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# Space

TECHNICAL

# INFORMATION DIGEST

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SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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SCIENTISTS SET UP INFORMATION GROUP. <sup>Account No. \_\_\_\_\_</sup> Scientists are entering the public picture more frequently. An organization of scientists was set up at a two-day meeting of about 100 scientists representing 22 independent information committees across the country. Established as a vehicle to interpret scientific information on public policy issues, the newly formed Scientists Institute for Public Information "will concern itself with questions arising from the military, industrial and medical uses of nuclear energy and radiation, and with pesticides, air pollution and detergents in water supplies."

The guiding principles adopted concern the purpose of the organization: the information should be exclusive of political or moral judgments, should be prepared with scientific objectivity, and should be freely available.

The scientific group emphasizes the need of informed citizens because of the importance of science in world affairs. To enable citizens to participate with informed judgment in "momentous political decisions," the Institute will publish its information in an understandable form.

The government is considering the establishment of a Commission on Science and Technology to study programs, methods, and procedures of Federal agencies that are operating, conducting, and financing scientific programs. The primary purpose of the Commission would be to bring about more economy and efficiency in this performance. Other objectives include ways and means of meeting scientific manpower needs; elimination of duplication in government science efforts; and provision of a medium for Congress to attain information (not now readily available) enabling the establishment of definite Federal policies in the field of science and technology. (Source: The New York Times, February 18, 1963, and Congressional Record, February 18, 1963)

RADAR OBSERVATIONS OF VENUS. In the February 1963 issue of the Astronomical Journal the results are given of extensive digital-computer analyses performed on radar signals reflected at 440 Mc/sec from the planet Venus during the period 3 April to 8 June 1961. A number of experiments were reported by the author, W. B. Smith, of MIT's Lincoln Laboratory.

Measurements of Doppler shift and of the round-trip travel time of the radar energy were made (with a minimum inaccuracy of approximately two parts in  $10^7$ ) and compared with predictions of ephemerides derived from elements due to Newcomb and to Duncombe; significant systematic discrepancies were found. A new and greatly improved determination of the astronomical unit, reported in a paper published in 1962 by Pettengill, has led to the measurement of range, Doppler shift, and Doppler bandwidth of a radar echo signal recorded on 14 September 1959.

A direct measurement of the power impulse response of the deep planetary target was made and compared with earlier such measurements of the Moon. Combining this with Doppler spectral measurements yielded an estimate of apparent rotational velocity of Venus; the (relatively weak) result implies a very slow or possibly retrograde rotation of the planet. For each eleven days during the two-month period the radar Doppler spectrum was obtained, the average width being about 0.6 cps. There were statistically significant but unexplained variations of width; these did not appear to indicate the orientation of the Venusian pole. Finally, the author reports that the echo power within a narrow bandwidth (2 cps) was compared with a measurement previously made over a much larger bandwidth (approximately 250 cps). He states that the close agreement confirms the implication of the direct spectral measurement--i.e., that virtually all the reflected energy was contained within a 2-cps bandwidth.

Certain inconsistencies in the data on range, Doppler shift, and Doppler spectral width cast some doubt on the assumptions of free-space propagation and the model of a uniformly rough spherical surface for the planetary target. (Source: Astronomical Journal, February 1963, Vol. 68, No. 1, pp. 15-21)

SATURN SAID TO HAVE "VAN ALLEN" RADIATION BELT. A "Van Allen" type radiation belt around the ringed planet Saturn was discovered with a 25.6-m (84-ft) radio telescope near Indian Head, Maryland. Three physicists, William K. Rose, Joseph M. Bologna, and Russell M. Sloanaker, all of the research laboratory, took part in the research. The project included 170 measurements of Saturn's radiation in the 3200 Mc/sec band between last July and October when Saturn was about 800 million mi from Earth.

Radiation from the bright, ringed planet is too intense to be ascribed to heat emission, the physicists said. Mr. Sloanaker added that "the only theoretical explanation is radiation from electrons spiraling in a magnetic field." The results of the research turned up one possible interpretation, which is that Saturn's Van Allen belts circle the planet from north to south, or perpendicular to its famous rings.

The idea of a polar Van Allen belt is hard to accept, Mr. Sloanaker said, because it seems to imply a magnetic field oriented east and west, rather than north and south as on Earth. Saturn is a rapidly rotating planet and should have a strongly north-south oriented magnetic field, according to current theory.

The scientist added that it seems more likely that Saturn's Van Allen belts parallel the equator, as do its rings and the Van Allen belts of Earth and Jupiter. He said the apparent north-south orientation may be an illusion traceable to the possibility that observed radiation comes from electrons spiraling more "loosely" in Saturn's field than in Earth's.

The scientists intend to make further studies of Saturn's radiation belts with the new 91.5-m (300-ft) radio telescope at Green Bank, West Virginia to clear some of the current uncertainties about the planet. (Source: Physical Review Letters, March 1963)

NOVEL ELECTROMAGNETIC PUMP ANNOUNCED. Atomics International has developed and tested an electromechanical pump that will handle alkali metals at temperatures up to 1040°C (2000°F) and at capacities up to 189 m<sup>3</sup>/min (50,000 gal/min).

Called a helical rotor electromagnetic pump, it can be designed for pumping metals such as sodium and cesium. A wide range of flow rates can be attained by changing the dc applied to the helical rotor windings. In the helical rotor design there are no moving parts in contact with the molten metal; there are no shaft seals or stuffing boxes.

One pump configuration has a helical rotor on which field coils, supplied by dc, are mounted; an annular pump channel is surrounded by a steel shell (for the magnetic flux return path). Liquid metal is confined within the annulus that surrounds but does not touch the rotor.

Operating on the principle of an induction motor, the helical pump's spinning rotor induces current in the liquid metal conductor by the rotor's traveling magnetic field. The current-field reaction produces a force on the liquid metal conductor that tends to move it with the field. This type of action, with the liquid velocity and force in the same direction, minimizes pumping losses. The metal flows in a helical path, from pump intake to discharge; guide vanes are not essential to direct the flow.

Using liquid sodium, the new pump has reached an efficiency of 26 per cent at 8.5 m<sup>3</sup>/min (2200 gal/min), developing 2.4 kg/cm<sup>2</sup> (34.5 lb/in<sup>2</sup>). Maximum flow rate was 10.8 m<sup>3</sup>/min (2750 gal/min), and maximum developed pressure was 33 kg/cm<sup>3</sup> (45 lb/in<sup>2</sup>). (Source: Data supplied by Atomics International, North American Aviation, Inc.)

PLASTIC LASER OFFERS FLEXIBILITY. The development and operation of the first plastic laser was reported in early March, 1963 by the Radio Corporation of America. The experimental device is made with a fiber of transparent material of the same type used in making many familiar clear plastics. Employing a newly discovered physical effect, it produces coherent pulses of intense crimson light at the highest visible frequency yet known to have been attained by a laser.

The unique laser mechanism that is employed may permit the development of plastic lasers that emit coherent light over the visible spectrum from infrared through ultraviolet. The scientists described it as a clear plastic fiber 38 cm (15 in.) long, containing traces of europium, a rare earth, in which the laser action is achieved. The plastic polymethyl methacrylate acts as a holder for molecules known as "chelates" or "molecular claws" that enclose each atom of europium.

To make the fibers work as lasers, they are placed in a liquid nitrogen filled dewar--resembling a thermos bottle--and exposed to intense flashes of ultraviolet light. The energy from the ultraviolet light is transmitted by the fibers to the chelates, which absorb the energy and transfer it to the europium atoms, causing them to emit bright flashes of red light.

The fibers, each only about 20 times the diameter of a human hair, trap most of the light and force it to travel along their length. Each time such a flash occurs, it sweeps along the fiber and stimulates other flashes, all of which combine to create a single pulse of coherent light that bursts from the ends of the fibers with enormous power.

The way may now be opened for the use of still other materials that resist laser action when contained in inorganic crystals. Some of these materials may be capable of producing coherent light at yellow, green, blue, and other frequencies. (Source: Data supplied by Radio Corporation of America)

ELECTRONIC "FROG'S EYE" BUILT. An electronic "frog's eye," based on an animal nervous system, was unveiled at an Air Force symposium by the Aeronautical Systems Division. Built by the Radio Corporation of America for research, the device is believed to be the most faithful reproduction of a complete animal nervous system yet achieved.

By duplicating the computer-like optical system of the frog, it is hoped that the device ultimately will lead to ways of providing data interpretation--even decision--in a variety of fields, including air traffic control, missile detection, and photo reconnaissance.

According to Marvin B. Herscher, RCA project engineer, the frog's retina was duplicated electronically because it is:

1. A far less complicated visual system than the human possesses;
2. The frog retina's function is well known as a result of much biological research; and
3. It performed tasks that could conceivably be of value to man if converted into an electronic system.

"The frog's eye is a natural computer," Mr. Herscher said, "because it makes life-and-death decisions for the frog without bothering his very limited brain. It screens out anything that is not important to the frog, and it transmits to the brain only those things which directly concern him.

"A fly, for example, is important to the frog--but a fly traveling away from the frog is not," he said. "The eye automatically discards this information and the frog's brain never sees the departing fly. Similarly, a sudden shadow may be important as an indication of a threat; the frog's retina tells this to the brain. But the frog learns nothing from the shadow of a cloud crossing the Sun, even though the eye sees it."

The "frog's retina" is 1.1 m<sup>2</sup> (3.5 ft<sup>2</sup>), 1.8 m (6 ft) long, and weighs hundreds of kilograms because the functions of the frog's microscopic nerve cells have been duplicated by printed circuits, photoelectric cells, neon bulbs, and relays. All told, the frog's eye model is made up of 33,000 electronic components, more than in a medium capacity computer.

It was explained that no attempt had been made to miniaturize the equipment because it was designed for laboratory experimentation, and ease of access and modification were of importance. Bionics is based on knowledge of living systems. While this knowledge is still limited, the frog's eye has been one of the most explored of all nature's sensory systems.

The eye model employs neuron logic instead of conventional computer logic. The Air Force said it would use the frog's eye model as a research tool ". . .to determine the usefulness of this logic." It may supply the link needed to build weapon systems that could detect targets, make the necessary decisions about what action to take against them, intercept them, and order their destruction--all automatically. (Source: Data supplied by Radio Corporation of America)

TWO-COMPONENT ADHESIVE HAS EXCEPTIONALLY HIGH STRENGTH. A new two-component synthetic resin adhesive that provides exceptionally high peel strength and produces bonds with excellent flexibility characteristics (Fig. 1) is announced by the Minnesota Mining and Manufacturing Company. The adhesive cures at room temperature under contact pressure and is used for high-strength similar and dissimilar metal and plastic structural bonding applications where either heat or pressure (or both) are not feasible in the operation. It also adheres excellently to rubber.

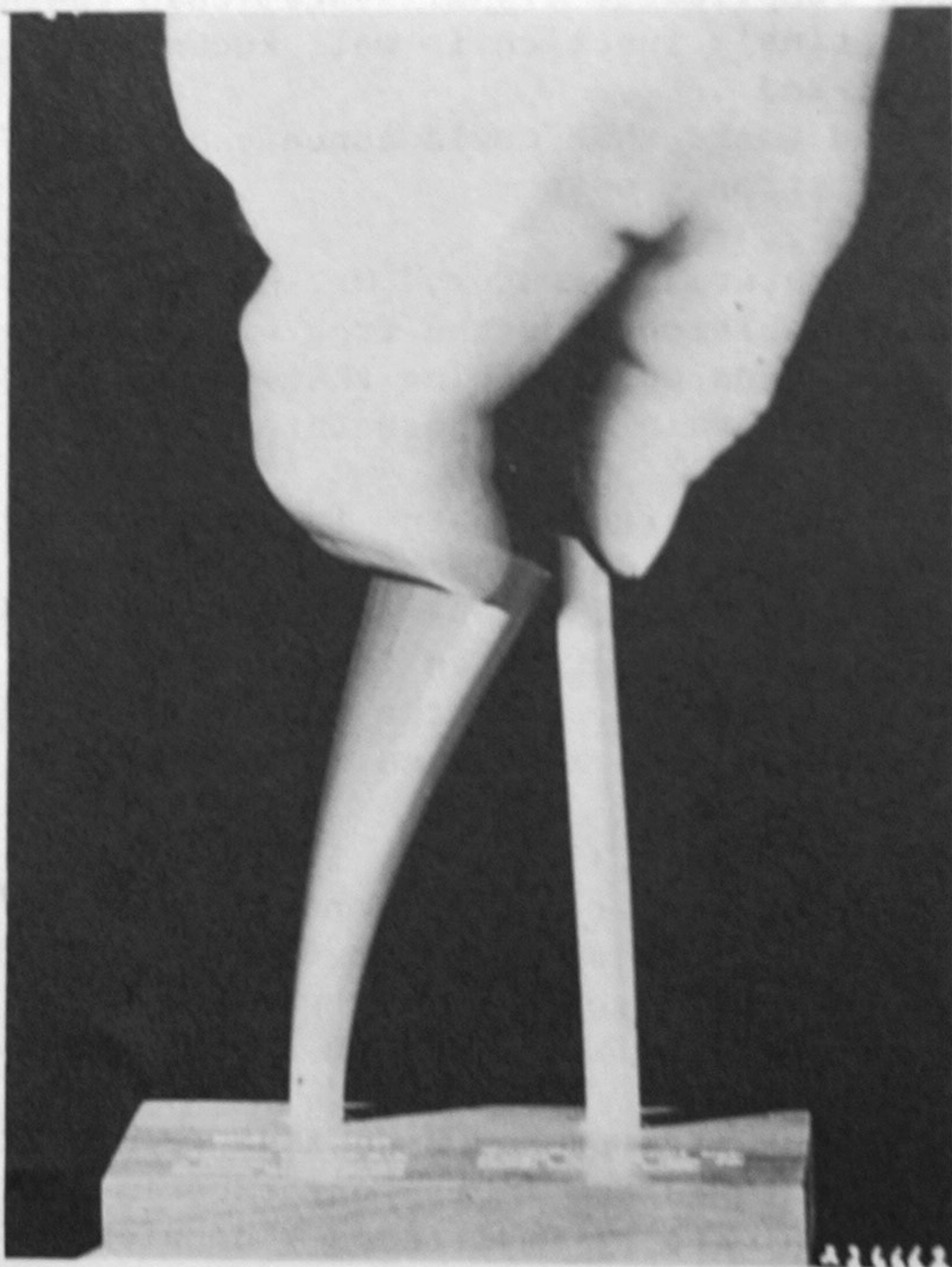


FIG. 1

The adhesive maintains high strength properties over a service temperature range of  $-55^{\circ}$  to  $-120^{\circ}\text{C}$  ( $-67^{\circ}$  to  $-180^{\circ}\text{F}$ ). Shear strengths of aluminum-to-aluminum assemblies are in excess of  $145\text{ kg/cm}^2$  (2000 psi) at  $-55^{\circ}\text{C}$  ( $-67^{\circ}\text{F}$ ) and in excess of  $210\text{ kg/cm}^2$  (3000 psi) at  $24^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ) service temperatures. After aging 28 days at  $24^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ), shear strengths of aluminum assemblies bonded with this adhesive increase to over  $280\text{ kg/cm}^2$  (4000 psi).

Different colors permit easy visual determination of mix. The adhesive has good resistance to water, hydraulic oil, and aromatic fuels. Excellent self-filleting property makes it useful for honeycomb sandwich construction. Its paste-type consistency provides void-filling properties that permit the structural bonding of loosely fitting parts. This property also permits use as a synthetic solder or void fillers for repairing and filling holes, dents and cracks in metal parts, castings, and sheet metal. Being 100 per cent nonvolatile, the adhesive is particularly useful for bonding impervious surfaces. (Source: Data supplied by Minnesota Mining and Manufacturing Company)

50-TON ROCKET ENGINE FIRED IN STATIC TEST. A one-segment solid-propellant rocket engine of the type intended as the first-stage booster power for the Titan 3-C space launch vehicle was statically test-fired on February 23, 1963 by United Technology Center.

Under Air Force contract, the company is developing a single engine consisting of five such segments. Two of these five-segment engines will give Titan 3-C a liftoff thrust of more than  $9 \times 10^5\text{ kg}$  ( $2 \times 10^6\text{ lb}$ ). They will be the largest and most powerful solid-propellant engines ever developed.

The 50-ton test engine (Fig. 2) was fired in a nose-down attitude, and produced a peak thrust of about  $110,000\text{ kg}$  (250,000 lb); it burned for approximately 120 sec. Three meters (10 ft) thick and more than 7.5 m (22 ft) tall, the engine consisted of the single segment with fore and aft closures, a nozzle, and equipment for the thrust vector control (steering) system. The test--the first 305-cm (120-in.) dia engine firing under the Titan 3 program--provided data including propellant performance, thrust vector control, case insulation, and nozzle materials.

Titan 3-C will consist of a modified Titan 2 liquid-propellant core; a liquid-propellant upper stage and control module with multiple restart capability, and the two five-segment, solid-propellant booster rockets. The space launch vehicle is planned for a variety of multiton manned and unmanned missions, including the X-20 Dyna Soar space glider. (Source: Data supplied by United Technology Center)

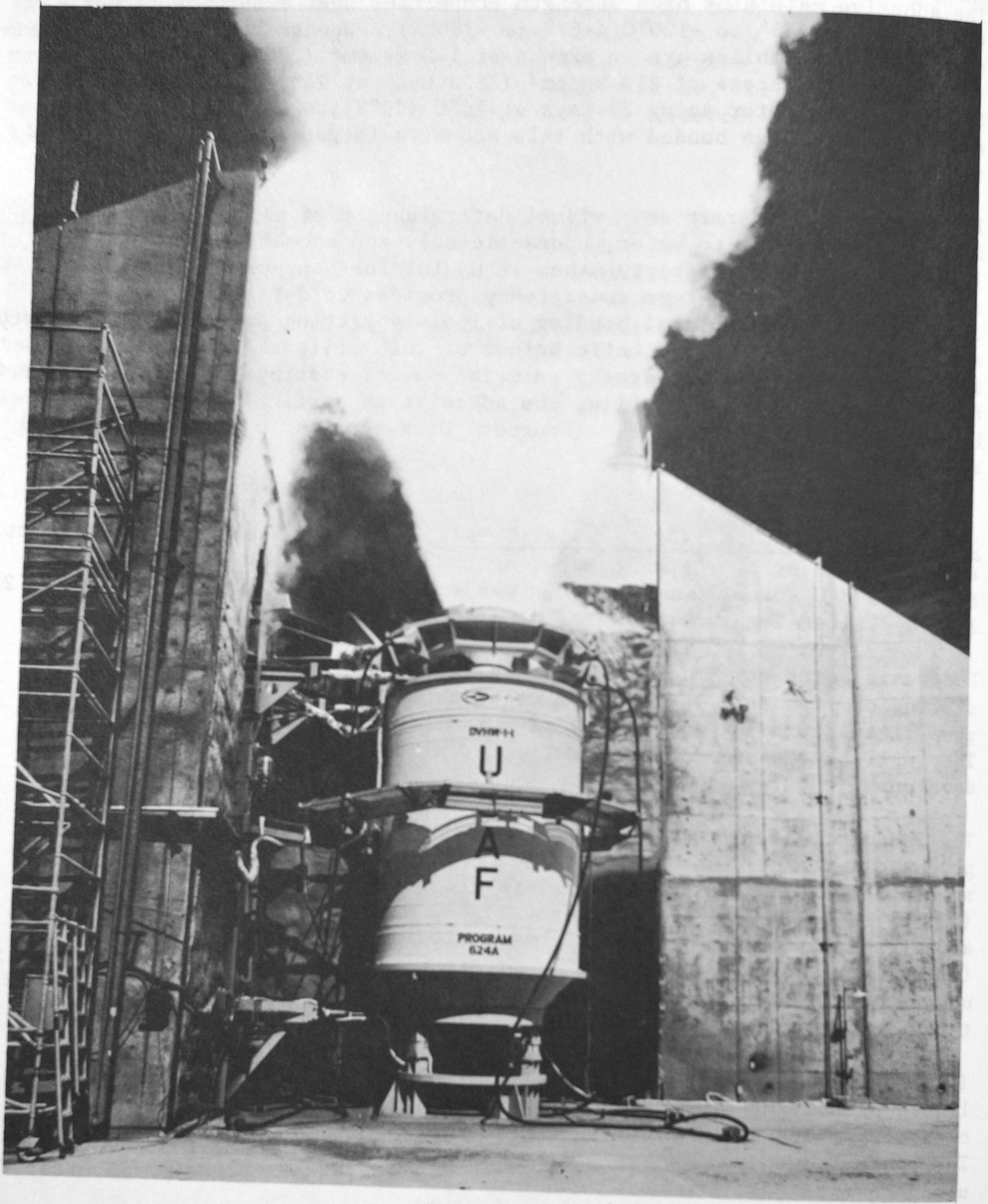


FIG. 2



TECHNICAL REPORTS AVAILABLE. The following listed technical reports can be requested through the NASA library, M-MS-IPL, Bldg. 4481.

NOTE: Those reports with an AD number may be on file in the local ASTIA branch in Bldg. 4484. Readers can save time by calling 876-6088 and inquiring if such reports are available before ordering them through NASA.

1. BIBLIOGRAPHIES OF TECHNICAL REPORTS-INFORMATION RETRIEVAL LIST NO. 1, Federal Aviation Agency. AD 282 111
2. FIRST REVISION OF THE THESAURUS OF ASTIA DESCRIPTORS, Armed Services Technical Information Agency. AD 278 168
3. A FEASIBILITY STUDY OF A THIONINE PHOTOGALVANIC POWER GENERATION SYSTEM, L. J. Miller. AD 282 878
4. VORTEX MAGNETOHYDRODYNAMIC GENERATOR EXPERIMENTAL TEST PROGRAM, H. G. Starck. AD 284 164
5. THERMOELECTRIC AIR CONDITIONER FOR SUBMARINES. AD 278 351
6. BERYLLIUM COMPOSITE STRUCTURES, VOLUME II--MATERIALS AND PROCESSES, J. N. Krusos et al. AD 278 526
7. STRUCTURAL RESPONSE OF BERYLLIUM SHEET PRODUCED BY THREE FABRICATION METHODS, C. J. Gienza. AD 273 707
8. BERYLLIUM FOR STRUCTURAL APPLICATIONS. AD 278 723
9. ENVIRONMENTAL POLLUTION BY MISSILE PROPELLANTS, W. W. Heck et al. AD 282 984
10. POSSIBLE IMPLICATIONS OF THE DAMAGE BY RADIATION IN THE STORAGE OF PROPELLANTS IN OUTER SPACE AND TENTATIVE METHODS FOR ITS MEASUREMENT, J. A. McMillan. ANL-6585
11. TEST DEVICE FOR THE DYNAMIC EVALUATION OF AIRCRAFT FUEL SYSTEM MATERIALS AND STRUCTURES, L. G. Middleton. AD 282 915