DYNAMICS LABORATORY (E SITE)

Vibration analysis data was obtained during the past Fiscal year (July 1, 1961 to July 1, 1962) in support of the following research programs:

a. Mercury Evaporation & Condensing Analysis (MECA)
b. Scout Rocket Pickup Calibration
c. Ozone Release
d. Micrometeor Patch
e. Ranger Payload (Bell Aero)

Twenty-nine research runs were completed between February and July of 1962. Prior to February the Dynamics Laboratory was in a maintenance status. During that time period a major modification was completed. This modification included changing the cooling oil from water glyco base to Sheel TULUS # 23.

6	Dynamics Laboratory "E" Site	PJO No. Unknown (Gabriel)	Vibration tests of the Atlas-Centaur vehicle

STATUS: Plum Brook personnel have attended several Centaur planning meetings, reviewed and criticized PERT schedule and made three trips - one each to General Dynamics and Astronautics, San Diego, Cape Canaveral, and Systems Engineering Laboratories, Fort Lauderdale, Florida. To date, most of the Plum Brook effort has been in the category of gathering information. Little productive effort can be exerted until some of the facility requirements and test objectives can be firmed up. Rocket Systems Division personnel plan to meet with Mr. Russ Dunbar and Ted Geris at their earliest convenience. The shaker equipment at "E" stand has been in rather continuous use during the past year. It has supported the SERT and MECA programs from Lewis Research Center and two outside contracts, both to Bell Aero Systems. The first contract was by J. P. L. for a digital accelerometer for the Ranger payload. The second was an Air Force contract covering the instrumentation package for the Sky Bolt missile.

PLUM BROOK ROCKET SYSTEMS FACILITIES STATUS REPORT CONTINUED

2/28/1963

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	MECA (A-1G) (B. Lubarsky)	Vibration tests of the MECA project.
		CENTAUR (C-3673) (D. S. Gabriel)	Vibration tests of the CENTAUR vehicle.
	STATUS:	MECA Dynamics testing will be continued as long as there is no interference to the required structural modifications to "E" Stand for Centaur Project. CENTAUR: Plum Brook personnel are in the process of accomplishing the following tasks; (a) Check out, clean up and repair of existing gas pressure system and piping system, (b) Maintenance check of shaker equipment, (c) Design of the water fill system, (d) Design of the missile pressurization system, (e) Preparation of handling, erecting and staging procedures, (f) Preparation of fueling procedure, (g) Assistance in evaluation of research instrumentation, and (h) Review of structural modification design on the basis of handling and erecting procedures. The February Pert schedule predicts the expected date for start of testing. Atlas in Sept. and Centaur in November.	

3/28/1963

E

DYNAMICS LABORATORY

MECA (A-1G) (B. Lubarsky) Vibration of various components for MECA project.

STATUS: A number of dynamics tests have been performed for MECA during February and March. It is estimated that major contractual effort for modification to "E" Building will preclude testing for MECA sometime subsequent to April 10, 1963.

CENTAUR (C-3673) (D. S. Gabriel) Vibration tests for CENTAUR vehicle.

STATUS: Plum Brook personnel are currently performing in the following assigned tasks; (a) limited evaluation of R & D accelerometers, (b) panel layout all systems (schematics), (c) process control and instrumentation (schematics), (d) some R & D instrumentation (data acquisition) - 10% complete, (e) instrumentation & control lines from "H" to "E" Site, (f) purchase & installation of digital system, (g) shaker control and general installation (schematics) - 50% completed, (h) propellant & pneumatics - remote valves, indicating devices and remoted disconnects.

The following schematics have been completed; loading and pressurization system, vehicle lateral stabilization controls, vehicle suspension lift and stretch controls, vehicle positioning (indication and read out). Design and purchase request for building modifications and suspension system were completed March 11, and March 15, 1963.

The following are problem areas (from the 3-20-63 PERT report) (a) award of contract for suspension system leading to completion 7.7 weeks beyond schedule, (b) design and purchase of propellant piping 5.7 weeks beyond schedule, (c) design and purchase for stretch mechanism 4.4 weeks beyond schedule, and (d) delivery of shaker amplidyne 3.4 weeks beyond schedule.

PLUM BROOK ROCKET SYSTEMS DIVISION STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (C-3673) (D. S. Gabriel)	Vibration tests for CENTAUR vehicle.
	STATUS:	Note (A) : New test start dates from April 17, 1963 PERT Report.	
			The following is the status of tasks assigned to Plum Brook personnel by the Program Manager; (a) Evaluation of R & D accelerometers has been completed. (b) The panel layouts for all systems are 75% completed. (c) Schematics of process control and instrumentation have not been started due to the lack of necessary information from the Lewis CENTAUR Office. (d) Design of instrumentation and control lines is 90% completed. (e) Digital system purchase is awaiting NASA Headquarters approval. (f) Schematics of loading and pressurization systems; vehicle lateral stabilization control; and vehicle suspension lift system control have been completed. (g) Schematics for remote disconnects are delayed pending decision by the Area 20 Safety Committee.
		MECA (A-16) (B. Lubarsky)	Vibration of various components for MECA project.
	STATUS:		Approximately ten dynamics tests were completed on various MECA components during April. This program will continue until the tests conflict with CENTAUR building modification and installation work.

PLUM BROOK ROCKET SYSTEMS DIVISION STATUS REPORT CONTINUED

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (C-3673) (D. S. Gabriel)	Static and dynamics test for CENTAUR vehicle.

NOTE (A) : The research objectives have been changed to include static testing of the vehicle at maximum "G" and maximum "Q" loading. The static test is scheduled for August.

STATUS: The majority of operations requirements (system schematics and panel layout) for the dynamics test have been completed.

Procedure check lists for erection, staging, and assembly of the vehicle are 50% completed. Plum Brook operations personnel with assistance from General Dynamics are presently working on procedure check list for filling the vehicle.

A pump for loading styrofoam balls into the CENTAUR LH_2 tank has been built and checked out.

The construction contractor has started modifications of "E" Stand.

	MECA (A-1G) (B. Lubarsky)	Vibration of various components for MECA project.

NOTE (B) : A one foot clearance between bottom of cross beam supporting Atlas CENTAUR vehicle and top of Shake Table may permit vibration tests of MECA components on a non-interference basis while CENTAUR vehicle is in the stand.

STATUS: Dynamics testing of MECA components continued during May.

June 1963

SITE	LABORATORY	RESEARCH INSTALLATION (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (C-3673) (D. S. Gabriel)	Static and dynamics test for CENTAUR vehicle.

STATUS: The construction is underway; (a) Steelwork - 75% completed. Delays were encountered due to fabricators inability to provide key fabricated members for erection. (b) Electrical - 30% completed. (c) Piping systems and hydraulic systems - 40% completed. (d) LN_2 transfer system - contract not awarded. (e) LN_2 tank cars - contract not awarded.

Contractors and Plum Brook personnel are working a fourteen hour day to accelerate facility modifications. In general, progress is delayed due to non-availability of contractor and government furnished material and equipment. Efforts are being made by purchasing personnel to expedite delivery dates of hardware and material.To circumvent delays, certain materials and equipment have been loaned to the contractor.

It is anticipated that systems checkout will be lengthy and accordingly the target date of 15 August for testing appears unrealistic. However, all efforts are being made to meet the test date.

Preparation of operations procedures is approximately 50% completed.

MECA OPO 223 (B. Lubarsky)	Vibration of various components for MECA project.

NOTE (A) : Testing delayed by construction work on Atlas CENTAUR Project.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (C-3673) (D. S. Gabriel)	Static and dynamics test for CENTAUR vehicle.

STATUS: Construction is underway; (a) steelwork - 95% completed (b) electrical - 70% completed (c) piping systems - 90% completed (d) LN_2 transfer system - 10% completed (e) LN_2 tank cars deleted for four LN_2 stationary tanks (13,000 gal. each). These tanks are in place and are scheduled for service by August 15. System checkout and operations procedures have been completed. The following systems will be installed and checked out as follows: (a) LN_2 loading system - 8-23-63; (b) Pressure control system - 8-14-63; (c) Stretch system - 8-14-63; (d) Instrumentation and data acquisition system - 8-24-63; (e) Vehicle XDucer and boil-off valve checkout - 8-23-63; and (f) Static load system - 8-12-63. The vehicle is scheduled for erection in the tower August 15, and the static test is scheduled for August 26 or 27, pending successful system checkout.

		MECA (A-1G) OP0223 (B.Lubarsky)	Vibration of various components for MECA project.

STATUS: Since the shake table has been removed from the tower and CENTAUR will tie up the facility for considerable time, this program is considered cancelled.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (C-3673) (D. S. Gabriel)	Static and dynamics test for Atlas Centaur vehicle.

NOTE (A) : A two-week delay for static testing of the 116D Atlas Booster has resulted from the following problem areas. (a) Load distribution cylinder - load did not distribute as expected. The load distribution cylinder will be installed on the 116D and a 20% load (8 kips) on the YY axis will be applied to evaluate distribution. (b) Due to the load distribution problem, delays were encountered in the stretch system checkout, installation of boiloff duct and checkout of boiloff valve. (c) Delays in delivery of LO_2 and RP-1 flex hose connections between the relief valve unit and the 116D tank. (d) Delays in delivery of missile components and ground support equipment components.

STATUS: (a) The 116D booster has been erected and tower pressurization and mechanical stretch connected. (b) The pressure control system is completed and checked out. (c) The LN_2 system is completed and checked out. (Minor modification is required at connection to the 116D booster). (d) The LN_2 duct and the de-ionized water duct have been installed on the 116D vehicle and pressure checked. (e) The hydraulic system is installed and checked out. (f) The 13,000 gallon LN_2 dewars are complete and ready for use. (g) The instrumentation system will be complete when connections are made from strain gauges on the 116D booster to junction boxes.

It is anticipated that the 116D Atlas Booster will be ready for static testing (Phase I) on or about September 15.

The following tasks must be completed for the longitudinal dynamics test (Phase II): (a) Shaker table control system installation and checkout. (b) Shaker table installation under the 116D Atlas Booster. (c) Installation of cables for suspension of the 116D.

It is anticipated that Phase II testing will commence on or about October 1.

RESEARCH

SITE	LABORATORY	INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (OVO-687) (D. S. Gabriel)	Static and dynamics test for Atlas Centaur vehicle.

NOTE Ⓐ: An undetermined delay for static testing of the Atlas 116D Booster, (Test Phase Ia), has resulted from failure of strain gauge epoxy bonding and load distribution problems. It is anticipated that these problems will be resolved by research engineers by mid-October. Accordingly, Phase I testing has been delayed approximately three weeks.

STATUS: During September the Atlas was tested to 20% of static load at flight pressures (No LN_2) to determine load distribution problems, data from this test indicated that load did not distribute as expected.

The Atlas also was loaded with LN_2 to test levels to determine missile pressure stability, check operation of airborne valves, and the missile instrumentation system. The 116D and associated support systems have been in operational status for Phase Ia testing since September 19, 1963.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (OVO-687) (D. S. Gabriel)	Static and dynamics test for Atlas Centaur vehicle.

STATUS: During the month of October, several important test milestones were passed, all of which culminated in lifting of the flight restraint for AC-2.

At the beginning of the period the reigning problem was the need for speedy replacement of strain gages, which had broken loose from the Atlas skin during previous LN_2 tankings. Research engineers suggested the use of GA-5 epoxy and the difficulty was effectively eliminated by October 8.

With the strain gages properly applied, and a thorough analysis of the load distribution problem completed as a result of the 10-3-63 test, the way was paved for successful completion of the Max. "G" portion of the static load test on 10-11-63. Four load cylinders were used to apply a total axial load of 248,000 pounds.

Subsequent to the Max. "G" loading, heating elements and skin thermocouples were installed in the station 570 area. The Aerodynamic heating test (with an applied axial load of 229000 pounds) was completed on October 17, 1963, although a one days delay was caused by first applying the incorrect type of thermocouple.

Because earlier load distribution tests had indicated that Max. "Q", or bending, loading might result in unsafe conditions on the Atlas, the top X-Frame was removed and a pair of 4-point whiffletree devices were substituted. With the 8 loading points made possible by this means, the decision was made to proceed with the Max. "Q" test. Accordingly, preparations were completed and the test was completed on October 21, 1963.

Operations following the end of static tests have been devoted to preparations leading up to initial longitudinal dynamic testing commencing on, or about, November 1, 1963.

NOTE (A) : The static test with simulated aerodynamic heating was rescheduled from Dec. to Oct. The estimated number of runs for the dynamics test (ZZ axis 116D) was increased from two to six and dynamics test (116D & CENTAUR) was increased from four to ten.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR (CVC-687) (D. S. Gabriel)	Static and dynamics test for Atlas Centaur vehicle.

STATUS: Early in November the facility modifications were completed for converting from Phase I static load tests to Phase II longitudinal dynamics. Major changes involved the following areas; (1) Removal of static load distribution system, (2) Installation of interstage adaptor, (3) Preparation and erection of the dummy Centaur, (4) Final installation and checkout of water tanking system, including remote disconnect feature in the LOX tank duct, and (5) installation of the vehicle spring suspension system.

Following the completion of these modifications, the first logitudinal vibration took place on November 4 with all tanks dry. This was primarily a shakedown test of the facility equipment, verification of proper instrumentation location, etc. With all systems operable, test #1 was performed on November 7. For this test the Atlas tanks were empty, but the dummy Centaur was loaded with H_2O to simulate its launch pad mass.

After some difficulty with a leaky LOX duct valve, test #2 (see table below) was attempted on November 13. However, the spring suspension system proved unstable at this tanking level in the Atlas, and the decision was made to install a horizontal, spring-loaded stabilizing system. With excellent cooperation of various groups, the task was completed in time to perform tests #2 & #3 the next day.

With three tests completed, the objectives called for an increase in the spring rate for the next two tests. Accordingly two springs were added to each spring box and tests #4 and #5 were performed on November 18. Immediately following test #5, two additional springs were added to each spring box, and the tanking levels were raised for the performance of test #6 on November 19. During this test the allowable pressure differential of 50 PSI across the LOX duct butterfly valve was reached, which made mandatory the removal of the boilerplate LOX duct and valve. This equipment is being replaced by recently delivered flight ducting, although non-flight type brackets are being fabricated locally to adapt to the X-Frame. It is expected that longitudinal testing will continue for several weeks subsequent to completion of the duct installation.

Continued on Page 20

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION

E

Status (continuted)

Summary of testing for the month is as shown in the table below:

Test No.	Fuel Tank Wt (lbs)	LOX Tank Wt(lbs)	Total Weight (lbs)	Fundamental Resonance CPS
1	0	0	29,410	15.2
2	7,480	15,370	67,993	12.7
3	9,795	20,725	75,668	12.4
4	15,210	33,420	93,951	11.7
5	20,625	46,020	112,110	11.2
6	35,880	77,325	159,346	10.6

Planning is underway for lateral dynamics testing. The calidyne shaker unit has undergone extensive checkout, a connection link to the X-Frame from the shaker is under design, and procedures are being prepared for Centaur erection and pneumatic system checkout.

E DYNAMICS LABORATORY

CENTAUR (OVO-687) (D.S.Gabriel) — Static and dynamics test for Atlas Centaur vehicle.

STATUS: As the reporting period opened final items in the flight type LOX duct installation were being completed, and on December 6, 1963, a rerun of Test #6 in the longitudinal dynamics series was completed. Test #6 was repeated to check the effects of both the LOX duct change and the removal of the XX Axis balance longerons.

Test #7 (with 10 springs per box) was completed on December 11, 1963, and on December 13, 1963, Test #8 (with 12 springs) was begun. This test, however, was aborted after investigating only the first mode because of a sudden, unscheduled increase in Atlas fuel tank pressure. Detanking was successfully accomplished under emergency conditions. A subsequent investigation revealed that ice had completely plugged the fuel tank pressure sensing line, which caused the pressure regulating and relief functions to go awry.

Following a short delay, utilized for protecting the pressurization and sensing lines from the elements, Test #9 (with 14 springs per box, and the final test in the longitudinal dynamics category) was completed on December 19, 1963. Dynamic strain gage data was recorded for the first time during this test.

In the meanwhile, CENTAUR vehicle 5-C arrived in Cleveland and was unloaded from the place on December 18, 1963. This was accomplished in spite of extremely adverse weather conditions, although the operation was slowed sufficiently to delay the road trip to Plum Brook until December 19, 1963. The test package is currently stored in the Locomotive Shop pending installation of the many items on the shortage list yet to be received from General Dynamics/Astronautics.

A significant decision made this month by the Project Office relieves the requirement for cryogenically tanking the CENTAUR This has the effect of eliminating considerable design effort as well as construction downtime and delay to the program. It will, however, be necessary to restore liquid nitrogen tanking capability to the Atlas.

NOTE Ⓐ : With the CENTAUR vehicle installed on the ATLAS, a one shot test will be performed to correlate dynamics of the CENTAUR with the dummy mass used for the longitudinal series. In effect, this serves to extend the end date for longitudinal testing.

Because of modifications and additions required for the CENTAUR test package and an unfavorable delivery date for the General Dynamics/Astronautics-furnished stretch mechanism, it is considered unlikely that the longitudinal dynamics test with CENTAUR will begin earlier than February 1, 1964.

NOTE Ⓑ : As a result of the delays mentioned in NOTE A above, and the addition of the longitudinal test with CENTAUR, lateral dynamics testing will commence on or about February 15, 1964.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR 0V0687 (D. S. Gabriel)	Static and dynamics test for Atlas-Centaur vehicle.

STATUS: Major activity during this reporting period was concentrated upon preparation for the laterial shake test. While a portion of the effort was directed toward expediting General Dynamics/Astronautics equipment, both ground support equipment and airborne, the primary endeavor was pointed toward completing the facility.

The Centaur pressure control unit is completely installed but cannot be checked out for lack of several valves. The 10-ton crane experienced both mechanical and electrical difficulties. Although not acceptable with respect to meeting

2. The pressure regulating equipment for nitrogen to the seals was replaced.

3. Work was started on the relocation of the exit pressure and dynamometer controllers, and the contracted portion of this work was completed.

A checkout run will precede the hot turbine run which is scheduled for mid-March.

NOTE (B): Both the 3 and 8-stage gas generators will be checked out and run hot during this period. (January, February and March.)

NOTE (C): The turbine is scheduled to be checked out with nitrogen gas before hot runs.

Continued on Page 20

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY		Centaur pressure control unit was checked out and accepted and isolation valves were installed in the Centaur pressurization lines. Boil-off valves were also checked for proper operation. Other facility or ground support milestones include the assembly and installation of the stabilizer-snubber system. The 1000 pound force shaker was mounted and aligned on the Y-Yaxis pedestal, although final alignment with the X frame is dependent upon the first lift of the entire vehicle into the lateral shake position. Of the airborne systems, the Centaur liquid oxygen pump was installed, but the liquid hydrogen pump installation was cancelled because of facility clearance problems. An adequate pump simulator mass has been mounted in the proper location. Approximately 4629 pounds of polystyrene balls were loaded into the fuel tank to simulate the mass of a liquid hydrogen tanking. After qualifying personnel in the proper welding technique, accelerometer brackets have been installed on two axes of the Atlas vehicle. The majority of accelerometer mounting and wiring work has been completed. One of the major problems of the remaining test program is that associated with vehicle stretch. With the nose fairing in place, there is no method for applying stretch to the Atlas or the Centaur. Lack of this capability introduces an added risk factor into the operation, which can be only partially eliminated by the planned payload support feature. Longitudinal shake testing will resume the week of March 2. NOTE (A): The longitudinal test with Centaur in place was delayed due to GD/A parts shortages plus unforeseen difficulties encountered while installing insulation panels and nose fairings.

E DYNAMICS LABORATORY

CENTAUR
0V0687 (D.S.Gabriel) Static and dynamics test for Atlas-Centaur vehicle.

Final preparations for initial tests in the Atlas/Centaur with Surveyor configuration were completed during early March. Major tasks included installation of the Centaur insulation panels, mounting of the dummy Surveyor (mass simulation only), installation of nose fairings (a first for this design), welding of accelerometer brackets, and final checks of the pneumatic and propellant loading systems.

On March 6, a successful vibration test was made in the longitudinal plane. Tank level simulated a flight time of 60 seconds and total suspended weight was approximately 202,000 pounds. Based upon maximum response, the first mode appeared at 7.95 cps, while the second mode was indicated at 10.5 cps. These values compared favorably with both predicted data and that data obtained during tests with the dummy Centaur. This data was judged sufficient to remove the flight restraint on AC-3.

Subsequent to the longitudinal test, accelerometers were relocated, the 1000# shaker and its disconnect were checked out, and stabilization systems were installed at the top and bottom of the missile.

On March 12, the first lateral vibration test was conducted. All tanks were empty with the exception of the Centaur fuel tank, which contained 4650 pounds of styrofoam balls for liquid hydrogen mass simulation. With empty tanks, pressurization levels were at standby. During the first lateral test, the first mode appeared at 6.23 cps, and the second at 14.6 cps. A number of decay points were taken in order to establish the dampening factor. Due to problems with the M. B. shaker equipment, it was necessary to limit the swept frequencies to those below 15 cps. This test also pointed out the need for the engine gimballing hydraulic system, particularly in the lower frequencies, to limit undue forces imposed upon the Centaur aft bulkhead.

Following a series of repairs on both missile and facilities systems, a second lateral test was performed on March 30. It was observed that the M. B. system once again functioned normally, but the "quick fix" applied to the gimballing hydraulic system was not totally satisfactory. Therefore, it will be necessary to re-examine this system before additional lateral tests are run.

NOTE Ⓐ : Additional longitudinal data runs have been added to the test program, and the test program has been revised to include cryogenic and multiple shaker phases.

April 1964

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR 0V0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur vehicle.

Following the lateral tests of March 30, it was evident that the hydraulic stiffness of the Centaur engine gimballing system was having a decided effect upon the vibration response of the missile. Activation of the hydraulic system was complicated by the fact that several of the components were scrap parts originally installed for weight simulation only, but were now required to serve a functional purpose. Flight conditions of the gimballing system were duplicated by certain modifications, plus special bleed techniques. Additional instrumentation was installed to monitor force inputs at the attachment points on the Centaur LOX tank aft bulkhead.

On April 15, two longitudinal tests were conducted. For the first test, propellant levels were set to simulate the flight condition at T+151.7 seconds, and the tank pressures were raised to flight levels. The total actual vehicle weight was 67,000 pounds. A manual sweep was made from 6 to 40 CPS, with resonant points being recorded at three drive levels. A number of decay points were also recorded to establish the damping factor.

The second test was conducted with Atlas propellant levels set to simulate the flight condition at T+144 seconds, which increased the vehicle total weight to 74,000 pounds. The effect of the added mass was determined by establishing new resonant frequencies. Total excitation time for both tests was 2.3 hours.

Between the two tests, it was observed that a slight leakage had developed at the Centaur LOX tank aft bulkhead pump hoursing flange. The bolts were re-torqued and the leakage problem was cured.

Considerable progress was made in checking out the missile guidance system. The output of the gyros will be recorded during future tests to determine the effect, if any, of vibration on their operation.

The feasibility of applying stretch to the Atlas vehicle was investigated in conjunction with GD/A stress groups and a satisfactory solution has evolved. This system is now in the drafting stage with basic components already on order.

On April 30, after changing over the instrumentation, etc., two lateral tests were conducted. The purpose of these tests was to determine the effect of pressure on dynamic response. The first test was made with empty tanks and at standby pressure. On the second test, the tank pressures were raised to flight values. The mode points and the decay rates were determined for each condition.

Five additional tests are scheduled for the month of May.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur vehicle.

During the month of May, the Atlas-Centaur vehicle was tested five times, with lateral tests occurring on the 1st, 13th and 14th. The longitudinal configuration was tested on the 26th and 28th, which completed this phase of the program. A brief summary of the tests performed is tabulated below:

DATE	CONFIGURATION	SIMULATED FLIGHT TIME
5/1	Lateral	150 sec.
5/13	Lateral	100 sec.
5/14	Lateral	75 sec. (Max Q)
5/26	Longitudinal	90 sec.
5/28	Longitudinal	Lift off

In all cases, the investigated frequency range was between 2 and 40 cps, with test results generally agreeing with predictions. However, during the tests conducted on May 13 and 14, a beat frequency phenomenon was observed in the region of the second mode. The "beat" appeared to be a function of force input rather than frequency variation and reasons for this are still being investigated. Checkout of the auto pilot gyro system was completed with output being monitored for the first time during tests on May 13. Signal strength appeared adequate, and good response to vibration input was noted.

While cleaning the missile between tests, a scratch was observed in the Atlas vehicle, 3rd quadrant, at Station 825.55. Careful measurements were taken to determine a depth of .003" with a length of approximately 0.1". Consultation with GD/A Atlas and Centaur Stress Groups resulted in a decision to polish out the scratch. Patches were not recommended because of stress riser effects.

Additional lateral tests are scheduled for the month of June.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY		

CENTAUR

OV0687(D.S.Gabriel) Static and dynamics test for Atlas-Centaur Vehicle.

During the month of June, three Atlas-Centaur tests were completed. The first test was the lateral vibration in the Y-Y axis. Following this test the 1500 pound force Calidyne shaker was moved 90° to place it in the X-X axis and two tests were completed in this plane. Both tests produced data generally conforming to predicted values and mode frequencies were similar to those obtained in the Y-Y axis.

During the June tests, guidance system gyro outputs were recorded for the first time. Comparison between gyro output and accelerometer signals is being evaluated. In addition, the hydraulic system of the C-2 engine was brought closer to flight configuration by the addition of a power pack, or reservoir. Plans were formulated during the month to institute a series of longitudinal tests on the Centaur vehicle only. Purpose of the test would be to determine Centaur bulkhead dynamics during engine start-up conditions.

Requirements for modifications have been defined and facility drawings are being prepared. Basically, the Centaur will be lifted higher in the tower so that the 80 foot level can be floored completely. The shaker and other necessary equipment will then be installed at this level. The Centaur engines will be removed, and shaker output will be introduced to the missile via the engine mounts. Four test points were requested at this configuration, although timing is yet unknown because of hardware delivery uncertainty.

NOTE (A): The test program schedule was rearranged to accomodate Centaur longitudinal test, plus, plus the addition of one Atlas-Centaur longitudinal dynamics test without Centaur insulation and nose fairing.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur Vehicle.

During the month of July three additional Atlas-Centaur dynamic tests were completed.

On July 7,a lateral excitation was provided in the X-X axis at tanking levels simulating 75 seconds of flight time (max Q).

On July 9,lateral dynamics tests were concluded in the X-X axis with the Atlas-Centaur filled to lift-off levels. Both the July 7 and 9 tests were successful, although on July 9 the 5th mode could not be definitely established.

On July 23, longitudinal test #2 was repeated, without the Centaur insulation panels. Tank levels in this instance simulated a flight time of 151.7 seconds.

With the current series of tests completed, the site is in the process of modification for a longitudinal program on the Centaur. For this series, the Atlas and Centaur will be demated, the Centaur hoisted to the very top of "E" Site tower, and a new floor will be installed between the two missiles. A separate suspension system, stretch system, and shaker mounting will then be provided for the Centaur. In the meantime, the Atlas vehicle tanks will be purged dry for subsequent cryogenic tanking test later in the program.

The current status of hardware indicates that the Centaur longitudinal series of tests will probably begin the third week in September.

August 1964

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur vehicle.

While no tests were completed during the reporting period, work was accomplished toward preparing for several different series of tests in the future. Projects in process include the following:

(1) Centaur Longitudinal Test: Pressure and propellant lines were extended to service the Centaur in the new test position. The contract for tower structure modifications was awarded to Mack Iron Works of Sandusky. Fabrication is underway with completion estimated for late September. All other necessary components are on order or in hand.

(2) Liquid Nitrogen Storage Dewars: Four surplus USAF dewars were received from Warren AFB for the purpose of replacing the Linde liquid nitrogen storage dewars. Unfortunately, preliminary attempts to activate the new equipment have revealed that all four are in poor condition, particularly with respect to vacuum systems.

(3) Automatic Tank Watch: Beginning as of August 17, the Atlas-Centaur twenty-four hour tank watch was replaced by a series of pressure switches and an automatic alarm system. The effect was to release two mechanics to man new test facilities at Plum Brook. The system has performed well to date, without seriously compromising the safety of the missile.

(4) Longitudinal Testing: An additional Atlas-Centaur longitudinal test was requested to be performed without styrofoam balls in the Centaur liquid hydrogen tank. Purpose of this test will be to determine the effect of the balls in the rigidity and damping characteristics of the structure. Planned data for the test is 9/9. The styrofoam balls have been removed and placed in a recently completed storage bin.

(5) Cryogenic Testing: Because of the fact that both Atlas tanks have been filled with water during the preceeding test series, these tanks must be dried before the forthcoming dynamic tests with liquid nitrogen aboard. For this reason, an electric heater, with associated piping and wiring, was installed so that heated, dry nitrogen gas would be available for purging through the missile tanks.

(6) Data Acquisition System: A 30-KC digital data acquisition system is currently being installed at Plum Brook. One of the stations in this system is located at "E" Site and consists of a scanner system, patchboard, etc. When installed and operating, this system will greatly increase data sampling rate, shorten instrumentation setup time, etc.

NOTE: Because of an additional longitudinal test with Atlas-Centaur, and because of difficulties incurred with contracting for "E" Site structural modifications, the testing program has been delayed one month.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur vehicle.

The current series of Atlas-Centaur longitudinal tests was completed on September 10. This test was, essentially, a repeat of longitudinal test #2, but without simulated Centaur hydrogen tanking (styrofoam balls). Preliminary analysis indicates that the balls have little effect upon rigidity and dampening of the structure.

Major site modifications are now underway to prepare the facility for a series of Centaur-only longitudinal tests. Contractor work was completed in eight days and all major hardware is on hand for the new suspension system. It is expected that this phase of testing will begin approximately mid-October.

Other facility operations include continued work on the new 30 KC data acquisition system, which should be in operation to support the October tests. In another area, the four Linde LN_2 storage vessels will be replaced by surplus USAF units. Linde has already been requested to remove their equipment.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamics test for Atlas-Centaur Vehicle.

On October 8, 14, and 22 longitudinal dynamics tests were completed using the Centaur Vehicle. In general, test results were satisfactory, and objectives were met.

Prior to initiating this test series, the new Centaur suspension system was proof-loaded, then installed. Test No. 1 was then performed on October 8, 1964, consisting only of two sweeps with varied free levels. On this occasion, propellant tanks were empty and at standby pressure levels. Test No. 2, ran off on October 14, was essentially a repeat of No. 1, except that 2000 pounds of water were in the LOX tank, and pressure levels were at flight conditions.

For Test No. 3 on October 22, fuel and oxidizer tank levels were at the two-thirds full mark (water and styrofoam balls) In addition to the accelerometers of tests No. 1 and No. 2, a total of 24 strain gages were mounted on the Centaur aft bulkhead. By making use of the new 30 KC data system, recording time for a digital data was reduced from 60 seconds to 10 seconds.

As far as possible, the site and the missile are being readied for the cryogenic tests planned for the month of December. Linde dewars are being replaced by USAF surplus tanks, an Atlas drying procedure is being prepared, the LN_2 fill line has been insulated, etc.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

On November 4, a re-run of the Centaur Test #3 longitudinal series was successfully completed. Data from the original test had proven to be somewhat inconclusive. For the re-run, therefore, additional accelerometers were added, and more stringent precautions were taken to eliminate possible friction points. Frequency range investigated was between 19 and 92 cps.

On November 19, Test #4 was performed with an increase in the propellant tanking levels. Results were generally satisfactory, thereby completing this phase of dynamics testing.

NOTE: During the month of November, the work at "E" Site was re-programmed to meet a requirement for completion of testing within the next three to six months. Accordingly, existing and new objectives were merged, with the following results:

(1) Two tests, termed "broad band spectrum", will be performed. Configuration will be essentially similar to the Centaur longitudinal series, although bulkhead masses will be changed slightly to conform with AC-4. Instrumentation changes are necessary to investigate lower bulkhead phenomena when excited in the 10 to 1000 cps range.

(2) A torsional vibration test, or tests, will be attempted late in January. The Centaur will be re-mated with the Atlas in this configuration, and two 200-pound force shakers will provide the driving force. Propellant levels will simulate booster engine cutoff (BECO).

(3) The dynamics tests with Atlas cryogenics have been cancelled.

(4) The "multiple shaker" series of tests has also been cancelled.

(5) The final test is now scheduled to be a static compression and bending load test. The present goal is to load the Atlas to failure. Plans are not yet complete for this test, nor have all safety problems been considered.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR OV0687(D.S.Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

In preparation for the broad band spectrum tests, two changes were made on the lower bulkhead to simulate mass configuration of the AC-4 vehicle. A simulated helium sphere was fabricated and installed, and the peroxide sphere was filled with trichloroethane. Accelerometers were then located at appropriate points on the bulkhead packages.

On December 1, the first test in this series was accomplished. For BECO simulation the Centaur fuel and oxydizer tanks were filled with styrofoam balls and deionized water, respectively. The vehicle was then subjected to frequency sweeps ranging from 12 to 1000 CPS with acceleration level maintained between 0.1 and 0.5 G's. Bulkhead and package responses appeared normal.

On December 10 Test #2 with this configuration (all tanks empty) was attempted. However, the test was aborted because of the failure of a calidyne shaker trunion block. A new block was fabricated and the test was successfully completed on December 16, which also completed this phase of the program.

Planning has been completed for the torsional vibration tests. Remating of the Atlas/Centaur/Surveyor is now in progress, and site preparations should be completed in ample time for these tests to take place late in January or early February. Disposition of the Centaur and Surveyor portion of the vehicle has been requested.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY		
		CENTAUR OV0687 (D. S. Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

Major activity at "E" Site during January was concentrated upon preparations for the torsional vibration tests. The temporary flooring at the 5th level was removed, and the Centaur was remated with the Atlas. Other work included the remounting of accelerometers and the installation of the small shakers to be used for torsional force.

While the vehicle and facility are essentially ready for the torsional tests, the dynamic model of the Surveyor is not available for the test. This equipment was "loaned" to GD/A for an urgent test program on payload separation latches. As a result, the Plum Brook tosional tests may be delayed an undetermined amount of time.

Due to the performance of the AC4 flight, an additional test was proposed to investigate dynamics of the Centaur LOX tank forward bulkhead. Accelerometers would be installed in the fuel tank then partially filled with water. Action of the water would be observed by means of TV and movie viewing ports located in the payload bulkhead. Accelerometer output could be correlated with action of the water.

Preliminary facility engineering and planning studies are being made for the forthcoming series of Atlas ultimate load tests. These tests, now designated as "Atlas post buckling static tests", have expanded considerably in scope with the addition of cryogenic fluid requirements and come rather complex loading schemes. The studies being made include relative costs, suitability and safety for buckling the Atlas in; (1) the present test stand, (2) just outside "E" stand structure or (3) a location relatively remote from the "E" Stand structure.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR 0V0687 (D. S. Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

The installation of the Centaur torsional test equipment has been completed. The shakers were tested as individual units, and then mounted in position on the 6th level of the tower. Preliminary checks with the shakers attached to the payload indicate that the system will operate as planned. Research instrumentation (accelerometers, etc.) and control transducers were installed and checked through their associated circuitry. Re-installation of the Centaur insulation panels was completed, and the missile and site hydraulic systems were returned to test configurations.

A checkout test on the complete missile, with all tanks at "standby" pressures, will be made on March 1. Assuming that the test is satisfactory, the dynamic model of the Surveyor will then be installed with the nose fairings and the test will be run at simulated flight conditions. Preparations are underway for the Centaur LOX tank, aft bulkhead, oscillation test. In addition, work is proceeding toward definition of the Atlas post-buckling test.

SITE	LABORATORY	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS LABORATORY	CENTAUR 0V0687 (D. S. Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

Preparations were completed for the first torsional dynamics test, and the first run attempt was made on March 3. Tentative modes were established at 15 and 45 cps. Some Brush data was taken, but before any digital recording was done, one of the shakers failed. Also evident from this test was the fact that additional driving torque was required.

Following the first test, the shakers were moved out to a 5-foot lever arm, as opposed to the original 2-foot arm, which substantially increased the available driving torque. The damaged shaker was replaced, and the suspension system was modified.

A second torsional test was conducted on March 16. Modes were identified and recorded with the missile tanks empty and at standby pressures. In addition, a dummy Surveyor payload was used in place of the dynamic model. A third torsional test at simulated BECO conditions, and making use of the dynamic Surveyor, is planned for April 9.

During the past months, a series of conferences were held with Lewis Research and Facilities Design representatives, as well as with General Dynamics structures groups, in an attempt to establish a means for conducting the Atlas post buckling experiment. There are presently two proposed methods for applying the desired bending moment. One would make use of bands applied to the missile tank, coupled with a lateral pulling force, while the second method would involve tilting the entire missile with varied tank levels supplying the necessary bending. In either method, liquid nitrogen would be the fluid in the LOX tank of the Atlas. Neither scheme has been fully evaluated, particularly with reference to safety of the missile and the test facility.

SITE	LOCATION	RESEARCH INSTALLATIONS (FOR)	DESCRIPTION
E	DYNAMICS STAND	CENTAUR 0V0687 (D. S. Gabriel)	Static and dynamic tests for Atlas-Centaur vehicle.

On April 8 a torsional vibration test at BECO conditions with the dynamic Surveyor model was attempted. Difficulties were encountered with the suspension system, and the test was aborted. The strain gage type load cells were then replaced with a crystal type. In addition, greater lateral stability was applied to the bottom of the Atlas.

On April 23, a successful BECO test was performed. Force inputs up to 150 poundsper shaker were applied over a frequency range of 10 to 100 cps. Torsional mode shapes were readily identifiable. A final torsional shake is scheduled for May 6, at which time lift-off conditions will be simulated.

Atlas "post-buckling" static tests are still in the planning stage. A testing concept was presented to the Area 20 Safety Committee on April 23. However, since that time, the proposed method for applying the required bending moment has changed. Where previously the moment was to be applied by a combination of tilting and various LOX tank levels, bending now is to be applied by application of a pulling force to bands welded or glued at appropriate stations along the length of the missile.

SITE	LOCATION	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR
OV0687(D.S.Gabriel) Static and dynamic tests for Atlas-Centaur vehicle.

On May 6, the final torsional dynamics test was completed. This test simulated lift-off conditions. Investigations were confined to the 0 - 100 cps frequency range, with force levels near 100 pounds per shaker. Data points were taken which identified five apparent mode shapes.

Preparations are nearly complete for removing the Centaur vehicle from the test stand. De-erection is scheduled for the week of June 6, and it will be stored in the "E" Stand area.

A test request was received to conduct an additional longitudinal dynamics test on the Atlas 116D vehicle only. Purpose of this test would be to determine frequency response characteristics and model damping at resonant conditions. For this test, tanks would be empty and at standby pressures. This test is scheduled for the week of June 20.

Planning and engineering are now in an advanced stage for the Atlas "post-buckling" tests. Drawings are being prepared and some equipment has been ordered.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687 (D.S.Gabriel) — Static and dynamic tests for Atlas-Centaur Vehicle On June 3, Centaur Project Office requested a special dynamics test to determine the response characteristics of a free-free Centaur/Surveyor nose fairing half. Purpose of this test data was to assist with the prediction of flight loads upon the fairing hinges. Accordingly a fairing half was assembled and reworked to simulate the latest missile configuration. This fairing was then suspended in the north bay of the tower, and the 1500-pound Calidyne Shaker was mounted on the second level to provide the necessary excitation force. On June 11 the fairing dynamics test was conducted, with sweeps made between 10 and 100 cps at a force level of approximately 150 pounds. Five resonances were located in this frequency range, and sufficient data points were taken to satisfy all research requirements. Following the test the Centaur was removed and stored at the site. At the present time, preparations are nearly complete for the Atlas dynamics test described in last month's report. This test is now scheduled for July 2. Engineering, Planning and Procurement support for the Atlas Post Buckling Test is proceeding. Major problem areas appear to be under control. Bi-weekly project meetings are being held to review status and discuss current difficulties.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR

OV0687 (D.S.Gabriel) — Static and dynamic tests for Atlas-Centaur vehicle

Two Atlas longitudinal dynamics tests were completed this month; one on July 2 and one on July 28. Purpose of these tests was to provide additional data with which to develop a mathematical model for the dynamic characteristics of the missile. Test conditions were at standby pressures and with empty tanks.

Approval of the operating concept for the Post-Buckling Test was given by the Area 20 Safety Committee, as engineering and planning for the total job continues at a rapid pace. Many of the items are already in procurement, and some equipment is now on hand. Modification of the hydraulic system is well underway, with more hardware scheduled for installation in the near future.

First attempt of the post-buckling test is scheduled to take place in November.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR
OV0687 (D.S.Gabriel) — Static and dynamic tests for Atlas-Centaur vehicle

The final test of the Atlas longitudinal dynamics series was completed on August 24. Data was obtained in the 2 to 8 cps frequency range. In order to test at the desired low frequencies, it was necessary to drive the MB shaker unit with the Amplidyne power supply. This was a combination never run before, so that considerable rework and checkout time was necessary to obtain an operating unit. Strain gage type accelerometers were installed to record the low frequencies. Another unique feature of the test was the use of a square wave input. A total of 40 data points were recorded.

Following the above test, preparations were begun for the Atlas "Post-Bucking" test series. The interstage adaptor was removed, the stretch adaptor was installed, and additional hydraulic and instrumentation system modifications are underway. Bids are due September 15 for tower structural modifications.

Mounting problems involved with the shear load pull-off pads appear to have been resolved in favor of the welding technique. Arrangements should be completed with General Dynamics in the near future for supplying the personnel and equipment necessary for pad installation.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687 (D.S.Gabriel) — Static and dynamic tests for Atlas-Centaur vehicle. Major activity for the past month was concentrated upon preparation for the Atlas post-buckling test series. Status of major items is as follows: (1) Major components utilized for dynamics testing were removed from the facility and stored. Included are the MB shaker, the 36 inch support beams, certain suspension components and the interstage adapter. (2) Hydraulic system modifications are complete, both for compressive and lateral pull-off loading. With the completion of control wiring for the marginator, a checkout of the system will be made. (3) A contract was awarded to cover tower structural modification. The contract completion date is October 30. (4) Major components for base and top reaction systems are being fabricated by AEC in Paducah. On October 28, a test was conducted to determine the feasibility of using glue instead of a welding technique to bond the horizontal pull-off tabs to the skin of the missile. The pads were attached with a silicon rubber adhesive to the Atlas fuel tank. The fuel tank was then filled with water and pressurized to simulate normal operating stresses. A horizontal free equivalent to twice the proposed test loading was then applied with no appreciable effect upon the bonding or the pad. While satisfactory for ambient tests, it is not expected that this same adhesive will be suitable for proposed cryogenic testing.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687 (D.S. Gabriel) — Static and dynamic tests for Atlas-Centaur vehicle. Status of site modifications for the Atlas "post-buckling" test is as follows: (1) Approximately eighty strain gages were bonded to the missile skin. (2) The Atlas pressure control unit (PCU) modifications are approximately 75% complete. (3) The hydraulic system has been modified and checked. For loading tests, a special test fixture, consisting of the load distribution cylinder and dummy Centaur, was assembled in front of the test stand. (4) Preparations are being made for raising the Atlas. As of this report date, all components attached to the X-frame have been disconnected. (5) The interstage adapter was received from General Dynamics/Convair on October 28 and the base reaction components from AEC-Paducah on October 29. Top reaction components are enroute. (6) Structural modifications to the tower for the lateral pull-offs will begin the first week in November.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.

OV0687 (D.S. Gabriel)

Work continued on the Atlas "post-buckling" test setup during the month of November. As of the close of the period, these items were accomplished:

1. Completed PCVA modifications. Initial checkouts of the system have been completely satisfactory.
2. Completed tower structural modifications.
3. Received the profile indicator instrumentation system. Modifications and checkouts are in process prior to fuel installation.
4. Match drilled and tapped load distribution cylinder to match the new interstage adapter.
5. Problems encountered during last month's check of the hydraulic loading system were corrected, and a second, satisfactory, loading test was accomplished.
6. Base reaction components were installed.
7. Where possible, portions of the lateral pull-off mechanism were installed.
8. Preliminary instrumentation sheets were prepared and transducer wiring is well underway.

While the post-buckling modifications, essentially, proceeded without difficulty, several problems were encountered:

1. Grouting under the bottom support of the base reaction assembly is cracked and crumbling. This will have to be repaired.
2. During installation of the base reaction components, the sustainer engine reaction cap was loosened by an unplanned operation which resulted in a small leak from the Atlas Fuel tank. This plate does not open into the tank but it is possible to leak pressure through the bolt holes. Repair of the leak was somewhat involved and caused several days' delay to the program.
3. One load cell has not yet been shipped due to vendor difficulties.

NOTE: It is planned to try system checkouts during the month of December. Actual tests are scheduled for January.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687 (E. R. Jonash) — Static and dynamic tests for Atlas-Centaur vehicle.

Preparations for the Atlas Post Buckling Test are nearly complete. The checkout of all systems is scheduled to be made on January 14, and the first test will be made the latter part of January.

The following items were accomplished during December:

(1) A leak in the Atlas fuel tank apex was repaired and pressure checked.

(2) The missile was mated to the lower X frame and all connections made.

(3) The lateral pull-off pads were glued on.

(4) The interstage adapter, load distribution cylinder, stretch, and all other upper reaction components were installed.

(5) The LOX and fuel tanking line modifications were completed.

(6) "E" Site control panel modifications were completed

(7) The hydraulic runs to all loading cylinders were completed.

(8) The wrinkle profile mechanism preliminary checks were completed and the mechanism was prepared for installation.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.

0V0687 (E. R. Jonash)

A system checkout run of all the post-buckling mechanics was conducted on January 14. Basic sub-systems performed as planned. Hydraulic loads were easily controlled to test specification, and instrumentation response duplicated predicted data with few distortion or noise problems.

Following the test, it was determined that some attempt should be made to provide greater flexibility in the lateral pull-off system to prevent strap distortion or unequal loading. To achieve this end, springs were installed in the lateral pull-off suspension system.

Final installation of the profile mechanism, camera tower, observation huts, etc., is now in progress.

Additional consultation with General Dynamics Corporation personnel resulted in the decision to change the method of vehicle loading. Shear load application was modified by removing the couple resulting from unbalanced compressive load, and developing the full bending moment by means of shear loading. As a result of this, some minor strengthening of the pull-off mechanism supports was made.

It is expected that the post-buckling test will be performed during the first week of February, or as soon as the weather permits.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687 (E.R. Jonash)

The first post-buckling test was conducted on February 9. All test systems performed satisfactorily and buckling resulted in areas on the vehicle skin as predicted.

A maximum moment of 15×10^6 in/lb was applied, and well-developed buckles occurred in the lower portion of the oxidizer tank. The maximum shear load was approximately 50 000 pound, applied simultaneously with an 80 000 pound compression load.

The buckling appeared to be uniform and to extend around the circumference of the missile. The extent and depth of the buckles were well-defined by the wrinkle profile mechanism, T.V. cameras, and strain gages.

The next test will probably be performed in the same axis, but with additional strain gage instrumentation installed to determine if permanent deformation of the skin occurred. Date for the next test is indefinite at this time.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687 (E.R.Jonash)

Test conditions for the second "post buckling" have been defined. Special 1/16 strain gages were ordered to provide means for a thorough analysis of stresses in and adjacent to the buckles. When available, these gages will be applied by Plum Brook personnel. No date has yet been determined for this next test.

Other modifications accomplished for the 2nd buckling test include the following:

(1) The wrinkle profiler was raised approximately six feet to permit scanning of the upper portion of the LOX tank.

(2) The 3rd level spandrel beam was changed to permit removal during the test for unobstructed visibility.

(3) Arrangements were made for recording one channel of television.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687(E.R.Jonash)

Preparations for the second post buckling test are nearly complete. This test is now scheduled for May 13.

All new strain gages are now installed. However, during their installation, a probe, charged to 110VAC, was accidently grounded to the Atlas missile skin. As a result, the arc formed a pit nearly 3/16 inch diameter by .007 inch deep in the LOX tank area. Upon investigation, we found that the variac used to reduce the probe voltage had some operating peculiarities requiring proper plug polarity. Corrections were made to avoid this possibility in the future. The pit will be polished, and following this, a brief test for stress concentration will be made by means of "stress coat" paint. Assuming no significant stress concentrations are noted, the post buckling test will be performed as planned.

Additional changes have been made to improve data quality as follows:

(1) The buckling area was painted white for better photographic resolution.

(2) More lights were installed.

(3) A larger motor was installed on the profile indicator to improve operation.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687 (E.R.Jonash)

On May 12, the second "post-buckling" static test was conducted. Data from the test agreed with theoretical predictions. In addition, the test accomplished all of the planned objectives. During the test, we applied a maximum bending moment of 10.2×10^6 in./lb. This moment was almost 0.8×10^6 in./lb. greater than that applied on the first test. At the maximum load condition, tank deflections increased without load addition. This fact indicated that the yield point had been reached. Following the test, an examination of the Atlas indicated some permanent deformation in the LOX tank area. Even though this damage is present, a third post-buckling test is planned.

A determination of the maximum strength of the interstage adaptor mounting flange (570 ring) is the objective of the final test. We have already held preliminary discussions concerning the proposed test method, and it now appears that the necessary loads can be applied to the 570 ring without extensive site changes. We have also held preliminary talks concerning a new series of dynamics tests. These tests will make use of the Atlas vehicle to study flow dynamics during vibration. Planning for the tests will proceed as soon as a test plan is made available.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR
OV0687 (E. R. Jonash) — Static and dynamic tests for Atlas-Centaur vehicle.

Preparations are now underway for the third test in the Post Buckling series. The object of this test will be to determine the maximum strength of the interstage adapter mounting flange (570 ring).

After a review of the alternate methods for performing the test, the following procedures were selected:

1. The Atlas will be rotated 50°. This will move the previously yielded portion of the LOX tank out of the area of maximum deflection.
2. The bending moment will be shaped by an unbalanced compressive load. This load will be applied by means of a two cable system.
3. The four point whiffle-tree system will be used to transmit the compressive force to the load distribution cylinder.
4. Compressive forces will require cable loads up to 130,000 pounds per cable. The loading system design will be reviewed to determine if modifications are necessary to accommodate the higher load points.
5. The profile indicator and other instrumentation will be relocated to more adequately cover the 570 ring area.

It is expected that the most difficult phase of the test preparation (rotation of the Atlas) will be accomplished during the first week of July. The third Post Buckling Test is planned for August.

Planning for the "duct dynamics" tests continues. Piping schematics are made and some valves have been obtained.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687 (E.R. Jonash)

Preparations are nearly complete for the third and final test in the Atlas "post buckling" series. Work accomplished during the month includes the following:

(1) The Atlas was rotated 50° (clockwise looking down) and secured in the new position.

(2) The wrinkle profile indicator assembly was removed. It will be reinstalled during the first week of August in a position to cover the 570 ring area.

(3) Fuel and LOX tank water connections were relocated to mate with the Atlas in its new position.

(4) The upper Y frame, compression cables and hydraulic cylinders were removed. Work is now in progress to install the 2-cable whiffletree compression system. This task should be completed the first week of August.

(5) Strain gage installation will begin after the whiffletree is installed and the missile is back into "stretch condition. It is expected that the second week in August will see the end of this task.

(6) System checkouts will be started as each system becomes available. Some flood damage to the Atlas PCU is still being repaired.

(7) Approximately 100 engineering manhours were supplied for the reduction of data from the second "post buckling" test.

It is expected that the third "post buckling" test will be accomplished during the third week in August.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
OV0687 (E.R.Jonash)

On August 31, the third and final test in the Atlas "post buckling" series was completed. The hydraulic load system applied a maximum bending moment 9.26×10^6 pound-inches to the missile. There was no apparent damage to the Atlas. Data quality appeared to be good, and generally matched predictions.

The total bending moment safely obtained at the 570 ring was over 200% of the value normally established as flight limit.

Preparations will now begin for a new series of tests covering Atlas duct dynamics.

Basically, the LOX duct dynamics test will be conducted while expelling water from the LOX tank at flight pressures. At the same time, we will vibrate the Atlas in the longitudinal direction. The primary area of interest is the correlation of pressure perturbations in the duct as a function of frequency.

Major tasks to accomplish the test are as follows:

(1) Remove all compression load components.

(2) Replace the 36-inch beams and other suspension system components.

(3) Reinstall the MB shaker system, and checkout.

(4) Install missile in the proper position for longitudinal dynamics.

(5) Modify LOX tank duct, and provide a flow system.

(6) Install instrumentation.

Approximately five test days are required to complete this program. It is expected that the first test will be completed by the end of November.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
		CENTAUR OV0687 (E. R. Jonash) — Static and dynamic tests for Atlas-Centaur vehicle. Research engineers have finalized the test plan for the "duct dynamics" series. Plum Brook has prepared plans and work schedules to match these test needs. The work is falling behind schedule due to manpower commitments on research programs in other areas. Preliminary discussions have been made on the "kick stage" program. It is planned that the kick stage hardware will be available by June 1967. Research Engineering has divided the testing into at least two phases. Lateral testing constitutes the first phase. We will use the Atlas/Centaur interstage adapter as a mount for the kick stage. The interstage adapter will be bolted to the floor. The 1500 lb. shaker, mounted on an adjacent stand, will drive the kick stage assembly through the required frequency range.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687 (E.R.Jonash) — Static and dynamic tests for Atlas-Centaur vehicle. The following work was accomplished in preparation for the "duct dynamics" series of tests: (1) The load distribution cylinder and the interstage adapter were removed from the Atlas, and the stretch adapter was installed. (2) The 12,000 pound shaker was moved into the tower and checkouts were started. (3) The 36-inch beams and the 8-inch hydraulic cylinders were installed in the tower. (4) The Atlas LOX duct lines were removed and shipped to Lewis-Cleveland for installation of instrumentation and calibration. (5) Hydraulic and shaker control panel modifications were started. The Centaur project group has requested an investigation of bulkhead dynamics with the missile in longitudinal shake configuration. This test will be piggy-backed on the duct dynamics tests. Plum Brook personnel will install six pressure transducers and seven vibration pick-ups on the Atlas intermediate bulkhead. The test will attempt to establish correlation between actual bulkhead movement and the theoretical predictions. Tentative plans for Kick Stage dynamic testing are essentially complete. However, design and procurement of test fixtures must begin soon if projected test dates are to be realized.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

CENTAUR
OV0687 (E.R. Jonash) — Static and dynamic tests for Atlas-Centaur vehicle.

Preparations are continuing for the "Bulkhead Dynamics Test" which will be the first test in the Longitudinal Shake Series. The missile has been lowered into position and prepared for installation of the transducers on the intermediate bulkhead. After venting the LOX tank, the boil-off valve was removed and a man was lowered 35 feet to the bulkhead. After analysis of the dynamics involved, it was decided to purchase special light weight, button type, transducers for installation on the bulkhead. They should be available the first week of December and will be installed immediately after delivery. Another pacing item has been the spring boxes, that were borrowed for the launcher simulation test at Lewis-Cleveland. They also will be available about the first week of December. Meanwhile the stabilization system has been installed, transducers mounted, sub-system checks performed, etc.

The flow ducts for the "Duct Dynamics Series" are now being fabricated at Lewis-Cleveland.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR OV0687(E.R.Jonash) — Static and dynamic tests for Atlas-Centaur vehicle. Final preparations were essentially completed for the bulkhead dynamics tests. Special techniques were developed for mounting the accelerometer and pressure pickups on the LOX tank bulkhead. During the test, the pickups will be underwater and subjected to a pressure of 30 psi. A special test chamber was made, and the transducers were checked under simulated run conditions. Modification of the flow ducts is in progress at Lewis-Cleveland, and some site work is being accomplished for the duct dynamics program. The initial test in the bulkhead series should be made during the middle of January.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	CENTAUR YOV0687 (E.R.Jonash) — Static and dynamic tests for Atlas-Centaur vehicle. The first bulkhead dynamics test was delayed due to difficulty in obtaining the "Scientific Advance" special miniature transducers. After delays in procurement, two of the transducers were found to be shorted and had to be returned for replacement. There were other problems in acceptance, calibration and installation which have been worked out. Preliminary evaluation of the transducers indicates that the transducers will improve the test data and warrant the delay in the program. The test has been rescheduled for the first week in February.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
		CENTAUR YOV0687(E.R.Jonash) Static and dynamic tests for Atlas-Centaur vehicle.
		A checkout run for the "bulkhead dynamics" test setup was made on February 9. Atlas tanks were empty and at stand-by pressures. Following minor adjustments the first test under flight conditions was conducted on February 16. For this test the Atlas tanks were filled to lift-off levels and then pressurized to flight values. Test results were generally satisfactory over the frequency range studied, although shaker force input was not the clean sine form desired. The new Scientific Advance Miniature Pressure Transducers and the accelerometers responded properly. And, on the whole, the underwater sealing technique proved effective. Two accelerometers did short out due to water seepage, but sufficient bulkhead instrumentation remained to successfully meet test objectives. This instrumentation will be repaired and left in place so that additional bulkhead data can be obtained during the forthcoming "duct dynamics" tests, if desired. Preliminary data evaluation indicates that the Atlas fuel-LOX bulkhead has a much softer spring rate than predicted. Modification of the propellant outlet lines for the duct dynamics series is now in progress. All components are now on hand and are being fitted to the Atlas. The first test of this series is expected to take place during the last half of March.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
		CENTAUR - ATLAS — Static and dynamic tests for Atlas-Centaur vehicle YOV0774 (E.R.Jonash) YOT2043 (H.M.Henneberry) Modifications to the Atlas propellant lines for the "Duct Dynamics" test series have been completed. Considerable difficulty was experienced in welding instrumentation bosses into the monel metal duct. In addition, wet bulkhead accelerometers were removed, repaired and then replaced. The next test run is scheduled for the week of April 10. Multiple objectives are to be realized from this test. The objectives are to: (1) Obtain additional "bulkhead dynamics" data. This comparison test will serve to determine the effect of varying ΔP upon the bulkhead stiffness. (2) Obtain initial flow data for the "duct dynamics" test series. (3) Determine the oil canning and out-of-roundness of the Atlas during longitudinal dynamics. This will be accomplished by measuring the output of accelerometers mounted around the circumference of the LOX tank at Station 826. It is expected that four or five additional test days will be required to complete the duct dynamics test program over the full range of tanking levels.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND

ATLAS-CENTAUR
YOV0774(E.R. Jonash)
Y0T2043(H.M.Henneberry)

Static and dynamic tests for Atlas-Centaur vehicle.

After completing the test set-up, a run was conducted on April 12. Three basic test objectives were accomplished:

(1) Bulkhead dynamics data was obtained at three bulkhead ΔP values. The fuel and LOX tank pressures were adjusted to provide data from minimum to maximum values of expected flight ΔP.

(2) The duct flow system was checked. A ΔP versus flow curve was obtained for the three individual duct orifices.

(3) The accelerometers installed on the outer periphery of the LOX tank responded properly and provided information on tank roundness under dynamic conditions.

This run should complete the bulkhead dynamics program. The instrumentation will be retained in case additional information is requested.

The anemometers for the duct dynamics program have been received at Lewis-Cleveland and will be calibrated. They are expected at Plum Brook by the middle of May, and the first duct test will be run toward the end of the month.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND ATLAS-CENTAUR YOV0774(E.R.Jonash) Static and dynamic tests YOT2043(H.M.Henneberry) for Atlas-Centaur vehicle. Hot wire anemometer type flow meters, special instrumentation required for the "Duct Dynamics" test series, were received this month. Following some preliminary evaluation of these instruments at Lewis-Cleveland, it was requested that the calibrations be completed at Plum Brook. A circulating water flow calibration stand was fabricated. Procedures were written and personnel were familiarized with the instruments. Initial checks indicated a shift of the calibration curve with temperature. In order to obtain accurate sensitivity, a family of curves was obtained over the 50 to 70°F. range. The first test in this series was scheduled for the week of June 12.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
		ATLAS-CENTAUR YOV0774 (E. R. Jonash) YOT2043 (H. M. Henneberry) Static and dynamic tests for Atlas-Centaur vehicle.
		On June 15, the first "Duct Dynamics" test was conducted. This test followed a lengthy and difficult period of calibration for four of the hot-wire anemometer type flowmeters. Basic test procedure was to identify first and second mode natural frequencies at decreasing LOX tank (Atlas) liquid levels. Dynamic data was then recorded while expelling water through the LOX duct at simulated missile flow rates. Data points were selected at seven discrete tanking levels. The anemometer flowmeters, however, did not respond properly. Following the test, the probes were removed for recalibration. After improving the procedure and circuitry modification, three probes were recalibrated. In addition, a ground loop was located in the site wiring. On June 29, a second test was run. Flow data more nearly matched predicted values. Data points were taken at ten different LOX tank levels. All test data is now being evaluated. A third test is tentatively scheduled for the week of July 10. NOTE: Because of difficulties experienced with the flow sensors, the Duct Dynamics program has been extended.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

ATLAS-CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
YOV0774(E.R.Jonash)
YOT2043(H.M.Henneberry)

The third test in the "Duct Dynamics" series was completed on July 13. Data was obtained over a wide range of missile natural frequencies by adjusting both the fuel and LOX tank liquid levels. Data points were first taken at six different LOX tank levels with the fuel tank half full. Two data points were generally recorded at each LOX tank level--one while expelling at a simulated missile flow rate and with the missile vibrating at its longitudinal natural frequency. A second point was taken by starting and then stopping flow, without missile vibrations, to determine natural oscillations of the fluid in the duct. The fuel tank was then drained completely. The above procedure was repeated for three LOX tank levels.

At the lower liquid levels, natural frequency of the suspension system was very nearly equal to that of the missile; thus compromising the data somewhat. It is planned to conduct a fourth duct dynamics test after the number of springs in the suspension system is reduced.

It has been decided to perform a fuel tank baffle test. Purpose of the baffle test is to prove or disprove the theory that the fuel tank baffle is the source of high damping,up to approximately 140 sec. of missile flight. This test is scheduled for early August.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	ATLAS-CENTAUR YOV0774(E.R.Jonash) YOT2043(H.M.Henneberry) Static and dynamic tests for Atlas-Centaur vehicle. Two runs were accomplished during August in the "bulkhead dynamics" test series. Data was inconclusive as it did not clearly indicate a change in damping due to the fuel tank bulkhead effect. Data is still under discussion. A leak in the Atlas fuel tank developed during the past month. Location of the leak is around the fuel tank level probe boss. X-rays indicate a crack in the doubler. The need for, and method of, repair are currently under study in conjunction with LeRC-Cleveland structures personnel. Status of both the "duct dynamics" and "bulkhead dynamics" future programs is unknown at this time.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	ATLAS-CENTAUR Y0V0774(E.R.Jonash) Y0T2043(H.M.Henneberry) Static and dynamic tests for Atlas-Centaur vehicle. The "bulkhead dynamics" test program has been terminated. A meeting with research personnel on October 3 will determine the future of the "duct dynamics" series. A course of action was selected for the leaking Atlas fuel level probe boss. Based upon X-Ray film and visual inspection spot welds around the boss were judged to be intact. It was the opinion of Centaur structures group that the Atlas is still structurally sound. To prevent possible growth of the present leak problem, these corrective actions will be, or have been, put into effect: (1) Perform future tests with fuel level probe removed. This will remove a substantial cantilevered load from the boss. (2) Apply a poly-urethane sealer around the inside of the boss. This will eliminate the small leakage now present. Centaur 5C, used in numerous Atlas/Centaur dynamics tests, has been removed from "E" Site. It was taken to Building 9205 for inspection and probable use in the "B-2" facility.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

ATLAS-CENTAUR — Static and dynamic tests for Atlas-Centaur vehicle.
YOT1152(H.M.Henneberry)
YOV0774(E.R.Jonash)

Repairs to the leaking Atlas fuel level probe boss were completed. Satisfactory leak checks at standby pressure have been made.

LOX ducts supplying sustainer and booster #2 engines were removed. These modifications are an attempt to reduce variables for the remaining "duct dynamics" tests. Additional instrumentation is now being installed on the remaining LOX duct.

It is expected that necessary vehicle and instrument changes will be complete by the end of November. However, at the present time there are no mechanics assigned to "E" Site and manpower availability is contingent upon progress in the preparation and checkout of Centaur 5C.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
		ATLAS-CENTAUR YOT1152(H.M.Henneberry) (ASD - C.F.Lorenzo; RSD - N.L.Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. A memorandum was received from Lewis-Cleveland outlining the final series of "duct dynamics" tests. In preparation for these tests, instrumentation has been removed from the Atlas bulkhead (LOX side). It is being checked and recalibrated for installation in the LOX duct. An item to be completed is the removal of the poppet from the LOX airborne staging valve. The Atlas stretch adaptor, used on previous tests, was removed and replaced by the Centaur forward handling adaptor. This change has no effect on the duct dynamics tests. The reason for the change is that the Centaur forward handling adaptor is made of carbon steel, and it was incompatible with the planned cold shock of Centaur 5-C at "F" Site. A test date for the duct dynamics series is not firm, due to Centaur commitments, but will likely take place in January.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	ATLAS-CENTAUR YOT1152 (ASD - C.F.Lorenzo; RSD - N.L.Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. Instrumentation transducers for the final phase of the "ducts dynamics" have been obtained and calibrated. Depending upon the assignment of the necessary manpower, the tests could be run beginning the week of January 29.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

ATLAS-CENTAUR
YOT1152 (ASD - C.F.Lorenzo; RSD - N.L.Schroeder)

Static and dynamic tests for Atlas-Centaur vehicle.

The last series of duct dynamics tests are scheduled to be run in February. Research plans have been changed with reference to instrumentation and test procedure.

The LOX duct was removed for installation of pressure transducers inside the duct. Fourteen accelerometers are being mounted externally. In addition, the airborne LOX staging valve was disassembled for the removal of all internal parts that could possibly cause secondary frequencies during the shake test.

Equipment will be shipped from Lewis-Cleveland in the near future to provide a "closed loop" shaker control system. The loan of this equipment will provide updated capabilities for the final duct dynamics tests.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	ATLAS-CENTAUR YOT1152 (ASD - CF Lorenzo; RSD - NL Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. All modifications and checkouts required for the final "duct dynamics" tests have been completed. Actual testing has been delayed because of the cold weather. Safety considerations require that test stand doors be open during testing. Water-simulated propellants must have above-freezing ambient temperatures to prevent freezing the sensor lines.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	

ATLAS-CENTAUR
Y0T1152
(ASD - CF Lorenzo;
RSD - NL Schroeder)

Static and dynamic tests for Atlas-Centaur vehicle.

Two tests in the "Duct Dynamics" series were attempted during March.

On March 7, leaks were discovered in a reference pressure system - both in tubing lines and in a transducer. Also, instrument patching difficulties were encountered.

With repairs completed, a second attempt was make on March 21. Digital data was taken, but excessive noise on the shaker force input ended the test prematurely. Analysis of the data at Lewis-Cleveland indicated that shaker repairs would have to be made before further testing.

A thorough checkout of the shaker was made, and a purchase request was written to cover service costs by MB Electronics. It is expected that repairs will be completed late in April, at which time testing will be resumed.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	ATLAS-CENTAUR YOT1152 (ASD - CF Lorenzo; RSD - NL Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. Shaker repairs which were scheduled to be completed by late April have not yet been accomplished. Procurement is checking into the reason for the delay.

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND ATLAS-CENTAUR YOT1152 (ASD - CF Lorenzo; RSD - NL Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. On May 27 a full scale duct dynamics test was completed. A total of eight data runs were recorded, for four different LOX tank levels. Shaker noise was observed several times during the day but no noise occurred during the data recording. The shaker noise problem was investigated this month. The shaker equipment was completely checked by an M.B. Company technician, and it was determined that the noise problem was due to high frequency noise in the Plum Brook Station electrical distribution system. All efforts to locate the noise source were unsuccessful. It is expected that a final duct dynamics test will be conducted during June.

SITE	SITE [redacted] RESEARCH INSTALLATION & DESCRIPTION
E	**DYNAMICS STAND** ATLAS-CENTAUR YOT1152 (ASD - CF Lorenzo; RSD - NL Schroeder) Static and dynamic tests for Atlas-Centaur vehicle. No data runs were made during June. However, a series of checkouts were conducted in a continuing effort to reduce shaker and data noise levels. Additional stiffening of the LOX duct was also accomplished. The test program is scheduledto be complete in July.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
	ATLAS-CENTAUR YOT2600 (ASD - CF Lorenzo; RSD - NL Schroeder)	Static and dynamic tests for Atlas-Centaur vehicle.
	During July, three test days were completed on the Atlas "duct dynamics" series. On July 1, one checkout and four data runs were accomplished at two different LOX tank levels. Testing was resumed on the following day. Five data passes were made at three LOX tank levels. It was necessary to end the testing due to loss of a critical pressure transducer. Testing was renewed on July 3. Three data runs were accomplished. However, while detanking to the second LOX tank level, all three LOX duct pressure transducers were damaged. Subsequent investigation indicated that these transducers were damaged by "water hammer" effects. Water hammer was induced by a quick closing facility water valve used to lower LOX tank level. An orifice was installed to slow down the water valve action. Replacement transducers are scheduled for end-of-August delivery. The test program should then be concluded in September.	

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND ATLAS-CENTAUR — Static and dynamic tests YOT2600 — for Atlas-Centaur vehicle. (ASD - CF Lorenzo; RSD - NL Schroeder) No tests were performed during August. Replacement pressure transducers are expected on or about September 9. Once the special pressure transducers are received, one or two test days will be scheduled, and the program will be completed.

SITE	SITE NAME	RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND	
	ATLAS-CENTAUR Y0T2600 (ASD - CF Lorenzo; RSD - NL Schroeder)	Static and dynamic tests for Atlas-Centaur vehicle.
	Preparations for the final tests in the "Duct Dynamics" Series are in progress. The special flush mount differential pressure transducers necessary for the test have arrived, been calibrated, and installed in the duct. All support systems at the site are being completely checked out to verify their proper operation after a shutdown of almost three months. It is expected that the next test will be performed the first week of October and the test series completed by the end of the month.	

SITE	SITE NAME RESEARCH INSTALLATION & DESCRIPTION
E	DYNAMICS STAND

ATLAS-CENTAUR
Y0T2600
(ASD - CF Lorenzo;
RSD - NL Schroeder)

Static and dynamic tests for Atlas-Centaur vehicle.

The Atlas test program at "E" Site was brought to a conclusion during the month of October with two successful tests in the "Duct Dynamics" test series. Results of these tests are as follows:

October 3 Test

The test was performed with the Atlas fuel tank empty and water at various levels in the LOX tank. A total of 16 data runs were recorded.

October 9 Test

The test was performed with the Atlas fuel tank full and water in the LOX tank at various levels. After twelve of the planned fifteen data runs were completed at four different LOX tanking levels, it was discovered that the digital recorder was not properly recording data. The second digital recorder at "H" Building was put into operation and nine data points were rerun. Then, three more data runs at the final tanking level were made to complete the test. All other systems functioned properly during the test.

The site is presently in a "standby/shutdown" condition. All systems and site equipment remain intact. No personnel are assigned to the site, although tank pressures are still checked by the crew working on the Centaur buildup at Building No. 5131.