

**United States Department of the Interior
National Park Service**

**National Register of Historic Places
Inventory—Nomination Form**

For NPS use only

received

date entered

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic Zero Gravity Research Facility (B-2)

and/or common Zero Gravity Research Facility

2. Location

street & number Lewis Research Center _____ not for publication

city, town Cleveland _____ vicinity of _____ congressional district

state Ohio code 39 county Cuyahoga code 035

3. Classification

Category	Ownership	Status	Present Use	
<input type="checkbox"/> district	<input checked="" type="checkbox"/> public	<input type="checkbox"/> occupied	<input type="checkbox"/> agriculture	<input type="checkbox"/> museum
<input type="checkbox"/> building(s)	<input type="checkbox"/> private	<input type="checkbox"/> unoccupied	<input type="checkbox"/> commercial	<input type="checkbox"/> park
<input checked="" type="checkbox"/> structure	<input type="checkbox"/> both	<input type="checkbox"/> work in progress	<input type="checkbox"/> educational	<input type="checkbox"/> private residence
<input type="checkbox"/> site	Public Acquisition	Accessible	<input type="checkbox"/> entertainment	<input type="checkbox"/> religious
<input type="checkbox"/> object	<input type="checkbox"/> in process	<input checked="" type="checkbox"/> yes: restricted	<input checked="" type="checkbox"/> government	<input checked="" type="checkbox"/> scientific
	<input type="checkbox"/> being considered	<input type="checkbox"/> yes: unrestricted	<input type="checkbox"/> industrial	<input type="checkbox"/> transportation
		<input type="checkbox"/> no	<input type="checkbox"/> military	<input checked="" type="checkbox"/> other: Space Exploration

4. Owner of Property

name National Aeronautics and Space Administration (NASA)

street & number

city, town Washington _____ vicinity of _____ state D.C. 20546

5. Location of Legal Description

courthouse, registry of deeds, etc. National Aeronautics and Space Administration (NASA)

street & number Real Property Management Office Code NXG

city, town Washington _____ state D.C. 20546

6. Representation in Existing Surveys

title None has this property been determined eligible? _____ yes _____ no

date _____ federal _____ state _____ county _____ local

depository for survey records

city, town _____ state

7. Description

Condition

excellent
 good
 fair

deteriorated
 ruins
 unexposed

Check one

unaltered
 altered

Check one

original site
 moved date _____

Describe the present and original (if known) physical appearance

The Zero Gravity Research Facility is at the Lewis Research Center in Cleveland, Ohio. It is the only known facility of its size in the free world capable of performing tests in a reduced gravity environment. It has successfully supported researchers involved in the Manned Space Program (Mercury, Gemini and Apollo), and the Centaur Program. Most research tests involve behavior of components, systems, liquids, gases, and combustion when under the influence of reduced gravity or low acceleration environments.¹

This facility consists of a concrete-lined, 28-foot diameter shaft that extends 510-feet below ground level. A steel vacuum chamber, 20-feet in diameter and 470-feet high, is contained within the concrete shaft. The pressure in this vacuum chamber is reduced to 13.3 newtons per square meter (1.3×10^{-4} atm) before use.

The ground-level service building has, as its major elements, a shop area, control room, and a clean room. Assembly, servicing, and balancing of the experiment vehicle are accomplished in the shop area. Tests are conducted from the control room, which contains controls for the "pump down" of the vacuum chamber, the experiment vehicle pre-drop checkout, release and the data retrieval system. Those components of the experiment that are in contact with the test liquid are prepared in the facility's clean room. The major elements of the clean room are an ultrasonic cleaning system and a laminar-flow work station for preparing those experiments requiring more than normal cleanliness.

Mode of Operation - The Zero-Gravity Facility has two modes of operation. One is to allow the experiment vehicle to free fall from the top of the vacuum chamber, which results in a nominal 5.15 seconds of free fall time. The second mode is to project the experiment vehicle upwards from the bottom of the vacuum chamber by a high-pressure pneumatic accelerator on the vertical axis of the chamber. The total up and down trajectory of the experiment vehicle results in a nominal 10 seconds of free fall time.

In either mode of operation, the experiment vehicle falls freely; that is, no guide wires, electrical lines, are connected to the vehicle. Therefore, the only force acting on the freely falling experiment vehicle is due to residual-air drag. This results in an equivalent gravitational acceleration acting on the experiment, which is estimated to be of the order of 10^{-5} g or better.

8. Significance

Period	Areas of Significance—Check and justify below			
<input type="checkbox"/> prehistoric	<input type="checkbox"/> archeology-prehistoric	<input type="checkbox"/> community planning	<input type="checkbox"/> landscape architecture	<input type="checkbox"/> religion
<input type="checkbox"/> 1400-1499	<input type="checkbox"/> archeology-historic	<input type="checkbox"/> conservation	<input type="checkbox"/> law	<input checked="" type="checkbox"/> science
<input type="checkbox"/> 1500-1599	<input type="checkbox"/> agriculture	<input type="checkbox"/> economics	<input type="checkbox"/> literature	<input type="checkbox"/> sculpture
<input type="checkbox"/> 1600-1699	<input type="checkbox"/> architecture	<input type="checkbox"/> education	<input type="checkbox"/> military	<input type="checkbox"/> social/ humanitarian
<input type="checkbox"/> 1700-1799	<input type="checkbox"/> art	<input checked="" type="checkbox"/> engineering	<input type="checkbox"/> music	<input type="checkbox"/> theater
<input type="checkbox"/> 1800-1899	<input type="checkbox"/> commerce	<input type="checkbox"/> exploration/settlement	<input type="checkbox"/> philosophy	<input type="checkbox"/> transportation
<input checked="" type="checkbox"/> 1900-	<input type="checkbox"/> communications	<input type="checkbox"/> industry	<input type="checkbox"/> politics/government	<input checked="" type="checkbox"/> other (specify) Space Exploration
		<input type="checkbox"/> invention		

Specific dates 1966-Present **Builder/Architect** NASA

Statement of Significance (In one paragraph)

The Zero-Gravity Facility is significant because it is the only such facility in NASA's inventory that can study the behavior of liquids in a low gravity environment. A knowledge of the characteristics of liquids in a space vehicle is important to design engineers. Information concerning liquid sloshing which can change the center of mass of a space vehicle and thus effect vehicle stability and control is absolutely essential to the successful performance of liquid high energy space vehicles such as the Centaur and Saturn upper stages. The study of the effects of liquid sloshing on the performance of upper stage liquid rockets was therefore essential to the successful completion of the objectives of the American Space Program.

The Zero-Gravity Facility is the only such facility of its type in the world and is directly linked to the development of the Centaur and Saturn upper stage rockets, which have transported Americans to the moon and sent American space vehicles such as the Viking, Voyager, and Mariner spacecraft to the planets. Research and data developed here involving the physics of liquids in a zero-gravity environment was indispensable to the successful development of these high energy liquid fueled rockets.

9. Major Bibliographical References

See continuation sheets

10. Geographical Data

Acreeage of nominated property Less than 1 acre

Quadrangle name Lakewood

Quadrangle scale 1:24,000

UMT References

A

1	7	4	2	7	7	8	0	4	5	8	4	6	6	0
Zone		Easting				Northing								

B

Zone		Easting				Northing								

C

Zone		Easting				Northing								

D

Zone		Easting				Northing								

E

Zone		Easting				Northing								

F

Zone		Easting				Northing								

G

Zone		Easting				Northing								

H

Zone		Easting				Northing								

Verbal boundary description and justification

The boundary of the Zero-Gravity Facility is shown as the green line on the accompanying map entitled "National Aeronautics and Space Administration, Lewis Research Center."

List all states and counties for properties overlapping state or county boundaries

state	code	county	code
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state	code	county	code
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11. Form Prepared By

name/title Harry A. Butowsky

organization National Park Service

date May 15, 1984

street & number Division of History

telephone (202) 343-8168

city or town Washington, D.C. 20240

state

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

national state local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

title _____ date _____

For NPS use only

I hereby certify that this property is included in the National Register

date _____

Keeper of the National Register

Attest:

Chief of Registration

date _____

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Recovery System - After the experiment vehicle has traversed the total length of the vacuum chamber, it is decelerated in a 12-foot diameter, 20-foot deep container which is centered on the vertical axis of the chamber and filled with small pellets of expanded polystyrene. The deceleration rate (averaging 32 g) is controlled by the flow of pellets through the area between the experiment vehicle and the wall of the deceleration container. This deceleration container is mounted on a cart that is retracted prior to utilizing the 10-second mode of operation. In this mode of operation, the cart is deployed after the experimental vehicle is projected upwards by the pneumatic accelerator.

This facility is in active service supporting present space shuttle experiments.

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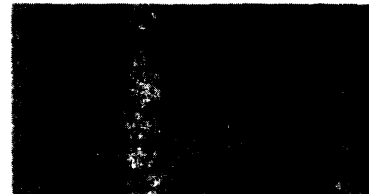
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Footnotes

1. The descriptive material in this section was taken from the following source:
Thomas Labus, Natural Frequency of Liquids in Annular Cylinders under Low Gravitational Conditions, NASA Technical Note D-5412, (Washington, D.C.: National Aeronautics and Space Administration, September 1969), pp. 22-4.

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Bibliography

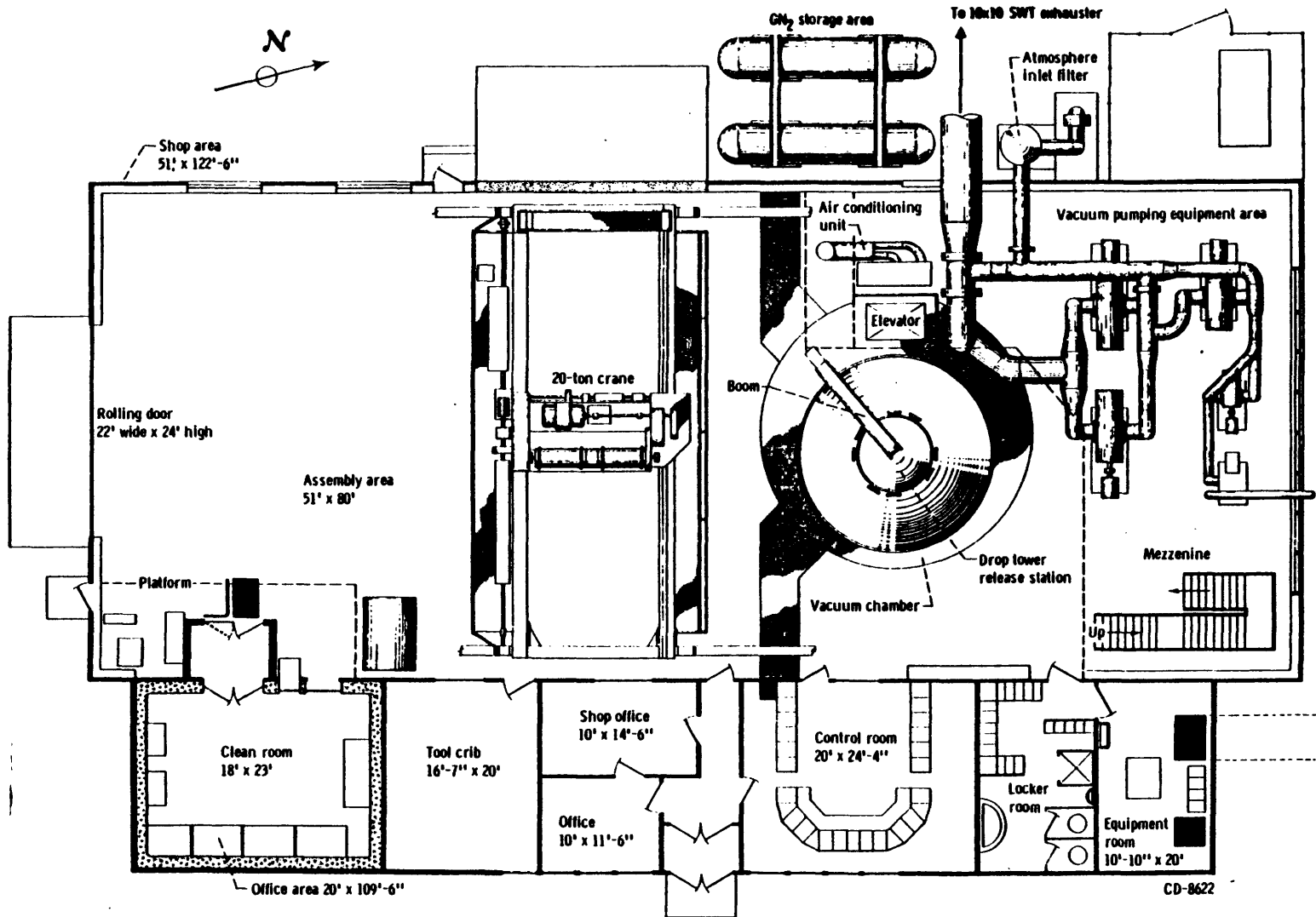
Labus, Thomas L. Natural Frequency of Liquids in Annular Cylinders under Low Gravitational Conditions. NASA Technical Note D-5412. Washington, D.C.: National Aeronautics and Space Administration, September 1969.

National Aeronautics and Space Administration. Technical Facilities Lewis Research Center. Cleveland, Ohio: Lewis Research Center, No Date.

National Aeronautics and Space Administration. Zero Gravity Research Facility. Cleveland, Ohio: Lewis Research Center, September 1966.

Petrash, Donald A. and Corpas, Ellias L. Zero Gravity Facility for Space Vehicle Fluid Research. Reprinted from the 1973 Proceedings of the 19th Annual Meeting of the Institute of Environmental Sciences. No place of publication, No date.

Zero Gravity Research Facility Floor Plan



Source: Zero Gravity Research Facility, op. cit., figure 5.