STATUS REPORT OF "J" SITE FROM JULY 1, 1961 = JULY 1, 1962

J-1

The gaseous hydrogen-liquid oxygen rocket test engine has been in operation for the entire 1 year period. At the same time construction has been proceeding to support the second phase of work to be done in the J-1 test rig.

J-2

For the period July 1, 1961 to December 31, 1961, the cell was operational. The H_2-F_2 rocket system test program was completed on December 31, 1961. From December 31, 1961 to May 7, 1962 the cell was inactive. Construction began on May 8, 1962 on a new H_2-O_2 rocket system. Construction is continuing and should be complete by August 1, 1962.

J-3

This facility has been under construction for the past 12 months. The space tank facility will be in partial operation by July 16, 1962.

MEMO to CS Moore, Subj: Info for Yearly exper fac oper rpt for P&S, 7-5-62

j. "J" Site - Rocket Test Area:

The operation of the various test stands making up the "J" site are listed below:

"J-1", The gaseous hydrogen - liquid oxygen rocket test engine has been in operation throughout the year. Work has now progressed to include the second phase of the test program.

"J-2", The rocket systems test stand ran from July 1, 1961 to December 31, 1961 with an H_2-F_2 rocket system test program and from December 31, 1961 to May 7, 1962 the cell was inactive. The remainder of the year has been spent in preparing for the new H_2-O_2 rocket system.

"J-3" has not been in operation during the past twelve months but construction has taken place to prepare for tests for the Space Tank Facility.

January 28, 1963

"J-3"	Vacuum Environment Facility 51201	This facility consists of a "zero leakage" high vacuum tank designed for testing fibreglas and resin liquid hydrogen tanks in low pressure environment. Diffusion of hydrogen through the walls of these plastic tanks was to be determined by sealing off the vacuum space and measuring the pressure rise in the known volume.

STATUS: The vacuum test rig was built up and installed during the first half of 1962. The facility's capability was demonstrated and validated using a metal tank. The experimental plastic tanks of approximately 20 gallon capacity were screened in Cleveland at cryogenic conditions. Most of them failed. The best tank was installed at Plum Brook but failed during the filling operation. No data was obtained and the facility has subsequently been idle for the past several months.

Recently, a request has been received from Cleveland to extensively modify the vacuum tank in "J-3". The immediate objective is to make the facility capable of accepting a larger metal tank insulated with Linde insulation. Heat transfer data would be obtained when the tank was filled with liquid hydrogen and the insulation exposed to high vacuum conditions. A longer term objective is to equip the tank with a large capacity diffusion pump and a heat source. A solar environment is to be simulated.

2/28/1963

PLUM BROOK ROCKET SYSTEMS FACILITIES STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
J	ROCKET SYSTEMS "J-3"	Vacuum Environment Facility 51201 (I.A.Johnsen)	This facility consists of a "zero leakage" high vacuum tank designed for testing fibreglas and resin liquid hydrogen tanks in low pressure environment. Diffusion of hydrogen through the walls of these plastic tanks was to be determined by sealing off the vacuum space and measuring the pressure rise in the known volume.

STATUS: Rebuilding cell to facilitate A. D. Little tank. By May the cryogenic valving and changeover to standardized LH_2 trailers should be completed. Test runs will start in June.

March 28, 1963

PLUM BROOK STATION ROCKET SYSTEMS FACILITY STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
J	J-3	Vacuum Environment Facility 5120 (I.A. Johnsen) A. D. Little Tank	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS: Physical building of the cell is awaiting final decisions by A. D. Little Company relative to specific requirements of process systems and instrumentation. The design of equipment is progressing but has not been finalized. Project managements schedule appears optimistic based on past facility build-up experience. A request has been made to test J-4 Linde tank in J-3 Facility. These tests will be run if they do not interfere with the A. D. Little tank tests. As of this report date no written requirements have been received from the research engineers relative to the Linde tank tests.

A. D. Little Tank types of insulation on liquid hydrogen tanks is to be studied.

STATUS: Physical building of the cell is awaiting final decisions by A. D. Little Company relative to specific requirements of process systems and instrumentation. The design of equipment is progressing but has not been finalized. Project managements schedule appears optimistic based on past facility build-up experience. A request has been made to test J-4 Linde tank in J-3 Facility. These tests will be run if they do not interfere with the A. D. Little tank tests. As of this report date no written requirements have been received from the research engineers relative to the Linde tank tests.

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
J		J-3 Vacuum Environment Facility 5120 (I.A.Johnsen) A. D. Little Tank	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.
		STATUS:	Note (A) : On March 28th it was decided to rebuild the J-3 facility to handle only the Linde tank test. Tank alterations for A. D. Little tank will be done after Linde tests are completed. The first 2½ weeks of April were spent in rebuilding the facility to accept the Linde insulated liquid hydrogen tank. The object of the test is to determine the effectiveness of the insulation under vacuum conditions.
		STATUS:	One test run was made on April 22nd and 23rd. Approximately 35% of the run was completed when the test was aborted due to accidental shut down of a vacuum pump. All data obtained before the shut down was usable. The second test run commenced on April 27th and will continue through May 12th. Research data is being recorded at one hour intervals on an "around the clock" basis.

PLUM BROOK ROCKET SYSTEMS DIVISION STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
J		J-3 Vacuum Environment Facility 5120 (I. A. Johnsen) A. D. Little Tank	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS:

NOTE (A): The schedule has been changed by two weeks which reflects the present anticipated deliveries of materials.

Two tests were completed on the Linde super-insulated liquid hydrogen tank. The first test was conducted with the space chamber evacuated to a pressure of five microns. Data was recorded at one hour intervals for eight days. The second test was made to evaluate the affects of compression of the super-insulation on the liquid hydrogen boil-off rate. To accomplish this the vacuum chamber pressure was raised in increments of twenty-five millimeters from five microns to two hundred millimeters of mercury. Data was recorded at thirty minute intervals for five days. The test data is now being analized by research engineers.

On May 14, 1963 the Linde tank was removed from the space tank and rebuilding of the test cell started for the A. D. Little tests. The space tank has been raised and modified and the new floor grating has been installed.

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
J		J-3 Vacuum Environment Facility 5120 (I.A. Johnsen) A. D. Little Tank ORO 399	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

NOTE (A): The schedule has been changed by two weeks which reflects delays in arrival of new equipment to support the program. Some instrumentation equipment is not scheduled tc arrive until mid-July.

STATUS: The test cell is currently being rebuilt to accept the Arthur D. Little Company environmental tankage test program. Work completed this month includes: (1) extension to the existing vacuum chamber, (2) panels for equipment mounting (3) second floor installation, (4) monorail on the existing roof frame to place the insulated tanks in the vacuum chamber. Work is progressing on the placement of equipment, valves, pumps, piping, and the electrical wiring of the test cell and the control panels. It is anticipated that a two shift per day, six day a week operation will be necessary to complete the facility by August 1, 1963. With the present workload in the "J" area, this type of support does not appear possible without closing down other cells in the "J" area.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	(Continued)		
		J-3 VACUUM ENVIRONMENT FACILITY (I. A. Johnsen) A. D. Little Tank 0V0698	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS: On July 9, it was decided by Cleveland personnel that the test cell would be used for CENTAUR arc tank insulation tests before the ADL insulated tank was tested. The test cell construction is complete for the CENTAUR tests and checkout of the facility will be made in the time period before the CENTAUR arc tank arrives. Construction related to the ADL tests will continue as manpower is available from the CENTAUR test program.

NOTE (A) : Schedule changes reflect current research program requirements.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J		J-2 M-1 HYDROGEN-OXYGEN GAS GENERATOR (Continued)	

NOTE (A) : Schedule has been changed to reflect deliveries of materials and anticipated cell buildup time.

J-3 VACUUM ENVIRONMENT FACILITY
(I.A.Johnsen)
(I.I. Pinkel)
OV0698

This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS: Two test runs were made during the month of August. Test program for #1 CENTAUR tank in J-3 was partially completed on August 21. A hydrogen leak from the CENTAUR tank to the vacuum chamber necessitated a premature shutdown of the test. Continuation of the test at this point would be highly dangerous since the test calls for introduction of 30 KW power into the vacuum chamber with the possibility of arcing during the vacuum chamber evacuation. Subsequent checks of the system revealed no leakage at ambient temperature. The research personnel therefore decided to repeat the test at a later date using LN_2 as the cryogenic fluid. On August 26, the #1 CENTAUR tank was tested in J-3 facility using LN_2 as the cryogenic fluid. Tank boiloff was stabilized, then test sequence was followed. The sequence consisted of evacuating the vacuum chamber for 150 seconds to a pressure of 7 mm Hg ABS., then energizing the heating section for 60 seconds. The tank insulation surface attained a temperature of 640° F. Subsequent investigation of the tank and insulation revealed that the insulation was badly burnt, and it was determined that the heater lamps had been installed improperly which accounted for the burnt condition of the tank insulation.

NOTE (A) : CENTAUR arc tank insulation program has been extended until October 1.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS		
		J-1 HYDROGEN-OXYGEN 28K Rocket Eng. OC0425 (N.D.Sanders)	A hydrogen-oxygen rocket engine operated over chamber pressure range of from 200 to 900 psi. Heat transfer is measured from the combustion gases to chamber wall. The objective is to extend heat transfer theory into the region required for the design of nuclear rocket nozzles. Presently, solid copper heat sink engines are being used. Ultimately, the program will progress to a highly instrumented liquid hydrogen cooled chamber.

STATUS: A total of 19 runs on 4 days were made this month. The objective of these runs was to check out the Pc and O/F controlling circuitry of the fire valve controller. Accurate control of these parameters is of prime importance in the heat transfer work to be done at J-1. To date, system stability with fast accurate response has been obtained only at the 300 psia chamber pressure. A satisfactory arrangement between system pressures and controller response characteristics has yet to be determined for 600 psia chamber pressures. Future tests are planned to meet this objective. A modification to the J-1 test cell structure is scheduled to begin early in October. Cell operations will be curtailed approximately 3 weeks during the cell modification construction period.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS		
		J-3 VACUUM ENVIRONMENT FACILITY OR0397 I.I.Pinkel I. A. Johnsen	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS: Two successful LH_2 test runs were completed on the Centaur Arc Tank #4 in "J-3" test cell during the month of October. The last test, on the 10th of October, concluded the Centaur tests to be performed in J-3 test cell.

Presently, the test cell is being modified to accept the A. D. Little Company test configuration. The vacuum chamber has been evacuated to 2×10^{-6} torr and both LN_2 and water systems have been checked out. A. D. Little Company tests are scheduled to start November 18, 1963.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS		
		J-3 VACUUM ENVIRONMENT FACILITY OF0567(I.I. Pinkel) OR0397(I.A.Johnsen)	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks to be studied.

STATUS: Preparations continued for the Arthur D. Little Co. tank insulation tests. During this report period, liquid nitrogen and water checkout runs were performed on all NASA thermal environment systems. The high vacuum conditions required for this test program have not been obtained because of the high frequency of vacuum leaks in new components. Continuous leak detection has been required during the past month.

NOTE (A) : It is anticipated that checkout runs of the Arthur D. Little tank and components will begin in the second week of December with actual testing commencing in late December.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J		J-3 VACUUM ENVIRONMENT FACILITY OFO-567 (I.I.Pinkel) ORO-397 (I.A.Johnsen)	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks to be studied.

STATUS: One LH_2 test run was made in this facility on the Arthur D. Little Company's insulated tank during this reporting period. The test commenced on December 20 and was terminated on December 23 so contractual obligations at the test cell could be fulfilled. During the first 12 hours of the test, a cold guard system designed to prevent heat transfer down the neck of the tank was not operational. The remaining 44 hours of testing were conducted at specified conditions. Pressure measurements in the 10^{-7} Torr range were obtained during the majority of the test. At this writing, it is not known if the test correlates with theoretical results extrapolated from LN_2 testing at Arthur D. Little Co.

The roof of the test cell is now being modified and is due to be completed by January 8. Further testing is scheduled to start January 20, 1964 on the above tank, or other A. D. Little tanks.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-1	
		J-3 VACUUM ENVIRONMENT FACILITY OF0567 (I. I.Pinkel) OR0397 (I.A.Johnsen)	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

STATUS: During this reporting period, testing was resumed on the first Arthur D. Little Co. aluminum-mylar multifoil insulated cryogenic tank. On January 20th, the tank was filled with liquid hydrogen; liquid nitrogen was used in the cold guard system with 80° F water environmental control surrounding the vacuum chamber. The tank was permitted to boiloff until January 23. The "boil-off" rate on this test was approximately 50% higher than anticipated from extrapolated date from liquid nitrogen tests performed at Arthur D. Little Co., at Cambridge, Mass. To determine if thermal degradation of the insulation had taken place during the tank's six-month storage at Plum Brook, the tank was refillec with liquid nitrogen on January 23 to duplicate the tests at Cambridge. This test was allowed to "boil-off" until the 28th, and, once again the boil-off rate was higher than anticipated.

The tank was refilled on the 30th with liquid hydrogen in the tank and cold guard systems, and it is anticipated that the test will be terminated by February 3.

NOTE (A): A. D. Little tests have been extended to February 28, 1964.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J		J-3 VACUUM ENVIRONMENT FACILITY 0F0567 (I.I.Pinkel) 0R0397 (I.A.Johnsen)	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

On February 3, the test started on January 20 was completed on the first A. D. Little Aluminum-Mylar multi-foil insulated tank. Test data indicated higher boil-off rates than on previous tests at A. D. Little Company. Tank inspection revealed some thermal degradation of the insulation had taken place near the brazed joint on the tank neck. The cause for this condition was not determined. The tank was returned to A. D. Little for further inspection and tests.

NOTE Ⓐ: The second A. D. Little tank was scheduled for testing on February 17, but since the tank insulation was destroyed during a test at the A. D. Little Company facility, no new Plum Brook schedule has been established. Minor cell modifications for the ADL tank tests were continued during February. Contractor maintenance work in the cell prevented the starting of any major modification work.

On February 6, a rapid chamber evacuation test was conducted to evaluate the pumping capacities required to simulate the launch profile of a missile. The test results are being analyzed and more tests are scheduled for March.

Initial planning and purchasing of equipment for the Linde super-insulated test tank were completed this month. All equipment is scheduled to be delivered by early April and testing should start by mid-April.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY 0F0567 (I. I. Pinkel) 0R0397 (I. A. Johnsen)	This facility consists of a "zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

The test cell was inactive until March 13 because of the required mechanical demands to support other test cells. On March 14, a nude ionization guage was installed and the chamber was continuously evacuated until March 23, reaching an ultimate pressure of 2.8×10^{-8} mm of Hg. On the following day, the second in a series of rapid chamber evacuation tests was performed. This test was to determine if the diffusion pump had sufficient pumping capacity to simulate the ascent of a typical missile between the altitudes of 50 to 250 miles. A third rapid evacuation test was performed on March 26.

The major portion of the evacuation equipment required for the Linde tank super-insulation tests had been received by March 20 when Plum Brook welders started the fabrication of this system. Late deliveries of some equipment will postpone completion of this system until April 10.

NOTE Ⓐ : It is anticipated that testing of the Linde tank will begin in mid-April and continue for one month. The second Arthur D. Little tank is scheduled to arrive the week of May 3, but the second tank testing schedule has not been established.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS		
		J-3 VACUUM ENVIRONMENT FACILITY 0F0567 (I. I. Pinkel) 0R0397 (I. A. Johnsen)	This facility consists of a "Zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

During April, the test cell was being modified to accept the Linde super-insulated test tank. A separate vacuum manifold has been constructed for evacuation of the Linde insulation and a bleed valve has been installed for controlling the chamber vacuum in the diffusion pump range.

On April 22, the insulation and chamber were evacuated in preparation for a test run. During the evacuation, a small section of the Linde insulation vacuum bag was torn by the shifting of an ionization gauge, and a large chamber leak was located between the adapter flanges. Both of these items have been repaired and chamber pressures in the low 10^{-7} Torr range have been recorded. The best obtainable pressure on the Linde insulation was 100 microns, after four continuous days of pumping. To further reduce this pressure, a baking of the insulation under vacuum at 260°F. was initiated on April 28. Baking will continue until pressure of the insulation stabilizes. A pressure of 1 X 10-5 Torr in the insulation must be obtained before testing can start. It is anticipated that liquid hydrogen testing will begin on May 6 and terminate in late May.

Arrangements are being made to test an Arthur D. Little polyurethane foam insulated, or an aluminum-mylar multifoil insulated, tank in mid-July.

NOTE Ⓐ : Due to pre-operation difficulties, the Linde tank testing will start May 6.

NOTE Ⓑ : The A. D. Little insulated tank tests will begin in mid-July.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY OF0567 (I. I. Pinkel) OR0397 (I. A. Johnsen)	This facility consists of a "Zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

On May 8, an evacuation of the Linde super-insulated test tank, which had begun on April 25, was terminated when the aluminum foil vacuum bag was torn while attempting to verify the integrity of the vacuum bag. The final pressures reached during this evacuation were 3.8×10^{-4} Torr in the upper insulation and 12 microns on the lower insulation. The test requirement was 1.0×10^{-4} Torr on both insulation readouts.

On May 21, after the vacuum bag was repaired a re-evacuation of the insulation and chamber was initiated. Failure of the chamber to pump down to test conditions was traced to a leak in the welded Linde flange adapter. While attempting to bring the chamber and insulation to atmospheric pressure to repair the leak, the insulation was overpressurized and consequently destroyed. The formal test program for the Linde tank was abandoned; however, data will be obtained on neck heat transfer characteristics in early June.

It is anticipated that an Arthur D. Little polyurethane and aluminum-mylar multifoil insulated tank will be tested in mid-July.

NOTE Ⓐ: Schedule changes were required because of operational difficulties encountered with Linde tank testing as mentioned above.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY 0F0567 (I. I. Pinkel) 0R0397 (I. A. Johnsen)	This facility consists of a "Zero leakage" high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

On June 22 and 23, the Linde "super-insulated" cryogenic propellant tank was tested with LH_2. The primary purpose of this test was to observe the degree that the cold boil-off gases would prevent heat transfer through the neck tube into the insulated tank under low boil-off conditions. During this test, the boil-off rate was approximately 0.1#/hr. Chamber pressure during the entire test was below 5×10^{-7} Torr. Test results are now being analyzed. The tank was dissected on June 30 to observe Linde's method of applying "super-insulation" to both curved and cylindrical shells, and to inspect for thermal degradation and damage on hidden layers of insulation. This concluded the Linde tests in the J-3 Facility.

The test cell is now being modified to accept the Arthur D. Little Inc. polyurethane and laminate insulated tank. This test program calls for an extended hard-vacuum with both LN_2 and water environmental shielding and is scheduled to begin in late July.

NOTE (A): The remainder of the program involving the Linde tank has been cancelled. The follow-up tests on a NRC tank have also been postponed.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY OR0399 (S.S.Manson) PG0852 (I.A.Johnsen)	This facility consists of a "zero leakage", high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

During the month, the test cell has been modified to accept the Arthur D. Little, Inc., polyurethane, fiberglas and aluminized mylar cryogenic propellant tank.

On July 27, a liquid nitrogen run was initiated to establish a qualitative comparison between J-3 test cell and the A. D. Little test cell in Cambridge, Massachusetts. This run was terminated on July 30 due to the large variance between test data and theoretical expectations. Analysis of the data obtained indicated faulty operation of the neck heat shield.

The Arthur D. Little tank neck shield was reworked on July 31 by NASA personnel. All work was performed under the direction of the A. D. Little representative at Plum Brook.

Further A. D. Little tests, using LN_2 and LH_2, will be performed in J-3 facility during the month of August.

Upon completion of the Arthur D. Little tests, the test cell will be modified to accept a "multi-foil" insulated tank. as designed by the Materials and Sresses Section, Lewis Research Center. The estimated test date for this tank is November 1964.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J-1	ROCKET SYSTE	J-3 VACUUM ENVIRONMENT FACILITY OR0399(S.S. Manson) PG0852(I.A.Johnsen)	This facility consists of a "zero leakage", high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

On August 15, the testing of the Arthur D. Little, Inc. cryogenic calorimeter was concluded. This testing sequence was started on July 27 and a total of five different test conditions was made during the 18 run days. The tests included both liquid nitrogen and liquid hydrogen in the calorimeter and cold guard; warm water and liquid nitrogen in the calorimeter environmental surroundings; and hard vacuum and helium-purged environments. During all phases of testing, the boiloff rate was greater than expected. However, a high degree of correlation between different run conditions was established. The calorimeter has been returned to A. D. Little for further liquid nitrogen testing at their laboratory.

The next scheduled test is a foil insulated tank, developed by the Materials and Structures Division's Structures Protection Section. Testing is scheduled to start in November.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYS	J-3 VACUUM ENVIRONMENT FACILITY OR0399 (S. S. Manson) PG0852 (I. A. Johnsen)	This facility consists of a "zero leakage", high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

Activity in the Test Cell has been limited during this month due to a lack of a firm research testing schedule, and demands of other test cells in the area. Minor modifications accomplished during this reporting period include the painting of the vacuum chamber and the LN_2 flash tank. All cryogenic lines have been insulated and covered during this month.

Several modifications to the Test Cell have been initiated this month. A proposal for extending the entrance of the Test Cell has received budget approval and is now being designed by the Civil Engineering Branch. A Purchase Request for caulking and painting of the Test Cell has been prepared and is presently out for bids. A cost estimate for upgrading of the electrical equipment of the Cell to conform with accepted hydrogen environment conditions has been obtained. This proposal is now pending budget approval. These three modifications will greatly improve the operating conditions and safety of the Cell under long duration cryogenic insulation tests.

The next scheduled test is a foil insulated double-guarded calorimeter as developed by the Materials and Stresses Division's Structures Protection Section. The anticipated testing date would be in late November or early December.

Contract negotiation with Arthur D. Little, Inc. has provided funding for testing of two A. D. Little calorimeters in this fiscal year. The testing period dates for these tests have not yet been established.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY OR0399 (S. S. Manson) PG0852(I. A. Johnsen)	This facility consists of a "zero leakage", high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

No manpower was expended in this facility during the month of October. Personnel will be assigned to the test cell as soon as a test date is established for the double-guarded calorimeter.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS		
		J-3 VACUUM ENVIRONMENT FACILITY ORO399 (S. S. Manson)	This facility consists of a "zero" leakage", high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

During November, no work was accomplished in this area. The double-guarded calorimeter tank tests are scheduled to start in mid-March.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY ORO399 (S. S. Manson)	This facility consists of a "zero" leakage, high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

No manpower was expended in this facility during the month of December. Preparations for the double-guarded calorimeter are scheduled to begin by mid-January. The double-guarded calorimeter tests are scheduled for mid-March.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-2 LIQUID HYDROGEN FACILITY ORO137(I.A.Johnsen)	This is a liquid hydrogen facility capable of handling 145 pounds of liquid hydrogen at 250 psi.

During January, one liquid hydrogen tests was made on the "K" Site research tank bottom package.

On January 12, the package was installed. Necessary piping and electrical work were completed by the 19th and a one hour warm helium check indicated that the seal configuration met the warm requirements. Its leak rate was approximately 5×10^{-9} cm^3/sec., at a seal differential pressure of 175 psi.

On January 21, a liquid hydrogen run was made. No leak larger than 1×10^{-6} cm^3/sec. was recorded. Greater mass spectrometer sensitivity could not be achieved because of an internal electrical drift. An attempt to obtain higher sensitivity by using helium was not successful. Due to possible external leakage sources, the recorded leaks could not be definitely traced to the internal seals.

Modifications to the leak detector and piping systems were made to eliminate the high background readings and to increase the leak sensitivity of the mass spectrometer.

NOTE: The run scheduled for January 28 had to be canceled because of a vacuum pump failure and the non-availability of liquid hydrogen. The next test is scheduled for the first week of February.

		J-3 VACUUM ENVIRONMENT FACILITY ORO399 (S. S. Manson)	This facility consists of a "zero" leakage, high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

No manpower was expended in this facility during the month of January. Build-up for the double-guarded calorimeter will begin in early February. The double-guarded calorimeter tests are tentatively scheduled to start in April.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY OR0399 (S. S. Manson)	This facility consists of a "zero" leakage, high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

Preliminary modifications to the test cell for the double-guarded calorimeter test program were initiated this month. Modifications to the cell and checkout included:

(1) Installation of a 4" emergency vacuum chamber over-pressure line.

(2) Leak-tightness checkout of the vacuum chamber.

(3) Initial fabrication of fill and vent probes for double-guarded calorimeter.

(4) Sizing of a control valve for rocket ascent simulation tests.

(5) Ordering of all hardware required for test support.

The double-guarded calorimeter testing is scheduled to start the middle of April.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS	J-3 VACUUM ENVIRONMENT FACILITY PG0852 (S. S. Manson) OR0399 (I.A. Johnsen)	This facility consists of a "zero" leakage, high vacuum tank for testing insulated liquid hydrogen tanks in low pressure environment. The effectiveness of various types of insulation on liquid hydrogen tanks is to be studied.

The test facility is undergoing modification and checkout for the double-guarded calorimeter tests. The calorimeter is scheduled to be delivered the second week of April, and testing will probably begin the first week of May.

The following tasks were completed during this reporting period:

(1) Dewar H-30 was derimed and evacuated. The rate of vacuum rise was monitored and results indicate that the vacuum jacketing is sound.

(2) Initial fill and vent modification were started on the dewar to make it compatible with the research program.

(3) Designs and procurement for the missile ascent simulation portion of the test program were completed.

All of the required parts are scheduled to be delivered by April 30.

(4) The vacuum chamber emergency vent system was installed and checked out.

Lewis personnel have indicated a need for the test facility to conduct tests under a newly issued contract with Arthur D. Little Company. The tests are tentatively scheduled for the 1st and 3rd quarters of FY66.

SITE	LOCATION	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
J	ROCKET SYSTEMS TEST SITES		

J-3 VACUUM ENVIRONMENT TANK

TANK INSULATION TESTS
PC0852 (S. S. Manson)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The double-guarded calorimeter test program has been delayed approximately two to four months due to a calorimeter failure during hydrostatic testing by the NASA contractor. Since this type of failure may be repetitive, a redesign of the calorimeter may be required.

The following tasks were completed during this reporting period:

(1) The H-30 storage dewar has been modified into a research dewar for "J-3" cell.

(2) Vent lines for the H-30 dewar and cold guard vent lines were completed.

(3) The dewar pressurizing and vent purge panels were completed.

(4) The water environment system was checked out. The water was heated from 45° F. to 95°F.

(5) Fabrication of the controlled evacuation rate plumbing was initiated. This will enable the vacuum chamber pressure to be controlled to simulate the ascent of a missile for a 90-second period.

(6) Assembly and checkout of an absolute back pressure regulation system for the calorimeter and cold guard vents were initiated. This system, using mercury reservoirs, will dampen changes in atmospheric pressure by a factor of 150.

SITE	LOCATION RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEM TEST SITES
	J-3 VACUUM ENVIRONMENT TANK
	TANK INSULATION TESTS PC0852(S. S. Manson) — Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.
	Due to the failure of the double-guarded calorimeter during hydrostatic testing, the manpower expended in this test cell has been marginal. However, the following tasks were completed during this recording period:
	(1) The mercury constant backpressure system has been completed. The accuracy of this sytem will be verified upon the procurement of an accurate manometer. Another constant backpressure system based on the "Cartesian Diver" principle will also be tested to establish the advantages of each system.
	(2) Initial checkout of the controlled evacuation system was completed.
	(3) Modifications to the H-30 dewar were completed.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
PCO 852 (S. S. Manson)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

Due to the delay in the test program, manpower expended in this test cell has been very small.

A series of tests performed on absolute pressure-controlling devices was inconclusive. Both the Cartesian diver and mercury-compensating devices do compensate for changes in barometric pressure; however, neither was capable of maintaining a constant back-pressure of $\pm$ .1 mm of Hg for extended periods as requested by the research engineers.

During the weeks of June 21 and June 28, the facility was used to check out vacuum instrumentation for use at "K" Site.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEM TEST SITES	
	J-3 VACUUM ENVIRONMENT TANK	
		TANK INSULATION TESTS PCO 852 (S. S. Manson) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.
		Due to the lack of a definitive test program, manpower expenditures in the test cell have been limited to maintenance for this reporting period.
		Tests on an absolute back pressure device were continued during this month. The Cartesian-Diver device is still not capable of maintaining a constant back pressure of $\pm$ 0.1 mm for extended periods. An electrical circuit is being constructed to control the temperature of the device to 0.1°F. to minimize temperature - pressure fluctuations.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS PG0852 (S.S.Manson) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. It is expected that at least two months will be required before the calorimeter is insulated and delivered to Plum Brook. Tests continued this month on an absolute backpressure device. The Cartesian diver manostat was found to be capable of maintaining a constant backpressure of 0.5 mm for extended periods.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
PF0852 (S.S.Manson)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

Fabrication of the copper calorimeter by the Atomic Energy Commission in Paducah, Kentucky is scheduled to be completed October 1. The calorimeter will then be insulated at Linde and the PB test program will be started. Eventually, a self-evacuating type insulation will be developed.

The major manpower expenditure in this reporting period has been updating the test cell equipment to Class 1, Group B, Division 1 standards. The cartesian diver back pressure regulator has been approved by the research engineers and is now being incorporated into the calorimeter and cold guard vent systems.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS PF0852 (S.S. Manson) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. The double guarded calorimeter was delivered to Lewis Research Center-Cleveland on October 12. The calorimeter was helium leak checked on October 28 and sent to Linde to have the insulation installed. It is expected that the calorimeter will be returned to Plum Brook the latter part of December and that the research testing will be started by mid-January. A test on a super-insulated self-evacuating panel is scheduled for December. Panels of this insulation will be bonded to a Centaur arc tank that was tested in J-3 and J-4 Test Cells, two years ago. Phillips discharge vacuum gauges will be attached to the panels to allow pressure monitoring during both the tank fill and the chamber evacuation.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEMS TEST SITES (Continued) J-3 VACUUM ENVIRONMENT TANK TANK INSULATION TESTS PF0852(S.S. Manson) — Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. The air-filled semi-panel for attachment to the Centaur arc tank was delivered on November 30. The carbon dioxide backfilled semi-panel is not scheduled to be delivered until the first part of January. Therefore, testing of the conductance capability of the air-filled semi-panel will be done during the month of December, with cryo-pumping tests scheduled for early January. The double-guarded calorimeter is expected to be delivered early in January; however, testing of this tank is dependent upon completion of the semi-panel tests. Therefore, the earliest possible test date is mid-February for the double-guarded calorimeter.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEMS TEST SITES J-3 VACUUM ENVIRONMENT TANK TANK INSULATION TESTS PG0852 (S.S. Manson) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. During this reporting period, the Centaur arc tank was qualified for testing under vacuum conditions by hydrostatic testing to 33 psi, cold shocking and leak checking. On January 11, a test run was performed using liquid nitrogen with a gaseous nitrogen chamber purge. On January 28 a test run was made to determine the ultimate cryopumping ability of the insulation. The insulation pressure was 130 microns prior to liquid hydrogen filling. The final vacuum produced by cryopumping was 1.3×10^{-4} Torr. The next test run is scheduled for February 1. Test conditions will be liquid hydrogen in the tank with a gaseous nitrogen chamber purge to evaluate ground hold conditions. A carbon dioxide backfilled semi-panel is scheduled to arrive in early February. This panel will be tested only for cryopumping ability. If this test does not produce a satisfactory vacuum ($< 10^{-4}$ Torr), evacuation and subsequent carbon dioxide backfilling of the panel will be conducted at Plum Brook. The double-guarded calorimeter was received on January 25. Testing of this calorimeter is dependent upon completion of the semi-panel tests. Therefore, early March is the earliest possible test date for the double-guarded calorimeter.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEMS TEST SITES J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS PG0852(S.S.Manson) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. During February, four test runs were performed, to various Linde semi-panel type insulation configurations which were attached to the Centaur sector tank. All test panels were evacuated by cryopumping on the lower one-third of each panel. On February 1, a test was made to evaluate the ultimate vacuum of the evacuated panel by both diffusion and cryopumping techniques, while the panel was continiously subjected to atmospheric compressive load. The lowest pressure obtained in this test was 8.0×10^{-4} torr. The February 9 test was identical to the February 1 test, except that the atmospheric compressive load was removed from the test panel. The lowest pressure obtained in this test run was 7.2×10^{-5} torr.

J

ROCKET SYSTEMS
TEST SITES

J-3 VACUUM
ENVIRONMENT
TANK

TANK INSULATION TESTS (Continued)

On February 18, a test run was made to evaluate the ultimate vacuum of the carbon dioxide backfilled semi-panel by cryopumping action alone. The test panel had been exposed to atmosphere for about one week, so some degree of diffusion was expected to limit the ultimate pressure. The final test results as monitored at three vacuum locations were:

Near side	20 microns
Mid-panel	25 microns
Far side	6 microns

The evacuated panel was also monitored during this test. The ultimate vacuum obtained in this panel by diffusion and cryopumping techniques was 5.1×10^{-5} torr. The ultimate vacuum obtained by cryopumping only, was 5 to 6×10^{-4} torr.

On February 24, since it was felt that atmospheric diffusion had limited the cryopumping ability of the carbon dioxide panel, the panel was re-evacuated and backfilled with instrument grade carbon dioxide. Paladium oxide was also added to the panel to act as hydrogen to water converter. Since the test program for the evacuated panel was completed, the same procedures were accomplished on this panel. The final test results are as follows:

If the test results are still unacceptable, this test program will be temporarily deleted until testing of the thermal effectiveness of this insulation as applied to the double-guarded calorimeter is completed. Contractual obligations on the double-guarded calorimeter necessitate its return to Linde by April 1.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
PG0852(S.S.Manson)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The eleventh, and final, test on the Linde semi-panel type insulation was completed on March 1. Test pressures obtained in the carbon dioxide cryopumped panel were 50, 30, and 27 microns at various pressure taps. Data obtained at Plum Brook compared favorably with data obtained by Linde throughout the entire test program. Although several techniques for obtaining lower panel pressures are still to be tried, the test program was terminated to permit testing of the double-guarded calorimeter in fulfillment of contractual obligations.

The test insulation on the double-guarded calorimeter is identical in composition with the semi-panel insulation; however, the insulation was not encapsuled in panel form casing material. The test period began on March 18 and terminated on March 28 with twenty-four hour data acquisition on March 23 and 25.

The apparent "K" valve for the insulation obtained in this test was 3.0 to 3.5 BTU/hr ft^2, which makes it the best insulation tested to date in "J-3" cell.

Test operations will be terminated on April 1, by action of the Area 20 Safety Committee in regard to the electrical safety of the test cell. A review safety meeting is scheduled for April 5 to determine if a revised system is acceptable.

Pending approval of the Area 20 Safety Committee, the double-guarded calorimeter will be reinsulated with 8 panels of Linde insulation and is scheduled to be tested in mid-May.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
PG0852 (S.S. Manson)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During this reporting period the test cell work has been progressing on the upgrading of the electrical systems to Class I, Group B, Division II rating. This action is in accordance with the Area 20 Safety Committee review of April 5. It is anticipated that the facility will be ready for testing by May 13.

The double-guarded calorimeter, insulated with eight Linde semi-panels, is scheduled for test program initiation between May 23 and 31.

The following individual test series are anticipated for this program:

(1) Ground hold thermal performance.

(2) Controlled evacuation of the vacuum chamber to simulate boost environment thermal performance.

(3) Space environment thermal performance.

TANK INSULATION TESTS (Continued)

a. Panels valved off from chamber.

b. Panels open to chamber.

(4) Permeability effects on the insulated system during a prelaunch period and resulting vacuum performance demonstration.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
J	ROCKET SYSTEMS TEST SITES J-3 VACUUM ENVIRONMENT TANK TANK INSULATION TESTS 0R0852(S.S.Manson) — Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. During this reporting period, an intensive effort has been maintained to upgrade all electrical systems to Class I, Group B, Division II rating. This task was completed on May 16. Since this date, manpower has been primarily scheduled for preparing the double-guarded calorimeter for testing. The anticipated test date is June 6. The test program will consist of the following individual test series: (1) Ground hold thermal performance test (2 day test period). (2) Controlled evacuation of the vacuum chamber to simulate boost environment thermal performance (5 day test period). (3) Space environment thermal performance with insulation panel evacuation by carbon dioxide cryopumping (4 day test period). (4) Space environment thermal performance with insulation panels exhausting to chamber vacuum (4 day test period).

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
OR0852 (I.A. Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied

Test runs of June 2, 8 and 15 were aborted due to an excessive boiloff rate in the cold guard section of the [illegible] calorimeter. Test data for these runs was not obtained as the hydrogen [illegible] could not be maintained for a sufficient period of time to obtain meaningful boiloff data. The high rate of heat flux in the guard section can be directly attributed to a lack of cryopumping in the tank guard insulation.

Since the last test date, several large leaks in the guard insulation system have been located and repaired with Narmco cement. A leak in the LH_2 calorimeter is impossible to repair without disassembling the calorimeter. A larger evacuation system has been installed in an attempt to overcome the leakage. The next test run is planned for July 5.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
ORI327(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The test run of July 11 was aborted due to a high boiloff rate of the guard tanks of the double-guarded calorimeter. The high boiloff was caused by a hydrogen leak from the measure tank into the guard insulation. A 4-inch diffusion pump installed in the guard evacuation line failed to overpower the leakage.

As three previous test runs were also aborted for identical reasons, the upper half of the guard insulation was removed, allowing unrestricted venting of the leak into the chamber vacuum system. Since four of the eight Linde test panels were ruptured by thermal movement in the previous runs, each panel was also allowed to vent to the chamber to produce the hard vacuum initially planned to be obtained by carbon dioxide cryopumping.

Test data under these conditions was acquired from July 25 to July 29. The approximate Q/A for the three panel thick shingle insulation was 0.85 BTU/hr. ft^2. A test run of May 25 established a Q/A of 0.39 BTU/hr.ft^2 for the basic insulation concept. The higher heat flux is predominately contributed by the insulation casing material. This completed the test program with Linde under Contract NAS3-6289.

No test programs are currently scheduled for this facility.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
ORI327(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

Since completion of the double-guarded calorimeter test program on July 29, the main effort in the facility has been directed in upgrading the electrical systems to meet Class 1, Group B, Division II requirements. This effort will be maintained until mid-September, whereupon testing of the Centaur arc tank will begin.

The arc tank has been insulated at Linde with six panels of carbon dioxide backfilled insulation. The objective of this program will be to measure the carbon dioxide cryo-pumping ability of each panel.

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SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
ORI327(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During this reporting period, the main effort in the facility has been directed in upgrading the electrical systems to meet Class I, Group B, Division II requirements. This task is expected to be completed by October 10.

Cryopumping tests of Linde semi-panels as attached to the Centaur arc tank are scheduled to begin on October 24. Various grades of carbon dioxide and gaseous nitrogen will be evaluated.

The Arthur D. Little gold mylar insulated calorimeter is scheduled for testing in January.

The double guarded calorimeter with a purge multilayer insulation system is scheduled for April testing. Both ground hold and space environment thermal effectiveness will be evaluated. Rapid evacuation tests to simulate a typical missile ascent will also be performed to evaluate transient heat fluxes.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
OR1327 (I.A. Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

On November 18 the cryopumping performance of six Linde self-evacuating multi-layer insulation panels was tested. Three test panels were backfilled with instrument grade CO_2, and the remaining three panels with water pumped GN_2. All six panels were attached to a Centaur Arc Tank. Under atmospheric ground hold conditions, with the tank filled with LH_2, the CO_2 panels cryopumped into the low 10^{-5} torr range. They remained at this pressure during the duration of the test. The GN_2 backfilled panels were capable of cryopumping to the low micron range during the ground hold portion of the test. As would be expected the cryopumping action of the GN_2 panels was considerably more sluggish than the CO_2 panels. Under space vacuum conditions, all panel pressures increased to the 20 to 100 micron range. Subsequent investigation of the panels showed they were leaking on the surface next to the tank wall, which explained the high test pressures. The leaks occurred when a vacuum was drawn in the vacuum chamber. This has been a continuing problem with the self-evacuating insulation system. Since these panels are not repairable, this test completed the testing of panel insulation systems.

The Arthur D. Little Gold-Mylar insulated calorimeter is scheduled for testing in February. A fifty-gallon vacuum insulated flash dewar is under fabrication to minimize cold guard liquid hydrogen consumption.

The double-guarded calorimeter, with a purged multilayer insulation, is scheduled for testing in April. Both ground hold and space environment thermal effectiveness will be evaluated. Rapid evacuation tests to simulate a typical missile ascent will be performed to evaluate transient heat fluxes.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
ORI327 (I.A. Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

A 50-gallon vacuum-insulated liquid hydrogen flash dewar was installed this month. The dewar will be used to minimize cold-guard liquid hydrogen consumption on the Arthur D. Little gold-mylar insulated calorimeter. This calorimeter is scheduled for testing in March.

The double-guarded calorimeter, with a purged multilayer insulation, is scheduled for testing in April. Both ground hold and space environment thermal effectiveness will be evaluated. Rapid evacuation tests to simulate a typical missile ascent will be performed to evaluate transient heat fluxes.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023 (I.A. Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

A 50-gallon liquid hydrogen dewar designed to minimize calorimeter cold guard consumption was evacuated, cold shocked and leak tested. The dewar will be mounted on the test cell roof next month.

The double-guarded calorimeter was helium leak tested. A leak rate of approximately 2×10^{-4} cc/sec was established between cold guard and measure volumes. The neck tube leak rate was below 10^{-8} cc/sec.

The environmental baffles were repaired, leak tested and installed during this report period.

The cryopumping ability of several gases at liquid nitrogen temperatures was established. These tests are being performed to find the optimum gas to use with the self-evacuating insulation program.

The gases tested this month were:

Gas	ULTIMATE CRYO-PUMPED VACUUM
Freon 12 (CCl_2F_2)	1.0×10^{-3} Torr
Freon 22 ($CHClF_2$)	2.5×10^{-2} Torr
Acetylene (C_2H_2)	8×10^{-7} Torr
Propane (C_3H_8)	2×10^{-7} Torr
Carbon Dioxide (CO_2)	8×10^{-3} Torr
Rough Vacuum (1×10^{-1} Torr)	5×10^{-3} Torr

The next scheduled test program is the Arthur D. Little gold-mylar insulated calorimeter and is scheduled for the month of March.

Improvements to the self-evacuating insulation concept will be tested in July and August. The system will again be retested after a 30 day storage period to determine degradation due to atmospheric permeability.

The projected schedule for the insulation technology program at Lewis-Cleveland indicates almost continuous testing throughout the 1968 fiscal year.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	**J-3 VACUUM ENVIRONMENT TANK**	

TANK INSULATION TESTS
YOR2023 (I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During this reporting period, the major activity was preparing the test cell for the Arthur D. Little calorimeter. The IRC and auxiliary trailer purged boxes and conduit were completed. The only non-explosion permanent equipment remaining in the cell is the thermocouple box.

A simulated A.D.L. cold guard coil was installed to checkout the operation of the LH_2 supply system. A temperature of $-417^{o}F \pm 1^{o}F$ was maintained on a liquid hydrogen consumption of 200 gallons/hour. No leaks were encountered during the seven hours of testing.

The A.D.L. calorimeter is scheduled to arrive in the first week of March. The insulation consists of five layers of gold mylar separated by silk netting material. The heat flux will be evaluated under LN_2 and LH_2 conditions.

SITE	SITE NAME	RESEARCH INSTALLATION	&	DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS Y0R2023 (I.A.Johnsen)		Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

Testing of the Arthur D. Little calorimeter began on March 16 and continued to March 30. The calorimeter is insulated with five layers of gold mylar foil with 14-mesh silk netting separators. An LN_2 heat flux of 0.32 BTU/hr ft^2 was measured. This corresponded to the heat flux obtained at Arthur D. Little and insured calibration of the facilities. A heat flux of 0.39 BTU/hr ft^2 was obtained with LH_2 testing.

The next scheduled test program will be the Linde self-evacuating multilayer insulation system. An exact test date for this system has not been established due to the uncertainty of obtaining copper for the calorimeter construction.
Checkout of a boiloff back pressure regulation system will be made next month.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

No manpower was assigned to the test cell during this reporting period.

The following major cell modifications are being contemplated for future test programs:

(1) The addition of a Kinney Model KDH-850 vacuum pump to the existing mechanical pump system. This will provide a total roughing capacity of 1150 C.F.M. The additional pump will be used for rapid evacuation of the chamber to duplicate the ascent of a missile for studying interstitual pressures of a multilayer insulation system. The additional pump should permit duplication of the missile ascent curve for a total of 3 minutes, covering the pressure range from atmosphere to one micron.

(2) A 12- to 15-inch extension to the chamber to permit additional cold-guard insulation for the calorimeters.

(3) A longer cryogenic baffle will be required with the chamber extension to insure continuous environmental control to the outer layer of tank insulation.

An exact test date for the next program (Linde self-evacuating panels) has not been established due to the uncertainty of the fabrication completion date of the calorimeters.

reporting period.

The following major cell modifications are being contemplated for future test programs:

(1) The addition of a Kinney Model KDH-850 vacuum pump to the existing mechanical pump system. This will provide a total roughing capacity of

(Continued on Page 30)

SITE	SITE NAME	RESEARCH INSTALLATION	&	DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023(I.A.Johnsen)		Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.
		No work was accomplished in the facility during this reporting period. Preliminary sketches for the addition of a 14" extension to the vacuum chamber, an additional 850 C.F.M. roughing pump and a longer baffle were completed this month. Engineering for these jobs will be handled by the Plum Brook Engineering Division, and is expected to be completed by July 15.		

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	**TANK INSULATION TESTS** YOR2023(I.A.Johnsen) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. A holding pump and evacuation line were installed to allow rapid cycling of the chamber diffusion pump. The Linde tank without insulation was installed for checkout of the back-pressure control system. The testing of this system is expected to be completed in July. Drawings have been completed for the installation of a 14" chamber extension, an 850 C.F.M. roughing pump, and a longer cryogenic baffle. It is anticipated that the semi-system insulation will be ready for testing by mid-August.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J		

J-3 VACUUM ENVIRONMENT TANK

TANK INSULATION TESTS
YOR2023(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The test cell is being prepared for the Linde Self-Evacuating Multilayer Insulation Test Program. This program is scheduled to start in late September.

The constant backpressure vent system for both the calorimeter and cold guard tanks is being fabricated. The system is expected to maintain a constant pressure within 0.0002 of a psi.

Instrumentation at the control trailer for use with the scanner system is almost complete. Local readings will be taken from a digital voltmeter system.

Parts have been received for the constant temperature environmental control system.

It is anticipated that the major emphasis for next month will be the completion and checkout of the backpressure control system.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023(I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

Preparations are nearly completed for the testing of the Linde self-evacuating multilayer insulation. The insulated calorimeter is scheduled to arrive in mid-October. The test program has therefore been rescheduled to start the first part of November.

The constant backpressure vent system control valves have been installed and are being readied for their electronics. The delta P transducers for this system had to be refabricated in an explosion-proof box and are near completion.

The constant temperature control system heat exchanger is being fabricated and is expected to be installed within the next two weeks.

The controlled evacuation system is being readied for the test program scheduled for the first part of next year. Necessary parts for the 850 cfm roughing pump arrived and the pump was then test operated. It is expected to be installed the latter part of this year.

Major emphasis during the next two weeks will be checkout of all vacuum measuring equipment and the constant backpressure system.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
Y0R2023 (I.A.Johnsen)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The aluminum double-guarded calorimeter has been fabricated by Lockheed, and is being insulated at Linde. The semi-panel system is anticipated to be ready for testing in early November.

The remote reading Veeco ionization gage has been checked out and is currently being installed as a permanent addition to the cell. The eductor system has been sized for the constant backpressure vent system. Checkout of this system has been delayed due to an apparent leak in the backpressure reference transducer system.

The chamber extension, baffle and concrete vacuum pump base have been cancelled. The Plum Brook Engineering Design Division is now planning on shock mounting the Kinney vacuum pump.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023(I.A.Johnsen) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. The aluminum stackable double-guarded calorimeter insulated with Linde self-evacuating panels was received at Plum Brook on October 30, and testing will start during the week of November 13. The initial test sequence consists of a ground-hold heat flux followed by a simulated missile ascent and a space-hold heat flux. After a 30-day soak period, the sequence will be repeated to determine degrading effects of the long-term storage. Principle problem areas in the test cell are the controlled backpressure vent system and the controlled environment temperature system. Due to extensive cell modification since the last test program, checkout of various sub-systems have now been initiated.

November 1967

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023(I.A.Johnsen)
(CRD - J.R.Faddoul, I.E.Sumner, and J.R.Barber; RSD - T.C.Cintula)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

A test run was started November 27 on the Linde semi-panel insulation applied to the aluminum stackable double-guarded calorimeter. The test sequence consisted of ground hold performance followed by a rapid evacuation to space hold conditions. The net heat flux under each condition of testing was slightly higher than desired; however, it was still low enough to represent an excellent insulation system. The same test sequence will be repeated after a 30-day air environment soak to determine the degradation to the insulation. The final test will be at space vacuum conditions with the insulation panel valves open to the vacuum chamber.

The next test program will be the "Transient Venting of a Multilayer Insulation" which will probably begin in early March.

December 1967

TANK INSULATION TESTS
YOR2023 (CRD - J.R. Faddoul, I.E.Sumner, and J.R.Barber; RSD - T.C.Cintula and D.G. Perdue)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During December, the environmental tank was altered to accept the KD-850 vacuum pump, and an additional ionization gage was added for measuring tank pressure.

The Linde semi-panel insulated calorimeter is undergoing a 30-day atmospheric soak which will be terminated in January. The same test sequence which was conducted on November 27, 1967 will be repeated. This test is scheduled for the week of January 8.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023 (CRD - J.R. Faddoul, I.E. Sumner, and J.R.Barber; RSD - D.G.Perdue)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

The program for the "Light-Weight Multi-Layer Insulation System", Contract No. NAS3-7953, was completed on January 26.

Two tests were conducted. The first test was conducted during the period from January 8 to January 16 to determine the insulation performance after a 30-day atmospheric soak period. The second test was conducted January 22 and 23 to determine the insulation performance at space-hold conditions with the valves to the insulating panels open to the chamber. The results from the second and third tests are similar to the results obtained from the first test conducted on November 27, 1967.

The KD 850 vacuum pump is presently being prepared for installation into the test cell.

The copper calorimeter is in Lewis-Cleveland being prepared for the J-3 vacuum chamber lid. Tests for the copper calorimeter are scheduled for March 1968.

February 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION	
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023 (CRD - JR Faddoul, IE Sumner, & JR Barber; RSD - DG Perdue)	Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

No test operations were scheduled during February. The month was spent preparing the test cell for the next configuration. The equipment is being modified to accept the copper heat transfer tank. The KD-850 vacuum pump was installed, and check-out runs are scheduled for March. The major portion of the instrumentation changes for the copper heat transfer tank are scheduled to be completed in March, and tests are scheduled to start in April.

March 1968

	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023 (CRD - JR Faddoul, IE Sumner & JR Barber; RSD - DG Perdue)	Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

No test operations were scheduled during March. Efforts were devoted to preparing the test cell for testing the copper heat transfer tank in April. The KD 850 vacuum pump was checked out and 80 percent of the cell instrument work was completed.

Insulation is presently being installed on the copper heat transfer tank. Tests are scheduled for April.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023 (CRD - JR Faddoul, IE Sumner & JR Barber; RSD - DG Perdue) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. No test operations were performed during April. The instrument equipment required to measure boiloff was not delivered on schedule. Efforts were devoted to preparing instrumentation and control equipment for the test operation. Vacuum pump-down checks were performed to determine the capabilities of the controllers. The test cell work is 90% complete. The research tank insulation installation is completed. Research tests will start in May pending receipt of the Hastings flowmeter.

May 1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
	J-3 VACUUM ENVIRONMENT TANK	TANK INSULATION TESTS YOR2023 (CRD - JR Faddoul, IE Sumner & JR Barber; RSD - DG Perdue) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. During May, the test cell and research tank were being prepared for June testing. Efforts were devoted to checking boiloff and pressure measuring instrumentation. The remaining work to be completed is as follows: (1) Connection of thermocouples and pressure transducers thru the chamber lid. (2) Insulation of the bottom cold guard on the research tank. (3) Installation of research tank in vacuum chamber.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	
		TANK INSULATION TESTS YOR2023 (CRD - JR Faddoul, IE Sumner & JR Barber; RSD - DG Perdue) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. On June 26 and 27, boil-off tests were conducted on the copper heat transfer tank. The tank and insulation were tested at vacuum chamber pressures of 760 and 100 TORR. Nitrogen gas was used to purge the chamber and helium gas was used to purge the insulation. The boil-off rates were 1568 SCFH at at 760 TORR and 1020 SCFH at 100 TORR. The test was terminated because of difficulty with the interstitial pressure measuring system. The test will be rescheduled to be completed in July. Engine #3 was acceptable after cold shocking and pressure testing. Engine instrumentation can now be installed. The manifold piping necessary for this engine is essentially complete except for qualification checkout. Test firing of Engine #3 is scheduled for late July.
J		

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	(Continued)	
	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023
(CRD - IE Sumner & JR Barber; RSD - DG Perdue)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During July, nine boil-off tests were conducted on the copper heat transfer tank. The insulation used on the copper tank was a composite design of 30 layers of double aluminized mylar separated by dexiglass and a fiberglass sublayer wrapped in a sealed mylar bag. The multilayer insulation was purged with nitrogen and the fiberglass was purged with helium. The purges were discontinued for space hold conditions. The results of the tests are as follows:

Date	Vacuum Chamber Press. (Torr.)	Helium Purge to the Insulation (psia)	Boil-off Rate (SCFH)
7/10/68	760.0	100.0	1605.0
7/11/68	100.0	30.0	1191.0
7/11/68	10.0	10.0	975.0
7/12/68	1.0	5.0	700.0
7/16/68	6.2×10^{-6}	0.0	5.77
7/16/68	2.4×10^{-4}	0.0	6.22
7/18/68	4.0×10^{-2}	1.0	60.0
7/19/68	2.0×10^{-1}	1.0	380.0

7/31/68 Conducted four-hour, controlled pumpdown simulating the "K" Site pumpdown rate on the 7' tank.

Three additional tests are scheduled during August. After completion of these tests, the copper tank will have additional insulation installed, and the same series of tests will be repeated.

August
1968

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION	
J	J-3 VACUUM ENVIRONMENT TANK		
		TANK INSULATION TESTS YOR2023 (CRD - IE Sumner & JR Barber; RSD - DG Perdue)	Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

During August, three controlled pumpdown tests were made. The tests were conducted on August 12, 13, and 16. A four-hour controlled pumpdown simulating the "K" Site pumpdown rate on the 7' tank, a one-hour controlled pumpdown rate, and a controlled pumpdown rate simulating the Saturn ascent, were conducted. The insulation used for these tests was the same as used for the space hold tests during July. A repeat of the Saturn ascent pumpdown will be conducted in September. Then, additional insulation will be installed on the copper tank and the same series of tests which were conducted during July and August will be repeated.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023
(CRD - IE Sumner & JR Barber; RSD - DG Perdue)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

On October 2 a test was conducted to simulate the Saturn ascent pressure curve. Helium was used to purge the insulation and vacuum chamber for this test. A simulated altitude of 300,000 feet was obtained in less than three minutes. The space hold boil-off was 3.8 SCFH.

The upper tank was removed from the chamber and is presently being insulated for tests starting in the latter part of November.

The aluminum tank was delivered to Goodyear Company, Akron, for preinsulation fabrication. This tank will be completed for testing in December.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	(Continued) J-3 VACUUM ENVIRONMENT TANK	

TANK INSULATION TESTS
YOR2023
(CRD-1E Sumner & JR Barber; RSD - DG Perdue)

Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied.

On November 25, 26, and 27, sixteen steady state data points were taken. The insulation system used for this test was 30 layers of mylar separated by silk netting for the MLI and a 3/4" thick fiberglass matting covered with a mylar bag for the sublayer. The upper tank was used for this test. Helium and nitrogen gases were used for the vacuum chamber gases. The results are listed below:

Boiloff in SCFH	Chamber Press. in TORR	Sublayer He Purge (PSIG)	Chamber Gas
5.5	1×10^{-5}	---	He
24.5	1×10^{-3}	---	"
199.0	1×10^{-2}	---	"
555.0	1×10^{-1}	---	"
1460.0	1.0	---	"
2030.0	10.0	---	"
2700.0	100.0	---	"
2730.0	760.0	---	"
9.52	1×10^{-6}	---	GN_2
14.6	3×10^{-4}	0.1	"
57.0	3×10^{-3}	0.5	"
76.0	1×10^{-1}	1.0	"
232.0	1.0	2.0	"
960.0	10.0	5.0	"
940.0	100.0	10.0	"
3000.0+	760.0	38.0	"

Three Saturn Ascent Pressure Tests are scheduled for this insulation system in December, which will complete the program on the copper tank in J-3. J-3 is the only facility presently capable of rapid pumpdown testing. A strong case was made to try a new configuration before the facility is bulldozed. Therefore, the aluminum test tank was sent to Goodyear for installation of a foam sublayer and is due back on December 6. Multilayer insulation blankets have been fabricated and will be installed when the tank is received. Testing will be carried out from December 16 through December 20, and the program will be terminated.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
J	J-3 VACUUM ENVIRONMENT TANK	
		TANK INSULATION TESTS YOR2023 (CRD - IE Sumner & JR Barber; RSD - DG Perdue) Various liquid hydrogen tanks will be tested under a vacuum environment. The effectiveness of various types of insulation will be studied. During December, six Saturn Ascent pressure tests were conducted and six steady state data points were taken. Four Saturn Ascent pressure tests were performed on the copper tank and two on the aluminum tank. All the steady state tests were performed on the aluminum tank. Insulation and testing of the aluminum tank was an addition to the original project closeout program. No further rocket engine tests are scheduled for the facility.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
J	J-3 (Continued)

TANK INSULATION TESTS (Continued)

The insulation system used for the aluminum tank consisted of a 3/4"-thick, high-density foam over the aluminum tanks, with a mylar vapor barrier covering the foam. Three MLI insulating blankets, consisting of ten alternate layers of mylar and dexiglass each, covered the vapor barrier. The results of the tests are listed below:

Copper Tank

Date	Boiloff in SCFH	Chamber Press. in TORR	Press. Curve	Chamber Gas
12-2-68	2730-5.5	760-1 x 10^{-5}	Saturn Ascent	He
12-3-68	3000-9.5	760-1 x 10^{-6}	Saturn Ascent	GN_2
12-4-68	*	760-1 x 10^{-6}	Saturn Ascent	GN_2
12-4-68	*	760-1 x 10^{-6}	Saturn Ascent	He

Aluminum Tank

12-20-68	800-9.0	760-1 x 10^{-5}	Saturn Ascent	GN_2
12-27-68	1400-7.7	760-6 x 10^{-6}	Saturn Ascent	He
12-30-68	8.0	7.8 x 10^{-6}	Saturn Ascent	He
12-31-68	7.7	7.8 x 10^{-6}	Saturn Ascent	He
12-31-68	14.4	2.3 x 10^{-4}	Saturn Ascent	He
12-31-68	65.0	1 x 10^{-2}	Saturn Ascent	He
12-31-68	750.0	1.0	Saturn Ascent	He
12-31-68	1300.0	100.0	Saturn Ascent	He
12-31-68	1400.0	760.0	Saturn Ascent	He

*Not applicable. Tank was empty and warm during these tests.

The completion of the tests on the aluminum tank terminates the programs for J-3.