Space TECHNICAL INFORMATION DIGEST

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IN THIS ISSUE

GROUND STATION TO BE BUILT IN NOVA SCOTIA FOR U. S. NIMBUS METEOROLOGICAL SATELLITE SYSTEM. The Governments of the United States and Canada have announced a cooperative venture to build a data acquisition station for the Nimbus meteorological satellite system at Ingomish, Nova Scotia, during 1963. The agreement involves NASA, the U. S. Department of Commerce, the Weather Bureau and the Canadian Department of Transport.

The command and data acquisition station for the Nimbus system, now under development by NASA and the Weather Bureau, is expected to be completed in 1964. It will supplement the station being completed at Fairbanks, Alaska.

Nimbus satellites will record meteorological data, including TV pictures, on tape recorders contained in the spacecraft. This information will be relayed back to Earth on command.

The Nimbus program will be the successor to the current Tiros weather satellite program, which has been highly successful since the first Tiros was launched in 1960. Weather data from Tiros spacecraft have been distributed throughout the world for more than 2-1/2 yrs by the U. S. Weather Bureau.

One of the differences between Nimbus and Tiros is the fact that Nimbus will circle the Earth in a near polar orbit "seeing" the whole world every 24 hr. Tiros sees only about 20 per cent of the Earth daily. Within a few years it is expected that there will be at least one Nimbus in orbit at all times to support weather analysis and forecasting.

The Ingomish station will be manned by Canadians with some U. S. personnel there to assist in operation, training of Canadian technicians, and liaison.

Canada is especially interested in the Nimbus program because of the valuable information expected from it on ice formation and movement in navigable waters, and for the tracking of storms affecting fishing areas, to name two of the many direct uses.

The Canadian Meteorological Service is enthusiastic about receiving these additional data. These data will, in addition to the local applications, support weather analysis and forecasting over the U. S. and the rest of the world. (Source: NASA news release)

<u>EXPERIMENTS ON OUTER SPACE PERCEPTION DISCUSSED</u>. Astronauts operating outside their capsules in outer space will have considerable difficulty estimating distances to other objects, even of known size, say three Ling-Temco-Vought aerospace scientists. Experiments were conducted in a blackened room using a frictionless platform in a 245-m (800-ft) long,

darkened area of the company's plant. Tests showed that subjects, some of them pilots, were unable to judge distance accurately when the size of the retinal image was the only clue available. Percentage of error in guesses as to the distance of a simulated man's image ranged from 3 to 247 per cent.

Distances tended to be underestimated in some tests and overestimated in others. Judgments of an object of known size were only slightly better than guesses on an unknown target like a luminous ball. The small 7.5-cm (3-in.) "target," a simulated 1.8-m (6-ft) tall man, was viewed from a distance of 185 m (600 ft). It was illuminated during the test only by ultraviolet light. The "astronauts" had difficulty in telling whether they were on a collision course or whether they would make contact with the "spaceman." In some cases they became disoriented and nauseated during the test.

Since orbital rendezvous may be one of his hardest tasks, the astronaut's ability to judge rate of closure and angle of approach will be of great value. Visual references such as the Earth, Sun Moon, or stars will help him in orienting himself and judging distances.

Man's ability to observe and make decisions on visual information will have important implications on space systems design. The accuracy of visual observation will affect the complexity of the guidance system and the total thrust requirement for close-in maneuvering. For this reason, man's visual performance capability must be defined as accurately as is other design data for successful space missions.

Experiments were made with subjects on an air-bearing platform to give a simulation of weightlessness. In a darkened room a glowing figure of a man was moved at angles, and the "astronaut" was asked to estimate the angular deviation from his own path. The test showed he had difficulty estimating angles less than 15 deg.

Results of the experiments strongly suggest that observers cannot make accurate distance estimates without the aid of some kind of artificial ranging device. (Source: Ling-Temco-Vought, Inc.)

HANDLING OF GEOPHYSICAL DATA SUMMARIZED. A very great increase in available geophysical data has occurred in recent years, leading to a major problem in reduction and analysis. This problem is well illustrated by the data coming from observation satellites. An average transmission from an observation satellite is 8000 bits/sec, produced by about 40 different sensors. For a satellite lifetime of a year, approximately 2 X 10^{11} bits will be produced. A stack of paper printout 0.3 m (1 ft) high contains about 10^7 bits; an average satellite observatory will therefore produce more than 566,400 cm^3 (20,000 ft^3) of valuable experimental data in paper printout form.

Electronic computers, while adding a new dimension to data processing, have presented investigators with many unsolved problems. These observations were noted by Gordon J. F. MacDonald, who wrote a report on the International Business Machines Corporation conference held from October 30 through November 1, 1962.

Handling, reducing, and interpreting geophysical data make severe demands on the best modern computers. This is because of the characteristically multidimensional nature of the problems. However, geophysical problems that include the Earth's weather, tidal motions, and motions inside the Earth's core are best coped with by using high-speed computers. The only area in which little progress has been made so far is that of treating the magnetohydrodynamic motions of the Earth's core.

The strong influence of geophysical research on the development of computer technology is established. The author says, "It is an open question whether the computers will develop faster than geophysics or geophysics will outstrip the services of the projected computers." (Source: Science, December 14, 1962)

SATELLITE ROCKET ENGINE GROUND TESTED AT "ORBITAL CONDITIONS." A full-scale, 7200-kg thrust (16,000-lb) satellite rocket engine--"coasting" for several days at conditions realistically simulating an actual orbital mission--has been test-fired, stopped, and re-started in a new ultra-high altitude rocket test cell at the Air Force Systems Command's Arnold Engineering Development Center, Tullahoma, Tennessee.

The test involved:

1. "Soaking" the engine at vacuum conditions equivalent to a 120-km (75-mi) altitude for 53 hr.
2. Maintaining the temperature on the engine at about -10° C (15° F) by using powerful solar radiation heat lamps while the test cell itself remained at -195° C (-320° F), simulating the intense cold of space.
3. Igniting it for a 4-sec burst of full thrust.
4. Shutting it down for a 54-hr period of "orbital coasting" at the 120-km (75-mi), -195° C (-320° F) conditions.
5. Re-starting it for a more than 3-min run at altitude simulation from 120 km (75 mi) to approximately 65 km (40 mi).

The test marked the most extreme flight conditions simulated to date in the Ultra-high Altitude Rocket Cell J-2(A) test cell in the Center's Rocket Test Facility. The test unit is the only one of its type currently available for testing large chemical rockets at such extreme simulated altitude and temperature environments.

The 7200-kg thrust (16,000-lb) engine, the Bell 8096, had 400 instrumentation channels attached to it during the run. Every critical aspect of the engine's behavior was recorded with more than 81,000 test data points taken in the simulated space flight.

The engine was cold-soaked for 53 hr before it was ignited. Immediately after ignition, the exhaust gases were captured by special diffuser-ejectors, then pumped to atmosphere, at the same time maintaining the 71-km (44-mi) altitude pressure for the duration of the test.

Ultra-high Altitude Rocket Cell J-2(A) is actually a special liner installed in the ducting of another test cell in the Rocket Test Facility. It is made of a special steel which required highly refined welding techniques in its fabrication to prevent leaks. It is 10 m (32 ft) long and has an inside diameter of 5.5 m (18 ft).

The cell has some 500 penetrations to provide entry for leads to instrumentation, controls and power supply. Each penetration required precise fitting to prevent air from leaking into the cell, which would have caused a pressure rise in the cell.

Cryogenic pumping surfaces utilizing liquid nitrogen and helium, supplemented by diffusion pumps, were used to attain and maintain the extremely low pressure in the cell. (Source: AFSC news release)

RF DETECTION METHOD ASSURES HIGHER CIRCUIT RELIABILITY. A method for detecting potential electronic circuitry failures that elude even the most stringent conventional tests has been announced by Honeywell engineers. The method, called radio frequency fault detection, is based on the discovery that certain types of circuitry imperfections--types that heretofore have slipped through test procedures--consistently generate detectable rf noise.

Experiments with the method have proved successful in testing production components for F-104 flight control systems at the company's Aeronautical Division in Minneapolis. The concept will be applied to systems for Gemini and Apollo spacecraft later this year.

The rf fault detection test, which requires only about 2 min, can be applied to components, subsystems, or entire systems. Imperfections such as poor solder joints, improper junctions between dissimilar metals, and erratic semiconductors and vacuum tubes will generate an rf noise easily detectable at approximately 25 Mc on an rf receiver.

Such imperfections sometimes are not found until months after installation. Company spokesmen said that they have established statistically that conventional tests, such as X-ray examination, pass as perfect the same elements that rf detection proves faulty.

Radio frequency fault detection, in addition to providing significant improvement in product reliability, is relatively simple and inexpensive. According to company spokesmen, it can be accomplished by a semi-skilled technician operating readily available and uncomplicated test equipment. (Source: Minneapolis-Honeywell Regulator Company)

NEW SOUTHERN HEMISPHERE OBSERVATORY PLANNED. A major observatory is being planned for the Southern Hemisphere to aid astronomers in their researches of the southern celestial regions. A joint project of the Air Force Cambridge Research

Laboratories (AFCRL) and the National Science Foundation, the new observatory is to be located in Chile; a specific site has yet to be selected.

The new observatory will feature a 150-cm (60-in.) reflecting telescope with a Coude (fixed position) focus. Although two 188-cm (74-in.) telescopes are now located in the Southern Hemisphere, neither is completely satisfactory. Nevertheless, astronomers have been largely dependent on these telescopes, one in Australia and the other in South Africa, for observations of the southern sky.

Presently most favored as sites for the new observatory are one near Copiopo, Chile, at an elevation of 3100 m (10,200 ft), and one near Seruruna, Chile, at an elevation of 2250 m (7300 ft).

During the planning of the Southern Hemisphere observatory, most activity has been devoted to a site survey for best astronomical "seeing" qualities. Not only is the absence of atmospheric haze and clouds desirable, but also the absence of many other factors, including air turbulence, diurnal temperature changes, and terrain features. As a result of the extreme care used in selecting the site, the planned observatory will occupy one of the finest locations for astronomical seeing in the world. (Source: OAR Research Review (USAF))

EXTREMELY LOW OUTPUT IMPEDANCE POTENTIOMETER DEVELOPED. A new 10-ohm output impedance potentiometer for high performance servos, analog computers, and navigation and guidance systems has been developed by the Vernistat Division, Perkin-Elmer Corporation, Norwalk, Connecticut.

The new Size 11 unit (Model 446) ac potentiometer (Fig. 1), features extremely low output impedance combined with an input impedance of 4000 ohms. It is the second of a series of low output impedance ac potentiometers to be developed by the company. The low output impedance of the unit results in negligible loading error, making it ideally suited for driving small resolvers. Its low output impedance advantages are applicable to all potentiometer uses where high accuracy is required.

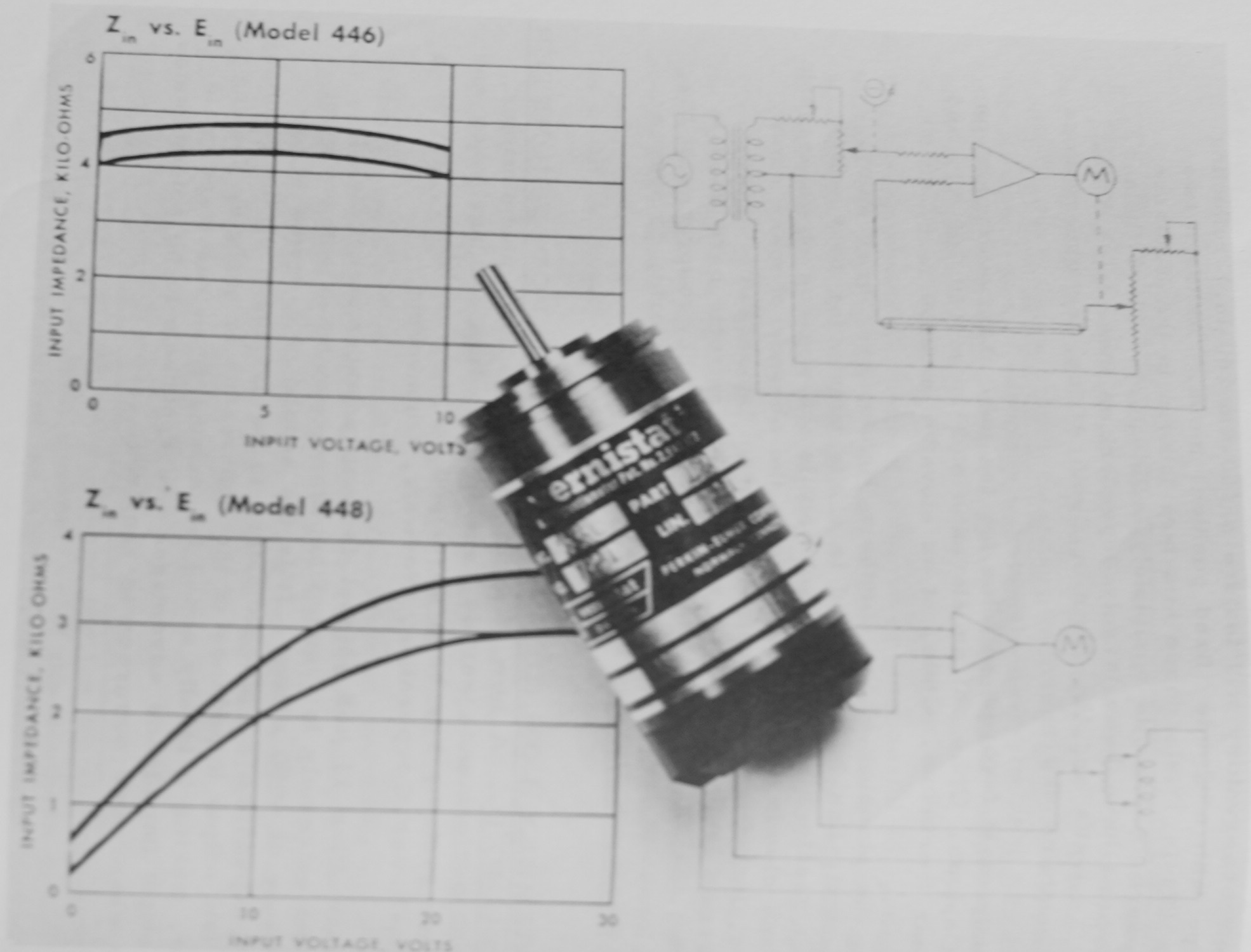
Z in vs. E in (Model 446)
INPUT IMPEDANCE, KILO-OHMS
INPUT VOLTAGE, VOLTS
Z in vs. E in (Model 448)
INPUT IMPEDANCE, KILO-OHMS
INPUT VOLTAGE, VOLTS

FIG. 1

Other electrical and mechanical characteristics include an absolute linearity of ±0.05 per cent, quadrature of only 0.01 mv/v, resolution of 0.013 per cent and continuous mechanical rotation with a 3600-deg (10-turns) electrical angle.

A companion unit, the Model 448 ac potentiometer, has a nominal input impedance of 3000 ohms with a nominal input-output impedance ratio of 300. Both models weigh 0.056 kg (2 oz). (Source: Data supplied by Perkin-Elmer Corporation)

REENTRY COMMUNICATIONS BLACKOUT BELIEVED SOLVED. Pilots of the X-20 (Dyna-Soar) orbiting glider will be able to maintain communications with the ground during the long reentry phase of their flights, RCA has announced.

This will be accomplished through the use of a new communications system that will use frequencies in the "super-high" (shf) range. These frequencies are expected to sustain telemetry communications for greater than 97 per cent of the reentry portion of the flight. This is in marked contrast to the total communications "black-out" that would occur if only the standard telemetry frequencies (vhf and uhf) were used. Vhf- and uhf-frequency "black-outs" are caused by reflections of the hot cloud of ionized air, called the ion sheath, that surrounds the glider during reentry. Super-high frequencies, on the other hand, actually penetrate this ion sheath.

One of the important research missions of the X-20 glider is to explore the high-speed, high-temperature region of flight where the ion sheath occurs. This ion sheath is created when the vehicle, travelling at near-orbital velocities, descends into the Earth's atmosphere.

The great maneuverability of the glider will allow it to descend into the atmosphere, and then to a landing, in a long glide covering thousands of kilometers. This long reentry time is in contrast to the rapid reentry of a non-gliding body such as a missile or a capsule.

The shf communications system will telemeter to Earth information concerning the glider's performance and the well-being of its pilot during reentry. It will also be used for the voice communications required during descent. (Source: Data supplied by Radio Corporation of America)

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. RADIATION EFFECTS ON ELECTRONIC COMPONENTS: AN ANNOTATED BIBLIOGRAPHY, W. L. Hollister. AD 277 840
2. THE EFFECT OF NUCLEAR RADIATION ON ELECTRONIC COMPONENTS, D. J. Hamman and others. PB 171 965
3. THE EFFECT OF NUCLEAR RADIATION ON SEMICONDUCTOR DEVICES, F. J. Reid. PB 171 964
4. THE EFFECT OF NUCLEAR RADIATION ON PROTECTIVE COATINGS, R. A. Mayer and others. PB 171 962
5. THE EFFECT OF NUCLEAR RADIATION ON ELASTOMERIC AND PLASTIC MATERIALS (FIRST ADDENDUM). PB 171 960
6. THE EFFECT OF NUCLEAR RADIATION ON LUBRICANTS AND HYDRAULIC FLUIDS, S. L. Cosgrove. PB 171 957
7. THE EFFECT OF NUCLEAR RADIATION ON ELASTOMERIC AND PLASTIC MATERIALS, N. J. Broadway and others. PB 171 956
8. THE EFFECT OF NUCLEAR RADIATION ON SILICONE ELASTOMERIC AND PLASTIC MATERIALS, R. Mayers and others. PB 171 967
9. THE EFFECT OF NUCLEAR RADIATION ON SEMICONDUCTOR MATERIALS (FIRST ADDENDUM), L. W. Aukerman. PB 171 955-1
10. THE EFFECT OF NUCLEAR RADIATION ON SEMICONDUCTOR MATERIALS, F. J. Reid and others. PB 171 955
11. FUTURE AIR FORCE REQUIREMENTS FOR HYDROCARBON FUELS, J. R. Fultz. AD 277 953