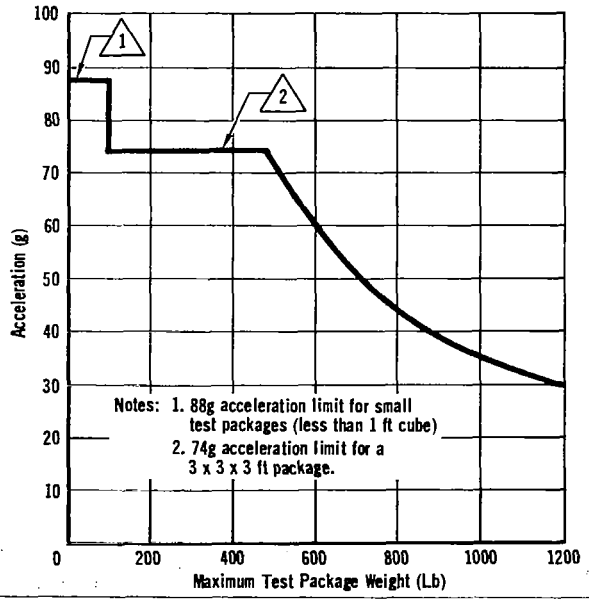
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $250	CONSTRUCTION YEAR: 1953 COST $100,000 ESTIMATED REPLACEMENT VALUE Not Available
CONTRACTOR: Rucker Co.	LOCATION: Oakland, California
IMPROVEMENTS AND COSTS: (1960) Fire prevention system, Cost $5000; (1962) Two additional rotary joints, Cost $5000.	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	Rucker Co.
Radius of Centrifuge Arm (feet):	7.5(to center of mounting platform)
Maximum RPM:	171 (No Load) 155 (Max. Specimen)
Maximum Force (g-lb):	36,000
Maximum Acceleration (g):	88 (w/1 ft^3 specimen) 60 (w/600 lb specimen)
No. of Slip Rings:	40
Maximum Specimen Weight (lb):	600
Maximum Specimen Size (feet):	3 X 3 X 4.17
No. of Hydraulic and Pneumatic Rotary Joints:	(3): 5/8 in. at 3000 psig (2): 1 in. at 1000 psig (2): 2 in. at 600 psig (1): 3 in. at 12S psig

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen		Other Capabilities
							Weight (lb)	Size (lxwxh) (inches)	
None									

GENERAL DYNAMICS/CONVAIR COMBINED ENVIRONMENTAL, VIBRATION, ACCELERATION, AND TEMPERATURE CENTRIFUGE FACILITY (CEVAT)

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
General Dynamics Corporation Convair Division P.O. Box 1128 San Diego, California 92112	COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mr. P. T. Gardner Department 578-00 Phone: (714) 277-8900, ext 1735

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: CEVAT is an integrated experimental centrifuge facility equipped to study the effects of acceleration upon test specimens within rigidly controlled temperature or vibration environments. CEVAT is also used as a test bed for human engineering studies of artificial gravity. CEVAT is installed in a concrete-lined pit 48 ft in diameter and 8 ft deep. A two-ton capacity overhead crane is available to handle test specimens and fixtures. The 4 ft by 4 ft specimen mounting platform provides a standardized bolt pattern for securing test fixtures. Right-angle fixtures are used for test specimen axis orientation. Very large or irregularly shaped specimens may be mounted at either end of the arm, using auxiliary mounting fixtures. For temperature-acceleration tests, a streamlined specimen pod is available, equipped with automatically controlled heating and cooling systems. The temperature range of the pod is -100° to +350°F with acceleration to 100g. Combined vibration-acceleration tests employ a modified M.B. Model C-25-H vibration exciter driven via land-lines from equipment in the Convair Vibration Laboratory. An automatic 80-channel equalizer-analyzer is used for random vibration tests.

TESTING CAPABILITIES: Among typical Convair uses of the CEVAT facility are research, development, and qualification tests of components for the Atlas SLV-3 boosters and Centaur high-energy upper stages. On a subcontract basis, Convair has conducted acceleration tests for Lockheed Missiles and Space Co., TRW Space Systems, and Raymond Engineering Laboratory.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available.

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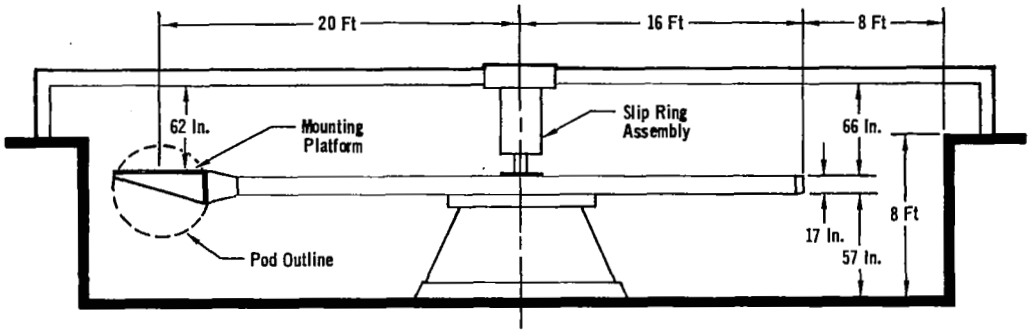
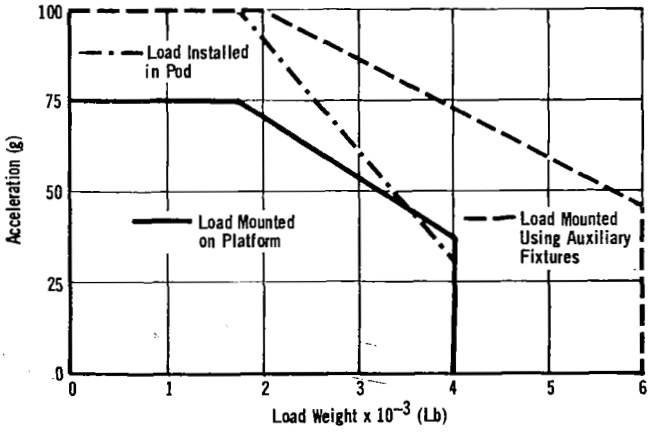


FACILITY PERFORMANCE DATA



Manufacturer:	Rucker
Radius of Centrifuge Arm (feet):	20 (to center of mounting platform)
Maximum RPM:	120
Maximum Force (g-lb):	600,000
Maximum Acceleration (g):	100 (w/6000 lb)
Maximum Specimen Weight (lb):	6000
Maximum Specimen Size (feet):	7 x 10 x 12
Number of Slip Rings:	112
Number of Hydraulic and Rotary Joints:	(No. Not Avail) 4000 psi (No. Not Avail) 3000 psi
Helium flow to 60 lb/min	

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
None									

GRUMMAN G-20 CENTRIFUGE

REPORTING INSTALLATION: Grumman Aerospace Corporation Plant Number 5 Bethpage, Long Island, New York	STATUS OF FACILITY: *Mothballed at present* COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Department 370
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Environmental Test Department 370 Phone: (516) 575-7062

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The nominal testing radius for this device is 20 feet. It has been designed to accept a payload of 2000 lb and subject it to a 40 g acceleration. The test platform will accommodate a 65 cu in. specimen, but with special adaptation, larger specimens can be mounted. The machine is set in a pit 8 feet in depth and 47 feet in diameter. Fifty slip rings are provided for power and instrumentation, ten of which will accept 20 amps at 280 volts, and the other forty, 5 amps at 117 volts. The noise level of the slip rings is 60 dB below the full rated output.

TESTING CAPABILITIES: The maximum acceleration build-up capability as well as the peak decay rate of the centrifuge for specimens of various size and shape are as follows:

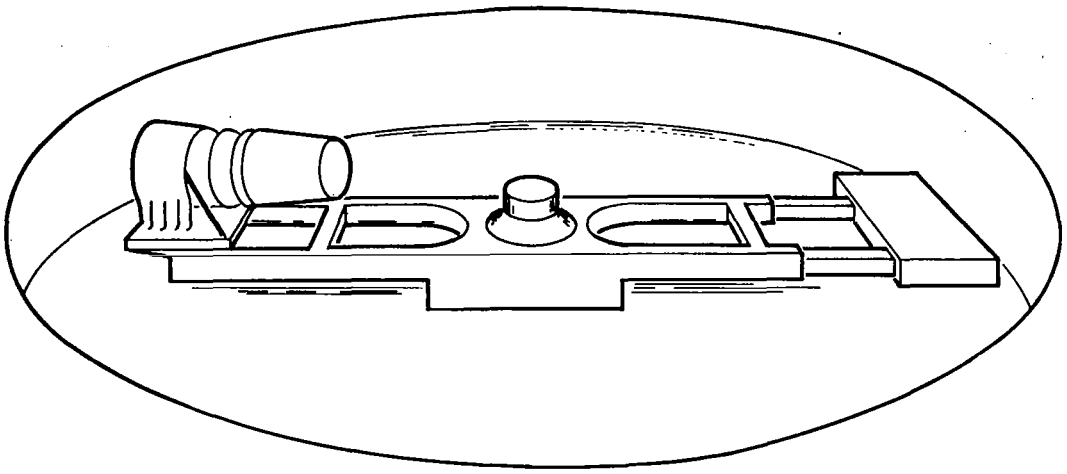
Test Weight (lb)	Condition	Average Rate of Acceleration	Average Rate of Decay	Peak "G's"
750	Test Weight	-	-	43.6
900	Test Weight plus 65" Diam x 54" can	-	-	33.4
750	Test Weight	.22 g's/sec	.4 g's/sec	5.5
900	Test Weight plus 65" Diam x 54" can	.236 g's/sec	.8 g's/sec	17

FACILITY COST HISTORY

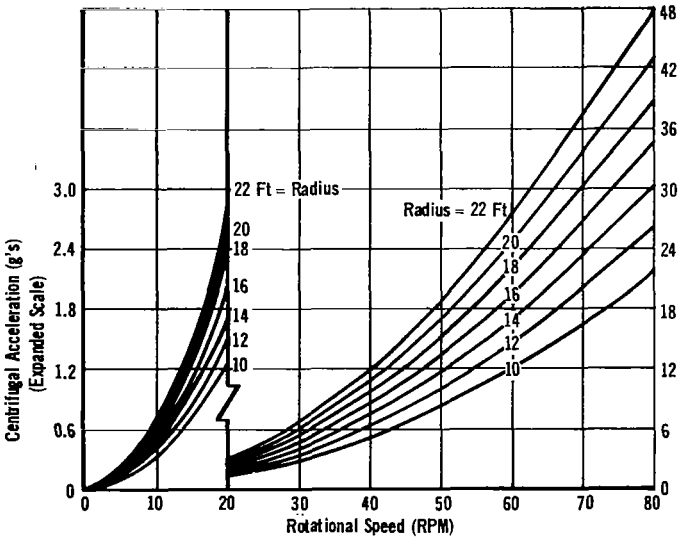
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Covering the centrifuge pit with a roof.

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	Grumman
Radius of Centrifuge Arm (feet):	23
Maximum RPM:	88
Maximum Force (g-lb):	80,000
Maximum Acceleration (g):	60
Maximum Specimen Weight (lb):	2,000
Maximum Specimen Size (in^3):	65
Number of Slip Rings:	50
No. of Hydraulic Joints:	Not Available
No. of Pneumatic Joints:	Not Available

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufactured	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
Genisco	A-1230 -1	4.5	400	150-100	200	24	150	18x18x18	

MCDONNELL DOUGLAS ACCELERATION TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Aircraft Company P.O. Box 516 St. Louis, Missouri 63166	COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION: MAC Brochure, "Facilities and Capabilities-Engineering Laboratories"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5276 or -8874 or -5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility provides the capability to subject aerospace and aircraft equipment and structural components to sustained acceleration environments. Test Packages (weight of test specimen and fixture) up to 500 pounds can be accelerated to 40 g's. Test packages that weigh less than 100 pounds may be subjected to accelerations of 200 g's.

TESTING CAPABILITIES: The centrifuge test facility is used to qualify and develop aircraft and aerospace components that must operate and survive sustained acceleration environments. Typical flight acceleration profiles lasting up to 11.5 minutes can be automatically programmed. A closed-circuit television and video recording system can be utilized to observe and monitor test specimens. Pneumatic and hydraulic glands enable test articles to be subjected to pressurization or fluid flow similar to flight conditions. The capability exists to test specimens at reduced or elevated temperatures by ducting heated or cooled air over the specimen in a controlled manner.

General purpose laboratory systems are used for on-line data recording and processing.

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1965 COST $40,000 ESTIMATED REPLACEMENT VALUE $60,000
CONTRACTOR: Trio-Tech, Incorporated	LOCATION: Burbank, California
IMPROVEMENTS AND COSTS: (1966) Increased rotational speed monitoring accuracy, Cost $500; (1969) Increased automatic programmer accuracy, Cost $300.	

PLANS FOR FACILITY IMPROVEMENTS: Modify servo-control system to improve rotational speed control.

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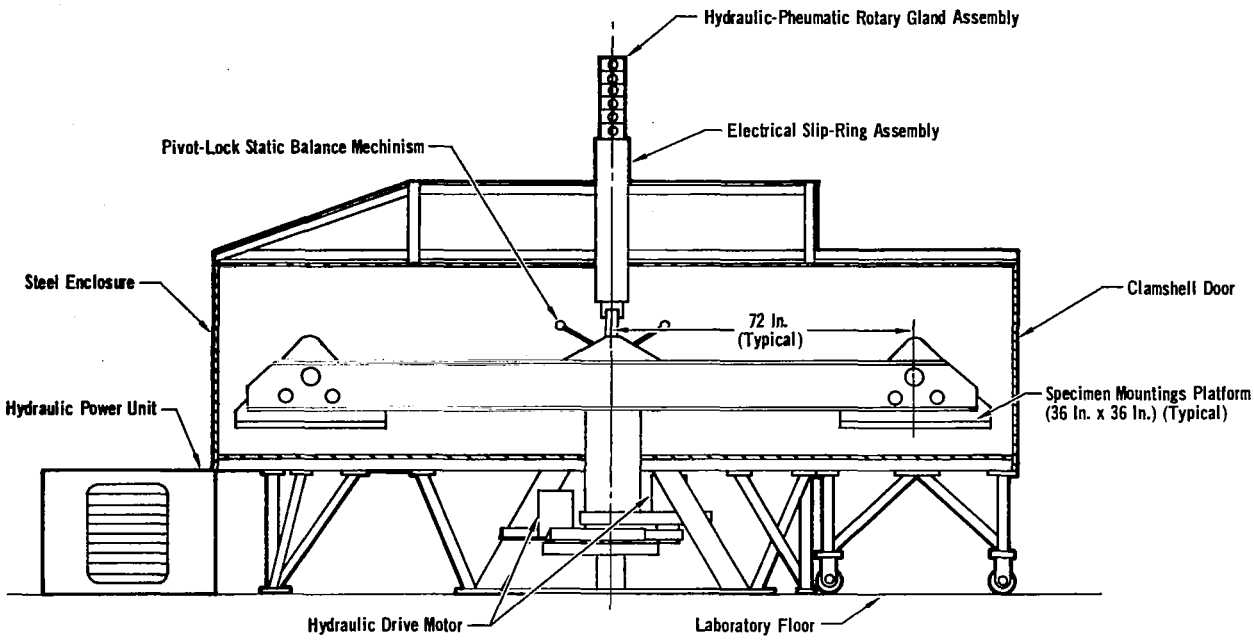
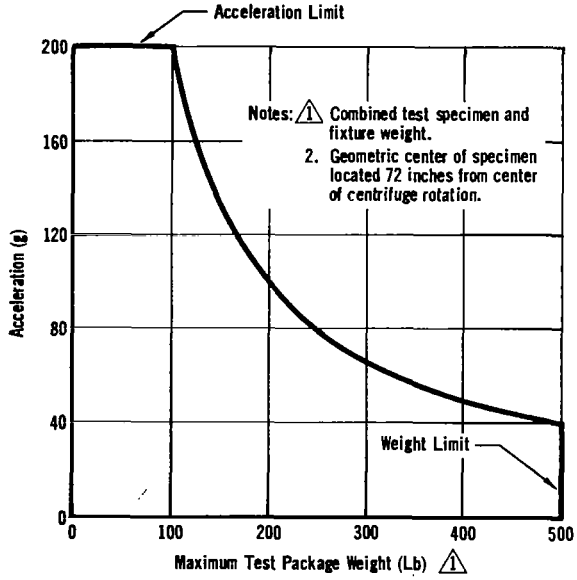


FACILITY PERFORMANCE DATA



Manufacturer: Trio-Tech, Model G-365-B

Radius of Centrifuge Arm (feet): 6 (to center of mounting platform)

Maximum RPM: 315

Maximum Force (g-lb): 20,000

Maximum Acceleration (g): 200

No. of Slip Rings: 80

Maximum Specimen Weight (lb): 500

Mounting Platform Size (feet): 3 X 3

No. of Pneumatic and Hydraulic Rotary Glands: 5 (rated at 3000 psig)

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
Schaevitz	C-3-B	1.3	475	500	100	22	50	13x13x6	Optical system for viewing specimen.

MCDONNELL DOUGLAS CENTRIFUGE TEST FACILITY (UNIT 143)

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Douglas Astronautics 3000 Ocean Park Blvd. Santa Monica, California 90406	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Environmental Laboratories Branch
OTHER SOURCES OF INFORMATION: MDAC-WD, "Engineering Laboratories Facilities Catalog," January 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief, Environmental Laboratories Phone: (213) 399-9311, ext 2462

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is capable of performing complex subsystem level operational acceleration tests to a limit of 76,000 g-lb. The centrifuge is mounted in a reinforced concrete pit, 41 feet in diameter and 10.5 feet deep, and is powered by a closed-loop hydraulic drive system of 450 hp which provides accuracies of 1/10 of 1 rpm. The overall centrifuge rotor arm is balanced about its center of rotation; however, the radii to each end of the arm are unequal. The radius to the mounting face of the larger arm is 15 feet, 10 inches (this normally results in an 18-foot radius to the center of gravity of the test specimen). The length of the shorter arm is 11 feet 4 inches. Both arms have identical mounting faces and are fully operational. Utilization of the shorter arm allows a centerline mounting of a larger test specimen envelope. Attachment points for specimen mounting are also provided along the full length of the top of the centrifuge arm.

TESTING CAPABILITIES: This facility is used to test and develop large sized, heavy components and subsystems that may require sophisticated operational support during the test. The centrifuge size, drive power available, numerous mounting provisions, operational service capability, and the availability of ancillary laboratory equipment allow a significant flexibility in the type and nature of testing. Previous tests have involved human subjects, operational tests of gas generators driving hydraulic systems, and actual firing of rocket engines at 150 g's. The centrifuge facility has been used to develop and qualify components of the Thor, Saturn SIVB, and Spartan programs.

An RW-300 Computer is available for on-line data recording and reduction. Data is normally recorded on an oscillograph and reduced manually. The typical time cycle for manual data processing is 24 hours although this can be reduced to from 1 to 4 hours for priority tests. Various configurations of closed circuit television are also available for test monitoring.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1958 COST $261,000 ESTIMATED REPLACEMENT VALUE $390,000
CONTRACTOR: The Rucker Co. and Pacific Iron and Steel	LOCATION: Oakland, California
IMPROVEMENTS AND COSTS: (1965) Rework of centrifuge arm for both short and long radius operation, Cost $10,000; (1965) Added full length mounting surface and provisions for human subjects, Cost $20,000.	

PLANS FOR FACILITY IMPROVEMENTS: New slip rings are to be installed. The G load rating and the weight carrying capacity may be upgraded if requirements arise.

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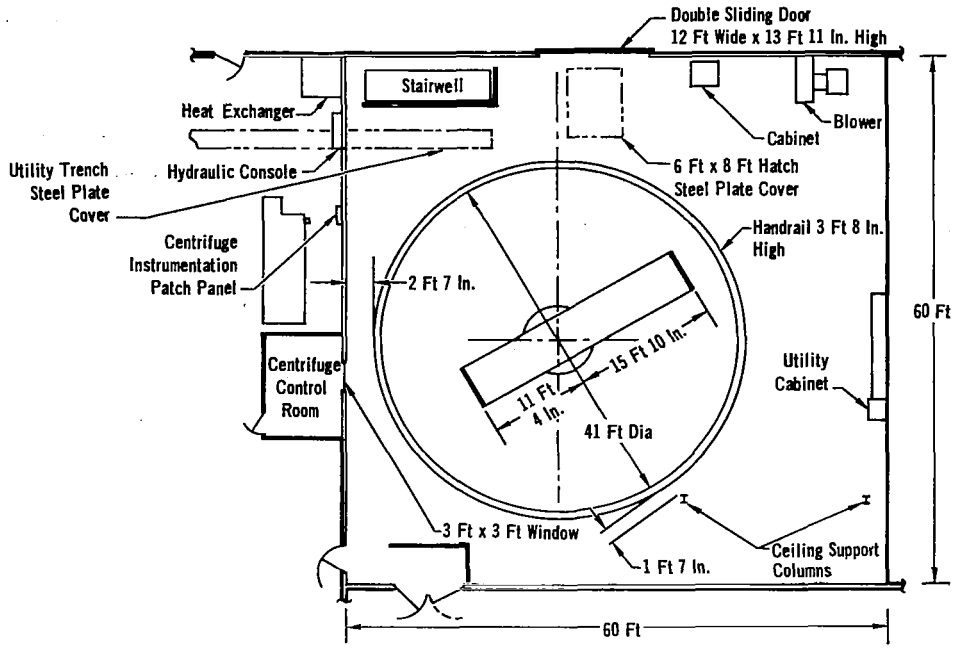
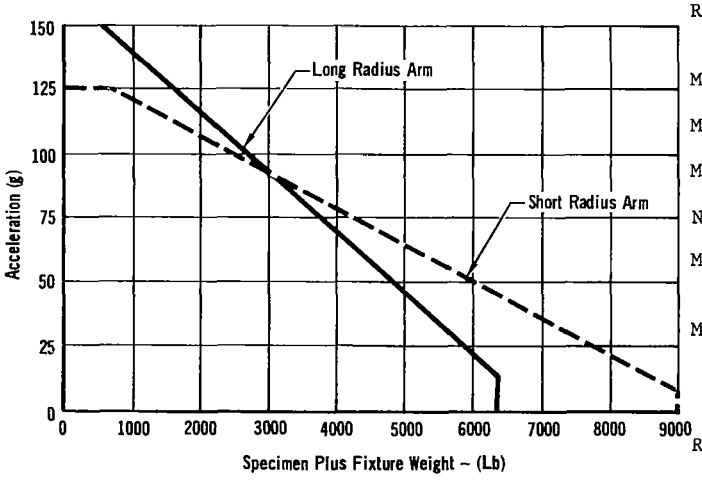


FACILITY PERFORMANCE DATA



Manufacturer: Rucker, Model 58-3189(Modified)

Radius of Centrifuge Arm (ft): 15.8(Long Arm)
11.3(Short Arm)

Maximum RPM: 150

Maximum Force (g-lb): 76,000

Maximum Acceleration (g): 150

No. of Slip Rings: 150

Max Specimen Weight (lb): 9000 (Short Arm)
6400 (Long Arm)

Max Size: (Long Arm): 5 ft clearance to wall on ℄, 4.17 ft to floor from ℄
(Short Arm): 9.5 ft clearance to wall on ℄, 4.17 ft clearance to floor on ℄

Rotary Unions: 1 system, hydraulic, 6000 psi (2 lines), pneumatic, 2500 psi

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
Rucker(1)	RCT-2	4	620(2)	12,000	500(2)	50	100	24x17x17	
Genisco	50078	2	430	1,200	120	24	100	10x10x10	.1% accuracy
Genisco	1020	3	600	10,000	250	36	500	14x14x14	.001% accuracy
Gyrex	-	3.5	460	25,000	250	4	250	18x18x18	.002% accuracy

Notes: (1) Facility modified by MDAC for improved performance; (2) Using hydraulic drive modification.

NASA GODDARD LAUNCH PHASE SIMULATOR

REPORTING INSTALLATION: NASA-Goddard Space Flight Center Test and Evaluation Division Code 320 Greenbelt, Maryland 20771	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Test and Evaluation Division
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Test and Evaluation Division Code 320 Phone: (301) 982-5050

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Launch Phase Simulator is designed to simulate the environmental conditions encountered by a spacecraft during launch. These environments include: acceleration, vibration, acoustical noise, and the decrease in atmospheric pressure. The Test Chamber size is 12-foot o.d. by 25-foot overall length supported on a 76.5-foot long rotating arm. Total rotating weight is 500,000 lb.

TESTING CAPABILITIES: This facility is capable of handling spacecraft (including adapters) up to 11 feet in diameter by 18 feet long. The maximum spacecraft weight is 5000 pounds. This facility can provide a rotational velocity of 38.3 rpm and a sustained acceleration of 30g. This facility can simulate acoustic (160 dB) vacuum (3×10^{-1} Torr) and vibrational type environments.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1966 COST $4,465,000 ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS:

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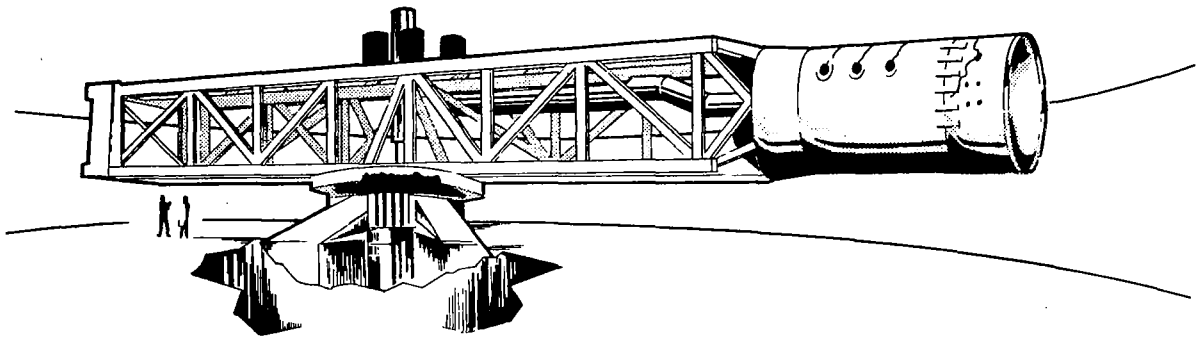

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:

Radius of Centrifuge Arm (ft): 76.5
Radius to Payload c.g. (ft): 67.5

Maximum rpm: 38.3

Maximum Force (g-lb): 150,000

Maximum Acceleration (g): 30 (Sustained)

Maximum Specimen Weight (lb): 5000

Maximum Specimen Size (feet): 11 diam x 18 L

Number of Slip Rings: 800

No. of Hydraulic and Vacuum Rotary Joints: 1

Vacuum Range (Torr): 3×10^{-1}

Acoustic (dB): 160 (100 to 12K Hz)

Vibrating Frequency (Hz): .5 to 200 (Sine)

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
None									

NASA-MSC FLIGHT ACCELERATION FACILITY

REPORTING INSTALLATION: NASA-Manned Spacecraft Center Houston, Texas 77058	STATUS OF FACILITY: Active COGNIZANT ORGANIZATION COMPONENT: Crew Systems Division System Test Branch
OTHER SOURCES OF INFORMATION: Technical Facilities Catalog (NASA), Vol. II, Report NHB 8800.5, March 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as Reporting Installation Phone: Not Available

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of a large truss arm which supports a spherical gondola. The arm is driven by a single (computer controlled) dc motor coupled directly to the arm. The environment within the gondola is controlled to simulate spacecraft temperature, pressure, and humidity conditions.

The facility is located in Building 29, which is a large cylindrical structure with two office wings. One wing is used for facility servicing and the other houses the staff, support, and operational functions. Building 34, located directly southwest of the main structure, houses the motor-generator power supply for the drive motor.

TESTING CAPABILITIES: The Flight Acceleration Facility is a complete and integrated, manrated centrifuge system. It is used to train the Apollo spacecraft crews, to develop their equipment under acceleration stresses, to evaluate the physiology of the men under space flight stresses, and to protect and evaluate human tolerance to specified acceleration profiles.

The instrumentation/data system that is used directly for centrifuge testing includes 2 DDP 24-digital computers and 2 magnetic tape units for 32 analog-to-digital and 32 digital-to-analog data channels. Ampex 1200 and 1300 tape recorders and strip charts are used for data recording. The typical time cycle for data processing is 50 MS.

ADDITIONAL CAPABILITY: The centrifuge has the alternate capability of being used as a lunar gravity simulator. The arm is used as a carrier for a boom which provides the overhead support for an inclined plane and vertical suspension system (POGO) 1/6 g simulator. The inclined plane is 8 ft wide and provides a 460 ft circumference plywood walking surface. The walking surface for the vertical suspension system is 6 ft wide, 450 ft circumference, with a simulated lunar surface consisting of six inches of sand and rock. A plywood walking surface is also available so comparisons can be made between the two types of 1/6 g simulations, inclined plane and vertical suspension systems.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1964 COST $11,238,000 ESTIMATED REPLACEMENT VALUE $15,000,000
CONTRACTOR: Bellows-Kiewit Westinghouse Electric Rulker Co.	LOCATION: Houston, Texas Pittsburgh, Pennsylvania Oakland, California
IMPROVEMENTS AND COSTS: (1969) Installation of vacuum pump (Bldg. 29), Cost $12,730.	

PLANS FOR FACILITY IMPROVEMENTS: None

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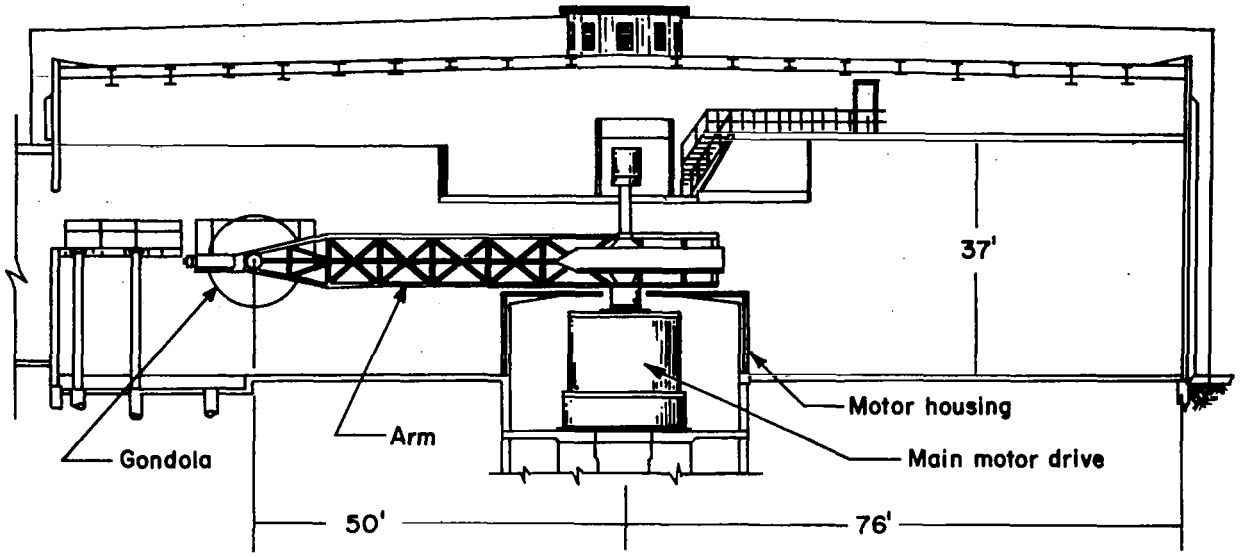

FACILITY PERFORMANCE DATA

Facility Operating Envelope

(Not Available)

Manufacturer:	Rucker Co.
Radius of Centrifuge Arm (feet):	50
Maximum RPM:	120
Maximum Force (g-lb):	60,000
Maximum Acceleration (g):	20
No. Of Slip Rings:	462
Maximum Specimen Weight (lb):	3000
Maximum Specimen Size (feet):	12 Diam.
No. of Hydraulic and Pneumatic Rotary Joints:	Not Available

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
None									

NORTH AMERICAN ROCKWELL/SPACE DIVISION SPACE STATION ROTATIONAL TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
North American Rockwell Corp Space Division 1221A Lakewood Blvd. Downey, California 90241	COGNIZANT ORGANIZATIONAL COMPONENT: Laboratories and Test, Department 098
OTHER SOURCES OF INFORMATION: Facilities Administration Department 083	LOCAL OFFICE TO CONTACT FOR INFORMATION: Laboratories and Test Branch 300 Phone: (213) 922-2814

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Rotational Facility was designed to investigate man's tolerance and adaptability to a rotating environment of the type commonly associated with a space station or vehicle designed to develop artificial gravity. The facility consists essentially of a 650-square-foot blockhouse-type control building and a large rotation device, all located within a two-acre fenced site which is floodlighted for nighttime operations. This facility currently has an 80-foot rotating arm radius.

TESTING CAPABILITIES: The Rotational Facility consists essentially of crew module and counterweight units mounted at opposite ends of a long steel box beam, which rotates upon a pedestal under its centerpoint. The pedestal incorporates the electro-hydraulic drive system which is presently rated at 300 hp and is expandable to 900 hp. The box beam is constructed of steel plate, with a top deck width of 80 inches and a present length of 160 feet overall, extendable to 260 feet. This provides nominal payload operating radii up to 75 feet and 125 feet, respectively. The crew module is 11 feet in diameter and 43 feet long, outside dimensions. The module tilts automatically with the resultant gravity vector according to mounting radius and operating speed. The total accommodation possible, up to 60 degrees of tilt, corresponds approximately to a resultant 2-g gravity force. The module and main beam are designed to supply all life support requirements for an uninterrupted research mission of 120 man-days. The crew module and control building are interfaced by a large capacity slip-ring assembly which provides unlimited electric power through 10 shielded channels and a wide variety of instrumentation and communication options through 100 shielded signal channels. Data are recorded with up to 100 channels and reduced off site using digital, analogue and magnetic tapes. The recording system is not an integral part of the facility.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $640	CONSTRUCTION YEAR: 1966 COST: Not Available ESTIMATED REPLACEMENT VALUE: Unknown
CONTRACTOR: Rucker Co.	LOCATION: San Francisco, California
IMPROVEMENTS AND COSTS:	

PLANS FOR FACILITY IMPROVEMENTS: (1) Providing remote operation of drive system; (2) Increasing available drive power; (3) Modification to permit access to either end of beam without going thru hub; (4) Adding 7-ft walls and fairing to beam to extend work area along entire beam length, and (5) Increasing rotating arm radius an additional 50 feet.

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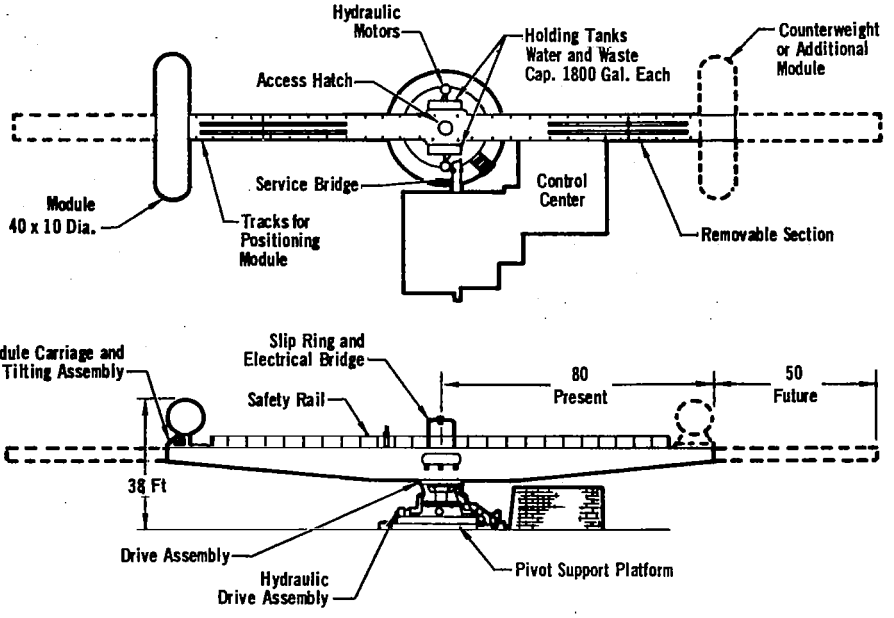

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Rucker Co.
Radius of Centrifuge Arm (feet):	80
Maximum RPM:	9
Maximum Force (g-lb):	40,000
Maximum Acceleration(g):	2
No. of Slip Rings:	110
Maximum Specimen Weight (lb):	20,000
Maximum Specimen Size (feet):	12 Diam
No. of Hydraulic and Pneumatic Rotary Joints:	

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum g's	Number of Slip Rings	Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inches)	Other Capabilities
None									

WYLE COMBINED ENVIRONMENT CENTRIFUGE TEST FACILITY
(Norco, California)

REPORTING INSTALLATION: Wyle Laboratories 1841 Hillside Avenue Norco, California 91760	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Same as Reporting Installation
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as Reporting Installation Phone: (714) 737-0871

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability to subject test hardware to sustained acceleration, high or low temperature, and vibration simultaneously on the combined environment machine. Rocket motor firing can be accomplished on this machine.

TESTING CAPABILITIES: The centrifuge test area has been used to perform qualification and development testing on various aircraft and aerospace components requiring sustained acceleration, temperature, and vibration as a combined effort. Liquid and Solid Propellant motors have been fired during acceleration.

Special instrumentation to record pressure, temperature, and strain are available.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING: COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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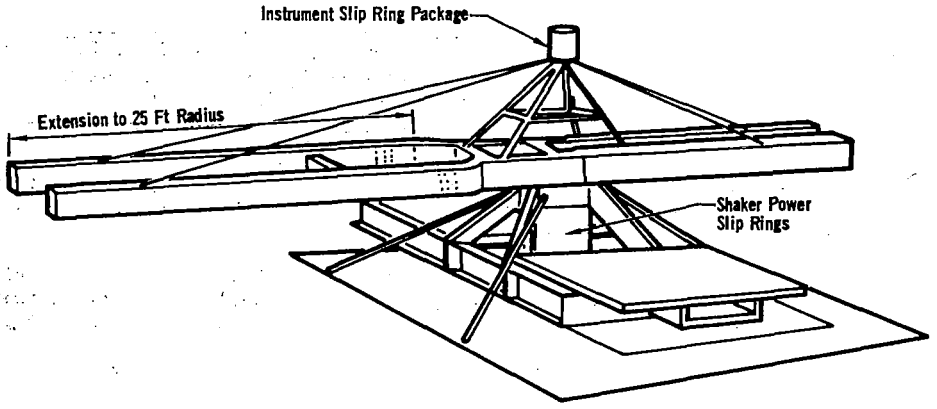


FACILITY PERFORMANCE DATA

Facility Operating Envelope

(Not Available)

Manufacturer: Wyle Design

Radius of Centrifuge Arm (ft): 9 (to center of mounting platform), 22 (w/extension)

Maximum RPM: 105 (12 ft radius)
55 (25 ft radius)

Maximum Force (g-lb): 150,000

Maximum Acceleration (g): 42 (12 ft radius)
25 (25 ft radius)

No. of Slip Rings: 200

Maximum Specimen Weight (lb): 15,000 (Including Fixture)

Maximum Specimen Size (ft): 6x6 (Mounting Platform size)

No. of Hydraulic Rotary Glands: (2), rated at 2000 psi

ADDITIONAL ACCELERATION TEST CAPABILITIES

Manufacturer	Model	Radius (feet)	Maximum rpm	Maximum Force (g-lb)	Maximum (g)	Number of Slip Rings	Maximum Specimen		Other Capabilities
							Weight (lb)	Size (lxwxh) (inches)	
Wyle Design	-	6	-	-	400	200	30	12x12	

AFSWC - HOLLOMAN TEST TRACK FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Air Force Special Weapons Center Holloman Test Track Facility Holloman Air Force Base New Mexico 88330	COGNIZANT ORGANIZATIONAL COMPONENT: MDT Directorate of Test Track
OTHER SOURCES OF INFORMATION: Brochure, "The Holloman Track, Facilities and Capabilities," 1969	LOCAL OFFICE TO CONTACT FOR INFORMATION: Directorate of Test Track Operations Office (MDTO) Phone: (505) 473-6511, ext 52181

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Test Track is an aerospace ground test facility. It simulates selected portions of flight trajectories under precisely programmed and rigorously controlled conditions. The test specimens are carried by rocket-powered sleds which are guided along a straight line path close to the ground by heavy duty (171 lb/yd) crane rails over a total length of currently 35,588 ft. Precision alignment and surface grinding of the continuously welded rails assure a high degree of straightness and surface smoothness. Track curvature exceeds a radius of 10 million feet at any point of the track. Depending on mission profile, sled weights range from approximately 100 lb to 30,000 lb. Sled speeds up to 6800 ft/sec (Mach 6) are operated on a routine basis, and speeds exceeding 8000 ft/sec have been demonstrated. Depending on payload, accelerations exceeding 200 g's are feasible.

Approximately 295 rocket sleds for operation on both rails (dual rail sled) or one rail (monorail sleds) are in the track inventory. Solid rockets or liquid rocket engine using storable propellants serve as sled propulsion. Braking systems include water braking for the dual rail and monorail sleds and aerodynamic drag brakes.

TESTING CAPABILITIES: Test specimens may be subjected to predetermined and controlled levels of acceleration, deceleration, vibration, supersonic and hypersonic aerodynamic loading, heating, buffeting, blast intercepts, rain erosion, and ejection or impact conditions. Main areas of application are dynamic events for which the track provides near ideal data acquisition capabilities (e.g., programming events to occur under optimum photographic conditions) without inherent safety risks and without the need for man rating experimental hardware. The track also duplicates flight environments and performance regimes, the essential similarity parameters of which are inaccessible by other ground test means; e.g., high Mach number flight at low altitudes, high Reynolds number operation, and duplication of specified rain and dust environments or blast intercept.

Characteristic examples of typical track missions are: (1) Aerodynamic testing: aerodynamic decelerators, transonic buffeting and loading at high Reynolds numbers, investigations involving aerodynamic heating, plasma effects, etc.; (2) Dispensing: cross-wind launches of aircraft missiles, ejection of bomblets and fly bombs, dispersing patterns of chemicals, deployment of wire guided missiles, etc.; (3) Crew escape: developmental testing, operational evaluation, qualification and man rating of aircraft ejection seats, crew modules, etc.; (4) Guidance: shakedown and error evaluation of guidance systems and components, fuze modeling and seeker evaluation for air-to-air and air-to-ground missiles in cooperation with the Central Inertial Guidance Test Facility; (5) Impact: full-scale impact tests for fuzing system performance and damage potential evaluation; (6) Rain and dust erosion: special trackside facilities allow operation through 6000 ft of artificial rain with controlled density and particle size distribution, and operation through dust environments; (7) Blast: supersonic intercept of sled-borne test items with blast waves generated by trackside HE detonations; and (8) Component shakedown under the effects of acceleration and vibrations. Potential new areas of application are the testing of aero-propulsion systems in high Mach number-low altitude flight under angles of attack and VSTOL testing, especially rotors exceeding wind tunnel capabilities and stowed rotor concepts.

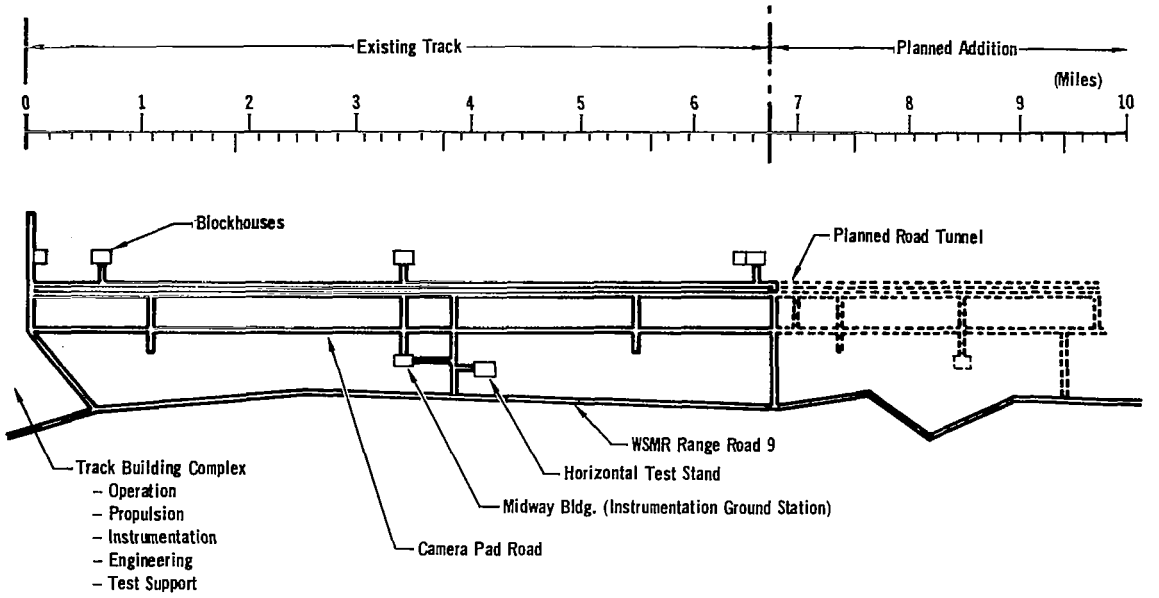
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1949 COST $ 451,000 ESTIMATED REPLACEMENT VALUE $28,600,000
CONTRACTOR: Ponsford Brothers	LOCATION: El Paso, Texas

IMPROVEMENTS AND COSTS: (1955) Extend track length 1521 ft to 5071 ft, Cost not available; (1956) Extend track length 30,000 ft and replace existing rails (McKee Construction Co, El Paso, Texas), Cost $5,108,000; (1965) Extend track length 517 ft and prepare blast area (Metz Construction Co, Tucson, Arizona), Cost $330,000. Inventory value of complex, Cost $26,000,000 (approx.)

PLANS FOR FACILITY IMPROVEMENTS: Addition to test track length 15,000 ft and improved rain and dust generating facilities; improved rocket sleds and equipment for aero-propulsion, VSTOL, and hypersonic testing and related data acquisition capabilities.

SCHEMATIC



FACILITY PERFORMANCE DATA

Track Length (feet):	35,588
Maximum Payload (lb):	16,000*
Maximum Acceleration (g):	200*
Maximum Velocity Attainable (ft/sec):	8200 (impact tests) 6800 (including recovery)
Maximum Deceleration (g):	75
Maximum Rate of Change of Deceleration (g/sec):	Not Available
Maximum Dynamic Pressure (psf):	65,000
Largest Sled, by Weight (lb):	30,000
Largest Sled, by Size (feet):	21.8L by 11.7W by 11.7H

*Depends on individual mission profile, and the envelope of maximum speed, acceleration, and payload weight must be determined for each specific case.

NAVAL WEAPONS CENTER
SUPERSONIC NAVAL ORDNANCE RESEARCH TRACK (SNORT)

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Naval Weapons Center Supersonic Track Division China Lake, California 93555	COGNIZANT ORGANIZATIONAL COMPONENT: Supersonic Track Division Code 307
OTHER SOURCES OF INFORMATION: (1) "Supersonic Tracks Brochure", NOTS 1938, Rev. 1, Sept. 1962; (2) NOTS (NWC), "Supersonic Track Handbook," IDP 1055, July 1960.	LOCAL OFFICE TO CONTACT FOR INFORMATION: Track Projects Branch Code 3071 Phone:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: SNORT, a two-rail heavy-duty, 21,550 ft track is constructed of precision-aligned 171 lb/yd crane rails. Alignment accuracy is .061 inches (horizontal) and .036 inches (vertical). The track can be used for either monorail or dual rail firings, has a maximum two-rail download capability of approximately 136,000 pounds and a maximum deceleration in captive flight tests. SNORT is a self-sufficient, well-staffed facility equipped with rocket powered vehicles to carry test items, optical and electronic data gathering instrumentation; and buildings, roads and utilities required for operation.

TESTING CAPABILITIES: The track is used for tests that require supersonic and hypersonic speeds, long duration runs, heavy carriages, and controlled deceleration. In addition to being equipped with instrumentation to gather data on aerodynamics, vibration, acceleration, velocity, pressure, and temperature, the range has a 2500 ft-long rain facility that provides controlled rainfall of various raindrop sizes and rates for environmental testing. Projects include the following types of tests: captive flights, aeroballistics, standard and VT fuze, inertial guidance, aircraft damage, crosswind firing, projectile recovery, terminal ballistics, aircraft and capsule escape systems, and rain erosion.

The Supersonic Track Ranges obtain their electronic instrumentation support from one fixed ground station and three mobile data recording systems. The fixed ground station is located in the SNORT headquarters building and supports the main track. The mobile vans provide support to all ranges including the main track at SNORT plus the B-4 and G-4 test tracks. The fixed telemetry ground station, located at the south end of the SNORT track, has the capability of receiving eight rf channels simultaneously at L and S Band frequencies. The rf channel information can be detected and recorded in the usual manner or prediction recording techniques may be used to preserve the format of the original rf for the application of various detection techniques. Two IRIG, 21-channel, frequency de-multiplexing systems are available for real time recording and display. Two PAM/PDM decommutation systems are available for time multiplexed formats and these may be programmed to accept a wide variety of formats including the Navy's high-bit rate (100kc) systems. Data records are provided by four 36-channel oscillographs for "quick-look" data and four tape recorders for permanent magnetic tape recordings. One tape machine is capable of 1.5 mHz direct recording. The instrumentation vans are completely mobile and can service any of the Supersonic Track Ranges. Two of the vans are primarily used for FM/FM Telemetry reception and have suitable antennas, preamps, receivers, discriminators, and recorders to accomplish field ground station capabilities. There are a limited number of discriminators in each van to provide real-time display capabilities and data may be recorded on magnetic tape or a 36-channel oscillograph. The remaining van is configured to record land-line telemetry signals from static motor test firings and fixed impact targets. All the vans have range timing and range communication equipment for data correlation and test coordination. The master range timing for data correlation purposes is, at present, a 100 Binary Coded Timing (BCT) system. A program is now underway to expand the range timing system to include the IRIG A and IRIG B modulated formats as well as the 100 BCT format now used. Two-way radio communications is provided on all ranges for test coordination and range safety. Photographic support for captive flight tests is afforded by tracking mounts, ground based arrays, and on-board camera and lighting systems. Over 150 medium and high speed cameras are availble for routine use.

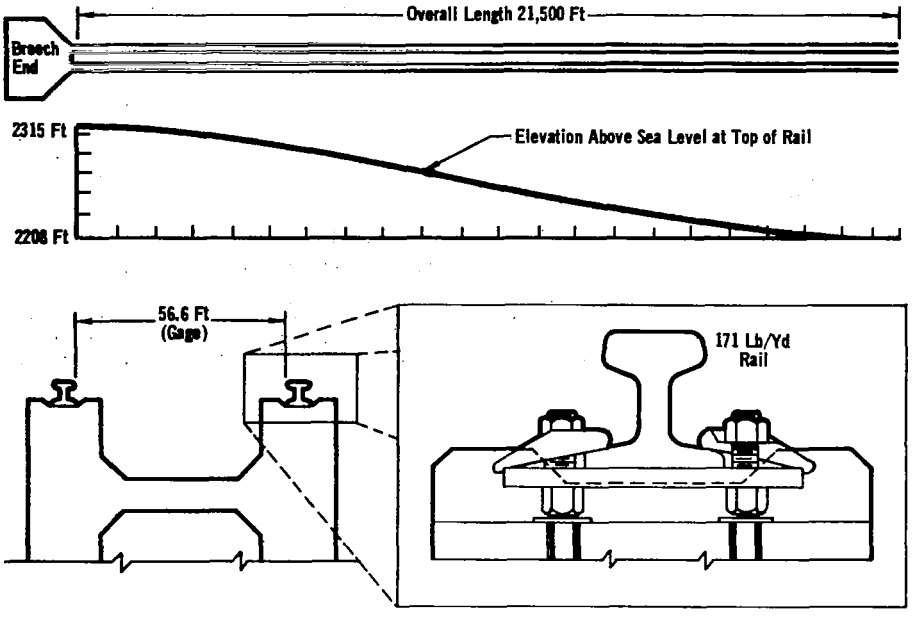
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $5000	CONSTRUCTION YEAR: 1953 COST $4,500,000 ESTIMATED REPLACEMENT VALUE $8,500,000
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: (1963) Rain erosion facility (2500 ft), Cost not available; (1969) Three ballistic ground-to-ground flight lines (plus launching pads and fixed targets), Cost not available; (1953-69) Numerous buildings, roads, etc., and new instrumentation (constantly being updated), Cost not available; (1969) Explosives magazine and small magazine, Cost not available.

PLANS FOR FACILITY IMPROVEMENTS: Long range: one-mile track extension plus new fabrication shop, new programmer, service termination building, rain erosion extension, target profile recognition fuze facility, and an instrumentation building. All items are desirable but not approved or funded at the time of this publication.

SCHEMATIC



FACILITY PERFORMANCE DATA

Track Length (feet):	21,550
Maximum Payload (lb):	128,000
Maximum Acceleration (g):	100
Maximum Velocity Attainable (ft/sec):	6000
Maximum Deceleration (g):	100
Maximum Rate of Change of Deceleration (g/sec):	300
Maximum Dynamic Pressure (psf):	33,000
Largest Sled, by Weight (lb):	140,000+
Largest Sled, by Size (feet):	30L by 8W by 12H

NAVAL WEAPONS CENTER
B-4 TRANSONIC TEST TRACK

REPORTING INSTALLATION: Naval Weapons Center Supersonic Track Division China Lake, California 93555	STATUS OF FACILITY: Stand-by COGNIZANT ORGANIZATIONAL COMPONENT: Supersonic Track Division Code 307
OTHER SOURCES OF INFORMATION: (1) "Supersonic Tracks Brochure" NOTS 1938, Rev. 1, Sept 1962; NOTS (NWC), "Supersonic Track Handbook," IDP 1055, July 1960	LOCAL OFFICE TO CONTACT FOR INFORMATION: Track Projects Branch Code 3071 Phone: (505)

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: B-4 is a 14,560-foot (2.76-mile), two-rail track constructed of lightweight (75 lb/yd) rail laid at a 4-foot 8 1/2-gage. Because of its less precise alignment and the relative ease with which it can be repaired, this track is used for tests that are more likely to result in damage to the track. A unique fuze-testing facility, in which up to three targets (each weighing as much as 75,000 pounds) can be suspended to a maximum height of 40 feet above the track, is used to gather data on target profile recognition. In addition to buildings, roads, and utilities needed for test operation, B-4 also has a model machine shop in which lightweight and medium-weight test vehicles are fabricated and other support functions are performed for all three NWC tracks.

TESTING CAPABILITIES: The B-4 track is used primarily for captive flight and aerodynamic tests of parachute deployment, aircraft damage, standard and VT fuzes, target profile recognition, and missile components. Relatively lightweight or medium-weight test vehicles are used. Accelerations as high as 50g's and velocities to 1,980 ft/sec are attained on this track, which can accommodate test vehicles weighing up to 10,000 pounds. Deceleration is accomplished by sand brake.

The Supersonic Track Ranges obtain their electronic instrumentation support from one fixed ground station and three mobile data recording systems. The fixed ground station is located in the SNORT headquarters building and supports the main track. The mobile vans provide support to all ranges including the main track at SNORT plus the B-4 and G-4 test tracks. The instrumentation vans are completely mobile and can service any of the Supersonic Track Ranges. Two of the vans are primarily used for FM/FM Telemetry reception and have suitable antennas, preamps, receivers, discriminators, and recorders to accomplish field ground station capabilities. There are a limited number of discriminators in each van to provide real-time display capabilities and data may be recorded on magnetic tape or a 36-channel oscillograph. The remaining van is configured to record land-line telemetry signals from static motor test firings and fixed impact targets. All the vans have range times and range communication equipment for data correlation and test coordination.

The master range timing for data correlation purposes is, at present, a 100 Binary Coded Timing (BCT) system. A program is now underway to expand the range timing system to include the IRIG A and IRIG B modulated formats as well as the 100 BCT format now used. Two-way radio communications is provided on all ranges for test coordination and range safety. Photographic support for captive flight tests is afforded by tracking mounts, ground based arrays, and on-board camera and lighting systems. Over 150 medium and high speed cameras are available for routine use.

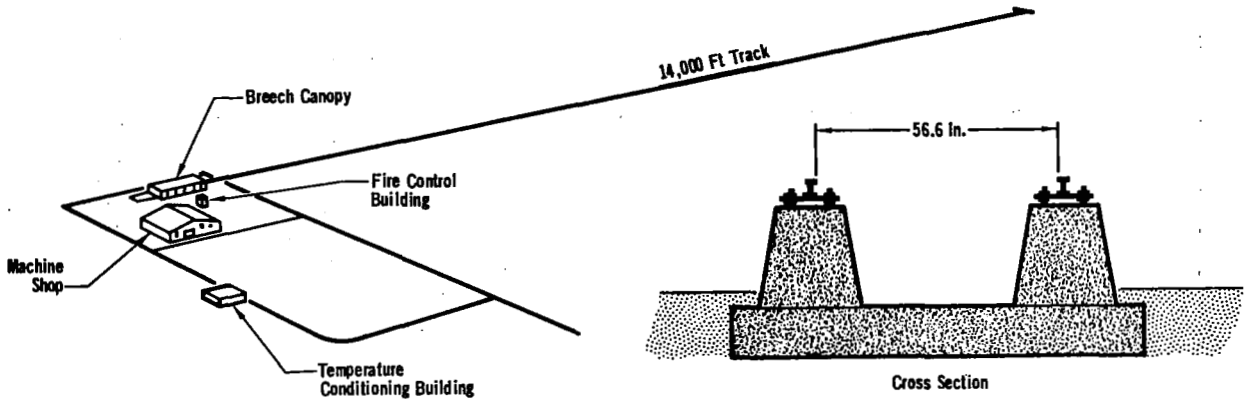
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $3000	CONSTRUCTION YEAR: COST $425,000 ESTIMATED REPLACEMENT VALUE $700,000
CONTRACTOR: Not Available	LOCATION:

IMPROVEMENTS AND COSTS: (1965) Target profile recognition fuze test facility, Cost not available.

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA

Track Length (feet):	14,560
Maximum Payload (lb):	2000
Maximum Acceleration (g):	50
Maximum Velocity Attainable (ft/sec):	1980
Maximum Deceleration (g):	15
Maximum Rate of Change of Deceleration (g/sec):	500
Maximum Dynamic Pressure (psf):	5300
Largest Sled, by Weight (lb):	10,000
Largest Sled, by Size (feet):	20L by 5W by 8H

2. ENVIRONMENTAL

AC ELECTRONICS SPACE SIMULATION FACILITY

REPORTING INSTALLATION: AC Electronics Division of General Motors Milwaukee, Wisconsin 53201	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Analytical Laboratory Department 32-81
OTHER SOURCES OF INFORMATION: AC Electronics Brochure, "Environmental Simulation Available at AC Electronics Division of General Motors Corporation", Revision April 1970.	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Phone: (414) 762-7000, ext 2996

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility contains various high altitude environmental and space simulation chambers. It is primarily designed to accommodate aircraft, missile, and deep space probe environmental tests. Simulation capability exists for the rapid pressure reduction of initial lift-off for simulating pressurized aircraft systems failure.

TESTING CAPABILITIES: Tests have been conducted to verify satisfactory operation of the Apollo Guidance System, the Guidance System for Titan II and Titan III Missiles, the Carousel IV Guidance System for Boeing 747 Aircraft, and the computer for the SRAM Missile System. Techniques have been developed to fully simulate navigation problems that might be encountered under both normal environments and probable failure mode environments. For the Lunar Rover Vehicle Wheel and Motor Drive System testing, special comprehensive test fixtures were designed to provide a simulated road bed with obstructions and Lunar Day and Night conditions.

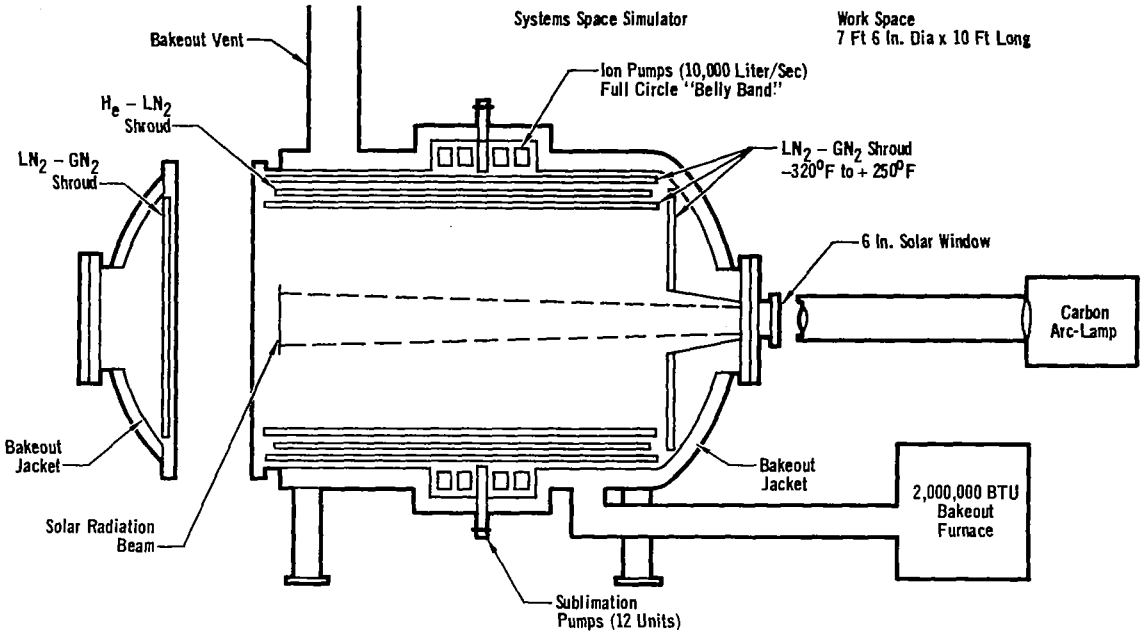
Data recording systems include magnetic tape recorders with 98 data channels and direct record oscillographs with 30 data channels. Data can be processed and produced in the form of X-Y plots typically in 1-1/2 hours/plot. For maximum priority tests, this number can be reduced to 1/2 hour/plot.

FACILITY COST HISTORY

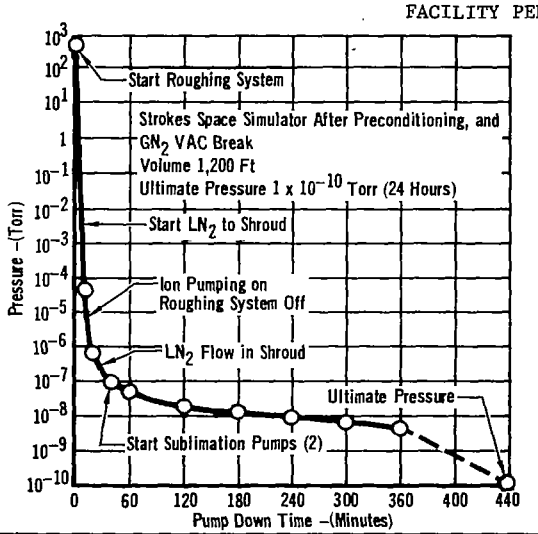
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Systems Space Simulator

Type of Environments Simulated*: 1, 6, & 7

Type of Pump or Ejector**: 1, 6, 7, & 8

Temperature Range (°C): -196 to +93

Minimum Work Pressure (Torr): 5 x 10^{-11}

Man-Rated: No

Maximum Specimen Size (feet):

Solar Simulator***: 24 ft diam @ 1 Solar constant

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Tenny	2, 6		-73 to 93	-	235K		No	No		19x13x10
NRC Equipment	2, 7		-73 to 316	-	-	1 x 10^{-6}	No	No		7.5x3.3x3.3
Parts Space	1, 6, 7	1, 2	-184 to 149	-	-	1 x 10^{-10}	No	No	2.5	30.33L
Murphy Miller	2, 7	1	-73 to 149	-	200K	-	No	No		3 x 3 x 3
Conrad	2, 7	1, 8	-73 to 149	-	200K	-	No	No		3 x 3 x 3
Tenny	2, 7	1, 8	-73 to 149	-	200K	-	No	No		4 x 3 x 3

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Ion, 7 Sublimation, 8 Blower
***Beam size (ft) and intensity (watts/ft^2)

AFFDL COMBINED ENVIRONMENTS RESEARCH LABORATORY

REPORTING INSTALLATION	STATUS OF FACILITY: Active
Air Force Flight Dynamics Laboratory Wright-Patterson Air Force Base Ohio	COGNIZANT ORGANIZATIONAL COMPONENT: Vehicle Equipment Division
OTHER SOURCES OF INFORMATION None	LOCAL OFFICE TO CONTACT FOR INFORMATION: J. F. Dreher Environmental Control Branch Phone: (513) 255-5195

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Combined Environments Laboratory is used primarily for exploratory development leading to MIL-STD-810 type test requirements for aeronautical equipment. Facilities are used to develop rapid, realistic, and cost effective environmental simulation and test methods. Environmental combinations critical to equipment are identified. Both performance and endurance type tests are developed using environmental combinations.

Thirteen environmental chambers are available for combined environmental testing. The largest, the System's Altitude Chamber, is shown in a schematic on the opposite page and its performance parameters are specified below the schematic. A partial list of the other environmental chambers is shown in the list on the bottom of the opposite page.

TESTING CAPABILITIES: In addition to the environmental chambers a number of vibration exciters and shock machines are available. These include for vibration testing: (1) Two Ling Model A300B Vibration Exciters, sinusoidal and random, one w/an 80 channel equalizer, and the other, w/a 26 channel equalizer, (2) A MB Model C25HA Vibration Exciter, sinusoidal and random, (3) MB Model C25H and Model C25 Vibration Exciters, (4) A Calidyne Model C82 Vibration Exciter, and (5) A Calidyne Model A174 Vibration Exciter. For shock testing, the following machines are available: (1) A Barry Model 15575 (controlled wave form), (2) A Convair Model 22-2 (pneumatically actuated), and (3) A Lycoming Model LSM-1 (controlled wave form).

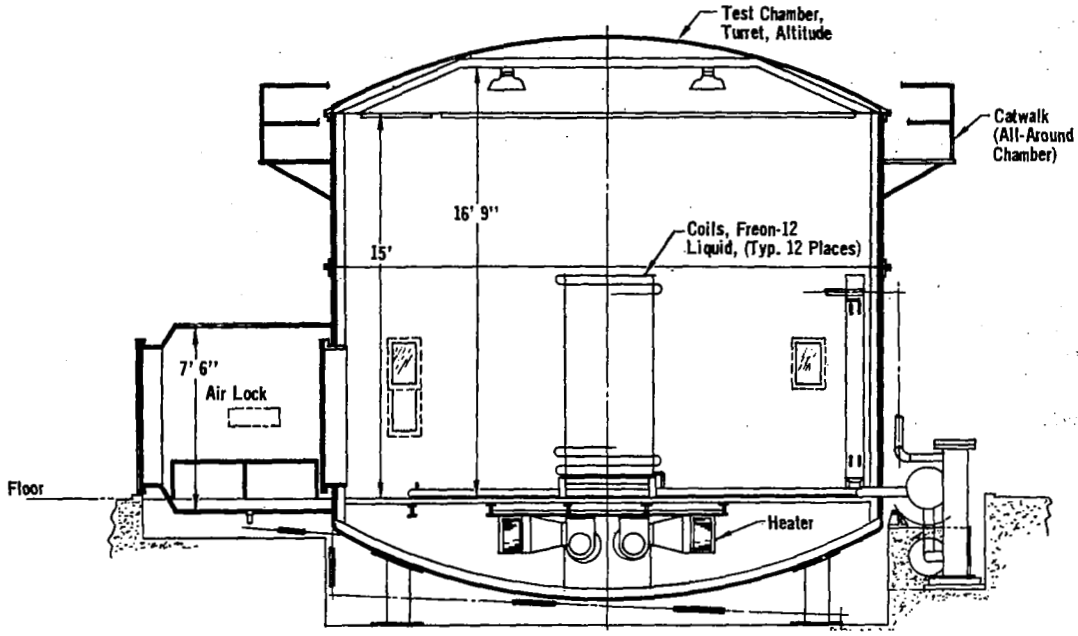
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): *	CONSTRUCTION YEAR COST $ Not Available ESTIMATED REPLACEMENT VALUE $2,894,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

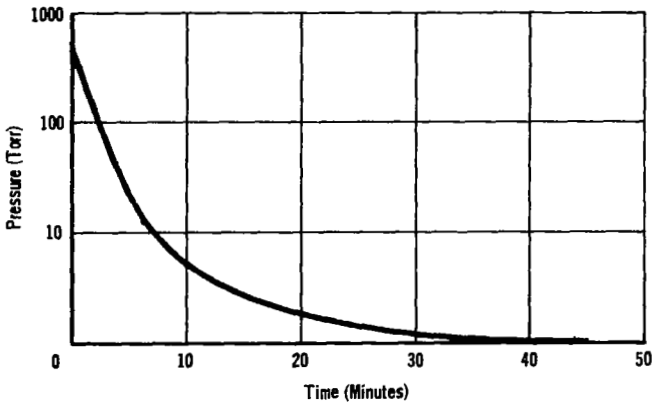
*Note above: Contact AFFDL relative to specific test character.

PLANS FOR FACILITY IMPROVEMENTS:

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Systems Altitude Chamber

Type of Environments Simulated*: 2 & 7

Type of Pump or Ejector**: 1

Temperature Range (°C): -62 to +80

Altitude (feet): 150,000

Man-Rated: Yes

Chamber Internal Dimensions (feet): 18 I.D. x 17H

Maximum Specimen Size (ft): 15D x 15H

Penetrations: 8-3 in. diam pipes for cables, wired connectors, etc.

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Stratosp. Chr.	2	1	-90 to 80	-	100K		No	No		10x10x6.5
Hum. Chamber	5		+10 to 90	-	-		No	No		18x12x11
Alt. Chamber	2		-100 to 80	-	100K		No	No		4x3x3
Env.'s Chamber	2,8		-74 to 80	-	100K		No	No		3x3x3
Space Chamber	1	2&3	-190	-	-	1×10^{-7}	No	4D/420(a)	7	10H
Space Chamber	1	2&3	-190	-	-	1×10^{-8}	No	4D/420(a)	4	5H

* 1 Space Simulation, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2) 8 - Vibration (a) Units: Btu/ft^2 hr

AFRPL SPACE PROPULSION ENVIRONMENTAL FACILITY (SPEF)

REPORTING INSTALLATION: Air Force Rocket Propulsion Laboratory Edwards Air Force Base California 93523	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Test and Operations Division (RPF)
OTHER SOURCES OF INFORMATION: AFRPL Test Facility Brochure, "Space Propulsion Environmental Facility"	LOCAL OFFICE TO CONTACT FOR INFORMATION: C. A. Notar, Branch Chief Area A (RPFA) Phone: (714) 553-2088

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is a 30-foot diameter space environment soak chamber housed in a large building 60 by 109.8 by 51 ft high. Two cranes are available for movement of test articles comprising 60 ton and 10 ton bridge capacities, respectively. Access openings to the 30-ft chamber include a 19-ft diam top opening door and an 8-ft diam hinged door of the equator. Radiant heat is available over a 350-sq ft area from an infrared lamp array with a maximum intensity of 200 watts/ft^2.

TESTING CAPABILITIES: This facility is used for Space simulation testing (primarily soaking) of propellant systems and propulsion system components, utilizing actual propellants.

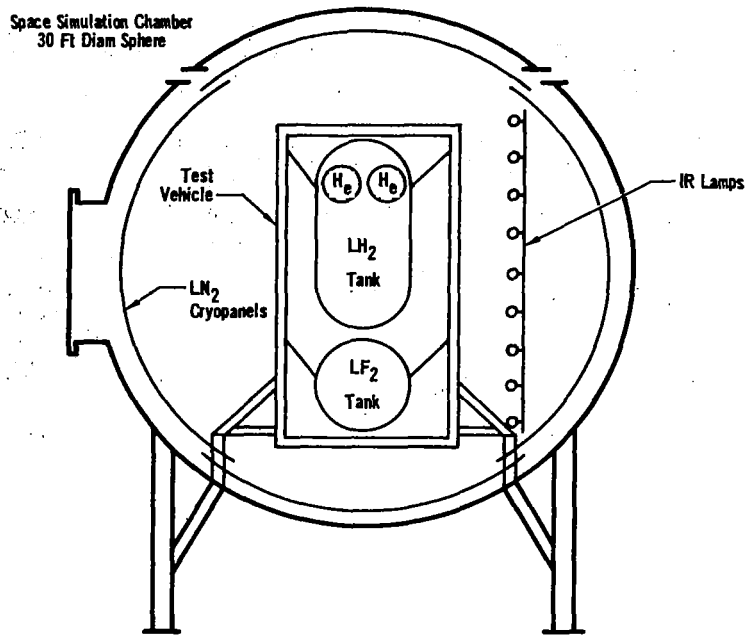
Data recording capabilities include a 12-channel high frequency FM tape recorder, a 474-channel digital tape recording system, (thirty) 30-channel strip chart recorders, and a 36-channel direct record oscillograph.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1966 COST $3,314,000 ESTIMATED REPLACEMENT VALUE $4,000,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Facility Operating Envelope

(Not Available)

Facility Name: Space Environment Simulation Facility

Type of Environments Simulated*: 1,2,6, & 7

Type of Pump or Ejector**: 1,2

Temperature Range(C°): -184 to 204 (Thermal Wall Temp.)

Minimum Work Pressure (Torr): 1 X 10-6

Man-Rated: No

Maximum Specimen Size (feet): 16 X 16 X 20 ft

Maximum Specimen Weight (lb): 100,000

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Chamber No.1	1,2,7,a	1,2	-184to149	-	-	1×10^{-8}	No	No	8	5H
Chamber No.4	2	1,2	None	-	-	5×10^{-5}	No	No	9	12L

* 1 Space Simulations, 2 Altitide, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air ejector
***Beam size (ft) and intensity (watts/ft^2) a Vibration

AFSWC - HOLLOMAN STRATOSPHERE CHAMBER

REPORTING INSTALLATION: Air Force Special Weapons Center Holloman Air Force Base New Mexico 88330	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: MDS
OTHER SOURCES OF INFORMATION: AFMDC, "Description of Environmental Laboratory for Combined Environmental Testing," MDC-TR 65-52, October 1965.	LOCAL OFFICE TO CONTACT FOR INFORMATION: Environmental Test Branch (MDSLE) Phone: (505) 473-6511, ext 5-2114

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This chamber was designed to create controlled and combined conditions of altitude, temperature, humidity, infrared radiation, and vibration in a laboratory room. Outstanding features of this chamber's operation are rates of change, and the ability to program environmental variables automatically and independently, or simultaneously. These variables can be programmed for extended periods of "flight" time, for example, 48 hours. An auxiliary vacuum tank 8 feet in diameter by 60 feet long is available that can be used as a separate chamber for altitude simulations.

TESTING CAPABILITIES: The figure on the opposite page shows the chamber interior, with the main door open. Penetrations, view ports, oxygen and communication systems, a TV system, a patch panel for power and instrumentation connections, and recorders are available. Thermal simulation of solar radiation effects is accomplished with infrared lamps. The chamber control console contains instrumentation for automatically controlling, programming, and recording chamber conditions. By placing a vibration exciter inside the chamber, a specimen can be tested under vibration conditions combined with chamber conditions. Two vibration exciters are available for this purpose. One can deliver 5000 lbs of vector force (over a frequency range of 5 Hz to 2 kHz, with 1/2 inch maximum total displacement) and the second can deliver 1750 lb of force (over a frequency range to 5 kHz with 1-inch maximum total displacement).

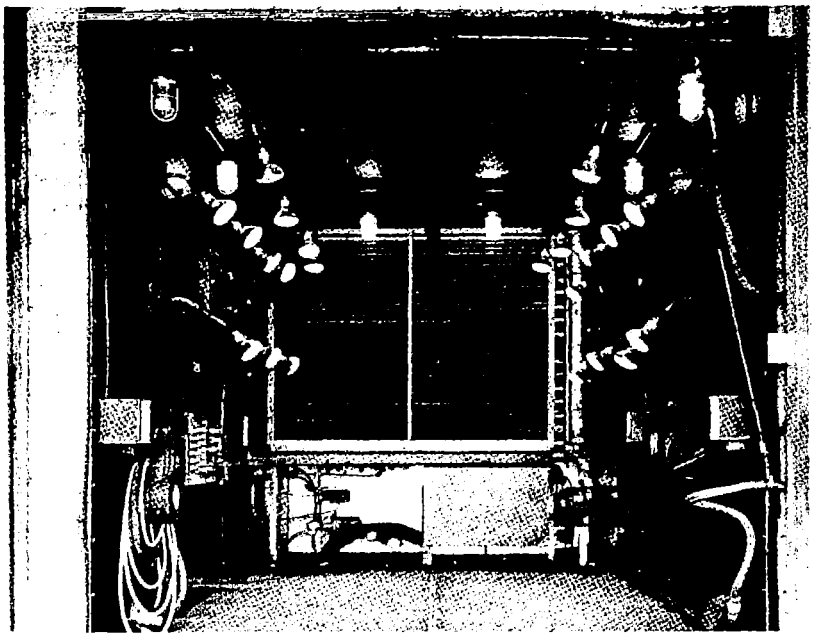
A 14 channel FR-600 tape recorder and a 65 channel automatic data logger are available for data recording. A CDC 3600 computer is used for data reduction. The typical time cycle for data processing is 2 weeks although this can be reduced to 1 day for maximum priority tests.

FACILITY COST HISTORY

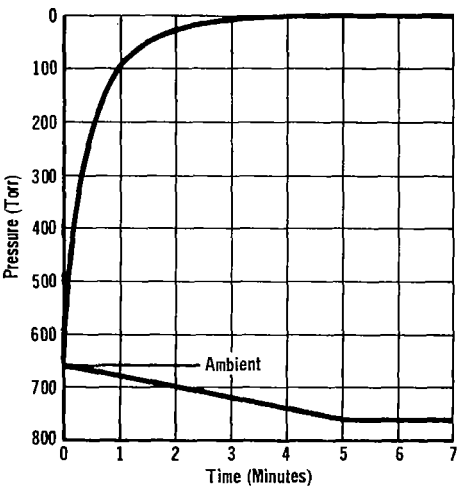
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Stratosphere Chamber

Type of Environments Simulated*: 2, 5, & 6

Type of Pump or Ejector**: 1

Temperature Range (°C): -75 to 90

Altitude (feet): 200,000
Altitude Rate: Ambient to 140K ft in 4 min.

Relative Humidity (%): 15 to 95 (from 1.7 to 60°C), Dew Pts to -49°C using an air drier

Man-Rated: No

Chamber Dimensions (ft): 8 W x 11 L x 8 H
(Anteroom) (ft): 4 W x 4 L x 8 H

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Space Chamber	1	1, 2	-195to150			1×10^{-7}		****	5	6 L
Vacuum Tank	2	1	Ambient		200K				8	60 L
Tenney Chamber	2, 5, 7			20-90	120K		Yes			3 x 3 x 3
Closed Env Sys	2,5,7,O_2		16 to 49	10-95	42K					2.5x3.5x3.8
(2)Temp.Chmbrs	7		Amb to370							.6x7x1.25
Eleven other small chambers are available.										

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2) ****18-in. dia port, but no solar sim on hand

AEDC AEROSPACE ENVIRONMENTAL CHAMBER (MARK I)

REPORTING INSTALLATION: Arnold Engineering Development Center (AEDC) Arnold Air Force Station, Tennessee 37389	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Air Force Systems Command
OTHER SOURCES OF INFORMATION: Test Facilities Handbook, AEDC 8th Edition, December 1969	LOCAL OFFICE TO CONTACT FOR INFORMATION: Director of Test (AET)

INFORMATION ON THE ENVIRONMENTAL CHAMBER (MARK I) IS SUBJECT TO SPECIAL EXPORT CONTROLS. FURTHER INFORMATION MAY BE OBTAINED FROM:

Air Force Systems Command
Arnold Engineering Development Center
Arnold Air Force Station, Tennessee 37389

BENDIX THERMAL/VACUUM LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Bendix Aerospace Systems Division Mail Stop G-10 3300 Plymouth Road Ann Arbor, Michigan 48107	COGNIZANT ORGANIZATIONAL COMPONENT: Quality Assurance Department
OTHER SOURCES OF INFORMATION: Bendix Brochure, "Environmental Laboratories Facilities Summary," August 1966	LOCAL OFFICE TO CONTACT FOR INFORMATION: E. M. Sieron, Manager Quality Assurance Department Phone: (213) 665-7766

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Thermal/Vacuum Laboratory contains various space simulation, altitude, and environmental chambers. The size of the vacuum facilities ranges from a 1.5 ft diameter bell jar to a 20 ft diam by 20 ft long space chamber. The largest climatic chamber is 4 x 4 x 4 ft. Instrumentation and power pass-through ports are available on all chambers to monitor or control experiments or environments. A 300-channel data acquisition system is available for obtaining environmental and functional data. Applied research, design verification, or flight qualification test programs are readily performed. Additional channels can be added to the data acquisition system, if required. A three channel program-control-record-system is used to program up to 600 kVA of ac power for environmental or functional control. Each channel may control 200 kVA. The actual test parameters are sensed and controlled by closed loop transducers and automatically recorded. Solar simulation is provided by high intensity, constant feed carbon arc lamps. The intensity available on a 75-inch diameter target is equivalent to one sun. The illuminated area may be varied from a 46 to 84-inch diameter. Optically tight cryogenic walls cooled by liquid nitrogen are available in the two larger chambers. The LN_2 is stored in a 14,700-gallon storage tank.

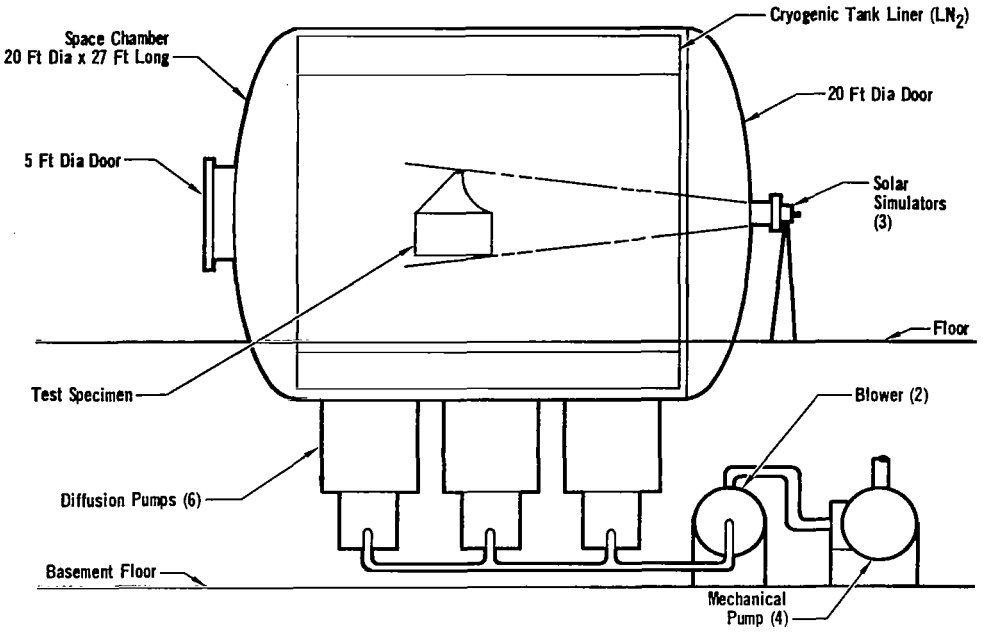
TESTING CAPABILITIES: The thermal/vacuum laboratory has verified the operation of aircraft and aerospace systems in their representative space, altitude, temperature and environmental conditions. Operation of the Apollo Lunar Scientific Experiments Package (ALSEP), currently transmitting data from the moon to earth, was verified during simulated lunar days and nights in this facility.

FACILITY COST HISTORY

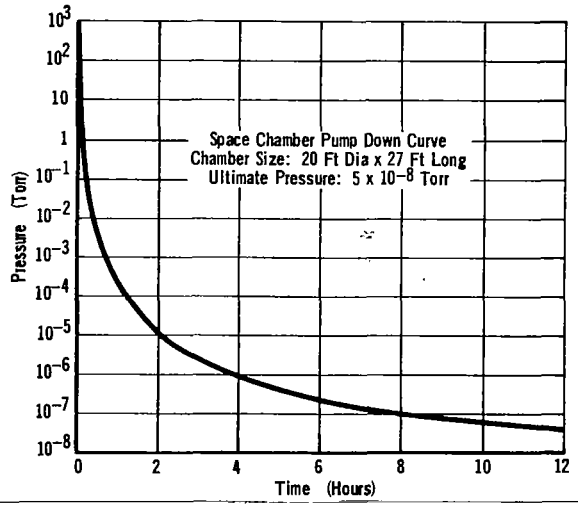
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Space Simulation Chamber

Type of Environments Simulated*: 1, 6

Type of Pump or Ejector**: 1, 2

Temperature Range (°C): -180 to 150

Minimum Work Pressure (Torr): 5×10^{-8}

Man-Rated: No

Solar Simulator***: 130 watts/ft^2

Maximum Specimen Size (feet):

Maximum Specimen Weight (lb):

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	1 x w x h
Ultra High Vac	1, 6	1, 2	-180to150	-	-	4×10^{-9}	No	130	4	8L
Extreme Hi Vac	1	1, 6, 7	-	-	-	5×10^{-11}	No	-	2	5L
Vac Chamber	1	1, 2	-	-	-	5×10^{-7}	No	-	4.4	2.5L
2,Temp-Hum-Alt	2, 5, 7	-	-75 to 150	5-100	200K	-	No	-	-	3 x 3 x 3
Temp-Hum Chmbr	5, 7	-	-75 to 150	5-100	-	-	No	-	-	3 x 3 x 3

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

BOEING ALTITUDE ENVIRONMENTAL FACILITY

REPORTING INSTALLATION: The Boeing Company Tulalip Test Site, Test Area 34 3202 116th St. N.E. Marysville, Washington 98270	STATUS OF FACILITY: Stand-by COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories (Remote Test Sites), Aerospace Group
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Mr. V. O. Parrish, Site Manager Phone: (206) 659-1291

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is a high altitude test facility capable of hazardous environmental testing. The basic facility components are: altitude chambers, steam jet ejector pumping systems, steam boiler system, and test control and instrumentation facilities. Two altitude chambers are available for test. Both are connected to the ejector system and have the same altitude capability. The small chamber has a volume of 640 ft^3 (8' x 8' x 10' long). The large chamber has a volume of 10,000 ft^3 and is 19 ft in diameter and 33 ft long, excluding the head ends. The large chamber has a steel grate floor at the same elevation as the surrounding grade level. The effective internal chamber height above the floor is 17 ft. Two independent steam ejector systems are available. One system is composed of two ejector stages with an inter-condenser between stages. This system is connected to each of the altitude chambers. The other ejector system is a 5-stage ejector system with an inter-condenser located between the 3rd and 4th stages. Either altitude chamber may be isolated from the system by a swing-blank plate in the connecting ducting. The facilities cooling water is circulated from a single cell, induced draft cooling tower. The rated performance of the cooling tower is 2000 gal/min at 115°F inlet and 85°F outlet temperature at 67°F wet bulb. This cooling water is used for chamber spray cooling, inter-condenser water supply, and other industrial water supply requirements.

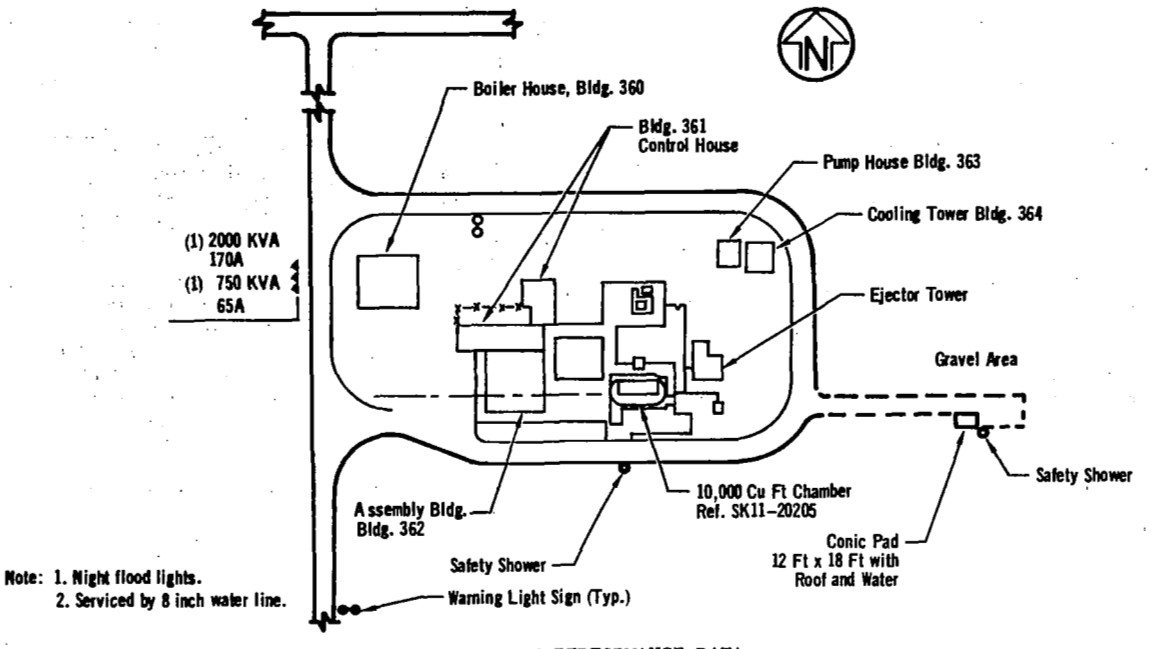
TESTING CAPABILITIES: The type of testing that may be conducted in this area is limited only by facility or test hazard requirements. To date many tests of varied types have been conducted here, some of which are: (a) Environmental heating capability at altitude to simulate temperature and pressure environment during reentry conditions; (b) Dyna-Soar APU test. These tests consisted of breadboard hookup of the entire X-20 environmental control system, including the liquid hydrogen transfer system and the supercritical hydrogen and oxygen systems; (c) Cryogenic tank tests on Boeing designed and built flightweight tanks of 8 ft diam and another tank (MOL configuration) of about 3 ft diam were conducted to demonstrate design and fabrication proficiency as regards low heat leak, flight type, cryogenic tanks; (d) Propulsion testing at altitude has been conducted on rocket motor systems. A test program was conducted on a 50-lb-thrust Minneapolis Honeywell reaction control, pulse rocket motor. Another test was conducted on the Lunar Orbiter velocity and attitude control system. Restart capability tests on Lunar Module Ascent and Descent engines were conducted in the facility. The control house has approximately 1850 ft^2 of floor space in which to locate control and instrumentation functions. The area is wired with permanent instrumentation lines which would allow 180 channels of steady-state data that may be recorded on a Beckman 210 data system. In addition, 72 channels of high response oscillograph and 8 strip charts are available. Forty-eight miscellaneous channels are wired to the control house and may be used for various purposes. There is an assembly building adjacent to the control house which has 2500 ft^2 of floor space. Electrical power is provided from 750 and 2000 kVA transformers for lighting, equipment motors, instrumentation, etc. Plant air is provided by a 360 CFM, 125 psig air compressor. Distribution lines carry this air supply to all work areas of the facility.

FACILITY COST HISTORY

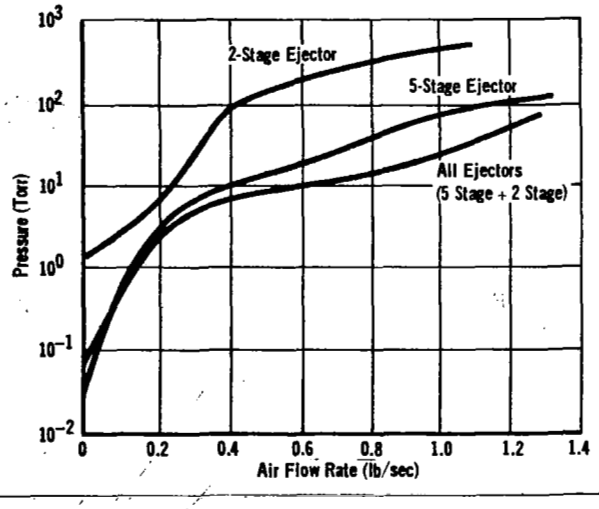
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1963 COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name:	19 Foot Chamber
Type of Environments Simulated*:	1,2,7
Type of Pump or Ejector**:	4
Temperature Range (°C):	
Altitude (feet):	220,000
Minimum Work Pressure (Torr):	
Man-Rated:	No
Chamber Dimensions (feet):	19 Diam x 33 Long

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
8 Foot Chamber	1,2,7	4			220K					8 x 8 x 10

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

BOEING ENVIRONMENTAL TEMPERATURE TEST FACILITY

REPORTING INSTALLATION: The Boeing Company Commercial Airplane Group P. O. Box 3707 Seattle, Washington 98124	STATUS OF FACILITY: Stand-by COGNIZANT ORGANIZATION COMPONENT: CAG, Propulsion/Mechanical Engineering Staff, Mechanical System Staff
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mechanical Systems Staff Mr. J. C. Stuart, Mail Stop 54-84 Phone: (206) 655-4856

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is 30-feet high, 30-feet wide and 80-feet long. Actual usable floor space is 30 X 70 feet. Wall and ceiling construction is of polyurethane foam core aluminum panels. The floor is steel-reinforced foamed concrete that has a floor loading capacity of 500 lb/ft^2. The refrigeration machinery consists of Carrier manufactured compressors in a cascade system designed for 35 tons at -65°F. Refrigerants are R 13 for the low stage and R 502 for the high stage. Heating above ambient is provided by electric air heaters of a total capacity of 120 kW. Electrical power available is single- and 3-phase 60 and 400 cycle. One observation window (3 X 1-1/2 ft) is located at eye level. Three wall penetrations (2 X 2 ft) are provided.

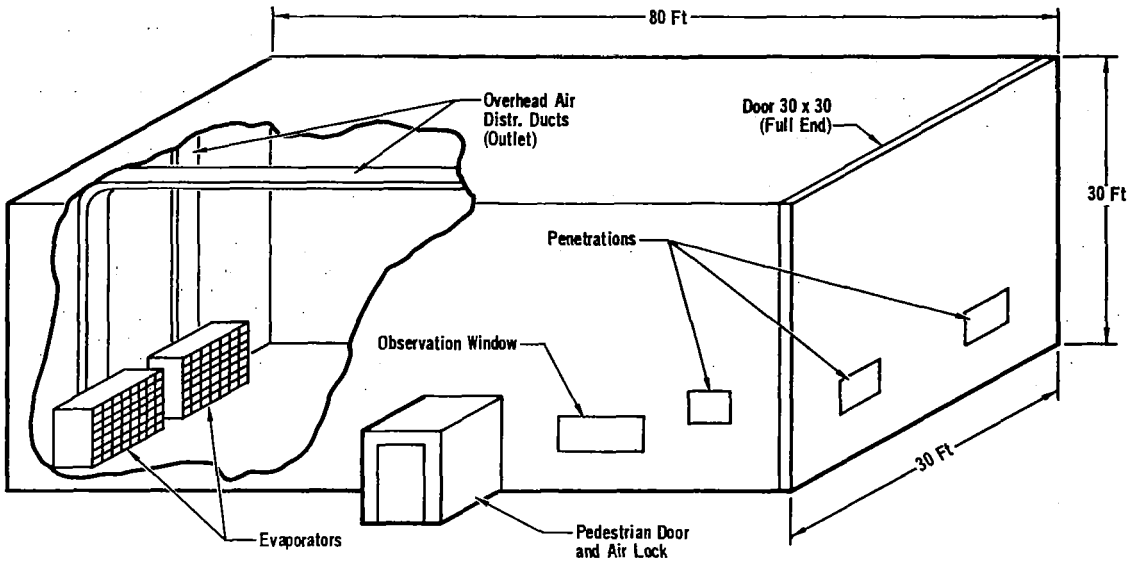
TESTING CAPABILITIES: Test equipment or test specimen may be placed into the facility through the pedestrian door or the end door 30 X 30 ft size. Instrumentation consists of a single-channel temperature strip chart and general purpose portable stamping chart recorders. Humidity can be added using steam.

FACILITY COST HISTORY

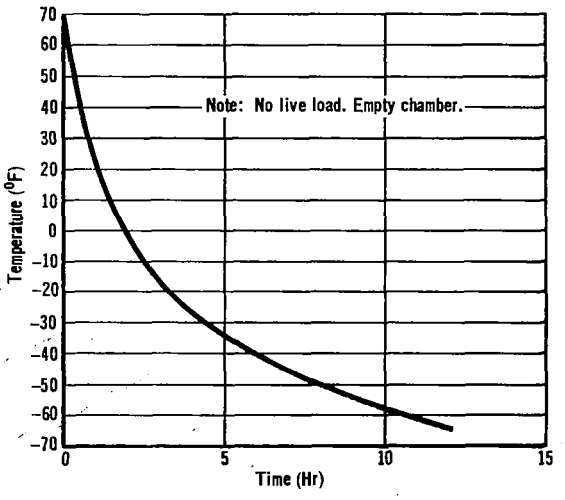
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1966 COST $487,000 ESTIMATED REPLACEMENT VALUE $547,000
CONTRACTOR: The Boeing Company IMPROVEMENTS AND COSTS: Not Available	LOCATION: Seattle, Washington

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Environmental Temperature

Type of Environment Simulated*: 5,7

Altitude: Atmospheric

Temperature Range (°F): -65 to 115

Minimum Work Pressure: Atmospheric

Chamber Dimensions (ft): 30 X 30 X 80

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen.(ft)	
									Dia.	l x w x h
None										

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
** Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam Size (ft) and intensity (watts/ft^2)

BOEING SPACE ENVIRONMENT LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
The Boeing Company Building 18-24 Kent Space Center Kent, Washington	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: C. J. Spengler, Manager Space Environmental Laboratory Phone: (206) 773-4340

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of three chambers (A, B, and C) located in a 10,000 sq ft high bay area. Chamber "A" is a top-loading, 39-ft-diam by 50-ft-high, stainless steel chamber, complete with 3.8 million liter/sec helium cryopanels (20°K) and total liquid nitrogen shrouding. The shielded work space is 28 ft in diameter by 40 ft high. Pumping is accomplished by a trapped 5000-CFM roughing system, two 100,000-liter-per-second bulk sublimators mounted coaxially in 2400-liter-per-second ion pumps, and the helium cryopanels. In addition, each pumping unit contains a 2-watt helium refrigerator capable of operating in the 10-to-200 micron range. Ultimate (demonstrated) pressure within the chamber is below 1×10^{-9} torr, with a working pressure below 1×10^{-5} torr with a 20-torr-liter-per-second oxygen or nitrogen gas load. Pumpdown to minimum pressure is accomplished within eight hours, and a warm gas system allows repressurization within five hours. The A-7000 solar simulator is a modular on-axis collimated solar source used in conjunction with Chamber "A". It can be operated either on top of Chamber "A" or at the building solar alignment bay adjacent to the space chamber. The first phase in developing the 20-foot-diameter solar beam consists of only 7 modules of the 37 module system. Each module illuminates approximately 10 ft^2 in the test volume to provide a nominal 7-foot-diameter beam. A separate lid permits chamber operation in the absence of the solar lid. The chamber was designed for versatility: The stainless steel structural floor, the 10-ft-diam by 20-ft-long anti-chamber with high vacuum, 10-ft-diam gate valve, and the ability to increase the chamber height. Chambers "B" and "C" are bottom-loading, ultra-clean, stainless steel chambers 10 feet by 20 feet and 10 feet by 10 feet, respectively. Each chamber is complete with total enclosure liquid nitrogen shrouds and 500,000-liter-per-second "Santeler Array" helium cryopanels (20°K). These chambers are roughed with a 1250-CFM blower system immediately between the chambers, or are valved to the Chamber "A" 5000-CFM roughing system for "rapid pumpdown" or ascent simulation. High-vacuum pumping is accomplished in a combination ion-sublimation pump of 110,000-liter-per-second capacity, in conjunction with the liquid-nitrogen shrouds and the helium cryopanels. Ultimate (demonstrated) pressure in these chambers is below 1×10^{-10} torr, with a working pressure of 1×10^{-9} torr under a 1×10^{-4} torr-liter-per-second nitrogen gas load. Time to working pressure is less than five hours, with eight hour warmup and repressurization. Since these chambers are completely "clean" pumped, absolutely no hydrocarbon contamination is possible. The bases to these chambers are interchangeable and are mounted on wheels for easy access. An extra base allows test setup to proceed while the chambers are in operation. The bases are lifted into position with a hydraulic hoist and are sealed either with Viton O-rings or with copper seals. Chamber "B" includes a 4-foot-diameter, off-axis solar simulator. Nineteen 2.5-kilowatt xenon and lamps provide a variable beam intensity of up to 1680 watts per square meter with a collimation half angle of 1.45 degrees. Beam uniformity is ±5% with a 42-inch-diameter circle and spectral match ±10% to the NRL solar constant.

TESTING CAPABILITIES: The Space Environment Laboratory has verified the operation of aerospace vehicles and components in flight representative environmental conditions. Thermal vacuum tests were conducted on the entire Lunar Orbiter spacecraft to verify operation in the extreme environments of space. Combined vacuum-vibration tests have been conducted on solar panels to 8 ft x 13 ft. A 5200 square foot M&C Laboratory is separately enclosed from the high bay laboratory and contains eight systems for specialized testing of solar cells, bearings, materials, electronics, packages, etc.

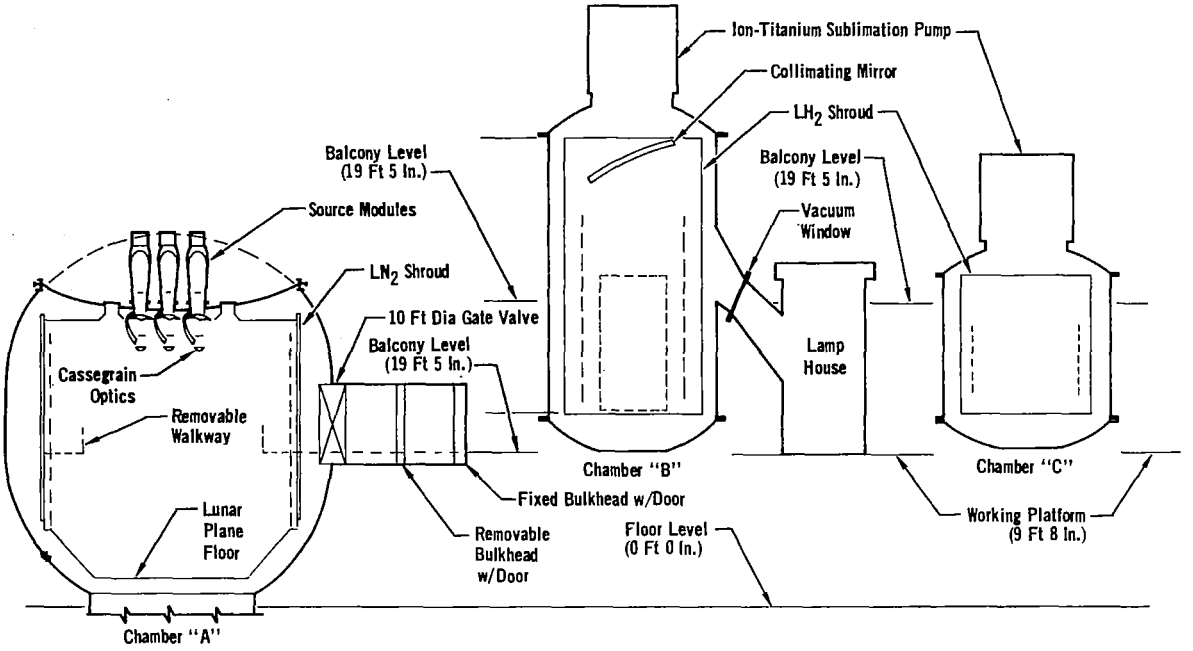
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1964-65 COST $7,000,000 ESTIMATED REPLACEMENT VALUE $8,500,000
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: (1964) A-7000 Solar Simulator-Spectrolab, Cost $1,200,000.

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATICS



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name:	Chamber A
Type of Environments Simulated*:	1,6
Type of Pump or Ejector**:	1,3,6
Temperature Range (°F):	Not Available
Altitude (feet):	Not Available
Minimum Work Pressure (Torr):	10^{-7}
Man-Rated:	No (Antichambers are constructed as manlocks if chamber becomes man rated)
Chamber Dimension (feet):	39 dia x 50H

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Chamber B	1,2,6	1,3,6	N/A	N/A	N/A	10^{-11}	No		10	20H
Chamber C	1,2	1,3,6	N/A	N/A	N/A	10^{-11}	No	N/A	10	10H
Chamber 1	1,6	1,3,6				10^{-10}	No	x-25L	5	5L
Chambers 2,3,4	1,6	1,3,6				10^{-10}	No	x-25L	3	4L
Chambers 5,6	1,6	1,2,3				10^{-10}	No	x-25L	2.5	2.5L
Chamber 9	1,6	1,3,6				10^{-9}	No	x-25L	3	6L

* 1 Space Simulations, 2 Altitude 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Ion-Titanium Sub-limation

***Beam size (ft) and intensity (watts/ft^2)

GENERAL DYNAMICS/FORT WORTH HIGH ALTITUDE LABORATORY

REPORTING INSTALLATION: General Dynamics Corporation Building 138, Fort Worth Division Fort Worth, Texas 76101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: "Document on High Altitude Laboratory Capabilities," Report No. FZM-1342	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager of Engineering Test Laboratories Phone: (817) 732-4811, ext 2203

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The High Altitude Laboratory is one of the largest facilities of its type in the United States. It is composed primarily of two large test chambers (one of which may be divided into two chambers), two test control and instrumentation buildings, a steam jet ejector vacuum system, a multi-stage refrigeration system, a 300 psi, 300 lb/min, 1000°F air system, and combined gas fired and electric chamber heating systems. A unique feature of this facility is its flexibility in the following ways: (1) The three chambers can be simultaneously operated at different conditions of altitude, temperature, and humidity; (2) the size of the test chambers is sufficient for environmental testing of large components or complete aircraft systems; (3) the arrangement and capacities of the auxiliary systems provide capability of supplying vacuum, refrigeration, and high capacities of heated or cooled compressed air to tests in the area adjacent to the High Altitude Laboratory; (4) by storing large amounts of cold brine, the rated capacity of the refrigeration system (100 tons at -85°F) may be exceeded for rapid temperature pulldowns.

TESTING CAPABILITIES: This facility is capable of providing the following environments: Altitude (Vacuum) Sea level to 100,000 feet; Temperature from -100°F to +400F; Humidity 20% to 95% relative between +35°F and 185°F dry bulb. Operation of High Altitude Laboratory equipment and systems is basically controlled from a console in the Equipment Building with distribution of services controlled from chamber consoles in the Main Control Building. Additional utilities consist of: Cooling water (10,000 GPM cooling tower and pumping system); Electricity (6600 KVA for short periods and 3000 KVA continuously); Compressed Air. (Up to 1200 ppm at pressures up to 300 psi); and Natural gas, water, airplane type electric power. Complete instrumentation including on line and off line automatic data (Honeywell system; and an onsite Hewlett Packard reduction system) processing, computer controlled test parameters, high speed and normal speed photography, Schlieren, closed-circuit TV tape systems, and a complete line of conventional temperature and pressure recording and monitoring instrumentation is available. Support testing such as hydraulics, thermodynamics, airflow, shock, sound and vibration, metallurgical, chemical, electrical, and structural are available. All instrumentation calibrations are traceable to the U.S. Bureau of Standards in the Division Standards Laboratory. Additional chambers have been used for qualification of flight and ground support equipment for various contracts of this division. Extensive use has also been made in such materials development as fabrics, seals, honeycomb structural materials, bonding materials, lubricants, thermal and electrical insulation, plastics, and many other materials used in aerospace vehicles.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $200 to $800	CONSTRUCTION YEAR: 1956-58 COST $1,300,000 ESTIMATED REPLACEMENT VALUE $5,000,000
CONTRACTOR: Arthur E. Magher Corp. IMPROVEMENTS AND COSTS:	LOCATION: New York, New York

PLANS FOR FACILITY IMPROVEMENTS: As required for prime contractors

FACILITY PERFORMANCE DATA (CONTINUED):

I. VACUUM SYSTEM

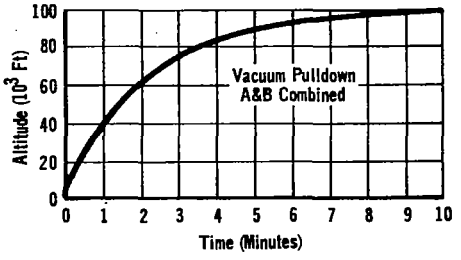
Dynamic Conditions

Chamber: A-B Combined Temp. Range: -100° to +400°F

Altitude - Feet From	To	Air Bleed Lb/min	Time to Attain Condition-Minutes
Station	40,000	150	1
Station	60,000	150	2
Station	75,000	150	3

Flow Capabilities:

Static - 120,000 Ft Altitude
40 PPM - 100,000 Ft Altitude
1000 PPM - 30,000 to 35,000 Ft Altitude
2000 PPM - 5,000 to 15,500 Ft Altitude
3000 PPM - Station Ambient Pressure



II. REFRIGERATION SYSTEM

Dynamic Conditions

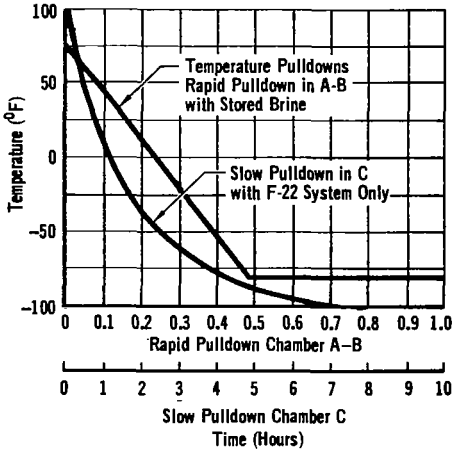
Chambers at Station Pressure

Chamber	Temperature °F From	To	Live Heat Load - kW	Steel Load Pounds	Time to Attain Temp.
A-B Combined	+ 70	- 85	17	10,000	30 Min.
C	+100	-100	0	10,000	8 Hrs.

Static Conditions

Rated: 100 Tons

Chamber	Temperature °F	Total Live Heat Load At Station Pressure - At 80,000 Ft Alt.
A-B Combined	- 65	100 kW
A-B Combined	- 85	50 kW
A-B Combined	-100	17 kW
C	- 65	10 kW
C	-100	200 kW
		50 kW
		10 kW



III. CHAMBER HEATING SYSTEMS

Dynamic Conditions - At Station Pressure

Chamber	Temperature °F From	To	Steel Load Pounds	Time To Attain Temp. - Minutes
A-B Combined	-85	+400	3000	10
C	-85	+400	3000	30

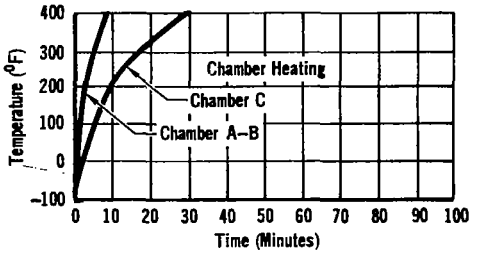
Maintain +200°F at 100,000 Ft Altitude
+400°F at 63,000 Ft Altitude

IV. HUMIDITY CONTROL SYSTEM

All chambers from 20% to 95% relative between +35° and +185°F dB.

V. COMPRESSED AIR

Refrigerated - 100 psi
100 PPM at -100°F
500 PPM at - 65°F
Heated - (Ambient to 1200°F)
50 PPM at 500 psi
300 PPM at 300 psi
- (Ambient to 1000°F)
630 PPM at 100 psi
- (Ambient to 500°F)
1800 PPM at 100 psi



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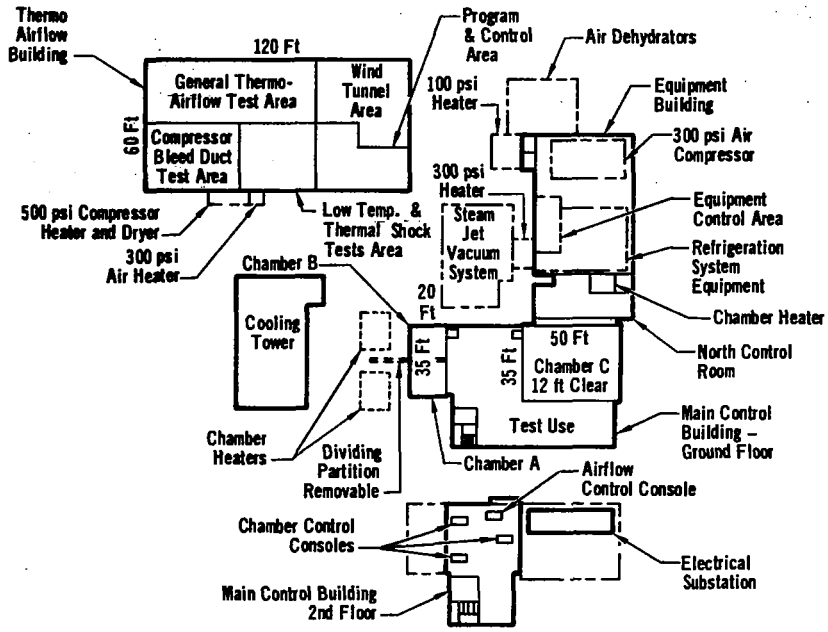
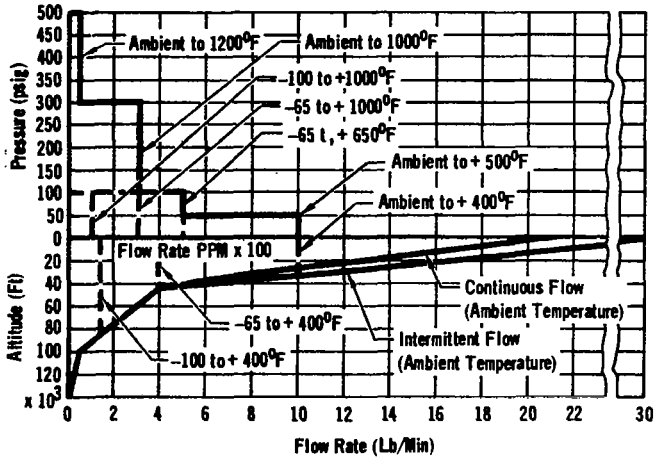


FACILITY PERFORMANCE DATA



Facility Name: High Altitude Laboratory

Type of Environments Simulated*: 2,5,7,8

Type of Pump or Ejector**: 4

Temperature Range (C°): -73 to 205

Altitude (feet): 120,000

Minimum Work Pressure (Torr): 3.3

Man-Rated: No

Chamber Dimensions (ft): Two - 34 x 50 x 14
Three - 35 x 20 x 14

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	1 x w x h
Zaleski	2,7,8	6	-73to82	Amb.	80K	21.1	No	No		7x7x7
Tenney (2)	2,7,8	6	-73to260	Amb.	120K	3.3	No	No		3x3x4
Tenney	5	N/A	1to93	Amb.	Atmos	N/A	No	No		1.5x1.5x4
Amer.Inst.Co.	9	N/A	Amb.to93	Amb.	Atmos	N/A	No	No		4x2x1.5
Blue M	5	N/A	-18to 93	Amb.	Atmos	N/A	No	No		4x4x4
Amer.Inst.(2)	7	N/A	Amb.to260	Amb.	Atmos	N/A	No	No		2x2x3

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal 8 Low Temperature, 9 Fungus

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Mechanical Pumps

***Beam size (ft) and intensity (watts/ft^2)

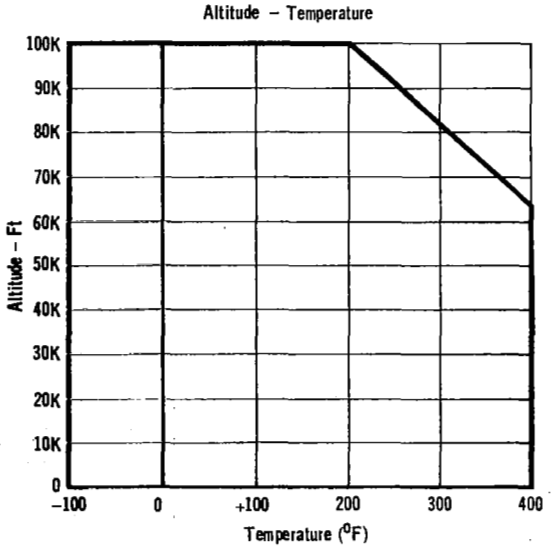
ADDITIONAL ENVIRONMENTAL CHAMBERS (CONTINUED):

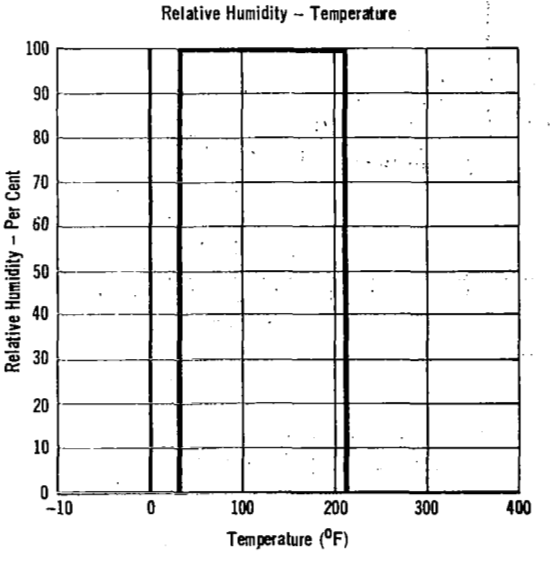
DESCRIPTION: These chambers are designed to perform qualification tests on flight and ground equipment per Military Specifications MIL-E-5272 and MIL-E-4970.

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Gen Dynamics	2	6	Ambient	Amb	75K	27	No	No	10	30L
Conrad	7	N/A	-73 to 260	Amb	Atmos	N/A	No	No		6.5x6.5x6.5
2, Blue M	7	N/A	Amb to 316	Amb	Atmos	N/A	No	No		4x4x6
Mich. Oven	7	N/A	Amb to 538	Amb	Atmos	N/A	No	No		4.5x4.5x6
Conrad	4	N/A	Amb to 177	Amb	Atmos	N/A	No	No		4x4x4
Indust F&P	3	N/A	Amb to 52	100	Atmos	N/A	No	No		4x2x3
Tenney	Explosion	6	Amb to 71	Amb	Atmos	N/A	No	No		3x4L
3, Tenney	7	N/A	-73 to 205	Amb	Atmos	N/A	No	No		3x3x4
2, Mantes	7	N/A	-73 to 149	Amb	Atmos	N/A	No	No		2.5x3x3

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Mechanical Pumps
***Beam size (ft) and intensity (watts/ft^2)

HIGH ALTITUDE LABORATORY/PERFORMANCE ENVELOPES
(CONTINUED)





GE SOLAR THERMAL VACUUM CHAMBER
(Space Environment Simulation Laboratory)

REPORTING INSTALLATION: General Electric Company Space Systems Organization, Building 200 P.O. Box 8555 Philadelphia, Pennsylvania 19101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Product Assurance, Test Operations
OTHER SOURCES OF INFORMATION: GE Brochure, "The Valley Forge Space Technology Center"	LOCAL OFFICE TO CONTACT FOR INFORMATION: H. R. Daw, Manager Test Operations, Building 200 Phone: (215) 962-4979

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The major component of the Space Environment Simulation Laboratory is the 54-feet high by 32-feet diameter solar-thermal-vacuum chamber. Capable of accommodating complete spacecraft up to 21 feet in diameter weighing as much as 44,000 pounds, the space chamber provides vacuum conditions from 10^{-6} to 10^{-9} torr and the cold black characteristics of space. The interior surfaces of the solar-thermal-vacuum chamber are maintained at extremely low temperatures to simulate the low energy, completely absorbing characteristics of space. A system of black anodized cooling panels is employed through which liquid nitrogen is circulated. All surfaces facing a test vehicle have an emissivity of .95 or higher. The cryogenic panels are arrayed as shown in the schematic on the opposite page and are covered with a three-quarter-inch-thick honeycomb. The baffle effect of the finned array combined with the multiple bounce path of the honeycomb produces the high emissivity. The cold black surfaces of the interior of the chamber simulate in appearance as well as the effect of "cold and black" of space. Xenon arc lamps and a unique optical system provide a 14-foot diameter collimated beam of simulated solar radiation. This "sun," among the largest in operation in this country, provides a variable intensity of 120-140 watts per square foot of solar radiation. A test preparation area is located immediately adjacent to the chamber and an overhead crane is available for placing test vehicles in the chamber. The hemispherical dome of the cylindrical chamber is rolled completely back for easy access and personnel entry is provided through the side. The dome contains the parabolic reflectors for the solar simulation system and three penetrations for visual monitoring by means of closed circuit television. A two-axis positioning device capable of supporting vehicles weighing up to 5000 pounds is currently available for use in the chamber. Special positioning devices for specific needs can be designed and built for use with any shape or size test vehicle.

TESTING CAPABILITIES: The control room for the solar-thermal-vacuum chamber is located on the second level of the Space Environment Simulation Laboratory. A single test conductor at a master console is responsible for operation of the chamber. The master console consists of a graphic display of each subsystem and start-stop and run controls. To eliminate possible confusion, only the information required for operating the system is included in the master console. A complete set of interlocks and permissive circuits gives the test conductor complete control against mis-operation. Sixteen penetrations in the chamber wall provide for power connections, strain gauges, thermocouples, and other devices to be attached directly to a test vehicle.

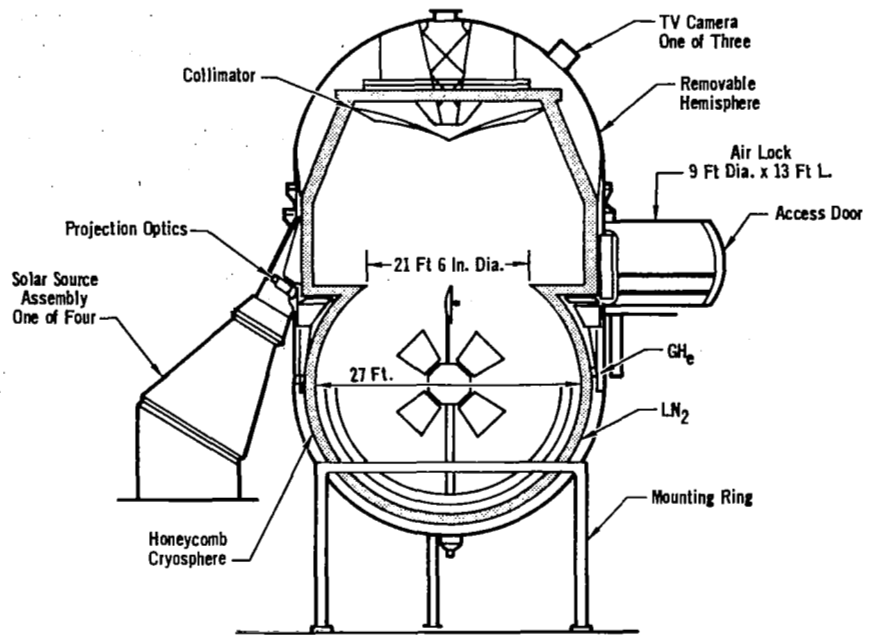
Data recording systems include Hewlett-Packard and GE equipment with 600 and 1800 data channels respectively. Data reduction is accomplished with 3 computers, an IBM 1620, a GE 605, and a GE 635. The typical time cycle for data processing is 15 minutes.

FACILITY COST HISTORY

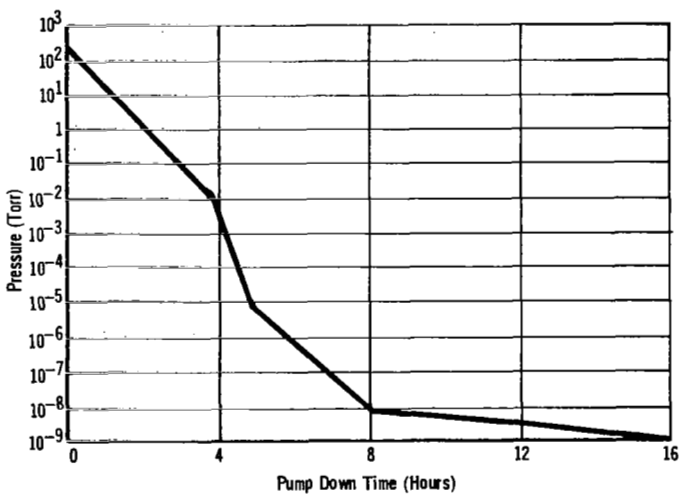
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: Solar Thermal Vacuum Chamber

Type of Environments Simulated*: 1,6

Type of Pump or Ejector**: 2,3

Temperature Range (°C): -179 to Amb.

Minimum Work Pressure (Torr): 1×10^{-9}

Man-Rated: No

Maximum Specimen Size (ft): 21 Diam.

Maximum Specimen Weight (lb): 44,000

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
S.E.S.	1,6	1,2,3	LN_2 Walls	-	-	10^{-9}	No	15D/130	27	Spherical
Tri-Metals	1	1,2	LN_2 Walls	-	-	10^{-6}	No	No	5	6L
Tri-M: 8x10 ft	1	1,2	LN_2 Walls	-	-	10^{-7}	No	No	8	10L
Tri-M: 10x24 ft	1	1,2	LN_2 Walls	-	-	10^{-7}	No	No	10	24L
(4) Long Life	1	1,6, & 7	-46 to 77	-	-	10^{-10}	No	No	3.5	4L
Star Trkr Cbr	1	1,2	-129 to 93	-	-	10^{-7}	No	No	2.5	2H

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Ion 7 Titanium Sublimation Deposition

***Beam size (ft) and intensity (watts/ft^2)

General Electric (Continued)

FACILITY DESCRIPTION (39-FT DIAMETER VACUUM CHAMBERS): The three 39-foot diameter thermal-vacuum chambers in the Space Environment Test Facility are capable of accommodating test spacecraft up to 21-feet in diameter and 30-feet long, weighing up to 20,000 pounds. The chambers provide vacuum conditions from 10^{-5} to 10^{-9} torr and the cold black characteristics of space. The chambers utilize liquid nitrogen (90°K) and dense gaseous helium (20°K) for cryogenic pumping. The chambers provide a capability for conducting space environment tests where true solar simulation is not a requirement. However, a programmable infrared heating system is available to produce the known or predicted thermal characteristics of a test vehicle.

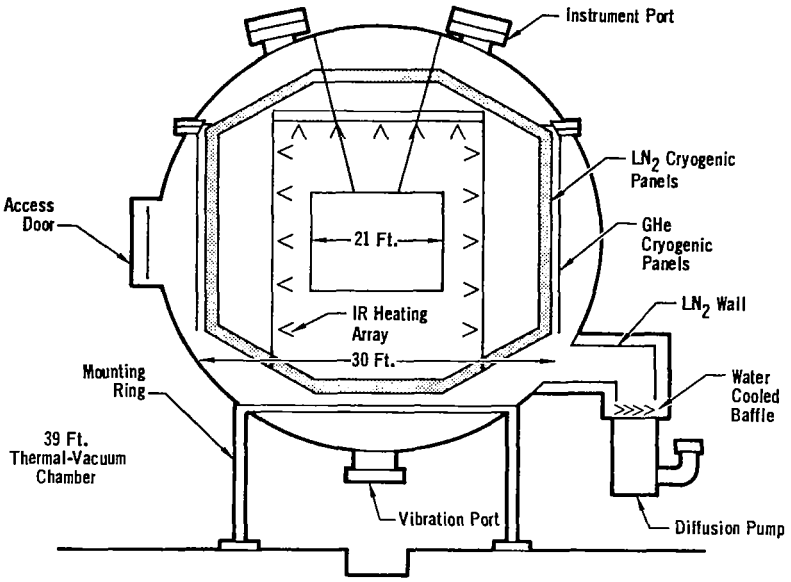
TESTING CAPABILITIES: A control room area, 29-feet wide, for the Space Environment Test Facility extends the entire length of the building. The environmental control equipment for the vacuum and cryogenic system is located in this area as well as test control and readout instrumentation. The area can be made as secure as required through the use of partitions, alarms, and other security measures. Each of the three chambers is independently operated from its own master console. A closed-circuit television system and an intercom system allow direct communication within the test areas.

ADDITIONAL ENVIRONMENTAL CHAMBERS

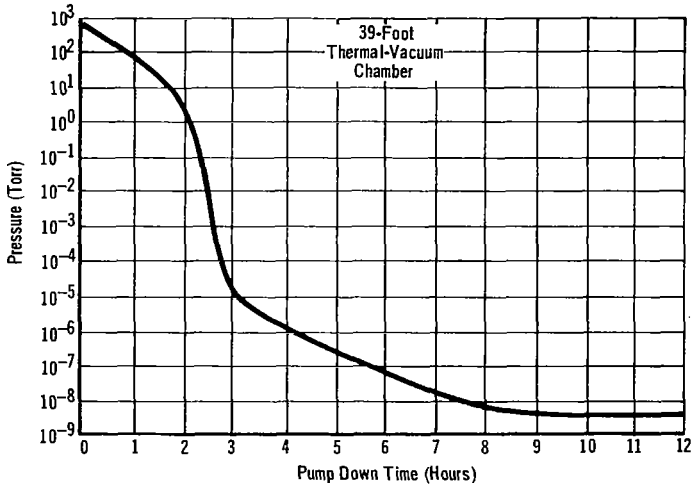
Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
(3) Gen.Vacuum	1	1,2	-31 to 121	-	-	10^{-7}	No	No	2	2H
(4) F.J.Stokes	1,6	1,2,3	-29 to 93	-	-	10^{-7}	No	3D/165	5	5H
ES-32	5,7	Not Applic	-73 to 93	20-95	N.A.	Not Applic	No	No	-	4x4x4
ES-29	7	Not Applic	-73 to 204	-	N.A.	Not Applic	No	No	-	2x2x2
ES-34	2,5,7	1	-73 to 177	20-95	200K	-	No	No	-	2.5x2.5x3
(2) ES-35& -36	5,7	Not Applic	-18 to 93	5-98	N.A.	Not Applic	No	No	-	3x2x3.5

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: 39-Ft Thermal Vacuum Chambers

Type of Environments Simulated*: 1

Type of Pump or Ejector**: 1,2,3

Temperature Range (°C): LN_2 Walls

Minimum Work Pressure (Torr): 10^{-9}

Man-Rated: No

Maximum Specimen Size (ft): 21D x 30H

Maximum Specimen Weight (lb): 20,000

Thermal Environment (watts/ft^2): 5-390 (multiple zone controllable, IR heating)

ADDITIONAL ENVIRONMENTAL CHAMBERS (Continued)

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
ES-33	5,7	Not Applic	-87to190	20-95	-	-	No	No	-	2 x 2 x 2.5
O_2 Compatibility	O_2 Compatibility	1	-	-	-	10^{-3}	No	No	4	4H

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

GRUMMAN THERMAL/VACUUM SPACE SIMULATION LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Grumman Aerospace Corporation Plant Number 5 Bethpage, L.I, New York	COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test, Department 370
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Environmental Test, Department 370 Phone: (516) 575-7062

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The vacuum facilities are located in a high-bay area within the Environmental Test Laboratory. Simulation of space environments is accomplished in large chambers and bell jars with vacuum capabilities ranging from 10^{-6} to 10^{-9} Torr.

The largest vacuum test chamber is a vertical cylinder accommodating vehicle size models and entire spacecraft system prototypes. The chamber is top-loading and has a test volume measuring 15 feet 6 in. in diameter by 20 feet high. A vacuum environment of 10^{-7} Torr is produced by eight 32-inch diameter diffusion pumps. The diffusion pumps are suspended from a high conductance vacuum manifold and are equipped with water-cooled baffles and liquid nitrogen traps. Mechanical pumps and Roots blowers are attached to the manifold system to accomplish chamber rough pumping and diffusion pump backing. Liquid nitrogen circulating through the stainless steel cold wall provides simulation of the heat sink condition of outer space. The liquid nitrogen is supplied at 80 psia at various flow rates. The outer surface of the cold wall is electro-polished to a high reflectivity, and the inner surface is treated with a flat black coating to provide high absorbtivity for incident radiation. The vertical panels of the cold wall are spaced an average of 1-1/2 feet from the vacuum shell, providing access for inspection and cleaning as well as efficient pumping conductance. To remove all condensation from the cold wall surface, an integral bakeout system employing proportional temperature controls provides temperatures from ambient to 300°F by circulating dry nitrogen gas through the liquid nitrogen flow channels. If required, an additional emergency heat-up system can be triggered automatically or manually to return the test volume from -320°F to ambient temperature within one hour. Personnel access to the chamber is through a four-foot diameter port at ground level. The vacuum chamber lid is specially designed to accommodate attachment of the test specimen and the necessary feedthrough connections to link the specimen with the data recording and power control equipment in the data acquisition room. The lid can also be equipped with two television cameras if visual observation of the test within the chamber is desired. A lid support structure is adjacent to the chamber to facilitate wiring and pretest operations before the specimen is placed in the chamber. A specimen up to 8000 pounds can be suspended from the lid and then both can be hoisted into the chamber together, or a specimen up to 32,000 pounds can be mounted on hard points on the floor of the chamber and the lid positioned separately. A special overhead travelling crane, 7-1/2 ton capacity with inching controls, is provided to permit transfer of lid and specimen from staging structure to vacuum chamber.

For more extensive evaluation of the combined effects of low pressure and solar radiation, Grumman has designed and built a solar simulation chamber. The basic chamber is an end-loading horizontal cylinder 8 feet in diameter and 35 feet long with a test specimen volume approximately 7 feet in diameter and 12 feet long. Solar energy is produced by an off-axis carbon arc light source focused on a spherical front surface mirror mounted at the far end of the chamber which directs the light through the length of the chamber to the test specimen. Energy of one solar constant is collimated within $\pm$ 1/2 degree to provide uniform irradiation of a four-foot diameter test field. Liquid nitrogen is circulated through the copper cold wall by one of two variable speed pumps. All component parts of the cold wall system

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

FACILITY DESCRIPTION (CONTINUED):

are specially designed for cryogenic service to produce temperatures to -320°F. The inner surface of the cold wall is optically dense to the test volume and is coated to provide a high emittance over the electro-magnetic spectrum between .2 and 30 microns wavelength. A vacuum environment of 10^{-6} Torr is achieved with two 50,000 liters-per-second diffusion pumps, backed up by two mechanical roughing pumps and two Roots blowers. The chamber end cover rolls on rails to facilitate positioning and wiring of the test specimen. Instrumentation from the specimen is brought out through multipin connectors mounted on feedthrough plates on the cover. All chamber processes are controlled from the control console adjacent to the chamber. Liquid nitrogen level sensors controlled from the console assure proper temperatures at each zone within the cold wall.

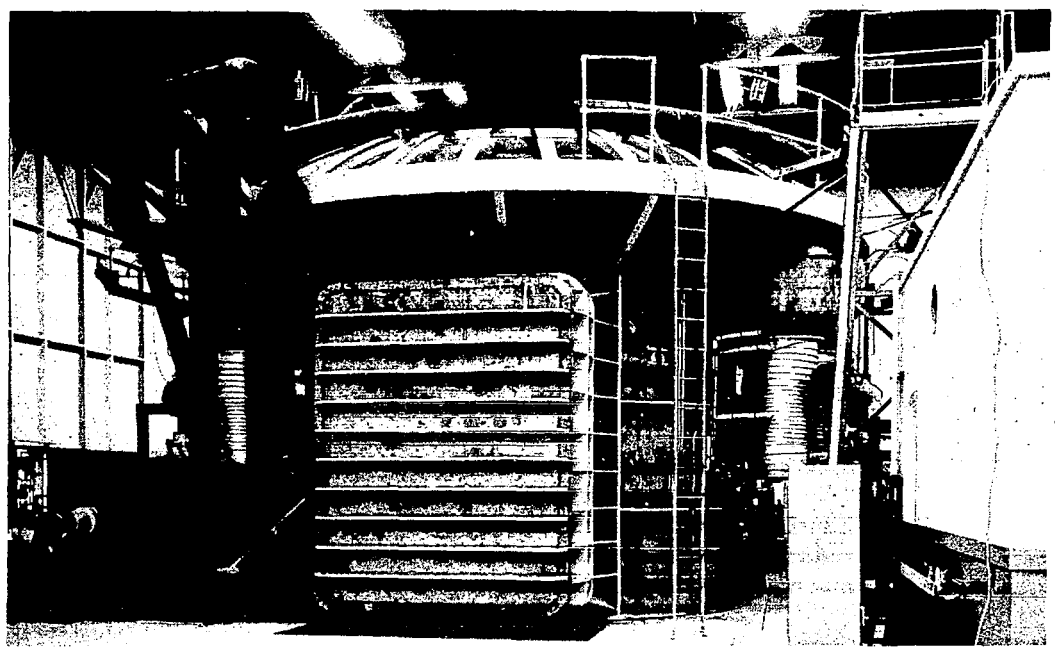
An ultra-high vacuum chamber, 4 feet in diameter and 8 feet long, is located in an air-conditioned enclosure to maintain precise control during thermal testing. The chamber is provided with an individual liquid nitrogen supply system and control console. Within the chamber is a stainless steel cold wall which is buffed to a high polish to reduce radiant heat transfer from the chamber walls. The interior of the cold wall is spray coated with flat black epoxy paint of approximately .9 emissivity. Liquid nitrogen is circulated through the cold wall to produce a -320°F temperature environment. Surrounding the outside of the chamber are heating elements for the bakeout system. The applied heat can be controlled at any temperature from ambient to 300°F for high temperature vacuum tests. Bakeout temperatures are also employed to dry the air in the chamber to facilitate faster pump-down to pressures in the 10^{-8} Torr range. The chamber can be adapted through the feedthrough plates on the door and chamber shell to supply a motion function to the specimen while maintaining vacuum and temperature conditions. Various drive motors, gear, and pulley assemblies can be used to induce rotary, linear, and oscillatory motions as required.

A second intermediate size ultra-high vacuum chamber is a horizontally mounted cylinder 7 feet in diameter and 7 feet long providing an internal work space 5-1/2 feet in diameter and 6 feet long. A copper cold wall and temperature control system allows two modes of operation: space environment temperature of -320°F with liquid nitrogen circulating through the cold wall; and temperatures at any point from -300°F to 300°F by high pressure injection of liquid nitrogen heated to the desired temperature by a variable horsepower gas circulator. The inside surface of the cold wall is blackened to provide high emittance over the electro-magnetic spectrum between .2 and 30 microns wavelength. Evacuation of the chamber by a 50,000 liters per second diffusion pump equipped with a liquid nitrogen-cooled baffle to eliminate backstreaming, produces pressures to 5×10^{-7} Torr in four hours and 5×10^{-9} Torr in 20 hours with the cold wall at -300°F. The vacuum pumping system also employs an 850-liters-per-second vapor booster pump and an 80-cubic-feet-per-minute mechanical pump. Pressure is monitored by an ionization gauge and control employing automatic range switching. Instrumentation connections are made through feedthrough plates on the end cover, and test specimens up to 500 pounds can be mounted on a beam extending from the cover to the center of the chamber. When the cover is opened the specimen is exposed so that all wiring and preparation can be accomplished without entering the chamber.

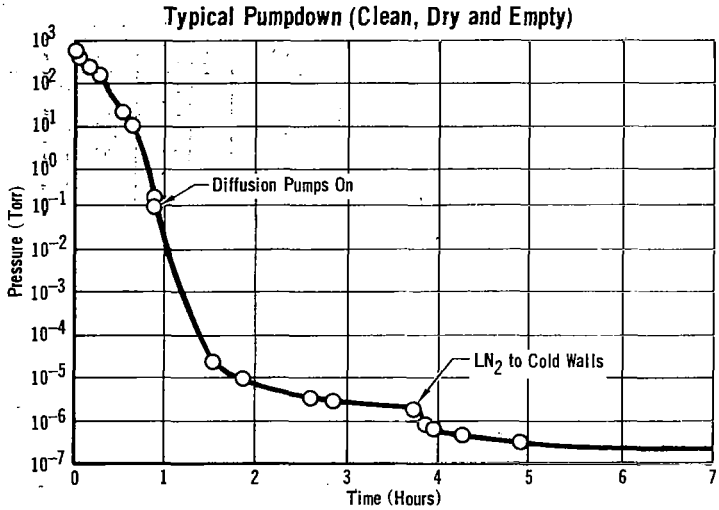
Located within the laboratory in separate air-conditioned rooms are several self-contained vacuum chambers and pumping stations. Roughing pumps and 4- and 6-inch diameter diffusion pumps provide vacuum ranges from 10^{-6} to 10^{-9} Torr. The high vacuum systems can be operated with stainless steel or pyrex bell jars. Two of the steel jars are equipped with liquid nitrogen cold walls. An analytic scale can be installed for material weight loss studies, and thermal vacuum tests can be conducted on small components such as switches, relays, and valves. Prior to installation, feedthrough collars and viewing ports are added to the chambers so that extra connectors can be added to obtain additional temperature information, more liquid nitrogen can be introduced, and various other motion and pressure devices can be employed to broaden the test capability of each chamber. Auxiliary vacuum pumps may be used to improve vacuum performance. There are three pumps which can be used in test programs at any station in the laboratory, or for vacuum test activity that is not contained within the large chambers. A Varian ultra-high vacuum system with a liquid nitrogen cold wall chamber is also available. This chamber utilizes an ion pump and titanium sublimation pumping to attain an ultimate pressure of 5×10^{-10} Torr. Because of the ultra-high vacuum capability, and clean, oil-free environment, the chamber is used for critical material tests, including ultraviolet irradiation of spacecraft window specimens and evaluation of bearing coatings.

A Grumman-built oxygen-humidity chamber, capable of simulating a manned cabin atmosphere, is located adjacent to the bell jars within an air-conditioned room. The chamber is 4-feet in diameter and 4-feet long and is enclosed within a cabinet 7-feet high, 6-feet wide, and 7-1/2-feet deep. The chamber is capable of operation at atmospheric pressure with 100 percent oxygen and up to 95 percent relative humidity at temperatures up to 160 degrees Fahrenheit. In operation, the chamber is rough pumped to a pressure less than 10^{-3} Torr, then back filled with oxygen and water vapor to maintain specified total pressure and humidity at required temperature. Temperature is controlled by passing preheated air through the insulated cabinet surrounding the chamber. Feedthrough ports are provided so that motion and pressure attachments can be introduced to the specimen.

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: 19 x 26-Foot Vacuum Chamber

Type of Environments Simulated*: 1, 2

Type of Pump or Ejector**: 1, 2

Temperature Range (°C): -206 to +176

Altitude (feet): -

Minimum Work Pressure (Torr): 1×10^{-7}

Chamber Internal Dimensions (feet): 15W x 20H

Maximum Specimen Size (ft): Not Available

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft) Dia.	1 x w x h
22-Ft Sphere	1, 6	1, 5	Ambient	N/A		1.5	No	Yes	18	
4-Ft Chamber	1, 2	1, 2	-206to149	N/A		10^{-6}	No	No	3.58	x 8L
7-Ft Chamber	1, 2	1, 2	-206to149	N/A		5×10^{-9}	No	No	5	x 6L
8x34-Ft Chmbr	1, 2, 6	1, 2	-195.5	N/A		10^{-7}	No	Yes	8	x 34
4-Ft Chamber	1, 2, 5	1, 2	-17.7to71	to95%		10^{-5}	No	No	4	x 4L
							No	Yes		

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

ADDITIONAL ENVIRONMENTAL CHAMBERS (CONTINUED):

GRUMMAN ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Tenney 1	2, 5	1	-73 to 93	20-95	80K	-	-	-	-	3'x3'x4'
Thermotron 1	2, 5	1	-73 to 177	20-95	100K	-	-	-	-	4x4.5x4.5'
Thermotron 2	2, 5	1	-73 to 177	20-95	100K	-	-	-	-	4x4.5x4.5'
Thermotron 3	2, 5	1	-73 to 177	20-95	100K	-	-	-	-	4x4.5x4.5'
Thermotron 4	2, 5	1	-73 to 177	20-95	100K	-	-	-	-	54"x54"x49"
T-A-H Wyle	2, 5	1	-73 to 149	20-95	100K	-	-	-	-	8'x8'x12'

GRUMMAN BELL JARS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
VEECO # 1	1, 2	1, 2	-184to121	-	-	2×10^{-6}	-	-	18" x	32" high
VEECO # 2	1, 2	1, 2	-184to121	-	-	2×10^{-6}	-	-	18" x	32" high
VEECO # 3	1, 2	1, 2	-184to121	-	-	1×10^{-4}	-	-	18" x	32" high
CVC-18B	1, 2	1, 2	-184to121	-	-	2×10^{-7}	-	-	18" x	32" high
Varian-VI	1, 2	1, 2	-184to121	-	-	2×10^{-10}	-	-	18" x	30" high
UHV-CVC	1, 2	1, 2	-184to121	-	-	4×10^{-9}	-	-	15" x	24" high

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

HUGHES ENVIRONMENTAL LABORATORY

REPORTING INSTALLATION: Hughes Aircraft Company Jefferson and Teale Culver City, California 90231	STATUS OF FACILITY: Active COGNIZANT ORGANIZATION COMPONENT: Product Evaluation Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Mr. R.L. Baker Phone: (213) 391-0711, ext 2619

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Product Evaluation Department's Environmental Laboratory contains various climatic, high altitude, and space simulation chambers where qualification, verification, and research and development tests are performed. The size of the facilities range from bell jars to a 7x7x18-foot environmental chamber.

TESTING CAPABILITIES: The Environmental Laboratory can verify the operation of aerospace vehicles under most environmental conditions. Realistic altitude flight profiles can be attained for missiles and avionics, including simulation of aerodynamic heating, with a 6-channel control transient heat facility. Ram Air for air-cooled aircraft systems is available with 15 pounds/min air at 50°F to 85°F and 60,000 ft altitude. Data are recorded with a 144 channel data acquisition system and reduced on site with a digital computer.

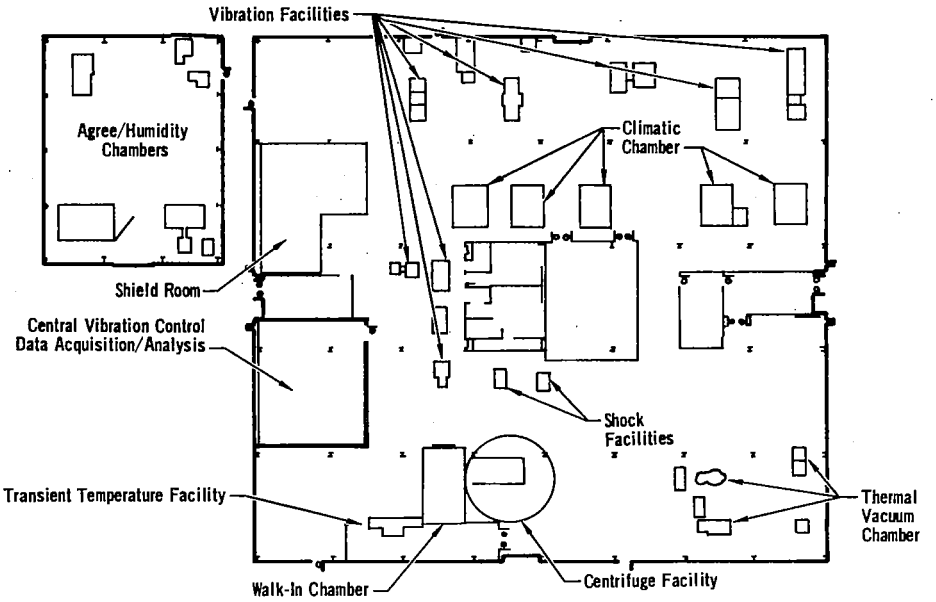
Combined environmental testing is available with a 7000 force-lb shaker placed in a walk-in chamber.

FACILITY COST HISTORY

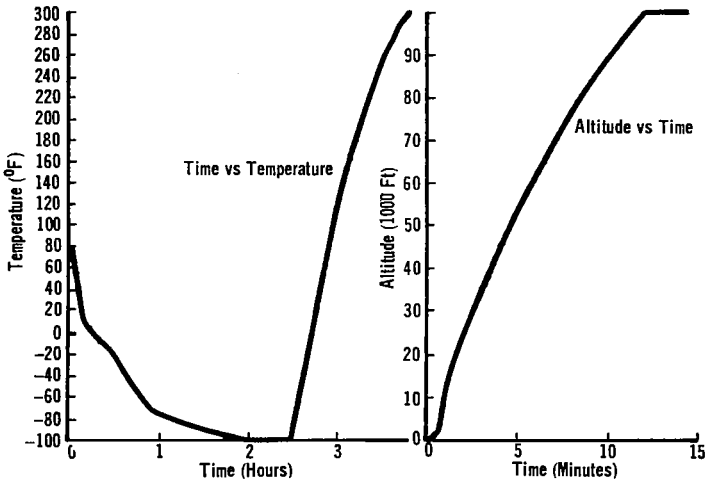
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: 3 additional chambers using a computerized control system: (1) Chamber No. 1, 8 x 7 x 18 ft, -100 to +300°F, 150K ft max. altitude; (2) Chamber No. 2, 6 x 6 x 6 ft, -100 to +300°F, 150K ft max. altitude; and (3) Chamber No. 3, 6 x 6 x 6 ft, -100 to +300°F, AGREE Facility.

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: 7 x 7 x 18-Foot Chamber (Hieatt H-12)

Type of Environments Simulated*: 2,7 (Ram Air and vibration or any combination)

Type of Pump or Ejector**: 1

Temperature Range (°C): -75 to 180

Minimum Work Pressure (Torr):

Relative Humidity Range (%): 20 to 97

Altitude (feet): 150,000

Maximum Specimen Size:

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Hieatt H5, H8	2, 5, 7	1	-75 to 200	20-97	100K	-	No	No		4 x 4 x 4
Hieatt H9, H10	2, 5, 7	1	-75 to 200	20-97	150K	-	No	No		4 x 4 x 4
Conrad K5	2, 5, 7	1	-75 to 235	20-97	120K	-	No	No		4 x 4 x 4
Conrad K8	5, 7		-75 to 235			-		No		4 x 4 x 4
Conrad K4	5, 7		-55 to 120	20-97		-		No		2 x 2 x 2.5
Bemco	5, 7		-75 to 150	20-97				No		8 x 8 x 8

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

HUGHES SPACE SIMULATION LABORATORY

REPORTING INSTALLATION: Hughes Aircraft Company Space Systems Division P. O. Box 92426, Building 365 Los Angeles, California 90009	STATUS OF FACILITY: Active COGNIZANT ORGANIZATION COMPONENT: Space Simulation Laboratory
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Space Simulation Laboratory Mr. Albert Stephenson Phone: (213) 648-3452

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Space Simulation Laboratory contains twelve thermal vacuum facilities ranging in size from a 1.5 by 3-foot chamber for evaluating small specimens to one 15 by 36-foot chamber capable of handling complete spacecraft and satellites.

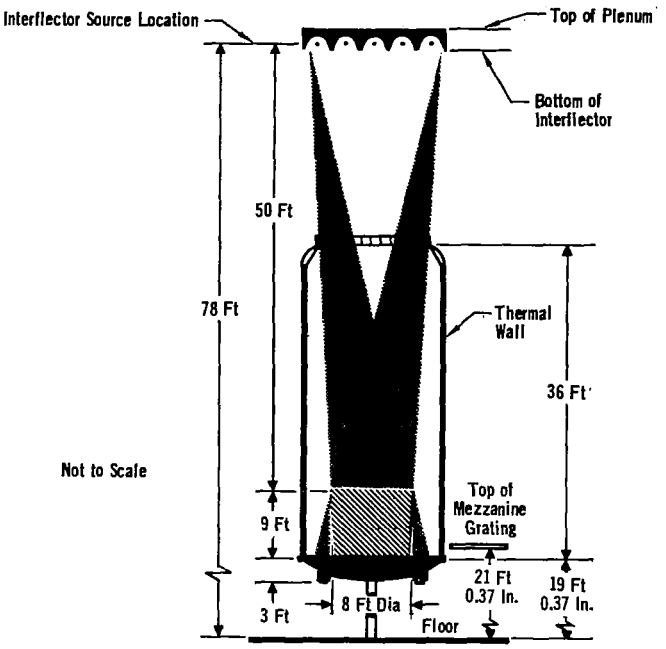
TESTING CAPABILITIES: A special feature of some of the chambers is that the top, side, and bottom thermal shrouds can be controlled individually, permitting considerable variation in temperature effects. This cold-wall hot-surface capability, combined with solar radiation, allows accurate duplication of such conditions as lunar day or lunar night. The Data Acquisition System will accept 800 thermocouples and 500 EMF signals (time multiplexed). In addition, 140 channels of data can be acquired and recorded by PCM-R.F. Link from a rotating spacecraft. All data can be tabulated in a programmable format and can also be automatically plotted. Data from any past period can be recalled and plotted or tabulated.

FACILITY COST HISTORY

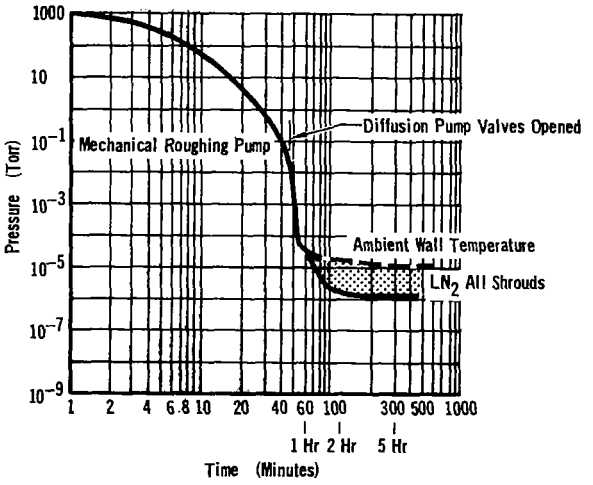
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name:	C-4 Chamber with S-4A Solar Simulator
Type of Environments Simulated*:	2,7
Type of Pump or Ejector**:	1,2
Temperature Range (C°):	-195 to 135
Minimum Work Pressure (Torr):	5×10^{-7}
Altitude (feet):	
Man-Rated:	No
Solar Intensity ($Watt/ft^2$):	13 to 230

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min.Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen.(ft)	
									Dia.	l x w x h
C-1	1	1,6,7	-196	0		2×10^{-8}	No		6	8.5H
C-2	1	1,2	-196	0		4×10^{-7}	No		6	8.5H
C-3	1	1,2	-196	0		3×10^{-8}	No		6	6.5H
C-4	6	1,2	-196to135	0		5×10^{-7}	No	8; 250	15	36H
C-5	1	1,2	-196	0		1×10^{-8}	No		4	6L
C-10	1	1,2	Ambient	0		1×10^{-6}	No		4	6H

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
** Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Titanium Sublimation, 7 CON
***Beam size (ft) and intensity ($watts/ft^2$)

MCDONNELL DOUGLAS SPACE SIMULATION LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Douglas Astronautics/Space Systems Center 5301 Bolsa Avenue Huntington Beach, California 92647	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Space Simulation Laboratory
OTHER SOURCES OF INFORMATION: MDAC-WD, "Engineering Laboratories Facility Catalog," January 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief, Space Simulation Laboratory Phone: (714) 897-0311, ext 2170 or 2172

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Space Simulation Laboratory contains various space simulation chambers and support facilities, which may be utilized for research and development, vehicle verification, and man-machine relationships. The size of space chambers range from bell jar systems to the large 39-foot diameter chamber space simulator.

The 39-foot Space Simulator is a welded stainless steel spherical vessel used for testing of complete systems, large subsystems, components, and units which evolve/produce high gas loads. Test articles can be subjected to combined environments of vacuum, cold black space, vibration, and radiant heat. The simulator has a 20-foot diameter, 1-1/2-inch-thick, ferromagnetic, stainless steel, flat, bedplate bottom. Shakers can be internally mounted, without quills or diaphragms, by using electromagnetic chucks. Controls, instrumentation, and data systems for the chamber/test article are housed directly adjacent to the simulator. Constant observation of the test article is made possible through closed-circuit television cameras located within the space chamber. A two-stage airlock is attached to the simulator for support of large manned-systems testing. Chamber vacuum is achieved through the use of four oil diffusion pumps having a total net noncondensable pumping capability of 53,000 liters per second. These are backed by four Roots-type blowers and four mechanical pumps with a combined capacity of 4800 cubic feet-per-minute. Below 10^{-5} Torr, the 20°K gaseous helium cryopumping system is employed. Cryopumping is achieved through the use of the dense gas helium cryopanels and the LN_2 shroud. The latter provides cryopumping capabilities of 5×10^7 liters per second of water vapor. The dense gas helium cryopumping system, at 18° to 20°K, is capable of pumping more than 3×10^6 liters per second of nitrogen gas. Two helium refrigerators provide a combined capacity of 2.8 kW at 20°K. One-third of this capability is normally required for chamber helium cryopanels; two-thirds is available for 5 x 6 foot chambers, special test cryotraps, or standby capability.

TESTING CAPABILITIES: The Space Simulation Laboratory has the capability for conducting large space systems, test programs - both manned and unmanned. The basic environments simulated are altitude (vacuum), thermal flux, and solar radiation. Evaluation tests determining the endurance of missiles and spacecraft to these simulated environments are conducted. Although designed primarily for the research and developmental testing of spacecraft vehicles, their materials, components, subsystems, and the study of man-machine relationships, the laboratory is also equipped for small rocket engine tests, cryogenic component tests, and long-term materials testing.

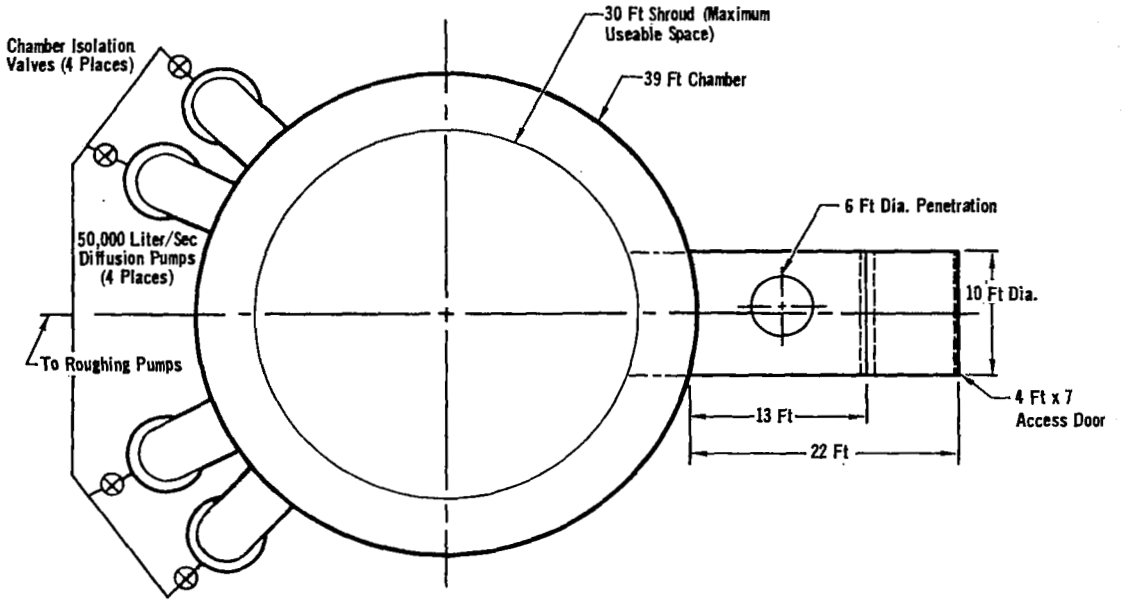
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1963 COST $3,146,975 ESTIMATED REPLACEMENT VALUE $5,000,000
CONTRACTOR: F. J. Stokes Corp. (Facility)	LOCATION: Philadelphia, Pennsylvania

IMPROVEMENTS AND COSTS: (1964) Solar simulator, Cost $228,396; (1966) Gaseous nitrogen warmup system, Cost $96,903; (1967) 39 Foot chamber manlock addition, Cost $302,715; (1965-68) Miscellaneous mods, additions, etc., Cost $24,274.

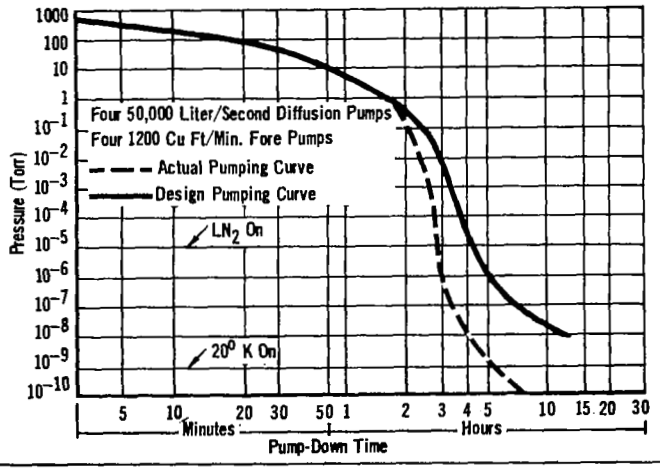
PLANS FOR FACILITY IMPROVEMENTS: Automation of equipment/systems to provide more efficient utilization of the facility.

SCHEMATIC



FACILITY PERFORMANCE DATA

Thirty-Nine-Foot-Diameter Space Simulator Pumping Curve



Facility Name: 39-Foot Space Simulator

Type of Environments Simulated*: 1

Type of Pump or Ejector**: 1, 2, & 3

Temperature Range (°C): Ambient and -195

Minimum Work Pressure (Torr): 1×10^{-9}

Man-Rated: Yes

Chamber Dimensions (ft): 39D Sphere

Maximum Specimen Dimensions (feet): 30 (in any dimension)

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Space Sta. Sim	2	1	Ambient	-	91K	-	Yes	No	12	40L
Prim. Airlk(a)	1	1, 2	Ambient	-	-	1×10^{-6}	Yes	4D/130	10	13L
Sec Airlock	2	1	Ambient	-	250K	-	Yes	-	10	7L
Space Simul.	1	1, 2	-195to135	-	-	1×10^{-6}	No	-	10	12L
Space Simul.	1	1,3,7,&8	-195&-253	-	-	1×10^{-10}	No	4D/130	8	8L

Plus 3 other space simulation chambers, two 5D x 6L (ft) and one 3D x 4L (ft).

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Sputter-Ion, 7 Titanium Sublimation, 8 Sorption

***Beam size (ft) and intensity (watts/ft^2) a: attached to 39-foot Space Simulator

MCDONNELL DOUGLAS 30-FT DIAMETER CYLINDRICAL SPACE SIMULATION CHAMBER

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Aircraft Company P.O. Box 516 St. Louis, Missouri 63166	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. A. Killoren, Manager Space Simulation and Systems Labs, Dept. 252 Phone: (314) 232-5079

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The 30-Foot Chamber is a man-rated high vacuum thermal simulation chamber. It is a stainless steel horizontal cylinder, 30 feet in diameter and 36 feet long. It has a full opening 30-ft diameter door, access and viewing ports, a removable track and floor, and interior hard points. The pumping system is composed of a steam ejector, mechanical pumps, and seven 32-inch diameter diffusion pumps. The interior walls of the chamber are lined with a shroud coated with a special black epoxy resin. The shroud temperature can be maintained at -280°F and can be programmed to control between -30°F and +200°F. Safety provisions incorporated into the chamber for manned spacecraft testing include: (1) Primary and secondary manlocks for observation and emergency rescue; (2) Emergency repressurization system for venting chamber from a vacuum condition to a pressure of 5 psia in 20 seconds; and (3) A mobile emergency rescue bridge located in the primary manlock for removal of the spacecraft occupants.

TESTING CAPABILITIES: For manned testing under simulated orbital conditions, minimum risk to the occupant is mandatory. To accomplish this requirement, a complete emergency medical station is located near the 30-Foot Chamber to provide resuscitation of the occupant, should the need arise. Physicians and physiologists, specializing in aerospace life systems, work closely with the aerospace system specialists during all manned spacecraft programs. Medical monitoring and recording equipment is included for complete evaluation of physiological parameters. A dysbarism treatment chamber is located in the vicinity of the chamber to facilitate hyperbaric treatment.

An on-site central data acquisition system is available for data recording and reduction. The typical time cycle for data processing is 24 hours for 300 data channels. For maximum priority tests, data from 600 channels can be processed in 24 hours.

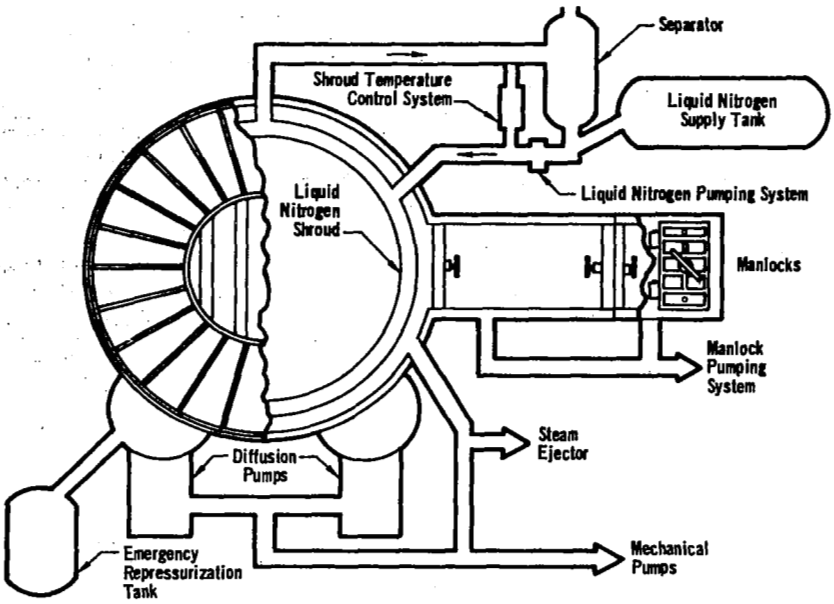
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $1000	CONSTRUCTION YEAR: 1964 COST $1,188,398* ESTIMATED REPLACEMENT VALUE $1,545,000
CONTRACTOR: Chicago Bridge and Iron IMPROVEMENTS AND COSTS: None	LOCATION: Chicago, Illinois

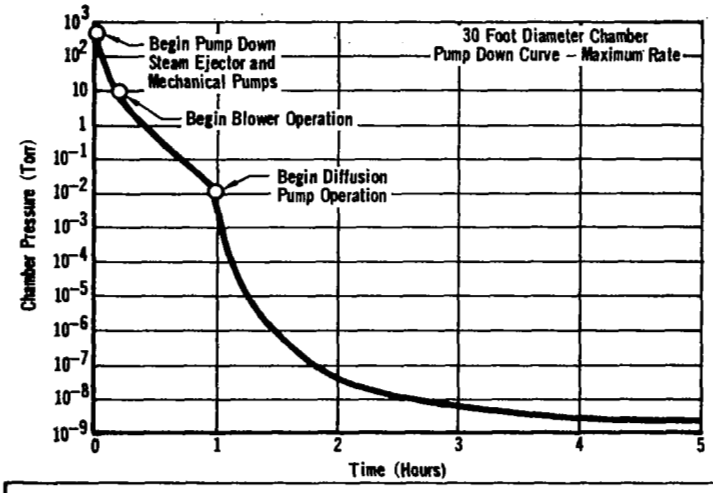
*Excludes cost of building and land.

PLANS FOR FACILITY IMPROVEMENTS: By January 1971, a fire suppression system, a redundant repressurization system, and an in-chamber alarm system will be added to the chamber to bring the chamber into full compliance with NASA management instruction MSCI 8825.2.

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name: 30-Ft Diam Cylindrical Space Simulation Chamber

Type of Environments Simulated*: 1,7

Type of Pump or Ejector**: 1,2,& 4

Temperature Range (°C): -175 to 95

Minimum Work Pressure (Torr): 5×10^{-9}

Man-Rated: Yes

Chamber Dimensions (ft): 30D x 36L

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
14 ft Chamber	2,7	1,2,& 4	-73to540	-	300K	8×10^{-4}	Yes	No		35x14x14
18 ft Chamber	1,7	1,2,& 3	-195to2K	-	1650K	7.5×10^{-9}	No	No	18	18Dx30L
Chambers A,B,C	1,6 (A)	1,2	-195to2K	-	1700K	6.3×10^{-9}	No	A****	8	8Dx16L
Chambers A & B	1,7	1,2,& 3	-195to2K	-	2000K	2×10^{-9}	No	No	5.5	5.5Dx16.5L
Chambers A,B,C	1,7	1,2,3,6,7	-195to2K	-	2100K	2.7×10^{-10}	No	No	2.5	2.5Dx5.5L
Plus 9 other chambers	*1,2,4,5,6, & Radiation									

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Ion Pump, 7 Titanium Sublimation

***Beam size (ft) and intensity (watts/ft^2) ****2.4 ft^2, 275 watts/ft^2

NASA GODDARD SPACE FLIGHT CENTER
ENVIRONMENTAL FACILITIES

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
NASA Goddard Space Flight Center Structural Dynamics Branch and Thermodynamics Branch Greenbelt, Maryland 20771	COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCE OF INFORMATION: GSFC, "Spacecraft Test Facilities," June 1964 Maintenance and Operations Handbook and GSFC Test Facilities Brochure	LOCAL OFFICE TO CONTACT FOR INFORMATION: Head, Structural Dynamic Branch (DTC) Phone: (301) 982-5071 Head, Thermo Br,(SES 12x15),Phone:(301) 982-5072

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The three unique environmental facilities at NASA Goddard are: Space Environment Simulator, Dynamic Test Chamber, and Thermal Vacuum Chamber. In addition to these facilities there is a normal complement of standard vibration and vacuum test chambers.

The Space Environment Simulator test volume is 27.5 ft in diam by 40 ft high with a 27.5-ft diam top loading capability.

The Dynamic Test Chamber is 33.5 ft in diam by 59 ft high with a 33-ft diam top loading capability.

The 12 x 15 ft Thermal Vacuum Chamber is top loaded, has a test volume 12 ft in diam by 15 ft high and will accommodate a payload weight of 4000 pounds. The building crane servicing this chamber has a capacity of 10,000 pounds. An ultimate vacuum of 1×10^{-9} mm Hg is reached in 24 hours when the chamber is clean and without a payload. Vacuum is obtained by the use of mechanical and oil diffusion pumps. The controlled temperature range is from -65 degrees centigrade to +85 degrees centigrade. Heating is accomplished by an electric to gaseous nitrogen heat exchanger and cooling, by a liquid to gaseous nitrogen heat exchanger. The chamber's optically dense shroud can also be operated near liquid nitrogen temperature (-190°C).

TESTING CAPABILITIES: The Space Environment Simulator is capable of accommodating thermal balance and performance tests on explorer and observatory class spacecraft. Two modes of operation are typical: (1) Orbital simulation: solar irradiation, cold wall and vacuum and (2) Thermal-Vacuum: temperature controlled wall -65°C to +85°C with vacuum. In addition, heat sources can be applied to induce crude simulation of earth reflected and emitted heat flux. Orbital cycling typical of sun-shadow modes for earth eclipsing spacecraft missions is routine. The solar beam diameter can be altered from 20-ft diam (127 modules) to a minimum size (7 modules) to accommodate variation in spacecraft configurations.

Special support equipment for the Space Environment Simulator are: (1) Gimbal, 5000 lb load tilt +120° -90°; 500 lb load - tilt +120° -90°, spin 0-60 rpm; (2) Clean Room - Class 10,000 under close control of personnel and spacecraft; (3) Gas/Contaminant Sensing - RGA, QCMB; (4) Thermal Flux - 130 circuits to 150 watts/sq ft over 300 sq ft surface area; (5) Zero Q - 52 circuits; (6) Intensity Sensing - (RØZ). 84 - 1 x 2 cm solar cells; 2-Eppley radiometers; 1-Cone radiometer; (7) Central Data Handling - up to 2500 channels of data each 100 seconds. 130 channel remote and selected real time C.R.T. plotting; (8) Service crane: 15 ton capacity, hook height above chamber: 43 ft; (9) LN_2 storage facility, 64K and 26K gal tanks; and (10) 100K cu ft GN_2 gas storage for back filling chamber.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $6,080,000* ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: Sperry Gyroscope IMPROVEMENTS AND COSTS: Not Available	LOCATION: Great Neck, Long Island, N.Y.

*Note Above: SES (1964), Cost $4,515,000
DTC (1962), Cost $1,183,000
12x15 (1963), Cost $ 382,000

PLANS FOR FACILITY IMPROVEMENTS: The Space Environment Simulator - Research is currently in process to determine methods to improve uniformity and to verify degree of improvement required to spectral distribution.

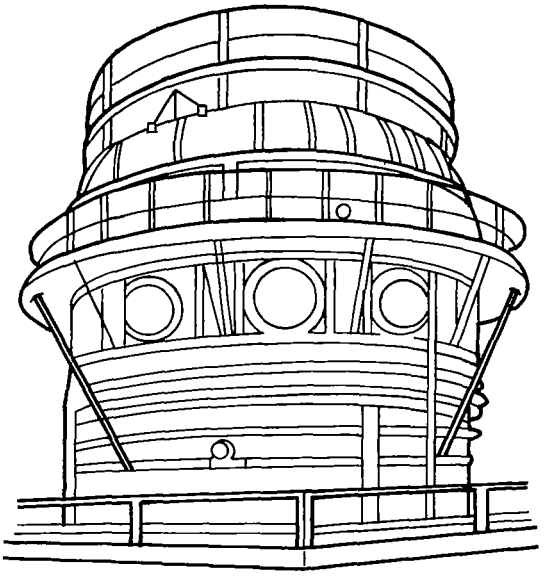
TESTING CAPABILITIES (CONTINUED):

Testing capabilities of the Dynamic Test Chamber are: (1) Ultimate Vacuum 1 x 10^{-3} mm Hg; (2) Times to pressure 1 mm Hg - 1-3/4 hours, 1 x 10^{-3} mm Hg - 4 hours; (3) Leak Rate - 1 x 10^{-4} standard cc air/sec; (4) Spin Device Capacity - 1000 lbs; (5) Test Control and Monitoring - dynamic measuring systems, automatic program sequencer, high speed photographic camera systems, and closed circuit TV; (6) Overhead crane capacity - 15 tons; (7) Communications - complete intercom system; (8) Simulated Aerodynamic Heating; (9) Zero Gravity for 2.5 seconds, and; (10) Gravity Negated Appendage Deployment.

Testing capabilities of the 12 x 15 Thermal Vacuum Chamber include the monitoring of chamber contaminants by a mass spectrometer permanently mounted to the chamber. The instrumentation and thermocouple penetration capabilities on the chamber consists of 57-37 pin connectors (5 amphere, 40 volts) 30 rf connectors, 9-4 pin connectors (50 amphere, 130 volts) and 180 thermocouple feedthroughs. Special high voltage 1K to 5K volt feedthrough plates are also available. This facility has two mechanical pumps with blowers backing six 50,000 l/s diffusion pumps. Ultimate pressure 1 x 10^{-9} Torr. The facility thermal capability consists of minimum shroud temperature -190°C and the shroud can be thermally controlled over a temperature range of -65°C to +85°C.

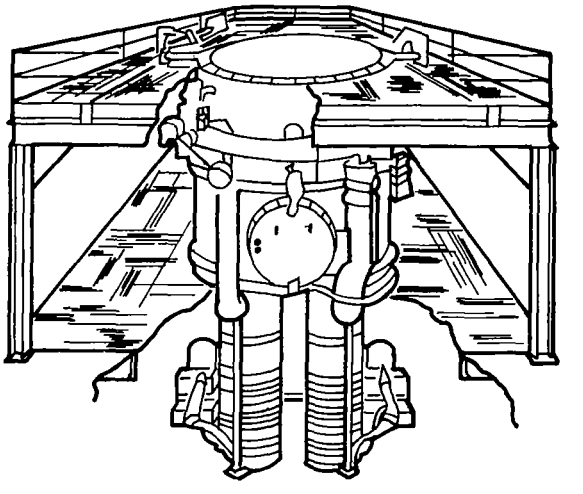
SCHEMATIC

DYNAMIC TEST CHAMBER



SCHEMATIC

THERMAL VACUUM CHAMBER



FACILITY PERFORMANCE DATA

Facility Operating Envelope

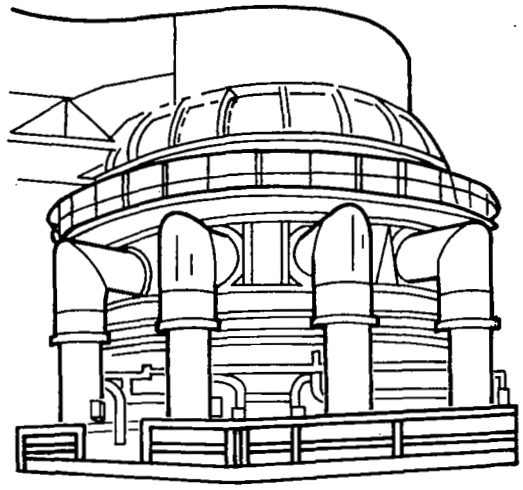
(Not Available)

Facility Operating Envelope

(Not Available)

SCHEMATIC

SPACE ENVIRONMENT SIMULATOR



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name: Space Environment Simulator

Type of Environments Simulated*: 1, 2, 6, 7

Type of Pump or Ejector**: 1, 2, and 3

Temperature Range (°C): -163 to 85

Altitude (feet):

Minimum Work Pressure (Torr): 10^{-9} to 10^{-10}

Man-Rated: No

Chamber Dimensions (ft): 27.5 dia x 40 H (Test Volume)

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
2-Ft Simulator	7	1,2	-196to100	N.A.					2	2 H
7-Ft Simulator	7	1, 2	-196to100	N.A.		10^{-7}	No	2/130	7	8 L
12-Ft Simulator	5, 7		-65 to 150	5-85		760				12 x 12 x 20

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector

***Beam size (ft) and intensity (watts/ft^2)

NASA LANGLEY DYNAMICS RESEARCH LABORATORY

REPORTING INSTALLATION: Langley Research Laboratory Dynamics Loads Division Hampton, Virginia 23365	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Dynamic Loads Division
OTHER SOURCES OF INFORMATION: "Dynamics Research Laboratory, NASA Langley Research Center, CN-119,816 1966"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models & Facilities Division Code 56.000 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory is designed for carrying out research on spacecraft structures, equipment, and materials under various environmental conditions, including the environments of vibration, shock, acceleration, vacuum, and temperature.

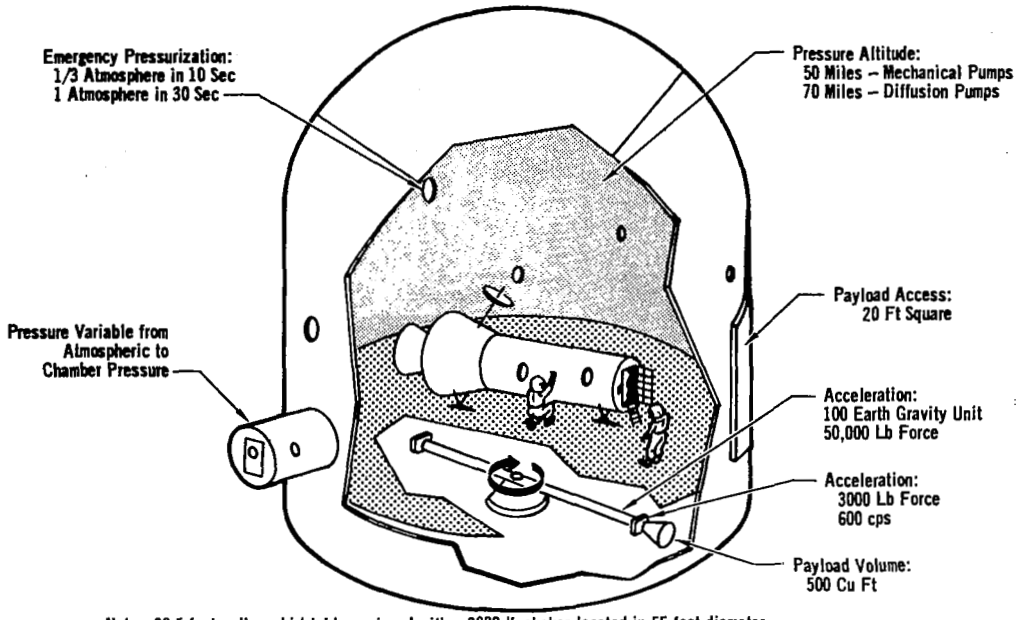
TESTING CAPABILITIES: This facility is capable of tests involving space vehicle systems, spacecraft structures and launch vehicle structures. Shakers, shock testers, analog computer, and a Data Logging System are all available at this facility.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT):	CONSTRUCTION YEAR: 1964 COST $ ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS:	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS:

SCHEMATIC



Note: 20.5 foot radius whirl table equipped with a 3000 lb shaker located in 55-foot-diameter, 55-foot-high cylindrical vacuum tank.

FACILITY PERFORMANCE DATA

Evacuation performance provides 10^{-1} Torr in 160 minutes.

Facility Name:	55-Foot Chamber
Type of Environments Simulated*:	1,2
Type of Pump or Ejector**:	1,2
Temperature Range (°C):	23 to 149
Minimum Work Pressure (Torr):	10^{-4}
Man-Rated:	No
Chamber Dimensions (feet):	55' High x 55' Diam

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h

*1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Vibration
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

NASA LANGLEY ALTITUDE CONTROL SIMULATOR FACILITY

REPORTING INSTALLATION: NASA Langley Research Center Applied Materials and Physics Division Hampton, Virginia 23365	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Applied Materials and Physics Division
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models and Facilities Division Code 56.000 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Altitude Control Simulator Facility (ACSF) will allow performance testing and complete mission simulation of spacecraft and experiment attitude control systems. Basic research will be conducted on fine pointing experiments, such as horizon scanning techniques and astronomical observations, and on future spacecraft control systems, such as the control moment gyros for Apollo and Manned Orbital Laboratory missions. The test spacecraft will be mounted on an air bearing in the center of the 60-foot spherical test chamber, and simulated solar, planetary, and stellar targets in the chamber will be driven to represent orbital or interplanetary environments. A constant temperature background for the planet simulator will be maintained by a thermal control housing, while the test chamber shields the spacecraft from the earth's magnetic field. Air drag and convection currents are eliminated by evacuating the test chamber to .2 mm Hg. The Facility will be equipped with a three-axis angular measurement system accurate to $\pm$ 1/2 min of arc. A complete FM-FM spacecraft-to-ground telemetry link will be available, and closed circuit television between the chamber and control room will be provided.

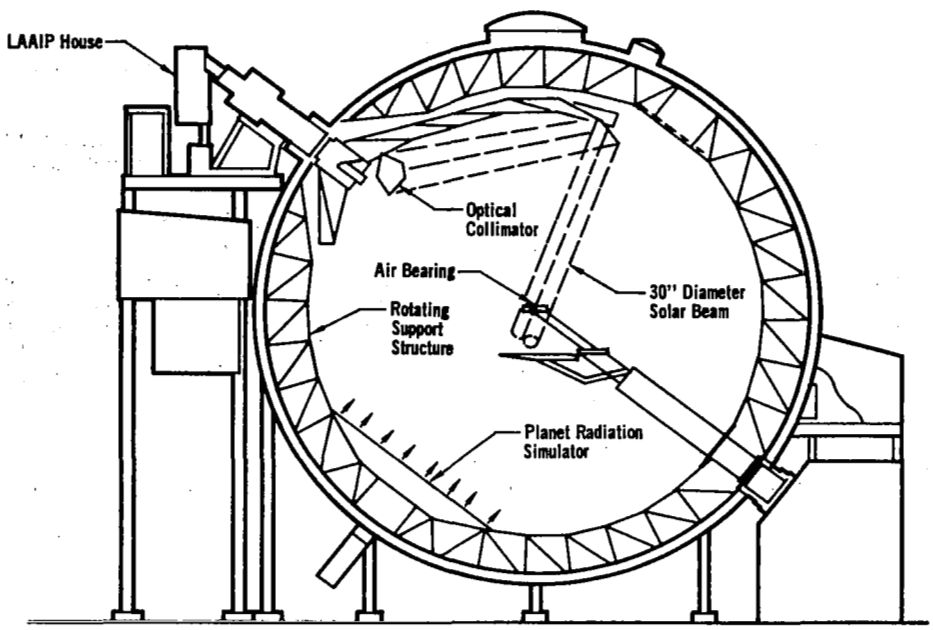
TESTING CAPABILITIES: This facility is capable of testing spacecraft attitude control systems.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1966 COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Future plans include the addition of an angular monitoring system with an accuracy of $\pm$ 1 sec of arc. Relatively hard vacuum can be provided by the installation of appropriate pumping equipment.

SCHEMATIC



FACILITY PERFORMANCE DATA

Evacuation performance provides .2 Torr in 6 hours, .3 Torr in 3 hours.

Facility Name: Altitude Control Simulator Facility

Type of Environments Simulated*: 1, 6, 7

Type of Pump or Ejector **: 1 (Stokes) and Blowers (Roots)

Temperature Range (°C): 93.3

Minimum Work Pressure (Torr): .2

Man-Rated: No

Chamber Dimensions (ft): 60 diam

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

NASA-LANGLEY 60-FOOT AND 41-FOOT SPACE SIMULATORS

REPORTING INSTALLATION: NASA-Langley Research Center Fabrication Division Hampton, Virginia 23365	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Fabrication Division
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models and Facilities Division Code 56.000 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The 60-foot simulator consists of a 60-foot diameter carbon steel sphere, support building, and vacuum system. The simulator has the following provisions and features: (1) 12-foot diameter opening in side level with 23-foot diameter deck, 4-foot diameter opening at base and top (2) Variable speed spin fixtures.

The 41-foot simulator consists of a 41-foot carbon steel sphere, support building, and vacuum system. This simulator has the following features and provisions: (1) 4-foot diameter access ports at top and base; 4-foot diameter port in side level with 17-foot diameter deck (2) Variable speed spin fixtures.

TESTING CAPABILITIES: The principal uses of the 60-foot simulator are testing of separation systems, being used as a zero gravity facility (three seconds of weightlessness can be obtained), and for inflatable spacecraft deployment testing. This facility is capable of the following: Ultimate pressures of 2×10^{-4} torr, closed circuit television, view ports and pressure boxes for photographic data coverage, adequate lighting for high speed photography, power and instrumentation feed throughs, programmer for event and camera control.

The 41-foot simulator principal uses are studies of nozzle exhaust of liquid and solid propellent motors firing in near space conditions; effect of plasma on rapid frequency signals; separation tests; inflatable or expandable spacecraft deployment. This facility is capable of the following: Ultimate pressures of 2×10^{-4} torr, lighting for photographic purposes with view ports and pressure boxes for cameras, feed throughs for instrumentation and power, programmer to control cameras and events, closed circuit television, and 250 kilowatt arc gas heater.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT):	CONSTRUCTION YEAR: 1952 COST $ * ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

*41-foot Simulator

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA

Evacuation performance provides 2×10^{-4} Torr in 8 hours.

Facility Name: 60-foot Chamber
Type of Environment Simulated*: 1
Type of Pump or Ejector**: 1, 2, and Blowers (Roots)
Temperature Range (°C): Ambient
Minimum Work Pressure (Torr): 2×10^{-4}
Man-Rated: No
Chamber Dimensions (ft): 60 diam

Facility Name: 41-foot Chamber
Type of Environments Simulated*: 1
Type of Pump or Ejector**: 1, 2, and Blowers (Roots)
Temperature Range (°C): Ambient
Minimum Work Pressure (Torr): 2×10^{-4}
Man-Rated: No
Chamber Dimensions (ft): 41 diam

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen (ft)	
									Dia.	l x w x h

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

NASA-MSC CREW SYSTEMS DIVISION ENVIRONMENTAL CHAMBERS

REPORTING INSTALLATION:	STATUS OF FACILITY: Acitive
NASA-Manned Spacecraft Center Houston Texas 77058	COGNIZANT ORGANIZATIONAL COMPONENT: Crew Systems Division (CSD) Systems Test Branch
OTHER SOURCES OF INFORMATION: Technical Facilities Catalog (NASA), Vol. II, Report NHB 8800.5, March 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION: Systems Test Branch (Mail Code EC4) Phone: (713) 483-4986

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The CSD Environmental Chambers include three large chambers, the 20-ft, 11-ft, and 8-ft chambers, which will be described separately as follows:
The 20-FT DIAM FACILITY is comprised of 5 compartments with widely varying uses. These compartments are: The Main Chamber, Inner Lock, Outer Lock, Rapid Decompression Chamber, and the 2-ft Thermal Vacuum Chamber. The main chamber is a 20-ft diam vertical cylinder which can accommodate a 17-ft high test article weighing 30K lbs. Vacuum in the main chamber can be maintained at .5 Torr with a test article gas load of 5 lb/hr water vapor and 1 lb/hr of oxygen. Tandem air locks connect to the main chamber providing crew transfer capability for long duration testing. The inner lock is employed for transfer operations only. In addition to serving as a transfer lock, the outer lock can operate as an independent test chamber. The outer bulkhead of the outer lock is removable to allow insertion of a 10K lb test package, 6 ft high, 6-ft wide, and 7-ft long. The 2-ft thermal vacuum chamber and the decompression chamber are both attached to the outer lock and are supported by the lock for manned testing. For rapid decompression testing, the main chamber serves as a vacuum reservoir connected to the decompression chamber by a 4-ft diam duct with integral decompression valve. The 2-ft thermal vacuum chamber contains a thermal shroud and quartz lamp array which allows controlled temperature testing from +300°F to -300°F at pressure of 5×10^{-5} Torr or better.
The 11-FT CHAMBER consists of a control room, pump room, and the chamber proper. The chamber is composed of 4 compartments which are described next: Cabin Section: Simulates the internal volume and arrangement of the LM Spacecraft Crew Compartment and contains a LM Environmental Control System to provide life support for two crewmen. Cabin walls can be heated for thermal evaluation testing. Inner Lock Section: Can be used to maintain lock observers at intermediate altitude during cabin testing, or allows operation with two pressure suited crewmen supported by Inner Lock Environmental Control System. Outer Lock Section: Can be used to transfer lock observers and/or crewmen during operations in cabin section. During inner lock operations with suited crewmen, the outer lock is used to maintain lock observers at intermediate altitude. Entry Room: Allows clean room conditions to be maintained in chamber interior. The chamber is man-rated and contains life support and safety systems required for manned testing.

TESTING CAPABILITIES: The chamber has been used for evaluation tests of the LM-ECS, Portable Life Support Systems, pressure suits, and various extravehicular activity components. Dual extravehicular activity can be performed at simulated lunar weight and metabolic rates using "1/6 G" simulators and a treadmill. Launch vehicle ascent rates can be simulated during evacuation and the chamber pumping system is capable of handling the water load imposed by simultaneous operation of two Portable Life Support Systems.
The 8-FT DIAM CHAMBER facility has a main chamber compartment and a lock compartment. The main chamber is an 8-ft diam cylinder 14-ft in length with an internal volume of 700 cu ft. The lock is 8-ft in diam and 5 ft long with an internal volume of 200 cu ft. An environmental control system that provides life support for test crewmen is integrated with the 8-ft chamber facility. This life support system can simulate a crewman working at metabolic rates from 0 to 3000 Btu/hr. This life support system was primarily used in the design verification and flight qualification testing of the Portable Life Support System (PLSS).

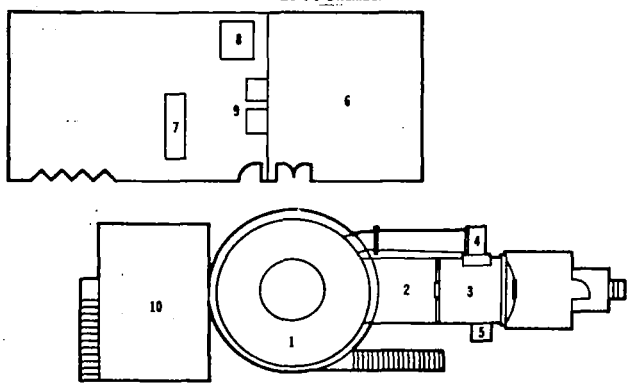
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST TYPICAL (8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ * ESTIMATED REPLACEMENT VALUE $
CONTRACTOR	LOCATION
IMPROVEMENTS AND COSTS: *Cost of equip and installation exclusive of building and utilities, 20 Ft Chamber, Cost $550,000; 11-Ft Chamber, Cost $760,000; 8-Ft Chamber, Cost Not Available	

PLANS FOR FACILITY IMPROVEMENTS: None.

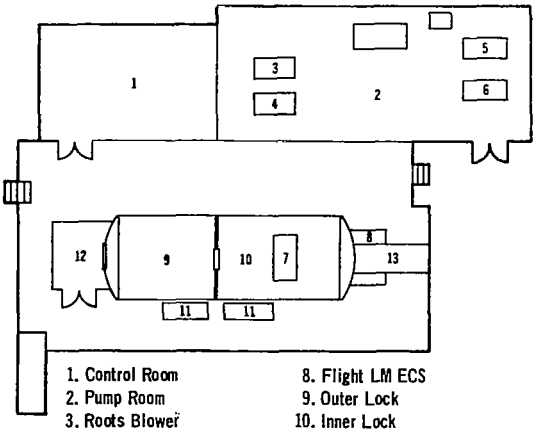
SCHEMATIC

20 Ft Chamber



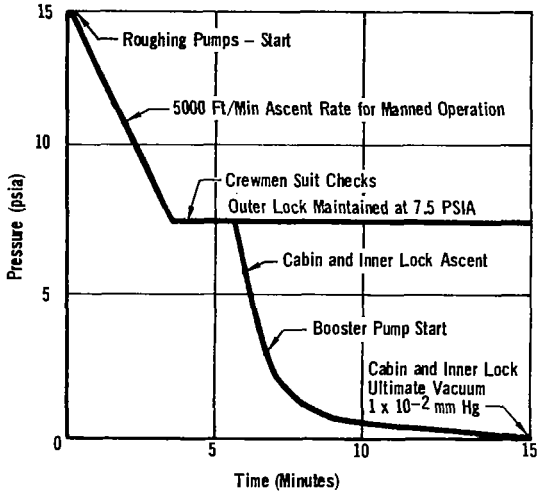
1. Main Chamber
2. Inner Lock
3. Outer Lock
4. Decompression Chamber
5. 2 Ft Thermal Vacuum Chamber
6. Control Room
7. Roots Connersville Pumps
8. Beach Russ Vacuum Pumps
9. Nash Vacuum Pumps
10. Equip. Platform

11 Ft Chamber



1. Control Room
2. Pump Room
3. Roots Blower
4. Beach Russ No. 3
5. Beach Russ No. 1
6. Beach Russ No. 2
7. Treadmill and 5/6 G Support
8. Flight LM ECS
9. Outer Lock
10. Inner Lock
11. Open Loop ECS – Modules 1 & 2
12. Entry Room
13. Cabin

FACILITY PERFORMANCE DATA



Facility Name: 20-ft Chamber

Type of Environments Simulated*: 1,2

Type of Pump or Ejector**: 1,2

Temperature Range (°C): -206.65 to +145 (2-ft Thermal Vacuum Chamber)

Altitude (feet): 225K (Main Chamber, Inner & Outer Locks), 120K (Decompression Chambers)

Minimum Work Pressure (Torr): 4×10^{-8} (2 ft Therm.Vac.Chbr)

Man-Rated: Yes

Chamber Dimensions (ft): 20 D x 20H (Main Chbr 10D x 9H (Inner Lock)

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
11-Ft Chamber									Same as LM Space-	
Cabin	2	1	0 to 60	Amb.	250K	1×10^{-2}	Yes	No	craft Crew Compart.	
Inner Lock	2	1	Ambient	Amb.	250K	1×10^{-2}	Yes	No	11	9x11x11
Outer Lock	2	1	Ambient	Amb.	65K	40	Yes	No	11	10x11x11
8-Ft Chamber	2	1	22	-	190K	2.5×10^{-2}	Yes	No	8	
Lock	2	1	22	-	18K	3.8×10^{-2}	Yes	No	11	

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

NASA-MSC SPACE ENVIRONMENT SIMULATION LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY:
NASA-Manned Spacecraft Center Houston Texas 77058	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering and Development Directorate Space Environment Test Division (Code: EL)
OTHER SOURCES OF INFORMATION: "Facility Description and Capabilities of the Space Environment Simulation Lab & the Space Environment Effects Lab," MSC Doc. DDC 021-043-001, April 1968.	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Phone: (713) 483-4407

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Space Environment Simulation Laboratory is comprised of various vacuum, thermal-vacuum, space simulation, and lunar surface simulation chambers used to perform qualification testing, integrated systems testing, and astronaut training. Size of the chambers range from bell jar size to the large 65-foot diameter space chamber.

The largest of the facilities, Chamber A, is a stainless steel vessel 65 feet in diameter and 120 feet high. This chamber can support a spacecraft weighing 150,000 pounds, positioned vertically on a rotating platform (lunar plane) 45 feet in diameter. The lunar plane rotation of $\pm$ 180° can be controlled, manually or automatically, to a maximum rotational speed of 1.75 rpm. The lunar plane surface temperature can be controlled from 90° to 400°K. A side-hinged door which provides a 40-foot diameter clear opening for vehicle loading is located in the cylindrical section of the vessel. The bottom of the opening is approximately 4 feet above the lunar plane level. There are four manlocks -- two at the lunar plane level and two at the mid-chamber level. All manlock doors are side-hinged and provided with quick-action latching devices for initial seal. The latching devices on all doors can be operated from one side only and will disengage when the doors become pressure-sealed. Chamber penetrations (12 inches in diameter) for utility servicing of the spacecraft are located at each manlock level. Instrumentation penetrations occur mainly through the hollow shaft of the lunar plane assembly. The chamber interior is equipped with walkways and hand rails around the perimeter at the mid- and upper-manlock levels. The chamber vacuum system consists of a combination of mechanical and diffusion pumps and a 20°K cryo-pump employing gaseous helium. The chamber can pump down to a 1.0×10^{-6} Torr in 20 hours with a gas leak load of 27.6 Torr liters per second. The interior of the chamber is lined with black, nitrogen-cooled heat-sink panels which operate at approximately 90°K. To the maximum practical extent, all surfaces in the chamber viewed by the vehicle (except solar simulator surfaces) act as heat-sink panels. Cryo-pump surfaces, cooled by gaseous helium, are also shielded from the test vehicle by heat-sink panels. The chamber is equipped for solar simulation from the top and from one side. The solar simulation system consists of 73 solar simulation modules. The simulator modules are an on-axis-modified carbon-arc system with a carbon-arc-burner assembly located outside the vacuum chamber. The solar simulator modules are mounted external to the chamber walls on one side and the top. Through penetrations in the chamber wall, the simulators irradiate the vehicle with an intensity which can be controlled in range from 60 to 140 watts per square foot. The solar simulators are of the carbon-arc type with a wavelength range from approximately .25 to 3.0 microns. The target area of the side sun is 13 ft wide by 33 ft high. The target area of the top sun is 13 feet in diameter.

TESTING CAPABILITIES: This laboratory is capable of providing a wide range of test situations and accommodating a wide range of test articles and subjects. Its large chambers (Chamber A and Chamber B) are capable of providing integrated systems tests of large items of flight hardware and simulated space and lunar surface vacuum and thermal environments for manned testing. Tests conducted in these chambers include operational tests of spacecraft systems and components, high fidelity engineering qualification of astronaut crew equipment, and tests of rocket engines. In its smaller chambers, pressures of 1×10^{-14} Torr and temperatures ranging from -263°C to +227°C can be reached.

FACILITY COST HISTORY

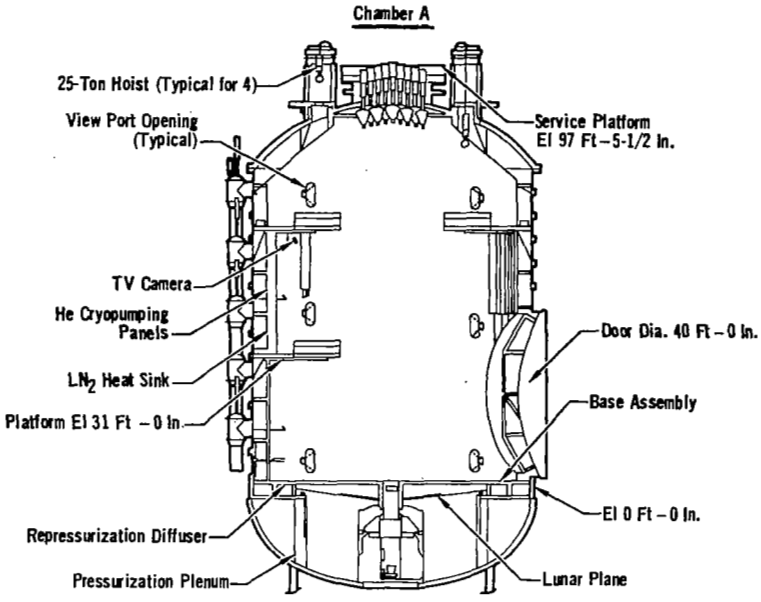
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1965 COST $34,822,000** ESTIMATED REPLACEMENT VALUE $56,965,000
CONTRACTOR: 8 Contractors	LOCATION:

IMPROVEMENTS AND COSTS: (1965) Albedo sim.'s & add. mod.'s, Cost $161,857; (1966) Ultra high vacuum space chamber fac., Cost $1994K; (1966) High bay area locks & other mod.'s, Cost $358,079; (1967) Bldg. add, system mod's & helium refrig., Cost $3502K; (1967) Fire protection system & misc. mod.'s, Cost $689,546; (1967) Liquid Nitrogen tank (SEEL), Cost $35.8K; (1968) Upgrade solar simulators, Cost $2948K; (1969) Mod.'s to exhaust system & covered stairs, Cost $15,040; (1970) ATM, vacuum system, & double manlock mod.'s, Cost $1255K.

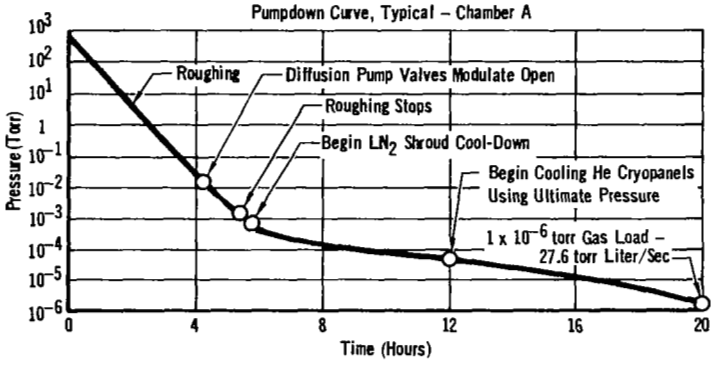
PLANS FOR FACILITY IMPROVEMENTS: Modify vacuum roughing system; additions to data test and evaluation area; modify thermal shroud of Chamber D.

** Steel frame window wall with high bay chamber area.

SCHEMATIC



FACILITY PERFORMANCE DATA



Facility Name:	Chamber A
Type of Environments Simulated*:	1, 6
Type of Pump or Ejector**	1, 2, & 3
Temperature Range (°C):	-185
Minimum Work Pressure (Torr):	1 x 10^{-6}
Man-Rated:	Yes
Solar Simulated***:	6 ft Diam, 130 watts/ft^2
Chamber Dimensions (ft):	65 Diam 35K ft^3 (vol.)

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Chamber B	1 & 6	1, 2, & 3	-185toAmb	N/A	See	1 x 10^{-6}	Yes	SeeNote 1	35	35,000
Chamber D	1 & 6	1,2,3,6&7	-185to260	N/A	Press	5 x 10^{-12}	No	3.5D/130	9	1,000
Chamber E	1 & 6	1, 2, & 3	-185to240	N/A	"	1 x 10^{-9}	No	3.5D/130	7	460
Chmbrs F & G	1 & 6	1 & 2	-185to240	N/A	"	1 x 10^{-9}	No	6D/130	2	8
Chamber H	1	1, 2, & 3	-263to260	N/A	"	1 x 10^{-14}	No		2.33	15
Chamber N	1 & 6	1, 2, & 3	-185to260	N/A	"	1 x 10^{-9}	No		4	40

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector, 6 Getter Ion Pump, 7 Titanium Sublimation
***Beam size (feet) and intensity (watts/ft^2) Note 1: 130 w/ft^2; top 13 ft diam, side 35 ft diam

NASA-MARSHALL ULTRA HIGH VACUUM FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
NASA-Marshall Space Flight Center Huntsville Alabama 35812	COGNIZANT ORGANIZATIONAL COMPONENT: Test Laboratory
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is designed to test super insulated tanks containing LH_2 under simulated altitude conditions with the capability of conducting hazard tests at a pressure of 1×10^{-6} Torr. With an additional cold shroud, the pressure obtainable will be 1×10^{-9} Torr. The coldness in space will be simulated at 110°K. The vacuum chamber is 15 feet in diameter, 20 feet high, and is constructed entirely of stainless steel. The chamber utilizes two 50,000 liter/second diffusion pumps. During the latter part of 1965, a cold shroud and cryopump array was added to the chamber.

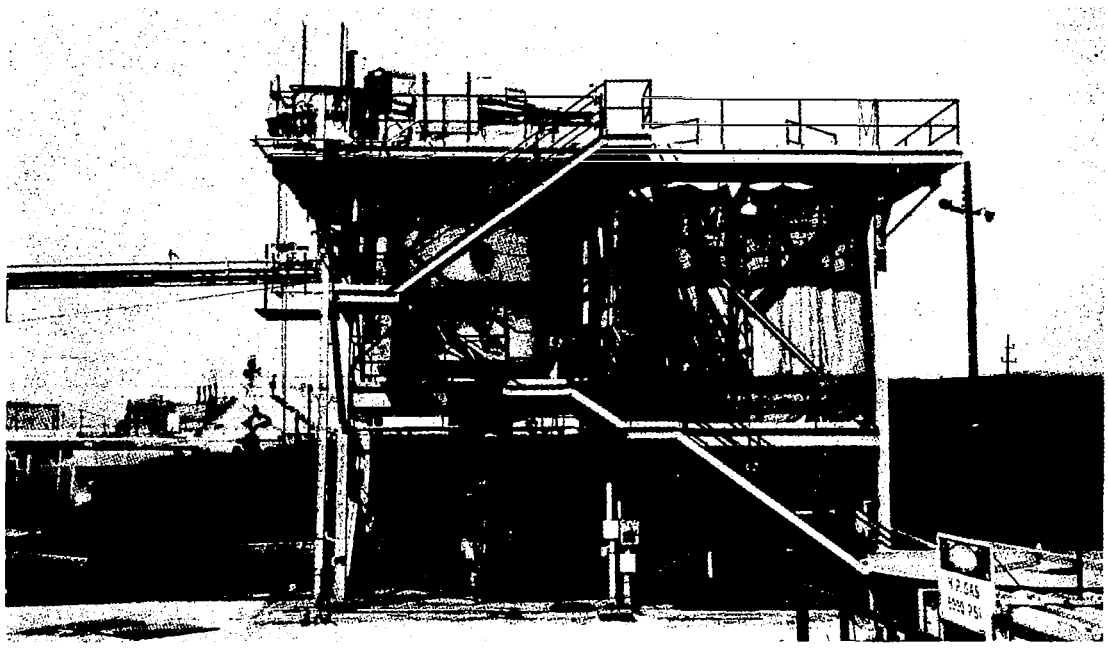
TESTING CAPABILITIES: Approximately 150 channels of instrumentation are available.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available.

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name: Ultra High Vacuum Facility

Type of Environments Simulated*: 1

Type of Pump or Ejector**: 3,4

Temperature Range (°C): To -163

Altitude (ft):

Minimum Work Press (Torr): 1×10^{-9}

Man-Rated: No

Chamber Dimensions (ft): 15 diam x 20 high

Note: In addition to those chambers listed below, there are 25 other vacuum or altitude chambers ranging from 1 ft diam x 2.5 ft L to 10 ft diam by 10 ft L.

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Location	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen.(ft)	
									Dia.	1 x w x h
Bldg. 4530	1	3		-	-	1×10^{-6}			20.5	35L
Bldg 4557	1	3		-	-	1×10^{-7}			15	20L
Bldg. 4619	1	3		-	-	7×10^{-9}			12	12L
Bldg. 4750	2			-	-	4			12	60L
Bldg. 4753	1	3		-	-	1×10^{-6}			20.5	25L
Bldg. 4753	2			-	-	4			12	15L

*1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector

***Beam size (ft) and intensity (watts/ft^2)

NORTH AMERICAN ROCKWELL/ROCKETDYNE ENVIRONMENTAL TEST FACILITY

REPORTING INSTALLATION: North American Rockwell Corporation Rocketdyne Solid Rocket Division P.O. Box 548 McGregor, Texas 76657	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Department of Solid Rocket Division
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Engineering Test Phone: (817) 475-2811, ext 1330

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of Large Temperature Chambers and Temperature Conditioning Boxes and Cells. The two large temperature chambers (for chamber size and capabilities see next page) are used for temperature conditioning in the structural test area from -100 to 200F. These chambers can change from -100 to 200F in approximately 30 minutes. Flexible temperature recording, combined with the superior chamber performance, provides a very versatile system. Direct injection CO_2 supplies the rapid cooling capacity. Small portable chambers using the same basic design are provided when special test conditions are necessary. Typical of these are temperature conditioning enclosures used for in-place temperature conditioning during actual structural tests.

Temperature Conditioning Boxes 11, 12, 13, and 14 have a range of 300F, extending from -100F to +200F. Temperature is controlled separately for each box by four Honeywell Model 152P controllers. These units have a control tolerance of $\pm$ 2F. Box temperature is regulated by means of electric strip heaters and liquid CO_2 injection. This enables the boxes (empty) to go from 165F to -65F in 30 minutes. Temperature transient time from -65F to +165F is 35 minutes. Each box is 27 feet long, 8 feet wide and 7.8 feet high on the inside. The door openings measure 7 feet by 7 feet. An inverted "V" rail track system (3 feet span) extends the entire length of each box.

Temperature Conditioning Cells 1, 2, and 3 are located in building R-1605. Cell No. 1 is capable of maintaining temperatures from ambient to 200F. Temperature is regulated for Cell No. 1 by means of a steam heat exchanger. Cell No. 2 is capable of maintaining temperatures from 30F to 100F. Temperature is regulated for Cell No. 2 by means of a steam heat exchanger, mechanical refrigeration, and liquid CO_2 injection. Cell No. 3 is capable of maintaining temperatures from ambient to -100F. Temperature is regulated for Cell No. 3 by means of mechanical refrigeration and liquid CO_2 injection. Temperature is controlled separately for each box by three Honeywell Model 152P controllers. These units have a control tolerance of $\pm$ 2F. Each box is 27 feet long, 15.5 feet wide and 7 feet high. Each cell has double doors with 5 feet by 7 feet openings. Each cell is equipped with two inverted "V" rail track systems (3 feet span) which extend the entire length of the cell.

FACILITY COST HISTORY

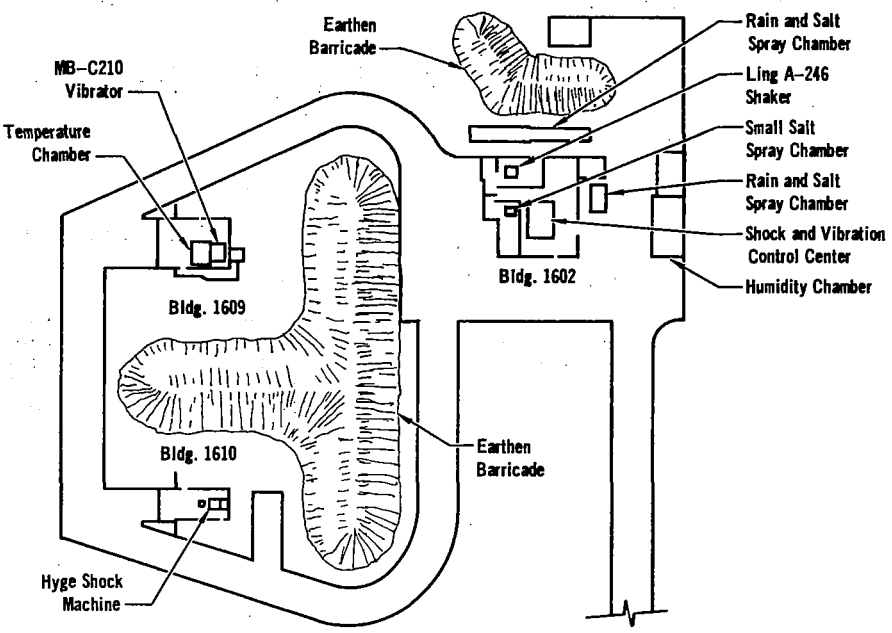
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $1120 (See Note)	CONSTRUCTION YEAR: 1960 COST $1,042,000 ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: North American Rockwell Corporation	LOCATION: McGregor, Texas

IMPROVEMENTS AND COSTS: None

NOTE: Operational cost is a highly flexible item, dependent upon the numbers of chambers and facilities in operation at any one time combined with the complexity of the individual test in progress.

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

Note: Pumping Capacity, 300 CFM; 60,000 ft altitude in 4 minutes, 200,000 ft altitude in approximately 30 minutes.

Facility Name:	Altitude Chamber
Type of Environments Simulated*:	2
Type of Pump or Ejector**:	1
Temperature Range (°C)	-35 to 129
Altitude (feet)	200,000
Minimum Work Pressure (Torr):	5×10^{-4}
Man-Rated:	No
Chamber dimensions (feet):	3.3 dia x 15L

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Hum. Chamber	5		20 to 71	95			No			20 x 10 x 8
Salt & Rain	3		11 to 35				No			36 x 7 x 9
6 Temp. Cham.	7		-35to129				No			27 x 8 x 7.8
3 Temp. Cham.	7		-35to129				No			27 x 15 x 7
Temp. Cham.	7		10 to 36				No			28 x 9 x 12
Temp. Cham.	7		24 to 129				No			28 x 16 x 12

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
** Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2)

NORTH AMERICAN ROCKWELL/SPACE DIVISION ENVIRONMENTAL LABORATORY

REPORTING INSTALLATION: North American Rockwell Corporation Space Division 12214 Lakewood Blvd. Downey, California 90241	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Laboratories and Test, Department 098
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACTACT FOR INFORMATION: Laboratories and Test Branch Department 098-300 Phone: (213) 922-2063

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Environmental Laboratory covers a total area of approximately 17,000 sq ft and consists of a vacuum and climatics section, a space simulation section, and an environmental control system (ECS) section. All three sections are located in the same building. Available environmental chamber sizes range from 18-inch diameter bell jars to an 18-foot diameter man-rated chamber. The Climatics Laboratory contains specialized test equipment for subjecting spacecraft hardware and materials to the following environments: Altitude - Sea Level to 200,000 ft at temperature extremes (+250 to -300°F) and relative humidity (20 to 95 + 5%) at temperature (50 to 200°F). Temperature - Range +350 to -300°F constant or cyclic and ambient to 1200°F constant. Humidity - Range 20 to 95 $\pm$ 5% RH at temperature (50 to 250°F) constant or cyclic. The Vacuum Laboratory contains specialized test equipment for subjecting spacecraft hardware and materials to combined space environment including high vacuum (1×10^{-4} to 1×10^{-11} torr), solar radiation temperature extremes (-320 to +700°F) and simulation of spacecraft launch profiles (manned and unmanned). The Laboratory is separated into three primary test areas as follows: (1) Intermediate Vacuum (Atmospheric to 1×10^{-7} Torr). (2) Ultra High Vacuum (1×10^{-4} to 1×10^{-11} torr), and (3) Solar Simulation (0 to 1.2 Solar Constant). All ultra high vacuum testing is conducted in a clean room environment. The Environmental Control Laboratory includes a man-rated chamber designed to perform development testing of the Apollo Environmental Control System (ECS) and Work Management System (WMS). The chamber has also been utilized to conduct research, design verification, and qualification testing of the Apollo Command and Service Module Thermal Control Systems.

TESTING CAPABILITIES: Data are recorded with Strip Chart Recorders using 24 to 72 channels and manually reduced off site.

FACILITY COST HISTORY

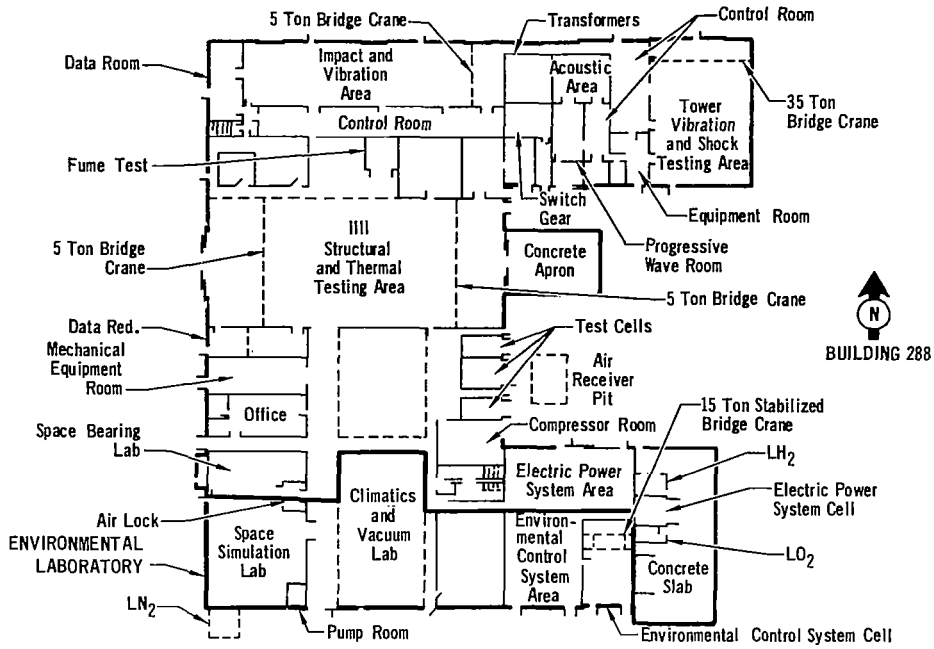
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Depends on number of tests.	CONSTRUCTION YEAR: 1964 COST $ Not Available ESTIMATED REPLACEMENT VALUE $ Unknown
CONTRACTOR: Vinnell Corporation IMPROVEMENTS AND COSTS: Unknown	LOCATION: Alhambra, California

PLANS FOR FACILITY IMPROVEMENTS:

(1) Central control and monitoring of 14 environmental test systems,

(2) Modification of 18 ft diam man-rated chamber to provide pressure environment of 1×10^{-6} Torr.

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name:	Environmental Lab
Type of Environments Simulated*:	2
Type of Pump or Ejector**:	1,2,5
Temperature Range (°C):	-185 to 315
Minimum Work Pressure (Torr):	Not Available
Altitude (feet):	240,000
Man-Rated:	Yes
Maximum Specimen Size (ft):	Not Available

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
Vacuum Lab	1	3	-196to315	N/A		2×10^{-11}	No	No	5	x6L
Vacuum Lab	1,6	1,2,3	-196to372	N/A		10^{-7}	No	4D/140	6	x14L
Climatics Lab	2	1	-73to149	5to100	200K		No	No		8x8x15L
Climatics Lab	2	1	-223to121	5to95	200K		No	No		8x8x7L
Climatics Lab	CCOH	2,5	-87to190	5to100	200K		No	No		4x4x4

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation 7 Thermal

**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector

***Beam size (ft) and intensity (watts/ft^2)

RCA ENVIRONMENTAL TEST CENTER

REPORTING INSTALLATION: RCA/Defense Electronic Products Astro-Electronics Division P. O. Box 800 Princeton, New Jersey 08540	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: F. J. Yannotti, Manager Environmental Simulation & Test Engineering Phone: (609) 448-3400, ext 2425

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Environmental Test Center is chartered as the cognizant organization responsible for the environmental testing that is required in the development, qualification, and acceptance of the deliverable products of this RCA division. The Environmental Test Center, through the Division's Marketing Group, also contracts to perform test operations for other RCA divisions as well as disassociated customers. This facility has qualified operating personnel available for around-the-clock, uninterrupted test performance. Associated support groups are available for remote recording of test data, test equipment maintenance and repair, and test equipment calibration.

TESTING CAPABILITIES: The Environmental Test Center performs operational verification tests on aerospace hardware from the smallest I.C. in a component part to the complete ready-for-launch spacecraft. Successful test programs have included Tiros, Nimbus, Relay, Ranger, and numerous classified projects. Capabilities are also present in earth environments testing including high-low temperature, temperature-humidity, temperature-altitude, temperature-vibration, shock, vibration, and acceleration.

FACILITY COST HISTORY

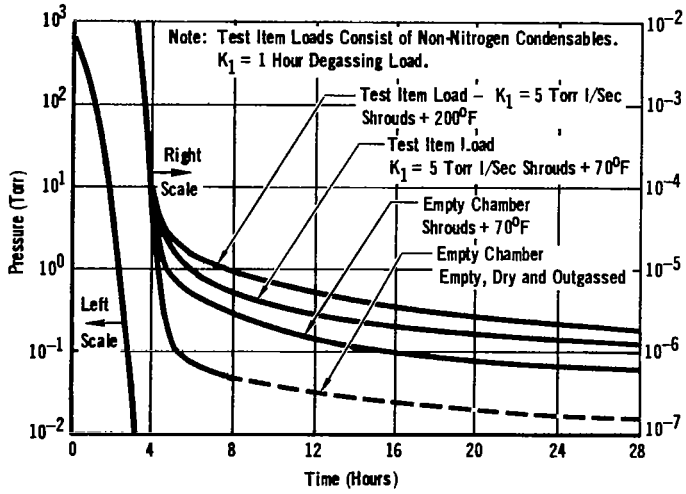
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA



Facility Name:	24 Foot Chamber
Type of Environments Simulated*:	1,7
Type of Pump or Ejector**:	2
Temperature Range (°C):	-75 to 120
Altitude (ft):	
Minimum Work Pressure (Torr):	5×10^{-6}
Man-Rated:	No
Chamber Dimensions (ft):	24 ft diam by 20 ft full open

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel. Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Chamber Dimen. (ft)	
									Dia.	l x w x h
10' Clam Shell	1,7	2	-195to100	-		5×10^{-7}			10	2(full open)
8'x10' Chamber	1,7	2	-185to150	-		1×10^{-6}			8	10(full open)
6'x10' Chamber	1,7	2	-190to150	-		5×10^{-6}			6	10(full open)
14' T-H Box	5,7			20-100						14 x 14 x17
4' T-H Box	5,7			5-100						4 x 4 x 4
5' Temp Box	7a									5 x 5 x 5

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal
**Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector
***Beam size (ft) and intensity (watts/ft^2) a Vibration

WYLE ENVIRONMENTAL CHAMBERS
(Huntsville, Alabama)

REPORTING INSTALLATION: Wyle Laboratories Huntsville Facility 7800 Governors Drive West Huntsville, Alabama 35800	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: Wyle Laboratories Brochure, "Scientific Services and Systems Group," Eastern Operations 1970	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone: (205 837-4411

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Wyle Laboratories maintains a large inventory of environmental chambers in sizes ranging from 1/3 cubic feet to large walk-in chambers to provide a complete range of natural environments.

Terrestrial Environments: Separate chambers are operated for each environment for efficiency of operation while walk-in chambers are designed to provide any of several environments so that large specimens can be accommodated and intricate test setups can remain stationary during a complete sequence of tests.

Space Simulation: For simulating the conditions of deep space, Wyle now has in operation four thermal vacuum test systems, each of which is capable of attaining vacuum conditions in the range of 1×10^{-6} Torr. These chambers vary in size for use with many different test specimens and the largest of the systems is seven feet in diameter and over eleven feet long.

TESTING CAPABILITIES: (Terrestrial Environments): Many chambers are capable of providing several environments simultaneously so that almost any combination of environments can be provided. These environments include numerous climatic conditions, vacuum, vibration, sustained acceleration, and shock. All chambers are equipped with automatic controllers so that a permanent record of chamber conditions is available. In addition, redudant controls are employed on all chambers to automatically shut down the entire test system in case of chamber or controller malfunction. Multiple chambers are available for nearly every enviroment, so that extensive test programs can be expeditiously performed and so that many test programs can be simultaneously performed. Most of the environmental chambers are portable, permitting environmental tests in conjunction with those functional tests which must be performed at various localities throughout the Huntsville facility, including the hazardous sites. Liquid CO_2 is piped throughout the facility to provide cooling and drying at any point in the facility.

Space Simulation: The thermal vacuum systems have a chamber wall capability to +300°F. Thermal walls are optically dense and coated with a nonreflecting black epoxy. One of the thermal vacuum systems is unique in that it offers vibration and shock capability with deep space conditions via connection of the vacuum chamber to a vibration exciter through a sealed diaphragm. All space vacuum systems are equipped with liquid nitrogen baffles to prevent backstreaming and with electrical and mechanical feedthroughs to allow operation and monitoring of the test specimens.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST Not Available ESTIMATED REPLACEMENT VALUE
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(High Low Temperature) - (Not Available)

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name:	High Low Temperature
Type of Environments Simulated*:	7
Type of Pump or Ejector**:	Not Applicable
Temperature Range (°C):	Not Available
Altitude (ft):	Not Available
Minimum Work Pressure (Torr):	Not Available
Man-Rated:	No
Chamber Dimensions(ft):	10x12x33

ADDITIONAL ENVIRONMENTAL CHAMBERS

Facility Name	Type of Environs Simulated*	Type of Pump or Ejector**	Temp. Range (°C)	Rel Hum. (%)	Alt. (ft)	Min. Work Pressure (Torr)	Man-Rated	Solar Sim.***	Max. Chamber Dimen	
									Dia.(ft)	lxwxh (ft)
(15)Hi-Lo Temp	7		-173to816	-			No			
(6) Temp-Hum.	5,7		0 to 149	20-100						33x10x12
(2) Sand-Dust	a, 4		21 to 38	-						20x12x12
(3) Salt-Spray	3b		38 to 260	-	80K					33x10x12
(2) Explosion	Explos.									6x3x3
(1) Radiation	Radia, c									5x6x5

* 1 Space Simulations, 2 Altitude, 3 Salt Spray, 4 Dust, 5 Humidity, 6 Solar Simulation, 7 Thermal

** Type of system used to evacuate chamber: 1 Roughing Pumps, 2 Oil-Diffusion, 3 Cryo-Pumping, 4 Steam Ejector, 5 Air Ejector

***Beam size (ft) and intensity (watts/ft^2) a Sand, b Salt Spray(5-20% Sol's) c Radia(360 Btu/nr/sglt)

3. IMPACT AND DROP

GRUMMAN DROP TEST FACILITIES
(Structural Test Laboratory)

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Grumman Aerospace Corporation Bethpage, Long Island New York 11714	COGNIZANT ORGANIZATIONAL COMPONENT: Structural Test Laboratory Department 360
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structural Test Laboratory Dept. 360 Phone: (516) 575-2346

DESCRIPTION AND TESTING CAPABILITIES

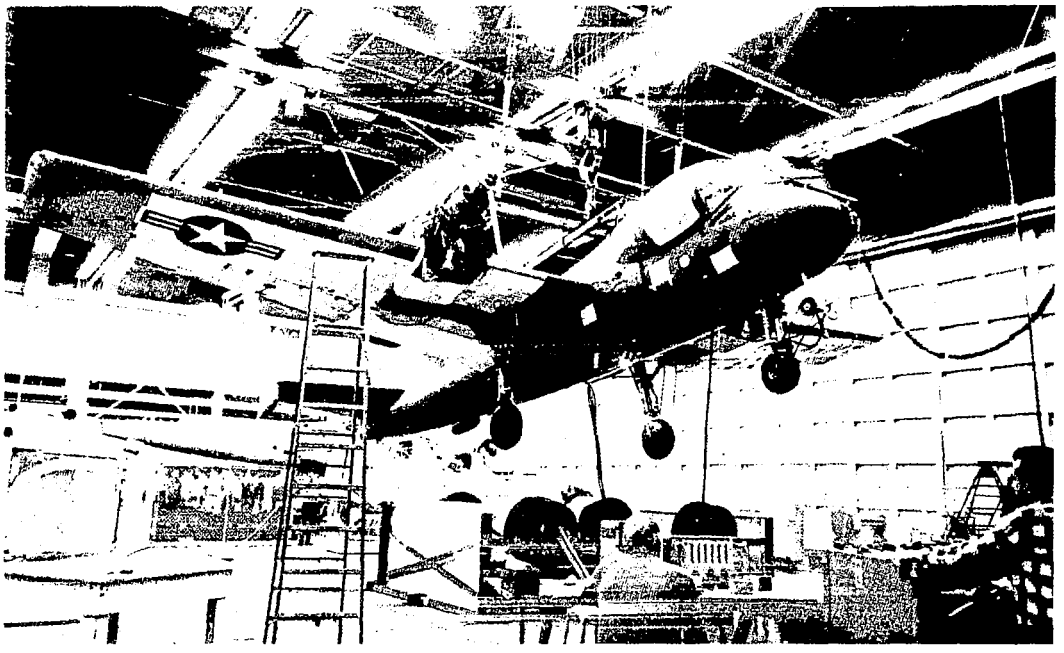
FACILITY DESCRIPTION: The Structural Test Laboratory performs drop testing on full-sized vehicles, both aircraft and spacecraft, in accordance with military specifications and customer requirements. For aircraft, physical demonstrations are conducted on a structurally complete aircraft in two main test regimes: the design ultimate and the failing series. Drop tests are conducted in the north hangar of the Structural Test Laboratory in Plant 5. Full-sized test vehicles are brought into the drop test area through hangar doors which open to a 119-foot wide by 27-foot high entry. Electrical, pneumatic, and hydraulic connections are provided within the immediate vicinity of the drop area. The control station for the test conductor is positioned near the drop area, as are high-speed cameras and several strain gage recorders. Special construction characteristics of the four-and-one-half foot thick concrete floor include steel rails embedded in a lattice configuration that permits advantageous selection of boltable tiedown points for securing of fixtures. A traveling overhead crane with inching controls has a 30,000 pound hoisting capacity. Centered 37 feet over the drop area floor, a fixed hook offers a 60,000 pound hoisting capacity; up to 100,000 pounds with modification. The test article is positioned in the drop area where special instrumentation and fixtures are installed on the vehicle, such as: accelerometers installed to fuselage and wing sections to record accelerations, a strobe light source attached to the landing gears to indicate wheel rpm, and position-velocity transducers installed on main gears to sense strut stroking action. Large mass items, such as engines and electronic equipment, are simulated by dummy structures, mounted in location and ballasted to actual weight and center of gravity of the components represented. Attachments for stores are accurately simulated. Fuels are simulated by the replacement of substitute fluids within internal and external fuel tanks. For ballasting, an inventory is maintained which includes 18,000 pounds of shot prepackaged in 10-and 25-pound bags; 20,000 pounds of shot in bulk; and 6000 pounds of lead shingles. Lead shingles are 3/16-inch thick by 15 inches square and weigh 15 pounds each. Drop platforms are available which are equipped with sliding plates which simulate the forward tracking effect of tires during carrier landings. The laboratory maintains two groupings of specially designed drop platforms: a small-load grouping with capacity to 125,000 pounds of vertical load, and a large-load grouping with capacity to 250,000 pounds of vertical load.

TESTING CAPABILITIES: In compliance with current military specifications, dynamic demonstrations are conducted on a structurally complete airplane in both the design ultimate and failing series. To satisfy design ultimate drop sequence requirements, drop heights are incrementally increased. The design ultimate test series is satisfactorily completed when the total airplane, upon being subjected to design sink velocity, remains structurally uncompromised. The failing test series, performed from successively higher drop heights to failure of the landing gear, is conducted to determine the reserve strength that remains; it is the final dynamic test on the airplane. Drop tests to maximum sinking speeds are also conducted with alternate combinations of internal and external loads that are identical to those of flight articles. The airplane is inspected and electronically weighed before being raised for test. Aircraft are dropped against impact platforms in specified combinations of gear conditions, pitch, yaw and roll attitudes, and sinking speeds. To most dynamically represent all force-related motions, including the large velocity difference between landing aircraft and carrier deck, the landing gear wheels are spun and a winglift system introduced for the drop. A time displacement tape, suspended from the ceiling and attached to the specimen, provides for a quick look following drop. At impact, the variety and magnitude of loads developed are recorded.

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Facility Name: Drop Test Facilities

Vertical Drop Height (feet): Up to 33

Horizontal Travel Length (feet): Not Applicable

Incline Rail Slope (degrees): Not Applicable

Maximum Specimen Weight (lb): 60,000

Maximum Impact Velocity (ft/sec): 24 (Approx.)

Facility Location: Indoor

Type of Specimens Tested: A-6A, EA-6B, E-2A, C-2A Aircraft, LM Spacecraft

Type of Impact Surfaces Available: Metallic

ADDITIONAL IMPACT OR DROP TEST CAPABILITIES								
Facility Name	Vertical Drop Height (ft)	Horiz. Travel Length (ft)	Incline-Rail Slope (degrees)	Maximum Specimen Weight (lb)	Maximum Impact Velocity (ft/sec)	Facility Location (Indoor or Outdoor)	Type of Specimens Tested	Type of Impact Surfaces Available
None								

MCDONNELL DOUGLAS LANDING AND SHOCK SIMULATION FACILITY

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Aircraft Company Box 516 St. Louis, Missouri 63166	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION: MAC Brochure, "Facilities and Capabilities Engineering Laboratories"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility contains the capability of drop testing components, landing gear, and entire airplanes under simulated landing environments. A component drop tower is capable of testing specimens as large as 5 x 15 feet and weighing 23,000 pounds. A larger drop test facility can accomodate specimens that weigh 60,000 pounds and are as large as 50 x 75 feet with sink speeds up to 30 ft/sec. One combined vertical and horizontal velocity landing simulator is available for testing specimens weighing up to 3000 pounds. Vertical and horizontal impact velocities are adjustable and a choice of either water or earth impact surface is available. Special test facilities to simulate orbital docking of two spacecraft (each weighing up to 65,000 pounds) with five-degrees of freedom are available.

The Airplane Drop Facility is used for simulation of airplane landings. The free-fall drop heights allow for sink speeds up to 30 feet per second. Test specimens as large as 50 ft x 75 ft and weighing up to 60,000 pounds can be accommodated. The impact surfaces for the landing gears have lateral translation freedom and simulate the surface roughness of real landing surfaces. Landing gear wheel spin-up is incorporated to simulate wheel effects on the landing gear upon impact. A wing lift system is also incorporated with the airplane to provide constant sink speed upon initial impact. Instrumentation can be provided to determine strains and deflections of the airplane as well as behavior of the landing gear system. High speed movie coverage is available to allow for complete analysis of the drop tests. The data collection systems include tape recorders and oscillographs. The test facility has been used primarily for conducting development, qualification, and extended life tests on the carrier-based F-4 Phantom airplane.

TESTING CAPABILITIES: The drop test facilities are used to develop and demonstrate the adequacy of landing systems designed to absorb the high energy of landing without damaging the landing system, structure, or occupants. Typical drop test programs have included verifying the carrier-landing capabilities of the F-4 and the landing qualities of the Mercury and Gemini spacecraft and the F-111 Crew Module on both land and water impact surfaces. Special spacecraft docking facilities have been used to develop and simulate docking techniques for the Gemini and Apollo programs.

Accelerations, loads, strains, and velocities are recorded on the Central Data Acquisition System or on tape recorders and oscillographs. More than 100 data channels are available. The typical time cycle for data processing is 4 hours, although this can be reduced to 1 hour for priority tests.

FACILITY COST HISTORY

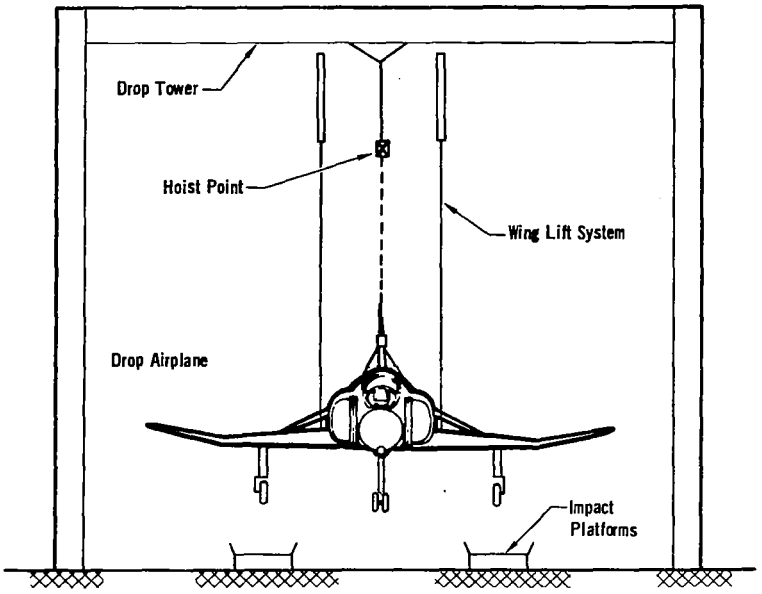
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1950-68 COST $ 800,000* ESTIMATED REPLACEMENT VALUE $1,200,000**
CONTRACTOR: McDonnell Douglas Corporation	LOCATION: St. Louis, Missouri

IMPROVEMENTS AND COSTS:

*Construction Year (1950): Component Drop Tower Facility; Initial Cost: $50 K; **Cost: $150 K
*Construction Year (1958): Airplane Drop Facility; Initial Cost: $150 K; **Cost: $250 K
*Construction Year (1964): Water/Land Impact Facility; Initial Cost: $250 K; **Cost: $400 k
*Construction Year (1968): Spacecraft Docking Simulation Facility; Initial Cost: $350 K; **Cost: $400K

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Sub-Facility Name: Airplane Drop Facility

Effective Drop Height (feet): 15

Horizontal Travel Length (feet): Not Applicable

Incline Rail Slope (degrees): Not Applicable

Maximum Specimen Weight (lb): 60,000

Maximum Impact Velocity (ft/sec): 30

Facility Location: Indoor

Type of Specimens Tested: F-4 Series Drop Test

Type of Impact Surfaces Available: Metallic

ADDITIONAL IMPACT OR DROP TEST CAPABILITIES

Facility Name	Effective Drop Height (ft)	Horiz. Travel Length (ft)	Incline-Rail Slope (degrees)	Maximum Specimen Weight (lb)	Maximum Impact Velocity (ft/sec)	Facility Location (Indoor or Outdoor)	Type of Specimens Tested	Type of Impact Surfaces Available
Comp. Drop Tower	25	N/A	N/A	23,000	40	Indoor	F-4 Landing Gear	Metallic
Water/Land Impact Facil.	20	140	N/A	3,000	Vert. (35) Hor. (50)	Outdoor	F-111 Crew Module, Gemini	Comp Soil, Sand, Water, Rock Strewn Soil
Space Dock Sim	N/A	N/A	N/A	65,000	1.5	Indoor	Apollo, LM, CSM, LM/SIVB	N/A

NASA-LANGLEY IMPACTING STRUCTURES FACILITY

REPORTING INSTALLATION: NASA-Langley Research Center Structures Research Division Hampton, Virginia 23365	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures Research Division
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models & Facilities Div. Code 56.00 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is designed for conducting studies of landing characteristics of reentry vehicles and planetary entry configurations. Launching equipment includes: (1) A slingshot (energy-source rubber shock cord) with vertical velocities up to 200 ft/sec; (2) A pendulum with vertical or horizontal velocities up to 21 ft/sec; and (3) Catapult and monorail launch and towing equipment with horizontal velocities up to 100 ft/sec. Types of landing areas include: A 260-ft-long dry area; (2) A 200-ft-long fiberglass-covered runway; (3) A 1500-ft length of water, and (4) Other surfaces such as sand.

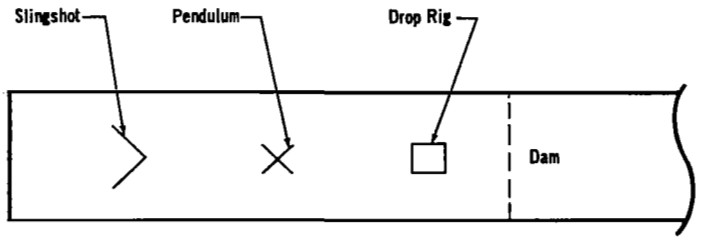
TESTING CAPABILITIES: This facility is used to conduct vertical type landing impact tests of manned spacecraft, horizontal type landing tests of aircraft and spacecraft, and vertical type landing impact tests of instrument packages and nose cones.

FACILITY COST HISTORY

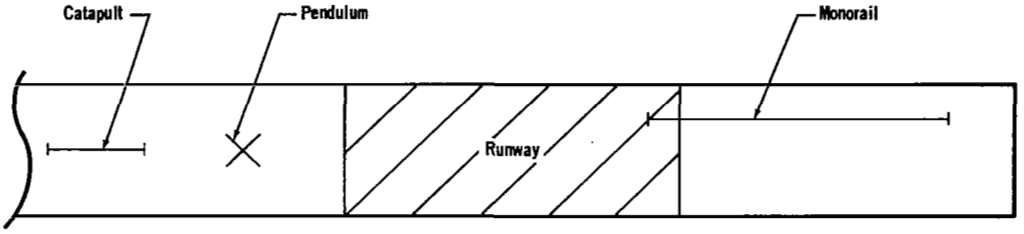
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1942 COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available.	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available.

SCHEMATIC



South End Launchers



North End Launchers

FACILITY PERFORMANCE DATA

Facility Name: Impacting Structures Facility

Vertical Drop Height (ft): 20

Horizontal Travel Length (ft)
(Water): 1500
(Fiberglass runway): 200
(Dry Area): 300

Incline Rail Slope (degrees): None

Maximum Specimen Weight (lb): 2000 (For Drop Rig)
25 (For Sling Shot, Monorail & Catapult)

Maximum Impact Velocity (ft/sec)
(Vertical): 200, 21
(Horizontal): 21

Facility Location: Outdoor/Indoor

Type of Specimens Tested: Not Available

Type of Impact Surface Available: Dry soil, water, fiberglass

ADDITIONAL IMPACT OR DROP TEST CAPABILITIES

Facility Name	Vertical Drop Height (ft)	Horiz. Travel Length (ft)	Incline-Rail Slope (degrees)	Maximum Specimen Weight (lb)	Maximum Impact Velocity (ft/sec)	Facility Location (Indoor or Outdoor)	Type of Specimens Tested	Type of Impact Surfaces Available

NASA-LANGLEY LANDING LOADS TRACK

REPORTING INSTALLATION: NASA-Langley Research Center Dynamic Loads Division Hampton, Virginia 23365	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Dyanamics Loads Division
OTHER SOURCES OF INFORMATION: "Investigations on the Ground Performance of Aircraft Relating to Wet Runway Braking and Slush Drag," N64-13883, January 1963	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models & Facilities Div. Code 56.00 Phone: (703) 722-7961, ext 4745

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The test carriage travels on steel rails, straddling a concrete track 2,177-feet long, and contains a drop frame to which a landing gear specimen is attached. The test carriage is catapulted to the desired speed, the drop frame is released from a predetermined height, and a landing is simulated.

During the landing, research is carried out on landing impact and stopping capability for a variety of landing surface conditions (dry, wet, slush, soils, etc.). Characteristics of the track are: Maximum forward speed, 150 mph, vertical impact velocity, 18 ft/sec, and drop weight, 6,500 to 20,000 pounds. A tank that parallels the landing loads track is used for hydrodynamic landing gear tests. The tank is 8-feet wide, 5-feet deep, and 2,177-feet long. Maximum forward speed of the hydrodynamics test carriage is 150 mph.

TESTING CAPABILITIES: This facility performs tests whereby loads and motions are measured during impact and braking tests on hard surfaces and soils.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1957 COST $ Not Available ESTIMATED REPLACEMENT VALUE Not Available
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: None

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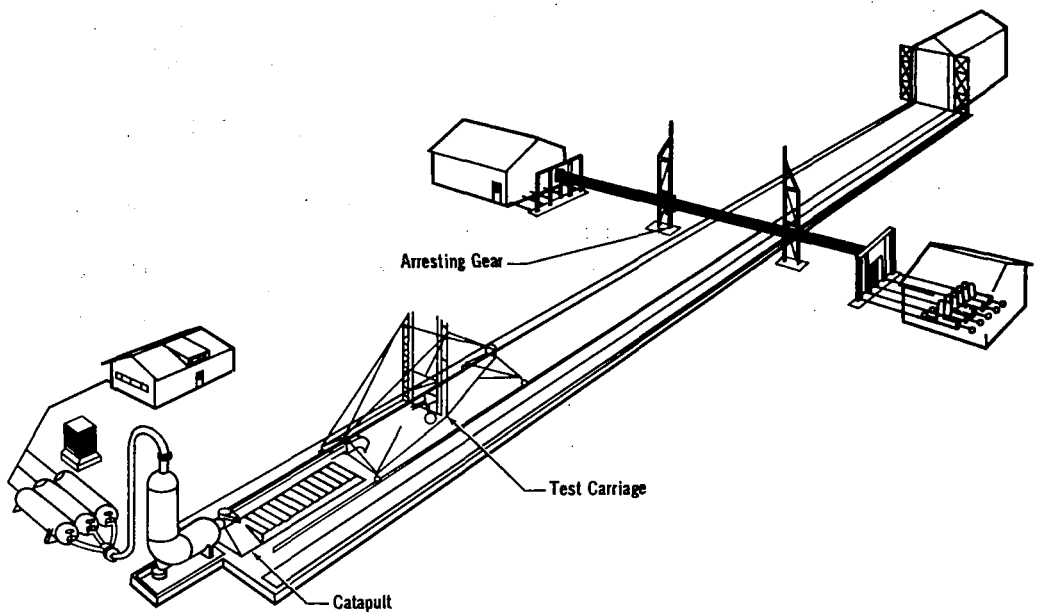

FACILITY PERFORMANCE DATA

Facility Name:	Landing Loads Track
Vertical Drop Height (ft):	Not Available
Horizontal Travel Length (ft):	2,177
Incline Rail Slope (degrees):	
Maximum Specimen Weight (lb):	20,000
Maximum Impact Velocity (ft/sec):	
(Vertical):	18
(Horizontal):	220
Facility Location:	Outdoor
Type of Specimens Tested:	Not Available
Type of Impact Surfaces Available:	Dry, wet, slush, soils

ADDITIONAL IMPACT OR DROP TEST CAPABILITIES								
Facility Name	Vertical Drop Height (ft)	Horiz. Travel Length (ft)	Incline-Rail Slope (degrees)	Maximum Specimen Weight (lb)	Maximum Impact Velocity (ft/sec)	Facility Location (Indoor or Outdoor)	Type of Specimens Tested	Type of Impact Surfaces Available

NASA-MSC LANDING AND IMPACT TEST FACILITY 338

REPORTING INSTALLATION NASA-Manned Spacecraft Center Houston, Texas 77058	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures and Mechanics Division Landing and Docking Branch
OTHER SOURCES OF INFORMATION "Major Test Accomplishments of Engineering and Development Directorate - 1967, 1968, 1969"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Landing and Docking Branch Mail Code ES3 Phone: 483-4446

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility can impact test landing systems and complete aerospace vehicles with combined vertical and horizontal landing velocities. The test fixture is constructed as an open structural steel framework approximately 100-feet long, 20-feet wide, and 39-feet high. The test article is installed on a monorail, attached inside the framework, and is accelerated to a preset horizontal velocity by a pneumatic catapult. At the end of the acceleration phase the vehicle is released and allowed to free-fall to the impact surface. The horizontal velocity is controlled by adjusting the operating air pressure of the catapult. Apollo Command Modules weighing 12,000 pounds were accelerated to horizontal velocities up to 65 ft/sec. Velocities exceeding 120 ft/sec can be achieved with lighter test articles. The height of the monorail is adjustable to provide free-fall vertical velocities from 0 to 40 ft/sec. Water and land surfaces are arranged at opposite ends of the launch structure. The water landing tank is 160-feet long, 128-feet wide, and 26-feet deep and is suitable for most flotation, egress, and recovery training in addition to landing test.

TESTING CAPABILITY: This landing simulator was used to develop and qualify the Gemini and Apollo Command Modules for earth landing. Approximately 100 full-scale boilerplate models and actual spacecraft were tested under both the normal water and emergency land landing conditions.

Approximately 100 channels of high-speed analog data acquisition equipment is installed at the test site. Transducers to measure accelerations, loads, strains, and velocity are available. In addition to the above, a limited telemetry data acquisition system is also installed. A high speed instrumentation photograph system is sequenced with the other data systems to provide visual data.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1965 COST $ 67,820 ESTIMATED REPLACEMENT VALUE $335,000
CONTRACTOR: Snowcon Corp. American Machine and Foundry Co.	LOCATION: Houston, Texas Stamford, Conn.

IMPROVEMENTS AND COSTS: (1965) Excavation of pond, Cost: $6,296; (1966) Modification and installation of surplus Gemini equipment at MSC, Cost: $110,000; (1968) Electrical power installation, Cost: $24,000; (1968) Modifications including building road hardstand, Cost: $69,240.

PLANS FOR FACILITY IMPROVEMENTS: Prop test tower and bunker protection for impact testing of hazardous components and systems (5000 lb WT capability, vertical velocity of 40 ft/sec).

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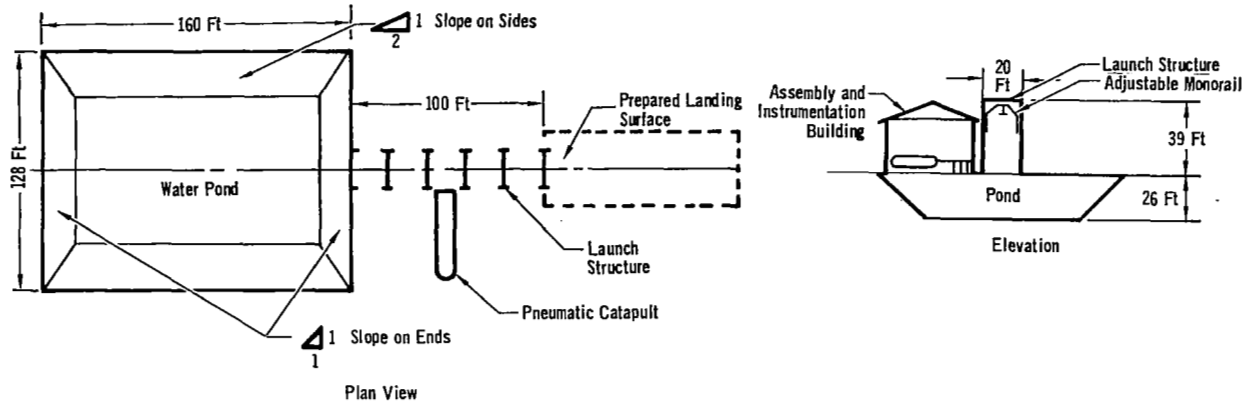
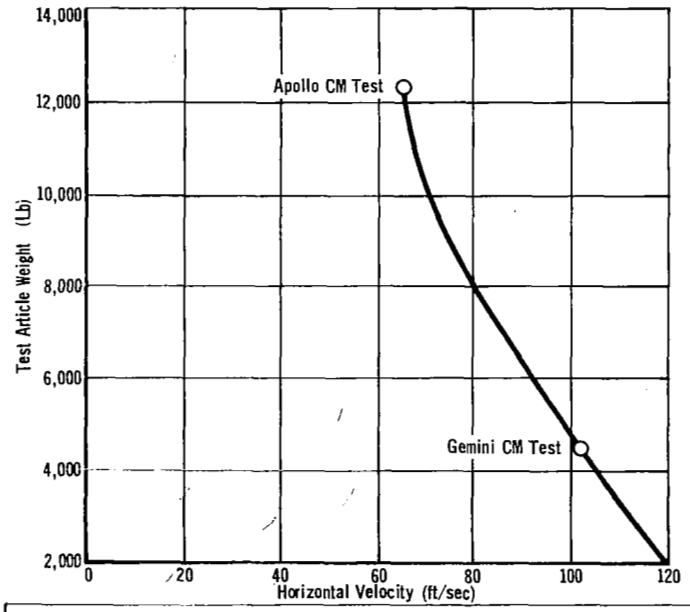


FACILITY PERFORMANCE DATA



Facility Name: Landing and Impact Test Facility 338

Vertical Drop Height (feet): 25

Horizontal Travel Length (feet): 100

Incline Rail Slope (degrees): Not Applicable

Maximum Specimen Weight (lb): 15,000

Maximum Impact Velocity (ft/sec):
65 @ 13,000 lb
103 @ 4,500 lb

Facility Location: Outdoor

Type of Specimens Tested: Gemini CM, Apollo CM, Landing Gear

Type of Impact Surfaces Available: Sand, Water, and others which may be easily installed (metallic, concrete, asphalt, soil, and compacted soil)

ADDITIONAL IMPACT OR DROP TEST CAPABILITIES

Facility Name	Vertical Drop Height (ft)	Horiz. Travel Length (ft)	Incline-Rail Slope (degrees)	Maximum Specimen Weight (lb)	Maximum Impact Velocity (ft/sec)	Facility Location (Indoor or Outdoor)	Type of Specimens Tested	Type of Impact Surfaces Available
None								

4. SHOCK TEST

BENDIX MISHAWAKA OPERATIONS SHOCK TEST FACILITIES

REPORTING INSTALLATION: Bendix Aerospace Systems Division Mishawaka Operations 400 S. Beiger Street Mishawaka, Indiana 46544	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Laboratory
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Phone: (219) 255-2111

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Shock test capability is provided by three shock machines. The first two shock machines utilize pneumatic cylinders to obtain the desired velocity and shock struts to obtain the deceleration pulses. Test specimens weighing up to 4000 lb can be subjected to 30g trapezoidal pulse on the large machine. The third machine, a Barry VP-1000, is of the free fall type and can subject test specimens up to 1000 lb to sine, sawtooth, and square wave shock pulses.

TESTING CAPABILITIES: The three shock machines are used to subject components and systems to a variety of shock pulses. In addition, packaged items weighing up to 6000 lb can be subjected to rough handling tests in the structural test area of the laboratory. Typical instrumentation consists of strain gage and crystal type accelerometers recorded on magnetic tape or oscillograph recorders (36 channels).

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $250	CONSTRUCTION YEAR: 1950,53,65 COST $147,000 (Total) ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: Bendix Corp.; Barry Corp. IMPROVEMENTS AND COSTS:	LOCATION: Mishawaka, Indiana Watertown, Massachusetts

PLANS FOR FACILITY IMPROVEMENTS: None

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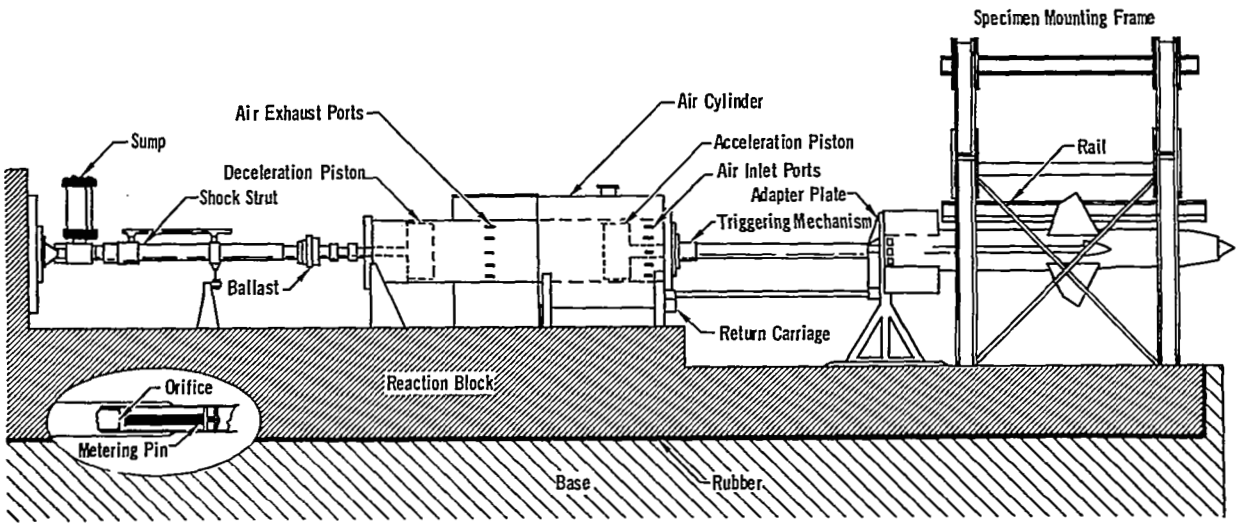
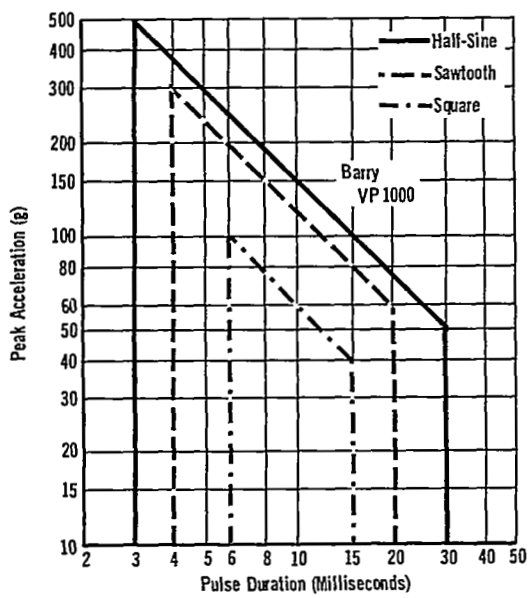


FACILITY PERFORMANCE DATA



Manufacturer:	Bendix
Type:	Hydro-Pneumatic
Maximum Force (g):	60
Table Size (inch):	32 diam
Maximum Travel (inch):	72
Pulse Shape:	Half Sine; Trapezoidal
Pulse Duration (millisec):	25 to 80
Max Specimen Weight (lb):	4000
Max Specimen Size (inch):	30 x 30 x 240

Manufacturer:	Barry
Model:	VP-1000
Type:	Free Fall
Maximum Force (g):	500
Table Size (inch):	36 x 36
Max Drop Height (inch):	96
Pulse Shape, Duration:	See Diagram at left
Max Specimen Weight (lb):	1000
Max Specimen Size (inch):	36 x 36 x 104

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lbs) or (g's)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape: Half Sine	Saw Tooth	Square	Trapezoidal	Maximum Specimen: Weight (lbs)	Size (lxwxh) (inch)	Elevated or Reduced Temp. Capability
Bendix		Hydro, Pneumatic	60g	12x24	30 in	X		X		250	24x24x24	

BOEING SHOCK TEST LAB

REPORTING INSTALLATION: The Boeing Company Kent Space Center P.O. Box 3999 Seattle, Washington 98124	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Labs Aerospace Group
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Engineering Test Laboratories Manager Mr. C.J. Adriance Phone: (206) 773-5463

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The primary shock testing capabilities are provided by one horizontal impact shock test machine and two vertical impact machines. The horizontal machine has an available impact force of 4,500,000 G-pounds, and the two vertical impact machines have ratings of 225,000 and 600,000 G-pounds. The horizontal shock machine may be operated in either an impact or an impulse mode. Shock pulses for all three impact machines may be of the terminal peak sawtooth, half-sine, or square wave shapes.

TESTING CAPABILITIES: The shock test facility is used to develop and qualify aircraft and aerospace components and subsystems. Typical shock test programs have included verification of Minuteman staging separations and B-52 and 747 avionics landing shock hardness and reliability. Time histories of acceleration, velocity, displacement, and strain are recorded on tape recorders and oscillographs. Quick-look shock spectrum analysis of the applied shock environment is available. A microwave link is also available for remote, on-line, computer analysis operations and a remote data printout station.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: None

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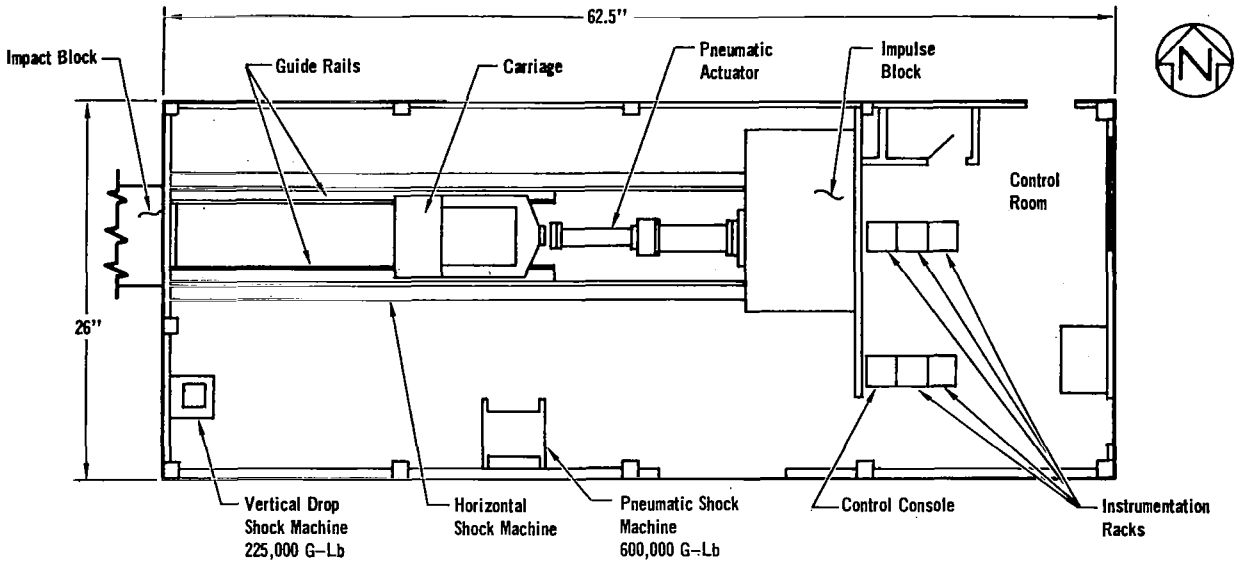
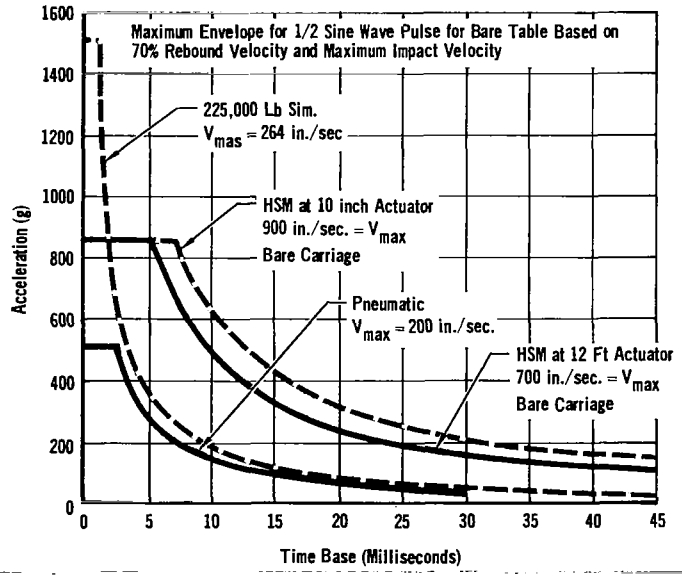


FACILITY PERFORMANCE DATA



Manufacturer:	Machine Dynamics, Inc.
Model:	-
Type:	Pneumatic, Impulse
Maximum Force (G-lb):	4,500,000
Table Size (in):	Not Applicable
Maximum Drop Height or Travel (in):	167 & 234
Pulse Shape:	Saw-Tooth, Half-Sine, Square, Impulse
Pulse Duration (ms):	3-40
Maximum Specimen Weight (lb):	4000
Maximum Specimen Size (inch):	48 x 48 x 60

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square	Trapezoidal	Weight (lb)	Size (lxwxh) (inch)	
Boeing		Vertical Drop	1500 g's			X	X	X		2000	48	
Boeing		Pneumatic	500 g's								No limitation on height	

GENERAL DYNAMICS ELECTRIC BOAT DIVISION SHOCK TEST FACILITIES

REPORTING INSTALLATION: General Dynamics Corporation Electric Boat Division Groton, Connecticut 06340	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Research and Development, Department 412 Test Division
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Test and Engineering Services R&D Phone: (203) 446-3860

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Shock Testing Facility is equipped to perform high impact shock testing to the requirements of MIL-S-901(Navy). Three types of shock machines are available for different weight ranges of test packages up to a max. of approximately 60K lbs, two hammer type and two barges exposed to underwater explosive attack. The heavyweight shock test facility consists of two floating test platforms and a dock-side data acquisition station. The platforms, or barges, are 28 feet in length with a 16-foot beam. Maximum platform capacity is approximately 60,000 lb with a center of gravity less than 5 feet above the inner deck. A barge outrigger is available when testing high center of gravity equipment. The platforms are constructed in accordance with MIL-S-901C and the Bureau of Ships Drawing SF645H1486. Equipment to be tested is mounted on the platform on simulated shipboard foundations. Foundation design and fabrication services are available at Electric Boat division.

Two hammer type machines are available, the lightweight and medium-weight shock machines, which are limited to equipment weighing up to 6000 pounds. During the shock test, normal operating conditions are simulated for each item by supplying electrical, hydraulic, pneumatic, steam, or any other required service. Equipment under test is mounted in a manner similar to the mounting that will be used in its service application. The High Shock facilities can be used to investigate stress concentrations, shock wave propagation, and other design studies involving impact loading. Available for these studies are specialized techniques of strain measurement, strain gages, photoelasticity, photo-stress, and stress coat.

TESTING CAPABILITIES: The Shock Testing Facility is used to qualify and develop shipboard machinery, equipment, and systems. Up to 60 channels of time histories of acceleration, velocity, displacement, and strain are recorded on a tape recorder using a FM multiplexing system. Four cameras are available for high-speed motion pictures. Various analyses of the applied shock environment are also available along with dynamic design analysis capability. The shock impacts simulate a near miss explosive attack of a ship. The impact magnitudes are defined by the test geometry. The usual maximum shock velocity is 12-15 fps. The heavy-weight shock facility has high-speed moving cameras which can be shock-mounted within a platform and their operation controlled remotely from the dockside instrumentation facility. A film processor for developing to a negative film, immediately after each shot, and a time-and-motion study projector for detailed data reduction and analysis, are located within the dockside data acquisition station. Portable reflective polariscopes are available to read residual strains from birefringent coatings. The moving film cameras can also be mounted to photograph dynamic strains as displayed by birefringent coatings during shock.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: None

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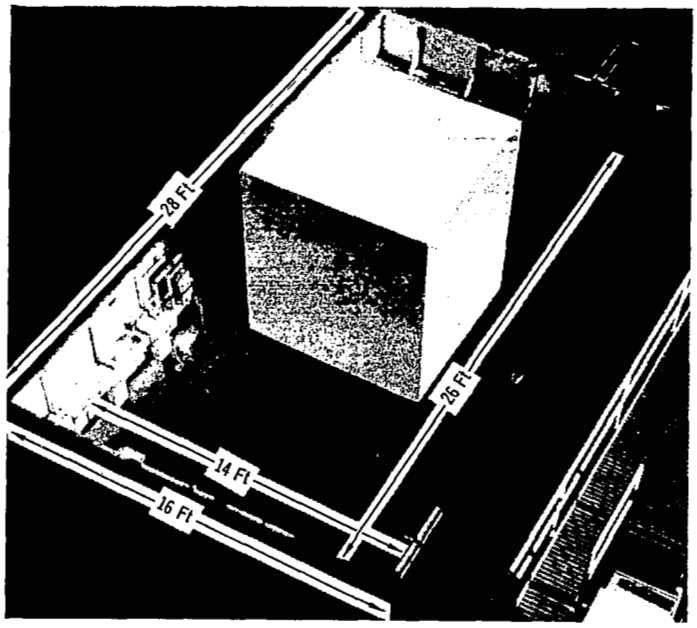

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer: General Dynamics

Model: Heavy Weight

Type: Floating barge exposed to underwater explosive attack

Maximum Force (lb): Mil-S-901

Table Size (inch): 168 X 312

Maximum Drop Height or Travel (ft): Not Applicable

Pulse Shape: Not Applicable

Pulse Duration (millisec): Not Available

Maximum Specimen Weight (lb): 60,000

Maximum Specimen Size (inch): Variable

Elevated or Reduced Temperature Capability: None

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen Weight (lb)	Maximum Specimen Size (lxwxh) (inch)	Elevated or Reduced Temp. Capability
New England Trawler	Medium Weight	Mechanical	To MIL-S-901	60 x 60	5.5 ft	N	A			5500	Variable	None
New England Trawler	light Weight	Mechanical	To MIL-S-90	48 x 34	5 ft	N	A			250	Variable	None

GENERAL DYNAMICS/FORT WORTH SHOCK TEST FACILITIES

REPORTING INSTALLATION: General Dynamics Corporation Fort Worth Division Fort Worth, Texas 76101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager of Engineering Test Laboratories Phone: (817) 732-4811, ext 2204

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The shock testing capabilities are provided by a pneumatic test machine capable of 40,000 pounds of thrust, a sand drop machine capable of testing a 400-pound specimen to a maximum of 75g, and a small JAN-S-44 shock machine. All machines provide a half-sine shock pulse. The pneumatic machine may be positioned in the horizontal axis and the pulse duration may be altered by changing the metering pin.

TESTING CAPABILITIES: The Shock Testing Facility is used in engineering qualification testing of aircraft and aerospace components and systems. Special applications for shock problem solution and equipment development is provided by the portability of the pneumatic shock machine. Shock response is recorded on magnetic tape and analyzed with a real-time analyzer. Peak holding meters that indicate the shock amplitude are used for real-time observations of input or response shock levels. Data are recorded through 14 channels using an Ampex Tape Recorder FR1100 and reduced on site.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $320	CONSTRUCTION YEAR COST $ ESTIMATED REPLACEMENT VALUE $40,000
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: (1954) Barry Model 150-400 VD, Cost $2,450; (1955) JAN-S-44, Cost $600; (1957) Convair Model Hyge 32-707, Cost $14,000

PLANS FOR FACILITY IMPROVEMENTS: As required for prime contracts.

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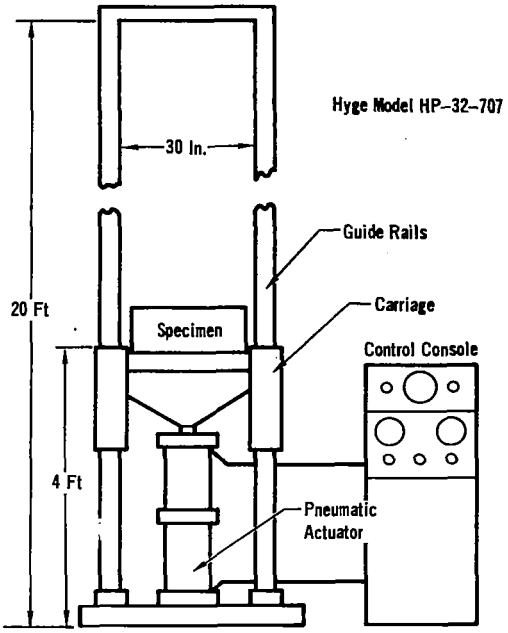
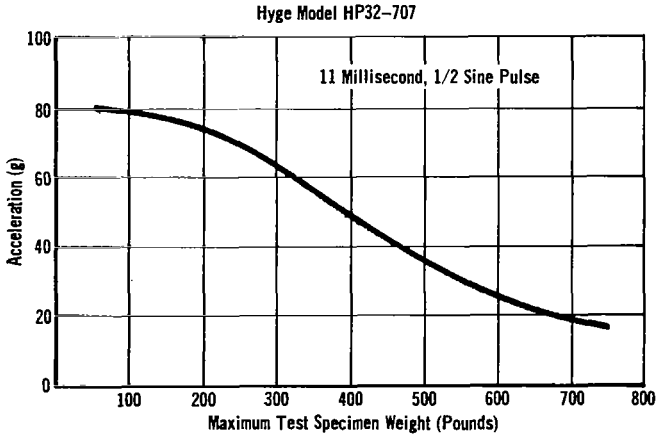


FACILITY PERFORMANCE DATA



Manufacturer:	Convair
Model:	HP-32-707
Type:	Pneumatic
Maximum Force(lb):	40,000
Table Size (inch):	30 x 24 (Custom built)
Maximum Drop Height of Travel(ft);	20
Pulse Shape:	Half-Sine
Pulse Duration (millisec):	11 to 20
Maximum Specimen Weight (lb):	2000
Maximum Specimen Size (inch):	30 x 30 x 24 or as required
Temperature Capability:	None

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lbs) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square Wave	Trapezoidal	Weight (lbs)	Size (lxwxh) (inch)	
Barry	150-400 VD	Free Fall	75 g's	36 x 36	5 ft	x				400	32x36x36	No
Genl Dynamics	JAN S-44	Free Fall, Mechanical	120 g's	4 x 4	1 ft	x				24	4x4x4	No

HUGHES SHOCK TEST FACILITIES
(Culver City, California)

REPORTING INSTALLATION: Hughes Aircraft Company Jefferson and Teale Culver City, California 90231	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Product Evaluation Department
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) R. L. Baker Phone: (213) 391-0711, ext 2619

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Shock test capabilities are provided by two free-fall shock machines or by using electrodynamic exciters and a wave synthesizer. Either terminal peak saw-tooth or half-sine shock pulses may be applied to small and large systems. A maximum test package of 2000 pounds can be tested to 50 g's Three-hundred g's, with a very short pulse duration, is attained for specimen weights of 200 lb. Higher g levels can be attained (up to 1000 g's, with limited specimen weights).

TESTING CAPABILITIES: The Shock Test Facilities are used to qualify and develop aerospace systems and subsystems. Time history of acceleration and strain are recorded (49 channels) on tape recorders, oscillographs and polaroid film. Shock spectrum analysis of the applied shock environment is also available. Data are recorded with a digital computer.

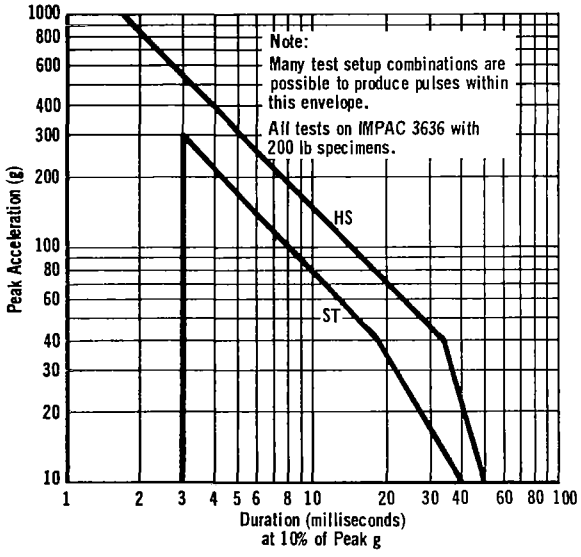
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

FACILITY PERFORMANCE DATA



Manufacturer:	MRL
Model:	3636
Type:	Free-Fall
Maximum Force (g):	1000
Table Size (inch):	36 x 36
Maximum Drop Height or Travel (ft):	7
Pulse Shape:	Half-Sine, Saw-Tooth
Pulse Duration (millisec):	3 to 40
Maximen Specimen Weight (lb):	2000
Maximum Specimen Size (inch):	36 x 36 x 60
Temperature Capability:	None

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square	Trapezoidal	Weight (lbs)	Size (lxwxh) (inch)	
HAC	ST2	Free Fall	250g	12 x 12	7 ft	X	X			65	12x12x60	None

HUGHES SHOCK TEST FACILITIES

(Fullerton, California)

REPORTING INSTALLATION: Hughes Aircraft Company P.O. Box 3310 1901 W. Malvern, Building 604, Mail Stop E-243 Fullerton, California 92634	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Engineering Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Environmental Engineering Department Mr. R. E. Freeman Phone: (714) 871-3232, ext 3191

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of three shock machines capable of handling specimens of 6000, 250 and 100 pounds. The lightweight shock machine handles loads up to 250 lb. This machine is equipped with two hammers, one which falls vertically and another, a pendulum, which strikes horizontally. A complement of accessories combined with features of the basic machine facilitates a wide variety of mounting orientations.

TESTING CAPABILITIES: Data are recorded on magnetic tape and oscillograph recorders (24 channels) and reduced on site. Maximum electrical power available is 100 kw.

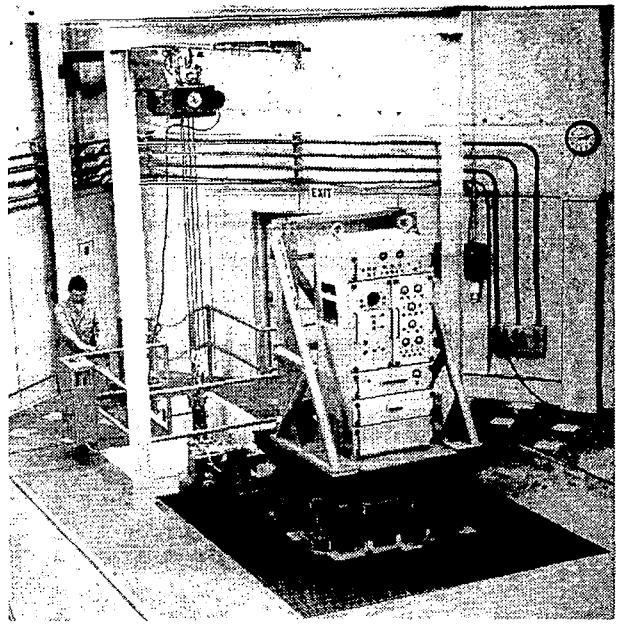
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $340,000
CONTRACTOR:	LOCATION:

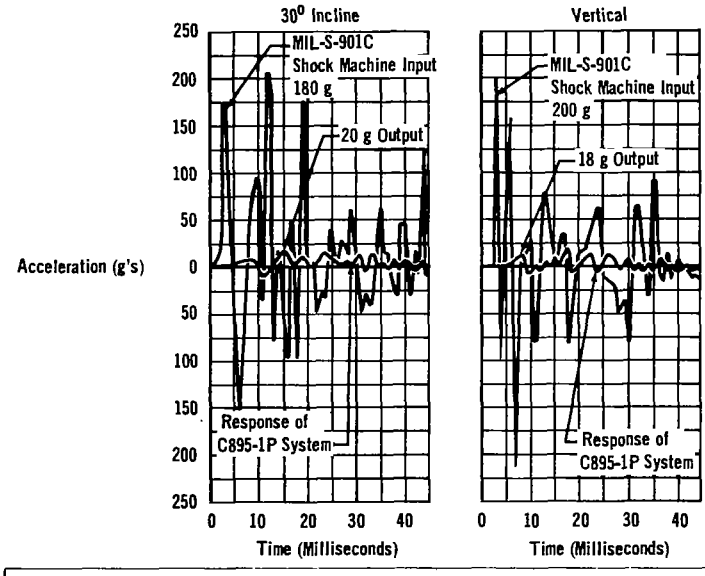
IMPROVEMENTS AND COSTS: (1957) Medium weight High Impact Shock Machine, Cost $200,000; (1957) Lightweight High Impact Shock Machine, Cost $40,000; (1959) Barry Vari-Phase Shock Machine, Cost $6000.

PLANS FOR FACILITY IMPROVEMENTS: Procurement of Programmable Pulse Shock Machine

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	BuShips
Model:	Navy Med-wt. Hi-Impact
Type:	Mechanical
Maximum Force (lb):	Per MIL-S-901
Table Size (inch):	60 x 60
Maximum Drop Height or Travel:	Per MIL-S-901
Pulse Shape:	Not Available
Maximum Specimen Weight (lb):	6,000
Maximum Specimen Size (inch):	Varies with weight and c.g.

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lbs) or (g's)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape: Half Sine	Saw Tooth	Square	Trapezoidal	Maximum Specimen: Weight (lb)	Size (lxwxh) (inch)	Elevated or Reduced Temp. Capability
LAB Corp.	Navy LtWt Hi-Impact	Mechanical	Per MIL-S-901	N.A.	Per MIL-S-901					250	20x20x20	No
Barry Vari-Pulse	15575	Free Fall	175g	17 x 17	72 in	X				100	20x17x17	No

LTV SHOCK TEST FACILITIES

REPORTING INSTALLATION: LTV Aerospace Corporation Unit 2-59900 P.O. Box 5907 Dallas, Texas 75222	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Laboratory
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. R. Raven, Chief Structures and Systems Laboratories Phone: (214) 266-5764

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The medium-impact shock machine consists of a drop table whose fall is arrested by dropping into a sandbox which forms the base of the machine. An adjustable number of blocks, attached to the underside of the table, penetrate the sand. The magnitude and duration of the stopping acceleration are determined by the height of drop and number of blocks.

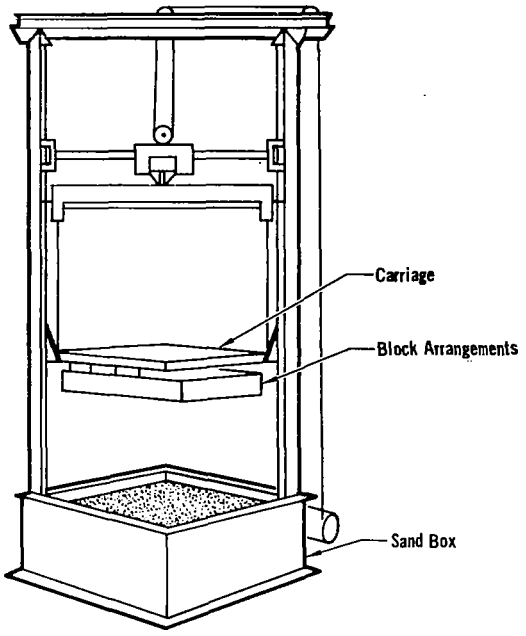
TESTING CAPABILITIES: The shock testing facility is used to qualify and develop aircraft and aerospace components. Time histories of accelerations and strains are recorded on tape or oscillographs. Shock spectrum analysis of the applied shock environment is also available. Fourteen data channels are available. The typical time cycle for data processing is 1 minute per channel.

FACILITY COST HISTORY

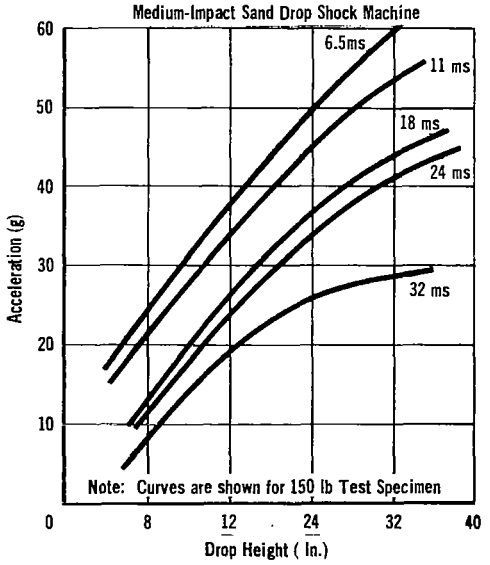
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $200	CONSTRUCTION YEAR: COST $3441* ESTIMATED REPLACEMENT VALUE $4000
CONTRACTOR: IMPROVEMENTS AND COSTS: *One machine only.	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS:

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	Barry
Model:	150 to 400
Type:	Free Fall, Sand Drop
Maximum Force (g):	180
Table Size (inch):	36 x 36
Maximum Drop Height (ft):	3.33
Pulse Shape:	1/2 Sine
Pulse Duration (millisec):	6.5 to 32
Maximum Specimen Weight (lb):	450
Maximum Specimen Size (inch):	30 x 30 x 30
Elevated or Reduced Temperature Capability:	None

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square	Trapezoidal	Weight (lbs)	Size (lxwxh) (inch)	
Barry	VP-400	Free fall	7000g	36 x 36	88 in	X	X	X		N/A	N/A	-100 to +400°F

MCDONNELL DOUGLAS SHOCK TEST FACILITIES

REPORTING INSTALLATION:	STATUS OF FACILITY:
McDonnell Douglas Corporation McDonnell Aircraft Company P.O. Box 516 St. Louis, Missouri 63166	COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION: MAC Brochure, "Facilities and Capabilities - Engineering Laboratories"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The primary shock testing capabilities are provided by pneumatic shock test machines. The two machines available have maximum thrusts of 15,000 and 40,000 pounds and can test electronic and mechanical equipment packages and other aerospace components. Shock pulses may be applied, either of the terminal peak sawtooth or half-sine wave shape. A maximum test package weight of 750 pounds may be tested to 35 g's, or a one pound component may be subjected to over 180 g's.

TESTING CAPABILITIES: The Shock Testing Facility is used to qualify and develop aircraft and aerospace components. Time histories of acceleration and strain are recorded on tape recorders or oscillographs. Twenty-four data channels are available.

FACILITY COST HISTORY

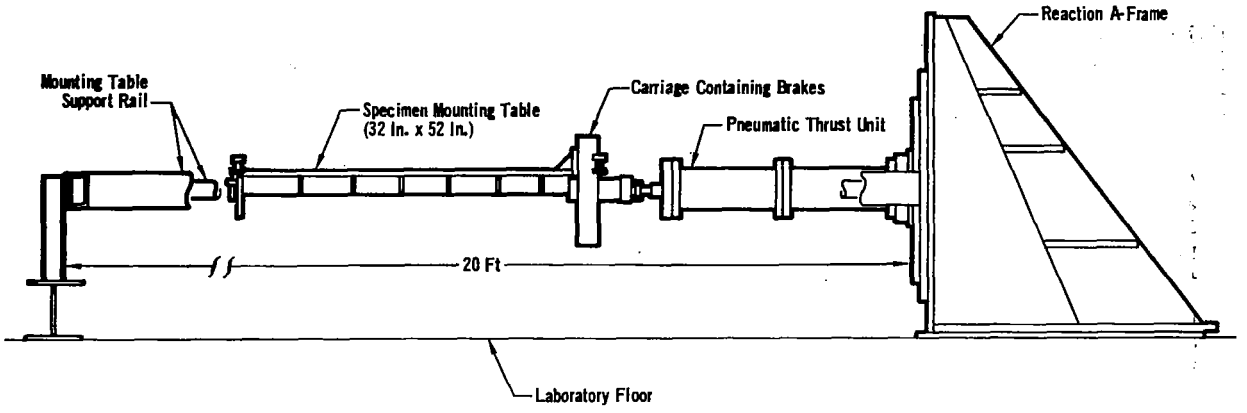
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1959 COST $23,000* ESTIMATED REPLACEMENT VALUE $50,000
CONTRACTOR: Consolidated Electrodynamics Corp.	LOCATION: Rochester, New York

IMPROVEMENTS AND COSTS: (1960) Converted to horizontal mode of operation, Cost $5000; (1961, 1965, 1969) Obtained additional metering pins, Cost $1700; (1965) Updated test monitoring instrumentation, Cost $4000.

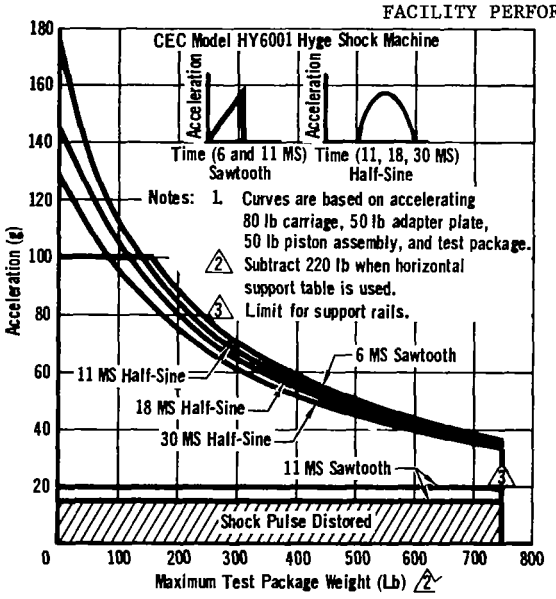
* Model HY 6001 Shock Machine

PLANS FOR FACILITY IMPROVEMENTS: Modify table support and brake system so that heavier specimens can be tested.

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer: Consolidated Electrodynamics Corp.

Model: HY 6001

Type: Pneumatic

Maximum Force (lb): 40,000

Table Size (in): 32 x 52

Maximum Travel Length (feet) 10

Pulse Shape: Half-Sine, Saw-Tooth

Pulse Duration (ms): 6 to 30

Maximum Specimen Weight (lb): 750

Maximum Specimen Size (lb): *

Elevated or Reduced Temperature Capability: Yes

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half-Sine	Saw-Tooth			Weight (lbs)	Size (lxwxh)	
CEC	HY6005	Pneumatic	15K lb	12.5D	2 ft	X	X			150	*	Yes

* - Note: Length and width of specimen can be cantilevered beyond table if properly fixtured. Height of specimen not restricted by shock machine.

MCDONNELL DOUGLAS SHOCK TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY:
McDonnell Douglas Corporation McDonnell Douglas Astronautics 3000 Ocean Park Boulevard Santa Monica, California 90406	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Environmental Laboratories Branch
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief, Environmental Laboratories Branch Phone: (213) 399-9311, ext 2642

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Mechanical shock environment, as provided by the Environmental Laboratories Shock Test Facility, employs four shock testing devices: (1) Electrodynamic shakers; (2) A Pneumatic thrust, Hyge shock tester; (3) AVCO SM-110 shock tester; and (4) Ordnance device fixtures. These are described as follows: The Electrodynamic Shaker: Within capability limitations, the most useful shock machine available in the laboratory is the electrodynamic shaker. The 32,000 force lb shaker has produced 1/2 sine pulses of 100 g's amplitude with a duration of 6 ms and specimen weight of 400 lb. The 17,500 force pound shaker has produced 1/2 sine pulses of 400 g's amplitude, .5 ms in duration. Shock specifications in terms of response spectrum (acceleration response as a function of frequency) are synthesized (shaped) directly on the shaker at low power level (-20 dB). Once the desired response spectrum has been achieved, a single full power shock is initiated. The shaker's mechanical shock capability is greatly increased since the available energy is used to excite the specific frequencies of interest as opposed to exciting all frequencies as associated with the classical pulses. The pneumatic thrust, Hyge Shock Tester: The basic dimensions, and capability curves for a CVC 6-inch, 40,000 lb thrust Hyge shock tester are given on the following page. A second type pneumatic shock machine available is the AVCO SM-110. This machine is capable of producing repeatable classic pulse shapes with specimens up to 200 lbs. It is an impact design capable of obtaining velocities of up to 400 inches per second with light loads and full stroke. The mounting surface, 16 inches square, is accessible from three sides. High level (50,000 g) short duration (200 ms) shocks such as those associated with stage separation are produced employing ordnance devices. The technique employed to produce these shock environments is to monitor test firings of the actual separation device at various distances from the plane of separation. The data is used to develop a reusable ordnance testing fixture. A skirt attached to the reusable fixture provides a mounting surface for specimens, with the specimens attached to the skirt in the area which closely duplicates the components actual shock environment.

TESTING CAPABILITIES: The shock test equipment described above has been utilized for testing components and systems of the Spartan, Saturn SIVB, and MOL programs.

The time history signal generated by a shock transducer is recorded on magnetic tape. Up to 75 data channels are available. The tape is re-recorded on a loop for shock spectrum analysis. A tape blanking device is employed to select the exact portion of the time history data to be used in the determination of the shock response spectrum. The output of the blanking device (input to the analysis system) is monitored on a storage oscilloscope. The exact portion of the signal to be analyzed is selected and photographed for time history records. The shock response spectrum is determined and plotted using a standard X-Y plotter. The typical time cycle for data processing is 1/2 hour per data channel. This includes both time history (acceleration as a function of time) and the response spectrum (acceleration as a function of frequency).

FACILITY COST HISTORY

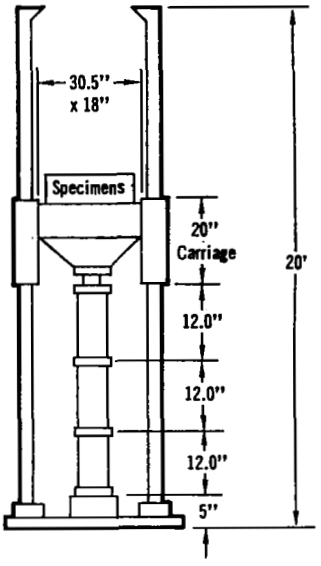
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $20,850* ESTIMATED REPLACEMENT VALUE $28,215
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: * Does not include cost of Ling Elect. A 249 and MB Elec. machines which can be used both for shock and vibration. Their cost is given in the MDAC-WD vibration test facilities section of this report. The remaining machines costs are broken down as follows: (1963) Consol. Vacuum Corp., Rochester, N.Y. (HY 6104), Cost $14,470; (1967) AVCO Electronics, Tulsa, Oklahoma (SM-110), Cost $6380; MDAC-WD, Santa Monica, Calif. Ordnance shock fixture built for specific test, Cost not available.

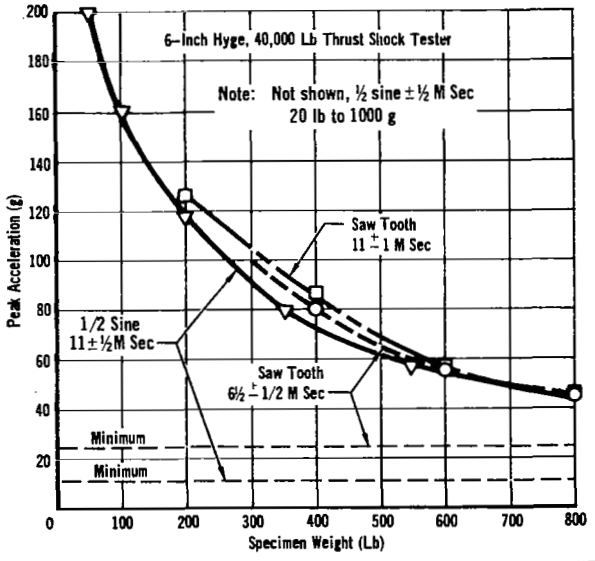
PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

HY6401 Hyge
20 Ft Rail System



FACILITY PERFORMANCE DATA



Manufacturer: Consolidated Vacuum Corp.

Model: HY 6401

Type: Pneumatic

Maximum Force (lb): 40,000

Table Size (in): 30 x 18

Maximum Drop Height (ft): 20' Rail System

Pulse Shape: Half-Sine, Saw-Tooth, Square

Pulse Duration (ms): 1 to 11

Maximum Specimen Weight (lb): 400

Maximum Specimen Size (in): 18 Diam x 120 L

Elevated or Reduced Temperature Capability: 200°F

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square	Transient	Weight (lbs)	Size (lxwxh) (inch)	
Ling Elec.	A 249		32K lb	30 Diam	1 in. Displ.	X			X	2000	240 x 30D	150°F
MB Elec.	C 150		17.5K lb	17 Diam	1.25 in. Displ	X			X	1000	144 x 20D	150°F
AVCO Elec.	SM 110	Pneumatic	40K lb	16 x 16	18 in. Stroke	X	X	X	X	200	16Dx72L	150°F
MDAC Barrel Device			N/A	N/A	N/A				X		36x36	Ambient

NOL AIR GUNS

REPORTING INSTALLATION: U.S. Naval Ordnance Laboratory White Oak Silver Spring, Maryland 20910	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environment Simulation Division
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: G. Stathopoulos, Chief Environment Simulation Division Phone: (301) 495-8684

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Air guns are used in the investigation and simulation of the effects of shocks associated with water entry, parachute openings, target impact, projectile firing, and guided missile and rocket launching. Presently, the guns are limited to performing rectilinear motion tests - acceleration applied in only one direction during any one test. There are five air guns available at the Laboratory for conducting shock tests. The guns are referred to by their bore size: the 26-inch, 21-inch, 15-inch, 5-inch, and 2-inch air guns. All of these air guns utilize the same principle of operation, which is to accelerate a piston containing a test object along the length of a closed barrel by means of high pressure air. A typical firing sequence begins with loading the piston with test object into the gun barrel. The barrel is sealed and the piston seated into the release mechanism in front of the breech chamber. The release mechanism holds the piston securely in place until the air pressure to produce the desired shock is built up in the breech chamber. Upon reaching this pressure, the release mechanism is actuated, freeing the piston and allowing the air charge to accelerate the piston along the length of the barrel. It is important to note that the piston does not make just one, but several oscillations; that is, as the piston moves forward, the initial high pressure air charge in the breech chamber is allowed to expand into the barrel with a corresponding reduction in pressure. Simultaneously, the low pressure air in front of the piston becomes compressed with an increase in pressure. A point is reached where the air pressure in front of the piston becomes great enough to slow, stop, and then accelerate the piston in the opposite direction. The process is repeated until the energy of the shot is expended in the form of friction.

TESTING CAPABILITIES: The 21-inch, 5-inch, and 2-inch air guns have muzzle tanks which prevent a significant build-up of pressure ahead of the piston. Air in front of the moving piston is forced into the tank and trapped there by means of one-way valves. Thus, the deceleration peak value is only a small fraction of the acceleration peak value, and both the number and amplitude of piston oscillations as greatly reduced. The deceleration peak value is somewhat less than 25 percent of the peak acceleration in the guns without muzzle tanks. The 26-inch, 21-inch, and 15-inch air guns are equipped with pistons that can produce either single-phase or two-phase shocks. The single-phase piston is used when only a single inertial loading is required, such as in soft target impact, launching, and parachute opening. The two-phase piston provides two shocks to simulate the effects of the prelaminar and laminar flow stages of high velocity weapon water entry. The first shock is caused by a metal, shock-inducing mass striking the test object mounting plate shortly after the piston is fired. Detents then lock the mounting plate to the shock mass. This shock is followed immediately by a longer duration pulse of much lower amplitude as the piston continues to accelerate forward in the barrel. The diameter and length of the piston imposes the only restrictions on the size of the test object. Weight is not an influencing factor as far as physical acceptance is concerned, although weight will affect the resultant shock forces of the shot. Because of the transient air pressures experienced during a shot, the test object must be housed in a protective covering if it is susceptible to pressure. In general, making electrical measurements from the piston during the initial acceleration produced in the 26-inch, 21-inch, and 15-inch air guns is practical through the use of cables (up to 3/4-inch in diameter) connected to the piston and passing through the muzzle door to external instrumentation.

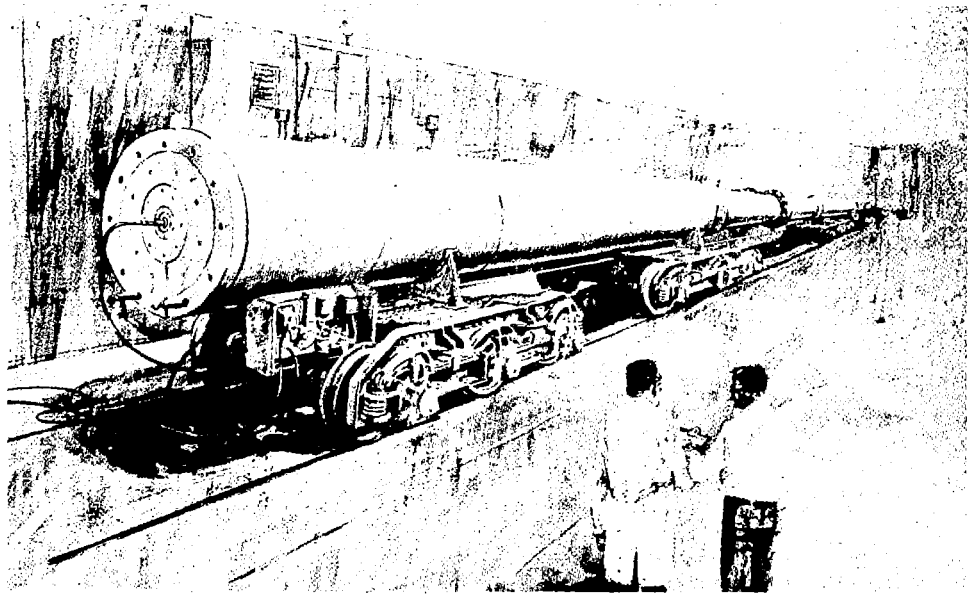
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $554,000* ESTIMATED REPLACEMENT VALUE $932,000
CONTRACTOR: U.S. NOL	LOCATION: Silver Spring, Maryland

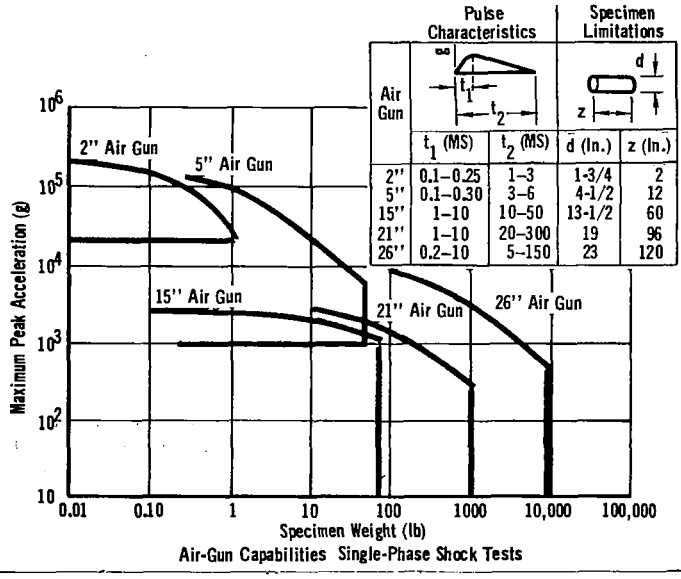
IMPROVEMENTS AND COSTS: 2-In. Air Gun: Initial Facility Cost&Mods, $10K; Est Replacement Cost, $12K
* 5-In. Air Gun: Initial Facility Cost & Modes, $37K**; Est Replacement Cost, $80K***
15-In. Air Guns: Initial Facility Cost & Modes, $47K, Est Replacement Cost, $90K
21-In. Air Guns:Initial Facility Cost & Modes, $170K: Est Replacement Cost, $250K
26-In. Air Guns:Initial Facility Cost & Modes, $290K; Est Replacement Cost, $500K
-5-In. naval gun including mount not included;* Cost does not include gun of note **.

PLANS FOR FACILITY IMPROVEMENTS: No funded plans.

SCHEMATIC



FACILITY PERFORMANCE DATA



Air-Gun Capabilities Single-Phase Shock Tests

Air Gun	Pulse Characteristics t_1 (MS)	Pulse Characteristics t_2 (MS)	Specimen Limitations d (In.)	Specimen Limitations z (In.)
2"	0.1–0.25	1–3	1-3/4	2
5"	0.1–0.30	3–6	4-1/2	12
15"	1–10	10–50	13-1/2	60
21"	1–10	20–300	19	96
26"	0.2–10	5–150	23	120

Facility Name: 26-Inch Air Gun

Barrel Length (feet): 90.2

Bore Area (sq in): 531

Breech Pressure, max (psig): 0 to 10,000

Breech Volume (cu ft): 1.5 to 5

Max Force Acting on Piston (lb): 5×10^6

Piston Weight (lb): 500 (Single-phase, min)
800 (Two-phase, min)

Test Object Size, Max(ft): 1.91 Diam, 10L; 2.14 Diam if test object can act as load bearing member of the piston assembly.

Theoretical Max. Acceleration (g): 8K,100 lb load Single phase
1K,3500 lb load Single phase
4.8K,2001b load Two phase
1.2K,30001b load Two phase
(1st phase vel change & 2nd phase peak accel)

ADDITIONAL SHOCK TEST CAPABILITIES

Facility Name	Barrel Length (feet)	Breech Chamber Volume (cu ft)	Maximum Accel. (g)	Muzzle Press. (inch) (psig)	Force Acting on Piston, Max. (lb)	Pulse Shape: Single Phase	Pulse Shape: Two Phase	Maximum Specimen: Weight (lb)	Maximum Specimen: Size (lxwxh) (inch)	Elevated or Reduced Temp Capability
21-In. Air Gun	93.3	1.5 to 11.5	2500	-12to90	340,000	X	X	200	19D @ 24L	No
15-In. Air Gun	58	1.4 to 1.8	1700	0 to 90	170,000	X	X	200	11.5D @ 27.5L	No
5-In. Air Gun	73	.05	48,000	0to300	290,000	X		5	3.5D @ 9L	No
2-In. Air Gun	53	.024	200,000	0to1000	47,000	X		.5	1.75D @2L	

NEW YORK TESTING LABORATORIES
SHOCK TEST FACILITIES

REPORTING INSTALLATION: New York Testing Laboratories, Inc. 81 Urban Avenue Westbury, Long Island New York	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Phone: (516) 334-7770

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The primary shock testing capabilities are provided by free fall shock test machines. The shock machines can test electronic and mechanical equipment packages and other aerospace components. Shock pulses may be applied either of the terminal peak or half-sine wave shape. A maximum test package weight of 100 pounds may be tested.

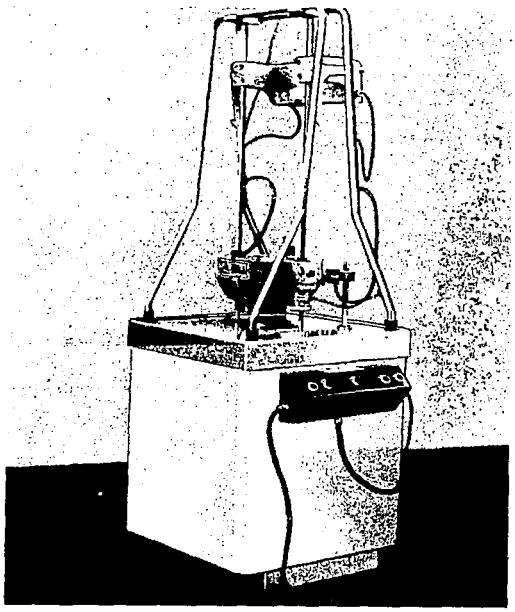
TESTING CAPABILITIES: The shock testing facility is used to qualify and develop aircraft and aerospace components.

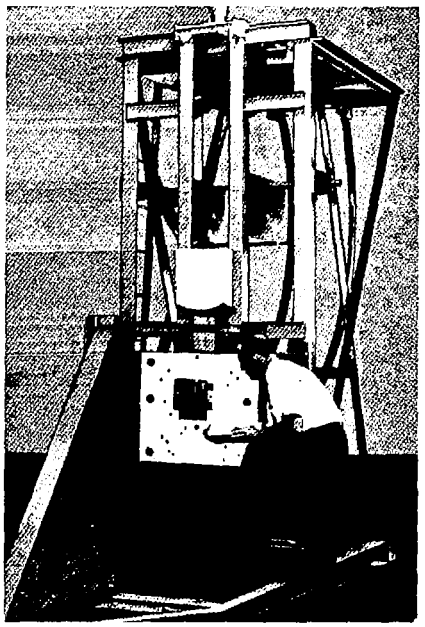
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS:	LOCATION:

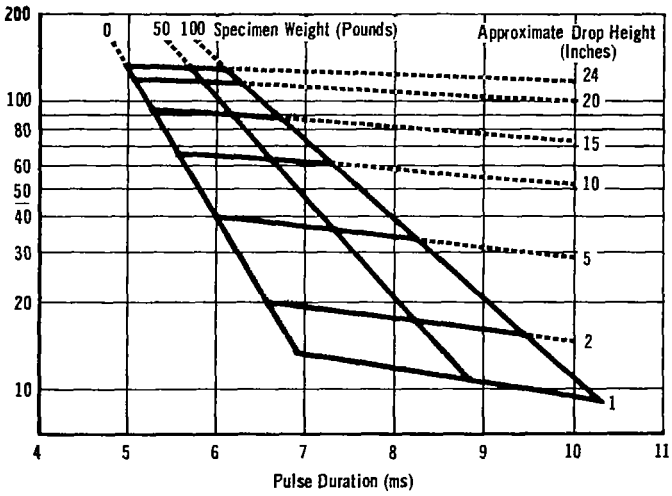
PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC





FACILITY PERFORMANCE DATA



Manufacturer:	AVCO
Model:	SM-010
Type:	Free fall
Maximum Force (g):	1500
Table Size (inch):	12 x 12
Maximum Drop Height (ft):	2
Pulse Shape:	Half-Sine, Saw-Tooth
Pulse Duration (millisec):	5 to 10
Maximum Specimen Weight (lb):	100
Maximum Specimen Size (inch):	12 x 12 x 12
Elevated or Reduced Temperature Capability:	-100 to 250°F

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine				Weight (lbs)	Size (lxwxh) (inch)	
Barry	150-400 VD	Free fall	50g	36 x 36	36 in	X				100	24x24x24	-100 to 250°F

PHILCO-FORD SHOCK TEST FACILITIES

REPORTING INSTALLATION: Philco-Ford Corporation Aeronutronic Division Ford Road Newport Beach, California 92663	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Department
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager Environmental Test Department Phone: (714) 833-1611, ext 1052

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Four separate facilities are available for performing mechanical shock tests. These facilities consist of three pneumatically actuated load columns and one drop table. The Model 347 Hyge is a unique facility which can test specimens from 30 to 3500g.

TESTING CAPABILITIES: The Shock Testing Facilities are used to qualify and develop aerospace and weapon components. One of the pneumatic facilities is specially designed and located to provide transportation shock environment for ordnance and hazardous items.

Data recording systems include memoscopes, oscillographs, and magnetic tape recorders with a total capability of 50 data channels. Response spectra or Fourier transform data are reduced on site by a computer. The typical time cycle for data processing is 24 hours although this can be reduced to two to four hours for priority tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ ESTIMATED REPLACEMENT VALUE $250,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer: Monterey Research Lab

Model: 2424

Type: Free-Fall

Maximum Force (g): 2000

Table Size (inch): 24 x 24

Maximum Drop Height (ft): 8.83

Pulse Shape: Half-Sine, Saw-Tooth

Pulse Duration (ms): .3 to 30

Maximum Specimen Weight (lb): 1000

Maximum Specimen Size (in): 24 x 24 (length is limited to drop height)

Elevated or Reduced Temperature Capability: No

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	1/4 Sine	Square Wave	Saw Tooth	Weight (lb)	Size (lxwxh) (inch)	
Convair-Pomona	347	Pneumatic	500K lb	20 diam	84 in stroke	X	X	X		500	27W x 36H	Yes
C.V.C.	HY 6500	Pneumatic	15K lb	12 diam	10 in stroke	X			X	150	24x24x24	Yes
Seco-Dyn	H8-24-15	Pneumatic	90K lb	20 diam	44 in stroke	X				500	27W x 36H	Yes

TELEDYNE BROWN ENGINEERING SHOCK TEST FACILITIES

REPORTING INSTALLATION: Teledyne Brown Engineering Company 300 Sparkman Drive, Mail Stop 10 Huntsville, Alabama 35807	STATUS OF FACILITY: Active *COGNIZANT ORGANIZATIONAL COMPONENT:* Test Laboratories
OTHER SOURCES OF INFORMATION: None	*LOCAL OFFICE TO CONTACT FOR INFORMATION:* (Same as Reporting Installation) *Phone:* (205) 532-1641

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The shock testing capabilities are provided by both drop shock test machines and an inclined plane machine. The largest machine is rated at 240,000 pounds force. The machines can test electronic and mechanical systems, subsystems, and components. Shock pulses may be applied of the saw tooth, square, and half-sine wave shape. A maximum test package weight of 4000 pounds may be tested. Vibration and shock equipment is positioned on steel reinforced isomode pads to isolate the vibration and shock reaction.

TESTING CAPABILITIES: The Shock Test Facility is used to qualify and develop aircraft and aerospace systems, subsystems, and components. Time histories of acceleration are recorded on tape recorders, oscillographs, or memory scopes.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Acquisition of MIL-5-90K Navy Lightweight Hammer Drop Machine.

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer: Brown Engineering

Model: Not Available

Type: Mechanical (Inclined Plane)

Maximum Force (lb): 240,000

Table Size (inch): 84 x 108

Maximum Drop Height or Travel (inch): 216

Pulse Shape: Half-Sine, Saw-Tooth, Square

Pulse Duration (millisec): 2 to 100

Maximum Specimen Weight (lb): 4000

Maximum Specimen Size (inch): Not Available

Temperature Capability (°F): -65 to 200

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half Sine	Saw Tooth	Square	Other	Weight (lbs)	Size (lxwxh) (inch)	
AVCO	SM030	Mechanical	150K lb	36 x 44	60 in	X	X	X		500	-	-65 to 200°F
AVCO	3	Mechanical	10K lb	12 x 12	24 in	X	X	X		100	-	-65 to 200°F

WYLE SHOCK TEST FACILITIES
(Huntsville, Alabama)

REPORTING INSTALLATION: Wyle Laboratories Huntsville Facility 7800 Governors Drive West Huntsville, Alabama 35800	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: Wyle Laboratories Brochure, "Scientific Services and Systems Group," Eastern Operations, 1970.	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone: (205) 837-4411

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: A variety of shock machines and systems are used not only for various pulses and sized specimens but also for different axes of test to maintain normal attitude on the test article. Several of the machines are located at remote sites for hazardous tests. Memoscopes with cameras, in addition to tape recorders and oscillographs, are used to provide a permanent record of pulse shapes. Frequency domain (shock spectrum) analysis of shock pulses using a digital computer can be provided, which is especially useful in measuring simulation of pyrotechnic separation shocks. Fixtures for shock testing requirements are designed and fabricated by the Wyle staff at the Huntsville facility, minimizing fixturing time. Wave synthesizers are also used in conjunction with vibration exciters to generate many shock pulses, so that vibration and shock testing requirements may be completed using a single test setup and fixture.

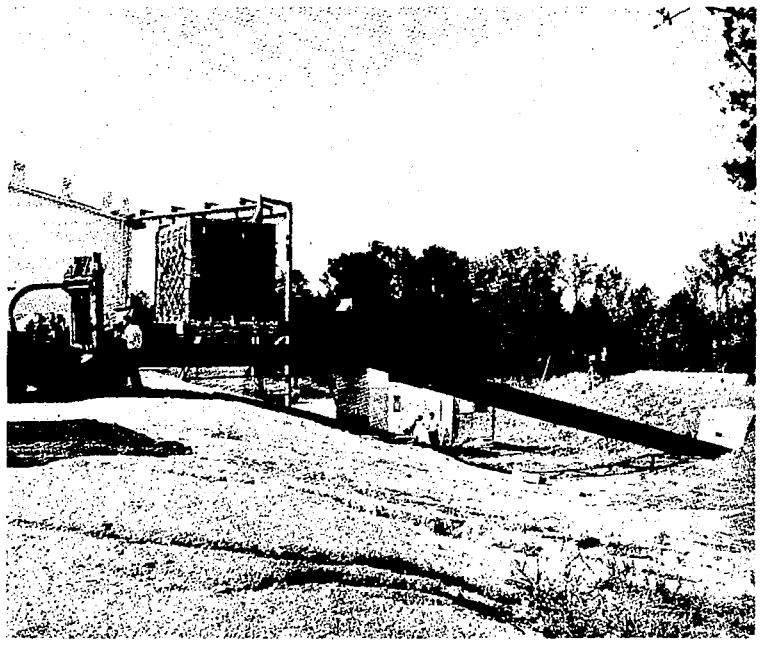
TESTING CAPABILITIES: Wyle-Huntsville facility shock machines are capable of producing shock pulses of widely varying shapes, magnitudes, and durations on test articles of almost any shape or size, from small electronic parts to large systems. Shock pulses associated with transportation, launch, impact, firing, separation, and nuclear blasts can be simulated.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Facility Name:	Inclined Ramp
Manufacturer:	Wyle
Model:	Not Applicable
Type:	Inclined Ramp
Maximum Force (lb):	250,000
Table Size (inch):	144 x 180
Maximum Drop Height or Travel (ft):	40
Pulse Shape:	Half-Sine, Square, Saw-Tooth
Pulse Duration (mil/sec):	.5 to 200
Maximum Specimen Weight (lb):	10,000
Maximum Specimen Size (inch):	144 x 144
Temperature Capability:	None

ADDITIONAL SHOCK TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force (lb) or (g)	Table Size (inch)	Maximum Drop Height or Travel (ft) or (in)	Pulse Shape				Maximum Specimen		Elevated or Reduced Temp. Capability
						Half-Sine	Square	Saw Tooth		Weight (lb)	Size (lxwxh) (inch)	
AVCO			3000g			X	X	X			12 x 12	
Wyle		Drop Tower	500g			X	X	X			36 x 36	
Wyle		Drop Hammer	2000g			X	X	X			20 x 40	
Hyge		Hydro-pneum.	2000g			X	X	X			20 x 20	
		Paral-Pendul	1000			X	X	X			48 x 108	
		Vibr-exciter	40			X						

5. STRUCTURES

AFFDL STRUCTURES TEST FACILITIES

REPORTING INSTALLATION: Air Force Flight Dynamics Laboratory Experimental Branch (FDTT) Wright-Patterson AFB, Ohio 45433	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures Division (FDT)
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Cognizant Installation) Phone: (513) 255-5723 or 5059

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The physical size and magnitude of supporting utilities permits structural testing of full-size vehicles and components with program controlled simulation of force and thermal flight environments from V/STOL through near earth orbit re-entry and on-line processing of many data channels. The functions of the facility are: (1) to provide in-house test support for exploratory and advanced development programs, particularly those conducted by the AFFDL; (2) to provide unique structural test support for current Air Force Weapons Systems when required; (3) to insure that structural test techniques and facilities are available for future Air Force systems. This facility consists of the following: (Test Floor Dimensions) - length 251 ft; width 170 ft; minimum clear height 60 ft. (Cryogenic Fuel Simulation) - 10,000 gal of liquid nitrogen. Controlled electrical power for thermal simulation (radiant heating to +3200°F): 50,400 kVA (5 min) or 25,800 kVA (continuous), (Special Purpose Heat Control Computers) - 110 channels, (High-Speed Data Acquisition and Processing System including CDC 1604B Computer) - 1928 channels. Miscellaneous indicating/recording systems: 770 channels. (Static Load Systems) - 100 channel programmed cyclic load systems: 110 channels, (Experimental RF Induction Heating Loop) - 250 kVA, (Small Theoretical Mechanics Lab) - 1500 ft^2. Facility available to users outside AFFDL by request on selective basis. A written or personal contact will initiate discussions as to capability and availability of facility for desired program.

TESTING CAPABILITIES: The Structures Test Facility is one of the most complete laboratories for conducting structural test programs in existence today. Due to its size and the testing systems incorporated, most of the known environmental parameters experienced by modern and future manned aerospace vehicles can be simulated on either small specimens or large built-up structural components of actual weapon systems. The test laboratory was designed and built as a room temperature test facility for testing aircraft up to and including the size of the B-36. The basic facility was completed in 1944 and the fact that the complete B-36 aircraft was successfully static tested in 1949-1950, while at the same time accommodating the test programs for the B-45 and F-86, illustrates the capability that was designed and built into this structure. Since its completion, more than 80 major systems have been tested, including most of the fighter aircraft produced for the United States Air Force.

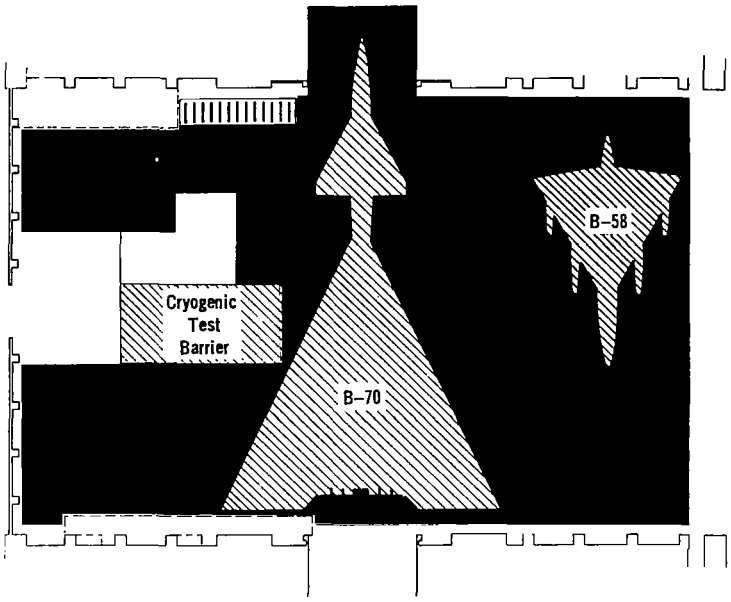
Combined mechanical loading and radiant heat tests simulating ascent and orbital entry conditions can be conducted in real time. Internal cryogenic fuel effects can be simulated with liquid nitrogen, including tank fill, ground hold, and engine usage. Such tests are generally conducted with the test structure in a horizontal position; a limited capability exists to test structures in a vertical position.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Dependent on scope and complexity of program	CONSTRUCTION YEAR: 1944 COST $ * ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: *Total Investment Costs $19,965,000.	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	42,670	415K	160	230	50
Struct. Fatigue	X					
Impact or Drop						
Thermal Shock	X					
Vibration						
Other Cryogenic	X					

No. of Programmable Servo Hydraulic Channels: 86

Size of Floor Available for Testing (ft^2)
(Reinforced): 42,670
(Non-reinforced):

Universal Machines Load Capability (lb): (1) Static Tension & Compression: 14 Metric Tons

Fatigue Test Machines Load Capability (lb): Max 100,000

Radiant Heat System: 3200°F

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability	
			Moment (ft-lb)	Shear (lb)
Floor	251 x 170	42,670		10K **
Ceiling				
Walls	50 x 40		13,000K ***	

**At each corner of 5 x 5 ft grid over entire floor

*Areas used primarily for struct. loads and fatigue testing ***Special fixed strongback

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	166	X	X	Up to ± 65K	5000	Paper tape, magnetic tape, magnetic drum	Permanent Portable	X
Pneumatic					Not Applic.			
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	X
Dead Weight					Not Applic.		Individual Design and Fabrication	

BOEING FRACTURE, STATIC, FATIGUE, STRESS ANALYSIS AND EXPOSURE LABORATORIES

REPORTING INSTALLATION: The Boeing Company Commercial Airplane Group Developmental Center, Bldg 9.101, 9.120 Seattle, Washington 98124	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures Lab Commercial Airplane Group G-8690
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mr. A. H. Kuhn Phone: (206) 655-4377

DESCRIPTION AND TESTING CAPABILITIES

FACILITIES DESCRIPTION: The Fracture Mechanics Laboratory is used to perform fracture mechanics tests on structural materials. The tests conducted in this laboratory include, but are not limited to fatigue crack growth tests, sustained load stress corrosion tests, center notched panel fracture tests, notched bend fracture tests, and charpy impact tests. Capabilities exist for testing specimens in various hot, cold, or corrosive environments. Cyclic tests are commonly run at 120 cpm; however, testing frequencies can range up to 240 cpm. The laboratory produces data used in screening new aircraft materials and in determining design criteria. Testing of some aircraft components is also performed in this facility. Instrumentation is available for but not limited to recording test temperatures, humidities, load rates, strain, crack opening displacements, acoustic emissions, and slow crack growth. The electromechanical test machines are capable of attaining load rates in excess of 1000 Kips/sec. Fracture mechanics data generated in this laboratory is used in all major Boeing aircraft design work.

The Static Test Laboratory uses standard universal static test machines to apply loads to structural materials and aircraft structural components. Accessories are available for measuring and recording load-deflection curves. Testing can be conducted at temperatures down to -300°F through the use of liquid nitrogen-cooled chambers, or up to 1200°F through the use of radiant heat units. The laboratory has the capability of performing mechanical properties tests to determine tension, compression, shear, and bearing properties at all temperatures from -300°F to 1200°F. The laboratory is equipped to conduct standard tests on honeycomb structure to determine face sheet stability, core shear and compression properties, and face sheet to core adhesion. Other types of work include tension and shear testing of fasteners to 1-inch diameter, compression testing of structural elements and component skin-stringer panels, and calibration for flight testing of aircraft components including the main landing gear of the Model 747.

The Fatigue Laboratory is used to perform fatigue tests on aircraft materials, fasteners and structural elements. Constant amplitude as well as programmed load fatigue tests can be conducted. Testing machines with dynamic load capacities ranging from 50 lb to 600,000 lb are available. Capabilities exist for testing specimens at cold and elevated temperatures at a variety of cyclic testing frequencies. The laboratory produces data on research programs involving new materials and new structural assembly concepts. To substantiate new airframe designs, extensive fatigue tests have been carried out on structural joints and fasteners. Test support is also provided for production airplane programs to verify the fatigue integrity. Instrumentation is available for recording strain, test temperatures, fatigue crack initiation, and crack growth. Through the use of electrohydraulic servo systems with a magnetic tape programmer, randomized spectrum fatigue tests have been performed on large size panels in the cyclic frequency range of 2 cpm to 1200 cpm. A wide assortment of test fixtures are available for axial, bending, and torsion fatigue tests on materials and joints.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

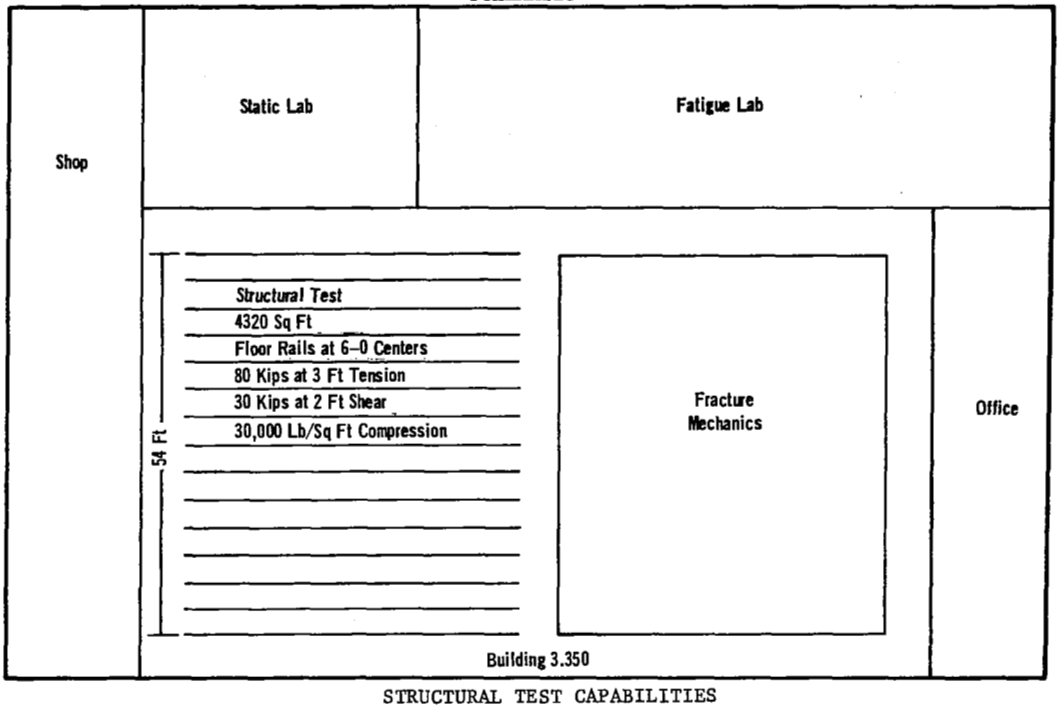
FACILITY DESCRIPTION (CONTINUED):

The Stress Analysis Laboratory (ESA) has the capability to perform structural investigations in the fields of photoelasticity, Moire' interferometry, strain gage technology, brittle coatings, crack detection methods, and structural model (Model Tech) tests. Photoelastic techniques available include two-dimensional models, three-dimensional models using the stress freezing method, and birefringent coatings, using both the wet layup process as well as the cured sheets. Moire' interferometry capability exists for both in-plane strain measurements and out-of-plane deformation mapping. Structural modeling (Model Tech) is a technique in stress analysis using reinforced epoxy models. It reduces costs of making metal prototypes, permits rapid design modifications and reduces flow time and costs of testing, through a reduction in test loads with its attendant lighter loading structure. These models may be analyzed by conventional stress analysis methods, using strain gages and photoelastic coatings. Facilities for mold making, casting, machining, and oven curing are available to this laboratory.

The Exposure Test Laboratory performs long term exposure testing at elevated temperatures with either steady-state or cyclic environments. Structural adhesives, metals, and components can be exposed to simulated service conditions associated with supersonic flight and special contaminants such as circulating or stagnant air, dry salt, salt water, and distilled water. All specimen measurements are made in an environmental controlled room. This laboratory has the capability of performing all types of creep, cyclic exposure, and stress rupture testing. The equipment is capable of automatic round the clock operation, with fail-safe designs to avoid damage to specimens because of power failure or equipment malfunction.

FACILITIES SCHEMATICS AND PERFORMANCE CAPABILITIES CONTINUED ON NEXT PAGE:

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	9200				85
Struct. Fatigue	X	9200				85
Impact or Drop	X	9200				85
Thermal	X	9200				85
Shock	X	9200				85
Vibration	X	9200				85
Other Cryogenic						

Facility Name: Materials Testing Labs

No. of Programmable Servo Hydraulic Controlled Channels: 2

Size of Floor Available for Testing (ft^2)

(Reinforced):	0
(Non-reinforced):	3110 (Fracture Mech. Lab)
	1800 (Static Test Lab)
	4870 (Fatigue Lab)
	1300 (Stress Anal. Lab)
	7610 (Exposure Test Lab)
	18,690 (Total)

Structurally Reinforced Test Areas*				
	Size 1 x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	96 x 96	9200	80,000	100 Kip
Ceiling	96 x 96	9200	None	None
Walls			None	None

*Areas used primarily for struct. loads and fatigue testing

Universal Static Testing Machines Load Capacities: (8), with various load capacities to 1000K lbs

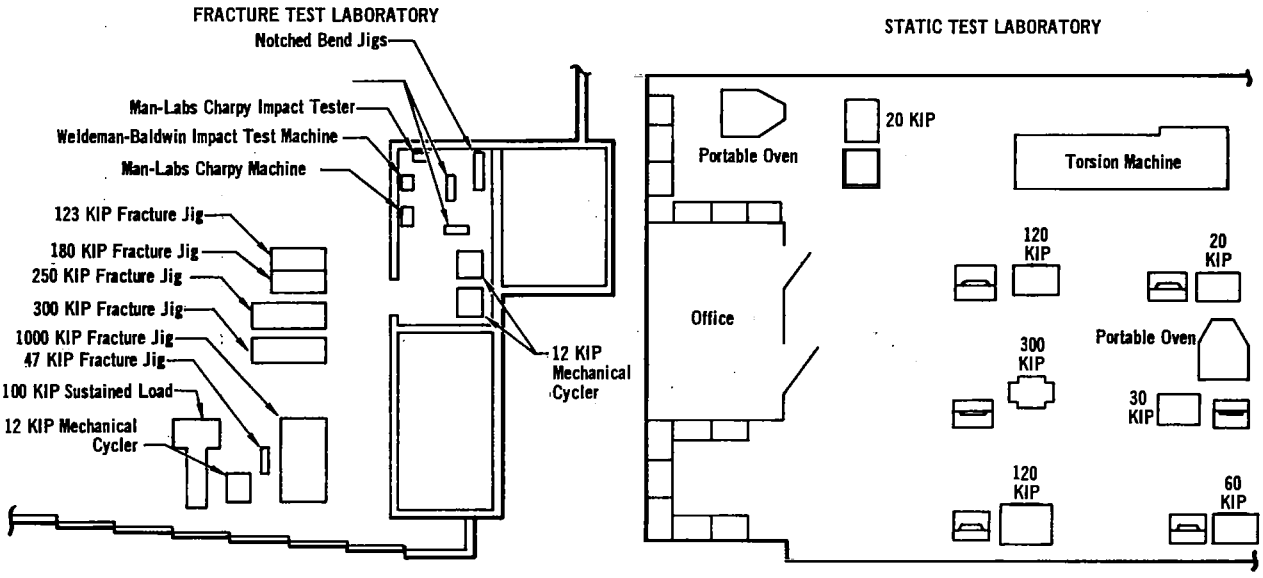
Radiant Heat System: 5000 kVA

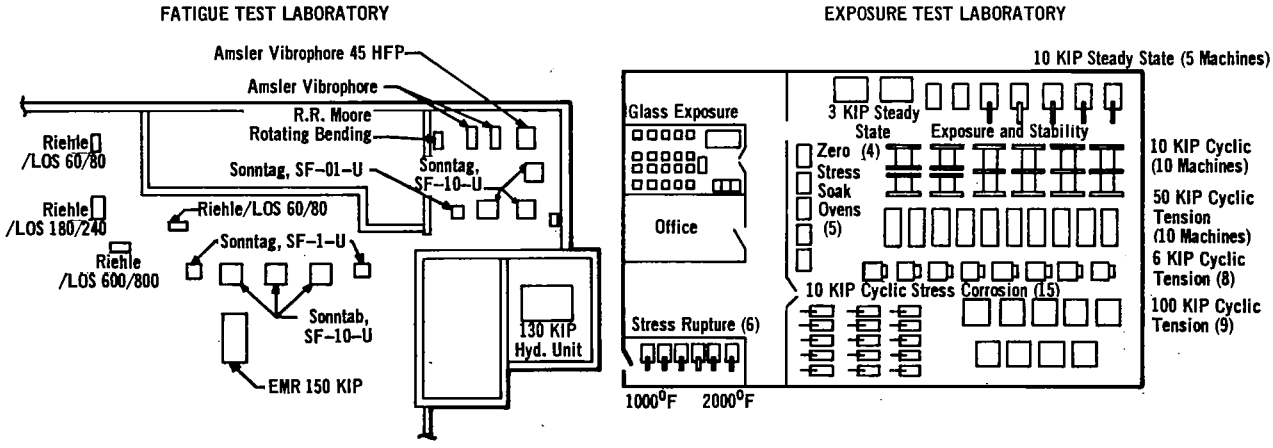
Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, Fatigue

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	N.A.			to 200 Kip	to 50,000		Permanent Portable Pre-Fabricated (Erector-Set Type)	X
Pneumatic								
Electro-Mech.	N.A.	X	18	N.A.	Not Applic.	Computer		
Dead Weight	N.A.	X		to 200 Kip	Not Applic.		Individual Design and Fabrication	X

SCHEMATICS


FRACTURE TEST LABORATORY
Notched Bend Jigs
Man-Labs Charpy Impact Tester
Weldeman-Baldwin Impact Test Machine
Man-Labs Charpy Machine
123 KIP Fracture Jig
180 KIP Fracture Jig
250 KIP Fracture Jig
300 KIP Fracture Jig
1000 KIP Fracture Jig
47 KIP Fracture Jig
100 KIP Sustained Load
12 KIP Mechanical Cycler
12 KIP Mechanical Cycler
STATIC TEST LABORATORY
Portable Oven
20 KIP
Torsion Machine
Office
120 KIP
20 KIP
300 KIP
Portable Oven
30 KIP
120 KIP
60 KIP


FATIGUE TEST LABORATORY
Amsler Vibrophore 45 HFP
Amsler Vibrophore
R.R. Moore Rotating Bending
Riehle /LOS 60/80
Sonntag, SF-01-U
Sonntag, SF-10-U
Riehle /LOS 180/240
Riehle/LOS 60/80
Sonntag, SF-1-U
Riehle /LOS 600/800
Sonntab, SF-10-U
EMR 150 KIP
130 KIP Hyd. Unit
EXPOSURE TEST LABORATORY
10 KIP Steady State (5 Machines)
Glass Exposure
3 KIP Steady State
Exposure and Stability
Zero Stress Soak Ovens (4)
(5)
Office
10 KIP Cyclic Stress Corrosion (15)
Stress Rupture (6)
1000°F
2000°F
10 KIP Cyclic (10 Machines)
50 KIP Cyclic Tension (10 Machines)
6 KIP Cyclic Tension (8)
100 KIP Cyclic Tension (9)

BOEING FULL-SCALE AIRPLANE STATIC AND FATIGUE TEST FACILITY

REPORTING INSTALLATION: The Boeing Company Commercial Airplane Group (CAG) Bldg 40-24 Everett, Washington	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures Lab Commercial Airplane Group G8690
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mr. A. H. Kuhn Phone: (206) 655-4377

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: A 48,000-square-foot structural slab exists in Building 40-24 at the 747 airplane assembly plant in Everett, Washington. The slab can be used for a full-size airplane up to 250 feet long and with a 240-foot wing span, or as a component test facility. The slab is 3 ft 0 in. thick and contains structural floor rails throughout spaced on 6 ft 0 in. centers. The rails are designed to support a tension load of 80 kips perpendicular to the rail centerline at 3 ft intervals. A shear load of 40 kips parallel to the centerline can be supported at 10 foot intervals. A shear load of 30 kips perpendicular to the rail centerline can be supported at 2 ft intervals. The support area consists of 2500 sq ft of shop and 2500 sq ft of space divided into instrumentation, maintenance, quality control, etc. A 5000 sq ft air-conditioned control room overlooks the test area from 30 ft above the slab. The control room can house the hydraulic control and associated instrumentation. An adjacent office area will accommodate 50 people. The test slab is serviced by a 30-ton crane on a 300-ft long craneway. The crane working height is 75 ft off the test floor.

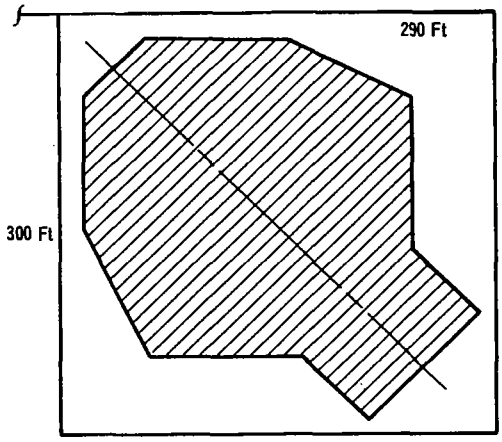
The Fatigue Test Facility consists of a 45,000 sq ft structural slab located outdoors at the 747 airplane assembly plant north of Building 40-24 in Everett, Washington. The slab is suited for full-scale airplane fatigue testing and will accommodate an airplane up to 250 ft long with a wing span of 240 ft. The test slab has the same load parameters as the static test slab except the structural floor rails are spaced at 8 ft 4 in. centers. The operation of the hydraulic actuators is provided by a 1400 GPM hydraulic system with an operating pressure of 4000 psi. A 5000 sq ft air conditioned control room is located in the adjacent building 30 ft above the slab. The control room is equipped with 100 channels of digital programming, signal conditioning, fail safe surveillance, and load monitoring equipment. Adjacent office area will accommodate 25 people. During fatigue test cycling, fuselage air pressurization is provided at the rate of 23,000 CFM for one minute or a continuous supply of 5200 CFM. A support area of 5000 sq ft is available for shop storage, etc. Mobile cranes are readily available.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

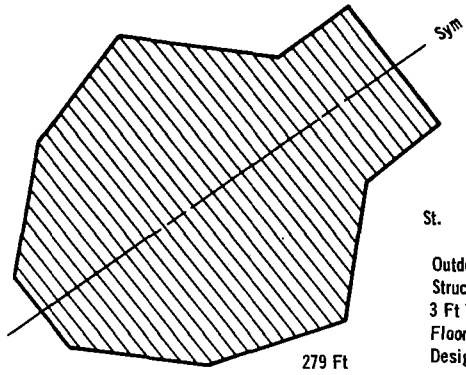
PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



Structural Test Floor
Structural Slab = 48,000 sq. ft.
3 Ft. Thick Reinforced Concrete
Floor Rails at 6 Ft 0 In. Spacing
Design 80 KIPS at 3 Ft 0 Tension
30 KIPS at 2 Ft 0 Shear
40 KIPS at 10 Ft 0 Parallel to Rails

Bldg. 40–24



Outdoor Test Floor
Structural Slab = 45,000 sq. ft.
3 Ft Thick Reinforced Concrete
Floor Rails at 8 Ft 4 In. Centers
Design 80 KIPS at 3 Ft. Tension
30 KIPS at 2 Ft. Shear

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	Static	48,000	800K	250	240	60
Struct. Fatigue	Fatigue	45,000	300K	250	240	60
Impact or Drop						
Thermal						
Shock						
Vibration						
Other						

No. of Programmable Servo Hydraulic Controlled Channels: Not Available

Size of Floor Available for Testing (ft^2):
(Reinforced): 90,000
(Non-reinforced):

Universal Testing Machines Load Capability: Not Available

Radiant Heat System: 5000 kVA

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure Transient, Static, Cyclic Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	240 x 240	90,000	4000	
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	109		X	0 to 500K	0 to 5000	Electro Hydraulic	Permanent Portable	X
Pneumatic	1	X	X		0 to 100	Servo System	Pre-Fabricated (Erector-Set Type)	
Electro-Mech.					Not Applic.		Individual Design and Fabrication	X
Dead Weight				400K	Not Applic.			

BOEING SPACE CENTER STRUCTURAL TEST FACILITY AND MATERIALS LABORATORY

REPORTING INSTALLATION: The Boeing Company Building 18-24 Kent Space Center Kent, Washington	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Labs Aerospace Group
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: C. J. Adriance, Manager Engineering Test Laboratories Phone: (206) 773-5463

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Kent Space Center consists of Environmental chambers which are described in the Environmental section of this report, Structural test and Materials Laboratory. The Structural test facility is a high bay area with a crane, structural floor, data acquisition, and electrical power equipment. The structural floor is built over a full basement to provide support equipment setup area. This provides for maximum utilization of floor space and efficiency of test operations. The loading capability and heating capability available allow service simulation of ground operation, launch (or takeoff), maneuver loading, wind gusts, pressure cycles, landing, etc., on ground vehicles, aircraft and missiles. Cyclic frequencies up to 30 Hz can be programmed. Testing programs have been conducted which required 1300K load application cycles during which frequencies to 10 Hz were programmed.

The Materials Lab has the capability to perform most types of mechanical tests on materials and components. The 8500 sq ft air conditioned laboratory is equipped with Universal test facilities to perform quasi-static tests in tension compression, shear, bending and torsion. Additional facilities perform fatigue, creep, high strain rate, and bearing friction and wear properties on materials and components. A variety of supporting equipment is available for gripping fixturing, environmental measuring and control, deflection and strain measuring, and test parameter recording.

TESTING CAPABILITIES: The Structural test area has been utilized for the calibration of Minuteman interstages for the flight test missiles, Lunar Orbiter, Large Area Solar Array, Burner II and Mars Mission Solar Array. The most extensive usage has been associated with the SRAM project. Tests have been conducted on the F-111 attachment fitting, the B-52 pylon, and the B-52 rotary bomb rack. Tests for the ejection loads of a SRAM launch were simulated as well as static calibrations. Twenty-four hydraulic servo channels can be independently controlled. A multi-channel automatic computer controlled programmer is available for digitally controlling static and cyclic forces applied to a structure. Up to 18 independent points can be loaded on single or multiple items to simulate service conditions.

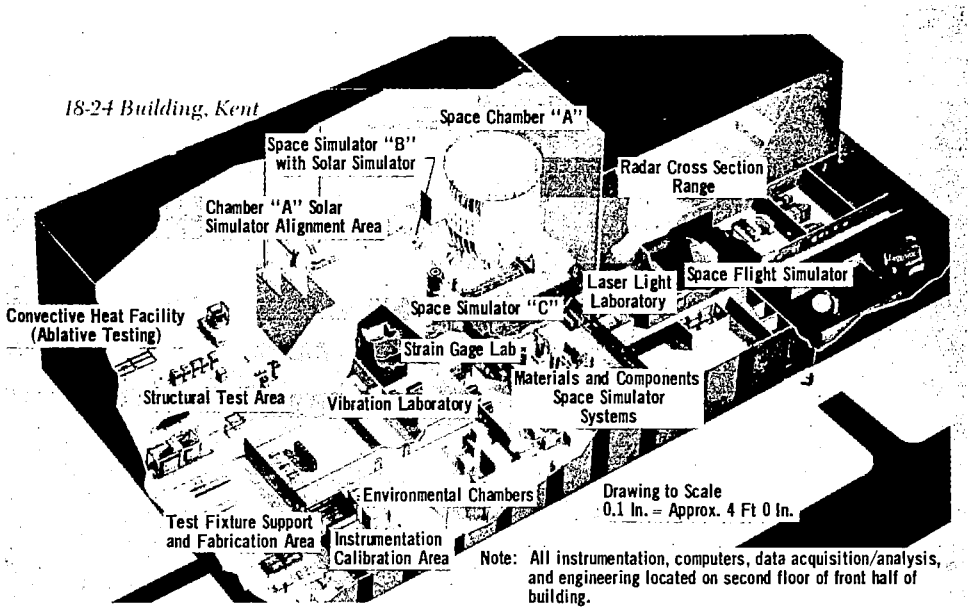
The Materials Lab has 5 universal test machines with loading capacities varying up to 300K lb which can perform quasi-static tests on materials and components in tension, compression, shear, bending and torsion. Fatigue tests can be performed in 7 fatigue machines with capacities ranging up to 350K lb. Tensile creep tests can be conducted in 9 units with loading capacities of up to 30K lb, and 1 Universal creep test machine with a 160K lb tension-compression capability. High strain rate tests at rates up to 10K in./in./sec can be conducted in a Hopkinson bar facility, and intermediate rate tests up to 100 in./in./sec in a 60K lb hydraulic actuated facility. Elevated temperature environments up to 2000°F can be applied to most test facilities, and up to 3000°F on several. Tests at cryogenic temperatures down to -320°F can be conducted within the laboratory, and down to -423°F at a remote site. An MTS control system has been incorporated into the 120 Kip Universal test machine to precisely program and control load, deflection or strain according to a predetermined ramp or cyclic rate. Test data from high speed tests can be recorded by a core buffer data system at rates up to 800K samples/sec in each of 4 channels. A line printer provides "quick look" printout immediately after the test, and a computer formatted digital tape for computerized data reduction can also be obtained.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb) **	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	9200	80K	96	96	85
Struct. Fatigue	X	9200	80K	96	96	85
Impact or Drop	X	9200	80K	96	96	85
Thermal	X	9200	80K	96	96	85
Shock	X					
Vibration	X					
Other Cryogenic	X					

**Per Reaction Point

No. of Programmable Servo Hydraulic Controlled Channels: 40

Size of Floor Available for Testing (ft^2)
(Reinforced): 9200
(Non-reinforced): -

Universal Test Machines: (5), Up to 300K lb load
(1), 160K lb load
Fatigue Test Machines: (7), 350K lb load

Radiant Heat System: 72 channels, 9360 kW
Misc. controllers, 2000 kW

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, Fatigue, Shock

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	96 x 96	9200	80,000	100 kip
Ceiling	96 x 96	9200	None	None
Walls			None	None

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	230Jacks		X	to 200 kip	to 50,000	Computer	Permanent Portable Pre-Fabricated (Erector-Set Type)	X
Pneumatic								
Electro-Mech.	24	6	18	N.A.	Not Applic.			
Dead Weight	N.A.	N.A.		to 200 kip	Not Applic.		Individual Design and Fabrication	X

BOEING STRUCTURAL COMPONENT TEST LABORATORY
(Commercial Airplane Group)

REPORTING INSTALLATION: The Boeing Company Commercial Airplane Group (CAG) Developmental Center, Building 9.101 Seattle, Washington	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures Labs Commercial Airplane Group G-8703
OTHER SOURCE OF INFORMATION: Document No. D-17345, "Strongback Specifications Structural Test Facility"	LOCAL OFFICE TO CONTACT FOR INFORMATION (Same as Reporting Installation) Mr. A. H. Kuhn Phone: (206) 655-4377

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The primary laboratory used for structural testing is located in the southwest corner of the 9.101 building and encompasses an area approximately 190 by 115 feet. The entire floor contains tie-down rails spaced 6 feet on centers, and is designed for single point up loads of 80,000 lb, and single point down loads of 300,000 lb based on 750 psi allowable bearing stress. The allowable shear loading is 40,000 lb per foot normal to the direction of the floor rails and 16,000 lb per foot parallel with the floor rails. The entire laboratory area is serviced by a 10-ton capacity overhead crane. The maximum vertical clearance, floor to retracted crane hook is 35 feet.

A rigid steel wall structure integrally installed with the test floor called a "strongback" is located normal to the floor rails, approximately 30 feet from the end of the test floor. The strongback was designed and built for static and fatigure tests of airplane wing and fuselage sections, but has been used for all types of tests. The strongback is capable of reacting 200,000,000 inch pounds bending moment, 633,000 pounds vertical shear on one face, or a torsion load of 50,000,000 inch pounds. The strongback is 25 feet high, 38 feet wide and is imbedded in a concrete slab 8 feet deep extending 50 feet from both sides. Both faces of the strongback have 2.0 inch diameter holes located on a two-foot grid to provide attachment points for test specimens.

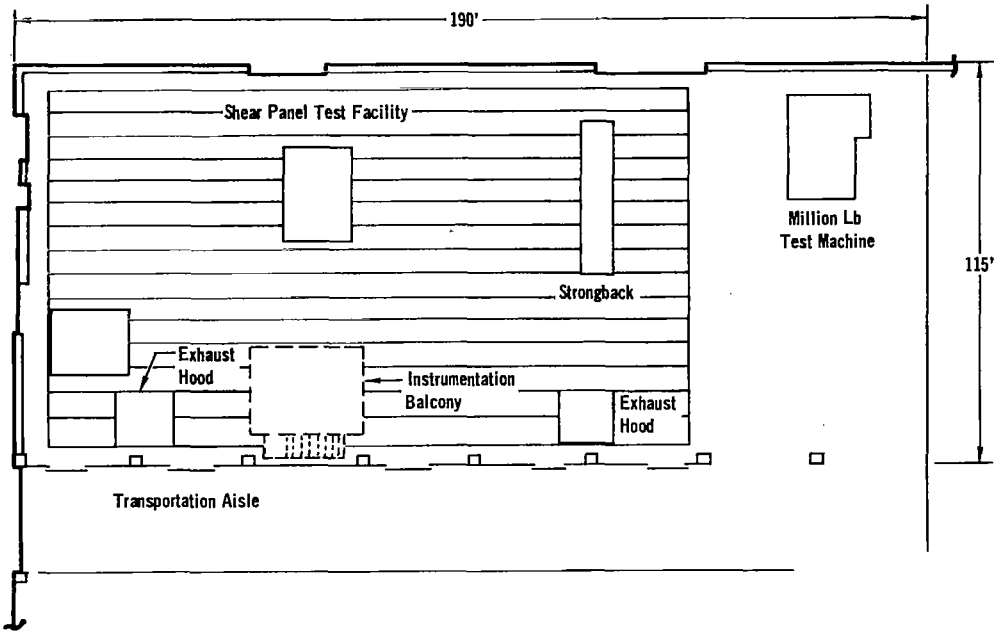
TESTING CAPABILITIES: The wing panel static and fatigue test machines are used to test large wing panels up to 260-inches long and 48-inches wide. The machines consist of structural steel load reaction frames, 11 x 22 1/2 x 42 ft with associated hydraulic actuators, servo valves, shutoff valves, accumulators, load programmers, controllers, strainometers, and load and deflection transducers. Each machine is capable of applying a fatigue load of $\pm$1,000,000 pounds at 60 cycles per minute or a static load of $\pm$1,500,000 pounds. These machines are unique in their load capacity and their ability to simulate wing bending loads. The ends of the panels are free to rotate $\pm$2° when bending loads are applied in phase with axial load. 350 kip capacity resonant beam fatigue machine is an axial load only constant dynamic force mechanical oscillating type machine. The theory of forced harmonic vibrations provides the basis for its construction and operation. Two loading systems (static and dynamic) are used in the operation of this machine. The static load system, a motor driven pump hydraulic system, applies load to the specimen through calibrated springs. The dynamic load, superimposed on the static load, is produced by rotating an adjustable eccentric mass which is driven, through flexible couplings, by a varidrive motor. The capabilities available for elevated temperature testing consists of 4000 kVA of power, 90 channels with 50 kVA/channel control, and 10 channels with 18 kVA/channel control.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Central hydraulic power source.

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X					
Struct. Fatigue	X					
Impact or Drop						
Thermal Shock						
Vibration						
Other						

No. of Programmable Servo Hydraulic Controlled: 3 (loads to 1000K lb)

Size of Floor Available for Testing (ft^2) 21,850
(Reinforced):
(Non-reinforced):

Fatigue Testing Machines
Load Capacities (lbs): (20), 30K-150K

Static Testing Machines
Loading Capacities (lbs): (1), 20K-1500K

Radiant Heat System: 5000 kVA (90 channels w/50 kVA/channel control & 10 channels w/18 kVA/channel control)

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, Fatigue, Shock

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic				0-1500K	3500 Cyclic	10 channels of	Permanent Portable	X
Pneumatic					5000	magnetic tape	Pre-Fabricated (Erector-Set Type)	X
Electro-Mech.	60				Not Applic.	spectral program-	Individual Design and Fabrication	X
Dead weight					Not Applic.	ming (30-120 cpm)		

BOEING STRUCTURAL LABORATORIES
(Wichita, Kansas)

REPORTING INSTALLATION: The Boeing Co. Wichita Division 3801 S. Oliver Wichita, Kansas 67210	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structural Test Laboratories W. K. Hayenga
OTHER SOURCES OF INFORMATION: Boeing/Wichita Division Brochure, "Engineering Laboratory Facilities," D3-4608-5, November 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. D. Scherer, Manager Plant Facilities Phone: (316) 687-4904

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Structural Laboratories have the capability to conduct environmental, dynamic, static, and fatigue tests throughout the range of small material property coupon tests to complete airframe tests of specimens as large as the B-52 airplane. The Elevated Temperature Creep Test Laboratory is an integral part of the structural testing facilities. Emphasis is placed on the allowables of materials useful in structures for high speed flight. Seven creep machines are available with a load capacity each of 20K lbs tension, and elevated temperature capability to 2200°F. The Cyclic Fatigue Test Facility has been used for the B-52 ECP 1128/1185 Airplane Cyclic Test Program. A 25K-sq ft structural loading floor with a 60-ft ceiling clearance provides ample room for the complete airplane. Several enclosed areas within the hangar provide facilities for electronic and hydraulic equipment buildup and maintenance, a hydraulic pumping center, and an electronic load control area. The hydraulic pumping facility is capable of continuously supplying hydraulic oil to the load rams at the rate of 910 gal/min at an operating pressure of 3000 psi. Spectrum loads applied to the airplane are controlled by 64 programmed automatic closed loop electrohydraulic servo systems. Twelve similar automatic-position controlled systems maintain the airplane in test position. Continuous load recorders, crack detection indicators, stroboscopic cameras, and automatic strain gage recorders and plotters are utilized to monitor the specimen. A Fractures Mechanics Laboratory has test facilities available to impose fracture loads of up to 1 million lb on a fracture specimen. Dynamic loads up to a maximum of 425K lb can be applied to a specimen to propagate cracks to the desired length prior to fracture. Shock and vibration capabilities include aeroelastic model vibration testing. Shock tests are conducted using either of two impact type shock machines or an electrodynamic vibration exciter. The Random Vibration Laboratory permits simulation of actual vibrational environments encountered under normal and adverse flight conditions. The existing equipment provides an excellent capability for spectrum shaping, equilization and control of a Gaussian distribution input. Forty-three vibration exciters are available with up to 5000 lb vector force capability for one machine. Static and fatigue testing of airframe structures is accomplished on two structural steel, static test floors of approximately 14K sq ft. Support equipment includes hydraulic rams, ranging in capacity from 3K to 1000K lb, used in both tension and compression tests. Specific components include the 400K lb Universal test machine, and a 10K lb tension testing machine. Fatigue testing equipment range from standard ± 5K lb machines to panel test machines with ± 400K lb capacity. Elevated temperature conditions to 2200°F can be achieved on most test specimens. The 400 Kip machines have random programming capability. The Thermal Test Laboratory has the capability to provide thermal simulation in the temperature range from -320°F through +3000°F. Temperatures above ambient room temperature are obtained through use of radiant heat lamps. Temperatures below ambient are attained by cryogenic mixing techniques utilizing gaseous and liquid nitrogen.

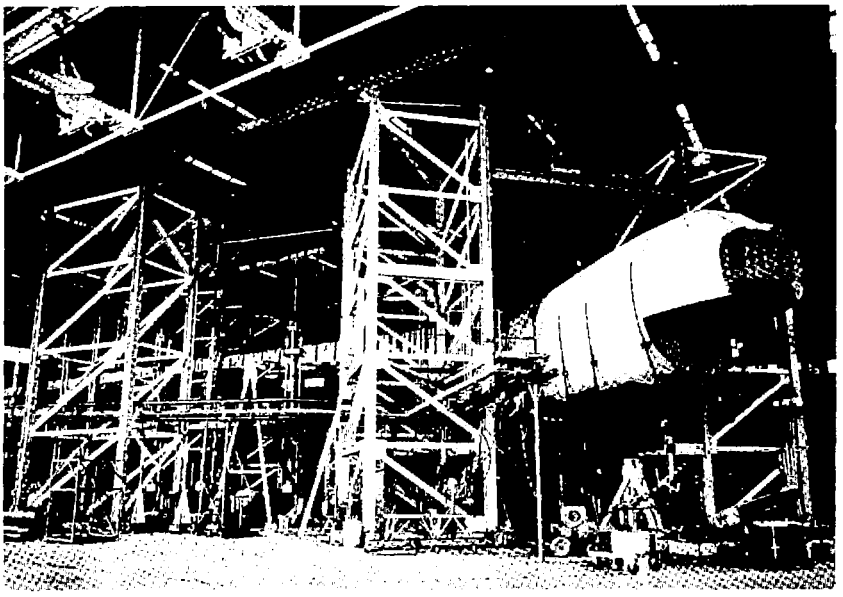
TESTING CAPABILITIES: A data reduction facility is available to provide a rapid, flexible, and economical method of transforming raw data taken from a great assortment of environmental tests into desired units or equivalent standard values for evaluation of test results.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT):	CONSTRUCTION YEAR: COST $7,878,500* ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR: Not Available	LOCATION:

IMPROVEMENTS AND COSTS: *(Creep): Equipment Cost $70.5K, Space Cost $14.3K; (Cyclic Fatigue): Equip Cost $2607K, Space Cost $1842.9K; (Data Reduction): Equip Cost $315K, Space Cost $82.4K; (Photoelasticity): Equip Cost $13.3K, Space Cost $27.5K; (Shock & Vibration): Equip Cost $256.6K, Space Cost $153.4K; (Static & Fatigue): Equip Cost $315.6K, Space Cost $1780.2K; (Strain Instrumentation): Equip Cost $61.2K, Space Cost $9.6K; (Thermal Test): Equip Cost $50K, Space Cost $37K; (Gen. Instrum): Equip Cost $241.6K.

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	(a) 50,100	600K	160	200	55
Struct. Fatigue	X	(b) 49,485	600K	160	150	60
Impact or Drop						
Thermal	X	927				
Shock	X	2511				
Vibration	X	(2511)				
Other Creep	X	358				
Cryogenic						

No. of Programmable Servo Hydraulic Controlled Channels: 64

Size of Floor Available for Testing (ft^2)*
(Reinforced): (a) 24K, (b) 20K
(Non-Reinforced): (a) 26K, (b) 25K
*-2 separate test floors: (a) & (b)

Creep Machines: (7), 0-20K lb Tension
Fatigue Machines: (4), ± 5K-30K lb Mean Load, ± 5K-30K Alternating Load
Hydro-Dynamic
Fatigue Machines: (2), ± 400K lb load capacity @ 30-120 CPM
Load Rams: (300) 3 to 1000 Kip load capacity & strokes to 12 ft
Universal Test Machines: (1), ± 400K lbs
Vibration Exciters: (43), 30-5K lb_f Vector

Radiation Heat System: 80 channels (programmable) 1320 kVA max power

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Static, Fatigue, Cyclic, Transient

Structurally Reinforced Test Areas*

	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor		(a) 24K		
Floor		(b) 20K		

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	64		X		3000	CDC 636 Processor Controller	Permanent Portable	X
Pneumatic							Pre-Fabricated (Erector-Set Type)	
Electro-Mech.					Not Applic.			
Dead Weight					Not Applic.		Individual Design and Fabrication	X

CHRYSLER ENGINEERING TEST LABORATORIES
(Structural Test Facilities)

REPORTING INSTALLATION: Chrysler Corporation Space Division P.O. Box 29200 New Orleans, Louisiana 70129	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Department 2720
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Department 2720 Phone:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of structurally testing large aerospace structures under conditions of static or fatigue loading conditions. Two permanent load reaction frames are available for testing large airframe sections. The main test frame accommodates specimens up to 25 by 25 by 35 feet high. It was designed to have vertical and side load reaction capabilities of six million pounds and one million pounds, respectively. The second test reaction frame handles specimens up to 14 by 14 by 45 feet high. It was designed to have vertical and side load reaction capabilities of one million pounds and 100,000 pounds respectively. The test frames' load-carrying capabilities, however, can be increased to meet any specific loading requirements by adding minor reinforcements. In addition, a modular reaction frame is available for testing hardware of small or irregular shapes and for providing extensions to the two permanent test frames.

TESTING CAPABILITIES: The laboratory hydraulic load control system permits the application of up to 60 loads in simultaneous, predetermined increments during any single test. Approximately 125 hydraulic cylinders and matching load-measuring transducers in selected ranges can simulate any required multiple static-load environment.

Structural test data acquisition is performed by a specially designed analog-to-digital data acquisition system. This equipment handles 800 channels of strain-gauge information and 150 channels of load pressure, temperature and deflection information. All data is recorded automatically and permanently on magnetic tape and can be visually displayed on a special plotting table during test. Data is reduced from the magnetic tape at the nearby Slidell Computer Center where programs provide final data in printout form or as finished plotted curves of the individual channels. There are 24 channels of strip chart and 100 channels of visual readout equipment to support the data acquisition system.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1964-65 COST $500,000* ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR: Chrysler Corp. Space Division IMPROVEMENTS AND COSTS:	LOCATION: New Orleans, La.

* - Note Above: Structural test facilities only.

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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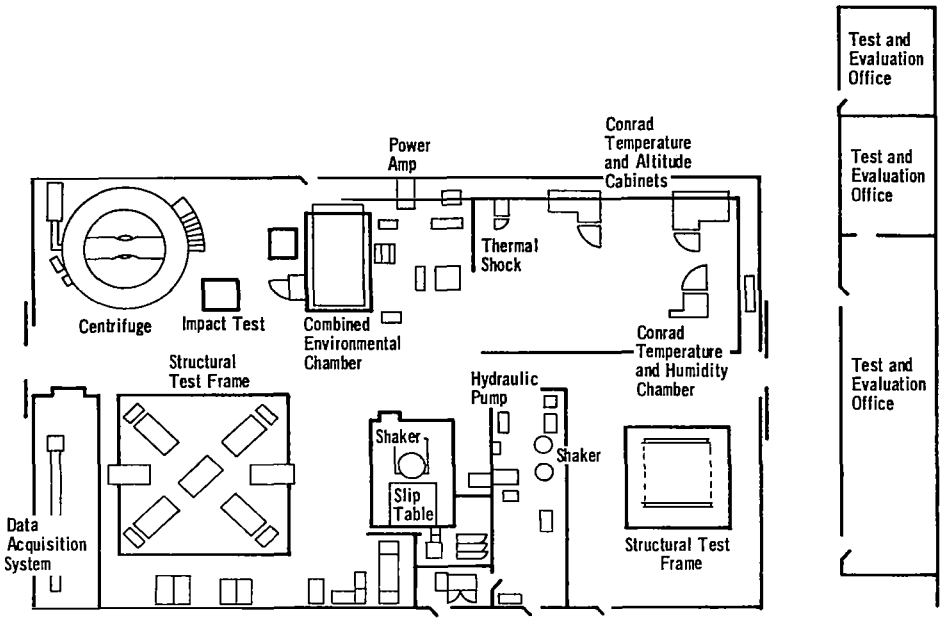


STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	821				
Struct. Fatigue	X					
Impact or Drop	X					
Thermal Shock	X					
Vibration	X					
Other Cryogenic	X	624				

No. of Programmable Servo Hydraulic Controlled Channels: 60

Size of Floor Available for Testing (ft^2)
(Reinforced): 821
(Non-reinforced): 1,742,400

Size of Reaction Frames (ft): (No. 1) 25 x 25 x 35
(No. 2) 14 x 14 x 45

Reaction Frame Load Capacity (lb):
(No. 1) 6 million (vertical)
1 million (side)
(No. 2) 1 million (vertical)
100,000 (side)

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor (a)	25 x 25	625	6000K	1000K
Floor (b)	14 x 14	196	1000K	100K

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles
		Manual	Program			
Hydraulic	60	X	X	0-400K ea	5000	Hydraulic Load
Pneumatic						
Electro-Mech.					Not Applic.	
Dead Weight					Not Applic.	

Type of Structural Test Fixtures Used	
Permanent	X
Portable	X
Pre-Fabricated (Erector-Set Type)	X
Individual Design and Fabrication	X

GENERAL DYNAMICS/CONVAIR STRUCTURES TEST LABORATORY AND CRYOGENIC TENSILE TEST LABORATORY

REPORTING INSTALLATION: General Dynamics Corporation Convair Division P.O. Box 1128 San Diego, California 92112	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: P. T. Gardner A. Hurlich Department 578-00 Department 572000 Phone: (714) 277-8900, ext. 1735 - 1800

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Static tests are conducted in two main areas. Both areas are serviced with utilities, heat power, and instrumentation input panels from an adjacent control building. Building 52, with a total floor area of 200 by 110 feet, is a completely enclosed integral jig: one area 110 by 110 feet with 35 foot clearance; two areas 110 by 45 feet with 56-foot clearance. They contain longitudinal floor tracks on 4-foot centers (10,000 lb/ft load reaction capacity); lateral roof trusses on 15 foot centers (to 225,000 lb per truss); and trussed columns on 15-foot centers (20,000 lb per column). An open slab area has tie-down pads on an 8-by 8-foot spacing with a load capacity of 100,000 lb per pad. Universal hydraulic testing machines of 120,000 and 400,000 pound capacities are used for tension/compression loading. For incremental testing, eight 10-channel Edison load maintainers allow simultaneous loading of 80 different channels. A modular system of jigwork with predrilled beams, fittings, and turnbuckle columns allows rapid fixture setup where required to supplement the integral capabilities above. A variety of hydraulic cylinders with strokes to eight feet and capacities to 200,000 pounds are available. One cylinder has a 1,250,000 pound capacity. Impact tests are conducted with a gun capable of propelling a four-pound bird at speeds to 450 knots. Another gun fires simulated hailstones up to 1 1/4 inch diameter at speeds to 450 knots, or 3-inch hail at terminal velocities. The high bays of Building 52 are used for pendulum swing or straight free-fall drops from heights to 60 feet.

The Cryogenic Laboratory tests mechanical properties of materials (metals, nonmetals, and composites) at moderate and cryogenic temperatures, including the temperature of boiling liquid hydrogen. Testing at -423°F is restricted to an isolated 30 ft x 60 ft laboratory equipped with explosion-proof electrical fixtures and plugs, high capacity exhaust fans, and automatic steel jalousie doors for air intake control. For additional safety, cryostats are connected directly to exhaust vents that discharge gaseous boiloff outside the laboratory. Remote operating consoles are under slight positive pressure to prevent possible hydrogen gas leaks from entering the operator's area. Two tensile test machines (30,000 lb and 60,000 lb Tinius-Olsen) can accommodate tensile, compression, bending, and crack propagation tests at -423°F. One is equipped with an automatic cyclic device that accommodates fatigue testing at six cycles per minute. Liquid hydrogen is transferred to cryostats (including a special container equipped with a 5 in. diameter window for visual observations) by either 150 litre dewars or by a direct-fill line drawing liquid from a 1000 litre trailer outside the laboratory.

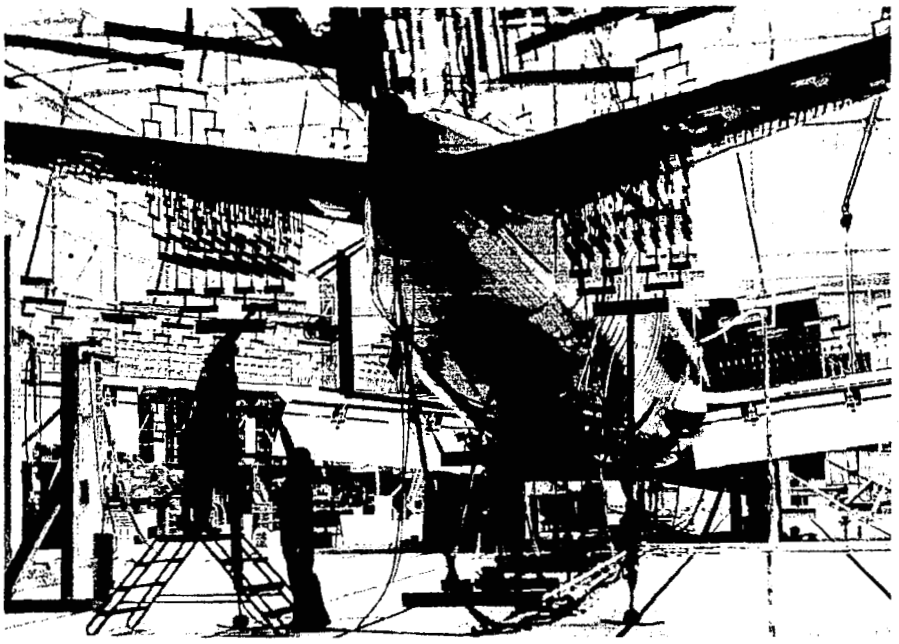
TESTING CAPABILITIES: The Convair division was the first company to determine materials properties at -423°F and was the first to obtain visual crack growth data on sheet materials at -423°F. Over 15,000 tests have been performed at cryogenic temperatures in support of such programs as Atlas ICBM, SLV, and Centaur as well as various research programs in materials evaluations.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	33,700	100K	120	130	45
Struct. Fatigue	X	22,000		120	130	45
Impact or Drop	X	9,900		75	65	17
Thermal Shock	X	22,000		120	130	45
Vibration						
Other Cryogenic	X					

No. of Programmable Servo Hydraulic Channels: 96

Size of Floor Available for Testing (ft^2)
(Reinforced): 33,700
(Non-reinforced):

Universal Testing Machines
Load Capability (lb): 600,000
120,000

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient Static, Cyclic, Fatigue, Low Temperature

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
Floor	220 x 110	11,700	Unlimited	
Ceiling			1,500,000	
Walls			250,000	

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	3		3	0-Unlimited	0-3000	Digital Tape	Permanent	X
Pneumatic	-		-			Analog	Portable	
Electro-Mech.	5		5	0 - 30,000	Not Applic.	Preset Counter	Pre-Fabricated (Erector-Set Type)	
Dead Weight	-		-		Not Applic.		Individual Design and Fabrication	

GENERAL DYNAMICS/FORT WORTH STRUCTURAL TEST FACILITIES

REPORTING INSTALLATION: General Dynamics Corporation Engineering Test Laboratories Fort Worth, Texas 76101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager of Engineering Test Laboratories Phone: (817) 732-4811, ext 2204

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory is one of six laboratories comprising the Engineering Test Laboratories. The capability exists for conducting static and fatigue tests of large airframe structures including complete structural airframes. Approximately 33,000 sq ft of covered floor area is available for structural testing purposes. Of this area approximately 21,000 sq ft has a clear height of 60 ft and the remainder a clear height of approximately 27 ft. A 10-ton overhead traveling crane covers the area with the 27 ft clear height. All test fixtures are self contained and shop fabricated. No load reacting floors or walls are available. All loading is applied with hydraulic cylinders or actuators. A photoelasticity lab is available with capabilities for photo-stress analysis and photoelastic model analysis for standard, frozen, and scattered light techniques.

TESTING CAPABILITIES: This facility is capable of the following types of load simulation: airloads distributions, inertia, mechanical, pressure, transient, static, cyclic and fatigue. Low and high temperature environmental conditions can be provided. Load control is manual or automatic by single channel or by groups of channels as required. In addition, five computer controllers are available with a total of 42 channels of control. Hydraulic capacity of approximately 855 gpm with pressures up to 5000 psig are available. Normal operating pressure is 3500 psig. The Central Data System consists of digital readout on punched paper tape, 1600 channels of readout, sampling rate 10 channels per second. Computer data reduction with print out and plotting. A portable data system consists of two digital systems, 1500 channels each with six channels-per-second sampling rate with punched paper tape output.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Based on costs for definable pkg. of work.	CONSTRUCTION YEAR: 1951 COST $ Not Available ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR: General Dynamics Corporation	LOCATION: Fort Worth, Texas

IMPROVEMENTS AND COSTS: (1961) 1,000,000 lb Universal Test Machine, Cost $150,000; (1967) Floor trenches with hydraulic lines for centralized hydraulic pumping and distribution, Cost $75,000; (1965 to 1970) Photoelastic analysis capability, Cost $25,000; (1960 to 1970) Equipment acquisitions such as hydraulic cylinders, servo controllers, computer controls, etc., Cost $700,000.

PLANS FOR FACILITY IMPROVEMENTS: Expansion of centralized hydraulic pumping and distribution system, acquisition of 2,000,000 lb fatigue machine, additional equipment acquisitions as required.

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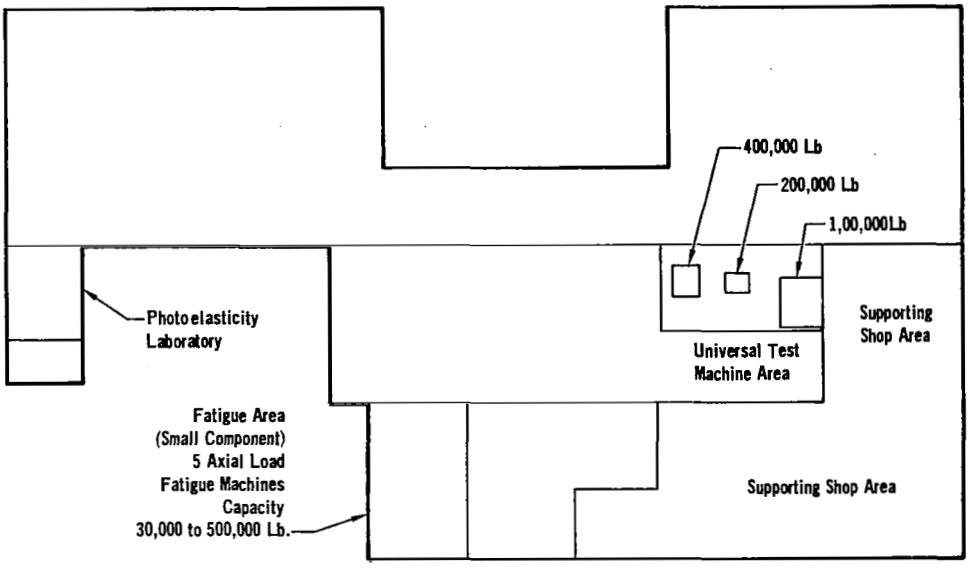

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	30,000	Smallest			40
Struct. Fatigue	X	30,000	Components			40
Impact or Drop			to Full			
Thermal Shock			Aircraft			
Vibration						
Other						

No. of Programmable Servo Hydraulic Channels: 162

Size of Floor Available for Testing (ft^2)
(Reinforced): None
(Non-reinforced): 30,000

Universal Test Machines Load Capability (lb): 1,000,000; 400,000; 200,000

Types of Loads Simulated: Airloads, inertia, mechanical, pressure, transient, static, cyclic, fatigue, low and high temperature environments

Structurally Reinforced Test Areas*	Size 1 x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	None			
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Electro-Hyd.	162	X	X	500,000	3500	Function Generator or Computer	Permanent Portable	
Pneumatic					Not Applic.		Pre-Fabricated (Erector-Set Type)	
Electro-Mech.					Not Applic.		Individual Design and Fabrication	X
Dead Weight								

GRUMMAN STRUCTURAL TEST FACILITIES

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Grumman Aerospace Corporation Structural Test, Department 360 Bethpage, L.I., New York	COGNIZANT ORGANIZATIONAL COMPONENT: Structural Test Department 360
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) Phone: (516) 575-2346

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Structural test facilities provide for a full range of static, drop, and fatigue tests of actual aircraft and spacecraft to demonstrate the compliance of vehicle and component structures with pertinent specifications such as MIL-A-8867, MIL-A-8629, and MIL-D-8706. Test activities also include development and qualification testing on aircraft ejection seats. Hydrostatic tanks are used to subject pressurized vehicles to ground and flight loadings, and may also be used in conjunction with hydraulic loading equipment which generates the applied forces to static and fatigue specimens. The overall laboratory offers general flexibility in its capability for conducting many development and qualification tests simultaneously. While some structures are being tested round-the-clock, other specimens are in various stages of preparation.

The structural test facilities also include an Experimental Mechanics Laboratory for development and evaluation of structural designs and fabrication and processing methods. Specialized testing includes programmed temperature and load inputs and experimental stress analysis utilizing stresscoat and strain gage techniques. A Photographic Laboratory is available for application of photoelastic, interfermetric, and holographic techniques to the solution of design problems.

In the northwest portion of Plant 5, the Structural Test Laboratory occupies two hangars which provide more than 43,000 square feet of floor space and can accommodate the testing of eight medium-size aircraft simultaneously. Many of the smaller components tested are set up wherever ample space allows. The unique floor construction of the hangars consists of a grid of steel rails embedded in four-and-one-half feet of concrete reinforced to resist 50,000 pounds at any single tie-down location. These test platforms serve as bases for mounting test articles and as hard points for attaching loading devices. The hangar doors are manually operated and when fully open provide a 119-foot wide by 27-foot high door opening. The north hangar has a 30,000 pound capacity overhead crane with inching controls, and a fixed hoist 37 feet above the floor with a 60,000 pound capacity. The south hangar has a 20,000-pound capacity overhead crane with inching controls, and a fixed hoist 27 feet above the floor with a 50,000 pound capacity.

TESTING CAPABILITIES: Data are recorded with 720 channels and AVCO Digital System and D.C.S. Analog System with on site reduction capability.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC

(Not Available)

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	59,000		40	50	15
Struct. Fatigue	X	59,000		40	50	15
Impact or Drop	X	5,000	60K	40	50	15
Thermal						
Shock						
Vibration						
Other						

No. of Programmable Servo Hydraulic Controlled Channels: 70

Size of Floor Available for Testing (ft^2)
(Reinforced): 18,000
(Non-reinforced): 41,000

Universal Testing Machines Load Capability (lb): 400,000

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor		18,000	50,000/ft	
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	20	4	16	Variable	0 to 3000	Punched Tape	Permanent	X
Pneumatic	1				0 to 15		Portable	X
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	X
Dead Weight					Not Applic.		Individual Design and Fabrication	X

LTV MECHANICAL PROPERTIES LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
LTV Aerospace Corporation Unit 2-59900 P.O. Box 5907 Dallas, Texas 75222	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. R. Raven, Chief Structures and Systems Labs, Unit 2-59900 Phone: (214) 266-5764

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This 2500-square foot facility has the capability of static and fatigue testing structural components or mechanical property specimens. Five tension-compression test machines, 5 creep test machines, and 5 electro-mechanical fatigue machines are available. The Laboratory contains a hydrodynamic test facility which provides the marine equivalent of a wind tunnel for sustained water velocities up to 100 knots. Also available is a radiant heat facility consisting of a three-channel programming circuit and ignitron power controller which supplies up to 1050 kVA to a series of radiant emitters.

TESTING CAPABILITIES: The mechanical test laboratory has been used to qualify structural components of the F-8, XC-142, A-7, and 747 aircraft, as well as material property specimens. The tension-compression test machines have capacities ranging from 20,000 pounds to 300,000 pounds; the fatigue machines have maximum cyclic ranges up to 20,000 pounds; and the creep machines are capable of applying 30,000 pounds. The hydrodynamic test facility is capable of maximum rotating speeds of 325 rpm, resulting in water velocities up to 100 knots and imparting 220 g's centrifugal acceleration to the test specimen. Instrumentation is available, including photography, to study lift, drag, and cavitation. The radiant heat facility is capable of supplying 1050 kVA continuous. The maximum heat flux available is approximately 70 Btu/ft^2 sec. This facility has been used to test the heat shield for the Apollo guidance system.

The instrumentation data acquisition system includes Non-Linear Systems, Inc. Models 24397 and 24399 for data recording. Sixteen hundred data channels are available with a maximum sampling rate of 10 samples/second. A 360 Triplex computer is used for data reduction. The typical time cycle for data processing is 8 hours.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Depends on scope and type of test	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $50,000
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available *Cost includes equipment only	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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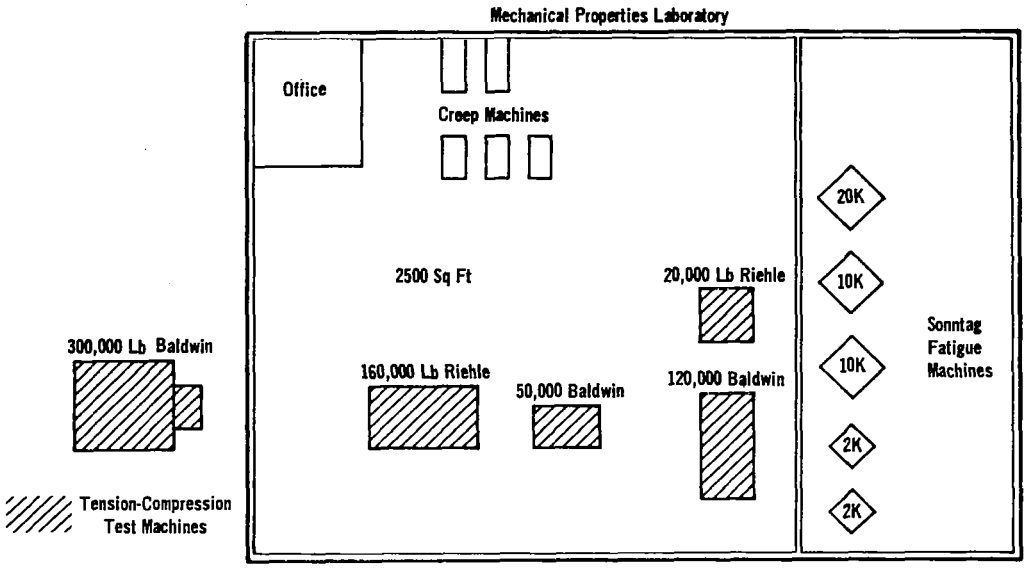

STRUCTURAL TEST FACILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	2500	1000	12	2.5	6
Struct. Fatigue	X	2500	20	1.8	1	1
Impact	X	100	-	.03	.03	.25
Thermal Shock	X	400	500	10	4	4
Vibration						
Other Hydro dyn	X	900	-	.5	.5	.1

Size of Floor Available for Testing (ft^2)
(Reinforced): -
(Non-reinforced): 2500

Creep Test Machines: 5, 30K lb load

Fatigue Test Machines: 5, 20K lb , 1800 cpm

Static Tension-Compression Machines: 5, ±20K-300K, 10 cpm

Radiant Heat System: 1050 kVA(5 min. max.)
525 kVA(Continuous)

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic and Fatigue

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	5	X		0-300,000	Unknown	-	Permanent	X
Pneumatic							Portable	
Electro-Mech.	5	X		0-20,000	Not Applic.	1800 Hz	Pre-Fabricated (Erector-Set Type)	
Dead Weight	5	X		0-30,000	Not Applic.	-	Individual Design and Fabrication	X

LTV STRUCTURES TEST LABORATORY

REPORTING INSTALLATION: LTV Aerospace Corporation Unit 2-59900 P.O. Box 5907 Dallas, Texas 75222	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. R. Raven, Chief Structures and Systems Lab's, Unit 2-59900 Phone: (214) 266-5764

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of structurally testing aircraft and aerospace structures under static and fatigue conditions. In addition, a mechanical test area exists where small structural components or special specimens are static and fatigue tested. An 8900-square foot reinforced concrete test floor is available. It is capable of reacting vertical loads of 100,000 pounds and horizontal loads of 50,000 pounds at a point. Ceiling clearance in the high bay area is 45 feet. Test loads are primarily applied by hydraulic loading cylinders.

The Wing Pivot-Joint Test Facility which is part of the Structures Test Laboratory has the capability of testing full-scale variable geometry wing configurations under conditions of static and complex load/sweep fatigue spectrums. Primary wing loads up to $\pm$ 250,000 pounds can be applied with servo-controlled actuators which are anchored to a movable loading truss. The loading truss and test article position are controlled by servo-controlled sweep actuators capable of precisely varying both the rate and arc of sweep. The facility is equipped with a thermal test box which provides a thermal environment of + 2000°F to -60°F (can be used for both static and fatigue conditions). The servo-controlled actuators are controlled by a digital computer capable of being programmed to complex load/sweep spectrums. The facility is equipped with a hydraulic power source capable of delivering 175 GPM.

TESTING CAPABILITIES: This laboratory has been used to structurally qualify the F8, XC-142, and A-7 aircraft and the Scout space research missile. Static as well as fatigue tests have been performed on the F8 and A7 series aircraft. Five tension-compression test machines are available with capacities ranging from 20,000 pounds to 300,000 pounds. Five fatigue test machines with maximum cyclic ranges up to 20,000 pounds are available in the Mechanical Test Laboratory. The Wing Pivot Joint Test Facility has been used to structurally verify and qualify the full-scale F-14A wing pivot joint.

The instrumentational data acquisiton system includes Non-Linear Systems, Inc. Models 24397 and 24399 for data recording. 1600 data channels are available with a maximum sampling rate of 10 samples/second. A 360 Triplex computer is used for data reduction. The typical time cycle for data processing is 8 hours.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Depends on scope of test**	CONSTRUCTION YEAR: COST $860,000 ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: * - Cost includes equipment only; $500,000 of the total is for the Wing Pivot Joint Test Facility and that cost is for test jig and equipment only.

** - $2500 for Wing Pivot Joint Test Facility.

PLANS FOR FACILITY IMPROVEMENTS: Computerized data reduction system to be operational by 3rd qtr. (1970)

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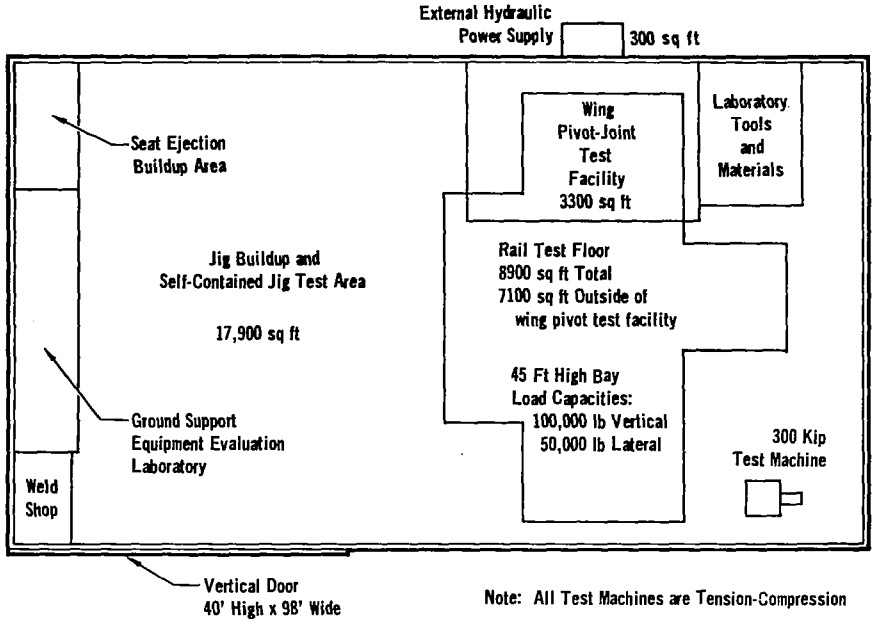

STRUCTURAL TEST CAPABILITIES

Type Testing Capability	Indicate Types of Testing Avail.	Floor Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	8900	39K	70	68	26
Struct. Fatigue	X	8900		51	46	21
Impact or Drop	X	3300	39K	70	68	26
Thermal Shock						
Vibration						
Other	X	8900	40K	70	68	26

No. of Programmable Servo Hydraulic Controlled Channels: 8

Size of Floor Available for Testing (ft^2)
(Reinforced): 8900
(Non-reinforced): 17,900

Tens-Comp Testing Machines: (5)$\pm$ 20K 300lb_f
Fatigue Test Machines: (5),20K lb_f (cyclic)

Wing Pivot-Joint Loads Capacity
Max Primary Loads (lbs): $\pm$250,000
Max Wing Sweep Loads(lbs):$\pm$ 50,000

Maximum Wing Pivot-Joint Thermal Environment (°F): -60 to + 2000

Type of Loads Simulated: Airloads, Inertia, Pressure, Static, Cyclic, & Fatigue

Structurally Reinforced Test Areas*				
	Size 1 x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	130 x 68avg.	8900		100,000
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program				Permanent	X
							Portable	
Hydraulic	118	110 ca	8Channels	250,000	0-5000	Computer Driven	Pre-Fabricated (Erector-Set Type)	
						Generators (1-20Hz)		
Electro-Mech.	5	X		0-20,000	Not Applic.	30 Hz	Individual Design and Fabrication	X
Dead Weight	5	X		0-30,000	Not Applic.			

MCDONNELL DOUGLAS ENGINEERING DEVELOPMENT CENTER

REPORTING INSTALLATION: McDonnell Douglas Corporation Douglas Aircraft Company 3855 Lakewood Blvd. Long Beach, California 90801	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Flight and Laboratory Development
OTHER SOURCES OF INFORMATION: McDonnell Douglas Brochure, "Flight and Laboratory Testing Facility Description"	LOCAL OFFICE TO CONTACT FOR INFORMATION: T. H. Abrahams, Manager, Testing Facilities Phone: (213) 593-4630

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The new Engineering Development Center (Building No. 41) is being used to conduct the structural test program for the DC-10. The main test structure is a hangar which has a clearance of 325 by 325 by 100 feet high and provides adequate space to house two DC-10 airplanes simultaneously. A noteworthy feature of the building is the cross-hatched network of reinforced pilings installed flush with the floor level, and having provisions for attaching test-jig beams or loading fixtures and "strong points" for load reactions and supports for overhead test structures. Utilities are distributed on the hangar floor via a trench and pit system. Adjacent to the hangar is a three-story 150 by 300 foot office building for Flight and Laboratory Development Management and Engineering personnel. Since static test and fatigue test programs are conducted concurrently, the laboratory is provided with all facility and equipment items necessary to conduct independent test programs. The floor area accommodates the complete fatigue test airframe and several fatigue test sections. A master test control center, including the hydraulic servo control system logic equipment, is housed in the building overlooking the test area. A central hydraulic pressure supply provides the required high-pressure high-volume fluid flow for effective operation of the servo loading system. In addition, a high-volume, low-pressure air system is used for static and fatigue testing.

TESTING CAPABILITIES: Structural testing of large parts or assemblies is accomplished by using hydraulic jacks to apply loads while the specimen is restrained by steel beam structures. Approximately 500 jacks (rated at 3000 psi) ranging in size from one-square-inch pistons with 8 inch stroke to 20-square-inch pistons with a 36-inch stroke are available. Included are special utilization jacks having an 8 foot stroke. These jacks are normally powered by a 1600 gal/min, 3000 psi hydraulic power units. Within the inventory are 35 gal/min, 3000 psi portable hydraulic power units. Either MIL-H-5606 or Skydrol hydraulic fluids are available. A 60,000 CFM centrifugal blower with a maximum output pressure of 11.7 psi delivers air for fatigue test purposes to the hangar through a 30 inch diameter pipe. The 1000 Channel Data Acquisition System used in structural testing is divided into five portable data stations which can be located in the hangar as desired and are tied to the Data Processing Center. Computers in the Processing Center are used to furnish on-line reduced data and to generate driving functions for fatigue spectrums on test specimens. Analog data inputs can be sampled at rates up to 20,000 data points per second. Plotters are available to provide graphic data on selected channels for instantaneous evaluation as testing progresses.

Other capabilities in Building No. 41 include a System Simulation Laboratory which is used to establish mathematical models of aircraft systems using experimental data (such as Wind Tunnel Test results) and dynamic equations supplied by design engineering. A medium sized hybrid computer and numerous analog computers are used in the simulation activities. Also located in the EDC is the Digital Data Ground Station whose computers will gather data from aircraft in-flight and instantaneously reduce and plot the data in graphic form on large TV-like screens. Satellite shops in the immediate area include Calibration Facilities, Aircraft Flight Simulators, and Machine Shops.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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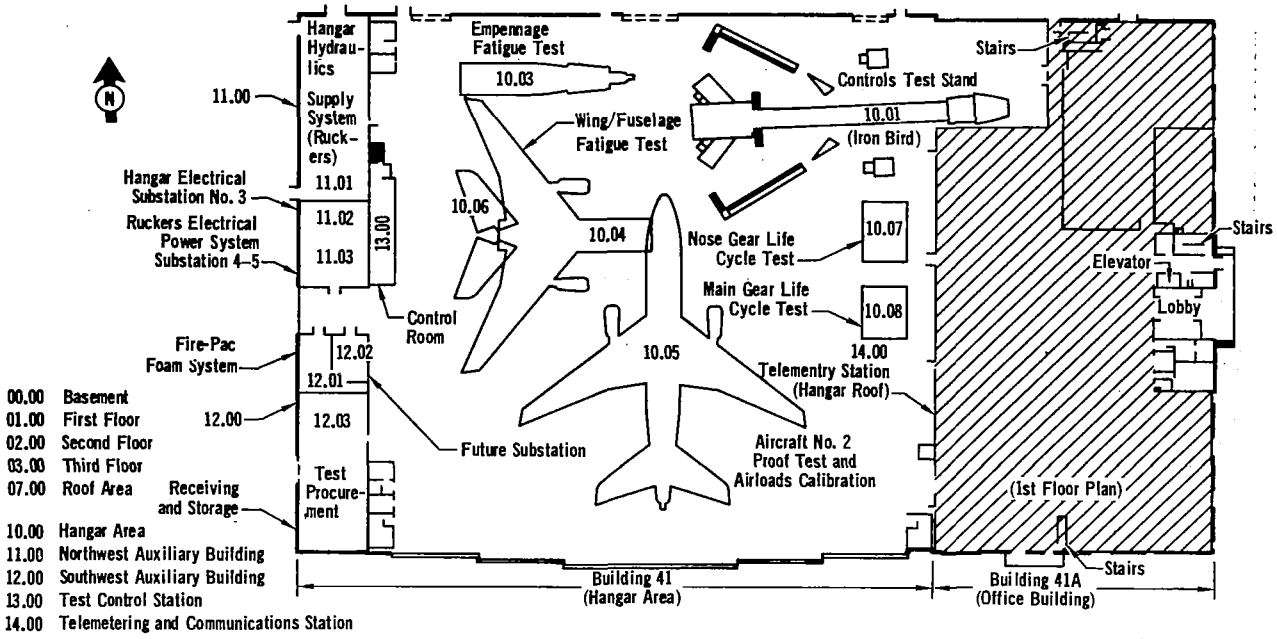

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X					
Struct. Fatigue	X					
Impact or Drop			60K			
Thermal Shock						
Vibration						
Other				20		

No. of Programmable Servo Hydraulic Controlled Channels: 500

Size of Floor Available for Testing (ft^2)
(Reinforced): 45,320 (approx)
(Non-Reinforced): 105,625

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	500		X		0-3000		Permanent	X
Pneumatic					Not Applic.		Portable	
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	
Dead Weight							Individual Design and Fabrication	

MCDONNELL DOUGLAS STRUCTURES LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Aircraft Company P.O. Box 516 St. Louis, Missouri 63166	COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of structurally testing large aerospace or aircraft structures under conditions of static or fatigue loading conditions. A reinforced floor (90 ft by 150 ft) is available that can react vertical point loads of 100,000 lb, and lateral loads of 50,000 lb on 10 ft centers. Specimens with heights up to 35 ft can be tested. Loads are primarily applied by hydraulic loading cylinders.

TESTING CAPABILITIES: The laboratory has been used to structurally verify and qualify the F-101 and F-4 aircraft and the Mercury and Gemini spacecraft. Extensive fatigue tests have been performed on the complete F-4 airframe. A fatigue test machine capable of applying 150,000 lb cyclic tension and compression loads is available. Over 600 channels of strain, deflection, pressure, temperature, acceleration, and load may be simultaneously monitored and recorded by the Central Data Acquisition System. An additional 228 channels may be recorded with portable systems.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1958 COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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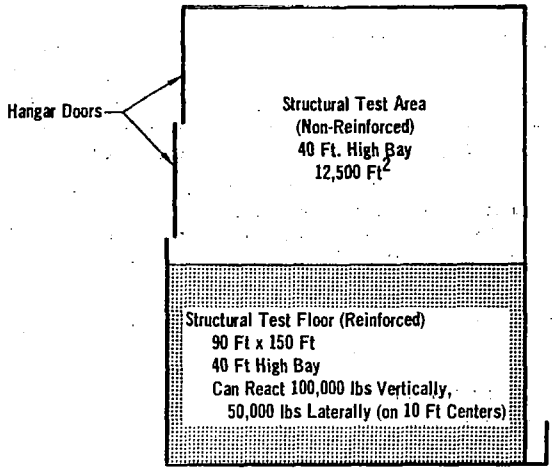


STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	12,500				
Struct. Fatigue	X	26,000				
Impact or Drop	X					
Thermal	X					
Shock	X					
Vibration	X					
Other						

No. of Programmable Servo Hydraulic Channels: 40

Size of Floor Available for Testing (ft^2)
(Reinforced: 13,500
(Non-reinforced): 12,500

Fatigue Test Machine: (2), 150K lb cyclic tension-compression
(1), 300K lb cyclic tension-compression

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	90 x 150	13,500	100,000	50,000
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Elec-Hydraulic	40	X	X		3000	Perf./Mag Tape	Permanent Portable	X
Pneumatic							Pre-Fabricated (Erector-Set Type)	X
Electro-Mech.							Individual Design and Fabrication	X
Dead Weight								

MCDONNELL DOUGLAS STRUCTURES TEST LABORATORY

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Douglas Astronautics/Space Systems Center 5301 Bolsa Avenue Huntington Beach, California 92647	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Structures Laboratory
OTHER SOURCES OF INFORMATION: MDAC-WD, "Engineering Laboratories Facility Catalog," Jan 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief Structures Laboratory Phone: (714) 897-0311, ext 4374

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Structures Test Laboratory consists of a laboratory building and an adjacent open area of 21,800 sq ft. Designed primarily for the testing of space booster structures, the laboratory is semi-circular, 200 ft in diam, with a 90-ft ceiling. Three 60-ft high doors and two smaller doors provide access. Designed around the central load-reaction tower 50 ft sq, the laboratory contains: a permanently installed hydraulic system, elevated temperature facility, data acquisition area, engineering office, storage areas, utilities installation, machine shop, and other laboratory support systems, including a 5-ton elevator. Five test pads, spaced around the tower, are part of a continuous floor slab 10-ft thick. A 40-ton-capacity bridge crane travels on circular tracks above the test pads. This, in combination with the large doors, makes it possible to efficiently handle large test components on all pads, in various stages of setting up for test, testing, and dismantling.

TESTING CAPABILITIES: This laboratory provides capabilities for simulating conditions of flight to an entire space vehicle. Structures are subjected to mechanical and heat stresses greater than those encountered on actual missions into space. Aerodynamic heating can be simulated, dynamic flight loads can be duplicated, and both can be automatically programmed as the structure is tested to destruction. The load-reaction tower has a capacity of 10^9 in.-lb of bending moment and 10^6 lbs of shear. Five test pads, arranged in circular array around the tower, are each capable of resisting a bending moment of 10^9 in-lbs, and a vertical load of 8×10^6 lbs. Structures as long as 70 ft in length, 50 ft in diam, and weighing 40 tons can be accommodated. Forces to the test specimens are transmitted from the load reaction tower and the floor through hydraulic jacks. These units each exert forces from a compression max. of 270K lbs to a tension max. of 200K lbs. A hydraulic pump and manifold system operates at 5000 psi and a 30 gal/min flow rate. Manual controls and the load programming system distribute the pressures to the desired areas, according to the requirements of each test. The laboratory has facilities to apply elevated temperatures (to 3000°F) for testing thermal behavior and characteristics of materials and assemblies in environments anticipated in actual flight. The available power for this purpose is 9000 kW for short duration (5 min) or 3000 kW for longer periods. Programmed environments can be applied to any structure, with modes of thermal conditions varying from steady state to ascending random temperatures, with respect to time. A programmed rate change of 800°F per second has been achieved. Multiple quartz tube infrared lamps, which are the heat source, can deliver energy at rates up to 120 Btu/ft^2 sec. A liquid nitrogen facility, located outside the Structures Test Laboratory, is used to impose environments upon specimens undergoing test. It is composed of a 13,500-gal storage tank with a complex of valves, lines, and gages that provide the required monitoring and transferring of liquid nitrogen to specimens.

Instrumentation capabilities include strain gage and thermocouple application facilities and a high speed digital data system of 1700 channel capability. The data system includes a hard wire link to an SDS 930 computer which feeds back reduced data to the test control center during test.

FACILITY COST HISTORY

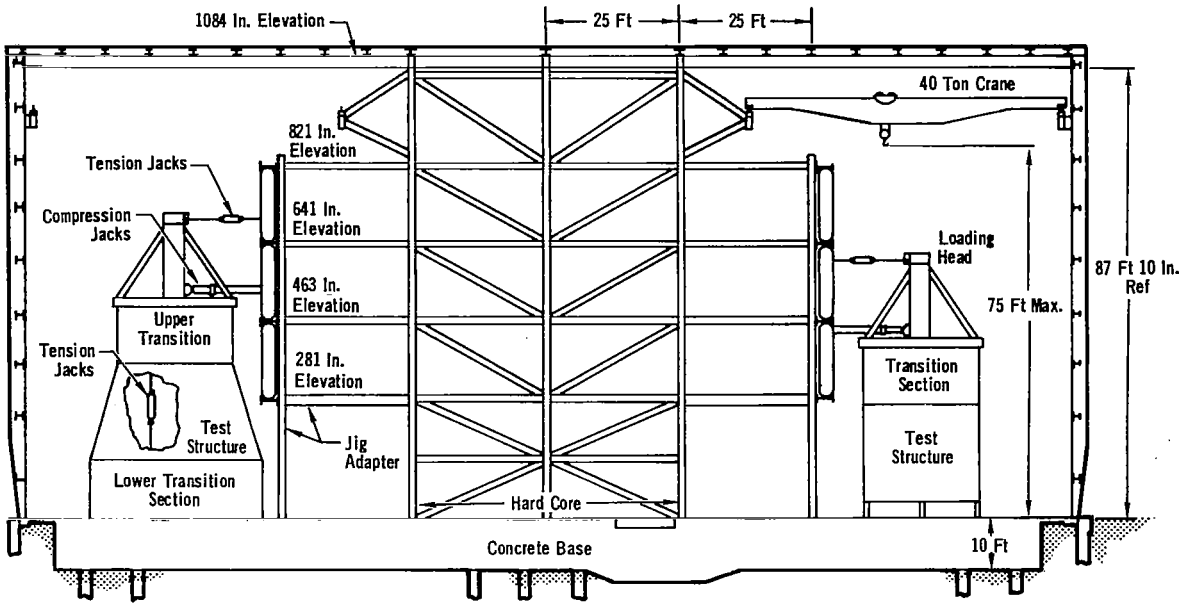
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT):	CONSTRUCTION YEAR: 1963 COST $2,000,000* ESTIMATED REPLACEMENT VALUE $2,750,000
CONTRACTOR: C. L. Peck	LOCATION: Los Angeles, California

IMPROVEMENTS AND COSTS: (1964) Jig adapter lateral extension of vertical core, Cost $114,000; Other improvements plus total through 1969, Cost $2,114,000.

* - Basic laboratory

PLANS FOR FACILITY IMPROVEMENTS: Expansion as programs require, particular specimen height.

SCHEMATIC



Structures Laboratory Elevation

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	18,250	-	50	50	70
Struct. Fatigue	X	10,000	-	60	60	20
Impact or Drop	X	3,600	-	-	-	-
Thermal	X	10,000	-	-	-	-
Pressure	X	3,400	-	-	-	-
Vibration	X	(MB C150 installed)				
Other Cryogenic	X	2,000	-	20	20	60

No. of Programmable Servo Hydraulic Controlled Channels: 4

Size of Floor Available for Testing (ft^2)
(Reinforced): 18,250
(Non-reinforced): 2,000

Tension-Compression Jacks: (300),
-270K lbs max. load,
+200K lbs max. load

Radiant Heat System: 3000°F
9000 kVA (5 min.)
3000 kVA (Continuous)

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*	Size 1 x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	-	18,250	120K/10 ft	-
Ceiling	-	-	-	-
Walls	50 x 75	3,750	N/A	1×10^6

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	300	X	X	0-200K	0-5000	Res Inc Load Prog.	Permanent	X
Pneumatic	5	X	-	-	0-100	-	Portable	X
Electro-Mech.	4	-	X	-	Not Applic.	Hydr.-Load Program	Pre-Fabricated (Erector-Set Type)	X
Dead Weight	-	X	-	10K	Not Applic.	-	Individual Design and Fabrication	X

NASA-LANGLEY FATIGUE RESEARCH LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
NASA-Langley Research Division Structures Research Division Hampton, Virginia 23365	COGNIZANT ORGANIZATIONAL COMPONENT: Structures Research Division
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models & Facilities Div. Code 56.00 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory contains a large number of fatigue testing machines including: (1) A Schenck fatigue testing machine: Programmed fatigue tests in 8 steps; Max load, 132K lb; Frequency, 4000 cpm; (2) A Krouse axial-load fatigue machine: Max load, 100K lb; Frequency, 1200 cpm; (3) An axial load hydraulic fatigue machine: Automatic cycling of load; Max load, 120K lb; Frequency, 60 cpm; (4) Nine axial-load fatigue machines: Max load, 20K lb; Frequency, 1800 cpm; (5) An atmospheric corrosion fatigue machine: Test 100 cantilever sheet specimens simultaneously; Frequency, 400 cpm; (6) An IV-20 fatigue machine: Max load, 20K lb; Frequency, 1200 cpm; (7) Three variable amplitude axial-load fatigue machines: Programmed fatigue tests at 55 presetable load levels in any arbitrary sequence; Max load, ± 20K lb; (8) Three axial-load hydraulic fatigue machines: Closed-loop servo-controlled; Max load, 20K lb; Frequency, 3000 cpm; (9) An axial-load hydraulic fatigue machine-Analog input, random load; Max load, ± 15K lb; Frequency, 24,000 cpm; (10) Ten Gilmore fatigue machines: Max load, ± 20K lb; Variable amplitude; 6 specimens in series possible in each machine (total of 60 specimens possible); Load controlled by curve-following closed-loop servo; Temperature programmed with variable-time scale (i.e., same load program may be compressed to shorter time period; (11) A Wiedman-Baldwin SF-1V fatigue machine: Tension-compression loading; Mean load, 1000 lb ± 1000 lb, Frequency, 1800 cpm; (12) An axial-load hydraulic fatigue and static test machine: Max load, 1000K lb; Max loading rate, 120,000K lb/sec; (13) A Weston Boonshaft, and Fuchs Fatigue machine: Closed-loop servo-control, axial-load; Max load, ± 400K lb; Frequency, 1200 cpm; (14) Three programmed variable-amplitude fatigue machines: Axial load; Programmed closed-loop servo-controlled hydraulic loading; Max load, ± 20K lb; Any one of 55 presetable load levels in any arbitrary sequence; Adaption for programmed temperature under construction; Cycling rate up to 420 cpm; (15) Two axial-load fatigue machines: Max load, 20K lb: Constant load at max amplitude; Closed-loop Servo-controlled hydraulic up to 3000 cpm; Infinitely variable up to 20K lb; (16) A fatigue machine: Max load, ± 20K lb; Variable amplitude; 10 load stations with 6 specimens in series possible at each Station (i.e., total of 60 specimens possible); Load controlled by curve following closed-loop servo; Temperature programmed with variable-time scale.

Hydraulic testing machines include 4 machines with 1200K, 300K, 120K, and 100K lb load capacities. These machines may be equipped with various types of heating equipment for elevated-temperature environment. A vertical abutment-type backstop is available for supporting and/or anchoring large structural test specimens. Portable hydraulic jacks with up to 300K lb capacity are available for use with this equipment. Eleven 20K lb capacity compression creep testing machines are available some of which are equipped with ovens to provide temperatures up to 2500°F.

TESTING CAPABILITIES: This laboratory is equipped to conduct basic research on the fatigue of aerospace materials and structural components with emphasis on effects of variable amplitude loading, elevated temperature, and environmental effects.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available.

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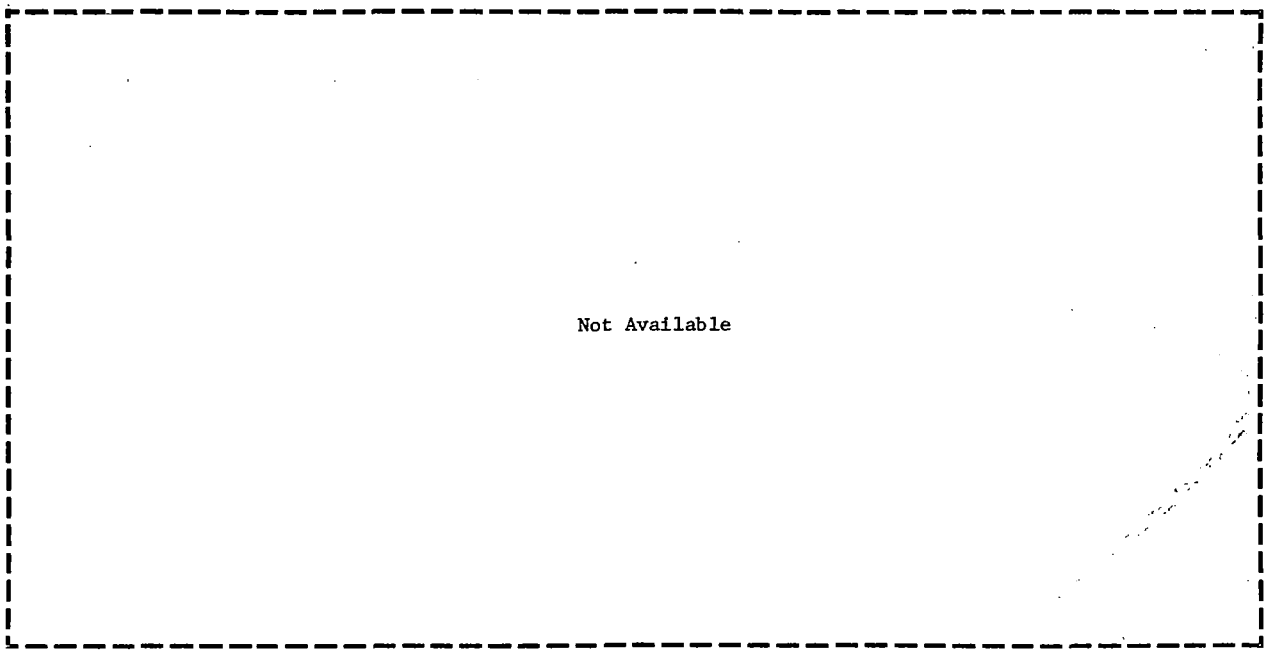

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X					
Struct. Fatigue	X					
Impact or Drop	X					
Thermal						
Shock	X					
Vibration	X					
Other						

No. of Programmable Servo Hydraulic Controlled Channels: 60

Size of Floor Available for Testing (ft^2)
(Reinforced):
(Non-reinforced):

Testing Machines: See list on Previous Page under facility description

Radiant Heat Systems:

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Static, Cyclic, and Fatigue

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic							Permanent	X
Pneumatic							Portable	
Electro-Mech.					Not Applic.		Pre-Fabricated (Ejector-Set Type)	
Dead Weight					Not Applic.		Individual Design and Fabrication	

NASA-LANGLEY STRUCTURES RESEARCH LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
NASA-Langley Research Center Structures Research Division Hampton, Virginia 23365	COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Research Models & Facilities Div. Code 56.00 Phone: (703) 827-2045

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory has a variety of static and fatigue testing equipment. Static testing equipment includes: (1) A 1,200,000 lb force capacity testing machine for tensile and compressive specimens up to 6 ft wide and 18 ft long; (2) Lower capacity testing machines of 300K, 120K, and 100K lb force capacity; (3) A torsion machine (±60K in-lb force capacity); (4) A combined load testing machine (can apply combinations of axial load, torsion, shear, and bending loads to specimens up to 40 by 40 by 240 in); (5) A vertical abutment-type backstop for supporting and/or anchoring large structural test specimens; and (6) Hydraulic and pneumatic pressurization equipment.

Fatigue testing machines include: (1) An axial-load fatigue machine: Random-load, 24K cpm hydraulic; Max load, ±15K lb; Analog input; (2) A Fatigue testing machine: Programmed fatigue tests in eight steps; Max load, 132K lb; Max frequency, 4000 cpm; (3) An axial-load fatigue machine: Max load, 100K lb; Frequency, 1200 cpm; (4) An axial-load fatigue hydraulic machine: Automatic load cycling; Max load, 120K lb; Frequency, 60 cpm; (5) Nine axial-load fatigue machines: Max load, 20K lb; Frequency, 1800 cpm; (6) Nine rotating beam fatigue machines: Bending capacity, 200 in-lb; Frequency, 8000 cpm; (7) Three fatigue machines: Max load, 25 lb; Frequency, 1800 cpm; (8) An atmospheric corrosion fatigue machine (outdoor installation): Tests 100 cantilever specimens simultaneously; Frequency, 400 cpm; Equipped for elevated temperatures to 550°F; (9) A fatigue testing machine: Max load, 20K lb; Frequency, 1200 cpm; and (10) Fatigue testing machines: Mean load, 1000 lb ± 1000 lb; Tens-Comp, 1800 cpm.

TESTING CAPABILITIES: This laboratory is used to support the technical areas of static testing, fatigue testing, elevated temperature tests, materials tests, and space environmental tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8-HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST Not Available ESTIMATED REPLACEMENT VALUE
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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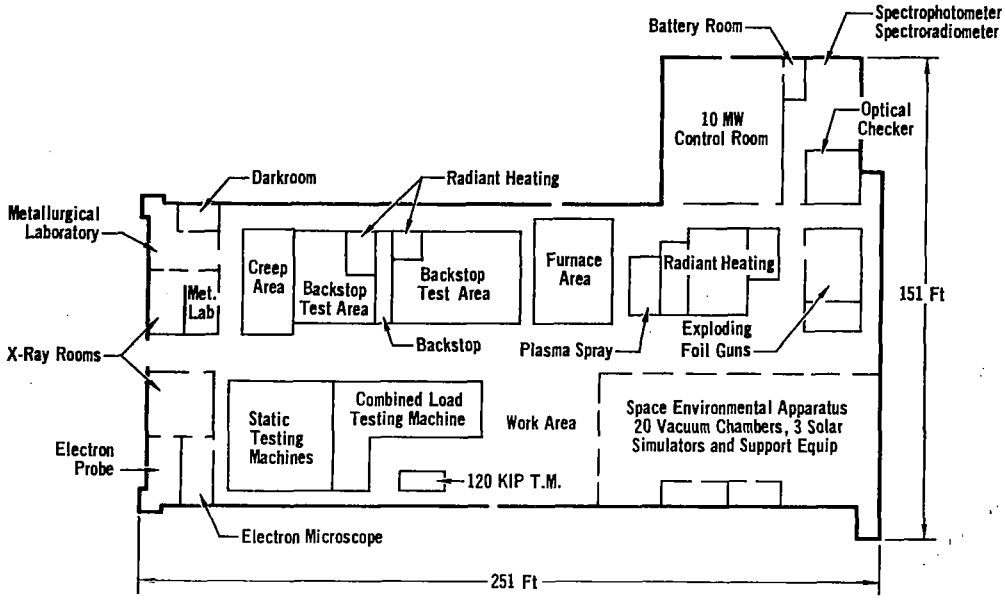

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (ft)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X					
Struct. Fatigue	X					
Impact or Drop						
Thermal	X					
Shock						
Vibration						
Other						

No. of Programmable Servo Hydraulic Controlled Channels:

Size of Floor Available for Testing (ft^2)
(Reinforced):
(Non-reinforced):

Tens-Comp Test Machines (lb_f): (1), 1200K
Tens-Comp Test Machines (lb_f): (1), 300K
Tens-Comp Test Machines (lb_f): (1), 120K
Tens-Comp Test Machines (lb_f): (1), 100K
Torsion Testing Machines (in-lb_f): (1), 60K
Combined Load Testing Machine
Axial Compression (lb_f): 250K
Axial Tension (lb_f): 120K
Horizontal Shear (lb_f): 25K
Vertical Shear (lb_f): 50K
Torsion (in-lb_f): 2500K
Horizontal Bending (in-lb_f): 600K
Horizontal Bending (in-lb_f): 3000K
Fatigue Testing Machines: See list on previous page

Radiant Heat System:
Type of Loads Simulated: Airloads, Inertia, Mech. Press., Transient, Static, Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic							Permanent	
Pneumatic							Portable	X
Electro-Mech.							Pre-Fabricated (Ejector-Set Type)	
Dead Weight					Not Applic.		Individual Design and Fabrication	
					Not Applic.			

NASA-MSC STRUCTURES TEST LABORATORY
(Structural Test Facilities and Mechanical Systems Laboratory)

REPORTING INSTALLATION: NASA-Manned Spacecraft Center Houston, Texas 77058	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures and Mechanics Division
OTHER SOURCES OF INFORMATION: Technical Facilities Catalog (NASA), Vol. II, Report NHB 8800.5, March 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures Test Section Phone: (713) 483-2576

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of testing materials, structural components, and relatively large structures under static, fatigue, and thermal loading. The entire laboratory floor, with the exception of an area approximately 40 ft by 50 ft in the southwest corner, is reinforced for structural loading. In addition, a vertical structural backstop approximately 20 ft by 20 ft with T-slotted plates provides a rigid wall for structural loading.

The Mechanical Systems Laboratory has the capability of performing environmental tests on various materials and components. Tensile tests can be conducted in situ while materials are exposed to a thermal vacuum environment. Fourteen chambers are available which utilize three pumping systems. Two systems utilize cold trapped diffusion systems with a vacuum capability of 1×10^{-8} Torr. The third system utilizes a turbomolecular pump and titanium sublimaters depositing on LN_2 cryopanels. This system has six chambers for performance of tensile tests in vacuum.

TESTING CAPABILITIES: The Structures Test Laboratory has been used in the development and testing of Apollo materials, structural components test, and handling hardware. Extensive fatigue and cyclic loading of Apollo materials has been done in establishing material thresholds for various fluids. A prototype space station structure, the subsystems test bed, was run through a complete structural loading spectrum, including launch loads simulation, pressure and leak tests and unit load deflection tests. Two data acquisition systems are available in the laboratory with a total of 900 data channels. Each system is equipped with a small programmer to give readouts in engineering units, stress, strain, load, degrees, etc. In addition, a complete inventory of checkout and maintenance equipment is available in the laboratory. The Mechanical Systems Laboratory was used to conduct a large number of tests on Apollo parachute materials, concerning the effects of a thermal vacuum environment on these materials. Other tensile tests have been performed on nonflammable paper and polymeric materials for spacecraft application.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $2,521,413 ESTIMATED REPLACEMENT VALUE $3,550,000
CONTRACTOR: Morrison-Knudsen-Hardeman Leavell Co.	LOCATION: Southgate, California Houston, Texas

IMPROVEMENTS AND COSTS: (1964) Hybrid computer, Cost $99,962; (1965) Tensile test machine, Cost $14,955; (1967) Mod's to Pm 267 thermochemical controls, Cost $6330.

PLANS FOR FACILTIY IMPROVEMENTS: Mod's to high capacity pumping station; Installation of ultra high vacuum test systems.

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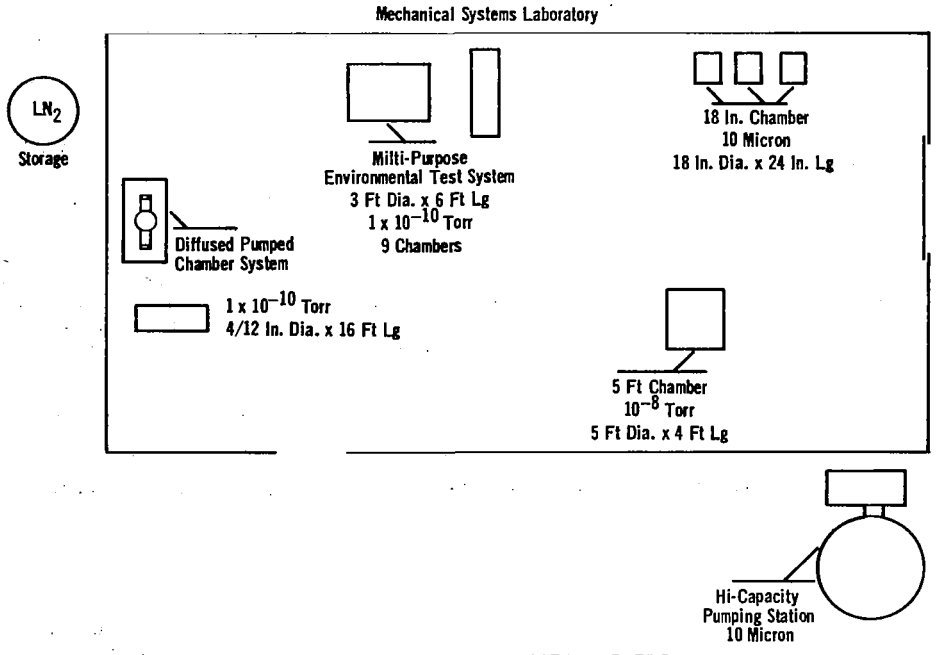


STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	4000	a	80	50	30
Struct. Fatigue	X	4000	a	80	50	30
Impact or Drop		-	-	-	-	-
Thermal	X	3200	a	80	40	30
Shock			-	-	-	-
Vibration			-	-	-	-
Other Materials	X	2500	N/A	50	50	30

a No Limit

No. of Programmable Proportional Controller Channels: 42

No. Of Programmable Servo Hydraulic Controlled Channels: 4

Size of Floor Available for Testing (ft^2)
(Reinforced): 11,700
(Non-reinforced): 2,000

Universal Testing Machines: (2) 0-10,000 lbs
(2) 0-50,000 lbs
(1) 0-100,000 lbs
(1) 0-600,000 lbs

Radiant Heat System: 36 Channels (programmable) 13 mW max power

Type of Loads Simulated: Airloads (Force & Thermal), Inertia, Mechanical, Pressure, Cyclic, Fatigue & Vacuum Effects

Structurally Reinforced Test Areas*				
	Size 1 x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	80 x 100	8000	-	-
Ceiling	-	-		
Walls	20 x 20	400		

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles
		Manual	Program			
Hydraulic	5			0-600,000	3000	Func.Gen/Arbitrary
Pneumatic	1		No	0-30,000	2500	Hand Loader
Electro-Mech.	2			0-10,000	Not Applic.	Func.Gen/Arbitrary
Dead Weight	13		No	0-12,000	Not Applic.	Manual Weights

Type of Structural Test Fixtures Used	
Permanent	X
Portable	
Pre-Fabricated (Erector-Set Type)	
Individual Design and Fabrication	X

NASA-MARSHALL STRUCTURAL STATIC TEST FACILITY

REPORTING INSTALLATION: NASA-Marshall Space Flight Center Huntsville Alabama 35812	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Propulsion and Vehicle Engineering Laboratory
OTHER SOURCES OF INFORMATION: NASA Marshall, "Technical Facilities and Equipment Digest," January 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Static Test Tower in Building 4619 has a test floor area of 86.5 feet by 48.5 feet with anchor plates. The tower can accommodate specimens 35 feet high and 21.5 feet in diameter. Small tensile test machines have capability up to 400,000 lb. Two 10-ton cranes are 42 feet high; one 20-ton crane is 80 feet high.

The Load Test Annex (LTA) 15,000 square feet in area, accommodates a static test tower with crosshead height of 115 feet and 30-million lbs capacity. The tower can accept a preassembled article of 54-feet diameter or an article 65-feet in diameter if it is assembled in the tower. Two 30-ton bridge cranes have a hook clearance up to 106 feet.

The LTA Extension building comprises a total area of 37,587 square feet. Included in this addition is a high bay section of 19,900 square feet with anchor plates and two 20-ton cranes with 80-foot hook height. A universal test machine has a 3 million pound capability. There are 2 test pads external to the building: one is 42 feet by 42 feet, the other is 52 feet by 52 feet and has dead man anchors. Articles 10 feet in diameter by 25 feet in length can be tested in this machine up to 2 million pounds shock loading and 3 million pounds non-shock loading. Loads can be cycled from one million pounds tension to one million pounds compression at a rate of one cycle per minute. The machine has an accuracy of .1 percent of actual load or .1 percent of scale range in use, whichever is greater.

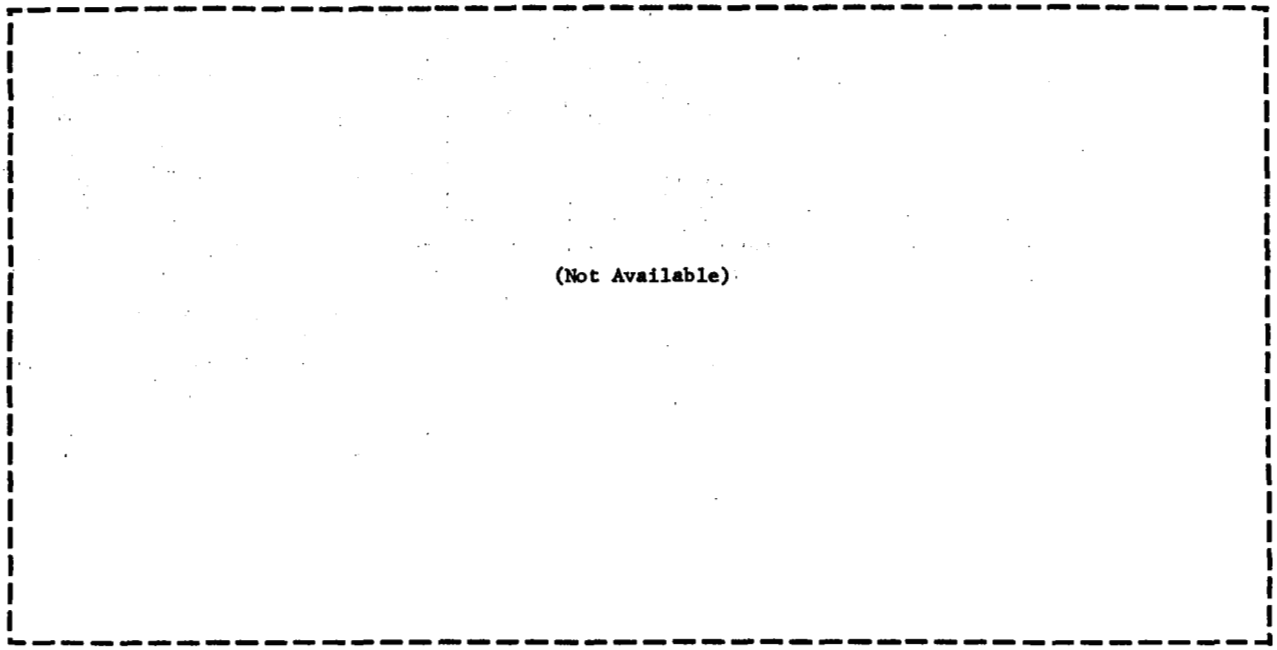
TESTING CAPABILITIES: The Data Acquisition/Processing System consists of 2 GE 235 computers together with a Master Control Program. The computer system serving Building 4619, LTA and its extension, and outside test pads, is comprised of four 1 kc subsystems capable of sampling a maximum of 3072 transducers in a single scan; total capacity is 8000. The multiplex Master Control Program permits concurrent testing.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	61,250	30x10⁶	64 Diam.		45
Struct. Fatigue						
Impact or Drop						
Thermal Shock						
Vibration						
Other Cyclic	X					

No. of Programmable Servo Hydraulic Controlled Channels:

Size of Floor Available for Testing (ft^2)
(Reinforced):
(Non-reinforced):

Universal Test Machine Capability (lb_f)
(Static): 3,000,000
(Shock load): 2,000,000
(Cyclic): 1,000,000

Radiant Heat System: Not Available

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurall Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor				
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing.

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic							Permanent	
Pneumatic							Portable	
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	
Dead Weight					Not Applic.		Individual Design and Fabrication	

NAVAL AIR DEVELOPMENT CENTER
AERO STRUCTURES TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
U.S. Naval Air Development Center Johnsville Warminster, Pennsylvania 18974	COGNIZANT ORGANIZATIONAL COMPONENT: Aero Structures Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility provides in-house structural test support for exploratory and advanced development tests and service problems as well as research and development of test techniques and ground test simulation. It is capable of testing full-scale vehicles and large components under real-time simultaneous simulation of mechanical (aerodynamic and inertial) and thermal environment. This facility is housed in two buildings. One building houses a high shop structural test area, with crane service, of 32,000 sq ft, of which 18,000 sq ft is a reinforced test floor with special tie down rails designed for attachment of jig members and loading devices, and the radiant heating facility. The second building houses a high shop structural test area with crane service, of 30,000 sq ft, of which 20,000 sq ft is a reinforced test floor with special tie down rails similar to that above. Both reinforced test floors can resist vertical-load components of 30,000 lbs applied on three-foot centers.

Sub-Facilities: (1) Test Machine Facility; (2) Loads Environment and Calibration Facility; (3) Data Analysis Facility; and (4) Non-Destructive Testing Technique Facility.

Major Equipment includes: 25-channel programmable dynamic loading system (0-100,000 lbs cyclic closed loop); 20-channel programmable dynamic loading system (0-100,000 lbs cyclic closed loop); 10-channel fixed sequence dynamic (0-100,000 lbs cyclic closed loop, 25 level); Radiant energy system 8,000 kVA of programmed power with 40 programmers rated 100 kVA and 24 programmers rated 350 kVA, full power for 3 minute duration, total of 64 programmers for automatic closed-loop heat control, 110 BTU/sq ft/sec; CDC Data Acquisition 288 channels any combination of strain and/or temp. at 15,000 chan/sec, conditioning for 300 strain and 180 thermocouples.

Major Equipment at the Test Machine Facility includes: A group of three Universal Testing Machines and a closed loop fatigue testing system contained in an area of 9600 square feet. Specifically, these are: (1) A 5,000,000 lb capacity machine capable of accommodating a specimen 30-ft long by 10-ft square, and equipped with extended wings which permit the application of loads up to 1,000,000 lbs at the center of a 48 ft long beam; (2) a 600,000-lb capacity machine which can accommodate a specimen 18 ft long by 6 ft square and equipped with side wings; (3) a 300,000-lb capacity machine which can accommodate a specimen 12-ft long by 30-inches square; (4) a portable three-section steady-state temperature chamber (clear test area - 4 ft cube) can be installed in the 5,000,000 or 600,000-lb machines; and (5) a closed loop 100,000-lb capacity programmed materials and structures fatigue testing system equipped with align-matic grips and 20,000 and 100,000-lb capacity loading frames.

TESTING CAPABILITIES: This facility supports the technological areas of structures, fatigue, heat, and non-destructive test techniques. The Data Analysis Facility provides in-house capability to investigate and implement automatic and semi-automatic methods of data reduction for the Aero Structures Department's technical programs. The facility operates one small computer and a variety of oscillograph film reading and plotting systems and other peripheral equipment, most of which has been designed or modified to meet ASD's special requirements. In-house computer programming is available to support specific data reduction and solution of engineering problems.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $12,150,000* ESTIMATED REPLACEMENT VALUE $29,000,000**
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

* Note above: Includes cost for Test Machine Facility of $1,150,000.
** Note above: Includes replacement cost for Test Machine of $4,000,000.

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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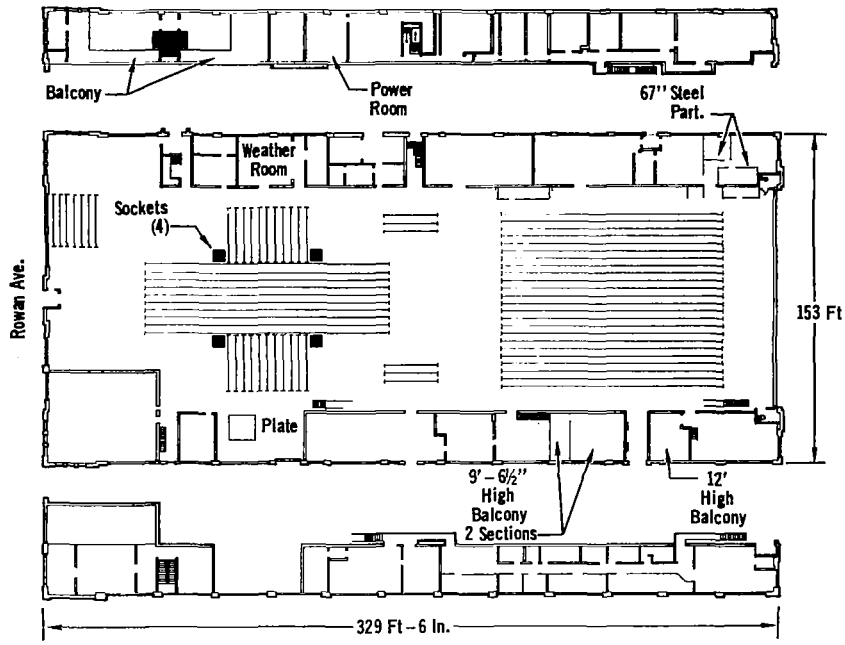

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	38,000		100	100	30
Struct. Fatigue	X	38,000		100	100	30
Impact or Drop						
Thermal	X	18,000		100	100	30
Shock						
Vibration						
Other						

Facility Name: Structures Test Facility

No. of Single Channel Fatigue Block Programmers: 6

Size of Floor Available for Testing (ft^2) (Reinforced): 38,000

Fatigue Systems: (1), 25 channel, 0-100K lb
(cyclic closed loop) (1), 20 channel, 0-100K lb
(1), 10 channel, 0-100K lb

Radiant Heat System: 8K kVA (Programmed Power)

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	316 x 52	18,000	Not Avail	Not Avail
Floor	100 x 80	8,000		
Floor	108 x 41	9,000		

*Areas used primarily for struct. loads and fatigue testing

Type of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Sub-Facility Name: Test Machine Facility

Universal Test Machines: (3), 300K, 600K, & 5000K lb

Fatigue Machine: (1), 100K closed loop

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic	8	X	X	100K ea	0-3000	Closed loop	Permanent	X
Pneumatic	6	X	X	150K ea	0-10,000		Portable	
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	X
Dead Weight					Not Applic.		Individual Design and Fabrication	X

NORTH AMERICAN ROCKWELL/SPACE DIVISION STRUCTURAL TEST LABORATORY

REPORTING INSTALLATION: North American Rockwell Space Division 12214 Lakewood Blvd. Downey, California 90241	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Laboratories and Test Department 098
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Laboratories and Test Branch Department 098-300 Phone: (213) 922-3491

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Structures Test and Structural Set-up Units of the Mechanical and Fluid Systems Branch have approximately 25,340 sq. ft. of area under roof. The main laboratory area is in the center of Building No. 288; the auxiliary area is a portion of the southwest corner of Building No. 1. Also included is the Impact Test Structure, No. 635, just east of Building No. 288. The structural test area in the Space Systems Development Facility, Building 288, covers approximately 14,400 sq. ft. Imbedded in the floor of this area on 4 ft. centers are 39 floor beams that are 60 ft. long and have a capability of reacting 75,000 pounds for each 10 ft. of length. Two 5-ton capacity overhead cranes, with maximum hook heights of 35 ft., are located near the north wall of the facility. Four large vertical columns (24 WF) are imbedded in the test floor for utilization as load reaction beams. Each column has a capability of reacting 10,000,000 inch pounds of moment. The facility is capable of supporting multiple structural test programs on major aerospace structures, or structural components. A large variety of hydraulic equipment is available to the facility for conducting tests. This includes 10 channel Edison proportioning units, load cells, and a range of sizes of hydraulic struts that have loading capacities of up to 500,000 pounds each.

TESTING CAPABILITIES: Test Area, Building 1 - Complete aerospace structural test programs may be performed in the main portion of this facility. It can accommodate airframes 90 feet in length with spans of 40 feet. Specimens and equipment are handled by bridge cranes spanning the entire area. Spaced throughout the floor area are structural beams capable of reacting normal vertical loads of 25,000 lb/ft. In the facility test area, 4-30 inch WF vertical columns 20 feet high are anchored in the test floor as an abutment for support of component testing. These columns are capable of reacting a moment of 10,000,000 in.-lb/column.

Impact Test Facility: The Impact Test Facility provides capability for testing of simulated parachute landings of test vehicles for either water or earth landings. The facility is capable of testing vehicles up to 12,000 pounds gross weight. Horizontal velocities are imparted from a long pendulum which may be moved into position over either water or land impact test areas.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Depends on number of tests	CONSTRUCTION YEAR: 1964 COST $ Not Available ESTIMATED REPLACEMENT VALUE $ Unknown
CONTRACTOR: Vinnell Corp. IMPROVEMENTS AND COSTS: Unknown	LOCATION: Alhambra, California

PLANS FOR FACILITY IMPROVEMENTS: None

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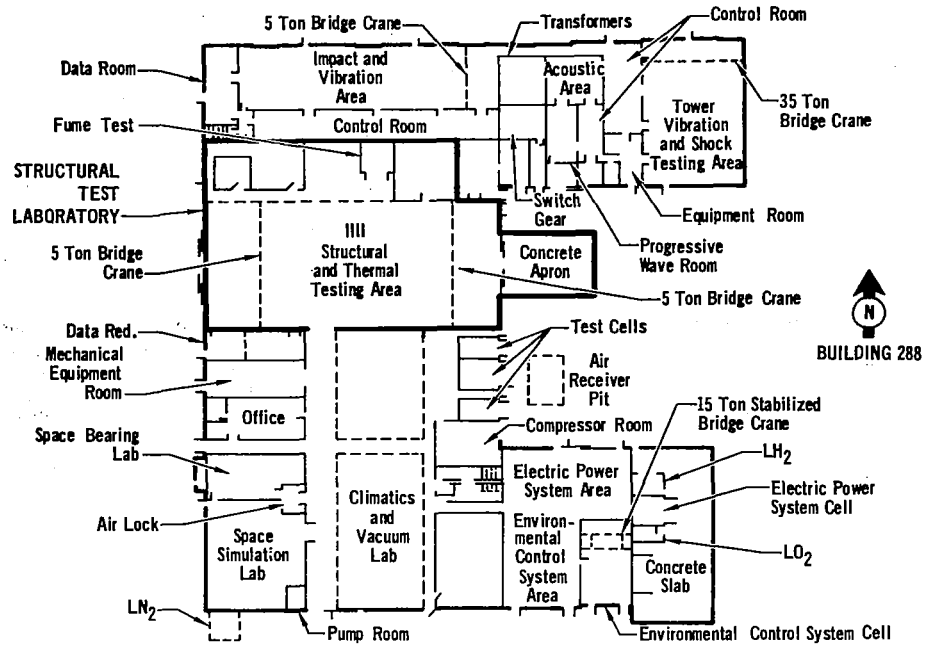

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	25,340	20K	120	40	25
Struct. Fatigue	X	25,340	20K	120	40	25
Impact or Drop	X	9,000	12K	–	–	–
Thermal	X	14,400	20K	120	40	25
Shock	X	200		1	1	1
Vibration	X					
Other						

No. of Programmable Servo Hydraulic Controlled Channels: 4

Size of Floor Available for Testing (ft^2):
(Reinforced): 25,340
(Non-reinforced):

Universal Testing Machines Load Capacities:
(1), Riehle: 10K lbs
(1), Riehle: 20K lbs
(1), Riehle: 60K lbs
(1), Riehle: 150K lbs
(1), Riehle: 200K lbs

Radiant Heat System: 36 channels

Type of Loads Simulated: Fatigue, Vibration, Shock, Thermal

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	9200	14,400	75,000	75,000
Ceiling				
Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic							Permanent	
Pneumatic							Portable	
Electro-Mech.					Not Applic.		Pre-Fabricated (Erector-Set Type)	
Dead Weight					Not Applic.		Individual Design and Fabrication	

WYLE HIGH FORCE TEST FACILITY
(Huntsville, Alabama)

REPORTING INSTALLATION: Wyle Laboratories Huntsville Facility 7800 Governors Drive West Huntsville, Alabama 35800	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: D.R. Reese and A.N. Levine, "Simulation of the Saturn V Boost-Phase Environment on Major Apollo Spacecraft Stages", IES Paper, 1969	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone: (205) 837-4411

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility incorporates an extensive structural test capability since the facility includes reaction masses weighing in excess of 5 million lbs. The facility has been used to provide approximately 200 structural loads on a single test article in combination with seven vibration inputs.

The launch of the Saturn V space vehicle imposes various combinations of loads on the entire spacecraft structure. The spacecraft, which includes the Service Module, the SLA, and the Lunar Module, as well as the more familiar Command Module, is designed to withstand the extremes of static and dynamic mechanical loads, aerodynamic loads and temperature variations. However, during the second Saturn V flight evidence of unexpected structural degradation was encountered. Thus, a test program was initiated to demonstrate the structural integrity of the assembled upper portion of the vehicle. This program, identified as the "Integrated Shell Static Structural Test," was designed to confirm that the structure, as an assembly, was capable of withstanding the rigors of flight. The assembled structure (as shown on the opposite page) provided realistic boundary conditions not possible when the component stages are tested individually. An expedited test program was initiated to subject the Service Module, the SLA, the Lunar Module, the Instrument Unit, and the Forward Skirt of the S-IVB to the two most critical environments encountered during that portion of flight where the vehicle is accelerated from the launch pad to a speed of approximately 5,000 mph by the thrust of the S-IC Stage. The two test conditions simulate "Max Q Alpha" (maximum product of dynamic pressure and angle of attack) and "End of Boost" where the maximum axial acceleration and near maximum temperatures on the structure occur. In the performance of the test program, 1,600 data channels, which recorded the response of the structure, were monitored while the structure was subjected to 76 controlled loads under five different test conditions.

TESTING CAPABILITIES: For the Saturn V "Integrated Shell Static Structural Test, the Wyle Engineering Staff designed and supervised the construction and assembly of fixtures, equipment, and control systems to apply all loads and environmental conditions. These included: (1) Temperature: Aerodynamic heating effects were simulated with a skin temperature profile that increased from room temperature to 285°F in approximately 140 seconds; (2) Aerodynamic Loads: Distributed pressures were applied in 32 structural zones using large pneumatic bladders; (3) Static Load: Shear, moment and axial loads were applied to simulate all major structural forces (the sum total approached 700,000 pounds); and (4) Dynamic Load: The Lunar Module was subjected to simultaneous dynamic excitation in two axes to develop specific flight stresses.

Wyle structural test capabilities such as loading, heating, cycling, etc. are not fixed, but are adjusted to the needs of each test program. The Saturn V test program given here is an example.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

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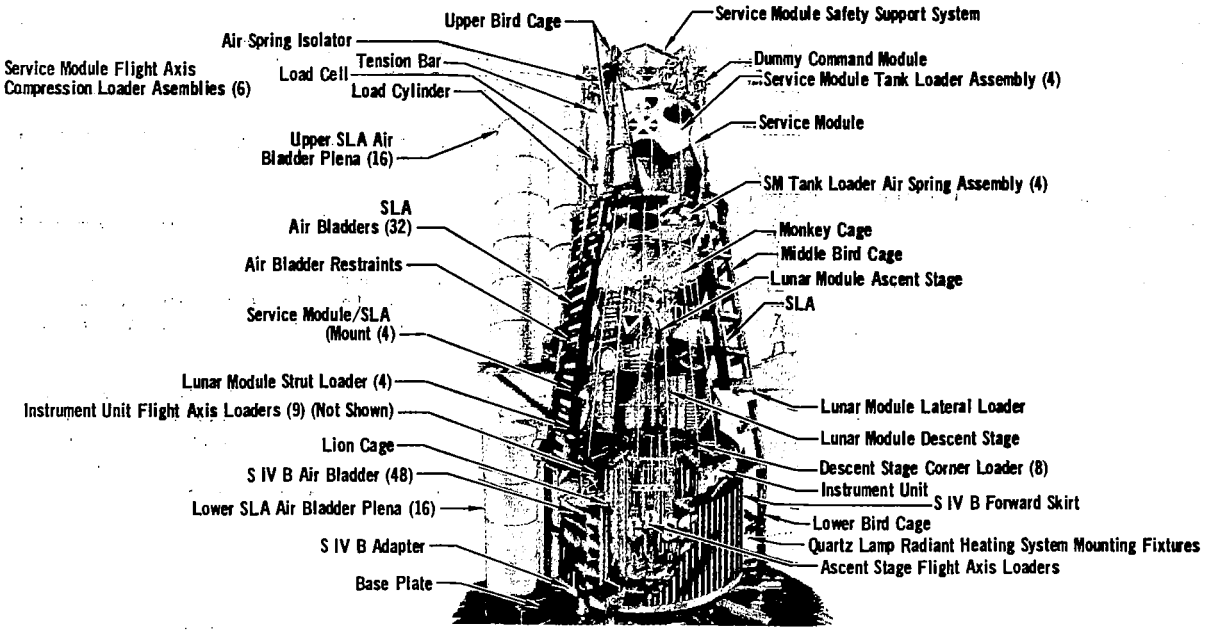

STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads Struct. Fatigue Impact or Drop Thermal Shock Vibration Other	Not Available					

No. of Programmable Servo Hydraulic Channels: Not Available

Size of Floor Available for Testing (ft^2) (Reinforced): 8150 (Basic Facility) 60 Ft High

Test Machines: Not Available

Radiant Heat System: Not Available

Types of Loads Simulated: Airloads, Inertia, Mechanical, Pressure, Transient, Static, Cyclic, and Fatigue

Structurally Reinforced Test Areas*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor Ceiling Walls				

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles	Type of Structural Test Fixtures Used	
		Manual	Program					
Hydraulic Pneumatic Electro-Mech. Dead Weight					Not Applic. Not Applic.		Permanent Portable Pre-Fabricated (Erector-Set Type) Individual Design and Fabrication	

6. THERMAL

MCDONNELL DOUGLAS THERMAL TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Douglas Astronautics 5301 Bolsa Avenue Huntington Beach, California 92647	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Structures Laboratory Branch
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief, Structures Laboratory Phone: (714) 897-0311, ext 4373

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of simulating the heating of aerospace structures produced by (1) aerodynamic effects, (2) exhaust plume impingement, (3) solar radiation, and (4) nuclear blast effects. Eighteen ignitron power regulators supplied by a 600 volt - 3000 kVA (continuous-power rating) substation can deliver 9000 kVA for seven minutes. This short duration overload capability is especially advantageous in the simulation of aerodynamic heating of high performance missiles, and re-entry vehicles. Heat transfer is primarily achieved by infrared radiation from tungsten-filament tubular quartz lamps.

TESTING CAPABILITIES: The facility has been used to simulate the predicted temperature history of the skirt and interstage sections of the Saturn IB and V in the structural qualification test program. Programmed temperatures and loads were applied simultaneously in the thermo-structural qualification test tests. Over 1200 channels of strain, deflection, temperature, and load data were simultaneously recorded by Digital Data Acquisition System in the Saturn V aft interstage thermo-structural qualification test. The total capability for the data acquisition system is 1700 channels. The sampling rate is 5 samples/sec. A SDS 930 computer is used for data reduction. The typical time cycle for data processing is 1 day although this can be reduced to "real time" for maximum priority tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1964 COST $170,000* ESTIMATED REPLACEMENT VALUE $250,000
CONTRACTOR: Research, Inc. IMPROVEMENTS AND COSTS: Improvements, Cost $30,000.	LOCATION: Minneapolis, Minnesota

*Includes $120,000 for 18 channels and $50,000 for the substation.

PLANS FOR FACILITY IMPROVEMENTS: Additional power and channels as programs require.

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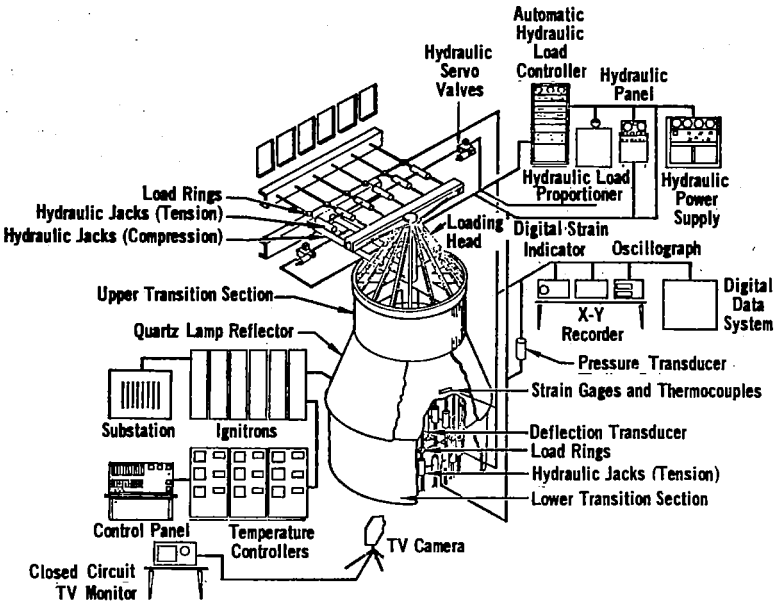
ELEVATED TEMPERATURE FACILITIES



FACILITY PERFORMANCE DATA

No. of Programmable Ignition Power Channels:	18
No. of Programmers:	9
Modes of Operation:	Manual, Set Point (Steady-state), and Program
Maximum Temperature Attainable (°F):	3000
Maximum Heat Flux Attainable (Btu/ft^2-sec):	120
Power Supply Capacity (kVA):	9000 (Intermittent) 3000 (Continuous)
Type of Infrared Heaters:	Quartz Lamps, Graphite
Heating Conditions Simulated:	Steady State, Transient and Cyclic

MCDONNELL DOUGLAS TRANSIENT HEAT FACILITY

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Aircraft Company P.O. Box 516 St. Louis, Missouri 63166	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION: MAC Brochure, "Facilities and Capabilities Engineering Laboratories"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability of subjecting spacecraft and aircraft structural components to elevated temperatures and structural loads. 75 thermal control channels may be used to supply 30,000 kVA for 30 seconds, or 7500 kVA for a continuous test. Nine load programmers are available for controlling loads. A large steel test jig is available that can react loads of up to 100,000 pounds.

TESTING CAPABILITIES: The Transient Heat Laboratory has been used for thermodynamic research and verification of aerospace vehicles such as Mercury, Gemini, and Asset. The facility is flexible and may be adapted to test re-entry vehicles at 3000°F or may test large areas of aircraft structure to relative low temperatures (200 to 700°F). Structural loads may be applied by a programmable hydraulic loading system while the specimen is subjected to elevated temperatures. Over 600 channels of strain, deflection, load, temperature, or pressure may be simultaneously monitored and recorded on the Central Data Acquisition System. Sampling rates for this system vary from 10 samples/second for 1000 channels to 10,000 samples/second for 1 channel. IBM 1401 and IBM 7090 computers are used for data reduction.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available.

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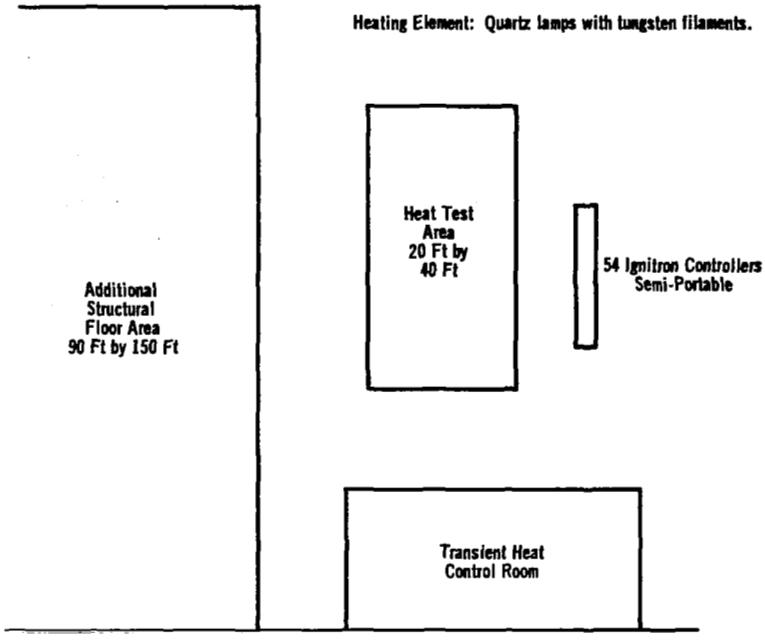

FACILITY PERFORMANCE DATA

No. of Programmable Power Control Channels:	75
Maximum Temperature Attainable (°F):	3500 (over 1 sq ft area) 3000 (over larger areas)
Maximum Heat Flux Attainable (Btu/ft^2-sec):	150 (over 1 sq ft area) 120 (over larger areas)
Power Supply Capacity (kVA):	34,000 (for 30 seconds) 7,500 (Continuous)
Type of Infrared Heaters:	Quartz Lamps
Load Programmers Available:	9 Units
Hydraulic Load System:	Flow capability of 35 gal/min @ 3000 psi (portable)

NASA FLIGHT RESEARCH CENTER
HIGH TEMPERATURE LOADS CALIBRATION LABORATORY

REPORTING INSTALLATION: NASA Flight Research Center P.O. Box 273 Edwards Air Force Base California 93523	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Research Division Aero-Structures Sub-Division
OTHER SOURCES OF INFORMATION: "NASA High Temperature Loads Calibration Laboratory NASA TM X-1868, September 1969	LOCAL OFFICE TO CONTACT FOR INFORMATION: W. Sefic, Laboratory Manager Phone: 258-3311, ext 674

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility has the capability for loading or heating flight structures under controlled conditions and simultaneously acquiring data from a large number of sensors. One hundred and three temperature control channels may be used to regulate 20,000 kVA for 3 minutes or 10,000 kVA for a continuous test. Fourteen channels of closed-loop hydraulic load control and 100,000 lbs of dead weight are available for structural loading, while simultaneously heating test specimens. The laboratory is a hangar-type structure with a small shop and office area attached to one end to accommodate the operations staff. It is located adjacent to Rogers Dry Lake and is connected to the dry lake and the Edwards Air Force Base runways by a ramp and taxiway. The figure on the opposite page shows the building layout. The hangar-door opening is 40-ft high and 136-ft wide. The unobstructed test area is 150-ft long by 120-ft wide by 40-ft high. There are 16 tiedown slots spaced 6 ft apart, 7 instrument wire trenches, 7 electrical power trenches, and 5 mechanical trenches. The control room for the heating equipment, loading equipment, and data acquisition system is on the second floor. Two observation windows and a closed-circuit TV system are provided for monitoring the test area.

TESTING CAPABILITIES: This laboratory is particularly suited for installing and calibrating strain-gage installations for in-flight structural-loads measurements, for the application of structural proof test loads in support of flight safety, and for the simulation of aerodynamic heating. The facility is flexible and may be adapted to test hypersonic aircraft components to 3000°F or large areas of aircraft structures to 800°F. Structural loads may be applied by a programmable hydraulic loading system while the specimen is subjected to elevated temperatures. Eight hundred channels of strain, deflection, load, or temperature may be monitored and recorded on the Central Data Acquisition System. The overall sampling rate is 12,000 samples/sec. An IBM 360 computer is used for data reduction. The typical time cycle for data processing is three days although this can be reduced to 12 hours for maximum priority tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $1,100	CONSTRUCTION YEAR: 1966 COST $1,976,403 ESTIMATED REPLACEMENT VALUE $3,000,000
CONTRACTOR: NASA FRC (3 major contracts)	LOCATION: Edwards, California

IMPROVEMENTS AND COSTS: (1967) Overhead crane installation (5 ton capacity), Cost $56,000; (1968) Closed-circuit TV station, Cost $25,000; (1969) Numerical control punch machine, Cost $45,000; (1969) Combustible gas alarm system, Cost $11,465; (1969) Data system computer replacement, Cost $199,607.

PLANS FOR FACILITY IMPROVEMENTS: Convert 96-channel analog temperature control system to a 512-channel direct digital control system. Increase power available from 10,000 kVA to 20,000 kVA.

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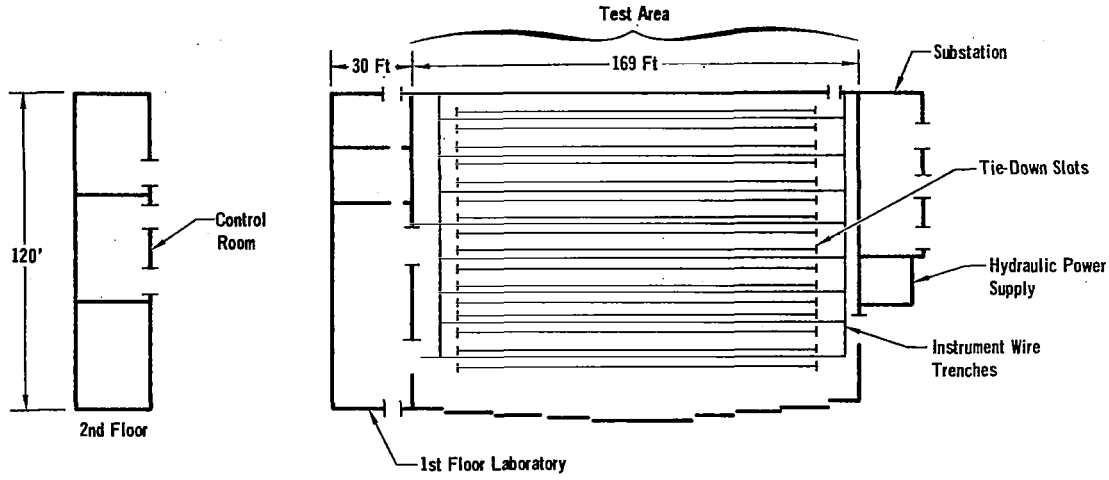


STRUCTURAL TEST CAPABILITIES

Type of Testing Capability	Indicate Types of Testing Avail.	Floor Area Avail. for Testing (ft^2)	Typical Maximum Specimen Size			
			Weight (lb)	Length (ft)	Width (ft)	Height (ft)
Struct. Loads	X	18,000	60K	100	55	40
Struct. Fatigue	-	-	-	-	-	-
Impact or Drop	-	-	-	-	-	-
Thermal	X	18,000	-	100	55	40
Shock	-	-	-	-	-	-
Vibration	X	18,000	60K	100	55	40
Other						

No. of Automatic Temp. Control Channels: 103

Maximum Temp. Attainable (°F): 3000 (Using Radiant Heat)

Maximum Heat Flux Attainable (Btu/ft^2 sec): 100 (over small areas)

Power Supply Capacity (kVA): 20,000 (3 min)
10,000 (Continuous)

Type of Infrared Heaters: Quartz lamps

Quantity of Cooling Air Available (SCFM): 845 @ 60 psig

No. of Programmable Servo Hydraulic Channels: 16

Dead Weight Loading Capability: 100,000 lbs of 25 lb shot bags

STRUCTURALLY REINFORCED TEST AREAS*				
	Size l x w (ft)	Area (ft^2)	Load Capability (lb)	
			Bearing	Shear
Floor	150 X 120	18,000	900 psi	15K 2ft o.c.
Ceiling	-		-	-
Walls	-		-	-

*Areas used primarily for struct. loads and fatigue testing

STRUCTURAL LOAD AND FATIGUE TEST CAPABILITIES

Type of Loading System	No. of Units	Type of Control		Load Ranges (lb)	Pressure Range (psig)	Method of Programming Load/Time Cycles
		Manual	Program			
Hydraulic	14		X	0-50,000	0-3000	Closed loop on Load
Pneumatic	2	X		0-50,000	0-5000	Manual
Electro-Mech.	4	X		0-50	Not Applic.	Freq&Ampl Man.Cont.
Dead Weight	4000	X		25-100,000	Not Applic.	25lb lead shot bags

Type of Structural Test Fixtures Used	
Permanent	
Portable	X
Pre-Fabricated	
(Erector-Set Type)	X
Individual Design	
and Fabrication	X

7. VIBRATION FACILITIES

ACOUSTIC AND MECHANICAL

AFFDL SONIC FATIGUE FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Air Force Flight Dynamics Laboratory Wright-Patterson Air Force Base Ohio 45433	COGNIZANT ORGANIZATIONAL COMPONENT: Vehicle Dynamics Division
OTHER SOURCES OF INFORMATION: Kolb & Magrath, "RTD Sonic Fatigue Facility, Design and Performance Characteristics," Bulletin 37 Suppl, "The Shock and Vibration Bulletin," Jan. 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Aero-Acoustics Branch (FDDA) Phone: (513) 255-5557

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility provides high-intensity sound environments to investigate acoustic fatigue strengths of full-size flight vehicles; aircraft, missile, and spacecraft subassemblies; components; electronic equipment; and transducers. The facility supports studies of acoustic phenomena, bio-acoustics, and advanced research and development work on materials and structures leading to the development of design criteria for construction of acoustic fatigue resistant structures, reduction of sound transmission, and sound proofing. The facility is housed in six buildings and has three sub-facilities. These are The Large Sonic Fatigue Facility, The Small Sonic Fatigue Facility, and The Wide Band Noise Facility. A 106 ft x 60 ft x 60 ft H preparation area equipped with a 20-ton capacity bridge crane exists where large test articles can be assembled and instrumented prior to test. The Large Sonic Fatigue test chamber is of a double-wall construction with approximately 70-ft long x 56-ft wide by 42-ft high inside dimensions and an 18-ft wide by 16-ft high access door. The chamber has retractable anechoic wall curtains and removable anechoic ceiling panels so that acoustic tests can be performed in either a progressive wave mode or a reverberant wave mode. The large access door permits build-up and instrumentation of all but the largest articles in an adjoining preparation area prior to test. The Small Sonic Fatigue Facility consists of a 1-ft by 1-ft by 4.33-ft long progressive wave test section that connects to about a 7.5-ft by 7.75-ft by 15-ft long termination area by means of a 16-ft long catenoidally flared horn. The horn and termination area are of double wall concrete construction with 12-inch inner walls. Access to the termination area is through a 3-ft by 7-ft high door. The Wide Band Noise test chamber is of a double wall construction with approximately 17.5-ft by 14-ft by 10.5-ft high inside dimensions and a 5-ft by 6.6-ft high access door. Acoustic environment is generated by either a wide band siren with four rotors, each of which has individual speed control for limited spectrum shaping, or an air modulator system with either discrete frequency or random frequency generation and spectrum shaping capability. Air to power the acoustic generators is supplied by the compressor for the small facility. When this is done, the small facility can be operated from the air compressor for the large facility.

TESTING CAPABILITIES: The large chamber size of the Large Sonic Fatigue Facility is such that full-size flight, orbital, or reentry vehicles as well as large subassemblies and booster sections can be tested. The large chamber size also permits simultaneous testing of groups of structural specimen arrangements for the development of design criteria. The facility is equipped with an analog and digital data analysis area in which detailed analyses of complex random signals in the audio frequency range are obtained from magnetic tape recordings gathered in the sub-facilities. Access to a large, general purpose, digital computer is also available. Reduced data can be presented in "X-Y" plots or tabular form. Major data analysis equipment consists of octave band, one-third octave band, power spectral density, amplitude probability density, and auto and cross correlation analyzers. The Small Sonic Fatigue Facility permits either progressive wave or reverberant wave acoustic testing. Acoustic research and development studies, sonic fatigue tests on structural panels, components, materials and electronic devices, response and acoustic absorption tests, and bio-acoustics studies are conducted in this facility.

*Note Below: $1325/shift (Small S.F. Fac.) and $1350/shift (W.B, Noise Fac)

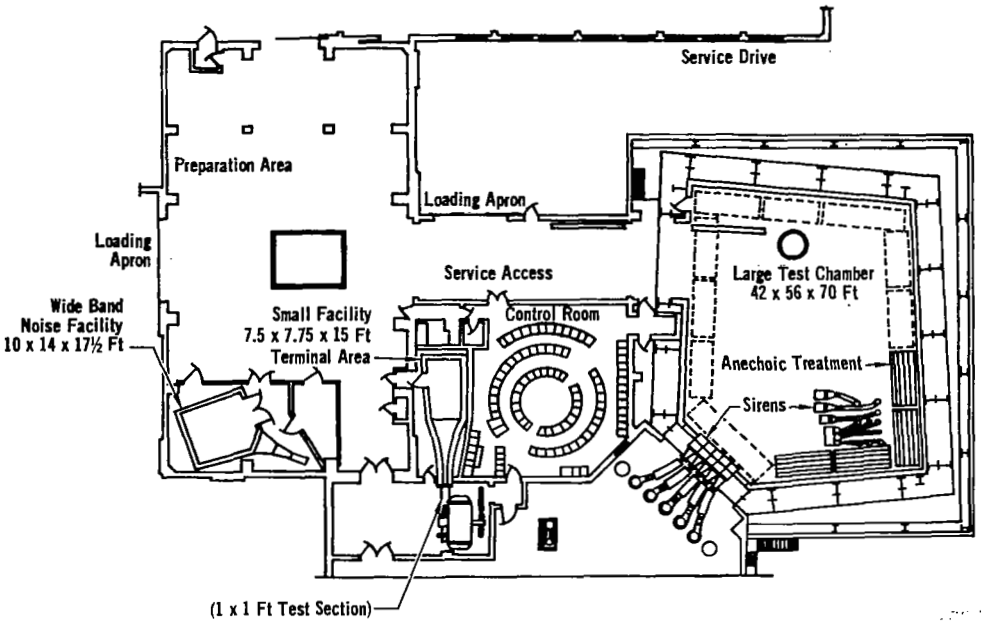
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING:	CONSTRUCTION YEAR: COST $12,500,000
COST (TYPICAL 8 HOUR SHIFT): $3300 Large S.F. Fac.*	ESTIMATED REPLACEMENT VALUE $19,000,000
CONTRACTOR: CHANEY & JAMES CONST. CO., INC.	LOCATION: DALLAS, TEXAS

IMPROVEMENTS AND COSTS: (1965) New inner chamber for wide band noise facility, Cost $15,700; (1966) Relocation of wide band noise facility, Cost $49,000; (1967) 56 channel siren programmer, Cost $78,000; (1967) Honeywell 9300 Power Spectral Density Analyzer, Cost $76,000; (1968) Modification (added 2 channels) to Honeywell 9300, Cost $17,000; (1969) Rapid 1/3 octave analog analyzer, Cost $52,000; (1969) Digital Computer, Cost $76,000.

PLANS FOR FACILITY IMPROVEMENTS: Design work is in progress on a 6-ft W by 12-ft H by 20-ft L progressive wave test section for the Large Sonic Fatigue Facility and design and fabrication work is in progress on an improved wide band noise siren and a wide band siren-air modulator coupling horn for the Wide Band Noise Facility.

SCHEMATIC



FACILITY PERFORMANCE DATA

Facility Operating Envelope

(Not Available)

Test Chamber Type: Reverb. or Prog. wave

Chamber Vol. and Inside Dimensions (ft^3), (ft): 154K, 70x56x42 H

Noise Level Range (dB): 174 (Prog. wave)**
162 (Reverb.)

Frequency Range (Hz): 50-10,000

Acoustic Power (watts): 1 million @ 1000(Hz)

Type of Generator: 26 - (50-2.4K Hz, 40K watt) pure tone sirens,
10 - (500-10K Hz, 10K watt) pure tone sirens

Facility Compressor Air Capability (SCFM): 310K @ 2:1 Press. Ratio

Maximum Specimen Dimensions (feet): Not Available

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability*	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)**	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol, and inside Dimensions (ft^3) (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Pure tone	1	9600 @ 29	Cont.	10,000	to 10K	175	Small Sonic	4.33,1x1x4.33L	
Sirens	1	Same Supply	"	40,000	50-2,4K		Fat. Fac.(PWT)		
WB Siren	1	1600 @ 100	"	18,000	50-12K	158	Wide Band	2.6K, 17.5 x 14 x 10.5H	
Air Modul	1	(Same Supply)"							

*Indicated Compressed Air Available is given as ____ SCFM at ____ psig. **Ref. .0002 dynes/cm^2

BOEING ANECHOIC - REVERBERANT CHAMBER

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
The Boeing Company Commercial Airplane Group P.O. Box 3707 Seattle, Washington 98124	COGNIZANT ORGANIZATIONAL COMPONENT: Aircraft Noise Group
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Acoustics Laboratory Mr. R. M. Wray Phone: (206) 655-3816

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of an anechoic chamber and a reverberation chamber installed side by side with an interconnecting opening 6 feet by 6 feet between the two chambers. The anechoic chamber has a working volume 8.33 x 11 x 8 ft high. The reverberation chamber has inside dimensions of 17.67 x 22 ft with a 13.5-ft high ceiling. Both chambers have 4 x 7-ft doors. Both chambers are double-wall construction with an air space between the two walls to allow for isolation of the inner rooms. Electrical power up to 208 volts is available.

TESTING CAPABILITIES:

Anechoic Chamber

Absorption coefficients of wedges

100 Hz	.99
125	.99
250	.99
500	.99
1000	.99
2000	.99
4000	.99
8000	.99

Sound Pressure Level
Deviation from inverse square law:
100-120 Hz ± 1 1/2 dB
120-20,000 Hz ± 1 dB

Sound Attenuation from Exterior Noise Not Less Than:

Preferred octave bands	31.5	63	125	250	500	1000	2000	4000	8000
Noise reduction dB	20	35	48	64	79	81	79	83	80

Reverberation Chamber

Minimum usable frequency of 100 Hz.

Absorption coefficients of walls

125 Hz	.07
250	.05
500	.04
1000	.05
2000	.04
4000	.07

Sound Attenuation from Exterior Noise Not Less Than:

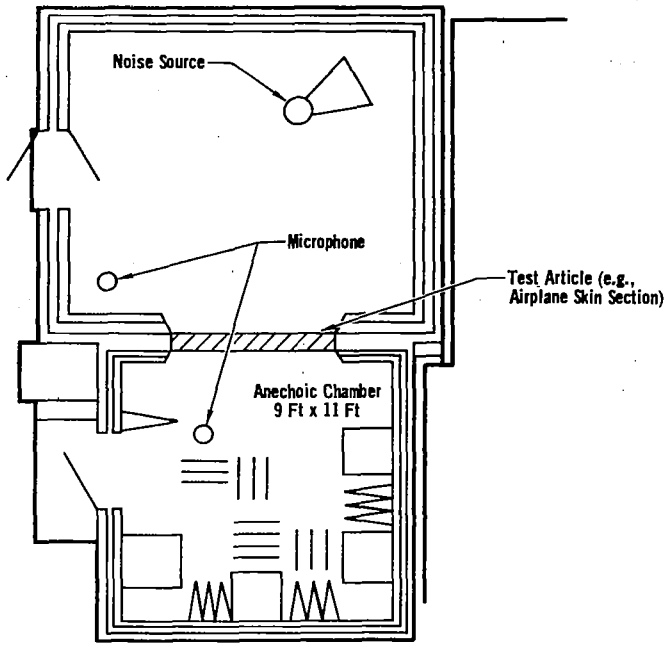
Preferred octave bands	31.5	63	125	250	500	1000	2000	4000	8000
Noise reduction dB	24	28	32	47	55	62	72	72	68

FACILITY COST HISTORY

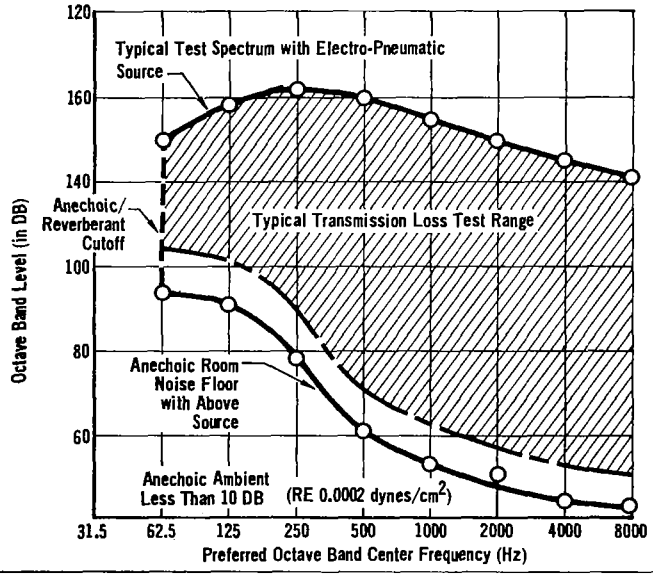
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1969 COST $176,000 ESTIMATED REPLACEMENT VALUE $176,000
CONTRACTOR: The Boeing Company	LOCATION: Seattle, Washington
IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA



Test Chamber: Anechoic and Reverberant

Chamber Vol. and Inside Dimensions (ft^3), (ft)
(Anechoic): 733, 8.33 x 11 x 8
(Reverberant): 5225, 7.7 x 22 x 13.5

Noise Level Range (dB): 150 (Overall)*

Frequency Range (Hz): 10-10,000

Acoustic Power (watts): 2000

Type of Generator: Electro-pneumatic

Facility Compressor Capability (CFM): 1000 at 300 psi

Vacuum Capability: 100 SCFM at 20 in Hg
200 SCFM at 10 in Hg

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)*	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
None									

*Ref. .0002 dynes/cm^2

BOEING SONIC TEST FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
The Boeing Company Commercial Airplane Group Development Center, Bldg 9.80 Seattle, Washington 98124	COGNIZANT ORGANIZATIONAL COMPONENT: Dynamics Group, G-8694
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mr. A.H. Kuhn Phone: (206) 655-4377

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of a separate building containing test cells, instrumentation and control, compressors and receivers, office, and shop areas. The reverberation test cell, 690 ft^3, has a reverberation time of approximately four seconds, with absorption coefficient varying from .01 to .02 as the frequency changes from 100 to 2000 Hz. The progressive wave test cell, 30 ft x 13 ft, accommodates either a 600-square-inch cross section horn (three transducers) or a 210 square inch cross section horn (two transducers). Three Ling EPT-110 transducers have a combined capacity of 60,000 acoustical watts.

TESTING CAPABILITIES: Maximum SPL available with the 210-square-inch test area is 170 dB. Both sinusoidal and random development and endurance tests are routinely run at this facility, and various special test horns are also available for unique shaped specimens.. Data analysis equipment consists of:
(1) Analog

Spectra: Make: B&K Audio Spectrometer
Type: 2112
Frequency: 40,000 Hz
Bandwidth: 1/3 and 1/1 octave
Probability density: (See digital)

(2) Digital

Type of computer: SDS sigma II
Type of A-D Converter: Astrodata
Number of Channels: 2
Analogue to digital conversion rate
per channel: 320,000/sec down to 312.5/sec.
Number of bits
per channel: Same
Form of Output: Plotted, listed or magnetic tape

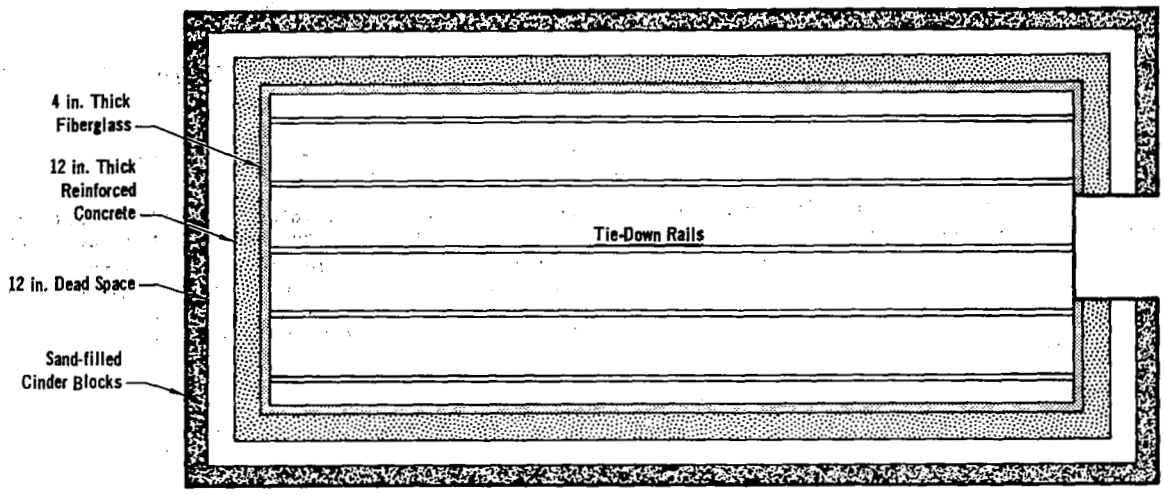
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: (1968) Additional Acoustic Transducer	

PLANS FOR FACILITY IMPROVEMENTS: On-line random equalization using computor; 400 square foot test cell expansion.

SCHEMATIC

Progressive Wave Test Cell



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Test Chamber Type: Progressive Wave Test cell

Chamber Vol. and Inside Dimensions (ft^3), (ft): 4680, 30x12x13

Noise Level Range (dB): Up to 172**

Frequency Range (Hz): 50 to 10K

Acoustic Power (watts): 60,000

Type of Generator: Ling EPT-110 (three each) (600 sq in, 210 sq in)

Facility Compressor Capability (SCFM): 3K @ 125 psig (Facility) 10K @ 125 psig (Plant)

Maximum Specimen Dimensions (ft): 6.65 x 3.34

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability*	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)**	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Horn	3	13K @ 125		60,000	2000	172	Reverberation	670, 7x9x11	80 x 40

*Indicated Compressed Air Available is 13K SCFM at 125 psig. **Ref. .0002 dynes/cm^2

GENERAL DYNAMICS/CONVAIR ACOUSTICS LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
General Dynamics Corporation Convair Division P.O. Box 1128 San Diego, California 92112	COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: P. T. Gardner, Department 578-00 Phone: (714) 277-8900, ext 1735

DESCRIPTION AND TESTING CAPABILITIES

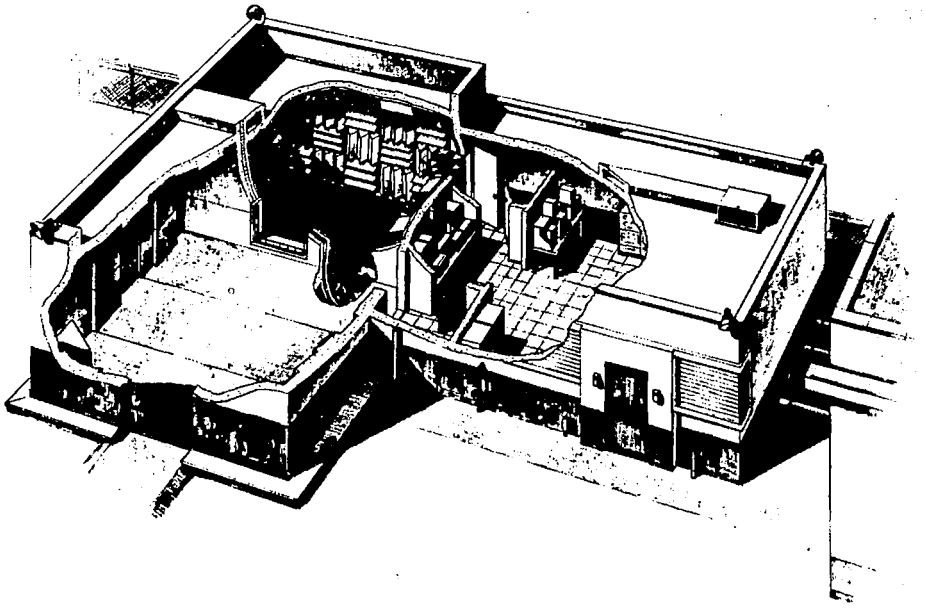
FACILITY DESCRIPTION: The Acoustics Laboratory comprises three reverberation chambers and a sonic fatigue facility. The three reverberation chambers with volumes of 1000 cu ft, 100 cu ft, and 9 cu ft are available for establishing high-intensity diffuse sound fields. In addition, a 35 by 26 by 22 foot high concrete building serves as a reverberation room. Sound surveys of all types can be made, either in the facility, or with completely portable self-powered equipment. Overall levels, octave band, half-octave band, and one-third octave band analysis can be readily obtained. The Sonic Fatigue Facility is used for determining the sonic fatigue resistance of various structures. A progressive wave tube establishes sound levels up to 170 dB at discrete frequencies from 50 to 1200 Hz. High or low temperature environments can be provided.

TESTING CAPABILITIES: The laboratory subjects aerospace components and subsystems to high-intensity acoustic environments to determine their reaction to the resultant forces. Using electropneumatic transducers as the sound source, discrete frequencies or shaped spectra can be produced. Reverberation chambers, an anechoic chamber, or progressive wave tubes are utilized for diffuse field testing, acoustic-free field applications, and sonic fatigue tests. Complete facilities for acoustic data acquisition and analysis are available.

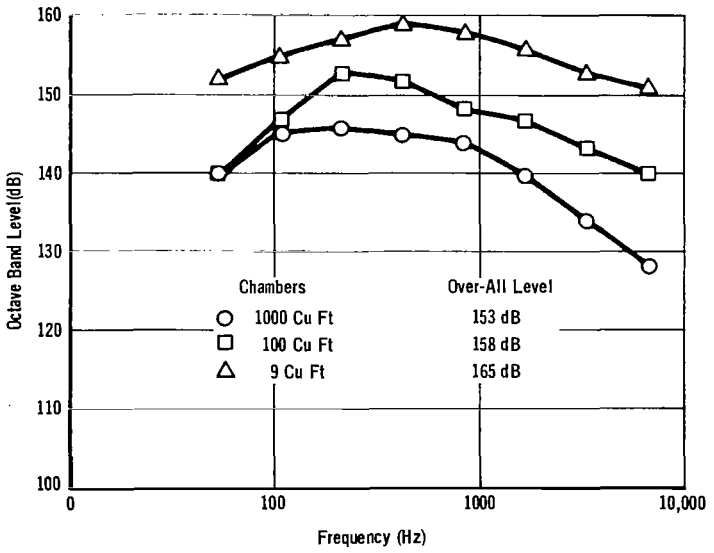
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: No operator response on this item.

SCHEMATIC



FACILITY PERFORMANCE DATA



LARGE REVERBERATION ROOM

Test Chamber Type:	Reverberation
Chamber Vol. and Inside Dimensions (ft^3), (ft):	20K, 35 x 26 x 22H
Noise Level Range (dB):	120*
Frequency Range (Hz):	50 to 10,000
Acoustic Power (Watts):	2000
Type of Generator:	Speakers
Facility Compressor Air Capability (SCFM):	Not Available
Maximum Specimen Dimensions (feet):	22 x 22 x 20

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)*	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
EPT 94B	2	200 lb/sec from High Speed Wind Tunnel Comp	Continuous	8000	50-10K	153	Reverberation	1000	108x90x96
					50-10K	158	Reverberation	100	24x24x48
					-	165	Reverberation	9	12x12x12
					50-1.5K	170	Prog. Wave	-	4 x 6

*Ref. .0002 dynes/cm^2

GENERAL DYNAMICS/ ELECTRIC BOAT DIVISION ACOUSTIC TEST FACILITY

REPORTING INSTALLATION: General Dynamics Corporation Electric Boat Division Groton, Connecticut 06340	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Research and Development Ship Silencing Department 413
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Test and Engineering Services R & D Phone: (203) 446-3860

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The General Dynamics/Electric Boat reverberation room is located in the Robinson Research Laboratory. The room volume is approximately 5000 ft^3 with dimensions 17-ft x 21.5-ft x 13.5-ft high. The room has 12-in. thick concrete walls and is structurally isolated from external noise sources. A rotating vane is used to produce a diffuse sound field. The room has three transmission windows: (1) 5 ft x 5 ft, (2) 3 ft x 3 ft, and (3) 2 ft x 4 ft. The room is equipped with a sound trap to permit airflow through the room without influencing the ambient. Also, two flush-mounted 10-ton seismic masses are available, one inside the room and one outside.

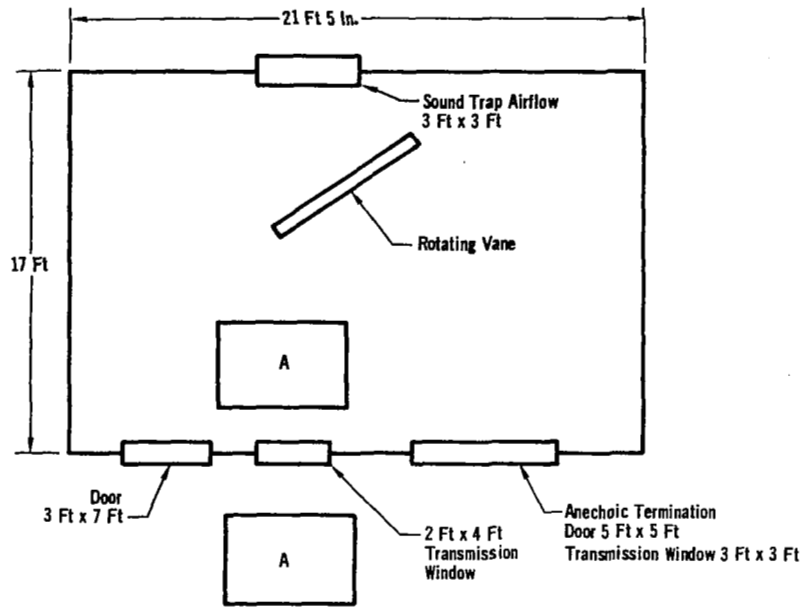
TESTING CAPABILITIES: This facility can be used to make three basic acoustic measurements: (1) total airborne source strength (sound power level) of components such as fans, motors, air conditioning units, etc.; (2) sound transmission loss tests; (3) sound absorption tests. A 5-ft x 5-ft anechoic box is available to provide an anechoic termination for sound transmission loss tests. A complete line of sound and vibration instrumentation is available. Data are recorded on a 14-channel magnetic recorder or strip chart tape and reduced on site with a spectrograph.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



A = Two flush mounted 10 ton seismic masses.

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Test Chamber Type:	Reverberation
Chamber Vol. and Inside Dimensions (ft^3), (ft):	5000 17 x 21.5 x 13.5
Noise Level Range (dB):	Not Available
Frequency Range (Hz):	Not Available
Acoustic Power (Watts):	Not Available
Type of Generator:	Not Available
Facility Compressor Air Capability (SCFM):	Not Available
Maximum Specimen Dimensions (feet):	Not Available

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
None									

GENERAL DYNAMICS/FORT WORTH ACOUSTIC TEST FACILITY

REPORTING INSTALLATION: General Dynamics Corporation Fort Worth Division P.O. Box 748 Fort Worth, Texas 76101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager, Engineering Test Laboratories Phone: (817) 732-4811, ext 2203

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is equipped with an automatically controlled siren which is coupled through a catenoidal horn to an anechoic test chamber measuring 6x6x12 feet. This system is primarily used to test structural panels with normal and parallel incidence sinusoidal noise. The output sound pressure level limits of the siren are 185 dB at 94 Hz (horn cutoff frequency) and 165 dB at 2000 Hz. An air modulating valve capable of 30,000 acoustic watts is coupled through a catenoidal horn to a reverberation chamber measuring 3.78 x 4.74 x 6 feet. This system is used for qualification testing of components and electronic packages and will provide a wide band random noise level of 165 dB. Provisions for shaping the spectrum are available through the use of a 26-band, 1/3 octave equalizer. The control microphone is monitored on a real-time one-third-octave analyzer during test operation.

TESTING CAPABILITIES: The acoustic testing facility has been used to develop structural aircraft panels and provide simulated environments for endurance testing and sonic fatigue problem solution. Qualification testing has been accomplished on B-58 and F-111 systems and components. Special test setups have been made to provide a simulated acoustic environment for testing of cryogenic insulation material in a nuclear environment. Other special test setups are available by using a portable air modulating valve and custom fabricating the required noise enclosure.

Instrumentation is available for monitoring specimen parameters and environmental conditions during a test. Signals from transducers such as accelerometers, strain gages, crack detectors, and microphones are recorded on magnetic tape during the test. The tapes are returned to the data play-back station for processing and plotting.

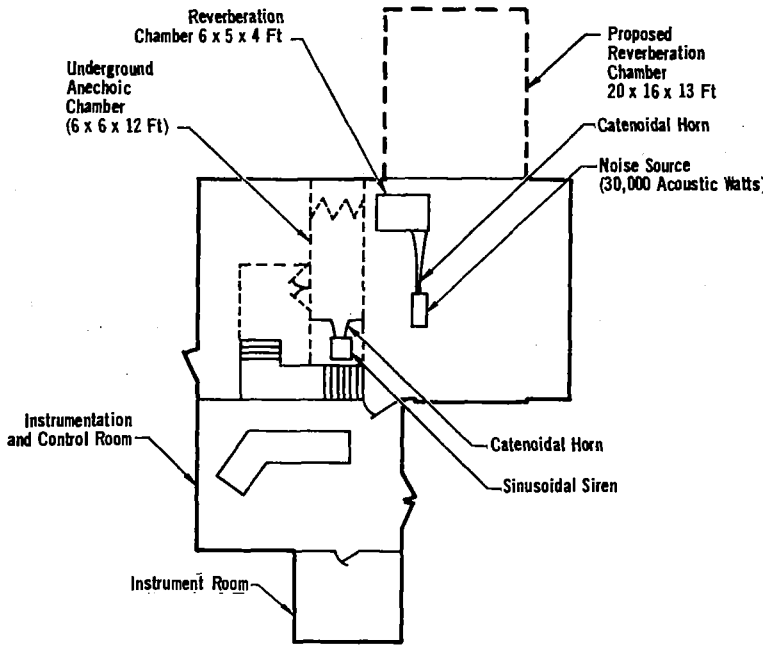
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $400	CONSTRUCTION YEAR: 1957 COST $ 75,000 ESTIMATED REPLACEMENT VALUE $250,000
CONTRACTOR: General Dynamics and Sub-contractors	LOCATION: Fort Worth, Texas

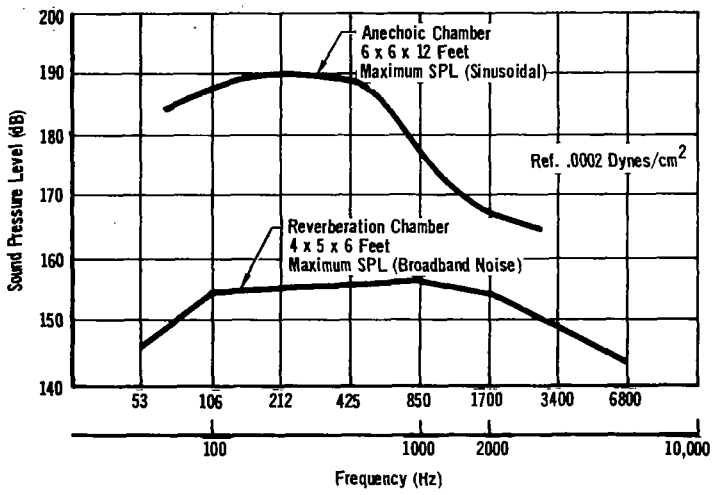
IMPROVEMENTS AND COSTS: (1968) Reverberation chamber and horn, Cost $4500; (1968) Air modulating valve, Cost $13,000; (1969) Equalizer-Analyzer, Cost $21,000; Other improvements plus total through 1969, Cost $113,500.

PLANS FOR FACILITY IMPROVEMENTS: A new reverberation chamber,with dimensions of 12 ft x 16 ft x 20 ft is planned for addition to the existing facilities.

SCHEMATIC



FACILITY PERFORMANCE DATA



Test Chamber Type: Anechoic

Chamber Vol. and Inside Dimensions (ft^3),(ft): 432, 6x6x12

Noise Level Range (dB): 185*

Frequency Range (Hz): 94-2000

Acoustic Power (watts):

Type of Generator: Sinusoidal Sirer

Facility Compressor Air Capability (SCFM): 8000 @ 60 psig

Maximum Specimen Dimensions (ft): 4 x 4 x .5

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)*	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Air Modulator	1	8K SCFM at 60 psig	Continous	30,000	53-6.8K	160	Reverberation	102,3.78x4.74 x6	24x24x36

*Ref. .0002 dynes/cm^2

LTV ACOUSTIC LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
LTV Aerospace Corporation Unit 2-53830 P.O. Box 5907 Dallas, Texas 75222	COGNIZANT ORGANIZATIONAL Structural Dynamics
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: R. N. Hancock, Unit 2-53830 Phone: (214) 266-2419

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Acoustics Laboratory has a floor area of 7800 sq ft and was completed in early 1969. It houses the acoustic test facilities, acoustics and vibration data analysis systems, and the offices for the laboratory staff. The test facility controls and monitoring equipment are located in the instrumentation laboratory. Tests requiring large quantities of customer checkout equipment can be accepted without difficulty. Similarly, desk space can be provided to accommodate customers witnessing tests of long duration. Three reverberation chambers are available including: (1) A 5,700-cu-ft reverberation chamber, (2) A 5,000-cu-ft anechoic/reverberation chamber, and (3) A 400-cu-ft reverberation chamber. The 5,700-cu-ft chamber is equipped with large access doors that will permit the installation of major structural components. The high intensity acoustic performance of this chamber is illustrated by the typical octave-band spectrum shown in the figure on the opposite page. The spectrum is compared with a current qualification spectrum from MIL Std 810.

The chamber is arranged beside the 5,000-cu-ft chamber for the purpose of transmission loss testing. Apertures are located in both adjacent walls and these are separately closed by concrete doors when not in use. These openings are sized to test portions of fuselage structure such as a 10 ft by 8 ft section of sidewall from an aircraft. The 5,000-cu-ft chamber is currently used in its reverberant configuration; a demountable anechoic treatment is to be installed in 1970. To minimize the effects of ground vibrations the chamber was constructed with a floating floor which is supported by a fiberglass isolator pads. The 400-cu-ft chamber provides a capability for high-intensity testing of electronic packages and similiar frangible equipment. It is located adjacent to the instrumentation laboratory to minimize the length of cable on monitoring consoles where required. An observation window permits viewing of the specimen during tests. The test cell, which houses the above chambers, is of reinforced concrete construction and also serves as a reverberation test chamber of 70,000-cu-ft volume for tests on very large specimens. Levels of up to 148 dB can be achieved in the cell with present generation equipment.

For high intensity acoustic testing a total of 20,000 watts of acoustic power is available from electropneumatic generators (10, Ling Electronic EPT 94 units). These are operable in broad-band or sine modes. The systems are used to drive fixed facilities or can be utilized in conjunction with special facilities tailored to the specific requirements. Typical performance data for an existing progressive wave facility using four transducers is shown in the figure on the opposite page. Spectrum shaping is possible with one-third-octave or full-octave filters.

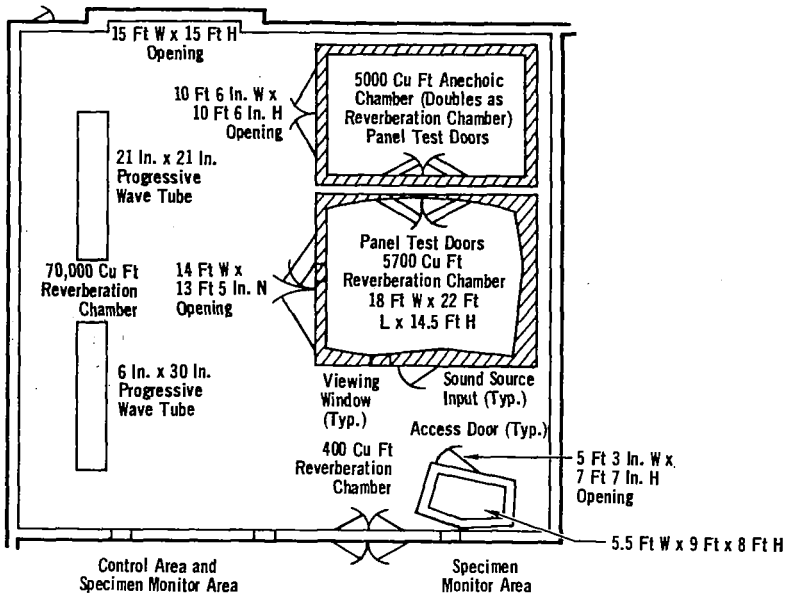
TESTING CAPABILITIES: The acoustic facilities have been used for sonic fatigue testing for development and proof testing. Aircraft projects include the XC-142 and the Boeing 747. Reverberation tests have been performed to qualify equipment packages in the small chamber, and major missile payloads in the larger chamber. The instrumentation laboratory is fully equipped for acquisition and reduction of random data. Extensive analysis programs have conducted on the A-7 and XC-142 in flight and on the ground. Data reduction equipment includes three near real-time analyzers in addition to usual signal averaging analyzers. Sound pressure measurements are made with Altec 21BR microphone systems.

FACILITY COST HISTORY

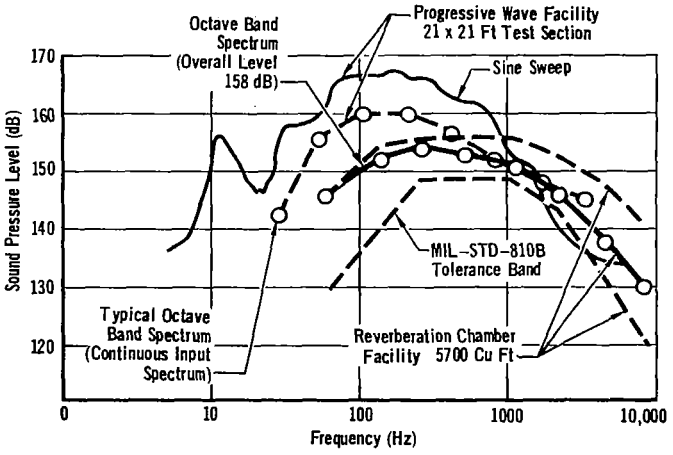
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $500 (Approx.)	CONSTRUCTION YEAR: 1969 COST: * ESTIMATED REPLACEMENT VALUE:
CONTRACTOR:	LOCATION:
IMPROVEMENTS AND COSTS: * Cost is not availabe in that it is included in total cost of other combined facilities and is not itemized.	

PLANS FOR FACILITY IMPROVEMENTS: Acquisition of two EPT 110 sound generators during 1971-72; complete anechoic chamber in 1970.

SCHEMATIC



FACILITY PERFORMANCE DATA



INTERMEDIATE REVERBERATION CHAMBER

Test Chamber Type:	Reverberation
Chamber Vol and Inside Dimensions (ft^3), (ft):	5.7K, 18 x 22 x 14.5H
Noise Level Range (dB):	158**
Frequency Range(Hz):	50-10,000
Acoustic Power (watts):	20,000
Type of Generator:	Electropneumatic (10-Ling Electronic EPT 94 Units)
Facility Compressor Air Capability (SCFM):	5000 @ 100 psig
Maximum Specimen Dimensions (ft):	14 x 13 Door

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc.)	No. of Generators Avail.	Facility Compressor Air Capability*	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)	Test Chamber Type(Reverb, Acoustic, Anechoic, etc.)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Same source for all Chambers	10	5K @ 100	Continuous	20,000	50-10K	168	Reverberation	400	90x63 Door
	10	5K @ 100		20,000	50-10K	146	Reverberation	7K, 60x55x21	180x180 Door
	4	5K @ 100		8,000	50-1K	170	Prog Wave Tube	3x.75x4	36x48 Door
	4	5K @ 100		8,000	50-1K	170	Prog Wave Tube	1.75x1.75x4	15x16x4

*Indicated Compressed Air Available is____SCFM at____psig. **Ref. .0002 dynes/cm^2

LOCKHEED LARGE VEHICLE ACOUSTIC TEST FACILITY (LVATF)

REPORTING INSTALLATION: Lockheed Missiles and Space Co. Missile Systems Division 1111 Lockheed Way, Box 504 Sunnyvale, California	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Space Systems Division
OTHER SOURCES OF INFORMATION: (1) LMSC, "Large Vehicle Acoustic Test Facility," LMSC-680923, 1968; (2) LMSC, A 964892, 1970	LOCAL OFFICE TO CONTACT FOR INFORMATION: Acoustic Test Group Phone: (408) 742-1861

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The building that constitutes the LVATF has an area of 36,000 sq ft and contains four test cells, a progressive wave-tube, a systems-control/data room, office space, and shop space. There are two vehicle preparation areas: a high bay and a low bay. The high bay is 60 ft wide, 184 ft long, and 122 ft high. The low bay is 30 ft wide, 90 ft long, and 44 ft high. The complete facility includes three acoustic reverberation cells and one anechoic (echo-free) cell. Acoustic energy is generated by 12 Ling Electronics EPT 200 transducers and four Wyle WAS-3000 transducers generating a maximum acoustic power of 240,000 watts in anechoic termination. The transducers are driven by gaseous nitrogen capable of delivering a continuous flow of 35,000 SCFM. Liquid nitrogen, which is kept in a central storage area, is converted by a heat exchanger to supply the gaseous nitrogen at 70°F for delivery to the transducers. This acoustic energy can be used in any of the four test cells, and in the progressive wave-tube.

TESTING CAPABILITIES: This facility has the capability for development, qualification, and acceptance testing of aerospace equipment and vehicles subjected to high-intensity acoustic environments. It can accept vehicles up to a size of 22 ft in diam by 70 ft high and can subject specimens to a combined direct or reverberant sound field simulating the complex acoustic environments to which a vehicle would be exposed. Noise spectrum control is achieved by means of one-third-octave bands. The control system is capable of spectrum shaping in the frequency range from 25 to 2500 Hz.

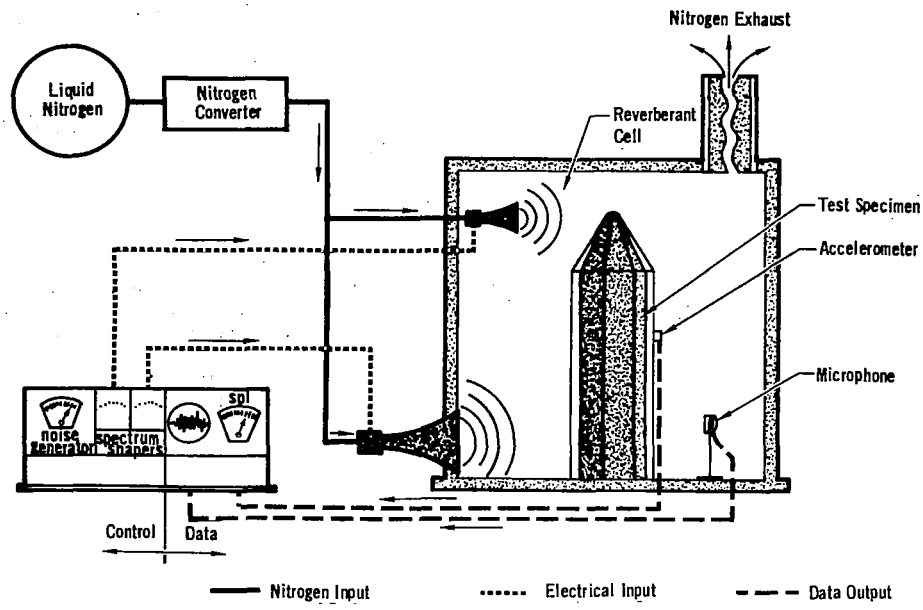
A central digital system within the LVATF provides control, data acquisition, and analysis. The system comprises a digital subsystem and an analog subsystem. The digital subsystem, consisting of the computer and the digitally controlled peripheral equipment, performs the functions of spectrum control, data acquisition, data storage, and data analysis. The subsystem is capable of sampling up to 140 data channels in groups of 14 channels at a rate sufficient to obtain resolution to 2500 Hz. Sampling of smaller groups permits extension of the frequency range to 10,000 Hz. The analog subsystem, consisting of signal-conditioning, recording, switching, and monitoring equipment, enables the 140 channels of analog data to interface with the digital acquisition system. The data channels are programmable through patch panels and coaxial switches; 28 channels are on-line continuously, and 112 channels can be selected from 8 groups of 14 channels each. Data reduction capabilities include one-third-octave band and narrow band Power Spectral Density plots, a portion of which may be obtained in real-time.

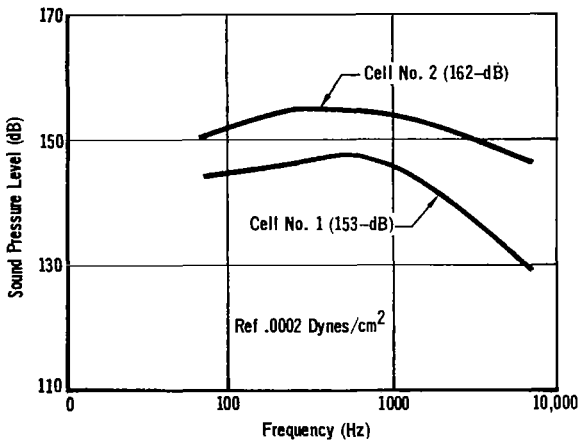
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $5,000,000 (plus) ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC





TEST CELL 1

Test Chamber Type:	Reverberation
Chamber Vol. and Inside Dimensions (ft^3), (ft):	189K, 44x50x86H
Maximum Broadband SPL (dB):	156*.
Frequency Range (Hz):	40 - 10,000
Acoustic Power (watts):	240,000
Type of Generator:	12 Ling EDT 200 Air Modulators & 4 Wyle WAS 3000 Transducers
Facility Compressor Capability (SCFM):	35,000 (gaseous Nitrogen)
Maximum Specimen Dimensions (ft):	(LVATF) 22 Diam x 70H

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)*	Test Chamber Type (Reverb, Acoustic Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Air Modulators	(Same as	Test Cell No. 1)	Continuous	240,000	25-10K	162.5 165 - 173	Reverb (Cell 2) Reverb (Cell 3) Anechoic (Cell4) Prog.Wave-Tube	16K, 20x26x31H 8K, 16x20x25H 30K, 31x31x31H 1.1 ft^2, .5x.5	156D x 300H 72D x 240H 48D x 120H

*Ref. .0002 dynes/cm^2

MCDONNELL DOUGLAS ACOUSTICS LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Douglas Astronautics 3000 Ocean Park Blvd. Santa Monica, California 90406	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Environmental Laboratories Branch
OTHER SOURCES OF INFORMATION: MDAC-WD, "Engineering Laboratories Facilities Catalog," January 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief Environmental Laboratories Phone: (213) 399-9311, ext 2462

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Acoustics Laboratory performs design evaluation and qualification tests on various space vehicle and aircraft components. These tests determine the ability of the subjected test specimen to perform in a simulated flight environment. Tests can be performed in any of four different test facilities. Two reverberation chambers, one 1,000 ft^3 and the other 10,000 ft^3 in volume, are used to simulate the noise radiated from a propulsion system or from any type of diffuse sound field. Progressive wave tubes (PWT) are used to simulate the fluctuating pressures that occur on a vehicle in flight caused by boundary layer turbulence. Two PWT's are available; one has a 6 in. x 60 in. cross section and will test panels up to 5 feet high and 10 feet long; the other has an 18 in. x 18 in. cross section and will test panels up to 1.5 feet high and 10 feet long. An anechoic chamber is also available for measuring the noise output of various components. The chamber has a volume of approximately 10,000 ft^3 inside the wedges and has a cut-off frequency of 100 Hz.

TESTING CAPABILITIES: The laboratory has performed tests on Saturn SIVB, Spartan, MOL, and is currently testing Orbital Workshop components and structures. Tests have been made on the full-scale Spartan Warhead and Guidance Section using special PWT's designed by the laboratory. Similar tests were made on full scale structural components of the MOL. The sound sources for the facilities of the laboratory are of the air modulator type, specifically Ling EPT 94B and EPT 200. The laboratory is presently capable of producing 40,000 acoustic watts in any of the test facilities, sinusoidal or broad band random. Modifications now in the planning stage will increase the power inputs to the two reverberation chambers to 60,000 acoustic watts. Maximum sound pressure level of 170 dB is attainable.

The laboratory is capable of recording and reducing data from microphones, accelerometers, strain gages, or other types of instrumentation. Data recording is accomplished by direct means or with FM magnetic tape records using multiplex equipment. 300 data channels are available. Data reduction is accomplished either digitally or with analog equipment. The typical time cycle for data processing is 24 hours (depending on quantity). Twenty microphone systems are available of the condenser type including the Bruel and Kjaer or Altec Lansing types.

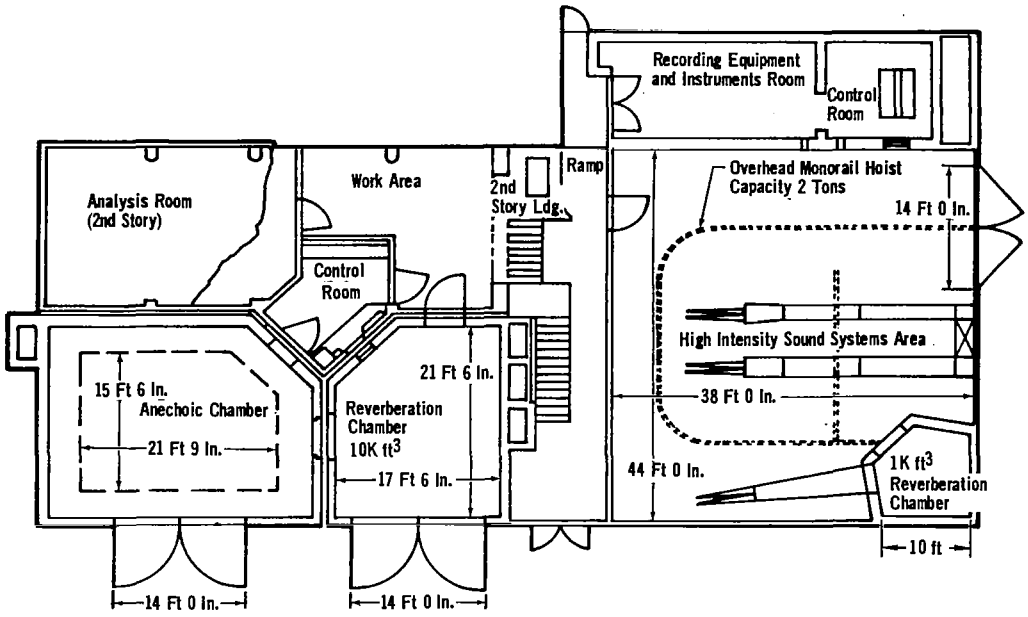
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1956 COST $202,156 ESTIMATED REPLACEMENT VALUE $577,000
CONTRACTOR: Herb Goldsworthy	LOCATION: Santa Monica, California

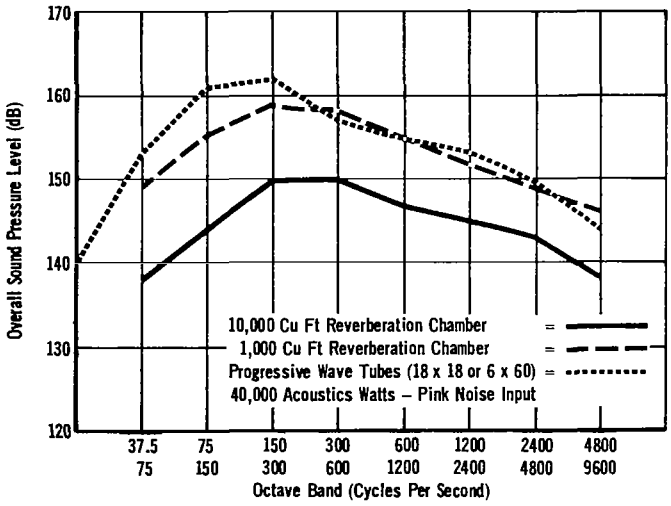
IMPROVEMENTS AND COSTS: (1961) 1000 cu ft reverberation chamber and progressive wave tubes, and air modulator system (Ling EPT 94B), Cost $150,000; (1969) EPT 200 System, Cost $110,000.

PLANS FOR FACILITY IMPROVEMENTS: Long range plans: additional EPT 200 noise generators and pneumatic source facilities.

SCHEMATIC



FACILITY PERFORMANCE DATA



Test Chamber Type:	10K cu ft Reverberation
Chamber Volume and Inside Dimensions (ft^3), (ft):	10K, 18 x 21 x 28
Noise Level Range (dB):	to 170*
Frequency Range (Hz):	50 - 1250 (Controllable)
Acoustic Power (watts):	80,000
Type of Generator:	Air Modulator: (10)-EPT 94 B's (4)-EPT 200's
Facility Compressor Air Capability (SCFM):	4500 @ 40 6000 @ 30
Maximum Specimen Dimensions (feet):	1000 ft^3

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc.)	No. of Generators Avail.	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (db)	Test Chamber Type (Reverb, Acoustic, Anechoic, etc.)	Chamber Vol. and inside Dimensions (ft^3), (ft)	Maximum Specimen Dimension (lxwxh) (inches)
Same Source as above		9K SCFM at 40 psig	Continuous	-	-		Reverb. Prog. Wave Tube Prog. Wave Tube	1000,10x10x10 .5 x 5 1.5 x 1.5	100 (ft^3) 60 x 120 18 x 120

*Ref. .0002 dynes/cm^2

NASA-MSC SPACECRAFT ACOUSTIC LABORATORY
(Building 49)

REPORTING INSTALLATION: NASA- Manned Spacecraft Center Houston Texas 77058	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structures and Mechanics Division Structural Dynamics Branch
OTHER SOURCES OF INFORMATION: NASA, "Concept, Design, and Performance of the MSC Spacecraft Acoustic Laboratory," NASA Technical Memorandum TMS-38017	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structural Dynamics Branch Phone: (713) 483-3166

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory is used for fluctuating-pressure qualification testing of manned spacecraft in the launch configuration and orientation (vertical). The laboratory is housed in a 60-foot by 70-foot by 105-foot high tower which consists of a structural steel framework with concrete panels for the exterior walls. The structure will accommodate a vehicle up to 30 feet in diameter and 85 feet in height. A door 39-feet high and 32-feet wide provides access for bringing individual spacecraft modules into the laboratory. The laboratory is serviced by a 75-ton fixed-point hoist which is used for stacking modular components of an integrated spacecraft and can be used to suspend a spacecraft during testing. A 5-ton, circular bridge crane is used for general purpose material handling and for handling test shrouds. Permanent-type platforms are located at elevations of 15, 30, 45, 60, and 75 feet. Movable platforms can be located at the same elevations. The movable platforms are essentially 3-foot wide catwalks which are used to encircle the test vehicles for assembly, servicing, and other preparatory activities. An elevator 5-feet wide, 7-feet deep, and 8-feet high is used to lift personnel and equipment to the various levels and to the control room. Pneumatic and electrical utility connections, communications stations, and instrumentation and cable chases are located throughout the laboratory.

TESTING CAPABILITIES: Tests conducted in the laboratory include: (1) Complete system evaluation of integrated spacecraft vehicles (which can include almost all electrical, mechanical, and structural systems), (2) Tests made on individual modules, such as the Apollo Command/Service Module, and (3) Tests of empty spacecraft modules (that is, without internal systems installed). Three modes of testing are used in the laboratory: progressive-wave testing (the primary mode); progressive wave-reverberant fill-in (the secondary mode); and full reverberant testing (the tertiary mode).

In progressive wave tests, the exposed surface of a test vehicle is enveloped by controlled high-intensity sound. Sixteen separate progressive-wave sound fields are directed downward over the vehicle in separate ducts (or shrouds) which encircle it. The shape of the ducts is adjustable so that specified sound pressure levels (SPL) can be achieved along the longitudinal axis of the test vehicle. Sound energy is supplied by 16 air-modulators which are electrically programed and have an output of 10,000 acoustic watts. The air-modulators are suspended from the top platform in the tower and are attached to coupling horns which are connected to the ducts. The air-modulators are independently controlled so that the correlation of the acoustic fields in the ducts can be programmed. The 160,000 acoustic watts of power generated by the air-modulators provide an overall SPL of 169 dB at the horn-duct interface (shoulder of Apollo vehicle). In progressive wave-reverberant fill-in tests the shrouds are removed from the horns and replaced with extension horn (flare) sections which couple the acoustic energy to the room volume. Thus, the lower portion of the vehicle is subjected to reverberant loading. In full reverberant testing, relocation of the air-modulators and associated horns is required. In this mode of operation, the 160K acoustic watts of power generated by the air-modulators provide an overall SPL of 153 dB. The air-modulators require a large volume of air (approx 27K SCFM) which is supplied by an air compressor driven by a 4500 HP motor.

*- Note Below: Cost history is for the SAL and the SVL combined.

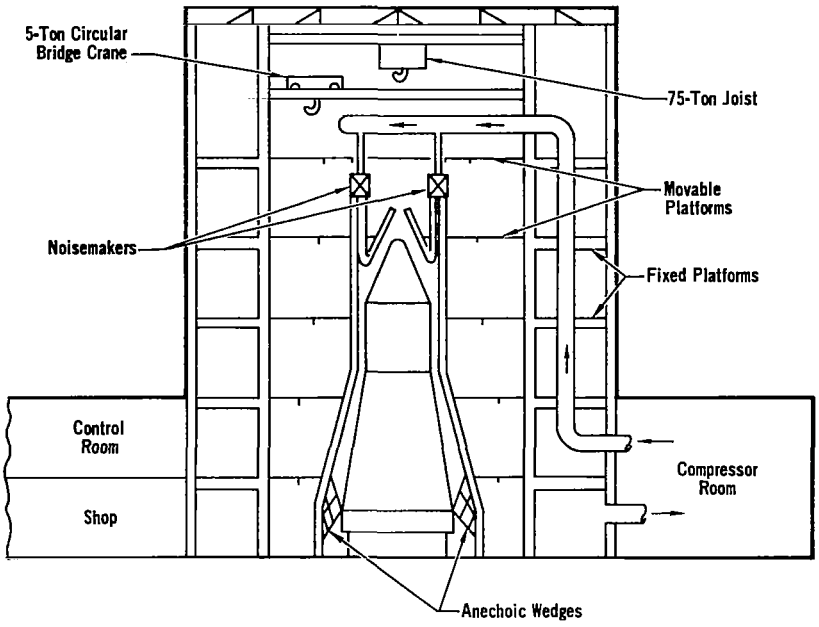
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1965 COST $4,520,571 ESTIMATED REPLACEMENT VALUE $7,000,000
CONTRACTOR: C. H. Leavall & Co./Morrison-Knudsen CO./ and Cheney and James Construction Co.	LOCATION: Houston, Texas

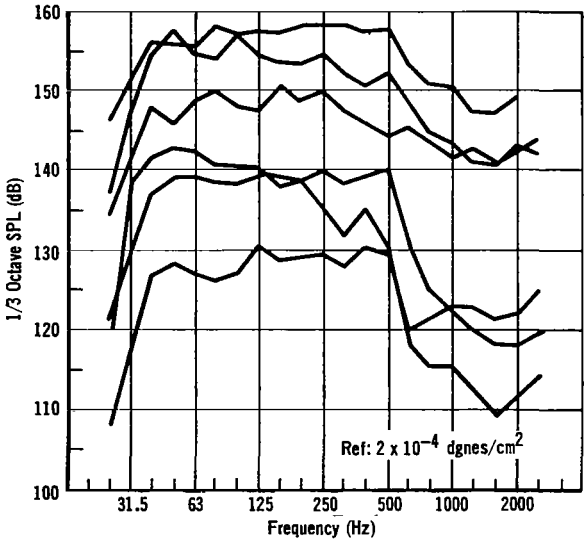
IMPROVEMENTS AND COSTS: (1966) Removable platforms for Vibration Lab., Cost: $10,244; (1967) Installation of removable platforms in Vibration Lab., Cost: $35,878; (1968) Air supply systems modifications, Acoustic Lab., Cost: $60,624; (1969) Five ton auxiliary hoist, Cost: $23,794.

PLANS FOR FACILITY IMPROVEMENTS: Control room modifications and upgrade elevator.

SCHEMATIC



FACILITY PERFORMANCE DATA



Test Chamber Type: Progressive Wave, Progressive Wave Reverb Fill-In, or Full Reverb

Chamber Vol. and Inside Dimensions (ft^3), (ft): 441K, 60 x 70 x 105H

Noise Level Range (dB): 169 (Prog. Wave)*
153 (Reverb)*

Frequency Range(Hz): 20-2000

Acoustic Power(watts):160,000

Type of Generator: 16 Air-modulators (electrically programed)

Facility Compressor Air Capability(SCFM): 27,000

Maximum Specimen Dimensions (feet): 30 Diam by 85H

ADDITIONAL ACOUSTIC TEST CAPABILITIES (Component Acoustic Lab)

Type of Generator (Horn, Siren, etc.)	No. of Generators Avail.	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)	Test Chamber Type (Reverb, Acoustic, Anechoic, etc.)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimension (lxwxh) (inches)
Air Modulator Air Modulator	1 2	3000 SCFM	Continuous	20,000 2000 each	50-5000		Reverb,Parallel Incidence,Plane Wave Calib Tube	540,20x50x15H	2 ft^3

*Ref. .0002 dynes/cm^2

WYLE ACOUSTIC TEST FACILITIES
(Huntsville, Alabama)

REPORTING INSTALLATION: Wyle Laboratories Huntsville Facility 7800 Governors Drive West Huntsville, Alabama 35800	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: Wyle Laboratories Brochure, "Scientific Services and Systems Group," Eastern Operations, 1970	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone: (205) 837-4411

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: There are several parallel-incidence and reverberant facilities, including the 100K cu ft Reverberation Facility, the High Intensity Acoustic Facility, and the Anechoic Chamber.

The 100K cu ft Reverberation Facility can be used both for reverberant and progressive wave testing. The room was designed to accommodate large specimens, such as complete segments of aerospace vehicles. Further, it was designed to provide good low frequency characteristics with a uniform and smooth model density down to 25 Hz. Below that frequency, the individual room modes can be distinguished. For testing of panel structures 2 test openings are provided, a 14 ft X 10 ft opening in the wall of the room for reverberant field testing and an 8 ft X 8 ft opening in the horn for progressive wave testing. At the latter position, the cross-sectional area is some 40 sq ft which ensures that the damping phenomena associated with progressive wave testing with narrow ducts are virtually eliminated. The sound generators are Wyle Laboratories' air modulator units, Model WAS 3000. They are coupled into a corner of the room by a concrete horn which has a 12 ft X 8 ft opening into the room. The lower frequency cutoff is 10 Hz. Sine wave or controlled random spectra can be achieved at full power up to 600 Hz. At high frequencies random spectra decrease at 3-5 dB per octave controlled by non-linar distortion in the horn and air absorption in the room. With present equipment the maximum overall sound pressure level is 155 dB reverberant and 158 dB at the horn test opening. In designing the room, considerable attention was given to achieving maximum utilization by providing access panels in the walls and a 3 ft diam duct to the control center for instrumentation and electrical cables. Thus, vibration exciters can readily be placed in the room for combined environment tests and specimens can be supplied with air, water liquid, gases, etc., if required, with the control gear located outside the room. To take maximum advantage of the room's dimensions, provision has been made to fully open one end for access purposes. This is presently accomplished with a 25-ft wide full-height door and removable wall panels.

High Intensity Acoustic Facility: The basic facility consists of a noise generator, an initial expansion horn, a "constant area" parallel incidence test section, a second expansion horn, and a reverberation chamber. A portable array of sound absorbent wedges can be placed in the end of the reverberation room creating a progressive wave configuration in the parallel incidence section and throughout the second expansion horn where the test can be made at varying angles of incidence.

TESTING CAPABILITIES: In addition to the normally used instrumentation system, provisions have been incorporated to increase the data acquisition capabilities of both the 100K cu ft reverberation room and the high intensity facility by interconnecting with the centralized instrumentation room. This allows all data to be acquired, processed, and printed with a computer-controlled digital data acquisition system. Over 450 channels of dynamic test data have been handled on a single test. The data analysis system is capable of a narrow-band (2 to 100 Hz) one-third, or full-octave analysis. Equipment is also available for correlation analysis and probability density analysis.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Test Chamber Type: Reverberant & Plane Wave

Chamber Vol. and Inside Dimensions (ft^3), (ft): 100K, 40 x 50 x 60
14.3K, 10 x 11 x 13

Noise Level Range (dB): 155* (Reverb.)
158* (at horn test operating)

Acoustic Power (Watts): 30,000 (each modulator)

Type of Generator: Air modulators (Wyle Model WAS 3000)

Facility Compressor Capability (SCFM): 9,600

ADDITIONAL ACOUSTIC TEST CAPABILITIES

Type of Generator (Horn, Siren, etc)	No. of Generators Available	Facility Compressor Air Capability	Run Time (min)	Acoustic Power (watts)	Freq. Range (Hz)	Noise Level Range (dB)*	Test Chamber Type (Reverb, Acoustic, Anechoic, etc)	Chamber Vol. and Inside Dimensions (ft^3), (ft)	Maximum Specimen Dimensions (l x w x h) (inches)
Air Modulator	4	9600 SCFM at 70 psig	Cont.	170,000	10kc	162	Acoustic (Reverberant)	1430,10x13x11	
						165	Acoustic (Parallell Incidence)	100K,30x40x60	

*Ref. .0002 dynes/cm^2

BENDIX MISHAWAKA OPERATIONS
VIBRATION AND ACOUSTIC TEST FACILITIES

REPORTING INSTALLATION: Bendix Aerospace System Division Mishawaka Operations 400 S. Beiger Street Mishawaka, Indiana 46544	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Laboratory
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as Reporting Installation Phone: (219) 255-2111

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of several vibration systems which are used to subject electrical and mechanical components and systems to simulated flight and transportation vibration environments. The two largest electromagnetic systems utilize 85 servo loops to automatically control random vibration in the 10 to 2025 Hz range. Each of the systems has two exciters powered from the same power supply.

The acoustic test facility consists of a 192-cubic-foot reverberation chamber, a progressive wave tube, an electropneumatic transducer and a packaged compressor system, all housed in a soundproof room. The reverberation chamber is pentagon shaped, 51 inches on each side. Minimum height is 70 inches and maximum height is 80 inches at the center.

TESTING CAPABILITIES: The vibration equipment is primarily used to subject components, systems, or entire missiles to sine and random vibration tests as part of Engineering Development, Quality Assurance, and Design Margin Evaluation programs. Instrumentation is available for recording and analyzing vibration and other data. Provisions are made for operating a shaker in the large environmental chamber for combined environmental testing. The two Ling B-300 shakers can be operated in parallel or in push-pull.

In the acoustic facility aircraft and space structures and components are subjected to acoustic excitation similar to that encountered in flight. Specimens may be tested to MIL-STD-810, Method 515 with an overall sound pressure level of 158 dB. In the progressive wave tube, specimens may be subjected to a flat broadband spectrum from 90 to 710 Hz with an overall level of 168 dB, a MIL-STD-810 spectrum with an overall level of 160 dB, or a sine sweep from 80 to 1000 Hz at a level of 160 dB.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $300**	CONSTRUCTION YEAR: COST $455,000* ESTIMATED REPLACEMENT VALUE $ Not Available
CONTRACTOR: M. B. Electronics (System No. 1) Ling Electronics (System No. 2 & Acoustics Facility)	LOCATION: New Haven, Connecticut Anaheim, California

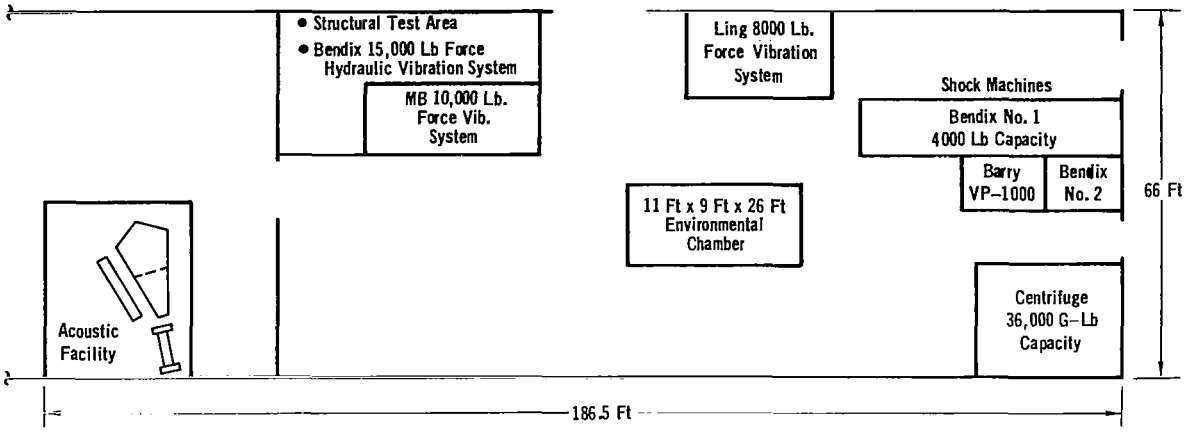
IMPROVEMENTS AND COSTS: (1965) System No. 1: Additional shaker and conversion to automatic random, Cost $35,000.

*(1962) System No. 1, Cost $150,000; (1964) System No. 2, Cost $180,000; (1967) Acoustic Facility, Cost $125,000.
**Each major system

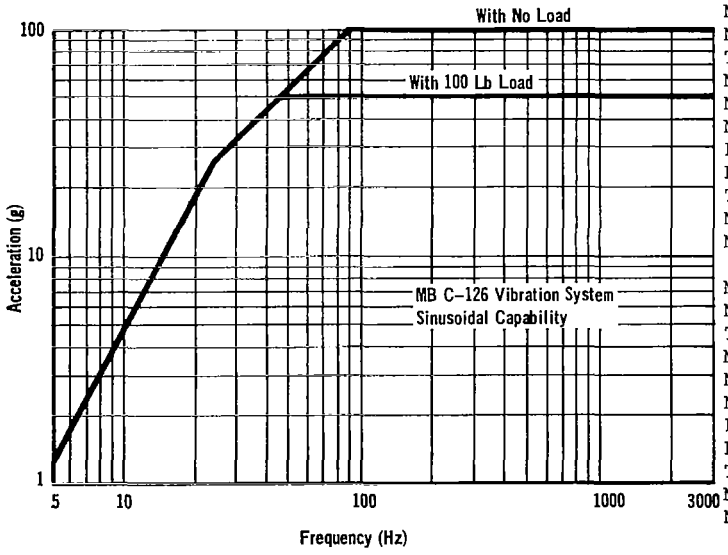
PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC

Environmental Test Laboratory



FACILITY PERFORMANCE DATA



Manufacturer:	Bendix
Model:	
Type:	Hydraulic
Maximum Force, Sine (lb):	15,000
Maximum Force, Random (lb):	
Maximum g's:	20
Frequency Range (Hz):	2-500
Double Amplitude (inch):	2
Table Size (inch):	24 x 36
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

Manufacturer:	M. B. Electronics
Model:	C-126
Type:	Electrical
Maximum Force, Sine (lb):	10,000
Maximum Force, Random (lb):	8,000
Maximum g's:	100
Frequency Range (Hz):	5-3000
Double Amplitude (inch):	1.0
Table Size (inch):	18 diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
(2) Ling Elec.	B-300	Electrical	8K	4.5K	100	5-3K	1.0	13.2 diam	Not	Available
MB Elec.	C-20D	Electrical	1.75K	950	100	5-3K	1.0	9 diam	Not	Available
Bendix	-	Hydraulic	8K	-	20	2-500	5	8 x 8	Not	Available

BOEING VIBRATION LABORATORY
(Boeing Space Center)

REPORTING INSTALLATION: The Boeing Company Boeing Space Center P.O. Box 3999 Kent, Washington 98124	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Aerospace Systems Division Aerospace Group
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: C. J. Adriance, Manager Environmental Test Laboratories Phone: (206) 773-5463

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility subjects hardware of all types to dynamic vibration environment either separately or combined with other environments such as heat, cryogenics, vacuum, pressure, and hot-cold cycling. Thirty-eight electromagnetic vibrators are available from 1.5 to 30,000 lb peak force. These provide a wide range of force for both sine and random vibration testing.

The types of vibration control equipment available are: (1) MB Random Automatic Equilizer Analyzer - 80 channel; (2) Ling Random Automatic Equalizer Analyzer - 40 channel; (3) Ling Random Equalizer Analyzer - 40 channel; (4) Ling Random Equalizer Analyzer - 20 channel; (5) Unholtz Dickie Servo Oscillator with Automatic Mil Spec Programmer and Protective Circuitry; (6) Unholtz Dickie Mac 5 Averager; (7) Chadwick Helmuth Amplitude and Phase Control; (8) Ling Shock Spectrum Synthesizer and Analyzer; (9) Sigma II Computer for Electromagnetic Vibrator; and (10) Shock and Transient Acceleration Control.

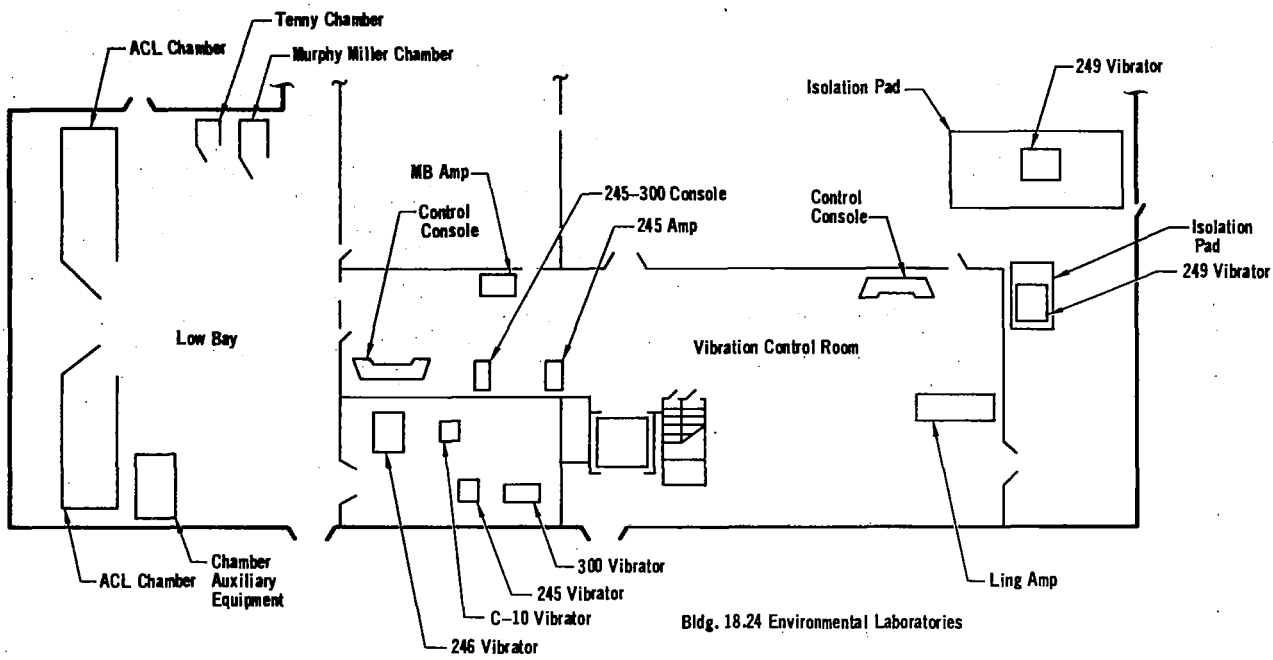
TESTING CAPABILITIES: (Transient Vibration Simulation) Techniques have been developed to synthesize a real-time flight transient acceleration on a spacecraft or flight vehicles in a laboratory test environment. The transient waveform control concept is implemented with modern digital computing algorithms and the reciprocal properties of the discrete Fourier integral transform. The transient testing concept is amenable to a safe, reliable method of defining structural response functions as well as accomplishing shock test requirements on electromagnetic vibration apparatus. Both modal response definition and structural transfer functions are available at the test location using transient test techniques.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Ling Electronics, (4)
Model:	A249
Type:	Electrical
Maximum Force, Sine (lb):	30,000*
Maximum Force, Random (lb):	32,000*
Maximum g's:	75
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	27 Diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

Manufacturer:	Ling Electronics, (1)
Model:	A182
Type:	Electrical
Maximum Force, Sine (lb):	25,000
Maximum Force, Random (lb):	17,675
Maximum g's:	71
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	Not Available
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb) 20g 50g	Size (l x w x h) (inch)
(1),M.B. Elec	C150	Electrical	17.5K	13.5K	150	5-3K	1.25	16 Diam	Not	Available
(1),Ling Elec	A246	Electrical	7.5K	5.5K	100	5-3K	1.0	11 x 11	Not	Available
(1),Ling Elec	A-300B	Electrical	6.0K	3.0K	100	5-3K	1.0	12 Diam	Not	Available
(1),Ling Elec	A177	Electrical	5.0K	4.0K	56	5-2K	1.0	11 x 11	Not	Available
(1),Ling Elec	A245	Electrical	2.25K	1.7K	100	5-10K	1.0	5.6 x 5.6	Not	Available
(2),M.B. Elec	C10VB	Electrical	1.75K	1.05K	58	5-6K	1.0	9.2 Diam	Not	Available

DAYTON T. BROWN VIBRATION TESTING FACILITIES

REPORTING INSTALLATION: Dayton T. Brown, Incorporated Testing Laboratories Division Church Street Bohemia, Long Island, New York 11716	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: Dayton T. Brown Brochure	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as Reporting Installation Phone: (516) 589-6300

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: Complete facilities are available for application and monitoring of sine and random excitation (individual or combined) from 5 to 4000 Hz with 28,000 pounds maximum force. Sine vibration to 60,000 pounds force is available using 4 hydraulic exciters with a 2-inch stroke, 0 to 100 Hz, and up to a 10-inch stroke at 10,000 pounds force. An L.A.B. Type 3000 vibration table is available for transportation simulation with a 4 by 4-ft vehiculer adapter plate and all fences.

TESTING CAPABILITIES: Types of vibration tests include (1) Wide band random vibration of 4kc bandwidth with analysis, (2) Automatic control of both sine and random signals in a combined sine-random mode, (3) Narrow band swept random tests, (4) Combined narrow band mixed with wide band random tests, and (5) Inclination and combined inclination/vibration testing. Shock testing is available using the electrodynamic exciters as well as low frequency high intensity shock simulation using the hydraulic exciter.

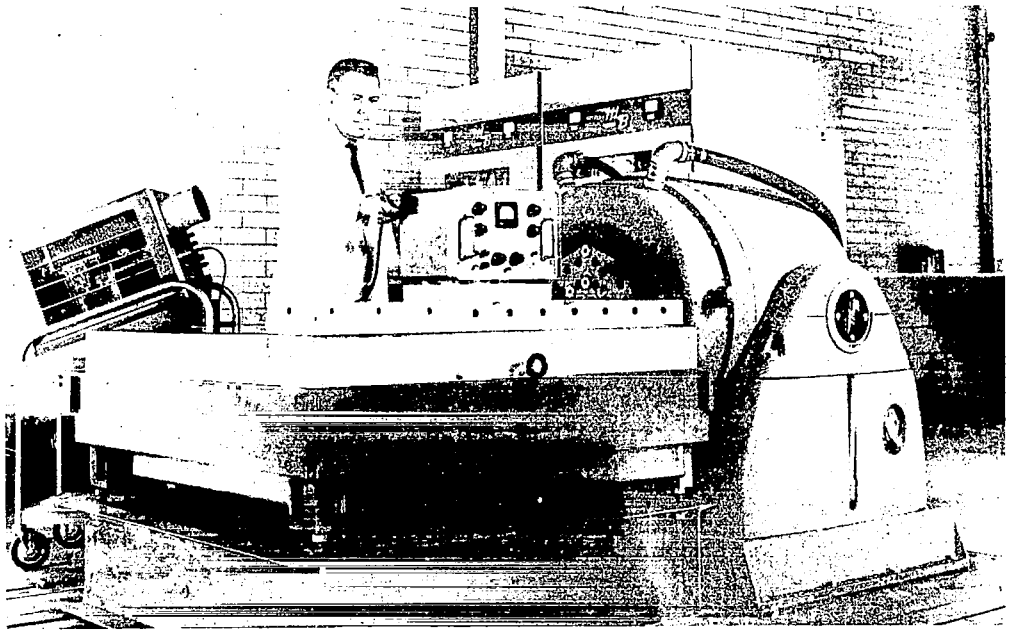
Monitoring equipment and instrumentation available includes: (1) Two MB-T-388 Automatic Random Equalizer and Analyzers with TRMS meters, scanners, and oscilloscopes; (2) Three 14 channel tape recording systems for AM and FM recording (frequency response: 0 to 100K Hz); (3) Four systems for random analysis and narrow band random tests; (4) Seven x-y recorders and seven log converters for recording spectral density, acceleration, etc.; (5) 36 charge amplifiers; (6) SKL filters; (7) 49 piezo electric crystal accelerometers including the microminiature, triaxial, and temperature extreme types; (8) 8 velocity pickups (MB-126) and 10 vibration meters (MB-M-3M-6); and (9) 6 oscillograph recorders.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

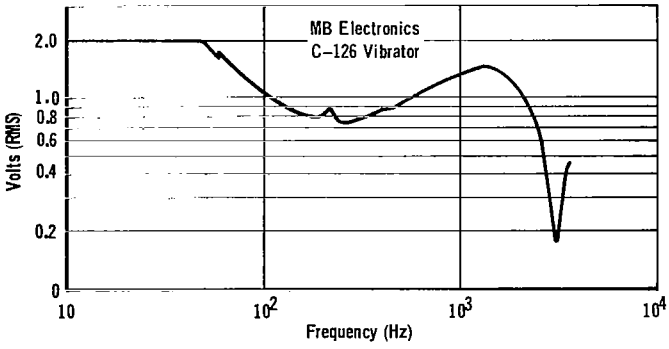
PLANS FOR FACILITY IMPROVEMENTS: Not Available.

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope



Manufacturer:	MB Electronics
Model:	C-126
Type:	Electrical
Maximum Force, Sine (lb):	10,000
Maximum Force, Random (lb):	8,000
Maximum g's:	100
Frequency Range (Hz):	5-3000
Double Amplitude (inch):	1.0
Table Size (inch):	16
Max Specimen Weight (lb):	1000
Max Specimen Size (inch):	-

Manufacturer:	MB Electronics
Model:	C-210
Type:	Electrical
Maximum Force, Sine (lb):	28,000
Maximum Force, Random (lb):	20,000
Maximum g's:	78
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	28
Max Specimen Weight (lb):	5000
Max Specimen Size (inch):	-

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
MB	C-150	Electrical	17.5K	15K	150	5-3K	1.25	16	2000	-
MB	J1DX	Hydraulic	60K	-	10	1-50	2.5	6	10000	-
(Hyd Slip	Table)	Hydraulic	8K	-	5	1-30	6.0	24 x 24	10000	-
MB	C-25H	Electrical	3.5K	-	45	5-2K	.5	16	500	-
MB	EL-250	Electrical	3K	2.1K	100	5-4K	1.0	10	200	-
MB	C-25B	Electrical	2.5K	-	37	5-500	.5	18	200	-

GENERAL DYNAMICS/CONVAIR VIBRATION TEST LABORATORY

REPORTING INSTALLATION: General Dynamics Corporation Convair Division P.O. Box 1128 San Diego, California 92112	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Mr. P. T. Gardner Department 578-00 Phone: (714) 277-8900, ext 1735

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory is housed in a building 240-feet long by 70-feet wide. A 5-ton traveling bridge crane services the test equipment areas, and a distribution system provides liquid and gaseous nitrogen and liquid carbon dioxide to the various vibration exciter locations. A 60-foot high dynamic test tower, located adjacent to the laboratory, is used for vibration tests of large structural assemblies and complete spacecraft. Each of the vibration systems is equipped with controls and instrumentation to function independently for sinusoidal waveform testing. For random or combined sine-random waveform testing, the vibration systems are remotely controlled from one of two automatic 80-channel equalizer-analyzers located in the Central Control Station (CCS) in the laboratory. The CCS also houses the instrumentation tape recorders, wave analysis equipment, transmissibility and mechanical impedance plotter, and probability density analyzer. The CCS is linked to each of the vibration systems, shock test areas, centrifuge, Pneumatics (Gas Flow) Laboratory, and the Data Acquisition Laboratory with multichannel landlines. The two Ling Model A-182 exciters of System No. 1 are frequently operated as a dual system for testing large specimens. In this case, each exciter is driven by a separate power amplifier, and the system is operated in the master/slave mode. Servo controls automatically maintain the prescribed vibration level; for sine wave testing, an automatic phase control system synchronizes the motion of the slave exciter to that of the master. The portable 7500-lb force, Ling Model A-246 vibration system is used for testing items where explosives, high pressures, or toxic compounds create a high risk in the vicinity of the test setup. The components of the vibration system except the shaker itself, are housed in two semi-trailer vans. With the shaker located in a test cell or bunker, the power amplifier, control equipment, and test personnel can be lcoated as far as 300 ft from the hazardous area. This vibration system is completely self-sufficient; the Control Van houses the power amplifier, control console, equalizer-analyzer, charge amplifiers, tape recorder, direct-writing recorders, PSD analysis equipment, and a small vibration calibrator for end-to-end calibration of the vibration monitoring system. The 8000-lb-force Ling Model A-300B vibration system, packaged as a plug-in system, can be quickly relocated to various testing stations. It is used at the Pneumatics Laboratory to subject valves and regulators to vibration while undergoing flow tests. The system is controlled from the Central Control Station for random vibration tests, but operates independently for sine wave tests.

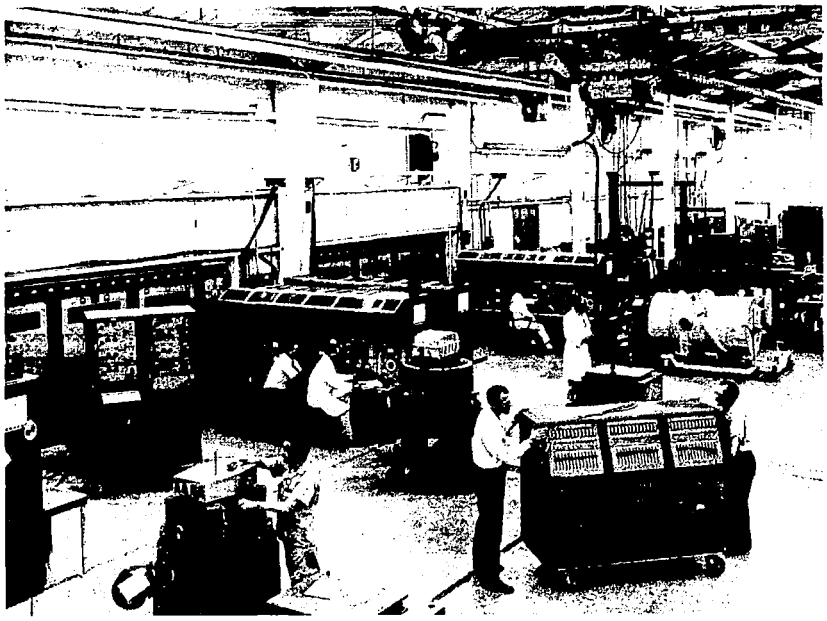
TESTING CAPABILITIES: This facility has the resources necessary to conduct shock and vibration testing of components, structures, spacecraft, and launch vehicles, the laboratory serves as the center of activities for all dynamic testing at Convair. Various types of crystal accelerometers, charge amplifiers, magnetic tape recorders, and direct-writing recorders are used to acquire test data. The specific instrumentation systems used are selected for each test according to the test conditions and objectives, but usually employ basic system components through the use of flexible switching networks and patch panels.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope (Not Available)

Special environmental chambers which mate with the vibration exciters are summarized below:

QUANTITY	FUNCTION OF CHAMBER	TEMP °F	PRESSURE	SIZE OF TEST SPACE
1	Temperature	-200to400	Ambient	30" x 30" x 30"
1	Temperature	-200to400	Ambient	36" x 36" x 36"
2	Temperature	-200to400	Ambient	42" x 42" x 42"
1	Temp/Vacuum	0to300	1 Torr	40" Dia x 48" Long
1	Temp/Vacuum	-160to140	10^{-5}Torr	42" Dia x 34" Long Inside Cold Wall

Manufacturer:	Ling
Model:	L-200
Type:	Electrical
Max Force, Sine (lb):	22,000
Max Force, Random (lb):	18,500
Max g's:	100
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (in):	21
Max Specimen Weight (lb):	Function of
Max Specimen Size (inch):	formula, F = ma
Armature Weight (lbs):	100
Manufacturer:	M. B.
Model:	C-200
Type:	Electrical
Max Force, Sine (lb):	21,500
Max Force, Random (lb):	15,000
Max g's:	100
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (in):	27 Diam
Max Specimen Weight (lb):	Function of
Max Specimen Size (inch):	formula, F = ma
Armature Weight (lbs):	300

*Can be combined

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Weight (lb)		Size (l x w x h) (inch)
			Sine (lb)	Random (lb)					20g	50g	
(2) Ling *	A-182	340	15,000	10,600	44	5-2K	1.0	20 x 20	410	-	Not Available
(2) M. B.	C-125	100	10,000	8,000	100	5-3K	1.0	16 Diam	400	100	
Ling	A-300B	60	8,000	5,000	100	5-3K	1.0	12 Diam	340	100	
(2) Ling	335	100	15,000	11,500	100	5-3K	1.0	16 Diam	650	200	
Ling	A-246 portable	30	7,500	6,000	100	5-2K	1.0	11 x 11	300	80	

GENERAL DYNAMICS/FORT WORTH VIBRATION TEST FACILITIES

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
General Dynamics Corporation Fort Worth Division Fort Worth, Texas 76101	COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Test Laboratories
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager, Engineering Test Laboratories Phone: (817) 732-4811, ext 2204

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is used to perform engineering qualification testing on aircraft and aerospace systems and components which must operate in a vibration environment. Electromagnetic shakers are used to provide the specified vibration levels and the amplitude and frequency is automatically controlled. Vibration levels, resonant conditions, and transfer functions are detected by accelerometers and displayed on x-y plotters. Actual vibrational environments are simulated or reproduced from recorded signals and used to subject specimens to endurance tests.

TESTING CAPABILITIES: The vibration laboratory conducts qualification testing, vibration fatigue tests with simulated environments, response and vibration problem investigations and vibration measurements and analyses. All vibration equipment is portable and may be operated in remote fuel, nuclear or hazardous areas. Tests are conducted on parts as small as integrated circuits and as large as complete electronic stations. Special fixtures and adapters are designed as required to simulate input structure or to provide a rigid attachment to the specimen. A full complement of vibration instrumentation and analysis equipment is provided and used during the vibration testing. Data are recorded with 14 channels on a Honeywell 7610 tape recorder and reduced on site.

FACILITY COST HISTORY

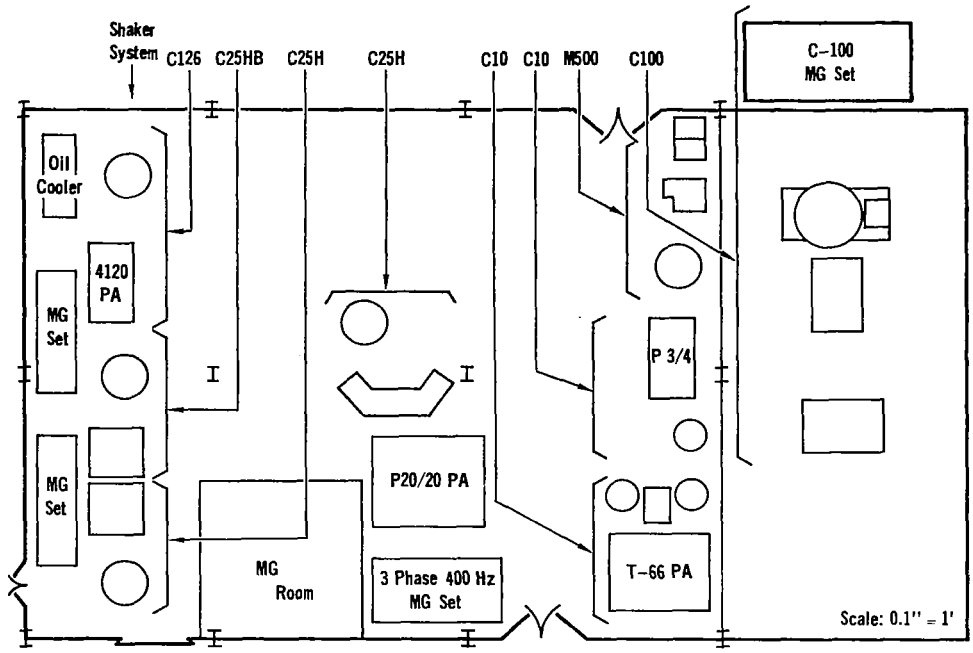
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): $420	CONSTRUCTION YEAR: COST $ * ESTIMATED REPLACEMENT VALUE $465,000
CONTRACTOR: MB Ling and Unholtz Dickie	LOCATION:

IMPROVEMENTS AND COSTS: (1955) C-25H vibration machine, Cost $30,000; (1957) C-25HB, C-100 vibration machines, Cost $190,000; (1958) Three C-10 vibration machines; Cost $50,000; (1964) C-126, M-500 vibration machines, Cost $105,000; (1968) Three SD104-105 vibration machines, Cost $18,000.

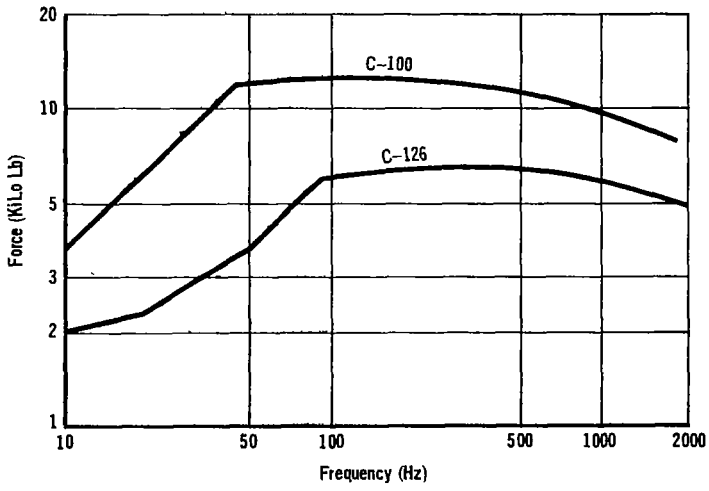
*Note above: Construction cost not available, Building 80, AF Plant No. 4.

PLANS FOR FACILITY IMPROVEMENTS: As required for major contracts.

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	MB Electronics
Model:	C126
Type:	Electrical
Maximum Force, Sine (lb):	6500
Maximum Force, Random (lb):	4500
Maximum g's:	60
Frequency Range (Hz):	5 to 2000
Double Amplitude (inch):	1
Table Size (inch):	16 diam
Max Specimen Weight (lb):	200
Max Specimen Size (inch):	24 x 24 x 24

Manufacturer:	MB Electronics
Model:	C-100
Type:	Electrical
Maximum Force, Sine (lb):	12,500
Maximum Force, Random (lb):	0
Maximum g's:	60
Frequency Range (Hz):	5 to 2000
Double Amplitude (inch):	1/2
Table Size (inch):	27 diam
Max Specimen Weight (lb):	1000
Max Specimen Size (inch):	60 x 60 x 60

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
MB Electronics	C-25H	Electrical	3500	2500	40	5 to 2000	.5	16 diam	150	24 x 24 x 24
MB Electronics	C-25HB	Electrical	5000	0	50	5 to 2000	.5	16 diam	150	24 x 24 x 24
Unholtz-Dickie	M-500	Electrical	5000	3500	50	5 to 2000	1	16 diam	150	24 x 24 x 24
MB Electronics	C-10	Electrical	1200	850	50	5 to 2000	1	8 diam	60	12 x 12 x 12
L.A.B.	RUC-100	Mechanical	600	0	2	5 to 60	1/2	36 x 36	300	36 x 36 x 36
Ling	370	Electrical	100	70	57	DC to 1000	4	N.A.	N.A.	N.A.

GE DYNAMIC SIMULATION LABORATORY

REPORTING INSTALLATION: General Electric Company Space Systems Organization, Building 200 P.O. Box 8555 Philadelphia, Pennsylvania 19101	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Product Assurance, Test Operations
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: H. R. Daw, Manager, Test Operations Building 200 Phone: (215) 962-4979

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory facility is designed to simulate the vibration effects present during spacecraft and re-entry vehicle flight. The facility includes two electrodynamic vibration exciters (each rated at 35,000 lbs force vector and root mean square) capable of producing a total force output of 70,000 lbs vector and rms over a frequency range of 5 to 2000 cycles per second. Power for the exciters is provided by two electronic power amplifiers, each of which dissipates 240,000 watts. These amplifiers have been specifically designed to drive vibration exciters and can be electrically switched as required for independent or dual system operation.

TESTING CAPABILITIES: Test results are translated into design information through monitoring, recording, and analysis of mechanical vibrations with the use of a 100-channel data acquisition system. Data reduction systems include a swept analyzer and a digital computer. The typical time for data processing is 30 minutes for 10 channels.

FACILITY COST HISTORY

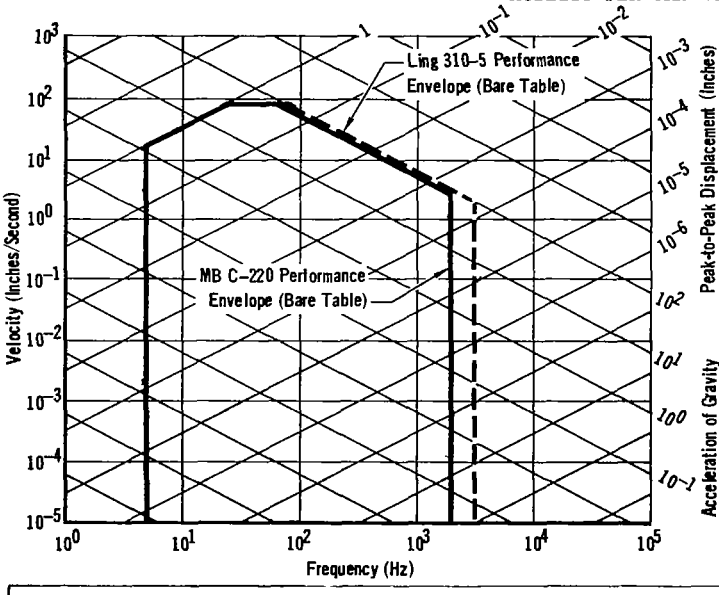
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA



Manufacturer:	M. B. Electronics, (2)
Model:	C-220
Type:	Electrical
Maximum Force, Sine (lb):	35,000
Maximum Force, Random (lb):	35,000
Maximum g's:	87
Frequency Range (Hz):	5 to 2000
Double Amplitude (in):	1.0
Table Size (in):	30
Max Specimen Weight (lb):	*
Max Specimen Size (in):	**

Manufacturer:	M. B. Electronics
Model:	C-150
Type:	Electrical
Maximum Force, Sine (lb):	17,500
Maximum Force, Random (lb):	15,000
Maximum g's:	175
Frequency Range (Hz):	5 to 3000
Double Amplitude (in):	1.0
Table Size (in):	17
Max Specimen Weight (lb):	*
Max Specimen Size (in):	**

*Function of test accel. requirements
**Function of test freq.range,accel reqs,wt

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
Ling Elect.	310-S	Electrical (Array)	54K	36K	100	5 to 3K	1.0	13 ea	*	**
M. B. Elect.	C-50	Electrical	5K	4K	125	5 to 3K	1.0	13	*	**
M. B. Elect.	C-10	Electrical	1.2K		68	5 to 3K	1.0	9	*	**

GRUMMAN VIBRATION LABORATORY

REPORTING INSTALLATION: Grumman Aerospace Corporation Plant Number 5 Bethpage, L.I., New York 11714	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test, Department 370
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION Environmental Test, Department 370 Phone: (516) 575-7062

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility subjects aircraft and spacecraft structures and equipment packages to dynamic vibration and acoustic excitation similar to flight environments. Electromagnetic shakers ranging from small portable units to 30,000 force-pound output shakers are available. Structural components may be subjected to sound pressure levels in excess of 150 dB in a progressive plane wave tube or in a reverberating chamber for conducting acoustic fatigue or structural integrity tests.

TESTING CAPABILITIES: The Vibration Laboratory has been used to verify the dynamic response, modes, and integrity of aircraft and aerospace components and entire vehicles. Acoustic testing of advanced structures and materials for aircraft usage has been performed. Special instrumentation is available for recording and analyzing acceleration, strain, and noise levels. The lab is equipped with three ASDE-80 Automatic Random Controllers and one ESD/ASD-40 Manual Random Controller.

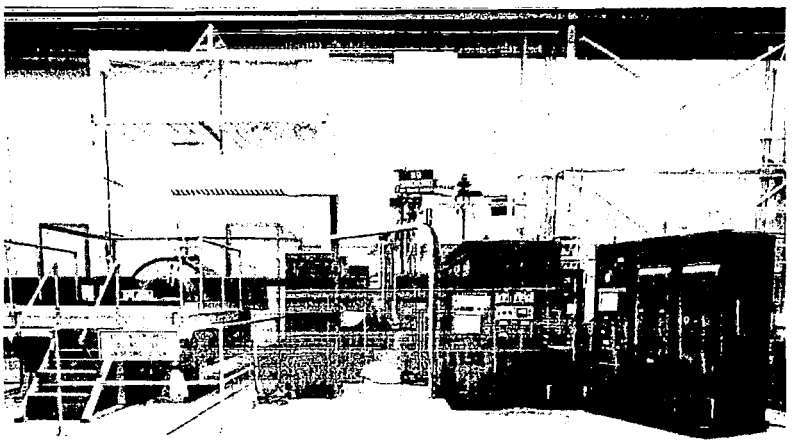
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

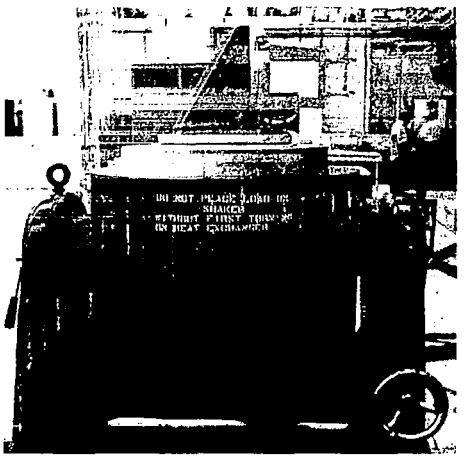
PLANS FOR FACILITY IMPROVEMENTS:

SCHEMATIC

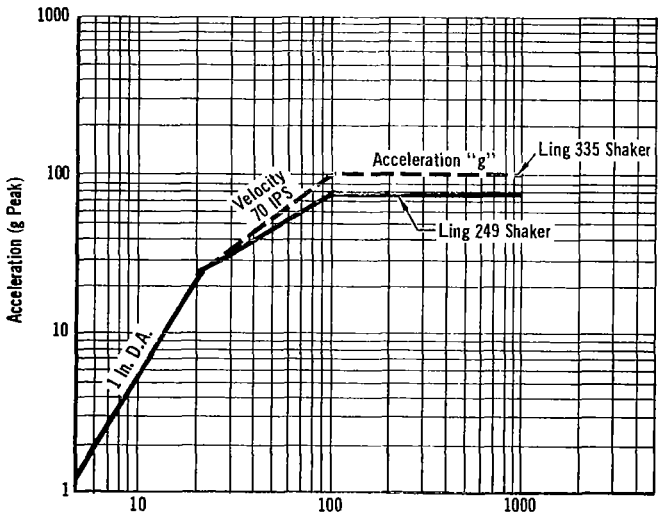
LING 249 SHAKER



LING 335 SHAKER



FACILITY PERFORMANCE DATA



Manufacturer:	Ling Electronics
Model:	A-249
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	32,000
Maximum g's:	75
Frequency Range (Hz):	5-2000
Double Amplitude (in):	1
Table Size (in):	28.375 diam
Max Specimen Weight (lb):	2604
Max Specimen Size (in):	

Manufacturer:	Ling Electronics
Model:	335
Type:	Electrical
Maximum Force, Sine (lb):	15,000
Maximum Force, Random (lb):	12,500
Maximum g's:	100
Frequency Range (Hz):	5-2500
Double Amplitude (in):	1
Table Size (in):	17 diam
Max Specimen Weight (lb):	1000
Max Specimen Size (in):	

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
Ling Elec	275A	Electrical	10,000	8,000	98	5 to 3000	1	16.5 diam	898	
Ling Elec	B300	Electrical	8,000	5,700	90	5 to 3000	1	13.25 dia	744	
MB Elec	C25	Electrical	5,000	3,500	75	5 to 2000	.5	17 dia	205	
MB Elec	C25H	Electrical	3,500	-		5 to 2000	.5	17 dia	205	
Lab Table		Mechanical	2,500	-	7.5	5 to 60	.0625	72 X 72	5000	
Five MB Elec	C10E	Electrical	1,200	850	60	5 to 3000	1	9 dia	100	

HUGHES VIBRATION TEST FACILITY
(Culver City, California)

REPORTING INSTALLATION: Hughes Aircraft Company Jefferson and Teale Culver City, California 90231	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Product Evaluation Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: (Same as Reporting Installation) R. L. Baker Phone: (213) 391-0711, ext 2619

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility subjects ground and aerospace equipment to dynamic vibration encountered in operational environments. Electrodynamic shakers ranging from small portable units to 30,000 force-pound output are available. Tests are controlled from a centralized control and data acquisition facility.

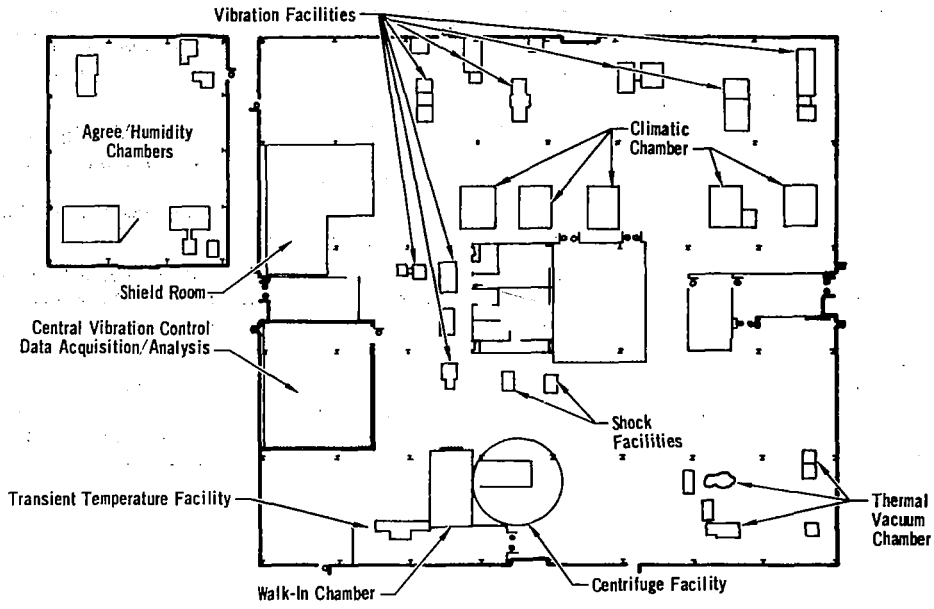
TESTING CAPABILITIES: These facilities are used for design, development, qualification and verification tests on aerospace aircraft equipment. The following vibration test capabilities are available: (1) Sinusoidal, fixed, or swept frequency; (2) Broadband random, flat, or shaped spectrum; (3) Combined Sine and random; (4) Stepped narrow band random; and (5) Gunfire. Data are acquired and analyzed using a hybrid analog/digital computer. Outputs are then plotted using a digital incremental plotter.

FACILITY COST HISTORY

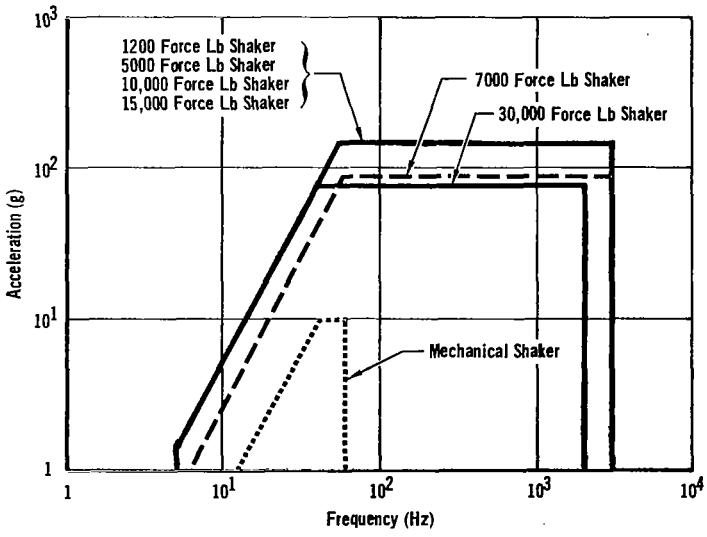
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: A solid state amplifier/15,000 force-pound vibration system is being added.

SCHEMATIC



FACILITY PERFORMANCE DATA



Manufacturer:	AB
Model:	RHV-12-2500
Type:	Mechanical
Maximum Force, Sine (lb):	77,000
Maximum Force, Random (lb):	0
Maximum g's:	10
Frequency Range (Hz):	5 to 60
Double Amplitude (inch):	.125
Table Size (inch):	72 x 72
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

Manufacturer:	Ling
Model:	249
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	30,000
Maximum g's:	79
Frequency Range (Hz):	5 to 2000
Double Amplitude (inch):	1
Table Size (inch):	28 diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
U-D	T1000V	Electrical	15,000	10,000	150	5 to 3000	1	16 diam	Not	Available
LAB	ERV48x66	Mechanical	3,200	-	3.2	20 to 30	.07	48 x 66		
Ling	275	Electrical	10,000	8,000	98	5 to 3000	1	12 x 12		
Ling	177A	Electrical	5,000	4,500	56	5 to 3000	1	12 x 12		
MB	C70	Electrical	7,000	5,000	89	5 to 3000	1/2	16 diam		
MB	C10	Electrical	1,200	1,000	69	5 to 3000	1	10 diam		

HUGHES VIBRATION TEST FACILITY
(Fullerton, California)

REPORTING INSTALLATION: Hughes Aircraft Company P.O. Box 3310, Fullerton Division 1901 W. Malvern, Building 604, M.S. E-243 Fullerton, California 92634	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Engineering Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Manager Environmental Engineering Department Phone: (714) 871-3232, ext 3191

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of a number of vibration systems. The largest is a 50,000 force-pound hydraulic system which is large enough to require a special building. This facility handles the heaviest shipborne and mobile electronic equipment presently foreseeable. There are two separate tables, one for horizontal motion and one for vertical motion. The machinery is mounted on an isolated reaction mass weighing 135 tons. Other Hughes vibration machines are large enough that man-machine systems can be tested to study the effects of vibration on the operator's interface with the equipment.

TESTING CAPABILITIES: This facility is capable of handling loads up to 10,000 lb, which can be tested on the 50,000 force-pound hydraulic vibration system. Items up to 5000 lbs can be vibrated on smaller machines. Facility data are recorded with 36 channels on magnetic tape and oscillogram recorders and reduced on site with a Federal Scientific UA-6A reduction system.

FACILITY COST HISTORY

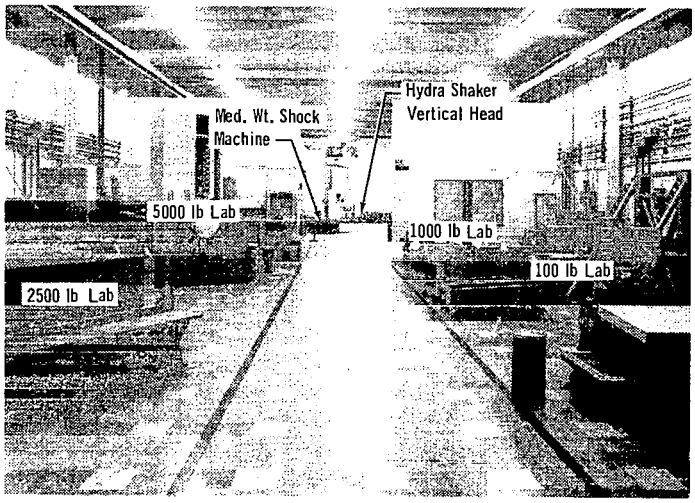
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $595,000
CONTRACTOR:	LOCATION:

IMPROVEMENTS AND COSTS: (1957) LAB RVH 72-5000, Cost $37,000; (1957) LAB RVH 72-2500, Cost $25,000, (1958) LAB RVH 48-1000, RVH 36-500, RVH 24-100, Cost $18,000; (1960-62) MB C110, Ling-Calidyne, Cost $46,000; (1966) Hydrashaker, Cost $250,000; (1967) LAB Vehicular Bounce SC-1000, SC-5000, Cost $25,000.

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC

FACILITY PERFORMANCE DATA



Vibration Facility – Hughes-Fullerton

Manufacturer:	Hughes
Model :	Hughes Design
Type:	Hydraulic
Maximum Force, Sine (lb):	50,000
Maximum Force, Random (lb):	None
Maximum g's:	5
Frequency Range (Hz):	5 to 250
Double Amplitude (inch):	1
Table Size (inch):	72 x 72
Max Specimen Weight (lb):	10,000
Max Specimen Size (inch):	144 x 144 (Foot Print)

Manufacturer:	Lab Corporation
Model:	RVH 72-5000
Type:	Mechanical Reaction
Maximum Force, Sine (lb):	25,000
Maximum Force, Random (lb):	None
Maximum g's:	5
Frequency Range (Hz):	5 to 60
Double Amplitude (inch):	.25
Table Size (inch):	72 x 72
Max Specimen Weight (lb):	5,000
Max Specimen Size (inch):	60 x 60 x 60

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
LAB Corp.		Mechanical	12,500	-	5	5 to 60	.25	72 x 72	2,500	60 x 60 x 60
LAB Corp.		Mechanical	5,000	-	5	5 to 60	.25	48 x 48	1,000	40 x 48 x 48
LAB Corp.		Mechanical	2,500	-	5	5 to 60	.25	36 x 36	500	36 x 36 x 36
LAB Corp.		Mechanical	500	-	5	5 to 60	.25	24 x 24	100	24 x 24 x 24
MB Elect.	MB C110	Electrical	1,200	-	10	5 to 2000	1.00	14 diam	120	20 x 20 x 20
Ling Calidyne	A174	Electrical	1,500	-	10	5 to 2000	1.00	14 diam	150	20 x 20 x 20

LTV VIBRATION TEST FACILITY

REPORTING INSTALLATION: LTV Aerospace Corporation Unit 3-40510 P.O. Box 6267 Dallas, Texas 75222	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Environmental Test Laboratory
OTHER SOURCES OF INFORMATION: LTV Brochure, "Environmental Test and Analysis Laboratory"	LOCAL OFFICE TO CONTACT FOR INFORMATION R. R. Raven, Chief Structures & Systems Lab., Unit 2-59900 Phone: (214) 266-5764

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is utilized to impose vibration environments. Two Ling 335 Systems are available with the capability of dual operation with phase control for sine testing. These units are also utilized for imposing half sine and terminal saw-tooth shock pulses.

TESTING CAPABILITIES: The exciters have been utilized to qualify through vibration and shock testing at extreme and ambient temperatures missile and aircraft components and entire satelites. Horizontal axes are accomplished on large specimens with one system for each exciter consisting of three hydrostatic bearing tables. The exciters are located on either of two air-supported reaction masses: 150,000 lbs and 200,000 lbs. Each system has full sine and random consols providing sine, random, or combined testing capability, with Ling ASDE-80's and Spectral Dynamics Sine Control.

Optional Operational Techniques: (1) Phase controlled for combined sine operation of exciters (Spectral Dynamics); (2) Pulse simulation which allows actual wave shaped pulse application with the exciters to impose shock tests; (3) Multi Level Programming; (4) Control Signal Averaging; (5) Selector Multi Level; (6) Peak Notch Filters; (7) Mixed Sine/Random, Pulse/Random, Swept Random, Combined Swept Random/Random; (8) Vibration and Shock @ -320°F to +450°F; (9) Displacement Velocity, Acceleration or Force-Controlled Vibration; and, (10) Ten Tracking Filter Channels.

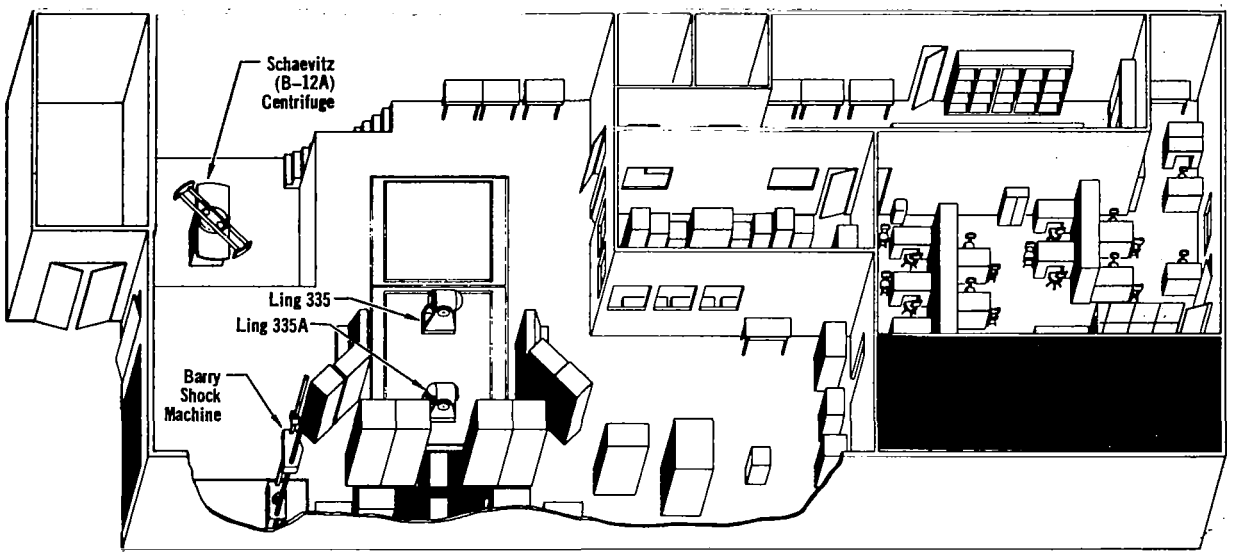
Special Data Reduction: Computer Random Analysis, PSD Analysis (SD 1001-2), and Mechanical Impedance Analysis (SD-1002A)

FACILITY COST HISTORY

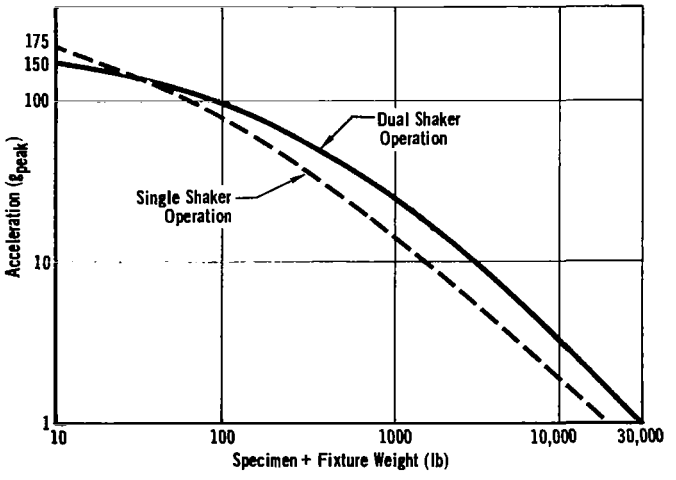
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA (Vibration Test Facility)



Manufacturer:	Ling Electronics
Model:	335
Type:	Electrical
Maximum Force, Size (lb):	15,000*
Maximum Force, Random (lb):	11,000
Maximum g's:	100
Frequency Range (Hz):	0-5000
Double Amplitude (inch)	1.0
Table Size (inch)	16 diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	Not Available

Manufacturer:	Ling Electronics
Model:	335A
Type:	Electrical
Maximum Force, Size (lb):	17,500
Maximum Force, Random (lb):	13,000
Maximum g's:	100
Frequency Range (Hz):	0-5000
Double Amplitude (inch):	1.0
Table Size (inch):	10 diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (inch):	

*-Dual operation gives 30K lb_f
0-2k phase controlled

ADDITIONAL VIBRATION TEST CAPABILITIES (Environmental Test Lab)

Manufacturer	Model	Type	Sine (lb)	Random (lb)	Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen Weight (lb)	Maximum Specimen Size (l x w x h) (inch)
Ling Elect.	390	Electrical	3.5K	-	120	5-3K	1.0	10 diam	250	12 x 12 x 12
MB Elect.	C-10	Electrical	1.2K	-	60	5-3K	1.0	10 diam	100	8 x 8 x 8
Ling Elect.	370	Electrical	-	-	-	0-1K	4.0	-	-	-
		(Array of 12) 150 lb_f shakers to force resonant modes of large structures)								

MCDONNELL DOUGLAS VIBRATION TEST FACILITIES
(St. Louis, Missouri)

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
McDonnell Douglas Corporation McDonnell Aircraft Company Box 516 St. Louis, Missouri 63166	COGNIZANT ORGANIZATIONAL COMPONENT: General Engineering Division Laboratories
OTHER SOURCES OF INFORMATION: MAC Brochure, "Facilities and Capabilities - Engineering Laboratories"	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structures and Dynamics Laboratories Department 253, Building 102 Phone: (314) 232-5688

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility is used to simulate the vibration conditions experienced by aircraft and spacecraft structures and equipment. To perform this function, a variety of electrodynamic shakers with force outputs up to 30,000 pounds are used. A number of instruments are available to detect, record, and display the vibratory conditions generated in the laboratory. This equipment included accelerometers and their associated amplifiers, magnetic tape recorders, transmissibility ratio computers, and harmonic analyzers.

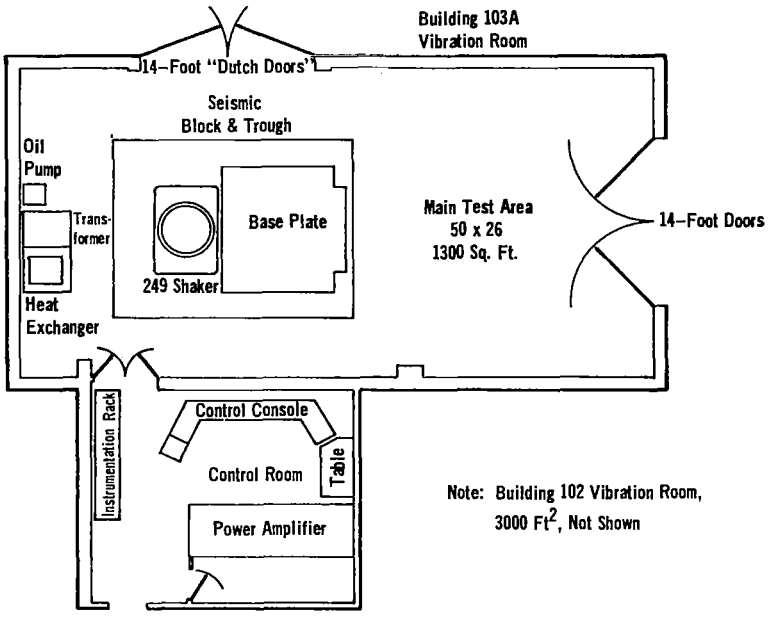
TESTING CAPABILITIES: The laboratory can perform vibration simulation and dynamic response tests on a broad range of specimens, ranging from small electronic components to full-scale space vehicles. Large fixtures are used to transmit the vibratory conditions to the larger specimens. It is possible to couple more than one shaker to a large specimen, so that total specimen size is virtually unlimited. Both sinusoidal and random vibration tests are routinely conducted. Three multi-channel equalizer/analyzers are available to generate and control random vibration levels within specified frequency spectrum limits. Another capability of the laboratory is portable equipment to cool or heat specimens, so that vibration tests can be conducted at reduced or elevated temperatures.

FACILITY COST HISTORY

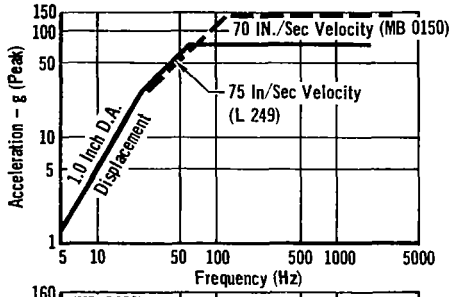
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

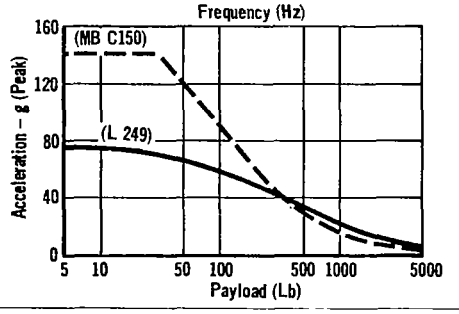
PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA





Manufacturer:	Ling Electronics
Model:	A-249*
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	28,000
Maximum g's:	75
Frequency Range (Hz):	5-2000
Double Amplitude (in):	1.0
Table Size (in):	29 Diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (in):	Not Available

Manufacturer:	MB Electronics
Model:	C150*
Type:	Electrical
Maximum Force, Sine (lb):	17,500
Maximum Force, Random (lb):	15,000
Maximum g's:	150
Frequency Range (Hz):	5-3000
Double Amplitude (in):	1.25
Table Size (in):	16 diam
Max Specimen Weight (lb):	Not Available
Max Specimen Size (in):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES (Building 102)

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
(1) Ling Elec	300*	Electrical	6K	3K	100	5-3K	1.0	12 diam	Not	Available
(2) Ling Elec	177*	Electrical	5K	4.5K	54	5-2.5K	1.0	11 X 11	Not	Available
(1) MB Elec	C25HB*	Electrical	5K	3.5K	46	5-2K	0.5	16 diam	Not	Available
(1) MB Elec	C-10	Electrical	1.2K	-	68	5-3K	1.0	10 diam	Not	Available

* - denotes with horizontal table

MCDONNELL DOUGLAS VIBRATION TEST FACILITIES
(Santa Monica, California)

REPORTING INSTALLATION: McDonnell Douglas Corporation McDonnell Douglas Astronautics 3000 Ocean Park Blvd Santa Monica, California 90406	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Engineering Laboratories Environmental Laboratories Branch
OTHER SOURCES OF INFORMATION: MDAC-WD, "Engineering Laboratories Facilities Catalog," January 1968	LOCAL OFFICE TO CONTACT FOR INFORMATION: Branch Chief, Environmental Laboratories Phone: (213) 399-9311, ext 2462

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility subjects aircraft and spacecraft structures and equipment packages to dynamic vibration similar to flight environments. Basic capability consists of 12 shaker systems, some with multiple heads, ranging in size from 100 lb to 30,000 lb force. Some of the more significant elements are: (1) Ling PP175/240 power amplifier with two Ling 249 shakers; (2) Four MB Model 4700 amplifiers (70 kVA output); (3) Ling 60/80 power amplifier, trailer installation; (4) Ling 12 head (100 lb each) modal survey test system, trailer installation; and (5) Four 80-channel automatic random equalizer/analyzer systems.

TESTING CAPABILITIES: The Vibration Laboratory has performed tests on Thor/Delta, Saturn SIVB, Spartan, MOL, and Orbital Workshop Programs. A major portion of dynamic testing has been performed on complete vehicle stages, large assemblies, or major sub-assemblies, and in conjunction with hazardous propellants at remote test sites. The dynamic test capability is flexible and responsive. Shaker power amplifiers, equalizers, and control units can be time-shared by several shakers or shakers combined for multiple or cluster system operation. The Ling 249, 30K lb force shakers, are located in a separate building (Unit 128) and are used mainly for tests where large heavy assemblies are involved. A 40 ft high bay housing a Ling 249 Shaker is located adjacent to Unit 128 for use in performing vibration tests on full scale assemblies and on test specimens of up to 18 ft in diameter. Shakers are also used for shock testing components to levels within the shakers' capabilities (refer shock test facilities resume).

One hundred and fifty channels of accelerometer instrumentation are available with recording accomplished directly on FM tape or through a multiplex system. Data analysis is performed using digital or analog reduction systems. The typical time cycle for data processing is 24 hours although this can be reduced to from 1-4 hours for maximum priority tests.

FACILITY COST HISTORY

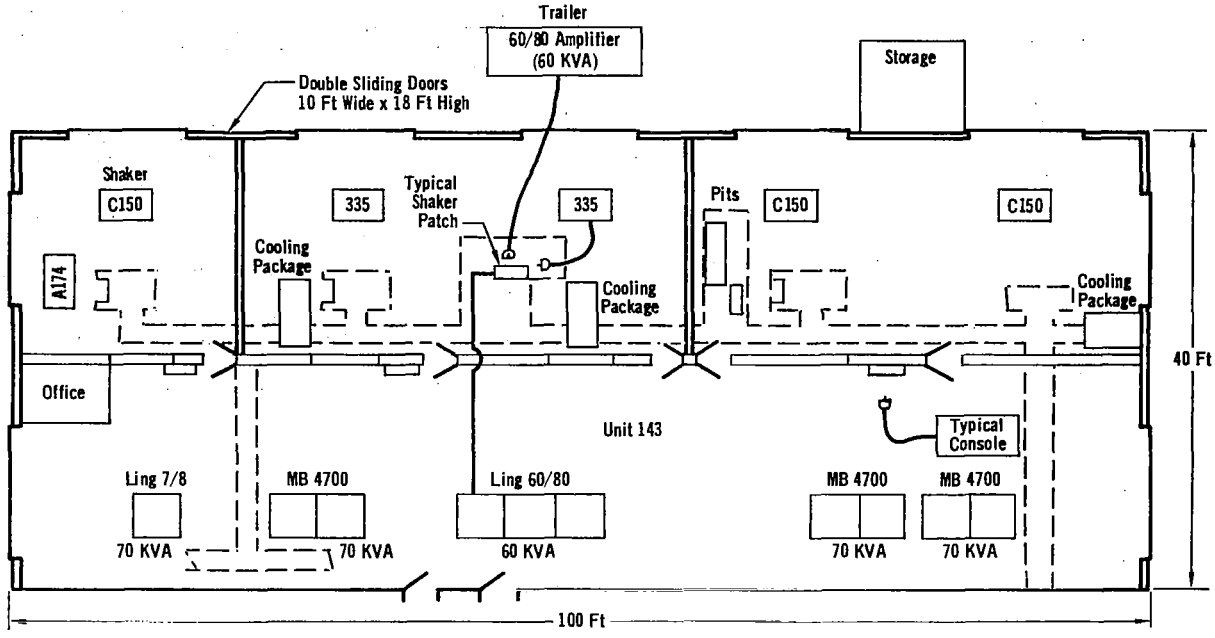
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1958, 1961 COST $743,695* ESTIMATED REPLACEMENT VALUE $2,066,280
CONTRACTOR: Pascoe Steel Company (Unit 128) Bethlehem Pacific Coast Steel Corp. (Unit 143)	LOCATION: Pomona, California

IMPROVEMENTS AND COSTS: (1959) Added A174 and C200 systems, Unit 143, Cost $340K; (1964) Added A249 and 80 channel ASDE, Unit 128, Cost $144.5K; (1967) Added Ling 335 and MB C150 and 80 channel EA, Unit 143, Cost $142K; (1969) Added MB C150/4700 systems, Unit 143 and Huntington Beach, Calif., Cost $336K.

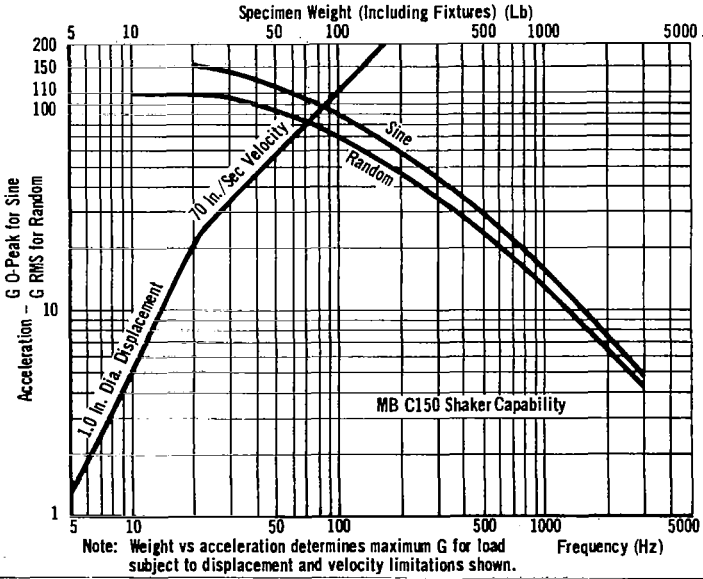
PLANS FOR FACILITY IMPROVEMENTS: A vibration test control center will be located in Unit 143 for control of both local and remotely located MDAC-WD shaker systems.

*Cost Breakdown: Unit 143: $261K; Unit 128: $482,695.

SCHEMATIC



FACILITY PERFORMANCE DATA



Note: Weight vs acceleration determines maximum G for load subject to displacement and velocity limitations shown.

Facility Name:	Vibration Facility (Units 128 and 143)
Manufacturer:	Ling Electronics, (2)
Model:	A249 (Unit 128)
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	32,000
Maximum g's	75
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	30 diam
Max Specimen Weight (lb):	1100 @ 20g
Max Specimen Size (inch):	216 W x 240 H
Manufacturer:	M. B. Electronics, (4)
Model:	C150 (Unit 143)
Type:	Electrical
Maximum Force, Sine (lb):	17,500
Maximum Force, Random (lb):	14,000
Maximum g's	150
Frequency Range (Hz):	5-3000
Double Amplitude (inch):	1.2
Table Size (inch):	17.25 diam
Max Specimen Weight (lb)	770 @ 20g
Max Specimen Size (inch):	144 H

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen		
			Sine (lb)	Random (lb)					Weight (lb) 20g	Weight (lb) 50g	Size (l x w x h) (inch)
(2) Ling Elec	335	Electrical	15K	11K	100	5-2.5K	1.0	17 diam	670	200	144H
(1) MB Elec	C125	Electrical	10K	6.2K	99	5-3K	1.0	18 diam	400	50	72H
(1) Umh-Dickie	VD500A	Electrical	5K	2.8K	90	5-4K	1.25	12 diam	196	46	72H
(4) Calidyne	A174	Electrical	1.5K	1.06K	70	5-4K	1.0	7.5 x 7.5	52	9	120H
(2) MB Elec	C10E	Electrical	1.2K	875	64	5-3K	1.0	9 diam	43	7	120H

NASA AMES STRUCTURAL DYNAMICS LABORATORY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
NASA Ames Research Center Moffett Field California 94035	COGNIZANT ORGANIZATIONAL COMPONENT: Director of Astronautics Vehicle Environment Division Structural Dynamics Branch
OTHER SOURCES OF INFORMATION: NASA, "Technical Facilities Catalog," NHB 8800.5, Vol. 1, March 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION: Chief, Structural Dynamics Branch Mail Stop N-242-1 Phone: (615) 961-1111, ext 2527

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The facility consists of 19,000 sq ft of test areas and shops. The principal test area is a central pentagon-shaped tower surrounded by smaller test areas which utilize the tower walls for strong-back mounting. The inside dimensions of the tower are 26.5 ft on each of the five sides and 100 ft to the ceiling. Access to the tower is through a 25 x 26 ft door. The tower can be evacuated to an atmosphere of 4 mm Hg and the roof can support a suspended load of 1,000,000 lbs. The chamber has a total volume of 140,000 cu ft. Its primary function is for environmental testing of aerospace structures under thermal, acoustic and vibration loads. The tower can also be used for drop testing for impact studies. The laboratories adjacent to the tower include an aeroelastic area for elastic wind-tunnel model checkout, a 30-ft high bay area with a 22 by 22-ft door for static and low frequency structural testing, a light test area for small-scale experiments and a photoelastic area for research in structural stress. The two-story office and shop structure and the laboratory facility, the center of which is occupied by the 100 ft high vacuum tower, are on individual concrete mat foundations separated by a two-inch gap to assure isolation of the two buildings from vibration and earthquake interaction. Because of the extremely heavy weight of the structure, and in order to minimize vibrations caused by earthquakes or those originating from within the tower, a concrete mat foundation system is used for both the office and testing structures of the facility. The mat under the tower is 6 ft thick and the mat under the office building is 2.5 in. thick. The 6 ft mat under the tower acts like a massive inertia or seismic block. The combined weight of the tower and supporting foundation mat is 19 million lbs. The tower chamber will accommodate full-scale segments, or smaller scale models of rockets and spacecrafts. Provisions have been made for 12.6 million watts of electric power, wherein controls are now available for 7.56 million watts for infrared lamps. A total or more than a million lbs of force can be brought to bear within the chamber through four hydraulic actuators. The tower is five sided to create a reverberation chamber. Air at a pressure of 120 psi and 50,000 SCFM is available for driving acoustic transducers. Present equipment in the laboratory includes a 2000 watt acoustic horn, a 50 Kip materials testing system, and a number of electrodynamic shakers ranging up to 20K lbs in output force. Frequency response, power spectral density, and correlation functions analyzers and associated measuring equipment are available.

TESTING CAPABILITIES: This facility supports the development of structural concepts for launch and entry vehicles and determines the response of structures to impact, vibration and thermal loads.

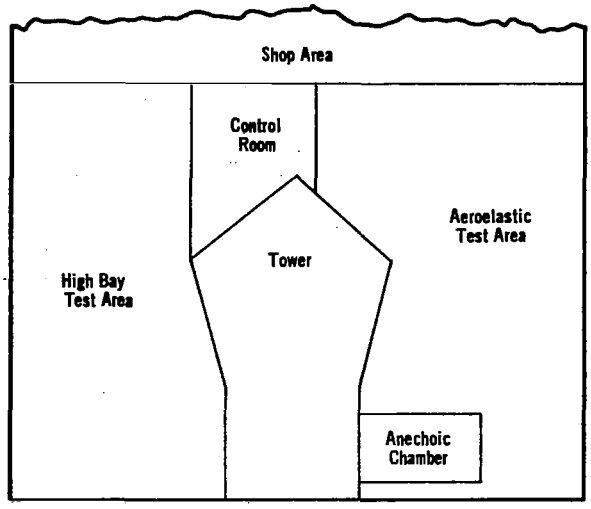
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1966 COST $1,448,000 ESTIMATED REPLACEMENT VALUE $2,132,000
CONTRACTOR: C. N. Swenson Company	LOCATION: San Jose, California

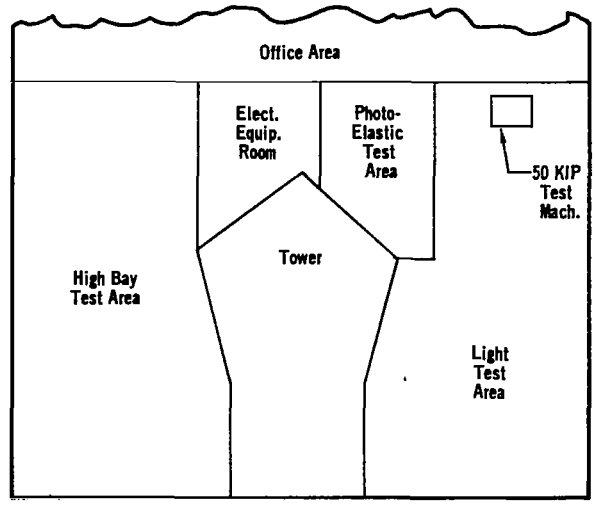
IMPROVEMENTS AND COSTS: (1967) Continued construction of basic facility, Cost $256,000; (1968) Continued construction of basic facility, Cost $21,000; (1969) continued construction of basic facility, Cost $38,000.

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC

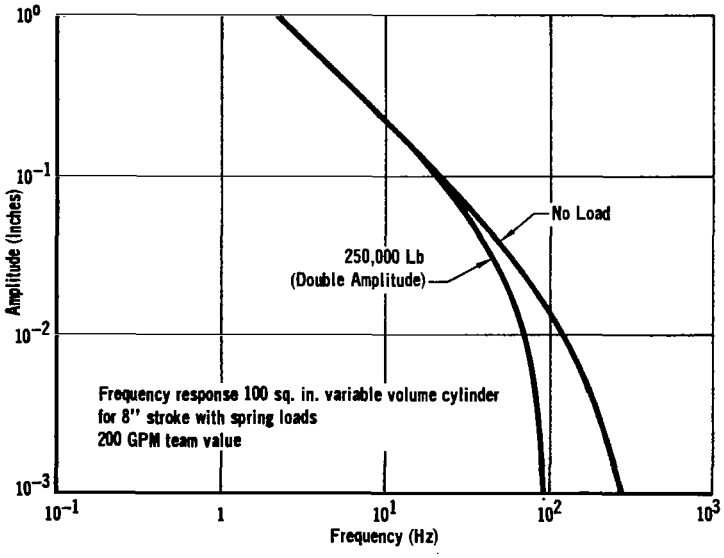


FIRST FLOOR TEST AREA



SECOND FLOOR TEST AREA

FACILITY PERFORMANCE DATA



Manufacturer:	MTS
Model:	901.09
Type:	Hydraulic
Maximum Force, Sine (lb):	100,000
Maximum Force, Random (lb):	-
Maximum g's:	50 (2.4K lbs load)
Frequency Range (Hz):	0 to 150
Double Amplitude (inch):	3
Table Size (inch):	No Table
Max Specimen Weight (lb):	-
Max Specimen Size (inch):	-

Manufacturer:	MTS
Model:	901.96
Type:	Hydraulic
Maximum Force, Sine (lb):	1000K (4 units)*
Maximum Force, Random (lb):	-
Maximum g's:	10
Frequency Range (Hz):	0 to 200
Double Amplitude (inch):	8
Table Size (inch):	No Table
Max Specimen Weight (lb):	-
Max Specimen Size (inch):	-

* Phase controlled @ 250K lbs each

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
Ling	350	Electro-dynamic	20K	-	70	0-1K	9.0	None	-	-
Ling	B-285	Electro-dynamic	400	-	93	5-4.5K	1.0	4 Diam	58 @ 10g	-

NASA-MSC VIBRATION AND ACOUSTIC TEST FACILITY (VATF)

REPORTING INSTALLATION: NASA-Manned Spacecraft Center Houston Texas 77058	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Structural and Mechanics Division Structural Dynamics Branch
OTHER SOURCES OF INFORMATION: Technical Facilities Catalog (NASA), Vol. II, Report NHB 8800.5, March 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION: Structural Dynamics Branch Phone: (713) 483-3166

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The Vibration and Acoustic Test Facility provides the capability of performing vibration and acoustic tests on components and systems ranging in size from small packages, such as electrical components, to fully integrated spacecraft. The facility consists of the following laboratories and work areas: (1) the office area, (2) the General Vibration Laboratory, (3) the Spacecraft Vibration Laboratory, (4) the main control room, (5) the Spacecraft Acoustic Laboratory, (6) the mechanical equipment room and shop, and (7) the Component Acoustic Laboratory. The facility is housed in two building complexes, Building 49 and a portion of Building 262. The Spacecraft Vibration Laboratory and General Vibration Laboratory will be described here. The Spacecraft Acoustic Laboratory description is given in the acoustic section of this report.

Spacecraft Vibration Laboratory - Building 49: This laboratory is designed for testing an entire (integrated) Apollo-type vehicle in its launch attitude. Dimensions of the laboratory are 60 ft by 60 ft with a clear working ceiling of 93 ft. A large access door 40-ft high and 33-ft wide, used for bringing individual spacecraft modules into the laboratory, is located in the north wall. The laboratory is serviced by a 75-ton fixed-point hoist and a 20-ton bridge crane. Permanent-type platforms (8-feet wide) are located at elevations of 15, 25, 35, 45, 65, and 85 feet. The platforms extend around the inside perimeter of the building, forming a U-shaped working area. For vibration testing, integrated spacecraft can be suspended form the interior columns of the building or from the 75-ton hoist. Movable-type platforms are located at elevations of 15, 25, 45, and 65 feet. These platforms can be adjusted to encircle vehicles of varying diameters. An adjustable vehicle support fixture is available which permits 360-degree rotation and provides for vertical alignment of the test vehicles. The base is capable of supporting an assembled vehicle 22 ft in diam, 85 ft high, and weighing 100K lbs. It also includes a pneumatic air spring suspension system which has a natural frequency of 1.0 Hz. Pneumatic and electrical utility connections and communications stations are located throughout the laboratory and at each platform level. The laboratory contains equipment capable of two different types of testing, environmental and modal. The equipment consists of: (1) Eight 10,000 force-lb thrusters. These thrusters are used for environmental level testing during which the spacecraft is subjected to high vibratory energy levels. Spacecraft onboard systems can be included in the test vehicle and may be operational during the tests. The thrusters differ from shakers in that they have a 1.5-inch diam rod as a driver instead of a tabletop armature, making them in effect point-load shakers. Three 175-kVA power amplifiers are used to drive the thrusters (each amplifier drives three thrusters). The thrusters are controlled by sine and random control consoles which allow various modes of operation for the thruster units, including feedback from the response of the spacecraft. This system is used primarily for low frequency (3 to 50 Hz) tests of large, elastic structures; (2) Eighteen 150 force-lb shakers and four 1100 force-lb shakers. These shakers are used for modal testing in which the spacecraft is subjected to low vibratory-energy levels. The energy level is high enough to determine resonant frequencies, mode shapes, and damping characteristics of the test structures. The shakers are portable and are the same equipment used in the General Vibration Laboratory. Each shaker is driven in a separate power amplifier.

FACILITY COST HISTORY

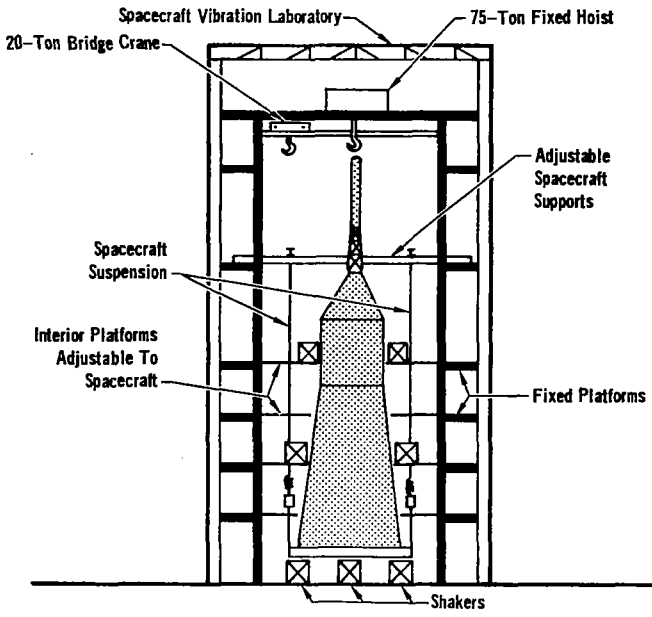
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: 1965 COST $4,520,571* ESTIMATED REPLACEMENT VALUE $5,600,000
CONTRACTOR: C. H. Leavall & Co. Morrison-Knudsen Co., Inc. Cheney & Janes Const. Co.	LOCATION: Houston, Texas Houston, Texas Houston, Texas

IMPROVEMENTS AND COSTS: (1966) Removable platforms for Vibration Lab, Cost $10,244; (1967) Install removable platforms in SVL, Cost $35,878; (1968) Air supply systems mod's, Acoustic Lab, Cost $60,624; (1969) 5-ton auxiliary hoist, Cost $23,795.

PLANS FOR FACILITY IMPROVEMENTS: Control room modifications and upgrade elevator.

*Cost includes Spacecraft Vibration Laboratory (SVL) and Spacecraft Acoustic Laboratory (SAL)

SCHEMATIC



FACILITY DESCRIPTION:(CONTINUED)

Control Room - Building 49: The control room is located on the second floor above the mechanical equipment room and the shop area. It houses the Electronic Control Systems for the Spacecraft Vibration Laboratory and for the Spacecraft Acoustic Laboratory and instrumentation for the data acquisition equipment of the two laboratories. The control room contains the following major items: (1) The control console for the thruster system and the modal system. Control of these portable systems is maintained in the control room, regardless of whether the systems are used in the Spacecraft Vibration Laboratory or in the General Vibration Laboratory; (2) Three 175-kVA power amplifiers which are located integral with the south wall of the control room. These amplifiers provide power to actuate the thrusters in either the Spacecraft Vibration Laboratory or the General Vibration Laboratory. Each amplifier can provide full-force output to three thrusters or can provide reduced power output to four thrusters; (3) Control consoles for the Spacecraft Acoustic Laboratory. These control consoles contain 16 control channels, each consisting of a noise generator, a 1/3 octave band-spectrum shaper, and a 3 kW power amplifier. They are located in the east portion of the control room; (4) Data acquisition equipment and instrumentation located in the control portion of the control room. Approximately 400 channels of data acquisition equipment for dynamic measurements are permanently installed. The instrumentation and data acquisition equipment includes analog tape recorders, FM multiplex systems, oscillographs, wave analyzer equipment, oscilloscopes, analog-to-digital recording systems, meters, and signal conditioners. Approximately 400 accelerometers of various types and 100 microphones are available for use as measurement pickups. The equipment supports the Spacecraft Vibration and the Spacecraft Acoustic Laboratories, the General Vibration Laboratory, and Component Acoustic Laboratory. The available data acquisition equipment is summarized as follows: (1) Tape recorders: 11 units, 403 channels; (2) Oscillographs: 3 units, 30 channels; (3) Wave Analyzer: 1 unit, 2 channels; (4) Oscilloscopes: 16 units; (5) Analog-to-digital systems: 100 channels; (6) Tracking Filters: 5 units; and (7) General instrumentation: transducers, meters, signal conditioning equipment, and noise generators. The entire control room area is built with computer-type flooring which serves as an air-conditioning plenum for equipment cooling and provides cable access. Observation of activity in the Spacecraft Vibration Laboratory is provided by a glass window located in the west wall of the control room. Observation of activity in either the vibration laboratory or the acoustics laboratory is provided by closed-circuit television.

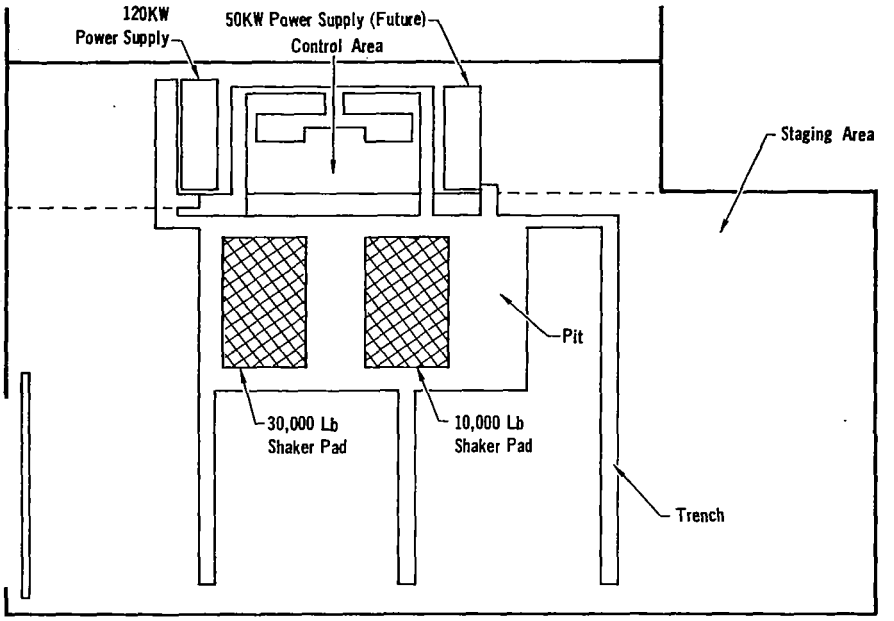
General Vibration Laboratory: This laboratory is used for environmental vibration testing of spacecraft modules, structural components, and assemblies. It is used also for qualification of equipment and hardware. Overall dimensions of the laboratory are approximately 65 ft by 115 ft with a clear working ceiling of 30 ft. A large door, 23-ft wide and 30-ft high, which is used for bringing test articles into the laboratory, is located in the west wall. A portion of the laboratory serves as a staging area for preparing full-scale test articles. The laboratory is serviced by a 20-ton overhead bridge crane.

FACILITY DESCRIPTION (CONTINUED)

Steel tie-down beams (located on 8-foot centers), cable trenches, pneumatic and electrical utility systems, and other shop facilities needed for test operations are arranged throughout the laboratory. Communications stations are located adjacent to test activity areas throughout the laboratory. The laboratory contains six separate vibration systems which provide a full range of testing capability. These systems are: (1) A 30,000 force-lb shaker system which is mounted on a seismic mass to prevent the transmission of vibration to surrounding facilities; (2) A 10,000 force-lb shaker system; (3) A slip table with two 10,000 force-lb shakers mounted to perform horizontal tests of heavy specimens; (4) Two 1500 force-lb shaker systems; (5) Eighteen 150 force-lb portable shakers which can be run either independently or together as a combined system; (6) Six 50 force-lb shakers; and (7) Six 2 force-lb shakers.

A small control room is located against the north wall of the laboratory. This room houses the control consoles for the shakers and power amplifiers and has provisions for instrumentation such as tape recorders, oscillographs, signal conditioners, oscilloscopes, and meters. Systems 2 and 3 above are also mounted on a seismic mass.

SCHEMATIC



FACILITY PERFORMANCE DATA (SVL and General Vibr. Lab)

Operating Envelope

(Not Available)

Manufacturer:	Ling Electronics, (1)
Model:	A249
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	28,000
Maximum g's:	75
Frequency Range (Hz):	5-2000
Double Amplitude (in):	1.0
Table Size (in):	288 diam
Max Specimen Weight (lb):	2600 @ 10 g
Max Specimen Size (in):	Not Available

Manufacturer:	Ling Electronics, (8)
Model:	310
Type:	Electrical
Maximum Force, Sine (lb):	10,000
Maximum Force, Random (lb):	-
Maximum g's:	100
Frequency Range (Hz):	5-2000
Double Amplitude (in):	1.0
Table Size (in):	1.5 (drive rod)
Max Specimen Weight (lb):	94 @ 10 g
Max Specimen Size (in):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb) 20g 50g	Size (l x w x h) (inch)
(1) Ling Elec	275A	Electrical	10,000	8,000	98	5-2K	1.0	16.2 diam	898@10g	-
(2) Ling Elec	B290	Electrical	1,500	-	94	5-2K	1.0	8.9 diam	134@10g	-
(4) Umh-Dickie	6	Electrical	1,000	-	90	DC-500	6.0	.5 dr rod	-	-
(12)Umh-Dickie	28	Electrical	150	-	30	DC-800	3.0	.5 dr rod	-	-
(6) Ling Elec	A280	Electrical	150	-	100	5-10K	1.0	3.5 diam	13.8@10g	-
(6) Ling Elec	V50MK1	Electrical	150	-	-	5-2K	.7	.25 dr rod	-	-

NASA-MARSHALL S-V DYNAMIC TEST STAND
(Building 4550)

REPORTING INSTALLATION: NASA-Marshall Space Flight Center Huntsville Alabama 35812	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Test Laboratory
OTHER SOURCES OF INFORMATION: NASA Marshall, "Technical Facilities and Equipment Digest," January 1967	LOCAL OFFICE TO CONTACT FOR INFORMATION:

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This test installation consists of a Dynamic Testing Facility with a base area 98-feet by 98-feet and 360-feet high, excluding the 64-foot stiff leg derrick. Dynamic tests on the entire Saturn V vehicle as well as on separate flight configurations are conducted in this facility. The main derrick has a 200-ton hook with 70-foot radius and an auxiliary 40-ton hook with radius of 100-feet; the secondary derrick has a 175-ton hook with 50-foot radius.

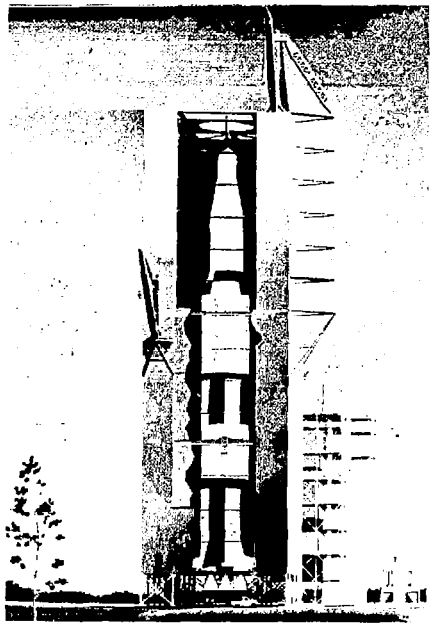
TESTING CAPABILITIES: This facility supports the technological area of structural dynamics. Vibration loads are induced in the pitch, yaw, roll, and longitudinal axis to obtain resonance frequencies and bending modes.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Not Available
Model:	Not Available
Type:	Not Available
Maximum Force, Sine (lb):	Not Available
Maximum Force, Random (lb):	Not Available
Maximum g's:	Not Available
Frequency Range (Hz):	Not Available
Double Amplitude (in.):	Not Available
Maximum Specimen Weight (lb):	Not Available
Maximum Specimen Size (in.):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size l x w x h) (inch)
Not Available										

NORTH AMERICAN ROCKWELL/AUTONETICS DUAL SHAKER SYSTEM

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
North American Rockwell Autonetics P.O. Box 4173, 3370 Miraloma Avenue Anaheim, California 92803	COGNIZANT ORGANIZATIONAL COMPONENT: Navigation and Computer Division Department 248-011
OTHER SOURCES OF INFORMATION: None	LOCAL OFFICE TO CONTACT FOR INFORMATION: L. J. Miller, Project Engineer Environmental Test Phone: (714) 632-6073

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility consists of two Ling shakers, Model 249, driven by a Ling power amplifier, Model 200/350. With front panel switching, the shakers can be readily interconnected to operate either in parallel or push-pull from the one amplifier. Each shaker has its individual cooling unit and field coil power supply.

TESTING CAPABILITIES: The facility is capable of generating 50,000 force pounds (RMS) sine and 40,000 force pounds (RMS) random. Maximum displacement is limited to .9 inch double amplitude. The facility was developed for vibration testing of the Minuteman Missile guidance and control and propulsion compartments. It is capable of testing articles with large areas (4-ft wide and 15-ft long) that cannot be accommodated with a single shaker system. The weight limit depends on the required displacement. Flexure stiffness is 12,000 pounds/inch.

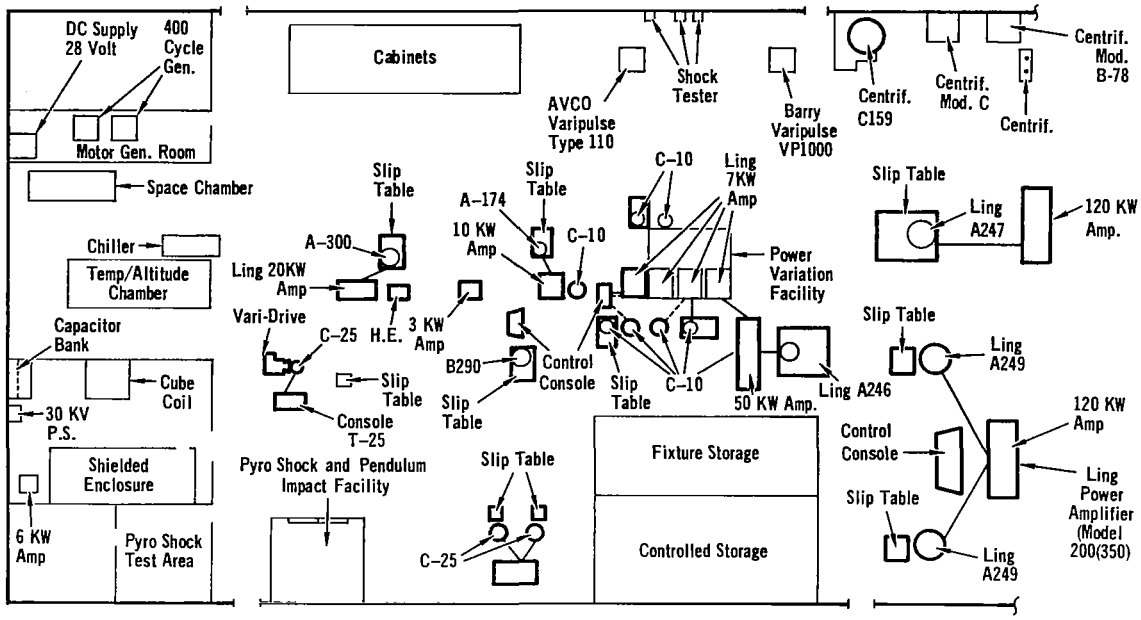
Data recording systems for the dual shaker system and other vibration test facilities listed on the opposite page include magnetic tape recorders (100 channels), pen recorders (8 channels), and Visicorders (20 channels). Data reduction consists of power spectral density plots and X-Y plots (acceleration (g) versus frequency). The typical time cycle for data processing is 30 minutes although this can be reduced to 15 minutes for priority tests.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING TIME (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION

PLANS FOR FACILITY IMPROVEMENT: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Ling Electronics, (2)
Model:	249
Type:	Electrical
Maximum Force, Sine (lb):	50K (Combined)
Maximum Force, Random (lb):	40K (Combined)
Maximum g's:	Not Available
Frequency Range (Hz):	5 to 2000
Double Amplitude (in):	.9
Table Size (in):	Not Available
Maximum Specimen Weight (lb):	Not Available
Maximum Specimen Size (in):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
(1) Ling Elec	A246	Electrical	7K	5.5K	100	5-3000	1.0	16.25 Dia	165@30g	
(1) Ling Elec	A300	Electrical	6K	3K	93	5-3000	.9	13.25 Dia	146@30g	
(1) Ling Elec	B290	Electrical	1.5K	1K	94	5-4000	1.0	8.94 Dia	34@30g	
(8) MB Elec	C10	Electrical	1.2K	850	68	5-3000	1.0	8 Dia	22@30g	
(2) MB Elec	C25A	Electrical	3.5K	2.5K	47	5-2000	.5	16 Dia	41@30g	
( ) MB Elec	174									

NORTH AMERICAN ROCKWELL/SPACE DIVISION DYNAMIC SIMULATION LABORATORY
(Vibration Test Facilities)

REPORTING INSTALLATION: North American Rockwell Space Division 12214 Lakewood Blvd Downey, California 90241	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Laboratories and Test Department 098
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Laboratories and Test Branch Department 098-300 Phone: (213) 922-3491

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This laboratory is equipped to perform the sinusoidal and random vibration testing of small components or large specimens requiring multiple phase controlled shakers. A data analysis capability, a 340,000 level vibration clean room, two bridge cranes rated at ten and 35 tons, and shock acceleration equipment are included in this facility. Maximum hook height for the bridge crane in the high-bay vibration area is 85 feet.

TESTING CAPABILITIES: This high force vibration laboratory provides the capability to excite test specimens to acceleration levels equivalent to 30,000 force-pounds (70g max,) over a frequency range of 5 - 2000 Hz and with a maximum displacement of one inch double amplitude. This laboratory also has the capability to subject test specimens to acceleration levels equivalent to 100,000 force-pounds over a frequency range of 0 - 500 Hz and with a displacement of 1-7/8-inch double amplitude.

Shaker systems available in the small components and subsystems test area range in output from 1500 to 12,000 force - lb (100 g max.)

The data acquisition and analysis system facility is equipped to reduce analog data to plot form. Although data can be processed "real time" in small quantities, the majority of data are recorded on magnetic tape. The use of magnetic tape expands the data acquisition capability greatly and provides a permanent record. The tape recorders will accommodate a wide range of analog inputs, from dc to 20K Hz in the frequency modulated mode, or 100 Hz to 300K Hz in the direct record mode. The dynamic range is better than 43 decibels. The bulk of vibration data are processed to X-Y coordinate plots, either power spectral density or acceleration versus frequency. Acoustic data are plotted on strip charts; sound pressure level versus time, or one-third octave analysis. Shock, chatter, pressure, low frequency sine vibration, and telemetry data are usually plotted on oscillograph strip charts; tape recorded data of this kind can be stretched out by reducing the tape reproduce speed and increasing the oscillograph paper speed. The typical time cycle for data processing is 1/2 hour per channel.

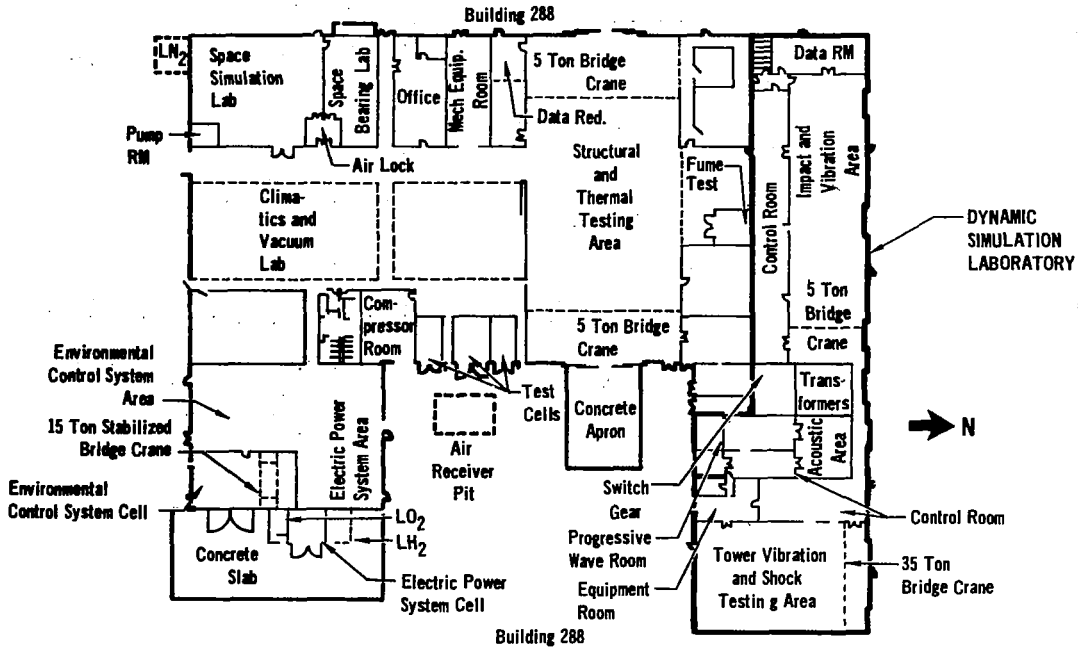
FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): *	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $ Unknown
CONTRACTOR: Vinnell Corporation IMPROVEMENTS AND COSTS:	LOCATION: Anaheim, California

*Depends on number of tests

PLANS FOR FACILITY IMPROVEMENTS: None

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Ling Electronics, (4)
Model:	A249
Type:	Electrical
Maximum Force, Sine (lb):	30,000
Maximum Force, Random (lb):	32,000
Maximum g's:	78
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	28 diam
Max Specimen Weight (lb):	30K @ 1g
Max Specimen Size (inch):	Not Available

Manufacturer:	Ling Electronics, (6)
Model:	310
Type:	Electrical
Maximum Force, Sine (lb):	10,000
Maximum Force, Random (lb):	7,000
Maximum g's:	100
Frequency Range (Hz):	5-2000
Double Amplitude (inch):	1.0
Table Size (inch):	Not Available
Max Specimen Weight (lb):	10K @ 1g
Max Specimen Size (inch):	Not Available

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Size (lb)	Random (lb)					Weight (lb)	Size (1 x w x h) (inch)
Ling Elect.	275	Electrical	10K	8K	98	5-3K	1.0	15 diam	10K @ 1g	Not Avail.
Ling Elect.	A300	Electrical	8K	4K	100	5-3K	1.0	13 diam	8K @ 1g	Not Avail.
Ling Elect.	A300B	Electrical	8K	4K	100	5-3K	1.0	13 diam	8K @ 1g	Not Avail.
Ling Elect.	B300	Electrical	8K	4K	100	5-3K	1.0	13 diam	8K @ 1g	Not Avail.
Ling Elect.	335	Electrical	10K	7K	100	5-3K	1.0	15 diam	10K @ 1g	Not Avail.
(3) MB Elect.	C-25	Electrical	3.5K	2.4K	35	3-2K	.5	17 diam		Not Avail.

WYLE HIGH FORCE VIBRATION FACILITY

REPORTING INSTALLATION:	STATUS OF FACILITY: Active
Wyle Laboratories Huntsville Facility 7800 Governors Drive West Huntsville, Alabama 35800	COGNIZANT ORGANIZATIONAL COMPONENT:
OTHER SOURCES OF INFORMATION: Wyle Laboratories Brochure, "Scientific Services and Systems Group," Eastern Operations, 1970	LOCAL OFFICE TO CONTACT FOR INFORMATION: Phone: (205) 837-4411

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: The largest high force vibration facility in the nation is now in operation at Wyle Huntsville. The first task was to simulate the vibration generated by Saturn V's engines and by unsteady aerodynamic flows during flight through the atmosphere. Designed to allow vertical as well as horizontal vibration testing of major structural elements, the building housing the facility is 60-feet high, 50-feet wide, and 163-feet long. Each of the two hydrashaker systems combines eight 50,000 force-pound exciters to generate a total of 400,000 force-pounds, with full phase and amplitude synchronization. The first specimens tested were Saturn substructures 33 feet in diameter and up to 32 feet in height, the largest weighing over 40,000 pounds. The test fixtures, which connect the specimen to the hydrashakers, were among the largest ever built. Over 7.5 million pounds of concrete were used in the construction of the reaction mass system which incorporates 30 exciter mounting locations. Vibration control is accomplished by an eight-channel phase and amplitude system, and four dual channel hydrashaker servo amplifiers. The vibration control monitor system includes two four-beam oscilloscopes and eight voltmeters for monitoring the phase and amplitude of the hydrashaker control signals. A three-channel closed circuit television system is used for monitoring the test specimen during test operations. The television cameras are designed to withstand service vibratory and acoustic environment.

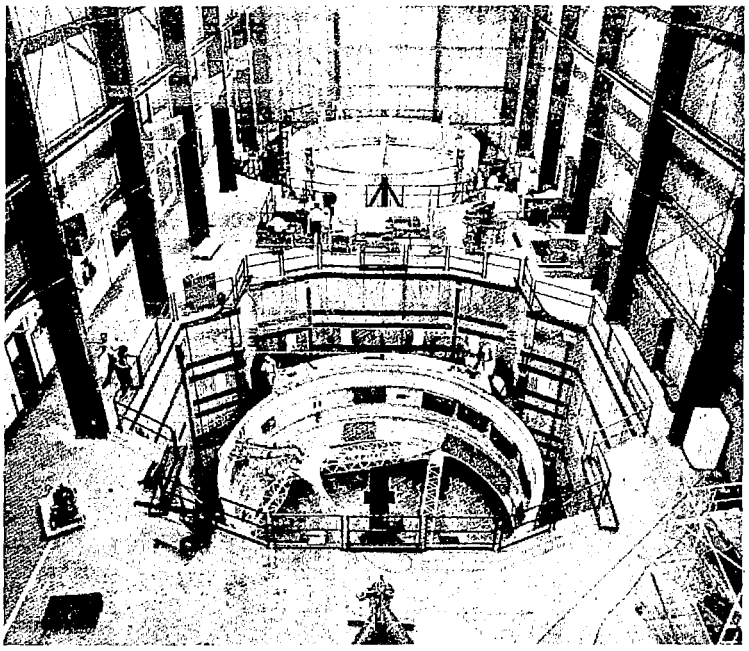
TESTING CAPABILITIES: Because of the high degree of flexibility in available force, the accuracy of its control, and the speed and precision of the data acquisition and analysis system, the facility can be used to vibrate a wide range of specimens, not only in the aerospace industry, but in any industry where precise knowledge of the effects of vibration on massive specimens is needed. These applications include: (1) Aerospace (random or sine vibration), test specimens: Any hardware or structure mounted on spacecraft or aircraft; (2) Launch Site (random or sine vibration), test specimens: Includes buildings and equipment located at or near the launch site; (3) Shipboard (random or sine vibration), test specimens: Structures and equipment associated with ships or submarines; (4) Over-the-Road (random or sine vibration), test specimens: Any vehicles, especially those transporting rocket launchers, electronic systems, and other precision equipment; (5) Consumer and Commercial Products: Random or sine vibration simulating transportation, shipping, service, and fatigue conditioning; and (6) Earthquake Simulation (random vibration with large excursions superimposed), test specimens: Reactors, buildings, dam or bridge models, storage tanks, and large industrial machinery and equipment.

FACILITY COST HISTORY

AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $2,000,000(plus) ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC



FACILITY PERFORMANCE DATA

Operating Envelope

(Not Available)

Manufacturer:	Wyle
Model:	W4800
Type:	Electro-hydraulic
Maximum Force, Sine (lb):	400,000 (Combination of eight 50,000 lb_f Sine exciters)
Maximum Force, Random (lb):	Same as Sine
Maximum g's:	16
Frequency Range (Hz):	2000
Double Amplitude (in):	1.0
Table Size (in):	Not Applicable
Maximum Specimen Weight (lb):	200,000
Maximum Specimen Size (feet):	40 (on a side)

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in.)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
(1) Ling Elec	249	Electrical	30K	28K	75	5-2K	1.0		2604@10g	
(1) " "	L200	Electrical	22K	15.5K	100	5-2K	1.0		2110@10g	
(3) " "	275	Electrical	10K	8K	98	5-3K	1.0		898@10g	
(2) " "	C25	Electrical	3.5K	2.5K	45	5-2K	.5		250@10g	
(1) " "	C10	Electrical	1.5K	1.05K	68	5-3K	1.0		100@10g	
(1) " "	286	Electrical	600	150	150	5-6K	1.0		45@10g	

WYLE VIBRATION TEST FACILITIES
(Norco, California)

REPORTING INSTALLATION: Wyle Laboratories 1841 Hillside Avenue Norco, California 91760	STATUS OF FACILITY: Active COGNIZANT ORGANIZATIONAL COMPONENT: Dynamics Test Department
OTHER SOURCES OF INFORMATION:	LOCAL OFFICE TO CONTACT FOR INFORMATION: Same as Reporting Installation Phone: (714) 737-0871

DESCRIPTION AND TESTING CAPABILITIES

FACILITY DESCRIPTION: This facility subjects aircraft, spacecraft, missile components, solid rocket motors, and ordnance packages to dynamic vibration excitation to simulate flight and transportation environments. Electrodynamic exciter capability of 30,000 force pounds sine and 32,000 force pounds wide band random are available with single Ling A-249 exciters. Four of these machines can be combined to give 120,000 force-pounds sine and 128,000 force-pounds wide band random.

TESTING CAPABILITIES: The Dynamics Test Department has performed Qualification Tests on several large aerospace programs requiring verification of response, modes, and integrity of components. Multiple shaker systems and phase control equipment are available for specimens requiring three or four points of excitation simultaneously. Special instrumentation is available for recording strain pressure, acceleration and temperature. Vibration testing and cryogenic flow simultaneously can be accommodated as required. Cryogenic flow capabilities for LN_2, LO_2, and LH_2 at temperatures to -400°F and continuous flow with a recirculating system include: (1) LN_2, 10,000 gal/min continuous flow from 40,000 gal storage; (2) LH_2, 10,000 gal/min continuous flow from 54,000 gal storage; and (3) LO_2, 5000 gal/min continuous flow from 24,000 gal storage.

FACILITY COST HISTORY

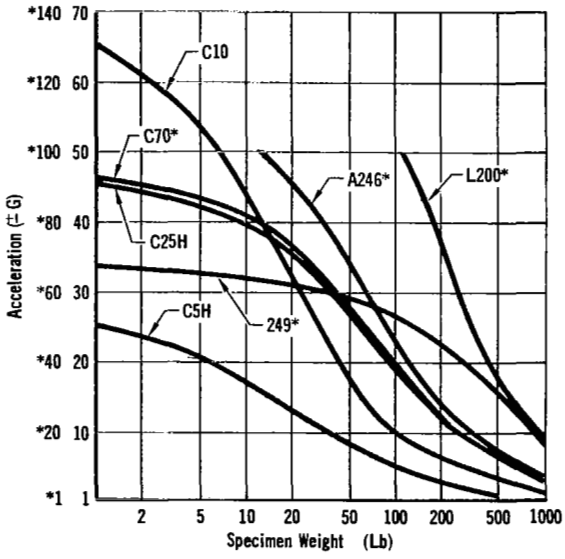
AVERAGE ESTIMATED OPERATING COST (TYPICAL 8 HOUR SHIFT): Not Available	CONSTRUCTION YEAR: COST $ Not Available ESTIMATED REPLACEMENT VALUE $
CONTRACTOR: IMPROVEMENTS AND COSTS: Not Available	LOCATION:

PLANS FOR FACILITY IMPROVEMENTS: Not Available

SCHEMATIC

(Not Available)

FACILITY PERFORMANCE DATA



Manufacturer:	Ling Electronics
Model:	Electrical
Type:	(5), A-249
Maximum Force, Sine (lb):	30,000**
Maximum Force, Random (lb):	32,000**
Maximum g's:	75
Frequency Range (Hz):	5 to 2000
Double Amplitude (in):	1.0
Table Size (inch):	Not Applicable
Maximum Specimen Weight (lb):	See graph
Maximum Specimen Size (inch):	-

Manufacturer:	Ling Electronics
Model:	L-200
Type:	Electrical
Maximum Force, Sine (lb):	22,000
Maximum Force, Random (lb):	21,000
Maximum g's:	100
Frequency Range (Hz):	5 to 2000
Double Amplitude (in):	1.0
Table Size (inch):	Not Applicable
Maximum Specimen Weight (lb):	See graph
Maximum Specimen Size (inch):	-

** 4 machines can be combined to give 120K lbf Sine or 128K lbf Random

ADDITIONAL VIBRATION TEST CAPABILITIES

Manufacturer	Model	Type	Maximum Force		Maximum (g)	Frequency Range (Hz)	Dbl. Amp. (in)	Table Size (inch)	Maximum Specimen	
			Sine (lb)	Random (lb)					Weight (lb)	Size (l x w x h) (inch)
(4) Ling Elect	275***	Electrical	10K	8K		5-3K			***	- 4 machines can be combined
(1) Ling Elect	335	Electrical	15K	-		5-2.5K				
(5) Team	W4500		45K	-		0-500				
(1) Team	W10000		100K	-		0-500				
(1) Team	W2500		25K			0-250				
(1) Team	W1000		10K	-		0-250				

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