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AIR FORCE SYSTEMS COMMAND
Andrews AF Base, Washington 25, D.C.

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INTRODUCTION

The AFSC Reporting System. AFSC technical documentary reports (TDRs) are formal documents that describe fo permanent record the precise nature and results of research and development efforts and achievements. The technical documentary reporting system does not include, nor does this index list:

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Indexes - Past and Present. In the past, AFSC field organizations issued quarterly indexes to their technical documentary reports, and Headquarters AFSC consolidated the content of these in an annual command index. Beginning with TDRs distributed on and after 1 January 1962, the individual quarterly indexes and the command annual index were discontinued in favor of a command quarterly index.

The index contains only unclassified information, in order to permit wide distribution. Because of this, it has been necessary to omit titles or abstracts that reveal classified information.

User comments and suggestions for improvement of the index are welcome; they should be addressed to Air Force Systems Command (SCAXT), Andrews AFB, Washington 25, D. C. Use the same address in ordering copies of the index, changing the number of copies to be received on automatic distribution, etc.

Old and New Report Designators. For some years the command's reports were issued in two different categories. Technical notes (TNs) were used to document interim findings (progress reports, for example) and short-term projects. Technical reports (TRs) were used for overall documentation of technical efforts and the more important individual tasks. There exists at present a stage of transition during which this differentiation is being dropped in favor of identifying all such documents as technical documentary reports (TDRs). Until the changeover has been completed, a given index may include listings of all three types (TNs, TRs, TDRs). Index users should pay close attention to the designators TN-, TR-, and TDR-, particularly when ordering documents.

Use of Cross-References. Included in the rear of the index are various cross-references according to contract number, project number, and so on. Note that these cross-references refer the reader to an "item" number. For example, in the "Contract Number Cross-Reference" section, a listing for contract AF 40(600)-906 might refer the reader to Item No. 8-16. The figure 8 stands for Section 8 of the index - the section that lists the TDRs of the Arnold Engineering Development Center. The figure 16 is the serial number of the TDR. Thus, the entry "8-16" in a contract number cross-reference listing is the same as writing out "AEDC-TDR-62-16." Do not use item numbers for ordering copies of TDRs; use the completely written out TDR number.

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NOTE: In the sections devoted to the individual field activities of AFSC (Section 2, for instance), TDRs are listed in numerical order by the serial-number portion of the TDR number rather than by the calendar-year portion. Thus, ASD-TDR-62-25 would be listed before ASD-TDR-61-130.

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LIST OF ABBREVIATIONS

Abbreviations used in this index are explained below. This listing does not include abbreviations or symbols used within the titles or abstracts of technical documentary reports.

ASTIA   Armed Services Technical Information Agency, Arlington Hall Station, Arlington, Virginia

OTS   Office of Technical Services, Department of Commerce, Washington 25, D. C.

C   Contract number.

P   Project number.

T   Task number.

AD   ASTIA document number (ASTIA's catalog number for an AFSC document).

SRN   Secondary report number. An additional document number sometimes placed on the report, typically by a contractor for his own purposes of recordkeeping.

ARPA   Advanced Research Projects Agency.

Codes AA, GD, MD, NS, NC, XX - Explained in Introduction.

1—HEADQUARTERS, AIR FORCE SYSTEMS COMMAND
Andrews AF Base, Washington 25, D.C.

1-3

**AFSC-TDR-62-3. NATURAL ENVIRONMENTAL INFOR-
MATION REQUIRED TO SUPPORT MINUTEMAN
(WS 133B).** Oct 1962, 31p. incl illus. Hq AFSC, Office
of Staff Meteorologist, Andrews AFB, Wash., D.C. Jesse
B. Havard, Maj., USAF, and K. L. Pitchford, Capt.,
USAF. ASTIA: Code NC. **Secret**

This report describes the WS 133B, Improved MINUTE-
MAN, and the effects of meteorological parameters upon
it. It presents estimates of requirements for meteoro-
logical information to support test and operational phases.

2.-AERONAUTICAL SYSTEMS DIVISION
Wright-Patterson Air Force Base, Ohio

2-1a (Part II)

ASD-TR-62-1, Pt. II. THE PREPARATION OF ORGANO-METALLIC DERIVATIVES OF INORGANIC "BENZENOID" COMPOUNDS. Interim rpt, Mar 1962, 23p. incl tables. P: 7023, T: 73666. C: AF 33(616)-7124, Mass. Inst. of Technology. Dietmar Seyferth, Minoru Takamizawa, Hiroshi Yamazaki. Not in OTS. ASTIA: AD 276106, Code AA. Unclassified

Selected addition reactions of B-trivinyl-N-triphenyl-borazine were investigated. Addition of bromotrichloromethane, carbon tetrabromide, benzenethiol, hydrogen bromide, di-methylchlorosilane and methyldichlorosilane to this borazine is described. Phenyllithium cleaved this vinylborazine, giving triphenylborane and aniline. The first carbon-bridged bisborazine, 1,4-bis [B-bis(trimethylsilylmethyl)-N-trimethyl-(B)-borazyl] butane, has been prepared and its thermal and hydrolytic stability studied. The complete hydroboration of trimethylvinylsilane and allyltrimethylsilane, as well as partial hydroboration of the former, are described. Use of the boranes produced in borazine syntheses has been studied.

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2-3

ASD-TDR-62-3. BASIC RESEARCH AND DEVELOPMENT IN FLUID POWER CONTROL FOR THE UNITED STATES AIR FORCE. Ninth progress rpt, Jan 62, 66p. incl illus., 19 refs. P: 8226, T: 822604. C: AF 33(616)-6120. Mass. Inst. of Technology, Cambridge, Mass. Not in OTS. ASTIA: Code XX. Unclassified

This report describes continuing applied research and development work on problems vital to the design and development of high performance hydraulic and pneumatic control equipment for advanced systems. Increased emphasis on high pressure pneumatic components and systems reflects the approach to an ultimate objective of employing hot gas power to operate such systems. Control valves, servomotors, fluid power and signal transmission, and techniques of control are the major items discussed in this report. Transient and frequency response studies of a reaction jet servosystem are described, and recent work on experimental determination of windage losses of reaction jet servomotor rotors is described. Basic investigations of jet relay devices has proceeded with the study of input impedance of a first stage device, study of jet reattachment to a downstream wall, and attachment to a downstream obstruction such as a knife edge. A recently completed thesis on flow induced forces in hydraulic jet-pipe valves is also summarized. Recently completed papers and theses are also listed.

2-4a (Part II)

ASD-TR-61-4, Pt. II. RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STABLE ORGANO-PHOSPHORUS COMPOUNDS. Final rpt, May 1962, 179p. incl illus., tables, 193 refs. P: 7340, T: 734004. C: AF 33 (616)-7963. Hooker Chemical Corp., Niagra Falls, N.Y. C. F. Baranauckas, R. D. Carlson, E. E. Harris. Not in OTS. ASTIA: AD 282027, Code AA. Unclassified

A number of symmetrical and unsymmetrical triarylphosphine oxides and sulfides have been prepared, using in general, a Grignard Reaction. Thermal testing at 450°-500°C in sealed tubes has been carried out to measure the hydrocarbon(s) formed by thermal decomposition. The oxides are shown to be considerably more stable than the sulfides. The more stable compounds tested contain phenoxy or fluoro groups, in a para position. Certain heterocyclic systems, based on dibenzophosphole and phenoxaphosphine, show exceptionally good thermal stability, exhibiting less than 0.2%/hour decomposition at 500°C. Some conclusions as to decomposition mechanism and effect of ring substitution are advanced.

2-5 •

ASD-TDR-62-5. AN ANALYSIS OF AN INTEGRATED PHASE SHIFT OSCILLATOR. Interim report, June 61, 28p. incl illus., tables, 4 refs. P: 4159, T: 415904. C: AF 33(616)-7553. Electronics Research Lab., Univ. of Calif., Berkeley, Calif. G. Hachtel. Series No. 60, Issue No. 375. Not in OTS. ASTIA: AD 277374, Code AA. Unclassified

In this report, an integrated phase shift oscillator (abbreviated IPSOR) is introduced together with its analysis design. A restriction is made for an output which is a near harmonic oscillation. The analysis and design proceed on the basis of the equivalence of electronic action in the regions of the IPSOR to those in a lumped circuit model. From the analysis, the first order dependence of the output oscillation on the parameters of the IPSOR regions is established. Experimental observations with carefully chosen lumped circuits verify the analysis and design procedures.

2-9

ASD-TDR-62-9. ANALYSIS OF LASER MODULATION TECHNIQUES. Final rpt, June 1962, 112p. incl illus., tables. P: 4334, T: 433513. C: AF 33(616)-7869. Technical Rsch. Group, Inc., Syosset, L. I., N.Y. Not in OTS. ASTIA: AD 283462, Code AA. Unclassified

An investigation is made of suitable methods for applying a modulated signal to a LASER so that the output of the

2

LASER is an information modulated optical signal. Existing optical modulators are analyzed in terms of limitations on frequency, power-requirements, bandwidth, and suitability for use with LASERs. A general analysis is made of limitations on bandwidth due to power dissipation and a method of extending the bandwidth by the use of traveling wave structures is investigated. Finally, recommendations are made for the further development of high information capacity modulators, based on methods of using small volume modulators to minimize power dissipation. Two methods are suggested and analyzed in detail involving modulation using dielectric fibers and varying conditions for surface reflection.

2-9a

ASD-TR-61-9. SYNCHRONIZATION METHODS FOR PCM TELEMETRY. Final rpt, Aug 1962, 59p. incl illus., tables, 13 refs. P: 4107, T: 82188. C: AF MIPR 33 (616)-5929. Naval Ordnance Lab., Corona, Calif. NOLC rpt 542. In OTS. ASTIA: AD 286835, Code AA.
Unclassified

A specially coded synchronization pattern is required for proper identification of repetitive frames of pulse-code-modulated (PCM) sequences of binary bits. Study has shown that, with an assumed set of criteria, there are many favorable sync patterns. An efficient pattern is described on the basis of assumed criteria and hardware implementation at NOLC. This pattern is compared with sync patterns proposed by others. A recommendation is made that a maximum frame sync pattern of 33 bits be specified at present and the choice of optimal patterns be determined by future study.

Part I of the report summarizes the conclusions reached in the sync study at NOLC; Part II presents a detailed mathematical analysis, experimental results, and extensive diagrams.

2-10 (Part 2)

ASD-TDR-62-10, Pt. 2. BASIC STUDIES IN RADIATION EFFECTS ON MATERIALS: Ionic Fragmentation of Molecules by X-rays and Secondary Electron Spectra from Bombardment of Gas with Electrons. Final rpt, Jul. 1962, 67p. incl illus., tables, 9 refs. P: 7360, T: 736003. C: AF 33(616)-7678, William H. Johnston Lab., Inc., Baltimore, Md. M. Vestal et al. Not in OTS. ASTIA: AD 285564, Code AA. Unclassified

The combination of a coincidence mass spectrometer (patented) and a special x-ray tube which was described in Part 1, has made possible direct measurements of the ion fragmentation patterns produced by x-ray impact on simple gas phase molecules. Also measurements concerning the secondary electron energy distributions for N_2, propane, n-butane, 1, 3, butadiene, n-pentane, argon, and cyclohexane in radiation chemistry are given, at a fixed angle, using primary ionizing electrons in the energy range of 100 to 1000 ev. Theoretical interpreta-

tion of the data in terms of radiation chemical effects is included. Mass spectra are reported for nitrous oxide, and propane under bombardment by low energy x-rays; and spectra were also obtained of these materials under bombardment by 1200 ev primary electrons. The design, construction, and instrumentation, which has made these measurements possible, are described.

2-16a (Part II)

ASD-TR-61-16, Pt. II. MOLECULAR STRUCTURE AND PHYSICAL BEHAVIOR OF POLYMERS. Interim rpt, May 1962, 30p. incl illus., tables, 15 refs. P: 7342, T: 734202. C: AF 33(616)-6965. Univ. of Akron, Akron, Ohio. M. Morton, et al. Not in OTS. ASTIA: Code XX.
Unclassified

Model branched polymers have been prepared by the reaction of relatively monodisperse polystyryl lithium with silicon tetrachloride. A study of the dilute solution properties of the branched molecules has confirmed the theoretical development of the branching coefficient, g^1, by Zimm and Kilb. The second virial coefficient, A_2, has been found to decrease with increased branching. In addition, the Huggins constant, K^1, has been found to be a poor measure of branching in molecules. A study has been carried out on the effect of polymerization temperature and age of active anionic polystyrene on its molecular weight. Results to date have shown that, at least up to 70°C, neither polymerization temperature nor polymer aging (up to six weeks) has any appreciable effect on the polymer, as indicated by intrinsic viscosity measurements. Furthermore, analytical tests failed to detect the presence of equilibrium monomer at 70°C, at least down to 0.5% concentration, based on polymer. Stress relaxation measurements have been carried out at room temperature using vulcanizates of butyl rubber and natural rubber. Some measurements have also been made over a wide temperature range with vulcanizates prepared from fractionated butyl rubber.

2-21

ASD-TDR-62-21. MOLECULAR BANDPASS AMPLIFIERS. Final rpt, June 1962, 100p. incl illus., 24 refs. P: 4159, T: 415904. C: AF 33(616)-7252, Hughes Aircraft Co., Newport Beach, Calif. H. G. Dill, C. H. Fa, W. P. Waters. Not in OTS. ASTIA: AD 284413, Code AA. Unclassified

This report concerns investigations of the possibility of combining semiconductor inductive and negative resistance effects to give high Q inductances for fabricating a molecular bandpass amplifier. The initial approach of combining forward biased p-n junctions with tunnel diodes has proved to be completely unstable. The use of current stable negative resistances in combination with forward biased junctions gave no better results. The Q of the inductive diode is always much less than one and requires a high negative resistance which is difficult to match with the diode characteristics. However, a transistor in grounded base configuration with the collector

short-circuited was found to give suitable inductance with a Q near one at frequencies below the alpha cutoff. It was also found that a suitable negative resistance could be produced within the device itself using avalanche multiplication at the collector. Avalanche multiplication at voltages considerably below the breakdown gives stable, low noise operation. Devices were fabricated using high lifetime germanium for low frequency operation. Experimental measurements on these transistors have verified the theoretical analysis and have demonstrated good thermal stability. These transistors have been used to fabricate a stable bandpass amplifier with Q's as high as 45 at resonant frequencies in the region of 200 Kc.

2-22a

ASD-TR-61-22. POLYMER STRUCTURES AND PROPERTIES. Final rpt, July 1961, 108p., incl illus., tables. P: 7340, T: 73404. C: AF 33(616)-6968, Mellon Inst., Pittsburgh, Pa. E. F. Casassa, et al. Not in OTS. ASTIA: AD 276297, Code AA. Unclassified

Investigations relating to dilute solutions of polymers have comprised: a theoretical treatment of Rayleigh scattering to include both intramolecular and intermolecular optical interference effects; the temperature dependence of the second virial coefficient for polystyrene in cyclohexane; the intrinsic viscosity-molecular weight relation for poly-(vinyl acetate) in butanone; and design and construction of a precision light scattering photometer.

The melt viscosity - molecular weight relation at 218° for monodisperse polystyrene prepared anionically was found to be identical with that for ordinary fractions.

Poly-(vinyl acetate), prepared by an emulsion polymerization in the presence of a protein, yielded an insoluble component containing bound protein.

Preliminary stress-strain measurements on cross-linked swollen polyethylene gave only equivocal evidence for specific solvent effects on the unperturbed random-flight dimensions of the polymer chains.

2-26

ASD-TDR-62-26. ESTABLISHMENT OF THE APPROACH TO AND DEVELOPMENT OF INTERIM DESIGN CRITERIA FOR SONIC FATIGUE. Final rpt, June 1962, 154p. incl illus., tables, 46 refs. P: 1370, T: 137001. C: AF 33(616)-7694, North American Aviation, Inc., Los Angeles, Calif. G. E. Fitch, et al. In OTS. ASTIA: AD 284597, Code AA. Unclassified

A literature survey provided the background from which an approach was selected for development of design criteria for sonic fatigue. The approach selected was accelerated, discrete frequency life-testing, the results of which are interpreted using a sine-random equivalence analysis. This approach offers the best compromise between economy, accuracy, and lead time to cover struc-

tural design problems for advanced design, design development, and prooftesting of completed vehicle structure. Methods were extracted from the literature with which to predict the acoustic environment and determine the duration of various environments from mission analysis. Fatigue data and an examination of cumulative damage are presented in support of the sine-random equivalence technique. This method takes advantage of the extensive fatigue S-N data available in the industry. Examples of the application of the analytical-empirical techniques are presented.

2-30 (Part I)

ASD-TDR-62-30, Pt.I. MECHANISM OF CROSS-LINKING IN THE VULCANIZATION OF NEW ELASTOMERIC POLYMERS. Interim rpt, June 1962, 37p. incl illus., tables, 22 refs. P: 7342, T: 734202. C: AF 33(616)-7798. Wyandotte Chemicals Corp., Wyandotte, Mich. Kay L. Paciorek, et al. Not in OTS. ASTIA: AD 284890, Code AA. Unclassified

The objective of this program was the elucidation of the mechanism of the peroxide induced cross-linking of fluoroelastomers.

Several model compounds: 4,4-dihydroperfluoroheptane (V), 5,6-diperfluoroethyl-4,4,7,7-tetrahydroperfluorodecane (VI), and 3,4-diperfluoroethyl-2,2,5,5-tetrahydroperfluorohexane (VIII) were prepared. Interestingly, VI and VIII as well as 2,2,4,4-tetrahydro-3-perfluoroethyl-5-iodoperfluoroheptane (XIII) were resolved by gas chromatography into their respective diastereoisomers. Treatment of XIII with triethylamine or potassium hydroxide gave either the olefin (XVI) or the diene (XIV) depending on the conditions chosen. VI afforded different olefins depending on whether triethylamine or potassium hydroxide was employed.

Treatment of 4-hydroperfluoroheptene-3 (IV) and VIII with benzoyl peroxide failed to yield any interaction products.

The lowest curing temperature of the vinylidene-fluoride perfluoropropene (VF-PFP) copolymer-benzoyl peroxide magnesium oxide-system was found to be $\underline{ca}$. 100°C, whereas the optimum curing temperature was found to be 140-150°C. No physical test data could be obtained for the VF-PFP copolymer-benzoyl peroxide system, due to the spongy nature of the product.

2-33

ASD-TDR-62-33. THIN AND ULTRATHIN ARSENIC-DIFFUSED LAYERS IN GERMANIUM. Interim rpt, Nov 1961, 38p. incl illus., tables, 12 refs. P: 4159, T: 415904. C: AF 33(616)-7726, Solid-State Electronics Lab., Stanford Electronics Lab., Stanford, Calif. R. T. Moore. Technical rpt No. 1659-2. Not in OTS. ASTIA: AD 273783, Code AA. Unclassified

Techniques and results for the control of thin arsenic-diffused layers in germanium are discussed. Attempts to achieve a device with an ultrathin junction depth of 1500

A and a reverse breakdown of 5 v have led to improved methods of measuring thin-junction depths. Measurements of body-diffusion constant and equilibrium-surface concentration have been extended down to 500°C, and the effect of the surface on ultrathin layers is described. Finally, sectioning of ultrathin diffused layers in germanium is discussed, and results are compared with the optical measurements of the junction depth.

2-34

ASD-TDR-62-34. THE DEVELOPMENT OF IMPROVED TECHNIQUES FOR CURRENT PROBES. Final rpt, Mar 1962, 153p. incl illus., tables, 24 refs. P: 4357, T: 435703. C: AF 33(616)-7393, General Dynamics/Astronautics, San Diego, Calif. L. G. Clough. AE 60-0997-5. Not in OTS. ASTIA: AD 274215, Code AA. Unclassified

Improved and more versatile techniques for measuring interference currents were developed. Test techniques and calibration procedures for transformer-type current probes are described. Commercially available probes are evaluated for electrical characteristics and new probes were designed to extend reliable measurements to 1000 mc. Measurement reliability is described for detecting currents flowing in multiconductor harnesses; a probe was designed for use on harnesses up to 8 in. in diameter. Theoretical and experimental results are presented on effects of adding a probe to a line. Skin current probes and measurement techniques were developed including an investigation of Hall effect sensors as detecting elements.

2-35

ASD-TDR-62-35. A SURVEY OF TECHNIQUES FOR THE ANALYSIS OF SAMPLED-DATA SYSTEMS WITH A VARIABLE SAMPLING RATE. Interim rpt, Feb 1962, 28p. incl illus., 22 refs. P: 8225, T: 82181. C: AF 33(616)-7139. Dept. of Engineering, Univ. of Calif., Los Angeles, Calif. G. A. Bekey. Rpt No. 61-24. In OTS. ASTIA: AD 273348, Code AA. Unclassified

This report presents several techniques which can be used for the analysis of sampled-data systems with a non-constant sampling period. It is shown that the application of z-transform techniques is limited to cases where the sampling pattern repeats periodically. Several special cases, including the cyclically-varying sampling period and the "Skipped sample" problem are outlined. The most general methods available are based on a direct solution of the system difference equations. These equations, while time consuming to solve, do make possible the evaluation of transient response sample-by-sample. The advantages, limitations and possible extensions of the various methods are outlined. The report includes a number of simple examples and an extensive bibliography.

2-36

ASD-TDR-62-36. AN INVESTIGATION OF SAMPLED DATA MODELS OF THE HUMAN OPERATOR IN A

CONTROL SYSTEM. Final rpt, May 1962, 343p. incl illus., tables, 201 refs. P: 8225, T: 822501. C: AF 33 (616)-7139, Univ. of Calif., Los Angeles, Calif. G. A. Bekey. Rpt. No. 62-6. In OTS. ASTIA: AD 273347, Code AA. Unclassified

This report presents an analytical and experimental study of a new class of human operator models, based on discrete rather than continuous operations. The frequency characteristics of the sampled-data models are analyzed by means of z-transform techniques. The experimental program was based on measurement of the power spectral density of the tracking error and output with both continuous and intermittent displays. The proposed models are shown to be consistent both with the experimental results and with previous evidence on human tracking.

The implications of the new sampled-data models for the design of man-machine systems are discussed and a number of suggestions for extensions of this work are presented.

2-41

ASD-TDR-62-41. FLARE-OUT COMPUTER. Final rpt, Dec 1961, 47p. incl illus. P: 6190, T: 619004. C: AF 33(616)-8148, Link Division, General Precision, Inc., Binghamton, N.Y. George W. Jensen, Edward D. Vinson. Not in OTS. ASTIA: Code XX. Unclassified

This report pertains to a Flare-Out Study conducted in an ME-1 Flight Simulator using the analog technique of computation. This investigation is part of flight control approach and landing program.

Since a critical phase of approach and landing is flareout, this study has been conducted to promulgate knowledge that could lead to development of an optimum approach and landing flight control system.

Results of this study have developed some very interesting characteristics. It is recommended that these characteristics be further investigated through applied research in a higher performance type of simulator.

2-42

ASD-TDR-62-42. COMPACT POWER FUEL CELL. Final rpt, June 1962, 78p. incl illus., tables, 7 refs. P: 3145, T: 60813. C: AF 33(616)-7735, Monsanto Research Corp., Everett, Mass. J. O. Smith, et al. In OTS. ASTIA: AD 282862, Code AA. Unclassified

A fuel cell battery was built meeting the contract specifications, namely, generation of 15 watts at 5 amperes for 8 hours utilizing hydrazine ($5\underline{M}$ in $10\underline{M}$ KOH) as fuel and nitric acid ($10\underline{M}$) as oxidant. The battery consisted of 3 cells each having an electrode area of 120 cm². The open circuit voltage was 5.95 volts. Over the 8-hour period the total current was just over 5 amperes at an operating voltage of about 4 volts. The battery produced 35 watt-hours/pound. Pentaborane and hydrogen peroxide were

also tested as fuel and oxidant, respectively, with each other and with hydrazine and nitric acid.

2-43

ASD-TDR-62-43. DEVELOPMENT OF HIGH TEMPERATURE DESIGN CRITERIA FOR AIRCRAFT TIRES. Final rpt, July 1962, 71p. incl illus., tables. P: 1369, T: 136903. C: AF 33(616)-5711, United States Rubber Co., Detroit, Mich. J. M. Almand, J. G. Manchetti. Not in OTS. ASTIA: AD 287225, Code AA. Unclassified

Aircraft tires were constructed using radial steel plies constrained with circumferentially wound breakers and utilizing silicone as the elastomer. The tires were capable of performing at 200 mph after undergoing soaks at 350°F. Dynamic tests were conducted after soaks up to 450°F. Static hydroburst testing was conducted up to 513°F. The current limiting factor in the tire design is adhesion of the silicone to the wire cables of the breaker. Liner extrusion, sidewall cracking, and bead chafing which had been deficiencies of the silicone-steel tire in the past, have been resolved. Although the primary elastomers studied were the high temperature Siloxane polymers, a cursory investigation of other polymers with attractive high temperature characteristics, was conducted. A high temperature test wheel suitable for brake testing was supplied to ASD.

2-44

ASD-TDR-62-44. BASIC PRINCIPLES OF THE INDICIAL LIFTING-SURFACE FLUTTER-ANALYSIS PROCEDURE. Final rpt, May 1962, 38p. incl illus., tables, 2 refs. P: 1370, T: 137003. C: AF 33(616)-7420, Aerojet-General, Azusa, Calif. B. Mazelsky, H. B. Amey, Jr. In OTS. ASTIA: AD 282002, Code AA. Unclassified

A method of flutter analysis utilizing indicial functions to represent the unsteady aerodynamics is described. Basic concepts are illustrated for a two-dimensional wing; the extension to a span-wise distorting wing is also discussed. Significant aerodynamic parameters pertinent to a highly swept, hypersonic delta wing are reviewed. For these wings the principal factor for adequate prediction of flutter is determination of the steady and quasi-steady aerodynamic influence coefficients. The unsteady contributions are shown to have a negligible effect on the flutter characteristics.

2-45

ASD-TDR-62-45. DESIGNER'S CHECKLIST FOR IMPROVING MAINTAINABILITY. Final rpt, Feb 1962, 36p., 13 refs. P: 7184, T: 71586. C: AF 33(616)-6924, General Dynamics Corp., San Diego, Calif. Not in OTS. ASTIA: AD 275889, Code AA. Unclassified

Results of review of many sources of information on maintainability design are presented in checklist form for use by designers. "Do's" and "Don'ts" for designers are arranged in twelve general design categories which are, in turn, cross-referenced to specific design applications.

2-47

ASD-TDR-62-47. MULTIPLE-BEAM INTERFEROMETRY FOR SMALL-STEP MEASUREMENT. Final rpt, Nov 1961, 48p. incl illus., tables, 11 refs. P: 4159, T: 415904. C: AF 33(616)-7726, Solid-State Electronics Lab., Stanford Electronics Lab., Stanford Univ., Stanford, Calif. J. W. Beck. Technical rpt No. 1659-1. Not in OTS. ASTIA: AD 273455, Code AA. Unclassified

This thesis summarizes the material on multiple-beam interferometry, which is pertinent to the problem of measuring small steps (with an accuracy on the order of 50 Å) on opaque material which has poor reflection and absorption qualities.

Much of the work on surface effects of materials is microscopic in nature. In cases where surfaces of good smoothness and flatness are available, it is possible to measure surface-dimension changes that are microscopic in depth with the use of visible light and interference techniques.

Multiple-beam interferometry is a powerful (yet relatively inexpensive) measuring technique for measuring height and depth to within two orders of magnitude of atomic distances. With further cost and care it can be extended to within one order of magnitude of atomic distances. In exceptional cases measurements of crystal-latice spacings of two to three angstrom units have been made (Ref. 1).

A short review of the basic principles involved is included. Derivations of the fundamental equations are included as an appendix. The parameters that must be controlled, and their relationships to the accuracy of this technique, are considered.

2-50

ASD-TDR-62-50. A PARAMETRIC FLEET SCHEDULING MODEL AND ITS APPLICATION TO EVALUATION OF LOGISTICS CAPABILITIES OF TRANSPORT AIRCRAFT. Final rpt, May 1962, 68p. incl illus., tables, 10 refs. Cheryle C. Smith. ASTIA: AD 330105, Code AA. Secret

A parametric fleet scheduling model is described (programmed for UNIVAC), also its application to design evaluation, and to the logistics capability analysis of various transports in situations representing limited and general war. Advanced future transport aircraft, and new state-of-the-art designs are compared with possible "off-the-shelf" and existing designs in their ability to deploy a tonnage nearly equivalent to the weight of men and equipment in a Composite Air Strike Force. Advanced designs include Multi-Purpose Long-Endurance, (BLC), and supersonic configurations.

Trade-offs between total deployment time, deployment outbound distance, critical hop length, and fleet size are given in performance charts used to assess each aircraft's

ability to meet a variety of logistics requirements. These charts can identify the best combination of transport design characteristics from families of parametric data; they can also detect deficiencies in the existing fleet (on missions with and without island bases) and to determine which of the proposed designs can fill these deficiencies. Additional uses of the charts are discussed.

2-51

ASD-TDR-62-51. STUDY AND PRELIMINARY DESIGN OF AN ENERGY MANAGEMENT COMPUTER FOR WINGED VEHICLES. Final rpt, June 1962, 222p. incl illus., tables, 18 refs. P: 8226, T: 822602. C: AF 33(616)-7463. Bell Aerosystems Co., Div. of Bell Aerospace Corp., Buffalo, N.Y. R. W. Austin and J. M. Ryken. ASTIA: AD 331140, Code AA.   Confidential

This report presents final results of a study and preliminary design of an energy management system for winged reentry vehicles of the 1965-1970 period. This system will utilize a vehicle's maneuvering capabilities without exceeding restraint limits. It will function in modes ranging from automatic to manual where the pilot provides all inputs based on displayed information.

The airborne computer predicts future maneuver capability and future temperatures by solving Kepler and differential flight path equations. The use of inflight measured data for initial conditions and the facility for pilot adjustment of predictor parameters provides the system with an adaptive capability. An optimization loop tends to minimize total flight criticality.

2-60a (Part I)

ASD-TR-61-60, Pt. I. THEORETICAL PREDICTION OF PRESSURES IN HYPERSONIC FLOW WITH SPECIAL REFERENCE TO CONFIGURATIONS HAVING AT-TACHED LEADING-EDGE SHOCK: Theoretical Investigation. Final rpt, May 1962, 177p. incl illus., 68 refs. P: 8219, T: 82159. C: AF 33(616)-6400, Grumman Aircraft Engineering Corp., Bethpage, N.Y., Aeronautical Research Associates of Princeton, Princeton, N.J. R. A. Scheuing, W. D. Hayes, et al. Not in OTS. ASTIA: AD 282284, Code AA.   Unclassified

An investigation has been undertaken to develop theories for predicting pressures in hypersonic flows, with special reference to low-aspect-ratio, delta-winged configurations. This report is the first of four covering our work to date and is concerned primarily with the following theoretical developments which, for the most part, are directed at the treatment of sharp-leading-edge shapes:

1. Improvement of the shock-expansion method to account for wave reflections from the bow shock and from vorticity layers.

2. Initial development of rotational, linearized, conical flow theory for analysis of the flow over three-dimensional, quasi-planar configurations.

3. Extension of thin-shock-layer theory to conical shapes of smooth, but otherwise arbitrary, cross section.

4. Discussion of the flow about conical wing-body combinations having a sharp corner at the wing body juncture together with a description of a partially successful, semi-empirical solution for a flat-plate delta wing.

2-60a (Part II)

ASD-TR-61-60, Pt. II. THEORETICAL PREDICTION OF PRESSURES IN HYPERSONIC FLOW WITH SPECIAL REFERENCE TO CONFIGURATIONS HAVING AT-TACHED LEADING-EDGE SHOCK: Experimental Pressure Measurements at Mach 5 and 8. Final rpt, May 1962, 169p. incl illus., tables, 7 refs. P: 8219, T: 82159. C: AF 33(616)-6400, Grumman Aircraft Engineering Corp., Bethpage, N.Y. H. R. Mead and F. Koch. Not in OTS. ASTIA: AD 282301, Code AA.   Unclassified

This report presents the results of an experimental hypersonic research program specifically designed to support an investigation of new theoretical means for the prediction of pressures on attached-shock configurations at hypersonic speeds. An analysis of the data is presented by comparison with the thin-shock-layer theory and the improved shock-expansion theory developed in the analytical program as well as with some of the simplified methods in current favor such as Newtonian, tangent-wedge, equivalent-cone, and shock-expansion methods. It is shown that in appropriate applications the thin-shock-layer theory is superior to any of these simplified methods. However, test conditions did not duplicate those necessary for complete evaluation of the improved shock-expansion theory. In certain instances the influence of viscous phenomena on the results is discussed, especially with regard to the distinct wing-body combinations. A modified technique for taking vapor screen photographs developed in the course of these tests was found to be particularly helpful in this connection.

2-61

ASD-TDR-62-61. DIGITAL ADAPTIVE FLIGHT CONTROL SYSTEM. Final rpt, May 1962, 127p. incl illus., tables, 15 refs. P: 8225, T: 82181. C: AF 33(616)-7290, Sperry Phoenix Co., Div. of Sperry Rand Corp., Phoenix, Ariz. Dr. R. E. Andeen, P. P. Shipley. LJ-1262-0068. Not in OTS. ASTIA: AD 282880, Code AA.   Unclassified

The research carried out in this program indicates the feasibility of using statistical methods and sampled-data techniques as the basis for digital adaptive flight control of the aerospace vehicle. The adaptive control concept studied includes two main elements, (1) identification of the dynamics of the vehicle and (2) synthesis of a digital compensator to give desired closed-loop flight control performance. In the program a digital adaptive flight control system utilizing the identification and synthesis techniques was simulated on a digital computer and sub-

jected to tests representative of realistic operating conditions. The simulation tests include operation of the digital adaptive flight control system with an aerospace vehicle which underwent wide changes in environment and dynamic characteristics in the presence of both turbulence and realistic amounts of noise.

2-62a

ASD-TR-61-62. AN INVESTIGATION OF FLIGHT PHASE STRUCTURAL DESIGN CRITERIA FOR FLIGHT VEHICLES. Final rpt, June 1962, 130p. incl illus., tables, 55 refs. P: 1367, T: 13582. C: AF 33(616)-6938. McDonnell Aircraft Corp., St. Louis 66, Mo. J. D. Shepherd, et al. ASTIA: AD 331497, Code AA. Secret

The research program reported herein examined the entire field of flight vehicle structural loading environment for flight in the sensible atmosphere. In order to establish as broad a base as possible for the conclusions, the problem was approached through a basic data gathering program. This program involved both a survey of pertinent literature and an extensive survey of the missile industry. A major portion of the survey involved an effort to assemble a significant amount of flight measured structural data from past and current flight test programs.

Additional research is recommended where necessary to bolster the areas where the current understanding of flight vehicle structural loading environment is inadequate. Recommendations are given for a continuous data gathering and reporting program for the large vertically-rising vehicles. This program would assemble the necessary data to form a statistical basis for future reliability prediction approaches and serve as background for a continuous modernization and improvement of military flight vehicle procurement requirements.

2-63

ASD-TDR-62-63. HIGH TEMPERATURE ACCELEROMETERS AND THERMOMETERS FOR APPLICATION ABOARD RE-ENTRY VEHICLES. Final rpt, June 1962, 96p. incl illus., tables, and 49 refs. P: 1367, T: 136709. C: AF 33(616)-8105. Allied Research Associates, Inc., Boston, Mass. F. B. Sellers, et al. ARA-1017. Not in OTS. ASTIA: AD 285087, Code AA. Unclassified

The characteristics of accelerometers and thermometers that are required for suitable application aboard re-entry vehicles are described. In particular, it is noted that it may be necessary for these sensors to operate for at least 15-30 minutes at temperatures greater than 3000° F. The accelerometers should be capable of reading 100 G's.

Brief surveys of the fields of high temperature thermometry, accelerometry, and the high temperature materials used in those fields are presented. Positive experimental evidence is presented on the operational feasibility of a pyrolytic graphite type thermo-couple. A cantilever spring accelerometer for operation in the high temperature environment is discussed, and experimental evidence indicating the practical possibilities of the device is given.

2-67

ASD-TDR-62-67. NICKEL - CADMIUM BATTERIES. Final rpt, Apr 1962, 87p. incl illus., tables. P: 3145, T: 314510. C: AF 33(600)-41670, Gulton Industries, Inc., Metuchen, N.J. E. Kantner, A. E. Lyall, R. C. Shair. In OTS. ASTIA: AD 275983, Code AA. Unclassified

This report covers the second phase of a Research and Development program leading to long life, reliable, high watt-hours per pound, sealed nickel-cadmium batteries. Design considerations based on the battery operating requirements are discussed. Results of investigations to determine the optimum quantity of electrolyte to be added to a sealed cell for improved overcharge performance are presented. A number of separator materials have been tested at elevated temperatures to find one that would prolong the useful life of a sealed cell. Studies were made to learn about the reactions occurring at the negative electrode in an attempt to improve the overcharge characteristics of sealed nickel-cadmium cells. Cycle test results and a failure analysis on three different types of sealed cells are presented and discussed.

2-68

ASD-TDR-62-68. ALKALINE BATTERY EVALUATION. Interim rpt, Jan 1962, 102p. incl illus., tables, 5 refs. P: 3145, T: 314510. C: AF 33(616)-7529, Inland Testing Laboratories, Cook Electric Co., Dayton, Ohio. I. F. Luke, W. G. Ingling, and W. W. Clark. In OTS. ASTIA: AD 273688, Code AA. Unclassified

This report covers the first two periods of an alkaline battery applied research and failure analysis program. The purpose of this program is to establish a broad base of battery test data for use in the design of the electrical system of future space vehicles and to determine the actual failure mechanism of all new battery systems under varying environmental and cycle-life conditions so that improved space batteries can be developed. Another objective is to determine techniques and/or materials to prevent these failures while at the same time increase the usable watt-hours-per-pound capability and cycle life of the battery.

To date cycle-life tests have been conducted on one type of 12 ampere-hour, sealed nickel-cadmium cells in four temperature environments and four depths of discharge, in groups of 10 cells and in batteries of 20 cells.

Initial results in the program show that: (1) Cell cycle-life with shallow discharges is considerably longer than cycle-life at deep discharges and (2) Cycle-life is reduced by high and low ambient temperatures.

The program will include as future work an evaluation of silver-cadmium and silver-zinc type cells.

8

2-69

ASD-TDR-62-69. RESEARCH ON SOLAR-ENERGY CON-
VERSION EMPLOYING CADMIUM SULFIDE. Summary
rpt, June 1962, 73p. incl illus., tables, 25 refs. P: 3145,
T: 314508. C: AF 33(616)-7528, Harshaw Chem. Co.,
2240 Prospect Ave., Cleveland 15, Ohio. F. A. Shirland,
G. A. Wolff and J. D. Nixon. In OTS. ASTIA: AD
284032, Code AA.   Unclassified

Application of CdS to photovoltaic conversion has been
continued with primary emphasis on cells fabricated from
vacuum evaporated CdS films. Back wall CdS film cells
on conducting glass substrates have given efficiencies
up to 5% on small areas. Front wall CdS film cells on
molybdenum foil substrates have given efficiencies up to
2.5% on small areas and up to 1.0% on larger areas of
9 in^2. Thin lightweight arrays have been constructed
from the latter cells having power to weight ratios up to
10 watts per pound. Improvements promising increases
up to 30 to 40 watts per pound are discussed. Arrays of
CdS film cells of 1 square foot area have been construc-
ted. Fundamental investigations were initiated on the
growth, annealing, etching, and orientation of CdS single
crystals and films. The results were correlated with the
type of crystal imperfection and its probable influences
on electrical properties. The photovoltaic barrier was
studied experimentally to identify the essential con-
stituents and to improve the expected efficiency of
energy conversion. Theoretical models were postulated
for the mechanisms occurring in the CdS photovoltaic cell.

2-69a (Part I)

ASD-TR-61-69, Pt. I. MECHANISM OF FRACTURE OF
RIGID POLYMERS: Environmental Stress Cracking of
Polyethylene. Final rpt, May 1962, 38p. incl illus.,
tables, 24 refs. P: 7021, T: 73656. C: AF 33(616)-
6222, Polytechnic Inst., Brooklyn, N.Y. P. Hittmair, et
al. Not in OTS. AD 283117, Code AA.   Unclassified

The environmental stress cracking of polyethylene has
been studied under a variety of experimental conditions
in Section I of this report. The importance of polymer
crystallinity and molecular weight has been assessed.
Many of the variables such as thermal history of the
sample, temperature of measurement, surface tension of
the stress cracking agent, and magnitude of the stress,
have been treated. The importance of the testing pro-
cedure has been emphasized, as well as the relationship
of stress cracking in polymers to the same problem in
non-polymeric systems. Some microscopic studies of
stress cracking were also carried out. Section II de-
scribes the influence of radiation on the environmental
stress cracking of polyethylene. The polymer was ir-
radiated by cobalt 60 γ-rays and studied as a function of
a variety of experimental conditions. The deleterious
effects of oxygen were noted. In order to prevent oxida-
tion deterioration, the free radicals created had to be
terminated by a heat treatment in the absence of oxygen.

Some procedures were developed in which polyethylene
could be made resistant to environmental stress cracking.

2-70

ASD-TDR-62-70. DESIGN OF A DIGITALIZED SPEECH
COMPRESSION SYSTEM. Final rpt, Jan 1962, 232p. incl
illus., tables, 12 refs. P: 4335, T: 433519. C: AF 33
(600)-39962. Melpar, Inc., Falls Church, Va. D. M.
Early, et al. Not in OTS. ASTIA: AD 271616, Code AA.
                                                Unclassified

This report describes the improvement study, a growth
potential study, and a boundary value coding study,
covering the period from September 1959 through Novem-
ber 1961. The improvement study culminated in the
development of a breadboard formant tracking speech
bandwidth compression system capable of operation
through seven 20 cps analog channels for a total of 140
cps active bandwidth. This improved breadboard demon-
strated a PB word articulation of 81.8%, equivalent to
97% sentence intelligibility. Under the growth potential
study, an increase to approximately 85% PB word articula-
tion was accomplished. In addition, other theoretical and
experimental efforts, such as articulation and vocal
quality, were studied in an effort to determine the potential
growth of formant tracking speech compression systems.
The boundary value coding study covers a method of
optimum coding by operation on the analog parameters of
the compression system. It is expected that speech
transmission at under 300 bits per second is possible
with this technique.

2-77 (Vol I)

ASD-TDR-62-77, Vol I. A STUDY OF ENERGY MANAGE-
MENT TECHNIQUES FOR A HIGH-LIFT VEHICLE:
Study of Advanced Energy Management Techniques.
Final rpt, June 1962, 193p. incl illus., tables, 12 refs.
P: 8226, T: 822602. C: AF 33(616)-7936, General
Electric Co., Schenectady, N.Y. F. B. Bailey and R. R.
Duersch. Not in OTS. ASTIA: AD 283491, Code AA.
                                                Unclassified

This report describes the work undertaken to develop
advanced energy management techniques for a high-lift
re-entry vehicle.

In this study, advanced control theories of prediction
and optimization were used to synthesize a Dynamic
Energy Management Control System capable of performing
both nominal missions such as flights to a given destina-
tion and off-nominal missions such as alternate target
and exploratory flights.

The results of this study show that by use of these
advance control techniques, a flexible yet accurate
Energy Management Control System can be developed that
is capable of handling the re-entry of a high-lift vehicle
from initial orbit to a safe landing on the surface of the
earth for a number of different missions.

2-77 (Vol II)

ASD-TDR-62-77, Vol II. A STUDY OF ENERGY MANAGE-MENT TECHNIQUES FOR A HIGH LIFT VEHICLE: Manned Re-entry Study. Final rpt, June 1962, 95p. incl illus., tables, 5 refs. P: 8226, T: 822602. C: AF 33 (616)-7936. General Electric Co., Schenectady, N.Y. R. Horton. Not in OTS. ASTIA: AD 2C3492, Code AA.
Unclassified

This report describes the work undertaken to finalize the design of an energy management system that is capable of flying an unmanned or manned lifting vehicle from re-entry to the desired landing site.

The heart of the system is an airborne digital computer operating in conjunction with an inertial system. The inertial system continually provides the computer with the vehicle position, velocity, etc. The range and the cross range to the landing site are computed and then compared with the vehicle's nominal flight capability to generate range and cross range error signals. These error signals ultimately command vehicle attitude, flying the vehicle to the landing site. While the system operation is basically simple the refinements necessary for an operable system result in considerable added complexity. This study has evaluated this energy management concept to establish the particular merits of the system, its capabilities, and its limitations. The study was divided into a linear analysis phase and a system simulation phase. Each phase proceeded along conventional lines to achieve the desired end.

2-80

ASD-TDR-62-80. STUDY AND DEVELOPMENT OF A NON-FLOATED INERTIAL QUALITY GYROSCOPE. Final rpt, Feb 1962, 116p. incl illus., tables, 1 ref. P: 4431, T: 443101. C: AF 33(616)-6974, Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N.Y. E. Luber and M. Klemes. LA-4254-0187. In OTS. ASTIA: AD 273092, Code AA.
Unclassified

This report describes the design, development, and test of two small, non-floated, single-degree-of-freedom gyroscopes of inertial quality which employ a ROTORACE ® gimbal suspension. The report includes description of tests performed on these units which show that the following typical performance characteristics have been obtained: A random drift rate of $0.03°/hr$ rms, a g-sensitive drift rate of below $0.2°/hr/g$, and a g^2-sensitive drift rate of $0.03°/hr$.

2-89

ASD-TDR-62-89. ENERGY CONVERSION STUDY OF SEMICONDUCTOR ELECTRODES. Final rpt, Jun 1962, 35p. incl illus., tables. P: 3145, T: 314504-12. C: AF 33(616)-7939, Electro-Optical Systems, Inc., Pasadena, Calif. I. R. Tannenbaum. EOS rpt 1640-Final. In OTS. ASTIA: AD 282849, Code AA.
Unclassified

This work is of a preliminary nature to investigate the parameters of semiconductor electrodes. Four electrodes, lithiated nickel oxide, zinc oxide, anthracene, and phenanthrene have been studied.

Sample preparation is described, overvoltage, specific reaction rate constants, stoichiometric number, rate limiting steps, exchange currents and equilibrium potentials are determined, and the application of these data to fuel cell technology is discussed.

2-91

ASD-TDR-62-91. TEST DEVICE FOR THE DYNAMIC EVALUATION OF AIRCRAFT FUEL SYSTEM MATERIALS AND STRUCTURES. Final rpt, Jun 1962, 98p. incl illus., tables, 10 refs. P: 3048, T: 304801. C: AF 33(616)-7847, The Boeing Co., Wichita, Kans. L. G. Middleton. In OTS. ASTIA: AD 282915, Code AA.
Unclassified

A test device that is capable of simulating, on a small scale, the dynamic loads and environmental conditions present in actual aircraft integral fuel tanks, was successfully developed and tested. Sixteen integral test tanks were sealed with eight different sealing systems and evaluated on the dynamic test device. Five of the eight sealing systems were considered very satisfactory and judged equal in ability to provide a reliable sealing system. The remaining three systems (a fluorocarbon fillet sealed system and two structural adhesive systems) were considered unsatisfactory because there was excessive leakage.

The effects of a jet fuel anti-icing additive (Phillips Fuel Additive No. 55MB) on the sealing materials used in the test tanks and in laboratory control tests were also evaluated. The anti-icing additive was found to be compatible with all of the sealing materials tested.

2-92a (Part II)

ASD-TR-61-92, Pt. II. ORDERING IN OXIDE SOLID SO-LUTIONS. Interim rpt, Oct 1962, 10p. incl illus., table, 5 refs. P: 7350, T: 735001. C: AF 33(616)-6870, Clemson College, Clemson, S.C. H. H. Wilson. In OTS. ASTIA: Code XX.
Unclassified

A study was made of solid solutions of magnesium oxide with manganese, iron and cobalt oxides to determine the effect of extended heat treatment and of controlled furnace atmospheres on the formation of superlattices. Heat treatments involving temperatures up to $1350°C$. and times up to 600 hours were used. Furnace atmospheres were controlled so as to be either neutral, slightly oxidizing, or slightly reducing with respect to the divalent metallic ions.

Indications of ordering were found in those compositions that were heated in reducing atmospheres. A broad diffraction peak was found at $6.4 Å$ which is three times the (002) spacing of the unordered lattices.

2-95

ASD-TDR-62-95. DEVELOPMENT OF AN AIRCRAFT STATIC DISCHARGER TESTER. Summary rpt, May 1962, 50p. incl illus., tables, 8 refs. P: 4357, T: 435706. C: AF 33(616)-6561, Stanford Research Inst., Menlo Park, Calif. E. F. Vance, et al. SRN Tech rpt 1 of SRI, P: 2848. Not in OTS. ASTIA: AD 282056, Code AA.
Unclassified

A test jig for determining the electrical properties of aircraft static dischargers is described. It was demonstrated that the test jig accurately simulates the RF field about an airfoil so that the noise measured in the test jig is related to the noise produced by a discharger on an aircraft.

A number of dischargers of different types, both new and used, were tested in the test jig to determine their noise reduction. A test of discharge capability and certain environmental tests were also conducted to determine the quality of static dischargers presently available. Partly on the basis of these test results, recommendations were made for changes in military specification MIL-S-9129A (ASG).

2-95a

ASD-TR-61-95. STUDY OF DESIGN PARAMETERS FOR STRUCTURE SUBJECT TO AERODYNAMIC HEATING. Final rpt, Aug 1962, 164p. incl illus., tables, 29 refs. P: 1367, T: 13584. C: AF 33(616)-7277, Republic Aviation Corp., Farmingdale, L.I., N.Y. A. Epstein, A. F. Hamilton. SRN RAC-641-60(298). Not in OTS. ASTIA: AD 286454, Code AA.
Unclassified

This report discusses the various parameters that are significant in design of a structure subject to aerodynamic heating both for aircraft and for orbiting glide re-entry vehicles. These parameters include such items as load factor, speed, and time of exposure at any particular speed and load factor. Means for documenting these parameters, so that flight environmental criteria are adequately prescribed, are developed, and two examples illustrating use of this documentation are presented; one a 4M transport airplane, the other a manned orbiting glide re-entry vehicle. The suitability of the recommended parameters for use in structural design criteria specifications and for continuous cockpit display, as an indication of airframe flight limitations, is discussed with pertinent conclusions drawn. The feasibility of using flight simulators to identify critical flight environments from a structural point of view is also considered. The report includes comments received in the course of an Industry survey on the subjects of this study, and incorporates results from this survey in the final recommendations given for design parameters and documentation techniques.

2-99

ASD-TDR-62-99. EFFECTS OF SURFACE ENVIRONMENTS ON THE MECHANICAL BEHAVIOR OF METALS. Final rpt, Aug 1962, 50p. incl illus., tables, 17 refs. P:

7353, T: 735303. C: AF 33(616)-7976, The Martin Co. of Martin Marietta Corp., Baltimore, Md. I. R. Kramer. RR-28. In OTS. ASTIA: AD 285567, Code AA.
Unclassified

A study of the mechanical behavior of copper single crystals in solutions containing surface-active agents shows that the weakening effect is associated with the formation and solution of metallic soaps. A large change in the stress-strain characteristics of polycrystalline aluminum alloys was found when the surface of the specimens was removed during plastic deformation. Studies of the effect of size of the specimen on the changes of slopes of Stages I and II by surface removal showed that the change of the slope of Stage I was independent of size with respect to the polishing rate; however, the change in the slope of Stage II with polishing rate increased directly in proportion to surface area or cross section. A surface removal treatment on single crystals eliminated the yield point, whereas the same type of treatment enhanced the yield point drop on aluminum alloys. Measurements of slipband spacing indicate that surface treatment affects the egress of dislocations.

2-103

ADS-TDR-62-103. ELECTROSTATIC PROJECTION OF HIGH STRENGTH PARTICLES. Summary rpt, July 1962, 44p. incl illus., tables. C: AF 08(635)-2164, Space Technology Lab., Inc., Canoga Park, Calif. J. F. Friichtenicht. ASTIA: AD 331174, Code AA.
Confidential

This report describes a preliminary feasibility study of the charging problem for electrostatic projection of single small cylinders of high strength. This has the primary purpose of testing the validity of omission of strength of projectile materials from theories of hypervelocity impact, by comparison of independent data of high precision with that derived from explosive projection by others. Appropriate charge to mass ratios for moderate velocities were demonstrated and methods of increasing the ratios and velocities with a high probability of success were further pointed out for later efforts.

2-105a

ASD-TR-61-105. DESIGN AND RELIABILITY STUDY FOR A-C GENERATORS AND CONTROLS. Final rpt, Aug 1962, 224p. incl illus., tables, 48 refs. P: 3145, T: 61081. C: AF 33(616)-6871, Jack & Heintz, Inc., Cleveland, Ohio. F. M. Mueller, et al. Not in OTS. ASTIA: AD 286888, Code AA.
Unclassified

The purpose of this study was to develop design and test criteria for an A-C generator and the required associated controls. In contrast to generator systems which have been developed for other applications, the Type I generator system was required to operate at temperatures in excess of 600°F and also have a minimum life of one year. The study pointed out that considerable effort must be expended in the development of high temperature materials and components followed by a thorough evaluation of same

from the standpoint of life, failure modes, parameter drift and statistical failure distribution. Also, evidenced in this study was that the long life requirements generated another problem, a problem of demonstrating the theoretical reliability prediction for the generator system had been achieved through life tests. It was obvious that the conventional method of demonstrating reliability achievement was not applicable to this study as it was either impractical or uneconomical. The problem that evolved from this study indicated the need for a long range development program covering materials and components and also an investigation of methods that would reduce the time needed to demonstrate reliability achievement.

2-105b

ASD-TN-61-105.   LINEAR OPERATORS FOR DATA PROCESSING. Interim rpt, May 1962, 28p. incl illus., tables. P: 5227, T: 50932. C: AF 33(616)-7994, Military Physics Research Lab., The Univ. of Texas, Austin, Tex. R. E. Lane. In OTS. ASTIA: AD 278143, Code AA.
Unclassified

This note is designed to provide a summary of the procedures required in the application of linear operator theory to one aspect of systems analysis—namely, the treatment of experimental data, or data processing. Essentially, the procedures described here are generalizations of the procedures usually discussed under the title of numerical analysis of the calculus of differences; the generalization consists of revising the various formulas to include any of various kinds or degrees of smoothing in order to minimize the effects of chance fluctuations, experimental errors, etc., upon the functions which are taken to be representations of the behavior of a system.

General formulas are provided from which the user can obtain a wide variety of special formulas for smoothing, interpolating or extrapolating, differentiating, integrating, etc.; a table is given to simplify the use of the general formulas, and a variety of examples is included to illustrate how special formulas are obtained.

2-109

ASD-TDR-62-109. INVESTIGATION OF ION BEAM PROJECTORS. Fifth quarterly rpt, May 1962, 127p. incl 37 illus., 6 tables, 5 refs. P: 3805. C: AF 08(635)-1636, General Electric Co., Santa Barbara, Calif. ASTIA: AD 330224, Code AA.
Secret

The problems of the space based ion beam projector are pursued toward completion, with special emphasis on ion beam dynamics, dynamics of tactical engagements, and structural dynamics. The ion beam dynamics analysis is completed with a definition of beam flow requirements inside the accelerator.

2-110

ASD-TDR-62-110.   THE COLLAPSE MECHANICS OF PERIPHERALLY INITIATED EXPLOSIVES HAVING

LINED CAVITIES. Final rpt, July 1962, 112p. incl illus., 36 refs. P: 2858-9860. C: AF 08(635)-486, Denver Research Inst., Univ. of Denver, Denver, Colo. Marvin W. Burnham. ASTIA: AD 331164, Code AA.   Confidential

This report entitled "The Collapse Mechanics of Peripherally Initiated Explosives Having Lined Cavities" is concerned with the mathematical relationships which delineate the collapse of such charges. The specific charge geometries concerned were described in a previous report APGC-TR-61-15 (Project 9860) AD-322-013 ("Research on Explosive Shaped Charge Mechanisms" Denver Research Institute Summary Report 8 October 1960); experimental data had previously been obtained for these charges. Comparisons of the mathematical theory and the experimental results are made, and some postulated supplementary functions are tested.

2-111

ASD-TDR-62-111. RESEARCH ON FLUOROCHEMICALS. Final rpt, July 1962, 76p. incl illus., tables, 17 refs. P: 2858. C: AF 08(635)-2109, Denver Research Inst. Josef J. Schmidt-Collerus, Don N. Gray, Francis S. Bonomo. ASTIA: AD 331186, Code AA.   Confidential

This report presents the results of research conducted from 1 June 1961 to 31 August 1962 to study the synthesis of high-energy fluorochemicals. Several of the physical and chemical properties of the compounds synthesized were determined and are reported herein.

2-112

ASD-TDR-62-112. CATEGORY II IM-99B WEAPON SYSTEM DEVELOPMENT TEST AND EVALUATION. Final rpt, Sept 1962, 192p. incl illus., tables. P: 200A. ASTIA: AD 331984, Code AA.   Secret

This report presents the results of the Category II IM-99B Weapon System Development Test and Evaluation conducted during the period October 1960-May 1962. Testing was accomplished using the Joint Test Force concept. Using technical order procedures, seven Category II missiles were processed and launched during a Contractor Functional Demonstration; each item of equipment was demonstrated to prove the operational capability of the IM-99B tactical base, and to prove, validate, develop, and demonstrate tactical Inspection, Calibration, and Checkout, System Readiness Checks, and operational procedures. The remaining 13 missiles were processed using the procedures specified in technical orders, as augmented by Interim Maintenance Instructions, when necessary. Additional information about the equipment was gathered by conducting Special Tests. Indicated areas of interest for the Category III test include missile performance at the proposed modified cruise altitude the EC? 2200 Target Seeker configuration, and additional confidence testing of airframe stability.

2-112b

ASD-TN-61-112. THE LARGE AREA PN JUNCTION AS A THREE TERMINAL CIRCUIT ELEMENT. Interim rpt, June 1961, 27p. incl illus., 4 refs. P: 4159, T: 415904. C: AF 33(616)-7553, Electronics Research Lab., Univ. of Calif., Berkeley, California. G. Hachtel and L. O. Hill. Series No. 60, Issue No. 370. In OTS. ASTIA: AD 277371, Code AA.   Unclassified

A study of the large area pn junction as a passive, distributed, 3 terminal device is made in this report. The analysis assumes, as is common in the field, a direct analogy between electronic action in the large area pn junction and that in a distributed RC transmission line. Most previous work assumes that a uniform RC line is an adequate representation of the device. However, in typical integrated circuits, the dc voltage level at one end of the large area pn junction invariably differs from that at the other end.

The total dc reverse bias across the junction is not constant along the junction interface. This causes the depletion layer capacitance to be nonuniform along the interface. The analysis which follows takes this variation into account. It is shown that for a broad range of bias conditions, the uniform line representation does not introduce sufficient error to justify the more complicated description.

The analysis, valid for small excursions from the dc bias levels, used solutions of the transmission line equations to arrive at expressions for the terminal properties of the large area pn junction. A two dimensional analysis is used. It is based on the assumption of physically plausible dependence of the junction reverse bias (dc) on the distance along the junction interface. Short circuit admittance parameters are derived for the large area pn junction with functional dependence on the (small signal) excitation frequency and on the terminal bias voltages.

2-113

ASD-TDR-62-113, INVESTIGATION OF THE GENERATION AND PROJECTION OF HIGH-ENERGY SPHERICAL PLASMOIDS. Summary rpt, Oct 1962, 109p. incl illus., 23 refs. P: 3850. C: AF 08(635)-1958, Raytheon Co., Wayland, Mass. ASTIA: AD 332736, Code AA.   Confidential

This report discusses in detail the twelve-month effort of the investigation. A comprehensive theoretical discussion of the characteristics of the spherical plasmoid and its projection are delineated. Limited experimental methods and results are described.

2-114

ASD-TDR-62-114. INVESTIGATION OF ELECTROSTATIC PROJECTORS. Final rpt, Aug 1962, 66p. incl illus., tables, 26 refs. P: 3801, T: 38011. C: AF 08(635)-2030, Armour Research Foundation, Illinois Inst.

of Technology. J. L. Radnik. SRN: ARF Project E159. ASTIA: AD 331442, Code AA.   Confidential

This report discusses in detail the nine month effort of the investigation. Results of tests employing different methods of charging and an analysis of power supplies and multi-stage projectors are delineated.

2-115

ASD-TDR-62-115. SYNTHESIS AND EVALUATION OF HIGH-ENERGY ORIENTED POLYMERS. Final rpt., Aug 1962, 21p. incl tables, 32 refs. P: 2858, T: 285801. C: AF 08(635)-1938, Denver Research Inst., Univ. of Denver, Denver, Colo. Don N. Gray, Josef J. Schmidt-Collerus, Claibourne D. Smith. Not in OTS. ASTIA: AD 283263, Code AA.   Unclassified

In connection with a study of polymers containing high-energy groups, poly(2-nitro-2-methylpropyl methacrylate) was prepared in both the isotactic (m.p. above 300°C.) and the atactic (m.p. 280°C.) forms. Isotactic poly(2-nitro-2-methylpropyl methacrylate) was prepared by adding the monomer to a relatively large amount of toluene containing phenylmagnesium bromide as a catalyst. Atactic poly(2-nitro-2-methylpropyl methacrylate) was prepared by a conventional free radical-type polymerization using azobisisobutyronitrile. Similarly, isotactic poly(methyl methacrylate) (m.p. 140-160°C.) was prepared and compared with a commercially available sample of atactic poly(methyl methacrylate) (m.p. 120-125°C.) Contrary to previous observations that the isotactic form of a polymer had higher mechanical strength than the atactic form, atactic poly(methyl methacrylate) had a higher tensile strength than the isotactic modification.

2-116

ASD-TDR-62-116. ARMAMENT TRAINING AND TESTING. Final rpt, Nov 1962, 13 p. incl illus. P: 7826, T: 782606. C: AF 08(635)-2096, Lockheed Electronics Co., Military Systems, Plainfield, N.J. W. L. McCulloh. ASTIA: Code XX.   Unclassified

Armament training of interceptor pilots and the testing of air-to-air missiles often require the use of radar augmented towed targets such as the TDR-9/B. The interceptor aircraft approaching the mother plane-tow target combination acquires and locks-on to a target by radar. Since it is not always possible for the interceptor pilot to differentiate between the tow target and the towing aircraft, a hazardous condition may exist, due to angle of attack, closure rate, or visibility. To maintain a high degree of range safety, it would be most desirable that a definite, unmistakable indication of interceptor radar acquisition and lock-on to the tow target exists; and, that the interceptor missiles are fail-safe disarmed until such indication is obtained and maintained. The augmented radar return is amplitude modulated at 10 cycles per second in the tow-target and detected in the interception aircraft to obtain an unmistakable indication of target acquisition. This is accomplished by switching a

controlled current through the diode modulator inserted in series in the augmenter transmission line. The level of current determines the amount of R. F. attenuation, hence the percentage of modulation. In the interceptor, an output is taken from the radar receiver and fed to a 10 cps filter and amplifier. Presence of 10 cps detected modulation for at least 5 seconds is required before the ARMING indicator will light. The 5 second ARMING delay reduces to a minimum, accidental indication of lock-on to spurious signals or noise. The 10 cps filter prevents an ARMED condition in the event of acquisition and lock-on to a non-modulated target. Two final models of the range safety system have been fabricated and delivered to Eglin Air Force Base. Flight tests have shown that this system has performed satisfactorily in providing the safety features for which it is intended.

2-119a (Part II)

ASD-TR-61-119, Part II. RADIATION HEAT TRANSFER ANALYSIS FOR SPACE VEHICLES. Final rpt, 322p. incl illus., tables, 23 refs., Sept 1962. P: 6146, T: 614609. C: AF 33(616)-8323, North American Aviation Inc., S&ID, Downey, Calif. J. C. Grafton and H. L. Nordwall. SRN: SID 62-356. Not in OTS. ASTIA: Code XX.   Unclassified

Topics covered in this report include (1) An IBM program for determining temperatures of orbiting space vehicles due to variable internal heat loads, and incident thermal radiation from planets. (2) Discussion of three IBM general heat transfer programs for complete thermal analysis of vehicles. (3) The results of a thermal analysis of a typical space vehicle and laboratory verification of the analysis in a simulated space environment. (4) Configuration factor analysis included are discussions on computer programs, drawing board procedures, analytical techniques, and the radiation fact-o-graph, as methods for determining configuration factors. (5) Lunar temperature environment, operation of radiators on the moon and storage of cryogenic fluids beneath the lunar surface. (6) An appendix is included which tabulates absorptivities and emissivities for thermal control surface coatings.

2-136a

ASD-TR-61-136. POSTFAILURE BEHAVIOR OF AIRCRAFT LIFTING SURFACE STRUCTURES. Final rpt, June 1962, 204p. incl illus., tables, 23 refs. P: 1350, T: 14045. C: AF 33(616)-6804, Mass. Inst. of Technology, Cambridge, Mass. Richard D'Amato. Not in OTS. ASTIA: AD 284599, Code AA.   Unclassified

A brief outline of the dynamic analysis used for the prediction of lethal envelopes is given and the role of the present investigation in the general lethality problem is described. The postfailure behavior of builtup beam structures is discussed and a review is made of the preceding study of the analytical prediction of post-

failure structural behavior. Practical methods are outlined for computing the postfailure behavior of a wide range of beam structures, including sheet-stiffener-rib, multiweb, and full depth honeycomb, as well as combinations of these configurations. The equations developed are in a form that can be readily used in a dynamic analysis and they can be applied to complex deformation paths. Account is taken of the tensile cracking and low-cycle fatigue of the individual elements comprising the structure. An experimental investigation indicated that the theory is in good agreement with measured postfailure behavior. A dynamic analysis was formulated to determine the progression of failure through highly-redundant structures.

2-151

ASD-TDR-62-151. COHERENT SUB-MILLIMETER GENERATOR FEASIBILITY STUDY. Final rpt, Aug 1962, 140p. incl illus., 4 refs. P: 5237, T: 523701. C: AF 33(616)-7507, General Telephone and Electronics Lab., Inc., Bayside, N.Y. G. E. Weibel, H. O. Dressel, and S. M. Stone. TR 61-209.11. Not in OTS. ASTIA: AD 286885, Code AA.   Unclassified

Progress is reported on an experimental program aimed at demonstrating operation of the Tornadotron at wavelengths about one millimeter and shorter. Magnetic pulsing of the Tornadotron with fields up to 25 kilogauss and the monitoring of emitted radiation is described.

Work done in preparation of Tornadotron operation at 1 mm is then described. A Helmholtz coil designed for pulsed operation in the range of 100 kilogauss peak field has been designed, built, and tested to 30 kilogauss. The development of quasioptical systems, crystal detectors, and test and calibration sources for crystal detectors in the 1 mm range is described. The report is concluded with a summary of the status of the program and the planned experimental work.

2-151a (Part II)

ASD-TR-61-151, Part II. REFLECTIVE COATINGS ON POLYMERIC SUBSTRATES. Final rpt, July 1962, 101p. incl illus., tables. P: 7340, T: 734007. C: AF 33(616)-6980, Engineering Experiment Station, Georgia Inst. of Technology, Atlanta, Ga. R. B. Belser, M. D. Carithers. Not in OTS. ASTIA: AD 286836, Code AA.   Unclassified

Methods of overcoating metal surfaces with polymer coatings to provide a surface of high gloss plus reflective metal films for controlling the optical properties of a metal surface, were examined. Polymers of the species epoxy, polyurethane, or silicone were applied to stainless steel substrates and were overcoated with metal films of gold, silver, aluminum, copper, nickel, or combinations by chemical reduction or vacuum deposition techniques. The polymers and the metal films were examined for adherence, survival from 25 to 200°C, spectacular

reflectance and emittance at various temperatures. Reflectance values of metallic films evaporated or chemically deposited on polymeric substrates were generally equivalent and were equal to that obtained for similar metallic films on glass substrates.

2-152

ASD-TDR-62-152. ON DEVELOPING A LOW ALTITUDE TURBULENCE MODEL FOR AIRCRAFT GUST LOADS. Final rpt, June 1962, 59p. incl illus., table, 16 refs. P: 1367, T: 136702. C: AF 33(616)-7302, New York Univ., University Heights, N.Y. U. O. Lappe, J. Clodman. Not in OTS. ASTIA: AD 284467, Code AA. Unclassified

An analysis of B-66 low level turbulence data was conducted to determine spectral variance and spectral shape behavior with respect to four physical parameters: mean wind speed, atmospheric stability, terrain, and height. The basic approach to the gust load design problem was considered, along with some of the underlying assumptions necessary for developing a turbulence model. Also, some of the limitations of the B-66 program from the standpoint of the current project have been described. Based on the results described in this report, the feasibility of developing a design gust load procedure for low levels has been greatly improved.

2-153

ASD-TDR-62-153. APPLIED RESEARCH ON HIGH-THERMAL-CONDUCTIVITY MATERIALS FOR USE IN MICROWAVE TUBES. Final rpt, May 1962, 86p. incl illus., tables, 4 refs. P: 4156, T: 415603. C: AF 33(616)-7542, Electron Physics Lab., The Univ. of Michigan, Ann Arbor, Mich. H. K. Detweiler, C. L. Dolph, J. E. Rowe. Not in OTS. ASTIA: AD 282761, Code AA. Unclassified

This final report summarizes the theoretical analyses and experimental work on the problem of heat flow along a helix and the power handling capability of typical helix structures. In particular theoretical studies are presented for helix cooling by radiation, end conduction and conduction through a high-thermal-conductivity dielectric support. The average power handling ability of typical S-band radiation-cooled helices is limited to 100-200 watts whereas if the helix is conduction cooled through a beryllium oxide support structure it is shown that 10 kw average power can be handled with a helix temperature of 520°C. Complete experimental data on an S-band helix mounted in BeO indicates performance equivalent to that of a sapphire rod supported helix in a glass envelope. The power handling ability of a helix in BeO with a pressure contact between the helix and the BeO cylinder have indicated improvements of 15-20 times in average power handling ability for a given temperature. A figure of merit for high-thermal-conductivity low-loss materials to be used as r-f structure supports and as microwave

windows is presented and it is shown that BeO is far superior to aluminum oxide.

2-155 (Part I)

ASD-TDR-62-155, Part I. LIFT, PITCHING-MOMENT, AND ROLLING-MOMENT COEFFICIENTS ON PLANAR, TWISTED, AND CAMBERED WINGS AND FLAPS FOR A 70° DELTA WING: Supersonic Flow. Interim rpt, June 1962, 64p. incl illus., tables, 6 refs. P: 1370, T: 137003. C: AF 33(616)-7420, Aerojet-General Corp., Azusa, Calif. Bernard Mazelsky, Harry B. Amey, Jr. SRN: 2143. Not in CFS. ASTIA: AD 284874, Code AA. Unclassified

Wind-tunnel tests were performed at Mach numbers 3, 4, and 6 on a 70° delta wing with forward and tip flaps located at the 50% root chord and semispan respectively. The configurations tested included 20 different combinations of planar, cambered, and twisted panels to simulate various down-wash distributions. For the total wing and each flap, coefficients were evacuated for lift, pitching moment, rolling moment, drag, side force and yawing moment. Results will be used to obtain aerodynamic influence coefficients.

2-156

ASD-TDR-62-156. NONLINEAR AND THERMAL EFFECTS ON ELASTIC VIBRATIONS. Final rpt, June 1962, 143p. incl illus., tables, 12 refs. P: 1370, T: 137006. C: AF 33(616)-7898, The Boeing Co., Seattle 24, Wash. R. C. Weikel, et al. In OTS. ASTIA: AD 284441, Code AA. Unclassified

This report presents a theory and the digital procedures for predicting the effects of nonlinear structural behavior on the stresses, deformations, and small amplitude oscillations of a structure subjected simultaneously to loading and heating.

The method is used to analyze a thin wing to determine the frequencies and mode shapes of the first six natural vibration modes of the wing subjected to simultaneous heating and loading.

2-159 (Vol V)

ASD-TDR-62-159, Vol V. STUDY OF AERO SPACE EARLY WARNING AND CONTROL SYSTEMS: Theoretical Considerations of Laser Radiation: Resonant-Mode Structure of a Ruby Fabry-Perot Cavity. Final rpt, Jan 1962, 19p. incl illus., tables, 6 refs. P: 0(11-4122), T: 41228. C: AF 33(616)-7095, The Univ. of Chicago, Lab. for Applied Sciences, Chicago 37, Ill. Y. H. Pao, M. Resnikoff. LAS-TR-190-11. Not in OTS. ASTIA: AD 273529, Code AA. Unclassified

A theoretical investigation was made of the resonant mode structure of a solid-state ruby rod. When the excited modes are in the form of narrow bands, it is estimated that the emitted radiation may be used in light

radar applications for the determination of range and range-rate information.

2-159 (Vol VI)

ASD-TDR-62-159, Vol VI. STUDY OF AERO SPACE EARLY WARNING AND CONTROL SYSTEMS: Theoretical Considerations of Laser Radiation; A Quantum Mechanical Description of Stimulated Emission Within a Multimode Cavity. Final rpt, Jan 1962, 21p. incl illus., 11 refs. P: 0(11-4122), T: 41228. C: AF 33(616)-7095, The Univ. of Chicago, Lab. for Applied Sciences, Chicago 37, Ill. Y. H. Pao. LAS-TR-190-12. Not in OTS. ASTIA: AD 273530, Code AA. Unclassified

This paper consists of a theoretical discussion of maser action at optical frequencies with emphasis on the differences between stimulated emission and absorption in coherent and incoherent fields. Use is made of a geometrical representation of the equations of motion of the density matrix to illustrate the conditions for continuous wave operation, amplification, production of large pulses and for the appearance of relaxation oscillations.

2-159 (Vol VII)

ASD-TDR-62-159, Vol VII. STUDY OF AERO SPACE EARLY WARNING AND CONTROL SYSTEMS: Detection of Laser Radiation. Final rpt, Jan 1962, 37p. incl illus., 5 refs. P: 0(11-4122), T: 41228. C: AF 33(616)-7095, The Univ. of Chicago, Lab. for Applied Sciences, Chicago 37, Ill. V. J. Corcoran, Y. H. Pao. LAS-TR-190-13. Not in OTS. ASTIA: AD 273531, Code AA. Unclassified

A laser detection system, as any detection system, is limited in range capability by fluctuations in the output of the detector that tend to mask the signal to be detected. The photoelectric detection of light is limited primarily by two effects: (1) shot noise, fluctuations in the rate of electron emission from the photosurface associated with the average intensity of the incident radiation; (2) photon noise, fluctuations which reflect the intensity fluctuations of the incident light. Before the advent of laser radiation the shot noise was the predominant effect that limited photoelectric detection; however, in laser detection photon noise can be the salient effect. In this paper the magnitudes of the fluctuations in electron emission associated with photon noise and shot noise and the parameters affecting these magnitudes are determined. Also, the influences of these fluctuations on the probability of detection and the attainable range of a laser detection system are investigated.

2-159 (Vol VIII)

ASD-TDR-62-159, Vol VIII. STUDY OF AERO SPACE EARLY WARNING AND CONTROL SYSTEMS: A Lens System to Improve the Resolution at Infinity of a Small, Plane Wave Source. Final rpt, 26p. incl illus. P:

0(11-4122), T: 41228. C: AF 33(616)-7095, The Univ. of Chicago, Lab. for Applied Sciences, Chicago 37, Ill. I. Goroff and S. Torres. LAS-TR-190-14. Not in OTS. ASTIA: AD 271431, Code AA. Unclassified

An analytical investigation was made of the effect of a two-lens system on the light from a laser. The diverging first lens, being large compared to the laser source, enlarges, but only slightly changes, the diffraction pattern, while the converging second lens, being smaller, passes only the central collimated portion of the pattern. It was found that such a system will have a resolution almost as high as that of a laser the same size as the second lens. The requirements for an optical radar using such a system are also considered.

2-162

ASD-TDR-62-162. SULFUR DIOXIDE-SULFUR TRI-OXIDE REGENERATIVE FUEL CELL RESEARCH. Final rpt, June 1962, 27p. incl illus., table. P: 3145, T: 314506. C: AF 33(616)-7975, AiResearch Mfg. Co., Phoenix, Ari. E. L. Kumm. SY-5332-R. In OTS. ASTIA: AD 283336, Code AA. Unclassified

This report discusses the thermodynamics and electrolytic characteristics of an SO_2-SO_3 regenerative, closed-cycle fuel cell, and summarizes the electrolytic, electrochemical, and phase separation research conducted during a study program to determine the practicability of such a fuel cell. As discussed in the conclusion of this report, the experimental results obtained during the program were at such wide variance with the theoretical concept that it became apparent that a fuel cell of this type is not feasible.

2-167

ASD-TDR-62-167. HYPERSONIC FLOW THEORIES FOR PREDICTING PRESSURES ON BLUNT TWO-DIMENSIONAL AND ON CONICAL SHAPES. Final rpt, June 1962, 136p. incl illus., 49 refs. P: 8219, T: 821902. C: AF 33(616)-6400, Grumman Aircraft Engineering Corp., Bethpage, N.Y. R. A. Scheuing, W. D. Hayes, et al. Not in OTS. ASTIA: AD 282300, Code AA. Unclassified

An investigation has been undertaken to develop theories for predicting pressures in hypersonic flows, with special reference to low-aspect-ratio, delta-winged configurations. This report is the fourth of four covering our work to date and is concerned primarily with the following theoretical developments:

1. A relatively simple numerical procedure for determining the pressure distribution on two-dimensional wings with blunt leading edges, extending the shock-expansion method improvement of Ref. 1 to the case of strong vorticity layers.

2. The further development of the thin-shocklayer theory for conical flows given in Ref. 1, with emphasis on

uniformly valid zeroth-order solutions in the vicinity of entropy layer singularities.

3. Initial theoretical results extending Dorodnitsyn's method of integral relations to conical flows, including the expression of the gas dynamic equations in divergence form for a variety of coordinate systems.

2-171

ASD-TDR-62-171. INVESTIGATION OF PRESSURE DISTRIBUTIONS OVER PLANAR, TWISTED, AND CAMBERED WINGS IN A HYPERSONIC SHOCK TUNNEL. Final rpt, May 1962, 164p. incl illus., tables, 3 refs. P: 8219, T: 821901. C: AF 33(616)-6846., Grumman Aircraft Engineering Corp., Bethpage, N.Y. H. B. Hopkins, B. A. Scheuing, J. Leng. Not in OTS. ASTIA: AD 276895, Code AA. Unclassified

An experimental program was undertaken in the Grumman Hypersonic Shock Tunnel at nominal Mach numbers of 12 and 19 to measure the changes in the pressure distributions on two basic wing planforms due to distortions in their profile shape. The models included three rectangular planform wings with a flat profile, a circular-arc cambered profile, and a profile with symmetrical linear twist, and three 70° delta planform wings with a flat profile, a circular-arc cambered profile, and a sine-wave cambered profile. Angle of attack was varied from 0 to 15°. Data are presented in both tabular and graphical form.

Appended to this report is a description of the tunnel calibration procedures, and a description of the development of a Grumman-designed piezoelectric pressure transducer employed in obtaining the data.

2-174a

ASD-TR-61-174. NEW FLIGHT CONTROL SYSTEM TECHNIQUES FOR A HIGHLY ELASTIC BOOSTER. Final rpt, Dec 1961, 269p. incl illus., tables, 14 refs. P: 8226, T: 10889. C: AF 33(616)-7354. Minneapolis-Honeywell Regulator Co., Aeronautical Div., Minneapolis, Minn. L. T. Prince. MH Aero Rpt 2491-TR1. ASTIA: AD 328107, Code AA. Confidential

An automatic flight control system was develop I for a highly elastic booster. The system developed utilizes an adaptive gain control and rate gyro blending. An analog computer evaluation of the system was made using 609A (Scout) and Titan II vehicle configurations. The developed system is much more tolerant of variations in vehicle control characteristics than the conventional linear automatic flight control system.

2-181

ASD-TDR-62-181. INVESTIGATION OF THE EFFECT OF ULTRA-RAPID QUENCHING ON METALLIC SYSTEMS, INCLUDING BERYLLIUM ALLOYS. Final rpt, June 1962, 33p. incl illus., 9 refs. P: 7351-03. C: AF 33(616)-8011, Electro-Optical Systems, Inc., Pasadena,

Calif. C. Jordan. SRN: 1650-Final. In OTS. ASTIA: AD 284409, Code AA. Unclassified

The effect of ultra-rapid quenching on eight binary alloy systems, namely, Be-H, Be-O, Be-Al, Be-Si, Be-Sc, Be-Ni, Be-Cu, and Be-Zn, has been investigated. In four of the systems, namely, Be-H, Be-O, Be-Sc, and Be-Zn, attempts to carry out the necessary experiments were unsuccessful because of difficulties as to material or technique which could not be overcome within the scope of the contract. In the other four systems, the best experimental results obtainable indicate that no significant change of structure is produced by rapid quenching.

2-183

ASD-TDR-62-183. ANALYSIS OF A MONOPULSE RECEIVER UNDER JAMMING CONDITIONS. Final rpt, Apr 1962, 27p. incl illus., tables, 4 refs. P: 4700, T: 470002. R. L. North, 1st/Lt., USAF. ASTIA: AD 329995, Code AA. Secret

A mathematical analysis of a typical monopulse radar receiver when confronted with a new monopulse deception technique is presented. The equation relating the change in radar performance as a function of jamming is derived. Based on these mathematical results, a typical monopulse radar and penetrating vehicle are assumed and the ECM powers required are calculated.

A qualitative analysis of the advantages and disadvantages for this technique are discussed.

2-191

ASD-TDR-62-191. STUDY AND RESEARCH ON ELECTRONIC SIMULATION OF THE BIOLOGICAL CLOCK. Final rpt, May 1962, 81p. incl illus., tables, 19 refs. P: 4160, T: 416004. C: AF 33(616)-7677, The Univ. of Arizona, Tucson, Ariz. A. P. Sage, Jr., et al. In OTS. ASTIA: AD 282210, Code AA. Unclassified

The term "biological clock" has been given to the phenomenon displayed by organisms, both plants and animals, that pace their function in a cyclic fashion related in some way to environmental stimuli. The report begins with a general review of the literature on the biological aspects of light and temperature in relation to pacemaking. Both periodic and random shock effects, including the effects of periods different from twenty-four hours, are described. This data is translated into a general mathematical model for the biological clock. A hybrid (digital-analog) model for the biological clock is then proposed. The electronic model consists basically of a sequential logic circuit, an analog response computer, and an activity state control. The sequential logic circuit is the basic decision mechanism which determines the changes to be made in activity state on the basis of past and present activity states and external stimuli. The analog portion of the model is used to determine the exact amount of change to be made; while the activity

state control represents the present activity state and receives all command inputs for state changes.

2-192

ASD-TDR-62 192. INVESTIGATION, DEVELOPMENT, AND EVALUATION OF IMPROVED TECHNIQUES FOR MEASURING SUSCEPTIBILITY. Final rpt, Feb 1962, 306p. incl illus., tables, 7 refs. P: 4357, T: 435703. C: AF 33(616)-7436, General Dynamics/Astronautics, Div. of General Dynamics Corp., San Diego, Calif. AE62-0010. Not in OTS. ASTIA: AD 277927, Code AA.
Unclassified

The purpose of this program was to develop improved techniques for measuring susceptibility. Existing techniques were investigated with a view to improving the susceptibility test requirements of MIL-I-26600, "Military Specification Interference Control Requirements, Aeronautical Equipment." Audio and radio frequency, and conducted and radiated susceptibility tests were considered.

It was found that better control and standardization of test conditions could be achieved for more meaningful and repeatable test data. This was shown experimentally in all cases. The audio susceptibility test set was standardized by describing the characteristics of the isolation transformer and the impedance represented by the power supply terminals of the test sample. A rigorous magnetic susceptibility test at power frequencies was devised. Investigation of radio frequency conducted susceptibility tests determined that such tests are not significant above 300 mc, except in certain cases, and should generally be discontinued. Conversely, radiated susceptibility tests seem to be insignificant below 300 mc (are even misnamed since the field is not a radiated one), and should only be performed above 300 mc. For this purpose, broadband spiral logarithmic periodic antennas were designed and evaluated.

2-195

ASD-TDR-62-195. INVESTIGATION OF CRYOGENIC-SOLID COOLING TECHNIQUES. Final rpt, Aug 1962, 132p. incl illus., tables, 65 refs. P: 4077, T: 407703. C: AF 33(616)-8144, Aerojet-General Corp., Azusa, Calif. U. E. Gross, A. S. Friedman. SRN: 2127. Not in OTS. ASTIA: AD 286463, Code AA. Unclassified

The properties of gases, insulators, and fabrication of materials potentially suitable for use in the development of a mechanically simple, cryogenic-solid, cooling apparatus are tabulated and graphically illustrated. Cooling-system weights, volumes, and operating times were analyzed for various coolants (93 to 10°K). It was concluded that the concept of a solid cooling system is theoretically feasible, and the fabrication of a laboratory-model, cryogenic-solid, cooling system is recommended.

2-198a

ASD-TR 61-198. ADAPTIVE TECHNIQUES FOR LONG RANGE TRANSMISSION OF PULSE CODE MODULATION TELEMETRY DATA. Final rpt, Aug 1962, 253p. incl illus., tables, 28 refs. P: 4107, T: 82188. C: AF 33(616)-7488, Dynatronics, Inc., Orlando, Fla. D. H. Ellis et al. In OTS. ASTIA: Code XX. Unclassified

This report describes a study and development program involving the application of certain techniques for long range transmission of PCM telemetry data.

The objective of the program was to explore and develop those areas of PCM system design which most satisfactorily meet long range transmission and data handling requirements. The technical approach includes optimization of system information capacity, selection of an optimum R.F. link, and investigations of format compromises, to attain the maximum information rate possible over a wide range of transmission path lengths, and a variety of data requirements. The type of modulation (phase) for the R.F. link is shown by theoretical analysis to be superior to any other.

A system design and engineering model development program has been completed. Results of tests performed on the model verify the feasibility of the engineering design.

2-201

ASD-TDR-62-201. PROPERTIES OF PLASMA SPRAYED MATERIALS. Final rpt, June 1962, 93p. incl illus., tables, 8 refs. P: 7381, T: 738101. C: AF 33(616)-6376, General Electric Co., Evendale, Ohio. M. A. Levinstein. Not in OTS. ASTIA: AD 283967, Code AA.
Unclassified

A detailed investigation of the plasma spraying of tungsten and several refractory carbides was conducted in a controlled environment tank. Optimum parameters for the spraying of these materials were established. The refractory carbides included CbC, ZrC, HfC, TaC and several binary carbides. The spraying of mixed oxides was studied both in the controlled environment tank and in air. Various properties for these materials were determined as applicable: tensile strength, yield strength, elongation, transverse rupture strength, bending strength, bending ductility, melting point, density, crystallographic structure, chemistry, coefficient of expansion, specific heat, oxidation resistance, and microstructure. The feasibility of spraying in a controlled environment is evaluated.

2-205

ASD-TDR-62-205. THE ANALYSIS OF THE BASIC FACTORS INVOLVED IN THE PROTECTION OF TUNGSTEN AGAINST OXIDATION. Final rpt, June 1962, 97p. incl illus., tables, 116 refs. P: 7312, T: 731201. C: AF 33(616)-8175, General Telephone and

Electronics Labs., Inc., Bayside, N.Y. M. G. Nicholas, et al. Not in OTS. ASTIA: AD 281827, Code AA.
Unclassified

The objective of this first phase of the contract was to decide on the areas in which lack of basic information would be likely to hamper the development of oxidation-resistant coatings for tungsten at temperatures above 1850°C. It was concluded from a preliminary review that five phenomena, in addition to refractoriness, would determine the usefulness of a coating: the rate of vaporization, breakaway, diffusion paths in ternary oxygen-metal-metal systems, coating-substrate reactions, and the rate of diffusion-controlled film growth. A literature review on each of these phenomena and trial calculations of the protectiveness of a number of coating systems enabled a number of conclusions to be drawn as to the areas in which additional basic information was most needed.

2-208 (Vol I)

ASD-TDR-62-208, Vol. I. TECHNIQUES FOR ANALYSIS OF NONLINEAR ATTITUDE CONTROL SYSTEMS FOR SPACE VEHICLES: Characteristics of the Spacecraft Attitude Control Problem. Final rpt, June 1962, 90p. incl illus. P: 8219, T: 82165. C: AF 33(616)-7811, Space Technology Lab., Inc., Redondo Beach, Calif. E. I. Ergin, V. D. Norum, T. G. Windeknecht. 8982-6-001-RU-000. In OTS. ASTIA: AD 282705, Code AA.
Unclassified

This four volume report was prepared in order to compile, describe, and apply the available nonlinear analysis and design techniques for space vehicle attitude control systems and to outline additional areas of future effort to improve present analysis and design procedures. Each of the four volumes is relatively independent of the others. Volume I is a definition and description of the problems associated with the design of the space vehicle attitude control systems. Volume II treats in detail the principal techniques for the analysis of nonlinear control systems and shows the application of these techniques to specific attitude control system problems. Volume III discusses three general problems in space vehicle attitude control systems: (1) single axis on-off gas jet system design, (2) active attitude control system design for a spin-stabilized vehicle, and (3) the design of a control system for a satellite vehicle with reaction wheels and gas jets. Volume IV is a collection of references and bibliography with annotations and comments covering the spectrum of the study effort.

2-208 (Vol II)

ASD-TDR-62-208, Vol. II. TECHNIQUES FOR ANALYSIS OF NONLINEAR ATTITUDE CONTROL SYSTEMS FOR SPACE VEHICLES: Techniques for Analysis and Synthesis of Nonlinear Control Systems. Final rpt, June

1962, 302p. incl illus., tables. P: 8219, T: 82165. C: AF 33(616)-7811, Space Technology Lab., Inc., Redondo Beach, Calif. E. I. Ergin, V. D. Norum, T. G. Windeknecht. 8982-6-001-RU-000. In OTS. ASTIA: AD 282805, Code AA.
Unclassified

This four volume report was prepared in order to compile, describe, and apply the available nonlinear analysis and design techniques for space vehicle attitude control systems and to outline additional areas of future effort to improve present analysis and design procedures. Each of the four volumes is relatively independent of the others. Volume I is a definition and description of the problems associated with the design of the space vehicle attitude control systems. Volume II treats in detail the principal techniques for the analysis of nonlinear control systems and shows the application of these techniques to specific attitude control system problems. Volume III discusses three general problems in space vehicle attitude control systems: (1) single axis on-off gas jet system design, (2) active attitude control system design for a spin-stabilized vehicle, and (3) the design of control system for a satellite vehicle with reaction wheels and gas jets. Volume IV is a collection of references and bibliography with annotations and comments covering the spectrum of the study effort.

2-208 (Vol III)

ASD-TDR-62-208, Vol. III. TECHNIQUES FOR ANALYSIS OF NONLINEAR ATTITUDE CONTROL SYSTEMS FOR SPACE VEHICLES: Examples of Analytical Design of Spacecraft Attitude Control Systems. Final rpt, June 1962, 70p. incl illus. P: 8219, T: 82165. C: AF 33(616)-7811, Space Technology Lab., Inc., Redondo Beach, Calif. E. I. Ergin, V. D. Norum, T. G. Windeknecht. 8982-6-001-RU-000. In OTS. ASTIA: AD 282706, Code AA.
Unclassified

This four volume report was prepared in order to compile, describe, and apply the available nonlinear analysis and design techniques for space vehicle attitude control systems and to outline additional areas of future effort to improve present analysis and design procedures. Each of the four volumes is relatively independent of the others. Volume I is a definition and description of the problems associated with the design of the space vehicle attitude control systems. Volume II treats in detail the principal techniques for the analysis of nonlinear control systems and shows the application of these techniques to specific attitude control system problems. Volume III discusses three general problems in space vehicle attitude control systems: (1) single axis on-off gas jet system design, (2) active attitude control system design for a spin-stabilized vehicle, and (3) the design of control system for a satellite vehicle with reaction wheels and gas jets. Volume IV is a collection of references and bibliography with annotations and comments covering the spectrum of the study effort.

2-208 (Vol IV)

ASD-TDR-62-208, Vol. IV. TECHNIQUES FOR ANALY-SIS OF NONLINEAR ATTITUDE CONTROL SYSTEMS FOR SPACE VEHICLES: References and Bibliography. Final rpt, June 1962, 68p., 369 refs. P: 8219, T: 82165. C: AF 33(616)-7811, Space Technology Lab., Inc., Redondo Beach, Calif. E. I. Ergin, V. D. Norum, T. G. Windeknecht. 8982-6-001-RU-000. In OTS. ASTIA: AD 282057, Code AA. Unclassified

This four volume report was prepared in order to compile, describe, and apply the available nonlinear analysis and design techniques for space vehicle attitude control systems and to outline additional areas of future effort to improve present analysis and design procedures. Each of the four volumes is relatively independent of the others. Volume I is a definition and description of the problems associated with the design of the space vehicle attitude control systems. Volume II treats in detail the principal techniques for the analysis of nonlinear control systems and shows the application of these techniques to specific attitude control system problems. Volume III discusses three general problems in space vehicle atti-tude control systems: (1) single axis on-off gas jet sys-tem design, (2) active attitude control system design for a spin-stabilized vehicle, and (3) the design of control system for a satellite vehicle with reaction wheels and gas jets. Volume IV is a collection of references and bibliography with annotations and comments covering the spectrum of the study effort.

2-214

ASD-TDR-62-214. FLAT-PLATE SOLAR THERMO-ELECTRIC CONVERSION PANELS. Final rpt, May 1962, 47p. incl illus., tables, 3 refs. P: 8173, T: 817302. C: AF 33(616)-7676, General Atomic Div. of General Dynamics Corp., San Diego, Calif. A. N. Himle, et al. SRN: GA-2823. In OTS. ASTIA: AD 282213, Code AA. Unclassified

Procedures have been developed for the construction of a lightweight solar energy converter, using thermoelectric materials sandwiched between flat sheets of aluminum. Two panels, each one foot square, have been delivered to the Flight Accessories Laboratory, Aeronautical Sys-tems Division. Each panel contains 153 n-type PbTe elements and 153 p-type ZnSb elements, arranged in eighteen alternating rows of seventeen elements each. According to measurements made on test panels con-structed in a similar fashion, the delivered panels are capable of an output of at least 1.33 w/ft^2 when sub-jected to an incident energy of 1400 w/m^2, which is equal to the solar energy intensity at the Earth's dis-tance from the sun. At this output, the solar panel weighs 96 pounds per electrical kilowatt. The observed output is lower than is calculated from the properties of the materials used; however, it is anticipated that im-proved performance can be obtained in future panels.

2-215

ASD-TDR-62-215. THERMOPHYSICAL PROPERTIES OF THERMAL INSULATING MATERIALS. Final rpt, July 1962, 324p. incl illus.,tables. P: 7381, T: 738103. C: AF 33(616)-7875, Midwest Research Inst., Kansas City, Mo. C. E. Moeller et al. Not in OTS. ASTIA: AD 284446, Code AA. Unclassified

This report is a compilation of thermophysical property data for insulating materials, for both cryogenic and high temperature applications. Thermal conductivity, linear thermal expansion, specific heat, total emissivity, thermal diffusivity, and compressive strengths are p'.t'rd with respect to temperature. Density, melting point, con-tinuous service temperature, typical available form, and modulus of elasticity are given in tabular form. Material composition and methods by which the data were obtained are also included.

2-218a

ASD-TR-61-218. EXOTHERMIC BONDING OF METAL SANDWICH CONSTRUCTION BY THE "EXO-FLUX" TECHNIQUE. Final rpt, May 1962, 46p. incl illus., tables. P: 7340, T: 73402. C: AF 33(616)-7115, Narmco Research and Development, San Diego, Calif. W. Bassett, R. Caughey, R. A. Long. Not in OTS. ASTIA: AD 283378, Code AA. Unclassified

The objective of this program was to adapt the "exo-flux" overlap bonding process to metal sandwich panel bonding. The process provides a continuous metal bond between the core feet and the facing sheets, and consists of painting the metal surfaces to be bonded with approxi-mately .01 gm./sq. in. of inorganic fluxing agent, placing exo-thermically reactive tape against the opposing ex-ternal faces, subjecting the core-facing sheet contact area to 100 psi pressure and igniting the tape. The resulting bond exhibits no discernible interfacial dis-continuities at a magnification of 1000 diameters. After the most suitable materials were selected (i.e. PH 15-7 stainless steel base metal, B$_2$O$_3$ + cryolite flux, and a tape exotherm) and procedures determined, successful 3"x4" sandwich panel bonding was achieved, although reproducibility was poor. Bonding of 3"x8" sandwich panels was marginal, with very poor reproducibility and no panels with 100% of area bonded. The maximum strengths obtained were 184,000 psi in edgewise com-pression at room temperature, 85,000 psi in edgewise compression at 1000°F.

2-221

ASD-TDR-62-221. EVALUATION OF RADIANT HEAT FLUX AND TOXICITY IN DYNA-SOAR—TITAN II DESTRUCT TESTS. Final rpt, May 1962, 28p. incl illus., tables, 11 refs. 620A Systems. Bureau of Mines, Pittsburgh, Pa. J. C. Gibson, J. M. Murphy, D. Burgess. In OTS. ASTIA: AD 278607, Code AA. Unclassified

This report deals with activities of the Bureau of Mines in cooperation with two destruction tes*:s of scale models of the Titan II fuel tankage systems. Total quantities of propellant involved were 14,000 pounds for one test, and 32,000 pounds for the other, of the Aerozine-N_2O_4 combination used in this booster. The work was supplemental to a broader program of the Martin Company (Denver) and was restricted to providing information on three specific questions: (1) The completeness of reaction on putting together the hypergolic propellant combination; (2) the radiant heat flux from the reaction zone; and (3) the quantity and distribution of toxic vapors. No consideration is given, in this report, to the overpressure produced by the explosion. It is estimated that reaction was about 20 percent completed within a period of 5-7 seconds. Additional reaction ensued on the test pad and all residual fuel was consumed by burning in air. About half of the oxidant was dispersed unreacted and largely carried upward in the thermal column resulting from the explosion. The peak radiation levels from the explosions were about 109 watts.

2-230

ASD-TDR-62-230. DETERMINATION OF ENGINEERING PROPERTIES OF MAR-STRAINED STEELS. Final rpt, Aug 1962, 145p. incl illus., tables, 7 refs. P: 7381, T: 738103. C: AF 33(616)-7655, General Electric Co., Evendale, Ohio. R.E.Yount. In OTS. ASTIA: Code XX.
Unclassified

The Mar-Strain response (the addition of strain and aging to quenched and tempered steels) was determined for eight alloys representing four classes of steel: low alloy martensitics, secondary hardening martensitics (hot work die steels), semi-austenitic and martensitic stainless. All four alloy classes responded to the process by demonstrating yield strength increases of 10-20%. It was found that the tempered structure and strain hardening characteristics were the most significant factors controlling the Mar-St: in response. The alloys were selected for determir.ation of their engineering properties including uniaxial tensile, fatigue and center notch properties and biaxial performance in sub-scale cylinder tests. One alloy, Ladish D6AC (.46%C, 1%Cr, 1%Mo), was capable of being Mar-Strained to a 275,000 psi .2% yield strength. A second alloy, Modified S-5 (.48%C, 2%Si, .5%Mo, .25%V), was capable of being Mar-Strained to a 300,000 psi .2% yield strength. Mar-Straining was found to increase the fatigue strength of both alloys. The process was adequately demonstrated in the sub-scale pressure vessel tests. Burst strengths (greater than 350,000 psi hoop) achieved with the Mar-Strained S-5 cylinders were higher than any previously reported for a homogeneous material.

2-231

ASD-TDR-62-231. PHOTOEMISSION STUDIES. Final rpt, Mar 1962, 72p. incl illus., 56 refs. P: 4156, T: 41653.

C: AF 33(616)-6455,. Dept. of Electrical Engineering, Univ. of Minnesota, Minneapolis 14, Minn. Ed. by: W. T. Peria. In OTS. ASTIA: AD 274712, Code AA.
Unclassified

Experimental results dealing with the influence of Na overlayers on the photoemission and work functions of Ge and Si crystals are presented. For Ge a model is presented which predicts the observed dependence of photoelectric threshold on coverage. For Si the simultaneous measurement of photoelectric threshold and work function has allowed inferences regarding the source of photoelectrons in the surface region, and the nature and degree of surface band bending. Methods of preparing bulk Na_3Sb are discussed, and a glovebox facility required for further study is described. Progress on the study of Na_3Sb films is summarized, and a tube for film composition control is described. A calculation of the potential variation in the surface space-charge region of an intrinsic semiconductor is given.

2-232a

ASD-TR-61-232. DESIGN CRITERIA FOR BEARING SYSTEMS FOR USE IN HIGH TEMPERATURE AIRCRAFT ELECTRICAL ACCESSORIES PHASE III. Final rpt, May 1962, 78p. incl illus., tables, 7 refs. P: 8128, T: 13424. C: AF 33(616)-5766, General Electric Co., Schenectady, N.Y. P. Lewis. In OTS. ASTIA: AD 282852, Code AA.
Unclassified

A program is described which had as its objective the attainment of several cycles of operation including portions at 700°F and the simulated pressure of 80,000 feet. Major attention was given to grease packed bearing systems. The most successful performance was obtained with both an auxiliary grease supply and periodic injection of base fluid to the grease. A circulating grease system is described which shows promise for improved elevated temperature operation.

Some attention was given to the use of an oil lubricated system. This was not as promising as the grease system. Dry Operation is discussed, and preliminary data is presented.

2-234

ASD-TDR-62-234. INVESTIGATION OF THE USE OF ELECTROMAGNETIC REFLECTION TECHNIQUES FOR AIR DATA MEASUREMENTS AT HYPERSONIC VELOCITIES. Interim rpt, June 1962, 93p. incl illus., 14 refs. P: 8222, T: 82175. C: AF 33(616)-7764, Giannini Controls Corp., Duarte, Calif. J. R. Rochester. RTR-91. Not in OTS. ASTIA: AD 282214, Code AA.
Unclassified

Detailed information on the experimental work performed using electromagnetic reflection techniques for air data measurements at hypersonic velocities is presented. The primary objectives were: (1) By laboratory simulation determine that a prominent ionization change can be

introduced in a hypersonic ionized gas or plasma by magnetic pulse techniques, and (2) That these magnetic disturbances in a high velocity plasma flow can be sharply detected and monitored downstream by probing techniques. The objectives were achieved. The system in its various parts has been demonstrated. The results show the special characteristics of the individual components of the measurement system and determine the anticipated performances, limitations, problem areas, and specific research which will be needed to obtain design parameters of an operational aerodynamic measurement system.

2-235a

ASD-TR-61-235. OPTIMUM FATIGUE SPECTRA. Interim rpt, Apr 1962, 161p. incl illus., tables, 30 refs. P: 1367, T: 14025. C: AF 33(616)-6576; Douglas Aircraft Co., Inc., Long Beach, Calif. G. S. Neuls, et al. Not in OTS. ASTIA: AD 277807, Code AA.   Unclassified

A review of available data on many types of airplanes has been made to determine the fundamental parameters which define an environmental load spectra. Certain statistical phenomena occurring on different size airplanes required a new approach to the gust problem. A power spectral definition of taxiways was obtained which closely matches statistical measurements. Maneuvers and landings were analyzed and the parameters presented in a useful form. Operating altitude and velocity were compared with estimated mission requirements on specific aircraft. From the results of this report recommendations have been made that may be used in a specification for fatigue loads.

2-238

ASD-TDR-62-238. A BASIC INVESTIGATION OF CONTROLLABLE THRUST DEVICES FOR ESCAPE FROM SPACE VEHICLES: Propellant and Ignition Study. Interim rpt, Oct 1961, 48p. incl illus., tables, 30 refs. P: 1362, T: 13981. MIPR 33-616-60-17. Frankford Arsenal, U.S. Army Ordnance Corps, Philadelphia, Pa. C. W. Booz. FA Rpt R-1609. Not in OTS. ASTIA: Code XX.   Unclassified

This phase of the program which investigated controllable thrust devices for escape from space vehicles concentrated on the use of suitable liquid propellants and ignition methods in propellant actuated devices (PAD) to achieve start-stop, rate, and directional control.

The choice of propellants or propellant combinations for use in a particular design depends on many factors. Since most PAD devices are used in proximity to personnel, the selection of propellants should be made only after extensive tests have proven them to be reliable.

Bipropellant, monopropellant, and hybrid systems were evaluated for use in PAD. The pressurization and liquid transfer methods for these systems were kept very simple to insure greater reliability to the device. Thrust versus

volume flow rate of propellant combination, based on a number of impulse densities, was charted to determine approximate PAD sizes using liquid propellants. A number of ignition methods were studied in the light of anticipated effects of a space environment. In addition loading, assembly, and design techniques were discussed to point out safety precautions in addition to those required with solid propellants. Well known and unclassified propellant properties and combinations were tabulated.

2-239

ASD-TDR-62-239. FEASIBILITY STUDY FOR THE DESIGN AND DEVELOPMENT OF A LIQUID PROPELLANT ROCKET-ASSISTED CATAPULT. Final rpt, May 1962, 22p., 14 refs. P: 1362, T: 13605. C: AF MIPR 33-600-7-39B and 33-616-59-17, Frankford Arsenal, Philadelphia 37, Pa. H. D. MacDonald. FA Rpt M62-8-1. Not in OTS. ASTIA: AD 283363, Code AA. Unclassified

Frankford Arsenal was requested to investigate the feasibility of using liquid propellants in propellant actuated devices (PAD). The investigation was conducted in several phases, Phase I consisting of a literature survey and Phase II establishing the performance parameters. The project was terminated after completion of the first phase.

At the present time, solid propellants are used exclusively in PAD; however, it was felt that because liquid propellants are usually less sensitive to variation in temperature, they might offer some advantages over solids.

Liquid propellants were considered for several emergency escape systems, but attention in this study was directed primarily toward their use in a small rocket catapult of conventional M3 catapult size.

The results of this investigation indicate that the use of liquid propellants in propellant-actuated devices is feasible. A liquid propellant system currently used in an air-to-air rocket could be developed and used as a replacement for existing catapults.

2-240

ASD-TDR-62-240. ZERO GRAVITY SEPARATOR DEVELOPMENT FOR REGENERATIVE FUEL CELL. Final rpt, June 1962, 58p. incl illus., tables, 12 refs. P: 3145, T: 314506. C: AF 33(600)-42449, TAPCO, Div. of Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. A. J. Stromquist. ER-4741a. In OTS. ASTIA: AD 284474, Code AA.   Unclassified

The separators tested in project were designed to show variance in separation between ground operation (+1.0G) and zero gravity operation as simulated by KC135 aircraft flying zero gravity trajectory. These separators, when sufficiently developed, are to be used in conjunction with the regenerative fuel cell. Because of safety

precautions aboard aircraft, simulated fluids were used instead of actual fuel cell fluids. Although the liquid-gas separator was later successfully tested at zero G aboard C131 aircraft, contract limitations restrict scope of this report to ground test data and results taken prior to delivery of test rigs to ASD for zero G flight testing. Analysis of test results is presented as well as summary of theoretical single fluid analysis and two fluid analysis. Theoretical analysis was conducted concurrently with experimental development. Design procedure for zero G separators is outlined in conclusion of report.

2-241
ASD-TDR-62-241.   ELECTRODE DEVELOPMENT PRO-GRAM.   Final rpt, June 1962, 49p. incl illus., tables, 7 refs.   P: 3145, T: 314506.   C: AF 33(600)-42449, TAPCO, Div. of Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. S. S. Carlton. ER-4741b. In OTS. ASTIA: AD 284434, Code AA.   Unclassified

This report covers the third phase of a program relating to the development of a thermally-regenerative lithium hydrogen fuel cell. Emphasis is placed on improvement of the solid columbium hydrogen diffusion electrode and methods for improving its performance. Various procedures are examined for purification of the operating media and for testing their purity. An all-columbium fuel cell is described, and the result of a successful test run embodying the data developed during the purification studies is presented.

Data are included for the various test steps, and the information is analyzed and discussed.

2-242
ASD-TDR-62-242.   ANALYSIS OF A HIGH SPEED EN-CAPSULATED SEAT CREW ESCAPE SYSTEM FOR ZERO SPEED AND ZERO ALTITUDE CAPABILITY. Final rpt, Aug 1962, 593p. incl illus., tables, 16 refs. P: 1362, T: 136203.   C: AF 33(616)-7923, Weber Aircraft Corp., Burbank, Calif.   M. A. Rickards.   SRN: DR-5704. Not in OTS. ASTIA: AD 284455, Code AA.
                                                   Unclassified

The equations of motion for six degrees of freedom of a high speed encapsulated crew escape system were developed and formulated into the ASD analog computer.

Problem areas encountered were bad lateral response, beyond limits of human tolerance to acceleration at high speeds and adverse effects of ejector rocket thrust to c. g. misalignment at low speeds. Method of evaluating linear G loads for six degrees of freedom system is given. Recommended configuration required to meet 800 knots E.A.S. and zero-zero escape requirements features aerodynamic spoilers, generation of a lateral afterbody, the "self seeking" nozzle and the ballistic landing spike.

2-243
ASD-TDR-62-243.   INVESTIGATION OF STABILIZA-TION AND CONTROL SYSTEMS FOR APPLICATION TO AERO SPACE VEHICLE ESCAPE CAPSULES. Final rpt, June 1962, 196p. incl illus., tables, 38 refs. P: 1362, T: 136203.   C: AF 33(616)-8265, Vought Astronautics, Div. of Chance Vought Corp., Dallas, Texas. F. E. Chew, H. A. Clutz, L. Oling. Vought Astronautics Rpt 3-14000/2R11. Not in OTS. ASTIA: AD 284618, Code AA.   Unclassified

Previous studies have established that methods for stabilization and control of escape capsules for low orbital manned vehicles are necessary. In this study the stabilization and control system requirements, methods, and problem areas were established, and system designs for lifting and ballistic capsules were described. Study objectives were to establish the optimum design of a fully automatic system with manual backup which provides adequate escape capability with the minimum of complexity. Aerodynamic studies showed that attitude control outside the atmosphere, damping augmentation for all flight conditions, aerodynamic roll trim, and two position stabilizing surfaces are required for both capsule designs. The control systems selected for the two capsules were similar and contained a gyroscopic attitude reference corrected by infra-red horizon scanners, gyrocompassing and temperature sensors; hydrogen peroxide reaction jets to supply damping and attitude control moments; stabilizing flaps; and aerodynamic roll trim by center of gravity control. Some manual mode switching during the normal mission is used, thus reducing system complexity and allowing proper system functioning despite deviations from the planned mission profile; however, both systems are fully automatic upon separation from the parent vehicle. Significant problems were discovered in controlling the magnitude of oscillatory accelerations during escape at high dynamic pressure and in measurement of capsule yaw angle.

2-245
ASD-TDR-62-245.   RESEARCH ON IMPROVED SOLAR GENERATOR. Final rpt, Sept 1962, 141p. incl illus., tables, 37 refs. P: 3145, T: 314504. C: AF 33(616)-6612, Westinghouse Electric Corp., Youngwood, Pa. M. F. Amsterdam, et al. Not in OTS. ASTIA: Code XX.
                                                   Unclassified

Theoretical studies directed towards the achievement of high efficiency solar cells were undertaken. An entirely new method of p-n device analysis, referred to as the "flux method" was evolved. This yields solutions to problems which cannot be treated simply by diffusion calculations. Extensive studies were undertaken for material evaluation and the determination of optimum material parameters. Efficiencies in the order of 15% and 14% were obtained in the case of boron diffused Czochralski crystals and silicon dendrites respectively. This indicates that silicon webbed dendrites can yield as

efficient solar cells as Czochralski crystals; however, the availability of large area silicon webbed dendrites makes them extremely desirable. N+P solar cells using silicon crystal and phosphorus diffusion were prepared with efficiencies better than 10%.

2-247

ASD-TDR-62-247. RESEARCH AND DEVELOPMENT OF MICROWAVE MEMORY. Interim rpt, Apr 1962, 72p. incl illus., tables, 73 refs. P: 4040, T: 40402. C: AF 33(616)-8512, ITT Federal Labs., Div. of ITT, Nutley, N. J. L. M. Vallese. ASTIA: AD 328991, Code AA.
Secret

A background investigation of the state of the art of the techniques based on electromagnetic and electroacoustic delay lines, echo boxes, ionic transport phenomena, frequency synthesis and other more advanced techniques is developed. A comparative analysis is given with particular emphasis on the advantages presented by the latter techniques with reference to the realization of a Microwave Memory System. Details of the design principles of the selected techniques are discussed.

2-254

ASD-TDR-62-254. EVALUATION OF HYDROCARBON MATERIALS AS VAPORIZING FUELS. Final rpt, Aug 1962, 253p. incl illus., tables, 59 refs. P: 3048, T: 30195. C: AF 33(616)-7502, Esso Research and Engineering Co., Linden, N.J. K. C. Bachman, E. K. Matthews, D. Zudkevitch. SRN: RL-2LM-62. Not in OTS. ASTIA: AD 281898, Code AA. Unclassified

Theoretical and experimental data for determining which hydrocarbon types and structures are most promising for use as vaporizing fuels in Mach 3+ aircraft, are presented. Thirty-three hydrocarbons covering a broad range of types and structures were evaluated. The source, e.g. literature, laboratory measurement and correlation method (used also to extend data to 1000°F and 800 psia), of required physical property and thermodynamic data are presented. Calculated liquid and vapor heat transfer coefficients are provided. A heat exchanger designed to check the calculated coefficients, but which could not be made operable during the contract period, is described. Thermal cracking studies on sixteen hydrocarbons are described. Combustion studies in which vaporization was simulated by ultrasonically-produced fuel fogs are described for four hydrocarbons. The results show that condensed or uncondensed dicyclic naphthenes, specifically spiro(4.5)decane, hydrindan, and spiro(5.5)undecane, best fill ASD target requirements for a vaporizing fuel.

2-259

ASD-TDR-62-259. $\vec{J} \times \vec{B}$ MAGNETO-HYDRODYNAMIC (MHD) WORKING FLUIDS. Final rpt, Apr 1962, 71p. incl tables and illus. P: 3048, T: 304802. C: AF 33(616)-8173, Plasmadyne Corp., Santa Ana, Calif. M. C. Gour-

dine. SRN: FR 121-8173. In OTS. ASTIA: AD 278837, Code AA. Unclassified

A literature survey covering the three types of MHD propulsors (shunt, series, induction) is provided. A theory suitable for analyzing the performance of the steady $J \times B$ accelerator is developed. The performance of various working fluids is determined using the criterion of maximum propulsion efficiency. Two broad classes of working fluids are considered: equilibrium plasmas have the advantage of good performance without high temperature materials problems.

A conductivity of 170 mhos/m in argon has been experimentally produced and measured in a "ring" discharge at a pressure of 1 mm Hg with a power input approximately 1 kilowatt. A temperature of over 5,000°K is required to do this thermally.

2-260 (Part I)

ASD-TDR-62-260, Part I. REFRACTORY REINFORCEMENTS FOR ABLATIVE PLASTICS: Synthesis and Reaction Mechanisms of Fibrous Zirconium Nitride. Final rpt, June 1962, 46p. incl illus., tables. P: 7340, T: 734001. R. L. Hough. Not in OTS. ASTIA: Code XX.
Unclassified

The need for improved fibrous materials to reinforce ablative plastics used in high shear force environments has precipitated consideration of metal carbides, borides, and nitrides because of their high melting temperature, high degree of hardness, low density, moderate strength, and resistence to chemical attack. In this report, the synthesis of zirconium nitride filaments was successfully accomplished by the reaction of electrically heated zirconium wires with gaseous nitrogen. Diffusion kinetics of the reaction were examined theoretically and experimentally, and the diffusion-controlled synthesis technique developed is superior to conventional vapor plating for obtaining chemically pure filaments of small diameter. Low-melting eutectic phases in the filaments and their subsequent withdrawal by a helictitic growth process were also studied.

2-260a (Part I, Vol II)

ASD-TR-61-260, Part I, Vol II. THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS: Bibliography of Coded References. Final rpt, May 1963, 303p. P: 7350 and 7381, T: 73500 and 73812. C: AF 33(616)-7327, Avco Corp., Wilmington, Mass. S. L. Bender, et al. SRN: RAD-TR-61-12. Not in OTS. ASTIA: AD 278633, Code AA. Unclassified

A theoretical and experimental study over the temperature range from 298.15° to 6000°K was made of the thermodynamics of oxides, borides, carbides, and nitrides of the metals in groups IVB, VB, VIB, and VIIB of the Periodic Chart in addition to silicon, boron, scandium, beryllium, magnesium, calcium, strontium, and osmium.

2-263

ASD-TDR-62-263. SYNTHESIS AND REACTIONS OF 2,2'-DIHALODIPHENYLAMINE. May 1962, 26p. incl illus., 12 refs. P: 7340, T: 73408. Christ Tamberski, George Baum, Helen Lloyd. Not in OTS. ASTIA: AD 284349, Code AA.   Unclassified

The preparation and reactions of 2,2'-dihalodiphenylamine have been investigated. The dihalodiphenylamine, where the halogen is chlorine or bromine, has been prepared via the Chapman rearrangement. The resulting secondary amines were alkylated successfully to the tertiary amines. The ability of converting the halogens of the tertiary amines to a reactive organometallic, Grignard or lithium derivative, has been studied. The resulting diorganometallic intermediates were reacted with carbon dioxide, diphenylphosphorus chloride and, phenylphosphorus dichloride to yield N-alkyl-2,2'-dicarboxydiphenylamine,   N-alkyl-2-diphenylphosphino-diphenylamine and N-alkyl-2, 2'-bisdiphenylphosphino-diphenylamine, and 5-alkyl-10-phenyl-5, 10-dihydropheno-phosphazine.   The last compound represents a new nitrogen-phosphorous heterocyclic structure which will be evaluated as an anti-oxidant and lubricity additive for high temperature operating engine oils.

2-268

ASD-TDR-62-268.   HIGH   TEMPERATURE   (-40° to +550°F AMBIENT) POWER TRANSMISSION FLUID. Final rpt, July 1962, 23p. incl illus., tables, 7 refs. P: 3044, T: 304405. Harold W. Adams. Not in OTS. ASTIA: AD 285812, Code AA.   Unclassified

The derivation of a power transmission fluid formulation suitable for use over an ambient temperature range of -40° to +550° to +600°F was the object of this project. Research and development techniques, background information, laboratory data influencing the formulation, and pump test data are presented and discussed.

The work described herein led to the selection of a fluid formulation based on a superrefined, deep dewaxed, paraffinic mineral oil as a suitable power transmission fluid for use over the -40° to +550°F temperature range. The fluid formulations mentioned in this report are limited to nonoxidizing environments in the +450° to +600°F range; however, they have good oxidative stability at +350°F and below.

2-269

ASD-TDR-62-269. SUPERCONDUCTIVITY IN METALS AND ALLOYS. Interim rpt, Aug 1962, 86p. incl illus., tables.   P: 7371, T: 737102.   C: AF 33(616)-6405, RCA Lab., Princeton, N.J. W. H. Cherry, et al. In OTS. ASTIA: AD 286456, Code AA.   Unclassified

Methods have been developed for the measurement of the interphase energy in superconductors. A description of the method is given along with preliminary results on thin foils and films of tin. Measurements have been

made of the thermal contact resistance (Kapitza resistance) between various solids and liquid helium. These measurements have been made in the normal and superconducting states for lead, tin, and indium, and for the insulator sapphire. Measurements have been made of the transition temperatures in the system (Nb, Ta, V)$_3$Sn. The transition temperatures range from 2.8°K to 18°K and can be related to a simple mass and volume dependence. A new method of preparation of Nb$_3$Sn has been developed, and is described in detail. With this method it is possible to prepare crystalline Nb$_3$Sn and to deposit films of Nb$_3$Sn in various geometries. The application of this technique to the continuous deposition of Nb$_3$Sn on wire is described, and some superconducting properties of this wire are given. Alloying experiments have been made and results indicate ambiguities in the electron-to-atom ratio ascribed to various elements. Resistance measurements on sintered and non-sintered specimens of Nb$_3$Sn reveal a resistance anomaly near 100°K.

2-270

ASD-TDR-62-270.   TESTS TO DETERMINE SUBSONIC PRESSURES, FORCES, AND MOMENTS ACTING ON A HYPERSONIC   RE-ENTRY   CONFIGURATION.   Final rpt, Aug 1962, 324p. incl illus., tables, 6 refs. P: 1366, T: 136604.   C: AF 33(616)-7832, Lockheed California Co.-Lockheed Aircraft Corp., Burbank, Calif. K. Mantz, D. B. Seager. LFL-L-11. ASTIA: AD 332696, Code AA.
                                       Confidential

This report presents the results of wind tunnel tests of a hypersonic re-entry configuration conducted at low subsonic Mach numbers and free stream Reynolds numbers ranging from 2.6 x 10^6 to 5.1 to 10^6 based on MAC. The model tested is geometrically similar to D-5 built and tested at high speeds under Contract AF 33(616)-6659, but is larger and instrumented so that surface pressures as well as aerodynamic forces and moments could be measured.   Six component aerodynamic data, pressure distributions over the wing, and base pressures were measured at angles of attack from -4° to +30° and angles of yaw from -15° to +15°. Effect of vertical surfaces mounted outboard on the wing on both longitudinal and lateral-directional data was investigated, and the model was tested at various attitudes in the presence of a ground plane. Reynolds number was varied systematically, and tests evaluating the effects of forced transition were conducted. Tufts were used throughout the program to provide a detailed picture of the boundary layer flow.

2-271

ASD-TDR-62-271.   AN INVESTIGATION OF THE SUB-SONIC AERODYNAMIC CHARACTERISTICS AND THE LANDING FLARE MANEUVER FOR HYPERSONIC RE-ENTRY CONFIGURATIONS. Final rpt, Aug 1962, 237p. incl illus., tables, 171 refs.   P: 1366, T: 136604. C: AF 33(616)-7832, Lockheed California Co.-Lockheed

Aircraft Corp., Burbank, Calif. D. B. Seager, J. E.
Mayer. LR 15693. ASTIA: Code XX.   Confidential

Results of study of landing problems of advanced flight
vehicles are presented. Included are:

1. Procedures for estimating low speed lift, drag, and
pitching moment. This material applies primarily to delta
and near-delta planforms with portion applicable to other
configurations.

2. Generalized flare data developed on the basis of
X-15 flight test results. The effects of extending flaps
and/or gear or using propulsive thrust are analyzed, and
an improved method for calculating pertinent flare charac-
teristics is presented.

3. Summary data obtained from two low-speed wind-
tunnel test programs conducted as part of this investiga-
tion. The first evaluated the effects of systematical
geometrical variations by testing 23 high speed con-
figurations, and the second measured forces, moments,
and pressures on a thick, round leading edge delta wing.

2-274

ASD-TDR-62-274. ALTITUDE CHAMBER CONVERSION
PLAN TECHNICAL REPORT AND DESIGN SPECIFICA-
TION. Final rpt, May 1962, 72p. P: 1309, T: 103903.
C: AF 33(616)-8294, Mt. Vernon Research Co., Alex-
andria, Va. Not in OTS. ASTIA: AD 282216, Code AA.
                                        Unclassified

This is the final report of a design study for providing
space environment capability in ASD Facility, Bldg. 22.
The feasibility of converting an altitude chamber into a
double walled ultra high vacuum facility has been carried
through for one altitude chamber to a design drawing
stage. Drawings, specifications, and cost estimates for
this conversion accompany this report.

The extension of ideas entering into this conversion will
be applicable to other facilities to the extent that simi-
larities exist. The discussion of individual problems in
each of the major subdivisions of the report will bear
directly on similar problems elsewhere.

2-274a

ASD-TR-61-274. DEVELOPMENT AND QUALIFICATION
OF INITIATORS T36, T37, T38, AND T39. Final rpt,
May 1962, 27p. incl illus., tables. C: AF MIPR 1375A-
178, Frankford Arsenal, Philadelphia 37, Pa. C. Glaser.
FA Rpt R-1634. Not in OTS. ASTIA: Code XX.
                                        Unclassified

The purpose of this project was to develop and test four
types of initiators, for emergency escape systems, which
would provide a time delay of 3.5 ± 0.5 seconds. This
delay time was to be maintained from –65° to 200°F.
The initiators developed (designated T36, T37, T38,
and T39) use standard components of previously tested
units. Only the composition of the charge for the car-
tridge delay element has been changed.

In qualification tests, the specified delay time of 3.5 ±
0.5 seconds could be maintained only through the tem-
perature range of 0° to 160°F. All efforts on this project
to limit variations in delay times to less than 1.5 seconds
over the entire specified temperature range of –65° to
200°F were unsuccessful.

Frankford Arsenal concluded that the one-half second
tolerance and the high temperature were not realistic at
this time and recommended two changes in the statement
of requirements. It recommended that the time delay
requirement be changed to a maximum of 4.2 seconds at
–65°F and a minimum of 2.3 seconds at 160°F. It also
recommended that the high temperature requirement be
changed from 200° to 160°F. Both recommendations
were approved by Wright Air Development Division (now
Aeronautical Systems Division).

2-275

ASD-TDR-62-275. STUDY FOR IMPROVEMENT OF
MATERIALS CENTRAL MASS SPECTROMETER. Final
rpt, June 1962, 19p. incl illus. P: 7360, T: 736005.
C: AF 33(616)-7932, Bell and Howell Research Center,
Pasadena, Calif. G. D. Perkins, D. H. Pollack. In OTS.
ASTIA: AD 283009, Code AA.   Unclassified

Considerable improvement in average yield and in ease of
spark manipulation has been achieved. Photographic
emulsion variations have been a serious limitation to
sensitivity and to analysis accuracy but with a satisfac-
tory plate sensitivity of approximately 1 in 10^9 has been
obtained with exposure durations of approximately one
and a half hours. The flexibility of Knudsen Cell opera-
tion has been greatly enhanced by a complete redesign
of the supporting structure.

2-276 (Part I)

ASD-TDR-62-276, Part I. EMERGENCY DETECTION
AND ESCAPE INITIATION SYSTEM: Liquid Propellant
Boosters. Final rpt, Aug 1962, 134p. incl illus., tables,
26 refs. P: 1362, T: 136203. C: AF 33(616)-8246,
Vought Astronautics Div., Chance Vought Corp., Dallas,
Tex. H. H. Edwards, et al. SRN: 3-14000/2R18. Not
in OTS. ASTIA: AD 287585, Code AA.   Unclassified

This report describes the investigation and design of an
Emergency Detection and Escape Initiation System.
Liquid propellant booster flight records were investi-
gated to define the hazards of multi-stage vehicles.
Vehicle responses to probable failures and flight en-
vironments were investigated and the resulting maneu-
vers described. Techniques for detecting these mal-
functions or hazardous situations are discussed. "Fail
Active," "Fail Inactive," and "Fail Operational" philo-
sophies were employed in the development of various
detection and initiation design concepts. Evaluation of
trade studies resulted in the selection of a concept
utilizing a unique approach to the fail operational
philosophy.

2-278

ASD-TDR-62-278. A STUDY OF A SELF-MANEUVERING UNIT FOR ORBITAL MAINTENANCE WORKERS. Final rpt, Aug 1962, 296p. incl illus., tables, 60 refs. P: 8170, T: 817008. C: AF 33(616)-8197, Chance Vought Corp., Dallas, Tex. James B. Griffin. Astronautics Engineering Rpt 00.59. Not in OTS. ASTIA: AD287053, Code AA.
Unclassified

This report describes the feasibility of a self-maneuvering unit for orbital maintenance workers. The unit is a small, self-contained pack, utilizing stabilization, control, propulsion, and life support systems to afford the orbital worker complete support while performing space maintenance functions. Details of the study program are presented with results of the evaluation and appropriate conclusions. Operational requirements and capabilities expected of an extravehicular worker were defined. Theoretical evaluation of supporting systems, both for existing and generated designs, were conducted to determine the degree to which the orbital worker's requirements and capabilities are accommodated. Results of these evaluations are integrated to produce the discrete preliminary design of the self-maneuvering unit.

2-279

ASD-TDR-62-279. ANALYTICAL STUDY OF APPROXIMATE LONGITUDINAL TRANSFER FUNCTIONS FOR A FLEXIBLE AIRFRAME. Final rpt, June 1962, 101p. incl illus., tables, 9 refs. P: 8219, T: 821901. C: AF 33(616)-7657, Systems Technology, Inc., 1630 Centinela Ave., Inglewood 3, Calif. B. F. Pearce, W. A. Johnson, R. K. Siskind. TR-117-1. In OTS. ASTIA: AD 283978, Code AA.
Unclassified

This report presents results of a study on elastic-airframe dynamics that are important from the standpoint of flight control system design. Approximate transfer functions are given in literal terms for three classes of vehicles. These are of such a form that the important poles and zeros are related directly to simple functions of aerodynamic, elastic, and inertial properties. The aeroelastic corrections required to account for the flexibility influences of all modes not included in the equations of motion are discussed, and a rigorous method for applying these corrections is presented.

2-287

ASD-TDR-62-287.   INVESTIGATION OF LANDING POINT CONTROL OF RE-ENTRY VEHICLES UTILIZING VARIABLE AREA AERODYNAMIC DECELERATORS INCORPORATING LIFT. Final rpt, June 1962, 507p. incl illus., tables, 42 refs. P: 6065, T: 606506. C: AF 33(616)-8464, Avco-Everett Research Lab., a division of Avco Corp., 2385 Revere Beach Parkway, Everett 49, Mass. Not in OTS. ASTIA: AD 282280, Code AA.
Unclassified

A study of the feasibility of using mechanically expandable structures as aerodynamic decelerators to achieve controlled re-entry and landing after orbital flight has been made. A flexible or expandable structure such as proposed during the development studies concerning the Avco Drag Brake Satellite system lends itself to distortion techniques which modify the aerodynamic characteristics of a blunt body to achieve variable lift and drag coefficients. By proper choice of body shape and trim control, both in and out of plane range, can be preferentially altered within limits. Various aerodynamic shapes have been studied with emphasis on performance, stability and trim techniques, structural feasibility and heat transfer. Landing point control and landing accuracies have been assessed for selected shapes utilizing limiting ground rules on heating and lift/drag ratio requirements commensurate with practical circular and supercircular orbital considerations. Foldable structures are amenable to trim techniques such as movable primary structural surfaces and/or center of gravity shifting. These techniques for trimming have been studied and the results are embodied in the selection of shapes. Studies resulted in the selection of two shapes, and their design possibilities. These shapes are foldable from shapes (conical or hemispherical). The performance, weights, and advantages of these shapes for a manned re-entry mission are discussed.

2-287a (Part II, Vol I)

ASD-TR-61-287, Part II, Vol I. THERMOELASTIC EFFECTS ON HYPERSONIC STABILITY AND CONTROL: Elastic Response Determinations for Severely Heated Wings. Final rpt, Aug 1962, 160p. incl illus., tables, 30 refs. P: 8219, T: 82158. C: AF 33(616)-6653, Bell Aerosystems Co., Buffalo, N.Y. R. H. Gallagher, R. D. Huff. Not in OTS. ASTIA: AD 287426, Code AA.
Unclassified

Methods for predicting the elastic characteristics of severely heated lifting surfaces are described. These methods, applicable to a wide variety of configurations and support conditions, account for nonlinear temperature distributions in all directions and the effects of finite deflections. Specific formulations are given for the case where the surface can be represented as a thin plate and for the flexural element-torsion box representation. Both approaches are applied in the prediction of test data, and their accuracy is assessed. The extension of other low aspect ratio wing analysis techniques to include elevated temperature effects is also described.

2-292

ASD-TDR-62-292. INVESTIGATION OF WELDING OF COMMERCIAL COLUMBIUM ALLOYS. Final rpt, May 1962, 138p. incl illus., tables, 20 refs. P: 7351, T: 735102. C: AF 33(616)-7796, Thompson Ramo Wooldridge, Inc., Inglewood, Calif. J. M. Gerken, J. M. Faulkner. In OTS. ASTIA: AD 282225, Code AA.
Unclassified

An investigation was made of the welding characteristics of three commercial columbium base alloys, FS82, D31, and F48. Tungsten inert gas, electron beam, spot, and flash butt welding methods were included in this investigation. The effect of the welding variables travel speed, shielding gas composition and purity, filler metal additions, preheat and post heat were studied. Thermal cycles were measured in the fusion zone and heat affected zone of TIG welds to help explain mechanical properties and microstructure on the basis of physical metallurgy of each alloy. The effect of welding on all alloys was to increase the ductile to brittle transition temperature. This temperature was increased 200°F for FS82, 800°F for D31, and 500°F to 800°F for F48 over that of the as-received wrought sheet. Of several post heat treatments investigated, those most beneficial in lowering the transition temperature of welds were: 2000°F for 4 hours for FS82; 2100°F for 24 hours for D31; and 2500°F for 4 hours for F48. The electron beam welding process consistently produced more ductile welds than the TIG process.

2-294a

ASD-TR-61-294. ENERGY CONVERSION IN LAMINAR MAGNETOHYDRODYNAMIC CHANNEL FLOW. Interim rpt, Aug 1961, 121p. incl illus., tables, 57 refs. P: 3145, T: 61098.   C: AF 33(616)-7624, Research Lab. of Electronics, Massachusetts Inst. of Technology, Cambridge, Mass. J. P. Penhune. Not in OTS. ASTIA: AD 275059, Code AA.   Unclassified

This report presents a detailed theoretical analysis of two types (d-c conduction-driven and a-c induction-driven) of laminar, incompressible, viscous magnetohydrodynamic flow in a high-aspect-ratio channel, and of the operation of these flows as various forms of energy converters. The introduction indicates that laminar flow may be of practical importance in magnetohydrodynamic channel flow devices because the strong magnetic fields that are necessary for efficient energy conversion have been found to suppress turbulence. The treatment is unified by obtaining all of the basic solutions from a single set of fundamental equations in dimensionless form, and by presenting the results in terms of characteristic dimensionless parameters.

First, the basic solutions for d-c conduction-driven (Hartmann) flow are obtained, and a variational principle for this problem is presented.

Second, the nonlinear differential equations are derived, which govern a-c induction-driven flow with either even or odd excitation, if the fluid velocity is independent of time. These nonlinear equations are converted to an infinite set of linear differential equations with variable coefficients which is uncoupled from below, by making a perturbation expansion in the magnetic Reynolds number.

2-296

ASD-TDR-62-296. INVESTIGATION OF NEW RADAR TECHNIQUES AND COMPONENTS. Final rpt, May 1962, 170p. incl illus. P: 4144, T: 414409. C: AF 33(616)-5489, Electronic Systems Lab., Massachusetts Inst. of Technology, Cambridge 9, Mass. ESL-TR-129. ASTIA: AD 329797, Code AA.   Confidential

Summaries of research performed by the Radar Research Group are reported under three headings: Systems Investigation, Circuits and Subsystems Investigations, and New Device Investigations. In the Systems area, the evaluation of a new, general theory of radars directed against a complex array of scatterers is traced; the theory is related to coherent ground-mapping radar and applied to a coded-pulse radar. As a part of Circuits and Subsystems Investigations, the development of light-weight, high-power semiconductor-magnetic radar modulators is described. Techniques are presented for stabilizing backward-wave oscillators, and effects of instability are determined. New Device investigations are summarized, and include studies of excess noise in thin metal films, development of thin-film thermal transducers, optical data processing with thin magnetic films, conductivity modulation of thin metal films, photovoltaic thin-film sandwiches, tunnel-diode switching circuits, preliminary development of a thin-film tunnel triode, electroluminescent films, and logical operations with multihole magnetic cores.

2-301

ASD-TDR-62-301. STUDY AND SIMULATION OF AN ENERGY MANAGEMENT SYSTEM. Final rpt, Aug 1962, 310p. incl illus., tables, 31 refs. P: 8226, T: 822602. C: AF 33(616)-7879, Bendix Systems Div., Ann Arbor, Mich. L. Galan. BSR-632. ASTIA: AD 332574, Code AA.   Confidential

A method for controlling the flight path of a manned spacecraft during its various mission phases is first synthesized in a general manner by emphasizing overall system and spacecraft integrity. The individual elements of the resulting Energy Management System are analyzed rigorously to assess the feasibility of the concept. Specific areas included are: inflight path prediction; re-entry and glide optimization; heating rate limiting; solution of the three dimensional equilibrium glide equations; self adaptive prediction techniques; display features; and overall system size, weight and power estimates.

2-303

ASD-TDR-62-303. EXPERIMENTAL AND THEORETICAL STUDIES OF JET NOISE PHENOMENA. Final rpt, June 1962, 163p. incl illus., 44 refs. P: 3066, T: 306601. C: AF 33(616)-6976, Armour Research Found. of Illinois Inst. of Technology, Chicago 16, Ill. W. C.

Sperry, R. Kamo, A. Peter. Nr 1190. Not in OTS. ASTIA: AD 282273, Code AA. Unclassified

Over-all sound pressure levels were measured in an anechoic room for noise generated by cold air flow through more than twenty different nozzle configurations, including converging, converging-diverging, slog, and annular types, the latter with and without center core flow. The results are examined in terms of over-all acoustic power and directivity versus mass flow and compared with various eighth power relations. The acoustic performance of most nozzles was similar in the subsonic region. However, certain annular type nozzles exhibited a marked superiority in the supersonic region.

Theoretical discussions are presented concerning the generation of sound and the relationship between various turbulence and statistical theories. A modified mixing length theory is developed showing its application to turbulence generation as well as its influence on the general forcing function equation. Temperature effects are included. Empirical data is given pertaining to the correlation of jet noise from circular and annular nozzles.

2-304

ASD-TDR-62-304. CATALYTIC EFFECTS OF THERMO-COUPLE MATERIALS. Final rpt, June 1962, 41p. incl illus., tables, 5 refs. P: 2(1-3066), T: 30245. C: AF 33(616)61-01, National Bureau of Standards, Washington, D.C. Lief Olsen. Not in OTS. ASTIA: AD 284880, Code AA. Unclassified

The object of this investigation was to determine the magnitude of the catalytic effects of all of the commonly used thermocouple materials in lean mixtures of hydrogen, carbon monoxide, propane, and methane in air.

Wires of platinum, palladium, iridium, platinum plus 15% iridium, and the two elements of the Platinel thermo-couple were found to catalyze the combustion of mixtures of hydrogen, carbon monoxide, and propane in air. Combustion of methane-air mixtures was not initiated by these materials at temperatures up to 1800°F. Experiments with gold, silver, Chromel, Alumel, and constantan wires showed no catalysis of any mixture at temperatures of the wires up to 1800°F. Base-metal thermocouples are therefore recommended for accurate determinations of temperatures of gaseous mixtures containing combustible materials.

2-305

ASD-TDR-62-305. INVESTIGATION OF INORGANIC PHOTOTROPIC MATERIALS AS A BI-OPTIC ELEMENT APPLICABLE IN HIGH DENSITY STORAGE COMPUTER MEMORIES. Interim rpt, Apr 1962, 50p. incl illus., tables, 8 refs. P: 7062, T: 70921. C: AF 33(616)-7333, Polacoat Inc., Blue Ash, Ohio. In OTS. ASTIA: AD 277793, Code AA. Unclassified

A general evaluation of the various types of phototropic (i.e., reversible, light induced, color producing) phe-

nomenon is given regarding the application of photo-tropic materials to bi-optic high density storage media for computer memories. The inorganic "F" center type phototropic systems were chosen as the area offering the greatest potential. The results of a detailed evaluation and synthesis program in this area substantiating this potential application are given.

2-305a

ASD-TR-61-305. RESEARCH ON SILICON AND PHOSPHORUS DERIVATIVES OF VARIOUS NITROGEN COMPOUNDS. Final rpt, July 1962, 23p. incl illus., table, 23 refs. P: 7023, T: 73666. C: AF 61(052)-175, Birkbeck College, Univ. of London, London, England. R. A. Shaw. Not in OTS. ASTIA: AD 284503, Code AA. Unclassified

The new compound, hexamethyldisilazyllithium, has been prepared in solution and its reactions with a variety of halogen derivatives are described. Reactions of cyanuric chloride with trialkyl phosphites and other tervalent phosphorus compounds have been investigated and several new phosphorus derivatives of s-triazine are reported. The reaction of cyanuric chloride with diethyl-aniline is reported, and the preparation of silicon derivatives of s-triazine are under investigation.

2-306a

ASD-TR-62-306. TRIMETALLIC FILM PREPARATION BY ELECTROPHORETIC DEPOSITION. Final rpt, June 1962, 31p. incl illus., tables, 36 refs. P: 7062, T: 706202. C: AF 33(616)-7727, Vitro Lab., Div. of Vitro Corp. of America, West Orange, N.J. M. H. Ortner, S.J. Klach. VL-2230-12-0. In OTS. ASTIA: Code XX. Unclassified

The feasibility was demonstrated of preparing thin (6000-10,000 A), low coercive force (2.5 oe.), 4-79 molybdenum permalloy films on molybdenum-on-quartz substrates by electrophoretic deposition. The trimetallic films prepared were uniform in composition and thickness, and had low drive field requirements. However, they did not exhibit the square loop behavior required for use as switching devices. The lack of uniaxial anisotropy may be due to surface imperfections, impurities, localized stress, or improper magnetic alloying and annealing.

2-307

ASD-TDR-62-307. TELEMETRY SOLID-STATE MICRO-WAVE TRANSMITTER T( )/AKT. Final rpt, Aug 1962, 144p. incl illus., 31 refs. P: 4107, T: 410717. C: AF 33(616)-7433, Sylvania Electronic Systems - Central, Buffalo, N.Y. John Bartnik. A79-9-5.0-27. In OTS. ASTIA: AD 287222, Code AA. Unclassified

The feasibility of the solid-state approach toward the development of telemetry transmitter within the micro-wave region is delineated in this report. It describes

the studies and surveys conducted into the state-of-the-art of solid-state devices and techniques prior to establishing design criteria for the two transmitters that were constructed during this program. One of the transmitters was a Single Sideband-Suppressed Carrier type with a minimum SSB r-f output of 25 mw and an r-f carrier of 0.6 w at 2250 mc. The other was an FM transmitter with a minimum r-f output of 2 w at 2250 mc. Both transmitters were characterized by: (1) small size, weight and power consumption, (2) high reliability, and (3) solid-state.

2-308

ASD-TDR-62-308. INVESTIGATION OF THRESHOLD SWITCHING TECHNIQUES FOR DIGITAL COMPUTERS. Final rpt, June 1962, 274p. incl illus., tables, 26 refs. P: 7062, T: 706203. C: AF 33(616)-8035, Lockheed Missiles and Space Co., A Group Div. of Lockheed Aircraft Corp., Sunnyvale, Calif. 2-01-62-1. In OTS. ASTIA: AD 278275, Code AA. Unclassified

Given are: theoretical aspects of threshold functions; synthesis methods for specifying networks of threshold devices; techniques to determine linear separability; weights and threshold for LSF's; algorithms for partitioning switching functions into sets of threshold functions; techniques for decomposing networks of unconstrained threshold devices into networks of devices satisfying certain design constraints; effects of noise and tolerances in several types of circuits suitable for threshold devices to determine the important design constraints; logical design examples to demonstrate the general utility of threshold functions.

2-309

ASD-TDR-62-309. A STUDY OF DESIGN AND MATERIALS FOR DEVELOPMENT OF LOW COST AERIAL DELIVERY PARACHUTES. Final rpt, June 1962, 152p. incl illus., tables, 1 ref. P: 6077, T: (60785) 607703. C: AF 33(616)-6009, AF 33(616)-8400, Cook Research Lab., Chicago, Ill. F. A. Ruprecht. Not in OTS. ASTIA: AD 284442, Code AA. Unclassified

A survey of materials was performed to yield candidate materials for low-cost expendable cargo parachutes.

A study of existing parachute designs, American and foreign, was accomplished.

Static tensile tests of the individual materials were conducted to determine their physical characteristics. Seams, loops, and combinations of materials were tested to ascertain their efficiency.

Upon completion of the static tests, dynamic tests were performed on parachute components and complete low cost parachutes by means of aircraft drops.

2-310

ASD-TDR-62-310. GAS LUBRICATION OF BEARINGS AT VERY HIGH TEMPERATURES, HIGH SPEEDS, AND

LOW LUBRICANT FLOW RATES. Summary rpt, Feb 1962, 63p. incl illus. P: 3304, T: 30340. C: AF 33(616)-8047, Stratos Div., Fairchild Stratos Corp., Bay Shore, N.Y. John S. Meacher. Not in OTS. ASTIA: AD 276998, Code AA. Unclassified

An investigation of 1.5-in. dia 2-in. long journal bearing using nitrogen gas as a lubricant was conducted. Test conditions ranged from room temperature to 1900°F, 0 to 65,000 rpm, and radial loads to 10 lb. Effects of temperature and shaft speed on lubricant flow are given. Nitrogen, helium, argon and Freon 14 lubricant gases were investigated in relation to a 1.5-in. dia thrust bearing at the above test conditions except that a 100-lb axial load was imposed. Effects of load, temperature, supply pressure, and lubricant gas differences on lubricant flow are given. An all-ceramic test rig is described.

2-312a

ASD-TDR-62-312. AN ARC-IMAGING FURNACE FOR MATERIALS RESEARCH. Final rpt, May 1962, 31p. incl illus., tables, 46 refs. P: 7340, T: 734001. R. W. Farmer. Not in OTS. ASTIA: Code XX. Unclassified

An arc-imaging furnace suitable for high-temperature materials research is discussed. The basic design, operation, and calibration of the furnace is presented. The original furnace was modified by incorporating an irradiance timing system. Various controlled atmospheric sample chambers were constructed and installed.

Several suggestions are made for improving the furnace.

2-315

ASD-TDR-62-315. AN AUTOMATIC RECORDING DILATOMETER FOR THERMAL EXPANSION MEASUREMENTS TO 2000°F. Final rpt, May 1962, 19p. incl illus., 10 refs. P: 7381, T: 738103. G. L. Denman. In OTS. ASTIA: AD 282838, Code AA. Unclassified

The design, construction, and calibration of an automatic recording dilatometer capable of accurately measuring thermal expansion properties of solid materials from room temperature to 2000°F, is discussed.

The dilatometer was of the quartz tube differential expansion type with auxiliary equipment capable of continuous and automatic recording of thermal expansion data. A statistical error analysis is included which indicates that an accuracy of ±1% can be obtained with the instrument.

2-318

ASD-TDR-62-318. RAMJET ENGINE MONITORING AND CONTROL REQUIREMENT INVESTIGATION. Final rpt, July 1962, 120p. incl illus., tables, 24 refs. P: 8224, T: 822401. C: AF 33(616)-8316, Curtiss-Wright Corp., Electronics Div., East Paterson, N.J. A. A. Zingoni, W. H. Dawson, L. Casagrande. Not in OTS. ASTIA: AD 282405, Code AA. Unclassified

An investigation was made to determine the controls and instrumentation necessary to monitor the performance of hypersonic, throttleable ramjet engines used in manned vehicles, in accordance with Exhibit A of Contract AF 33(616)-8316, Exhibit A is included in this report as Appendix G. A complete engine control system concept was developed consisting of automatic inlet, nozzle and fuel control systems and a pilot operated engine throttle. The tolerances necessary for the control systems are tabulated in Part III of this report. The necessary monitoring parameters and the eight sensing requirements (pressures, flows, etc.) needed to effect the instrumentation are also tabulated in Part III, along with the tolerances for the sensing requirements. The selection of the recommended parameters and sensing requirements is not restricted by present day measurement technology. New technology will have to be created in order to effect the required instrumentation.

2-319

ASD-TDR-62-319. INVESTIGATION OF ROCKET MOTOR MONITORING AND CONTROL REQUIREMENTS, Final rpt, Oct 1962, 164p. incl illus., tables, 17 refs. P: 8224, T: 82178. C: AF 33(616)-8355, Rocketdyne, A Div. of North American Aviation, Inc., Canoga Park, Calif. R-3466. Not in OTS. ASTIA: Code XX.
Unclassified

Analytical investigation was made to develop a methodology for determining instrumentation requirements for all types of chemical rocket engines, and determine quantity, quality, and type of measurements for monitoring operation and performance. Detailed information relative to required analyses and instrumentation is presented.

2-320

ASD-TDR-62-320. STUDY OF MHD AND EHD FREE-CONVECTION ENERGY CONVERTERS. Final rpt, June 1962, 110p. incl illus., tables, 12 refs. P: 3145, T: 314513-9. C: AF 33(616)-8007, Plasmadyne Corp., Santa Ana, Calif. M. C. Gourdine. FR022-8007. In OTS. ASTIA: AD 282325, Code AA. Unclassified

A theoretical and experimental feasibility study of single and two-phase free-convection MHD and EHD energy conversion is summarized in this report. Single-phase operation is shown to be impractical because the maximum possible efficiency of converting heat into flow kinetic energy is very low. On the other hand, two-phase operation is far more efficient and definitely has possibilities for practical energy conversion applications.

2-324

ASD-TDR-62-324. THE DEVELOPMENT OF A LOW TEMPERATURE VAPOR FILLED THERMIONIC CONVERTER. Final rpt, June 1962, 168p. incl illus., tables, 12 refs. P: 3145, T: 314509. C: AF 33(616)-7903,

RCA, Lancaster, Pa. F. G. Block, J. J. O'Grady. In OTS. ASTIA: AD 278810, Code AA. Unclassified

This report covers a one year program of applied research toward developing a low-temperature, plasma, thermionic converter. The converter uses a third electrode to ionize plasma so as to neutralize the space charge. The lower temperature thus achieved should significantly prolong the life of the converter and contribute to the development of a more reliable power supply for space application.

The program was directed toward optimizing geometry and operating characteristics and investigating the effects of temperature and pressure, starting pulse, magnetic fields, and operation in both series and parallel circuitry. Materials were investigated to achieve practical electrodes by determining compatibility of material, atmospheric corrosion, and gas permeation. Converters were fabricated, evaluated, and life tested with the parameters optimized by the test program.

2-327 (Part I)

ASD-TDR-62-327, Part I. GAS-METAL REACTIONS IN ROCKET NOZZLES. Final rpt, June 1962, 77p. incl illus., tables. P: 7351, T: 735101. C: AF 33(616)-7744, Atlantic Research Corp., Alexandria, Va. J. D. Batchelor, et al. Not in OTS. ASTIA: AD 283957, Code AA. Unclassified

Reactions between W, Ta, and a 90%-Ta-10%-W alloy and the combustion products of solid propellants are described. Lab studies of hot filament tests where electrically heated wires were exposed to selected gas environments and optical bomb tests where wires were exposed to a burning propellant strand, were used to determine the important reactions.

Three typical propellants and one with a fluorocarbon binder (as a source of HF), were used. Experimental results and theoretical thermodynamic predictions were compared. Metallographic examination, microhardness measurements, X-ray analysis, and weight changes were used to define the reactions. Oxidation by CO_2 and H_2O was the most serious mode of attack. Other gases were much less damaging. Tungsten was least reactive and tantalum most reactive in each environment; the alloy behaved similar to but was less reactive than tantalum.

2-329

ASD-TDR-62-329. A STUDY OF QUENCH HARDENING IN PLATINUM AND GOLD. May 1962, 51p. incl illus., tables, 56 refs. P: 7353, T: 735302. H. L. Gegel. In OTS. ASTIA: AD 282836, Code AA. Unclassified

The results of this program have shown that vacancy complexes form during the quenching period when the average quenching speed is less than 10^5°C/second. The binding energy for divacancies in gold was estimated to be approximately 0.28 ev. The influence of increased quenching speeds is to increase the temper-

ature recovery range for isochronal recovery. Similarly, fast quenching rates caused an incubation period in the isothermal aging experiments for gold. Two distinct hardening mechanisms exist for platinum and gold when the values of the activation energy for recovery are taken into account. The hardening mechanism for gold is thought to be due to the interaction of dislocations with extended sessile dislocations, and the hardening mechanism for platinum is thought to be due to the interaction of dislocations with dislocation loops. This model has been extended to other F.C.C. metals.

2-331

ASD-TDR-62-331. X-RAY DIFFRACTION INVESTIGA-TIONS ON IRON WHISKERS. Final rpt, June 1962, 31p. incl illus., tables, 7 refs. P: 7353, T: 735304. C: AF 33(616)-6607, Univ. of Dayton Research Inst., Dayton, Ohio. W. R. Rambauske, R. R. Gruenzel. In OTS. ASTIA: AD 282844, Code AA.   Unclassified

Iron whiskers have been investigated by x-ray diffraction. The Laue method is employed to determine the orientation of the lattice planes. For a series of hexagonal type whiskers it was found that the lateral face, which according to earlier reports belongs to a (110) plane orientation, belongs to a (211) plane orientation. In another series of whiskers which were grown in one boat condition, a twist of the lattice indices of direction over the whisker length was found. This twist is not visible optically. Necessary exposure times and degree of information obtainable from Laue-diffraction are determined. Higher resolution over the whisker length is necessary to find variations in the parameters, which determine the microstructure of the whiskers. To achieve this resolution, experimental ways are proposed and in progress. Digital computation for analysis of data is reported.

2-335a

ASD-TR-61-335. THEORY OF LINEAR TIME INVARI-ANT CIRCUITS. Final rpt, Sept 1961, 63p. incl illus., tables. P: 4150, T: 41709. C: AF 33(616)-7630, Univ. of Michigan Inst. of Science and Technology, Ann Arbor, Mich. W. M. Brown. Not in OTS. ASTIA: AD 275756. Code AA.   Unclassified

This report covers a large part of the theory of linear time invariant circuits. Circuits satisfying various important constraints are characterized mathematically, the utility and synthesis of complex parameter circuits is described, a new all inclusive operational analysis called area transforms is developed, and the theory of response time and band pass circuits is developed.

2-341

ASD-TDR-62-341. RESEARCH ON TECHNIQUES FOR ALTITUDE MEASUREMENT BEYOND THE EARTH'S ATMOSPHERE. Final rpt, Aug 1962, 114p. incl illus., tables, 4 refs. P: 8222, T: 822203. C: AF 33(616)-8147, Westinghouse Electric Corp., Air Arm Div., Balti-

more, Md. L. A. Hauck, C. R. Kline. C-45228Y-451. ASTIA: Code XX.   Secret

This report describes three potential techniques investigated in the conduct of a research study program to establish new techniques for measuring altitude to the earth, but which would be extendible to other bodies in the solar system.

The first technique involved measurement of the earth's thermal disc diameter or radius to provide range value or altitude, the second technique employed an active optical system using the Zeeman effect to provide spectral shift or modulation of the radiated and received energy, and the third technique involved measurement of altitude by means of the detection of the earth's quadrupole moment with a high density, high Q crystal, using theoretical quantum mechanics.

2-344a (Part I)

ASD-TR-61-344, Part I. A STUDY OF MANUAL AND AUTOMATIC CONTROL SYSTEMS FOR THE TERMI-NAL PHASE OF ORBITAL RENDEZVOUS: Basic Guid-ance and Control Information. Interim rpt, June 1962, 154p. incl illus., tables, 41 refs. P: 8219, T: 82165. C: AF 33(616)-7094, Systems Technology, Inc., Inglewood, Calif. H. B. Thompson, R. L. Stapleford. Not in OTS. ASTIA: AD 284885, Code AA.   Unclassified

Basic data required for manual and automatic rendezvous control system analysis and synthesis are derived and/or summarized and discussed for the case of terminal rendezvous with a nonmaneuvering target in a circular or noncircular orbit at an altitude of between 300 and 1000 n mi. For report purposes, terminal rendezvous is defined to commence at a range between target and interceptor of the order of tens of miles, and a relative velocity of less than 1000 ft/sec, and to terminate at essentially zero range and relative velocity. Basic data which are presented include an analysis of initial conditions due to various approach maneuvers; the derivation of complete equations of motion for various reference axis systems; a discussion of various rendezvous guidance concepts; a parametric error analysis of guidance and control in a simplified rendezvous situation; and a brief examination of the capabilities of the human for target search, identification, and range estimation in a manned vehicle rendezvous. A guidance concept is selected to be used for a following rendezvous control system study and limitations of certain specific orbital rendezvous literature are pointed out. It is noted that there currently exists a significant deficiency in the amount of available rendezvous guidance and control mechanizational information.

2-347

ASD-TDR-62-347. STOCHASTIC DISTURBANCE DATA FOR FLIGHT CONTROL SYSTEM ANALYSIS. Final rpt, Sept 1962, 254p. incl illus., tables, 147 refs. P: 8219, T: 821904. C: AF 33(616)-8088, Lockheed-

Georgia Co., Marietta, Ga. John E. Hart, et al. In OTS. ASTIA: Code XX.   Unclassified

Disturbance data, together with guidance signals, are needed to perform realistic analyses of flight control systems. Stochastic disturbances, which are by definition defined only in a statistical sense, have not previously been compiled and codified for use in such analyses. The stochastic data included in this report cover the subjects of winds, wind shear, gusts, magnetic fields, solar radiation, vibration and acoustics, meteors, thrust irregularities, and sensor noise. Areas of these subjects in which needed data are lacking have been exposed by the study. Present programs of data accumulation cited and the recommended new programs will produce significant information required to supplement the data of this report. A table of earth magnetic field intensities is included as an appendix.

2-348

ASD-TDR-62-348. A HIGH TEMPERATURE THERMAL CONDUCTIVITY APPARATUS. Final rpt, July 1962, 22p. incl illus., 24 refs. P: 4776, T: 6. C: AF 33(657)-7136, Atomics International, Canoga Park, Calif. R. E. Taylor. ARPA Order No. 24-6. In OTS. ASTIA: AD 275417, Code AA.   Unclassified

A high temperature, steady-state thermal conductivity apparatus is described. This apparatus has been used to measure the conductivity of diverse materials, such as graphite, metals, carbides, oxides, and liquid copper. Measurements have been made from 200 to 2500°C. The procedures used, difficulties encountered, limitations, and accuracy are discussed. Results previously obtained with this apparatus on graphite, molybdenum, tantalum, porous carbon, liquid copper, Armco iron, beryllia, magnesia, and titanium carbide are presented graphically and are compared with other literature results.

2-350

ASD-TDR-62-350. SEMICONDUCTOR SINGLE-CRYSTAL CIRCUIT DEVELOPMENT. Semiannual rpt, Feb 1962. P: 4159, T: 415906. C: AF 33(616)-6600, Tex. Instru. Inc., Components Div., Dallas, Tex. Arthur D. Evans. 03-61-83. Not in OTS. ASTIA: AD 275636, Code AA.
                                                   Unclassified

This Technical Documentary Report describes progress made in the design and fabrication of Functional Electronic Blocks (FEB'S). The feasibility of using the FEB in various circuit functions is being proved. A receiver was constructed and successfully demonstrated in July 1961 using these blocks.

Space charge structures and the application of the field effect tetrode as a reversible isolator, transformer, gyrator, and modulator are discussed.

The objective of research in the field of low level phenomena was to find the cause of alpha fall-off at low currents in diffused structures. It was found that the

space charge recombination current was responsible for this and originates at the emitter-base periphery.

2-351

ASD-TDR-62-351. INVESTIGATION OF NOTCH FATIGUE BEHAVIOR OF CERTAIN ALLOYS IN THE TEMPERATURE RANGE OF ROOM TEMPERATURE TO -423°F. Final rpt, Aug 1962, 79p. incl illus., tables, 12 refs. P: 7381, T: 738103. C: AF 33(616)-6888, Battelle Memorial Inst., Columbus, Ohio. D. N. Gideon, Ronald J. Favor, A. Koppenhafer, et al. In OTS. ASTIA: AD 286480, Code AA.   Unclassified

The notched fatigue behavior of 13 alloys has been investigated in the temperature range room temperature to -423°F and in the lifetime range 10^4 to 10^6 cycles. The alloys studied were chosen on the basis of actual or potential application in missile and spacecraft cryogenic systems. The materials were in sheet form and were fatigued in fully reversed bending experiments. V-notches in the edges of the specimens had theoretical stress concentration factors of about 3.1 and 6.4. The results are presented as S-N plots and comparisons with unnotched fatigue strengths are made in tables of notch sensitivity values. S-N plots of the unnotched fatigue data obtained in the previous year are included for convenience.

2-354

ASD-TDR-62-354. RESEARCH FOR A FUNDAMENTAL STUDY ON THE WORK HARDENING OF BODY-CENTERED CUBIC METALS. Interim rpt, Sept 1962, 121p. incl illus., tables, 85 refs. P: 7351, T: 735106. C: AF 33(616)-7855, Pratt and Whitney Aircraft Corp., Middletown, Conn. D. P. Gregory, G. H. Rowe, A. N. Stroh. In OTS. ASTIA: Code XX.   Unclassified

The first portion of this report contains a literature survey and a critical analysis of the development of work hardening theory. The second portion, experimental, describes work hardening mechanisms in columbium deduced from results of tensile studies at various strain rates and temperatures, strain rate and temperature cycling tests, and transmission electron microscopy. Work hardening in the fine grain Cb polycrystals at 50°C appears to result from a decrease in both the number of mobile dislocations and the activation volume with increasing strain. The particular mechanism responsible for work hardening appears to be the movement of jogs in screw dislocations which results in the formation of lattice vacancies. Polycrystals were found to yield by a Luders mechanism while the single crystals yield homogeneously. The number of mobile dislocations in the polycrystals decreases with increasing strain while the number of mobile dislocations in the single crystals increases continuously with strain.

2-356a

ASD-TR-61-356. RESEARCH IN HIGH TEMPERATURE WINDOW DESIGN. Final rpt, June 1962, 90p. incl illus.,

tables. P: 1368, T: 136802. C: AF 33(616)-7296, Narmco Industries, Inc., Research and Development Div., San Diego, Calif. G. K. Partain, J. L. Robinson, R. P. Wittmann. Not in OTS. ASTIA: AD 283580, Code AA.
Unclassified

This report describes the development of processes for sealing glazing systems to operate from –100°F to 900°F at 25 psi internal pressure, employing Corning Glass Works Codes 7900 high silica, 1723 and P.P.G. 6695 aluminosilicate glasses. Fused glass-to-metal seals, the feasibility of which was previously demonstrated, proved practical only on small specimens under laboratory conditions, while a measure of success was obtained with brazed glass-to-metal seals. Sealed high silica glazing systems have been successfully tested at 900°F and 25 psi and demonstrate a high degree of practicability. Data are also included on organically bonded load carrying systems, which operate under high tensile loading conditions up to 500°F.

2-356

ASD-TDR-62-356. RESEARCHES ON HYDROGEN OVER-VOLTAGE ON METALLIC SINGLE CRYSTALS: GOLD. Interim rpt, June 1962, 13p. incl illus., table, 7 refs. P: 7353-05. C: AF 61(052)-144, Chimica Fisica e Metallurgia del Politecnico di Milano, Milano, Italy. L. Peraldo Bicelli, M. Graziano. In OTS. ASTIA: AD 284600, Code AA. Unclassified

Hydrogen overvoltage on gold polycrystalline and single crystal-cathodes, oriented following the (100), (110), and (111) planes, has been investigated in 0, 1 M perchloric acid solutions, in a c.d. range up to 200 A/m^2.

The Tafel law holds true, but two different slopes are observed, that in the lower c.d. range having the smallest value.

The parameters are different for the different electrodes.

2-357

ASD-TDR-62-357. RESEARCHES ON HYDROGEN OVER-VOLTAGE ON METALLIC SINGLE CRYSTALS. Final rpt, May 1962, 26p. incl illus., tables. P: 7353, T: 735305. C: AF 61(052)-144, Laboratori di Elettrochimica, Chimica Fisica e Metallurgia del Politecnico di Milano, Milano, Italy. R. Piontelli, et al. In OTS. ASTIA: AD 281805, Code AA. Unclassified

The purpose of the research work sponsored by ARDC, USAF, Contract No. AF 61(052)-144, and here summarized, was the determination of the hydrogen-overvoltage for metallic single crystal electrodes (SCE), whose working surface was oriented following different lattice planes and for polycrystalline ones, in various conditions as far as current density (c.d.), temperature and other conditions are concerned.

2-359

ASD-TDR-62-359. ADVANCED VEHICLE GUIDANCE SYSTEMS RELIABILITY INVESTIGATION. Final rpt, July 1962, 64p. incl illus., tables, 69 refs. P: 5219, T: 521903. C: AF 33(616)-7689, Stanford Research Inst., Menlo Park, Calif. W. M. Lynch, C. B. Clark, B. Epstein. Not in OTS. ASTIA: Code XX. Unclassified

The work reported represents a start toward finding a means to predict the reliability of military interplanetary space guidance systems. The space environment, as determined from a survey of various satellite and space probes, is described. Two mathematical models for representing the reliability of a particular gas bearing gyroscope are developed from laboratory test data supplied by the manufacturer. Sources of failure data and considerations of life testing are discussed. It is concluded that the theory and practice of life testing of electromechanical components that are subject to wear-out failure are still in an early stage of development.

2-360

ASD-TDR-62-360. A PRELIMINARY INVESTIGATION OF THE EFFECTS OF VARIATIONS IN REYNOLDS NUMBER AND SURFACE TEMPERATURE ON FOUR SURFACE PRESSURES ON A SLIGHTLY BLUNTED 7-1/2° HALF-ANGLE CONE AT MACH NUMBERS 5 AND 8 FOR ANGLES OF ATTACK UP TO 24°. Final rpt, Aug 1962, 28p. incl illus., tables. P: 8222, T: 822207. C: AF 33(657)-7715, Litton Systems, Inc., Systems Management, Woodland Hills, Calif. Dr. Fred O. Smetana. Systems Documentation No. 22-7-1. In OTS. ASTIA: AD 287452, Code AA. Unclassified

It was found that the variation of cone pressure with angle of attack followed the expected Sin^2 distribution and that the β plane pressure changes with angle of attack (a) could be predicted from the characteristics of a cylinder normal to a stream of Mach Number M Sin α.

Results indicated that although the cone was insensitive to changes in Mach Number in the investigated Mach Number range for constant Reynolds Number, a reduction in free stream Reynolds Number by an order of Magnitude appeared to reduce the angle of attack sensitivity by about ten percent. For the range of Mach Numbers tested the displacement of the free stream by the boundary layer was small amounting to a maximum of 1/2° increase in effective cone angle for M = 8 and Re/ft = 3 × 10^5 and insignificant increases for the lower Mach Number and higher Reynolds Numbers. At the Reynolds Numbers investigated the effect of wall temperature was also found to be small, the ratio of free stream stagnation to wall temperature had to be greater than three to produce measurable changes in the pressure distribution from the T_W/T_S = 1 values.

2-361

ASD-TDR-62-361. **MICROBIOLOGICAL EXAMINATION OF JET FUEL-WATER SAMPLES RAMEY AND EGLIN AIR FORCE BASES.** Final rpt, July 1962, 9p. incl illus., tables, 3 refs. P: 3048, T: 304801. A. V. Churchill. Not in OTS. ASTIA: AD 285002, Code AA.
Unclassified

An investigation was conducted to identify microorganisms permitting microbiological contamination and resulting corrosion of B-52 and KC-135 integral fuel tanks at Ramey and Eglin Air Force Bases. Of the microorganisms isolated, the most predominant groups found were the transparent bacterium and the iron-depositing bacterium. Sulfur-oxidizing bacterium was possibly present in a wet sludge sample from a corroded wing tank. The role of these predominant microorganisms on corrosion of aircraft fuel tanks should be further investigated. The corrosive activity of jet fuel-water sample from Bulk Storage Tank #55, Ramey AFB, was also investigated, as well as analyses of sludge samples from aircraft based at Ramey AFB.

2-364

ASD-TDR-62-364. **INVESTIGATION OF PULSE INTERFERENCE CONTROL VIA SOLID STATE DEVICES.** Final rpt, June 1962, 83p. incl illus., tables, 108 refs. P: 4357, T: 435712. C: AF 33(616)-8128, Cook Tech. Center Div., Morton Grove, Ill. I. N. Mindel, W. Macdonald. SRN: P-3463. Not in OTS. ASTIA: AD 284875, Code AA. Unclassified

Several techniques for producing limiting at microwave frequencies using solid state devices are discussed. A brief discussion of the techniques considered and the results are presented. A detailed discussion of the most promising technique, the associated analysis, and the results are included. The limiting thresholds obtainable by the various techniques, and guidelines for further research if lower limiting thresholds are to be obtained are presented.

2-368

ASD-TDR-62-368. **RESEARCH ON MICROBIOLOGICAL SLUDGE INHIBITORS.** Final rpt, Apr 1962, 71p. incl illus., tables, 10 refs. P: 3048, T: 304801. C: AF 33(616)-7729, Gulf Research and Development Co., Pittsburgh, Pa. A. V. Churchill, W. W. Leathen. Not in OTS. ASTIA: AD 284183, Code AA. Unclassified

A research investigation was continued to develop information and materials for control of microbiological sludge in jet fuel bulk storage tanks and in aircraft fuel tanks. The most predominant groups of fungi and bacteria which were isolated from jet fuel-water bottom samples under Contract No. AF 33(616)-6989, were characterized and identified as to genus and species. Four groups of fungi, which were found occasionally, were characterized but not completely identified. Ap-

proximately 302 fuel-soluble materials were evaluated as potential microbiological sludge inhibitors. Three compounds are recommended for trial in jet fuel to control microbial growth. These are tributyltin acetate, 2-nitro-resorcinol and β-nitro-styrene. Several others satisfactorily controlled microbial growth but had deleterious effects on fuel properties and/or fuel system materials. Substantial changes in properties and composition of jet fuel were noted between certain inoculated and uninoculated samples in storage tests of 270 days' duration. In addition, gas chromatographic studies indicated that the microorganisms utilize the hydrocarbons in their metabolic processes. The microorganisms also affect the water-holding capacity of jet fuel.

2-370

ASD-TDR-62-370. **DEVELOPMENT OF A GERMANIUM SEMICONDUCTOR MODULATOR.** Final rpt, Sept 1962, 121p. incl illus., 4 refs. P: 4335, T: 433513. C: AF 33(616)-8307, Minneapolis-Honeywell Regulator Co., Aeronautical Div., Electro-Optical Facility, 1915 Armacost Ave., Los Angeles 25, Calif. Marvin L. Chatkoff. R-ED 11184. Not in OTS. ASTIA: Code XX.
Unclassified

Absorption, transmission, distortion, bandwidth, and power-handling characteristics of a germanium infrared modulator are described. Absorption ranged from 40 percent at a wavelength of 2 microns to 95 percent at 12 microns. Transmissions in the order of 90 percent were obtained with the proper antireflecting coating.

Distortion was less than one percent during normal operation. Bandwidth was limited to the audio frequency range. The optical power-handling capacity of the modulator was found to be wholly dependent upon external means of dissipating the power-handling capacity of the germanium modulator to 50 watts; however, forced air cooling or a coolant would be required for higher input power.

It is recommended that any further development of the modulator be confined to improvement of the bandwidth. All other parameters tested proved satisfactory for communications applications.

2-371a

ASD-TR-61-371. **STATIC POSTFAILURE BEHAVIOR OF THE WING STRUCTURES OF THE B-47, B-52, BEAR, AND BADGER AIRCRAFT.** Final rpt, Aug 1962, 40p. incl illus., tables, 5 refs. P: 1350, T: 14045. C: AF 33(616)-6804, Massachusetts Inst. of Technology. R. D'Amato. ASTIA: AD 332745, Code AA. Secret

The equations describing the postfailure behavior of aircraft wing beams are outlined and the procedures used to obtain numerical data are described. A brief summary and discussion of the major assumptions that have been made in the analysis are presented. The constants

required by the postfailure equations are given for several selected stations of the B-47, B-52, Bear, and Badger wing beams.

2-372

ASD-TDR-62-372. CONFERENCE ON HIGH TEMPERATURE POLYMER AND FLUID RESEARCH. Final rpt, Aug 1962, 650p. incl illus., tables, 183 refs. P: 7340, T: 734004. Robert J. McHenry, 1st/Lt., USAF. Not in OTS. ASTIA: AD 287790, Code AA. Unclassified

This report is a collection of the papers presented at the Directorate Of Materials And Processes ASD conference on "High Temperature Polymer And Fluid Research" held in Dayton, Ohio, on 8-11 May 1962.

The purpose of this conference was to review the recent progress in both contractual and internal research programs sponsored by the Polymer Branch of the Nonmetallic materials Laboratory in the area of synthesis of new polymers and fluids.

2-373

ASD-TDR-62-373. A FEASIBILITY STUDY OF A THIONINE PHOTOGALVANIC POWER GENERATION SYSTEM. May 1962, 219p. incl illus., tables, 75 refs. P: 8173, T: 817301. C: AF 33(616)-7911, Sundstrand Aviation, Denver Engineering and Testing Lab., Pacoima, Calif. L. J. Miller. In OTS. ASTIA: AD 282878, Code AA. Unclassified

This report covers a feasibility study of the thionine photogalvanic system for converting solar energy to electrical energy. Theoretical and experimental investigations have been made to determine the maximum voltage and power available from the system. The effects of operating conditions as well as solution composition variables on cell performance have been studied. The low attainable concentration of leucothionine in the photostationary state at present prevents the utilization of the photogalvanic cell as a practical device. Electrode activation and long term dye stability are also important problems. Cell voltages up to 220 mv and power levels up to 1.8 μ watts were obtained. Although the voltage does not represent an improvement over the best previously reported voltage, the power is 1000 times more than the only other reported value. Estimates of the power, weight and cost of a photogalvanic cell have been made on the basis of present knowledge. Recommendations are made for more fundamental investigations to develop a better understanding of this system or similar systems, so that practical devices can be made.

2-373a

ASD-TR-61-373. SURFACE TEMPERATURE MEASUREMENTS WITH THERMOELECTRIC MATERIALS. Final rpt, Aug 1962, 119p. incl illus., tables, 32 refs. P: 1347, T: 134702. C: AF 33(616)-7377, Stanford Research

Inst., Menlo Park, Calif. W. Lai. In OTS. ASTIA: AD 286098, Code AA. Unclassified

Presented in this report is a study of the errors in surface-temperature measurements made with a thermocouple (TC), when both TC wires and surface are exposed to radiant energy. The errors arise from (1) net heat transfer at the TC junction, and (2) quality and stability (change in calibration) of the TC materials. Results from steady-state experiments show that heat-transfer errors are influenced by (1) specimen thermal conductivity and absorptivity, (2) orientation of the TC with respect to convection currents, (3) proximity of TC wires and specimen surface, (4) relative changes of absorptivity and over-all thermal conductivity due to thermal aging of the TC material, TC insulation, and the specimen and (5) heat flux level. Results of some transient heat experiments for a single specimen thickness, showed that response is greater for large TC wire diameter during the initial transient heating period but becomes independent of diameter when the heat flux rate reaches steady state. It was shown that moisture absorbed by the TC insulation has a negligible effect on the heat transfer error. The magnitude of errors from instability, which is independent of the quality of TC materials, depends upon exposure condition and duration. The calibration of commercial TC's, whether noble metal or base metal, will probably change less than 1°F after exposure below 1000°F in air for 1000 hours. Twisting the TC wires together and shielding power cables reduced pickup noise from thyratron power regulators to an acceptable level. Failure of TC's due to vibration at 40 cps and 2 to 3g acceleration for up to 4 hours is unlikely up to about 1300°F. A bibliography is appended.

2-377

ASD-TDR-62-377. STUDY OF BIOELECTRIC ENERGY SOURCES. Final rpt, June 1962, 166p. incl illus., tables, refs. P: 8173, T: 817303. C: AF 33(616)-7693, Ohio State Univ. Research Foundation, Columbus, Ohio. Quentin Van Winkle. Not in OTS. ASTIA: AD 284881, Code AA. Unclassified

A comprehensive literature review has been made on the subject of bioelectricity. The review includes the following topics: (1) survey of species which produce bioelectricity, (2) mechanism of production of bioelectricity, (3) electrochemistry of membrane phenomena, (4) preparation and properties of synthetic ion-selective membranes, and (5) production of electricity by ion diffusion. The electric discharge characteristics were determined for two species of knifefish and for the electric eel. Using the method of Langmuir and Waugh, very thin protein-lecithin membranes were prepared.

2-380

ASD-TDR-62-380. DEVELOPMENT OF AN ULTRA-HIGH VACUUM GAUGE. Final rpt, June 1962, 21p. incl

illus., 18 refs. P: 8222, T: 822203. C: AF 33(616)-6526, Univ. of Nevada, Reno, Nev. George Barnes. SRN: 1. Not in OTS. ASTIA: AD 283975, Code AA.
Unclassified

This report describes the results of an attempt to establish design criteria for a new kind of vacuum gauge, based on the idea that low pressure measurements can best be accomplished by literally counting individual particles rather than measuring the overall or gross effects of large numbers of them. The technique is to obtain scintillations of light from ions produced from the residual gases inside the vacuum system making use of the well known techniques of nuclear physics for counting the scintillations. Several unforeseeable side effects, which have so far prevented this gauge from becoming completely satisfactory in its operation, are discussed.

2-381

ASD-TDR-62-381. A FUNDAMENTAL STUDY OF THE INFRARED SPECTRA OF SUBSTITUTED AROMATIC COMPOUNDS. Final rpt, Aug 1962, 82p. incl illus., tables, 24 refs. P: 7360, T: 736005. C: AF 33(616)-8205, Southern Research Inst., Birmingham, Ala. W. C. Coburn, Jr., et al. In OTS. ASTIA: AD 286830, Code AA.
Unclassified

Attempts have been made to correlate the intensities of far infrared absorption bands of mono- and disubstituted benzenes with physical properties of the molecules or of their substituents. The intensities of ν_{18}' and ν_{19}' were measured for monosubstituted benzenes having these substituents: $-F$, $-Cl$, $-Br$, $-I$, $-CN$, $-CH_3$, $-CF_3$, $-CCl_3$, $-NO_2$, and OCH_3. Some second-degree correlations but no useful simple correlations were found. Correlations were sought for the intensity of ν_4 of symmetrical 1,4-disubstituted benzenes, a vibration probably not as likely to mix with other modes of its symmetry species as ν_{18}' and ν_{19}'. However, the intensities of ν_4 did not correlate well either.

Complete infrared spectra of all 38 compounds studied are cataloged from 4000 to 265 cm⁻¹.

2-386

ASD-TDR-62-386. MODIFICATION AND EVALUATION OF A CONCENTRATING PHOTOVOLTAIC GENERATOR. Final rpt, June 1962, 124p. incl illus., tables. P: 8173, T: 817301. C: AF 33(616)-7346, Electro-Optical Systems, Inc., Pasadena, Calif. R. Spies. 1530-Final. Not in OTS. ASTIA: AD 282212, Code AA.
Unclassified

The applicability of concentrating photovoltaic power systems to space operations was studied. Eight programs were undertaken: component improvement, 50-watt model modification, environmental test and evaluation, particle degradation analysis, spectrum determination of optical system, panel diagnostics, thermal test and

evaluation and analysis of concentrating systems. Work has been done in each of these phases. Where possible, new components were evaluated and incorporated; effect of particle shielding on performance was found; the spectrum available for energy conversion was determined; various concentrating schemes were analyzed. Tests were made to determine thermal characteristics in a simulated space environment and to determine losses due to mismatching of components, uneven illumination and wiring resistance. Operation in a space environment was confirmed and all effects proved predictable.

2-386a

ASD-TR-61-386. DEVELOPMENT OF NEW AND USEFUL ELEVATED TEMPERATURE STEELS FOR AIRCRAFT APPLICATIONS. Final rpt, June 1962, 72p. incl illus., tables. P: 7381, T: 738102. C: AF 33(616)-7376, Crucible Steel Co. of America, Pittsburgh, Pa. A. Kasak, V. K. Chandhok, E. J. Dulis. In OTS. ASTIA: AD 282927, Code AA.
Unclassified

A heat-treatable stainless steel with an outstanding combination of strengths at ambient and elevated temperatures was developed. Of the experimental steels studied, the 0.15C-14.5Cr-Mo-V-Co type showed the best combination of desired characteristics and properties. Analysis of the effects of the alloying elements show that Mo is an effective room- and elevated-temperature strengthening agent in these steels. The strengthening mechanics is associated with precipitation of a FeMoCr intermetallic compound. On the basis of work on laboratory-sized heats, a nominally 0.15C-14.5Cr-5Mo-0.5V-13.5Co steel (AFC77) was selected for scaling-up for production on mill facilities. It was produced by air-induction and vacuum-arc-remelting methods and processed to bar and sheet products without difficulty. AFC77 has very high strength (290,000 psi tensile strength) at ambient temperature and retains its strength remarkably well up to about 1200°F (120,000 psi tensile strength at 1200°F). It has appreciably higher strength, particularly in prolonged exposures, than any stainless steel known today. The excellent strength properties over a wide range of temperatures are accompanied by good ductility; good formability and weldability are indicated. AFC77 is also resistant to atmospheric corrosion and oxidation.

2-388

ASD-TDR-62-388. CALCULATION OF STACKING FAULT ENERGIES FOR FACE-CENTERED CUBIC METALS. Final rpt, May 1962, 10p. incl illus., tables, 14 refs. P: 7353, T: 735302. Harold L. Gegel. In OTS. ASTIA: AD 282001, Code AA.
Unclassified

A theoretical investigation was undertaken to determine the stacking fault energy for face-centered cubic metals. An expression was derived which relates the Debye characteristic temperature of the metal and the absolute temperature to the stacking fault energy. An Einstein oscillator was used as a model for the derivation.

2-392a (Vol I)

ASD-TR-61-392, Vol I. REFRACTORY METALS STRUC-TURAL DEVELOPMENT PROGRAM: Selection and Analysis of Structural Component. Final rpt, June 1962, 85p. incl illus., tables, 2 refs. P: 1368 and 7381, T: 13719 and 73810. C: AF 33(616)-6578, McDonnell Aircraft Corp., General Electric Co., St. Louis 66, Mo. C. W. Neff, R. G. Frank. Not in OTS. ASTIA: AD 284418, Code AA. Unclassified

The unique requirements of this program have effected close cooperation of inter-related groups involving structural engineers, designers, fabrication specialists, physical and process metallurgists, coating and test specialist. This constitutes a fruitful approach to the complexity of problems at hand and provides a guide as to how such programs should be administered in the future. An immediate result of this type of approach has been the resolution of many problems involving the integration of various technologies and is likely to result in a more realistic and rational approach to over-all problems in the future.

Distinctive problem areas encountered in this program included: (1) material processing, (2) joining and (3) coating. Many phases of these problems have been partially solved and the sponsoring agency has initiated supplemental programs to investigate and solve other phases of the same problems and also, other problems.

2-392a (Vol III)

ASD-TR-61-392, Vol III. REFRACTORY METALS STRUCTURAL DEVELOPMENT PROGRAM: Design, Fabrication, and Testing Evaluation. Final rpt, Sept 1962, 195p. incl illus., tables. P: 1368 and 7381, T: 136804 and 73810. C: AF 33(616)-6578, McDonnell Aircraft Corp., P.O. Box 516, St. Louis 66, Mo.; General Electric Co., Flight Propulsion Lab. Dept., Evendale, Ohio. C. W. Neff, McDonnell Aircraft; R. G. Frank, General Electric. Not in OTS. ASTIA: Code XX. Unclassified

This particular report, Volume III, is one of a series of five volumes. The data compiled within this volume describes the processes involved to evaluate various designs and fabrication techniques prior to final component design and fabrication. The final component, a representative load carrying structure capable of efficient operation in the temperature range of 1800°F to 2500°F, was fabricated from columbium F-48 alloy and coated with the LB-2 (Al-Cr-Si) slurry coating for oxidation protection.

2-392a (Vol IV)

ASD-TR-61-392, Vol IV. REFRACTORY METALS STRUCTURAL DEVELOPMENT PROGRAM: Structural Component Design and Fabrication. Final rpt, Aug 1962, 109p. incl illus., tables. P: 1368 and 7381, T: 13719 and 73810. C: AF 33(616)-6578, McDonnell Aircraft

Corp., St. Louis, Mo.; General Electric Co., Evandale, Ohio. C. W. Neff, R. G. Frank. Not in OTS. ASTIA: Code XX. Unclassified

Information is given on the design and fabrication of a representative load carrying structural component capable of efficient operation in the temperature range of 1800°F to 2500°F. The final component (fin-rudder assembly), basically was fabricated from F-48 columbium alloy and coated with General Electric LB-2 (Al-Cr-Si) slurry coating for oxidation protection. Major problem areas such as material processing, joining, and protection are discussed.

2-393

ASD-TDR-62-393. RESEARCH ON LINEAR OPERA-TORS WITH APPLICATIONS TO SYSTEMS ANALYSIS. Final rpt, June 1962, 67p. incl illus., tables, 11 refs. P: 5227, T: 50932. C: AF 33(616)-7994. The Univ. of Texas, Austin, Tex. Ralph E. Lane. In OTS. ASTIA: AD 278171, Code AA. Unclassified

In this report a transformation which has the following properties is said to be a linear operator: If f is a member of a certain class of quasi-continuous functions, then Tf is a function. Note that the function f need not have a derivative, and it need not even be continuous; $i^\wedge$ may be a step-function or almost any other kind of function with which one may need to deal.

If $f = f_1 + f_2$, then $Tf = Tf_1 + Tf_2$; and k is a number, then $T(kf) = k(Tf)$. That is to say, the transformation T is linear.

For each number s, there is a positive number B_s such that if $M \geq |f(s-t)|$ for each number t in a certain set, then $|Tf(s)| \leq MB_s$; that is to say, the transformation T is bounded.

The present status of research on linear operator theory and applications is surveyed. The treatment is brief and non-technical—published papers and reports are referenced for details on specific topics. Technical emphasis is devoted to use of linear operator equations for solving problems about physical systems. Analysis of electric circuits is used as a framework to make the presentation specific. A summary of the required theory is given along with numerous examples. Appendix A treats the application of linear operator theory to the numerical approximation of solutions to differential equations.

2-394

ASD-TDR-62-394. ELEVATED TEMPERATURE CREEP PROPERTIES OF 17-7 PH AND A-286 STAINLESS STEEL. Final rpt, July 1962, 40p. incl illus., tables, 5 refs. P: 7381, T: 738103. Marvin Knight. In OTS. ASTIA: AD 285471, Code AA. Unclassified

The creep properties for 17-7 PH stainless steel were investigated at room temperature, 600°, 800°, and 900°F. The same properties were investigated for A-286 stain-

less steel at 1200°, 1350°, and 1500°F. The data includes ultimate tensile strength, tensile yield strength, elongation, creep deformation, and creep rupture properties.

2-397

ASD-TDR-62-397. THERMALLY ACTIVATED CERAMIC-METAL CELLS. Final rpt, June 1962, 93p. incl illus., tables, 4 refs. P: 8173, T: 817302. C: AF 33(616)-8231, Westinghouse Electric Corp., Lima, Ohio. R. D. Turner et al. In OTS. ASTIA: AD 284891, Code AA. Unclassified

Investigations were made of the energy conversion mechanism in thermally activated ceramic-metal cells. Research was focused upon the iron anode, lithium borosilicate enamel-electrolyte and silver cathode cell configuration. The cell operation temperature range was 450° to 700°C with 600° being the most satisfactory. The silver cathode functioned as a gas electrode which absorbed oxygen. The enamel's ionic conductivity increased with temperature and transferred O^{--} from the cathode to the anode. Electric power generation resulted from the free energy of anode oxidation reaction which can be predicted by the Nernst equation. Chemical analyses of discharged cells indicated lithium migrated in the electrolyte to the cell cathode. Recharging of cells was not successful due to the iron oxide stability; however, anomalous charge storage was noted at 450°C. Cells made of more reactive anode materials were studied. An alloy of Li, Mn, Al, and Si gave approximately twice the power density of the iron anode cell.

2-398

ASD-TDR-62-398. FERROELECTRIC ENERGY CONVERSION. Final rpt, June 1962, 49p. incl illus., tables, 28 refs. P: 8173, T: 817302-7. C: AF 33 (616)-7940, ITT Federal Lab., Nutley, N.J. S. R. Hoh, F. E. Pirigyi. In OTS. ASTIA: AD 282414, Code AA. Unclassified

A study was conducted to explore the usefulness of ferroelectric energy conversion for flight vehicle power supplies. The development of barium titanate-based materials was encouraging and fruitful. Ceramic sheets with very high values of polarization, permittivity, and insulation resistance were prepared. A new approach for introducing low valency anions such as fluorine simultaneously with high valency cations such as uranium proved successful and practical. The conversion efficiency does not exceed 1% with $BaTiO_3$-based compositions, but good specific outputs can be calculated for very thin ferroelectric films.

2-399

ASD-TDR-62-399. STRESS WAVE PROPAGATION AND SPALLATION IN UNIAXIAL STRAIN. Final rpt, Sept 1962, 125p. incl illus., tables, 41 refs. P: 6906, T: 690601. C: AF 33(616)-6373, Massachusetts Inst. of Technology, Cambridge, Mass. W. Herrmann, et al. In OTS. ASTIA: Code XX. Unclassified

A discussion of the analytical methods of predicting uniaxial stress wave propagation and spall as a result of uniformly distributed intense impulsive loading is given. For the materials for which data currently exists, no strain-rate effects are observed on yield (i.e., two aluminum alloys) and the strain-rate effect on the fracture threshold is found to be small (copper). For such materials a detailed analytical treatment is possible, once the constants associated with the constitutive equation and fracture criterion are evaluated. The plate impact experiment provides a convenient means of evaluating these constants. Considerations entering into the interpretation of the plate impact experiment and a detailed analysis of the effect of air between the impacting plates, are given.

2-400

ASD-TDR-62-400. ABLATIVE ELASTOMERIC INSULATION MATERIALS. Final rpt, Aug 1962, 29p. incl illus., tables, 3 refs. P: 7340, T: 734005. Roger E. Headrick. Not in OTS. ASTIA: Code XX. Unclassified

This is a report of a preliminary investigation of representative vulcanizates of nearly all types of elastomeric polymers as ablative insulations from oxy-acetylene torch and the arc-plasma jet evaluations. In these evaluations acrylonitrile/butadiene copolymer (NBR) based compounds, which are now the most widely used in insulation compounds, were rated only fair among the materials investigated. The silicones, the polysulfides, and vinyl pyridine/acrylonitrile vulcanizates exhibited appreciably higher thermal protection than did NBR vulcanizates. Also reported are the results of a literature survey and a detailed discussion of the evaluation procedures and equipment.

2-401

ASD-TDR-62-401. BIAXIAL STRESS AND STRAIN DATA ON HIGH STRENGTH ALLOYS FOR DESIGN OF PRESSURIZED COMPONENTS. Final rpt, July 1962, 191p. incl illus., tables, 12 refs. P: 7381, T: 738103. C: AF 33(616)-7720, Chance Vought Corp., Dallas, Tex. E. L. Terry, S. W. McClaren. In OTS. ASTIA: AD 283348, Code AA. Unclassified

A cross shaped specimen was developed for generating complete biaxial stress-strain curves under 1:1 and 2:1 biaxial tension stress ratio loading. Tests on several materials have shown that the specimen has good reliability.

The influence of strength level on the behavior of the 5CrMoV steel under biaxial loading was investigated. These tests showed that by lowering the uniaxial strength level from 280 to 260 ksi, the shattering type failure observed at the 280 ksi level ceased to exist. However,

the biaxial failure strains did not increase as the strength level was decreased.

Good correlation was obtained between the failure stresses from the pressure vessels and the biaxial specimens.

The data is presented in a form which can be used directly in the design of biaxially loaded components. The test materials are ranked according to the efficiency parameters "biaxially ductility rating," "resistance to crack-like flaws," and "biaxial strength weight."

2-404

ASD-TDR-62-404. TRACK TESTS OF CANOPY ESCAPE CAPSULE. Aug 1962, 86p. incl illus., tables, 5 refs. P: 1362, T: 136203. T. P. Lubinski. In OTS. ASTIA: AD 287281, Code AA. Unclassified

This report presents the results of all of the track tests for the Air Force Canopy Escape Capsule. The purposes of these tests were to evaluate the ejection and recovery of the capsule and to obtain aerodynamic, structural, component functioning, and physiological information. Descriptions of the capsule model, test equipment, and test procedure are included in the report.

Feasibility of the canopy-type capsule method of escape was not fully demonstrated because the track tests were terminated prior to completing the design range of test velocities and because the test results indicated a need for an evaluation of the stability and impact problems of the capsule for these velocities.

The tests showed that unguided separation of the capsule was successful, that proper functioning of the recovery system was demonstrated for the 150-knot run, and that low-level ejection capability of the escape capsule was indicated.

2-406

ASD-TDR-62-406. STRENGTH PROPERTIES OF RE-INFORCED PLASTIC LAMINATES AT ELEVATED TEMPERATURES. (Silicone-Asbestos, R/M Pyrotex Felt 45-RPD). Final rpt, Sept 1962, 39p. incl illus., tables, 6 refs. P: 7381, T: 738103. C: AF 33(616)-61-06, Forest Products Lab., Forest Service, U.S. Dept. of Agr., Madison, Wis. K. H. Boller. Not in OTS. ASTIA: Code XX. Unclassified

This report on a reinforced plastic laminate (silicone-asbestos laminate made of R/M Felt Style 45-RPD) is the sixth of several reports that present strength and elastic properties at elevated temperatures. Properties of this silicone-asbestos laminate were evaluated in flexure, tension, compression, interlaminar shear, and bearing parallel to the machine direction of the felt. In general the strength retention with increasing severity of exposure is high. Strength drops with the first absorption of heat, but at constant temperatures of 300° to 700° F, the exposed material hardens and has a tendency to

either maintain constant strength or even increase in strength. Continued increasing temperatures above 700°F cause decreases in strength but never a complete loss within the limits evaluated. From the curves and data presented, the effects of temperatures between 80° and 1,000°F and exposure periods between 0.05 and 1,000 hours on individual strength properties may be judged and interpreted separately.

2-413

ASD-TDR-62-413. PERFORMANCE EVALUATION OF PARACHUTE CANOPIES WITH VARIOUS CLOTH PERMEABILITIES. June 1962, 65p. incl illus., tables, 4 refs. P: 6065, T: 6065-03. R. J. Gross, C. V. Eckstrom. Not in OTS. ASTIA: AD 284395, Code AA. Unclassified

Parachute drops from aircraft and a whirl tower were conducted on parachute canopies that had been stored for 12 years to determine the effects of age upon cloth permeability and opening characteristics of the canopies. These flat-circular canopies were 24 feet in diameter and made of 1.6-ounce nylon cloth. They had permeabilities ranging between 50 to 270 cubic feet of air per square foot of cloth per minute. The canopies, originally fabricated in 1947, were subjected to "captive" whirl-tower testing at that time. After the 12-year storage, both cloth permeability and deployment of canopy tests were conducted to compare results with those obtained from 1947 tests of these same canopies. In addition, twisted suspension-line tests were conducted to validate all tests under actual operational conditions. The results of tests conducted confirm the relationship between cloth permeability and opening force and time. No essential changes in opening characteristics or cloth permeability were indicated after a 12-year aging period.

2-417

ASD-TDR-62-417. FEASIBILITY INVESTIGATION AND DEVELOPMENT OF 2000°C RESISTANCE TEMPERATURE SENSOR. Final rpt, July 1962, 57p. incl illus., tables, 10 refs. P: 8224, T: 822401. C: AF 33(616)-8263, Advanced Technology Lab., Div. of American-Standard, Mountain View, Calif. J. T. Chambers. ATL-D-757. Not in OTS. ASTIA: AD 282358, Code AA. Unclassified

A program was undertaken to determine the practical feasibility of developing a resistance thermometer, composed of an iridium resistance element mounted in yttrium oxide, for measuring temperatures in solids in the range 500 to 2000°C in an oxidizing environment. A sensor design was evolved that embodies a flat grid of 10 inches of 3-mil iridium wire with 10-mil iridium leads. This sensing element is cast in yttrium oxide under pressure, and the sensor is consolidated by high-temperature sintering.

The resistance-temperature curve of unencapsulated iridium wire was established experimentally as a standard of comparison for the sensors, since this information is not available in the literature. A rapid decrease in the apparent resistance of the wire above 1600°C was noted; this was attributed to shunting through impure oxides in the calibrating installation. Calibration of model sensors was carried to 2010°C, but electrical shunting again placed the upper valid limit of the results at 1400°C. The accuracy of the sensor calibrations was within ±1% in the range 500 to 1400°C, and within ±1½% in the range 300 to 1400°C.

It is concluded that a resistance thermometer of iridium mounted in yttria is feasible to at least 1400°C. It is probable that the range can be extended to 2000°C by improving controls on the purity of the oxides used with the iridium wire. Recommendations are made for continued development and testing.

2-418

ASD-TDR-62-418. HIGH TEMPERATURE COMPOSITE STRUCTURE. Final rpt, Sept 1962, 253p. incl illus., tables, 22 refs. P: 1368, T: 136804. C: AF 33(616)-7497, Martin Co., Baltimore, Md. R. M. Davis, C. Milewski. RR-30. Not in OTS. ASTIA: Code XX.
Unclassified

Two re-entry heat shield systems intended for efficient operation with surface temperatures in the range of 3000° to 4000°F when adapted to spherical nose cap shapes were designed, developed, fabricated, tested, and evaluated. The heat shields were of the radiative type, utilizing a foamed aluminum oxide material in the structural insulation design concept. Dense facings and resin impregnation were used to alter the basic foam, with the latter proving to be the better modification, as shown by simulated re-entry tests in a large hot gas facility. Effects of various combinations of plasma jet enthalpy and heating rates on resin-impregnated ceramic foams were compared. These more closely simulated re-entry conditions for ablative (and semi-ablative) type materials.

2-419

ASD-TDR-62-419. RESEARCH ON DYNAMIC SELF-ORGANIZING PATTERN RECOGNITION MODEL. Final rpt, June 1962, 57p. incl illus., tables, 8 refs. P: 4160, T: 4160-01. C: AF 33(616)-7867, Lab. for Electronics, Inc., Boston, Mass. R. R. Evans. SRN: TP-291. Not in OTS. ASTIA: Code NC.
Unclassified

This report presents the results of an investigation into the properties of a dynamic pattern-recognition system involving a Scanner whose operation was suggested by some of the properties of the human eye. The output from the Scanner is a sequence of the primitive percepts into which the pattern may be decomposed, and the sequence itself constitutes a sample function of a Markov

process which is unique for each pattern class. Various decision processes are suggested for identifying the process, and, hence, the pattern. Neural analog networks are used to identify the primitive percepts. A learning procedure is presented for identifying patterns for which a list of attributes has been measured.

2-421

ASD-TDR-62-421. EVALUATION OF COATING SYSTEMS FOR HIGH STRENGTH, LOW ALLOY STEEL EXTERIOR MISSILE AND ROCKET CASINGS. Final rpt, May 1962, 67p. incl illus., tables. P: 7381, T: 738101. C: AF 33(616)-7739, Armour Research Foundation, Chicago, Ill. H. R. Nelson, K. E. Hofer. In OTS. ASTIA: AD 287873, Code AA.
Unclassified

Existing organic coating systems were evaluated by exposing coated specimens to environments to which missile and rocket casings may be exposed during fabrication, storage, shipment, and readiness. SAE 4340 steel was the substrate material. The protection afforded the substrate was evaluated by direct tests of the coatings or by the change in the performance of the coating or substrate following exposure to various adverse environments.

Sixteen systems were studied. Tension, fatigue, embrittlement, abrasion, adhesion, flexibility, stress-corrosion, thermal change and humidity, accelerated weathering and salt spray corrosion were the tests made.

2-425

ASD-TDR-62-425. SOME RESULTS OF EXPERIMENTAL INVESTIGATIONS OF THE SURFACE PRESSURE FIELD DUE TO A TURBULENT BOUNDARY LAYER. Progress rpt, Aug 1962, 56p. incl illus., 8 refs. P: 1370, T: 137005. C: AF 61(052)-358, Univ. of Southampton, Dept. of Aeronautics and Astronautics, Hampshire, Eng. M. K. Bull, J. L. Willis. Tech Note No. 1. Not in OTS. ASTIA: AD 284433, Code AA.
Unclassified

Experimental results for the space-time correlations of fluctuating pressure field of turbulent boundary layer are given, and empirical representation of the pressure field suitable for structural response calculations is put forward. Variation with Mach number of rms pressure as function of skin friction is given for Mach numbers up to about 1.6. Probability distribution of the pressure fluctuations at a fixed point in the field is found to approximate closely to Gaussian. Acoustic power output from a boundary layer on a larger boundary surface is obtained as roughly $2.10^{-4} \rho_\infty U_\infty{}^6 S / a_\infty{}^3$. Spectra of boundary layer noise in two jet aircraft are presented and compared with the spectrum of boundary layer excitation.

2-426a

ASD-TR-61-426. STUDY OF PRESSURE PACKING TECHNIQUES FOR PARACHUTES. Final rpt, June 1962, 47p. incl illus., table. P: 8151, T: 60151. C: AF

41

33(600)-39643, Space Recovery Systems, Inc., El Segundo, Calif. SRS-613. Not in OTS. ASTIA: AD 282341, Code AA.   Unclassified

This report summarizes the results of a parachute pressure packing investigation designed to find optimum parachute volume reduction techniques. Included are a description of the test equipment and a discussion of the influence of parachute types, time rate of pressure application and container shapes on the pack density. The results are presented in graph form.

The study revealed that pressure packing using a mechanical press can reduce the volume of a good hand-packed parachute by approximately fifty percent under application of about 100 PSIG of pressure. This results in a pack density of 45 pounds per cubic foot. The obtained pack densities are independent of parachute type and time rate of pressure application.

2-427a

ASD-TR-61-427. LITHIUM HYDRIDE AS A THERMAL ENERGY STORAGE MATERIAL. May 1962, 94p. incl illus., 4 refs. P: 3145, T: 314507. Editors: F. L. Woods, 1st/Lt., USAF, O. K. Houck, M. P. Wannemacher. Not in OTS. ASTIA: AD 284185, Code AA.
                                                   Unclassified

Since problems were being encountered with lithium hydride as a thermal storage material, a conference was held at ASD to gain an insight as to the knowledge possessed by various companies that were engaged in work with lithium hydride. Seven firms gave presentations on their experiences in the manufacture of lithium hydride, fabrication of containment devices, and various tests on lithium hydride to determine its feasibility as a thermal energy storage material. After the presentations, a panel discussion and a question and answer period were held. This discussion included the following topics: lithium hydride corrosion phenomena, hydrogen generation, thermodynamic properties of lithium hydride, and general information on handling and filling techniques. Information presented by the manufacturers and a coverage of the panel discussion are included in this report.

2-429

ASD-TDR-62-429. EFFECTS OF AQUEOUS SOLUTIONS ON LATENT IMAGES. Final rpt, Aug 1962, 8p. incl illus., tables. P: 6237, T: 623701. A. C. Zonars. Not in OTS. ASTIA: AD 286023, Code AA. Unclassified

Aerial photographic films of various exposure indexes were subjected to immersion in different aqueous solutions and distilled water before processing. Degradation to photographic characteristics were: (1) increase in chemical fog (density), (2) loss in sensitivity and contrast (gamma), and (3) mottling, staining, and peeling of the emulsion. Low-speed aerial films with exposure index values of 1.6 to 6 were more significantly affected by the immersion than medium-speed films with exposure index values of 20 to 80.

2-432

ASD-TDR-62-432. INVESTIGATION OF DIFFUSION BARRIERS FOR REFRACTORY METALS. Final rpt, July 1962, 87p. incl illus., tables, 30 refs. P: 7312, T: 731201. C: AF 33(616)-6354, ManLabs, Inc., Cambridge, Mass. E. M. Passmore, J. E. Boyd, B. S. Lement. In OTS. ASTIA: AD 285569, Code AA.   Unclassified

Thirty-three base barrier combinations involving the four refractory metals W, Mo, Ta, and Cb and 12 potential barrier metals having melting points over 1700°C were evaluated for relative interdiffusion behavior at 1700° C and 1800°C. The relative extent of interdiffusion decreases with increasing base-barrier solidus temperature, although wide variations occur for melting points up to 2100°C. Interdiffusion in the Mo-Cr combination was found to be substantially reduced by the presence of a Re barrier.

Re, Ru, and Ir barriers appear optimum for W base metal; W, Re, Ru, and Ir appear optimum for Ta; and W, Re, Os, and Zr appear optimum for Cb.

The thickness (X) of the total interdiffusion zone as well as of the intermediate phase layers in the W-Re, Mo-Re, Ta-Re, and Cb-Re combinations was found to increase with time (t) in accordance with the relationship $X^n = kt$, with values of n in the range 1.4 to 4.9.

2-435

ASD-TDR-62-435. INVESTIGATION OF POLYBENZIMIDAZOLE FIBERS AT HIGH TEMPERATURE. Final rpt, July 1962, 17p. incl illus., tables. P: 7320, T: 732001. Frederic S. Dawn, Jack H. Ross. Not in OTS. ASTIA: Code XX.   Unclassified

An investigation was conducted on the behavior of fibers spun from polybenzimidazole (PBI) during and after exposure to high temperatures and gamma radiation environment. The yarn has an initial tenacity of 4.1 grams per denier and 6.8 percent rupture elongation, and at 600°F (with a 15 minute exposure time) has a tenacity of 2.6 grams per denier and 9.2 percent rupture elongation. As a comparison, the tenacity of HT-1 dropped from 5.92 to 2.51 grams per denier for the same temperatures (except exposure time was 5 minutes). (1) The PBI yarn was found to be structurally intact after exposure to 977°F for 5-10 minutes. (Future work will include determination of strength properties at this temperature). The strength of the PBI fiber was approximately 10 percent less than that of HT-1 after gamma radiation exposure to 1.4×10^9 ergs gm^{-1} carbon hr^{-1} total dosage. These results indicate that fibers of this polymer are definite candidates for utilization in expandable structures and decelerators where temperatures of 600° to 900°F are anticipated.

2-439

ASD-TDR-62-439. APPLICABILITY AND EFFICIENCY OF ANGLE RETURN ARRAYS (VAN ATTA ARRAYS) IN PASSIVE COMMUNICATION SATELLITES. June 1962, 18p. incl illus., 3 refs. P: 698-G. Y. E. Stahler. Not In OTS. ASTIA: AD 284396, Code AA. Unclassified

This report treats the feasibility of automatic angle return arrays (Van Atta arrays) as elements of a passive communication satellite.

Although the reflection from a Van Atta array theoretically does not appear to depend on angle of incidence, the requirements of a passive communication satellite severely limit the applicability of such arrays and practically annihilate the angle independence. Particularly degrading requirements are: the need for three-dimensional symmetry of the reflection, the independence from the plane of polarization, and a wide frequency range.

Practical tests show that Van Atta arrays at short wavelengths are not as independent of angle as theoretically assumed. Finally the overall gain of a spherical arrangement of Van Atta arrays is estimated, and the directivity may be improved by approximately 10 decibels. This improvement appears rather insignificant if compared with the 7-decibel gain of an extremely simple wire-grid sphere.

2-442

ASD-TDR-62-442. EFFECT OF SHOCK-INDUCED HIGH DYNAMIC PRESSURES ON IRON-BASE ALLOYS. Final rpt, Aug 1962, 86p. incl illus., tables, 3 refs. P: 7351, T: 735103. C: AF 33(616)-8190, Pratt and Whitney Aircraft Div., E. Hartford, Conn. S. M. Silverman, Loren Godfrey, et al. SRN: PWA-2050. In OTS. ASTIA: AD 287473, Code AA. Unclassified

The object of this program was to investigate the effect of high dynamic pressures generated by strong shock waves on the metallurgical properties of selected iron based alloys. This investigation included a study of the effects of shock wave duration, repeated shocks on a single test specimen, increasing shock wave intensity, and post shock treatment on the yield and tensile strengths of H-11 tool steel and 25 percent nickel steel. As a result of explosive shock hardening, H-11 steel increased in yield strength from 235 ksi in the pre-shocked condition to 340 psi in the as-shocked (360 kilobars) condition, while the 25 percent nickel steel showed yield strength increases from 235 ksi in the austenitized-plus-aged condition to 255 psi in the shocked-plus-aged condition. These increases in yield strength were brought about without any significant macroscopic plastic deformation.

2-443

ASD-TDR-62-443. RESEARCH FOR LOW AND HIGH EMITTANCE COATINGS. Final rpt, May 1962, 92p.

incl illus., tables, 121 refs. P: 7340, T: 734007, C: AF 33(616)-7276, American Machine and Foundry Co., Alexandria, Va. E. A. Schatz, L. C. McCandless. Not in OTS. ASTIA: Code XX. Unclassified

Eight transparent protective coatings for gold were evaluated with respect to their ability to withstand temperatures of 1000°C and not to significantly increase the low total emittance of the substrate. Thin coatings, of the order of 100mμ, of vacuum evaporated SiO, Al$_2$O$_3$, and WO$_3$ were found to be highly satisfactory. Samples with a protective topcoat over gold which in turn was applied over a diffusion barrier coating of CeO$_2$, were able to maintain a total normal emittance of less than 0.1 for up to twenty hours at 1000°C in air. A second aspect of the work was the study of the spectral normal emittance in the 1-15μ wavelength range at 1000°C of sintered binary mixtures of pure compounds to correlate the spectral emittance of a mixture with the crystal structure of the sample and the spectral emittance of the pure components. Such a correlation would allow the preparation of coatings with any desired emittance characteristics. Forty-seven sintered samples were measured including various mixtures of Y$_2$O$_3$-Cr$_2$O$_3$, Al$_2$O$_3$-Cr$_2$O$_3$, MoSi$_2$-Cr$_2$O$_3$, Al$_2$O$_3$-SiO$_2$, and Al$_2$O$_3$-NiO. No significant correlation was found between the crystal structure and the spectral emittance. In most cases, the spectral emittance at any wavelength for the binary mixtures was between the values for the spectral emittance of the pure components. In some cases, however, the spectral emittance at a given wavelength was higher or lower than for either of the pure components.

2-445

ASD-TDR-62-445. THE MECHANICAL DESIGN OF A HIGH TEMPERATURE MACH NUMBER 4 AXISYMMETRIC WIND TUNNEL NOZZLE. Final rpt, June 1962, 23p. incl illus., tables, 10 refs. P: 1426, T: 1426-01. James T. Van Kuren, 1st/Lt., USAF. Not in OTS. ASTIA: AD 284166, Code AA. Unclassified

The mechanical and thermal design of a high temperature axisymmetric Mach number 4 nozzle is presented in detail.

This nozzle is used in the ASD High Temperature Gasdynamics Facility. The heat source for this facility is a zirconia, pebble-bed, storage heater. The thermal and mechanical stresses in a nozzle wall are analyzed to achieve an optimum structure at the design air flow conditions of 600 psia and 4000°F stagnation temperature. Metallurgical and thermal properties are considered in the selection of the nozzle wall material. Coolant selection and coolant channel design are given. Criteria are presented for selecting other components in the nozzle assembly including a heat-sink back-up block.

2-446

ASD-TDR-62-446. DEVELOPMENT OF A MAGNETRON-TYPE CONTINUOUS-WAVE BACKWARD-WAVE OSCIL-

LATOR. Final rpt, Sept 1962, 83p. incl tables, illus., 25 refs. P: 4156, T: 415603. C: AF 33(600)-36806, Sylvania Electric Products, Inc., Microwave Device Div., 500 Evelyn Ave., Mountain View, Calif. R. R. Moats. BPSN 8(8-4136)-41533. Not in OTS. ASTIA: Code XX.
Unclassified

Development of a backward-wave magnetron (BWM) oscillator voltage tunable over the 10.8- to 15.0-Gc frequency range with a CW power output of 125 watts is described. The basic electrical design parameters of the magnetron were scaled in part from the X-band Type 7095 BWM. The major effort of the project was directed toward fundamental design improvements consistent with the higher frequency range. Six tubes meeting or closely approaching most of the objective specifications for electrical performance were completed. Significant improvements over earlier, lower-frequency BWM's include: (a) a ceramic mount for the electron gun which is highly stable under temperature changes and mechanical vibration, (b) a single-ridge stepped output transducer with the desired bandwidth and mechanical characteristics, and (c) a heater embedded in the cathode to minimize problems of heater burnout and sagging.

2-450

ASD-TDR-62-450. SILVER OXIDE-CADMIUM BATTERY PROGRAM. Final rpt, Aug 1962, 99p. incl illus., tables. P: 8173, T: 817304. C: AF 33(600)-42988, Power Sources Div., Telecomputing Corp., Denver, Colo. John W. Rhyne. Not in OTS. ASTIA: AD 287224, Code AA.
Unclassified

The problems associated with the design and development of a sealed silver oxide-cadmium secondary cell for aerospace applications have been investigated. These problems were considered to be primarily the development of high capacity electrodes that would be efficient over long cycle life, the problem of gas generation and recombination of evolved gases, the solubility and subsequent migration of silver within the cell, and the problems associated with maintaining the seal of the cells and battery under the specified conditions. A study was conducted on the effect of various organic agents of the type that form metal chelates on the solubility of silver oxide. No agent was found that materially reduced the activity of the silver solution. The majority of the materials tested adversely affected the silver electrode or directly reduced the silver oxide to free silver. A study was conducted on the effect of various organic addition agents to the electrolyte that might be effective in promoting the recombination of any evolved gases or in preventing the formation of gases through the mechanism of preferential oxidation or reduction. Two such materials were found, but both had adverse effects on the electrochemical activity of the silver electrode. Several separator systems were tested with regard to their effectiveness in withholding or preventing the migration of silver within the cells. Two materials were found to be more effective in this regard and to have other advan-

tageous properties than those which have been used in prior cells. These are Permion 300 and 600 manufactured by Radiation Applications, Inc.

2-452

ASD-TDR-62-452. ABSORBEFACIENT COATINGS FOR USE ON STAINLESS STEELS AND SUPERALLOYS AT ELEVATED TEMPERATURES. Final rpt, Aug 1962, 40p. incl illus., tables. P: 1347, T: 134704. C: AF 33(616)-8387, Battelle Memorial Inst., Columbus, Ohio. C. L. Peterson. W. D. Wood, P. D. Miller. Not in OTS. ASTIA: AD 287961, Code AA.
Unclassified

During structural test programs, more efficient simulation of the rapid temperature rises resulting from aerodynamic heating is accomplished by the application of absorbefacient coatings to high-performance flight vehicles. This increases the transfer of radiant energy from radiant-heat lamps to the test item. Conversion-type coatings and paints with absorbefacient pigments were evaluated for use on stainless steel (AISI 304) to 1500°F and on superalloys (Haynes 25, Haynes R41, and Inconel X) to 2000°F. The preparation and application of the coatings as well as the effects of the coatings on the heating rates of panels of the four alloys based on a screening evaluation utilizing infrared lamps are described. In addition, a metallographic study of the effect of some coatings on the substrate metal and the quantitative measurement of the absorptance of several of the better coatings are reported.

2-453

ASD-TDR-62-453. INTERFERENCE MEASUREMENT TECHNIQUES. Final rpt, Apr 1962, 231p. incl illus., tables, 18 refs. P: 4357, T: 435703. C: AF 33(616)-7424, General Dynamics/Astronautics, San Diego, Calif. C. L. Neal. AE52-0366. Not in OTS. ASTIA: AD 277066, Code AA.
Unclassified

The purpose of this program was to develop improved techniques for measuring electromagnetic interference (EMI). Existing techniques were investigated to improve interference measurement requirements of MIL-I-26600, "Interference Control Requirements, Aeronautical Equipment." Conducted and radiated measurement techniques were considered.

It was found that better control and standardization of test conditions could be achieved for more meaningful and repeatable test data. Methods were investigated toward reducing measurement cost and time. Techniques suggested toward this end include modifying methods for using EMI receivers and eliminating superfluous and/or redundant data taking.

An investigation was made into application of a method for measuring impedance of a closed series loop to measuring conducted interference. Areas are recommended for further investigation.

The problem of measuring and evaluating transient interference was examined in some detail. A definite need for a standard test procedure for solenoid-type equipments was established. A suggested standard procedure is presented. An evaluation was made of the various equipments which are used for the measurement of transient interference. Of particular interest was the applicability of computer techniques. Finally, a method was developed by which transients can be directly measured to MIL-I-26600 limits with an oscilloscope.

2-457

ASD-TDR-62-457. A THEORETICAL INVESTIGATION OF CRIMP INTERCHANGE IN A WOVEN FABRIC UNDER BIAXIAL STRESS. Final rpt, Aug 1962, 56p. incl illus., tables, and 4 refs. P: 7320, T: 732002. Peter G. Popper, 1st Lt, USAF. In OTS. ASTIA: Code XX. Unclassified

This report describes the theoretical behavior of a woven fabric which is subjected to biaxial stresses. The stress-strain equations are derived for an idealized plain-weave fabric which extends by means of crimp interchange. To obtain solutions to these equations it was necessary to use an iterative procedure on a digital computer. The results have been presented in several ways and may be used in the design of such items as pressurized structures. A number of sample solutions using the computer results are given.

2-459

ASD-TDR-62-459. VORTEX MAGNETOHYDRODYNAMIC GENERATOR EXPERIMENTAL TEST PROGRAM. Final rpt, June 1962, 73p. incl illus., tables. P: 8173, T: 817306. C: AF 33(616)-7808, AiResearch Mfg. Co., Los Angeles 9, Calif. H. G. Starck. SRN: SS-708-R. In OTS. ASTIA: AD 284164, Code AA. Unclassified

A vortex type magnetohydrodynamic generator was designed and fabricated on the basis of currently available materials, and was tested to determine the feasibility of obtaining electric power from a seeded combustion gas. The combustion gas was oxygen-hydrogen, seeded with potassium hydroxide solution.

A power output of 0.15 watts was obtained from a vortex channel which was 4 inches diameter and 1/2 inch wide with a magnetic field strength of 4000 gauss. The gas flow rate varied from 0.4 to 0.7 pounds per minute. This result compares with a theoretical output of 29 to 60 watts which was calculated by digital computer methods. The low output was due to material failures throughout the unit and particularly of the combustion chamber and the center electrode.

The study program indicated that the small vortex MHD generator has a significant potential provided that the material problems can be solved, either through the use of lower ionization temperature fluids or higher temperature materials.

2-461

ASD-TDR-62-461. CHARACTERIZATION AND EXTENSION OF SIMULATION CAPABILITIES OF THE LAS HIGH TEMPERATURE ARC FACILITY. Final rpt, Aug 1962, 72p. incl illus., tables, 8 refs. P: 7360, T: 736001. C: AF 33(616)-8115, Univ. of Chicago, Chicago, Ill. H. Halle, C. F. Price. In OTS. ASTIA: AD 288506, Code AA. Unclassified

The operation of an existing subatmospheric plasma arc facility was characterized to assist the user in selecting the proper simulation conditions for materials test application. To this end, eight principal test conditions were established within the operating limits of the arc, and the pertinent parameters describing the thermal environment were determined and tabulated. Subsequently, the hypersonic re-entry conditions corresponding to the thermal environment of the test conditions were computed and plotted on a velocity-altitude chart. In addition, an arc unit with water-cooled, non-consumable electrodes was developed to reduce contamination of the arc plasma. This arc, having double-ring electrode configuration, will generate plasma with a net average enthalpy of 8000 Btu/lb. The final phase of the program concerned testing various materials under different exposure conditions.

2-463

ASD-TDR-62-463. FURTHER STUDIES ON HIGH-SPEED UNSTEADY FLOW. Final rpt, Sept 1962, 90p. incl illus., tables, 29 refs. P: 1370, T: 137003. C: AF 33(616)-7883, Mass. Inst. of Technology, Cambridge, Mass. Garabed Zartarian, Harry Sauerwein. In OTS. ASTIA: Code XX. Unclassified

In furtherance of earlier studies by one of the present authors, three specific problems of high-speed unsteady flow are investigated. The first involves an extension of the shock-expansion method and its application to wing and body oscillations at large amplitude. Secondly, the unsteady Newtonian theory of Hayes and Probstein, with centrifugal and Coriolis effects included, is examined in the light of the nontrivial questions of computational organization and engineering usefulness. Thirdly, the subject of time-dependent airloads as influenced by rapid changes in the ambient environment is explored. Although the motion of two dimensional airfoils is emphasized, the difficulties are discussed which arise when one attempts to analyze three-dimensional cases.

2-464

ASD-TDR-62-464. FATIGUE PROPERTIES OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN GLASS FIBERS. Final rpt, Sept 1962, 21p. incl illus., tables, and 11 refs. P: 7381, T: 738103. C: DO 33(616)-6106. Forest Products Lab., Forest Service, U.S. Dept. of Agriculture, Madison, Wis. Kenneth H. Boller. Not in OTS. ASTIA: Code XX. Unclassified

Fatigue characteristics are presented for epoxy-type plastic laminates at various resin contents and reinforced with layers of unidirectional unwoven glass fibers. Fatigue properties were determined by axially loading flat laminates that had alternate layers at $0°$, $±5°$, $±10°$, and $±15°$ to the principal axis. Properties are also presented for three special constructions of unwoven glass fiber laminates in which 71.4 percent of the fibers are parallel to the principal axis, 85.2 percent are parallel to the principal axis, and all layers were parallel, with each layer supported by a "carrier" of 2-mil glass fabric. All experiments were conducted on unnotched specimens at zero mean stress after conditioning in an atmosphere maintained at $73°F$ and 50 percent relative humidity; loads were applied parallel to the principal axis.

2-473

ASD-TDR-62-473. INVESTIGATION OF OPTICAL TECHNIQUES FOR LUNAR TRACKING. Final rpt, Aug 1962, 256p. incl illus., tables, 14 refs. P: 4427, T: 442704. C: AF 33(616)-8242, Nortronics, A Div. of Northrop Corp., Hawthorne, Calif. Roger S. Estey. NORT 62-86. Not in OTS. ASTIA: AD 288573, Code AA.
Unclassified

This document details a study by which a tracker axis could be directed at the geometrical center of the partially illuminated disk of the moon or a planet. The technique proposed senses the circular part of the limb by measurements in the visible spectrum and computes error signals resolved along two orthogonal gimbal axes. Appropriate commands to servo motors close the control loops.

A feasibility-type breadboard has been designed, fabricated and tested. This optical device tracks automatically through the agency of a multiplier phototube, a sophisticated scanning unit and a digital computer. The gimbal angles are read to about 10 seconds. Tracking is reliable and precise to 15 to 20 arc-seconds at all phases except within 2.5 days of new moon. Within this limited unfavorable region the crescent is so narrow and faint that tracking is impossible because of a poor signal-to-noise ratio.

The design study and experimental confirmations have a space-oriented design potential as indicated.

2-477

ASD-TDR-62-477. NEEP NUCLEAR ELECTRONIC EFFECTS PROGRAM. Interim rpt, Mar 1962, 177p. incl illus., tables, 40 refs. P: 1448-50956. C: AF 33(616)-6235, Bell Telephone Lab., Inc., for Western Electric Co., Inc., New York 38, N.Y. Not in OTS. ASTIA: AD 278181, Code AA.
Unclassified

The effects of gamma-radiation damage on the important parameters governing the performance of semi-conductors have been evaluated, and the effects of pulsed gamma radiation on circuits designed for high radiation tolerance

have been studied. The performance of planar silicon devices under fast-neutron bombardment has been investigated. A study has been completed on the in-pile performance of AT-cut resonators which were exposed to an integrated neutron flux of 10^{18} nvt. Since a detailed knowledge of the fast-neutron flux is necessary to determine the accuracy of neutron damage results, a preliminary study has been initiated to determine the fast-neutron flux and energy spectra of the Pennsylvania State University water-moderated reactor. The effect of 16.8-Mev energy protons on the performance of $\underline{p}$-on-$\underline{n}$ gallium-arsenide solar cells has been determined.

The effect of the current degradation on the physical lifetime of solar cells passing through the inner Van Allen Radiation Belt has been determined for a series of circular and elliptical orbits.

2-480

ASD-TDR-62-480. FATIGUE AND DYNAMIC CREEP OF HIGH-STRENGTH STEELS. Summary rpt, Aug 1962, 105p. incl illus., tables, 3 refs. P: 7381, T: 738103. C: AF 33(616)-6946, Lessells and Associates, Inc., Boston, Mass. R. F. Brodrick. SRN: Proj. 681/c48. In OTS. ASTIA: AD 286832, Code AA. Unclassified

A program was conducted to obtain detailed tensile, stress rupture and fatigue data on a series of high-strength steels. Data were obtained from D6AC, LaBelle HT, Thermold J, Vascojet 1000 and Peerless 56, heat treated to nominal ultimate strength of 280,000 psi.

Tests were conducted at room temperature and at elevated temperatures, the particular temperatures being selected according to the material. Maximum test temperature was $1000°F$.

Dynamic creep data were obtained in conjunction with the fatigue tests.

2-483

ASD-TDR-62-483. STANDARD PROCEDURE FOR EVALUATION OF INFRARED EMISSION FROM PYROTECHNIC DEVICES. Final rpt, Aug 1962, 37p. R. A. Awock, et al. Not in OTS. ASTIA: AD 287525, Code AA.
Unclassified

This report recommends procedures for the evaluation of the Infrared (I.R.) output of pyrotechnic devices. Two formats with accompanying notes are described. The first outlines the minimum amount of information a researcher should furnish with his data; the second outlines a more complete and desirable description of the information his data sheet should contain. The purpose is to provide a sound and uniform basis for the meaningful exchange of information among the numerous workers in the field, to apply this information to various devices, and further, through this exchange to explain more fully the reaction mechanisms of pyrotechnics.

2-484

ASD-TDR-62-484. EXPERIMENTAL EVALUATION OF A SOLAR HEAT RECEIVER. Final rpt, July 1962, 212p. incl illus., tables, 16 refs. P: 3145, T: 30500. C: AF 33(616)-6624, AiResearch Mfg. Co. of Arizona, Phoenix, Ariz. J. W. McDonald. Not in OTS. ASTIA: AD 282265, Code AA.   Unclassified

The results of an applied research program to experimentally evaluate a small cavity-type solar heat receiver and integral lithium hydride thermal energy storage unit are described in this report. The operational characteristics of the heat receiver were determined using both solar energy and an artificial heat source. Heat was extracted by boiling mercury and dry air, respectively.

Both steady-state and cyclic (orbit simulation) tests were conducted using solar energy reflected into the cavity from a five-foot-diameter parabolic mirror. Subsequent long-term cycling tests were performed using an electrical resistance heater installed in the absorber cavity. No apparent depletion of thermal storage capacity occurred during approximately 190 hours of cumulative operation prior to the failure of a thermocouple weld which terminated the tests.

2-487

ASD-TDR-62-487. INVESTIGATION OF ELECTRIC RESISTANCE HEATED ROCKET FOR FEASIBILITY IN SPACE PROPULSION APPLICATIONS. Final rpt, June 1962, 45p. incl illus., tables, 5 refs. P: 3141, T: 01. C: AF 33(616)-8377, The Marquardt Corp., Van Nuys, Calif. J. M. Howard. TMC FR 25, 051. ASTIA: Code XX.   Confidential

An analytical and experimental evaluation of the feasibility of an electrical resistance heated rocket engine is described. Design analyses, engine configuration, and test results are presented. The materials and fabrication techniques investigated and used are also described. The resistance heated rocket concept is feasible and useful for a wide variety of missions in cislunar space.

2-488

ASD-TDR-62-488. STUDY OF TECHNIQUES FOR THE FORMATION OF SPHERICAL ROTORS. Final rpt, Aug 1962, 184p. incl illus., tables, 16 refs. P: 4431, T: 443121. C: AF 33(616)-8072, Minneapolis-Honeywell Regulator Co., Military Products Group, Minneapolis, Minn. W. E. Anderson, et al. MH MPG Report 1530-TRI. ASTIA: AD 332747, Code AA.   Confidential

This is a report on the study of techniques for the formation of spherical rotors. Results of sphere fabrication efforts, surface finishing experiments, film studies, new lapping machine designs, a local material removal rate calibration, precision measurement techniques, gas bearing and flotation balancing, lapping equations, and some parametric studies are presented.

2-490

ASD-TDR-62-490. MIRAGE III C EVALUATION REPORT. Final rpt, June 1962, 118p. incl illus., tables. P: 921X, T: 97030. Robert C. Otto, Lt/Col., USAF. ASTIA: AD 329710, Code AA.   Secret

Flight tests of the Mirage III C by a USAF team demonstrated the aircraft's capability of performing its design missions of fighter/interceptor or fighter/bomber. Since the evaluation was primarily of combat potential not only were performance, stability and control data obtained, but actual warhead firings were made using the Matra 511, AS-30, 68 mm rockets, conventional bombs, and 30 mm cannon. The evaluation was performed using the Cyrano Ib fire control system.

2-493a

ASD-TD-61-493. AIRCRAFT PROTECTION FROM ATMOSPHERIC ELECTRICAL HAZARDS. Final rpt, Dec 1961, 109p. incl illus., tables, 22 refs. P: 4357, T: 43387. C: AF 33(616)-3991, Lightning and Transients Research Inst., Minneapolis, Minn. Not in OTS. ASTIA: AD 274741, Code AA.   Unclassified

Thunderstorm atmospheric electric gradients can induce intense corona streamers and severe though usually short duration radio interference. Direct lightning strokes to faster aircraft can involve structural hazards, and protection has consequently been developed for areas with plastic sections as in case of fin-cap antenna systems and radomes. Potential problems of as yet statistically undetermined degree of hazard, such as possible fuel system lightning ignition, are discussed, and related researches being continued are briefly outlined. Extension of artificial lightning facilities to closely approximate natural lightning environment is feasible; and further expansion of research in such as yet uncertain areas as fuel tanks and vents is demonstrably worthwhile, based on comparative examples of actual flight experience proven values of the applications of aircraft lightning protection researches already worked out on antenna systems and radomes.

2-494

ASD-TDR-62-494. ADVANCED STAR TRACKING TECHNIQUES. Final rpt, Aug 1962, 655p. incl illus., tables, 183 refs. P: 1(620-4431), T: 44169. C: AF 33(616)-7861, Kollsman Instrument Co., Elmhurst, N.Y. J. Zuckerbroun. ASTIA: AD 331389, Code AA.   Confidential

The salient points found in the report are: results of a study of star tracking techniques, including advantages and limitations of fiber optics and electromechanical scanning devices; star distributions related to star magnitude, spectra and location, as well as methods for calculating photosensor color indices; applications of photomultiplier tubes to star tracking techniques, in addition to the effects of junction depth, area and resistivity on performance characteristics of a silicon diode

star sensor; scanning action and phase-locked loop of a precision angle transducer; influences of noise and vehicle dynamics on tracker performance are evaluated utilizing statistical mathematics; applications of field-effect and double diffused mesa transistors to a low-noise preamplifier for use with a solid state photosensor; analysis of the mechanical design features of a reed scanner and a discussion of the effects of space environment on star tracker design.

2-497

ASD-TDR-62-497. GENERAL DISCUSSION OF SEVERAL TECHNICAL METHODS FOR IMAGE MOTION COMPENSATION. Sept 1962, 39p. incl illus., tables, 4 refs. P: 6220, T: 622016. B. K. Wernicke. ASTIA: AD 332753, Code AA. Confidential

Several technical approaches to the problem of image motion compensation, especially the problem of sensing the speed over ground (V/H) value, are discussed generally. Comparisons are made of specific features, main criteria, and operational aspects of those technical approaches that have been considered. The technical details of the different methods are not described. In general, the characteristics, advantages and disadvantages, and the probability of successful operation of each system are discussed. Research and development in these areas is continuing.

2-499

ASD-TDR-62-499. ALL-PURPOSE PLATING APPARATUS FOR RESEARCH ON VAPOR PHASE COATINGS. Final rpt, Sept 1962, 23p. incl illus., table, 7 refs. P: 7312, T: 731201. C: AF 33(616)-8337, Alloyd Electronics Corp., Cambridge, Mass. I. Marinow, C. A. Gellar, R. Bakish. In OTS. ASTIA: Code XX. Unclassified

An apparatus has been developed to perform experimental vapor phase coating research which is capable of plating many of the metals and ceramic materials now deposited by the vapor phase process, and more importantly, it is capable of producing alloys and composite materials. The apparatus obtains the closest possible physical control of the deposition conditions, while emphasizing versatility and ease and simplicity of operation, so as to become an excellent vehicle for the evaluation of both plating compounds and deposited coatings. A variety of coating tasks was also undertaken to demonstrate the flexibility of this apparatus. The necessary laboratory facilities and support equipment to operate, maintain, and service the apparatus, and also to conduct pre-deposition bench testing of potential plating compounds, were also included in the program.

2-500

ASD-TDR-62-500. ENVIRONMENTAL EFFECTS ON PHOTOSENSITIVE MATERIALS. Interim rpt, June 1962, 118p. incl illus., tables, 61 refs. P: 6272, T: 627203.

C: AF 33(616)-8261, Ford Aeronutronic, Aeronutronic Div., Ford Motor Co., Newport Beach, Calif. T. A. Bergstralh. Aeronutronic Publication No. U-1747. Not in OTS. ASTIA: AD 278594, Code AA. Unclassified

This interim report reviews the progress on the first phase effort in the development of an experimental device for use in a probe or orbiting type space vehicle to collect qualitative and quantitative data on the nature and-effects-of space environmental radiation on gelatin-silver-halide emulsions. The flight instrumentation package under design will include a film supply, latent image processor, image data readout device, and data processing circuitry compatible with standard research vehicle telemetry. During this phase of the program preliminary design has been performed and breadboard instrumentation has been completed and tested for the in-flight film processor, inflight densitometer, radiation monitoring system and electronic data processing circuitry. Rapid processing tests have been conducted on selected reconnaissance films and processing formulations have been established. The design of flight equipment incorporating the elements which have been developed is under way.

2-502

ASD-TDR-62-502. IMPROVING THE EFFICIENCY AND SPECTRAL RESPONSE OF PHOTOPOLYMERIZATION INITIATORS. Final rpt, Aug 1962, 80p. incl illus., tables. P: 6272, T: 627204. C: AF 33(616)-8167, Defense Products Div., Fairchild Camera and Instrument Corp., Syosset, Long Island, N.Y. J. E. LuValle, et al. AY-17. Not In OTS. ASTIA: Code XX. Unclassified

Photopolymerization initiators that act with visible light wavelengths between 5000 and 7000 Å, and which do not require the presence of ancillary reducing agents or oxidizing agents, have been synthesized. These initiators fall into two classes, the trinuclear cyanine dyes and the xanthene dyes. Additional trinuclear dyes of interest should be found in the penta-, hexa- and heptamethines. It has been clearly demonstrated that alkyl substituents on the nitrogens of the xanthene dyes or on the ring carbons do not affect the photo-initiation properties of the xanthene dyes. Replacement of the nitrogens by oxygen, carbonyl or hydroxyl or replacement of the central carbon and oxygen by nitrogens completely eliminates the photo-initiating properties of the xanthenes. Preliminary N.M.R. spectra of three xanthenes that do initiate polymerization indicated that the basic structure in terms of proton chemical shift was not altered by substituents which did not affect the photo-initiating properties of the xanthenes. The mechanism whereby the dyes initiate polymerization is not clear at present. It is probable that either electron exchange takes place, i.e., free radicals are formed, or that an energy transfer mechanism is important. The primary objective of this program, namely, the extension of the photopolymerization initiators' sensitivity into the

green and red portions of the visible spectrum has been achieved.

Preliminary work on monomer systems has led to the conclusion that polyfunctional monomers, especially those which will yield an extended conjugated chain in the polymer and which permit crosslinking, should be utilized in the final initiator-monomer-accelerator system.

2-504

ASD-TDR-62-504. FLIGHT VIBRATION SURVEY OF F-106A AIRCRAFT. Final rpt, May 1962, 37p. incl illus., tables. P: 1309, T: 130906. H. K. Reich. In OTS. ASTIA: AD 282207, Code AA. Unclassified

An F-106A aircraft, SN 53-466, was surveyed at Wright-Patterson Air Force Base, Ohio to determine the vibration environment existing throughout the vehicle under all flight conditions expected in service. Approximately 18,890 data points were obtained from 25 separate locations on the vehicle during 23 test flights. The data obtained in this survey were evaluated to determine the adequacy of vibration test requirements as contained in Specification No. Mil-E-5272C. The data indicated that the vibration testing requirements of the specification are more than adequate, a finding substantiated by all previous (vibration) surveys performed on Century Series aircraft.

2-506

ASD-TDR-62-506. COMPARISON OF HIGH ENERGY RATE (DYNAPAK) AND CONVENTIONAL EXTRUSION OF REFRACTORY METALS. Final rpt, Sept 1962, 90p. incl illus., tables, and 6 refs. P: 7381. T: 73811. C: AF 33(616)-7842, Westinghouse Electric Corp., Pittsburgh, Pa. Dirk G. Rabenold. In OTS. ASTIA: AD 288019, Code AA. Unclassified

A comparison was made of the surface quality, dimensions, chemistry, hardness, tensile properties, and re-crystallization behavior of extrusions produced by high-velocity and conventional techniques. Temperatures were established for the development of hot-worked, cold-worked, and duplex metallurgical structures for the Mo-25W-0.1Zr and W-0.6Cb alloys which were then extruded by both methods at a constant 4:1 reduction ratio. The data indicate that equally good surface conditions can be obtained from the two processes if proper lubrication and tooling are used; lower hot working temperatures can be used for high-velocity extrusions; and lower recrystallization temperatures are obtained in material cold worked on a high-velocity machine. The latter fact indicates that high-velocity-extruded metals retain a higher degree of internal stress than do conventional-extruded metals.

2-508

ASD-TDR-62-508. DEVELOPMENT OF WORKABLE MOLYBDENUM- AND TUNGSTEN-BASE ALLOYS. Final

rpt, June 1962, 70p. incl illus., tables, 7 refs. P: 7351-01. C: AF 33(616)-7930, Climax Molybdenum Co. of Michigan, Detroit, Mich. M. Semchyshen, Robt. Q. Barr, G. G. Chesmar. In OTS. ASTIA: AD 284832, Code AA. Unclassified

A number of complex Mo-, Mo-W-, and W-base alloys have been consolidated by the vacuum-arc-casting technique. Difficulty was experienced in obtaining sound castings of alloys based on varying Mo/W ratios and containing nominally 1.25% Ti and 0.3% Zr. No difficulties were experienced when the Zr content was reduced to 0.1%. Carbon synergism was studied in the alloys Mo + 3% Ti + 0.5% Zr and Mo + 25% W + 1.25% Ti + 0.1% Zr. In the case of the former alloy, the optimum carbon content from the standpoint of elevated temperature strength appeared to be lower than that predicted on the basis of earlier work with Mo-Ti and Mo-Zr binary alloys. Conversely, the optimum carbon content of the latter alloy agreed well with the extrapolated forecast. In the case of both alloys, the carbon contents yielding the highest elevated temperature strengths also resulted in the highest transition temperatures. An alloy based on Mo-50% W, and containing 0.8% Ti and 0.3% Zr, displayed exceptionally high strengths at elevated temperatures. The tensile transition temperature of this material was, however, above room temperature.

2-509a

ASD-TR-61-509. STUDY OF VISUAL AIDS FOR ARCTIC AIRSTRIPS. Final rpt, Apr 1962, 89p. incl illus., tables, 67 refs. C: AF 33(616)-7427, United Engineers, Inc., Boston, Mass. H. B. Watson, Jr., A. J. Greenberg. Not in OTS. ASTIA: AD 284616, Code AA. Unclassified

A world-wide study has been made into the State-of-the-Art of Visual Aids for Arctic airstrips.

In the conduct of this study the emphasis has been placed on finding better visual aids for use during the meteorological phenomenon referred to as "white-out."

Based on the subjective questioning of operational pilot personnel and the objective testing, various recommendations for the improvement of existing Visual Aids are advanced. Many additional and promising areas for study and testing have been suggested.

2-511a (Vol I)

ASD-TR-61-511, Vol. 1. NGL PLATFORM NUCLEAR RADIATION PROGRAM: Research and Analytical Data Section. Final rpt, June 1962, 328p. incl illus., tables, 110 refs. P: 8222, T: 82288. C: AF 33(600)-41452, Litton Systems, Inc., Woodland Hills, Calif. A. B. Kaufman, L. B. Gardner. Not in OTS. ASTIA: AD 284445, Code AA. Unclassified

The gyro, accelerometer, d-c amplifier, and other components of the No Gimbal Lock Inertial Platform were modified and tested directed toward producing a system that

could operate in a steady state or pulse nuclear and Specification MIL-E-0052728 environment. The test program indicated that, within certain limitations, the components could be modified or redesigned to achieve the specified goal.

2-513a (Part II)

ASD-TR-61-513, Pt. II. HIGH-TEMPERATURE, VAPOR-FILLED THERMIONIC CONVERTER. Final rpt, June 1962, 113p. incl illus., tables, 7 refs. P: 3145, T: 60962. C: AF 33(616)-7422, General Atomic Div. of General Dynamics Corp., San Diego, Calif. A. E. Campbell, et al. General Atomic Rpt. GA-2911. In OTS. ASTIA: AD 284410, Code AA. Unclassified

This report describes progress on a research and test program being conducted under Contract AF 33(616)-7422 on the development of a high temperature, vapor-filled thermionic converter for application with a nuclear reactor for space-vehicle electrical power generation. Problems associated with the design and operation of a thermionic converter employing a UC-ZrC emitter, a cesium plasma for space charge neutralization, and a high-temperature collector are described. Emitter fabrication techniques are also described.

A test cell employing a cylindrical UC-ZrC emitter, which was pressure bonded to a tantalum sleeve, and a low-temperature copper collector, was fabricated and operated for 400 hours to provide experimental data. The emitter was operated at temperatures of the order of 2000°C while the collector temperature was maintained at 200°C to 300°C.

This report also includes a conceptual design study for a thermionic power reactor incorporating the thermionic converter under development. It was concluded that a thermionic fuel element would be about 20 inches long and 0.68 inch in diameter and would incorporate 10 thermionic cells. The load voltage per fuel element would be about 14.5 volts and two elements would be connected in parallel (electrically) to provide an output of 29 volts. The overall design would provide an electrical power level of approximately 1 megawatt.

2-519

ASD-TDR-62-519. A PROGRAM OF BASIC RESEARCH TO STUDY X-RAY SPECTRA IN THE REGION 15 TO 50Å. Final rpt, Aug 1962, 24p. incl illus., tables. P: 7360, 7364, T: 736005, 736702. C: AF 33(616)-8040. Picker X-Ray Corp., Cleveland, Ohio. D. W. Beard, T. C. Fumas, Jr. In OTS. ASTIA: AD 284883, Code AA. Unclassified

Performance tests have been completed on the vacuum spectrographic system described in a previous report. High-intensity X-ray excitation was found to produce low working intensities, and was not useful in the detection and analysis of low energy x-rays. Electron excitation provided satisfactory intensities, and made possible

the measurement of radiation as "soft" as carbon (44a), as well as the L series spectra from transitional elements. A wave length shift in the L line was observed between metallic iron and iron in the form of the oxide. A Bendix M-304 detector was studied and found to give non-proportional response to incident photon energy, but it did maintain a low noise level.

2-519a (Vol II)

ASD-TR-61-519 (II). TOLERANCE CRITERIA FOR CONTINUOUS INHALATION EXPOSURE TO TOXIC MATERIAL. II. Effects on Animals of 90-Day Exposure to H2S, Methyl Mercaptan, Indole, and a Mixture of H2S, Methyl Mercaptan, Indole, and Skatole. Final rpt, Dec 1961, 36p. incl illus., tables, 23 refs. P: 7165, T: 716501. Biomedical Laboratory. C: AF 33(616)-7055, Midwest Research Inst., Kansas City, Mo. C. Sandage. OTS: $1.00. ASTIA: 287797, Code AA. Unclassified

Physiological changes in rats, mice, and monkeys were studied during continuous 90-day exposure to controlled atmospheres of toxic vapors and gases. Concentrations of test chemicals were those recognized as Industrial Threshold Limit Values and included: (a) hydrogen sulfide (20 ppm), (b) methyl mercaptan (50 ppm), (c) indole (10.5 ppm), and (d) a mixture of these three compounds plus skatole (3.5 ppm). Hematological and urine analyses and liver function tests were performed before exposure and at 30-day intervals thereafter. At the end of the 90-day exposure period, stress tests were done prior to autopsy for gross and microscopic pathology. Mortality rates were high only in the group exposed to a mixture of four compounds. There was evidence that animals can adapt to tolerate otherwise lethal concentrations of some of these compounds, and that there are great individual differences in the ability to so adapt.

2-523a

ASD-TR-61-523. IN-FLIGHT MEASUREMENT OF HELICOPTER ROTOR SHAFT LOADS UNDER CONTROL CYCLIC TRIM VARIATIONS. Final rpt, June 1962, 126p. incl illus., tables, 5 refs. P: 1370, T: 1370-04. C: AF 33(616)-7292, Vertol Div., The Boeing Co., Morton, Pa. R. G. Ricks, et al. SRN: R-262. In OTS. ASTIA: AD 285586, Code AA. Unclassified

The hub load measurement system developed for the H-21 helicopter has been utilized in this study for measurement of metal blade loads for both standard controls and combinations of Differential Longitudinal Cyclic Trim. Cockpit floor motions were measured concurrently to permit correlation of load and vibration data. The H-21 helicopter used for this program was flown at 13,500 lb normal gross weight, through an airspeed sweep and two rotor speed sweeps for metal blade evaluation with standard controls. At the same gross weight, the effect of longitudinal cyclic was investigated during an airspeed sweep at normal rotor speed for each cyclic combination.

The data was computer processed to provide rotating and fixed coordinate system loads on the fuselage and correlative vibration data. Torque distribution between rotors and total power for each cyclic configuration was obtained from torque bridges located on the forward and aft synchronizing shafts.

2-524

ASD-TDR-62-524. TENSILE AND CREEP PROPERTIES OF A110-AT TITANIUM SHEET MATERIAL AT ELEVATED TEMPERATURES. Final rpt, July 1962, 35p. incl illus., tables, and 2 refs. P: 7381-03. James O. Hachet, Edward L. Home. In OTS. ASTIA: AD 285011, Code AA. Unclassified

This investigation was made to determine creep properties at elevated temperatures of hot-rolled annealed sheet A110-AT titanium alloy.

Tests were conducted at 800°, 1000°, and 1100°F on sheet specimens cut parallel to the direction of rolling. Differences in properties with respect to chemical composition of the material from two sources were small. The data includes ultimate tensile, tensile yield strength, and creep properties at each temperature.

Ultimate tensile strengths varied from 132,000 psi at room temperature to 62,300 psi at 1100°F. Creep deformation becomes more rapid at the two higher temperatures indicating that 1000°F is close to the upper useful temperature limit of this alloy. There was marked scatter of the creep properties of the alloy at 1000° and 1100°F, but the average strength properties are good.

2-526

ASD-TDR-62-526. A PROGRAM TO ADVANCE THE TECHNOLOGY OF FIRE EXTINGUISHMENT. Interim rpt, Sept 1962, 65p. incl illus., tables, and 27 refs. P: 6075, T: 607507. C: AF 33(616)-8110, Atlantic Research Corp., Alexandria, Va. M. Markels, et al. ARC-62-5069-F. In OTS. ASTIA: AD 288077, Code AA. Unclassified

Extinguishing agents for fires of liquid hydrogen in dewars and controlled spills, and detonation suppressants for mixtures of hydrogen and oxygen gases were evaluated. Both spill and dewar fires were most effectively extinguished by first applying a mechanical foam followed by potassium bicarbonate powder. Foam by itself decreased the intensity (burning rate) but extinguished neither type of fire. Water fog, steam, sodium bicarbonate, ABC powder, bromotrifluoromethane, and nitrogen were found ineffective as extinguishing agents. Ten additives were evaluated as suppressants. Carbon tetrachloride acted as a sensitizer for the detonation. Methane or methyl chloride inhibited the detonation, but iron pentacarbonyl was the best suppressant evaluated.

2-528a

ASD-TR-61-528. NEW METHOD FOR THE DETERMINATION OF THERMAL CONDUCTIVITIES BETWEEN 1000° AND 3000°C. Final rpt, June 1962, 59p. incl. illus., tables. P: 7364, T: 73652. C: AF 33(616)-7123. Univ. of Cincinnati, Cincinnati, Ohio. Michael Hoch, Donald A. Nitti. In OTS. ASTIA: AD 284544, Code AA. Unclassified

The heat conduction equation in a finite cylinder, heated by high frequency induction and losing heat only by radiation, has been solved. In the steady state, the cylindrical surface is at a constant temperature, and the flat circular surfaces exhibit a temperature gradient along the radius. This temperature gradient has been analytically correlated to the thermal conductivity. The thermal conductivity of molybdenum has been measured between 2100° and 2400°K and that of vanadium between 1600° and 1800°K; for molybdenum, $k = -0.191T + 81.0$, for vanadium $k = 0.0320T - 41.4$ BTU/hr-ft-°F.

2-529

ASD-TDR-62-529. IMAGE INTENSIFIER ISOCON FEASIBILITY STUDY. Final rpt, Aug 1962, 26p. incl illus., tables, 1 ref. P: 4156, T: 415605. C: AF 33(616)-7696, Radio Corp. of America, Lancaster, Pa. R. E. Hoffman. In OTS. AD 283594, Code AA. Unclassified

A comparison is made of the operating principles of image orthicons and image isocons. The superiority of the image isocon is shown by a graphic representation of the output signal resulting from an image of black, gray, and white stripes. Experimental intensifier image isocons having electrostatic focus intensifier section of the type developed under Contract DA 44-009-Eng-3254 and isocon readout structure as developed under Contract AF 33(616)-6497 were constructed for evaluation of the performance of the combination. The tube performance is expressed in terms of resolution, aperture response, signal-to-noise ratio, and dynamic range.

Information on the equipment necessary for operation of the intensifier image isocon and operating procedure is included.

2-529x

ASD-TDR-61-529. DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS. Final rpt, June 1962, 367p. incl illus., tables. P: 7381, T: 738103. C: AF 33(616)-7056, Southwest Research Inst., San Antonio, Tex. M. M. Lemcoe, A. Trevino, Jr. In OTS. ASTIA: AD 287223, Code AA. Unclassified

This investigation was conducted to determine mechanical properties of several high performance alloys at room and elevated temperatures. The effects of temperature (up to 1900°F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties

were determined from measured stress-strain information in both the elastic and plastic range. The following five materials were considered in the program; 1. 301 extra hard stainless steel; 2. Ph15-7Mo (TH1050); 3. AM 355; 4. René 41; 5. N-155.

All material was from 0.050-inch sheet, except the material for the 1/8-inch diameter shear pins, which were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties. Descriptions of test specimens, equipment, and procedures used are included. Test results are reported in tables and in curves showing the effects of temperature and time on the various mechanical properties.

2-530

ASD-TDR-62-530.   BASES OF NEUTRON DAMAGE MONITORING. Final rpt, June 1962, 74p. incl illus., tables, 11 refs. P: 7360, T: 736003. C: AF 33(616)-7902, TRG, Inc., Syosset, N.Y. L. Solon, et al. In OTS. ASTIA: AD 283983, Code AA.   Unclassified

The problems of monitoring and reporting neutron damage effects have been reviewed. The commonly used monitors and the analyses generally associated with them are discussed in relation to the problems of damage. Areas requiring further development or revision of technique are indicated.   Three analytical procedures are described, each suitable in different situations dependent upon the sample under consideration, the detectors, and the control fluxes available.

Results of monitoring damage to structural steel (obtained by NRL) are examined in some detail to learn what they imply about the state of damage monitoring and analysis.

2-533

ASD-TDR-62-533.   ELECTROLUMINESCENT - PHOTO-CONDUCTOR ELEMENTS. Final rpt, Aug 1962, 87p. incl illus., tables, 50 refs. P: 1610-7062, T: 70949. C: AF 33(616)-8020, Westinghouse Research Lab., Pittsburgh, Pa. P. N. Wolfe, et al. SRN: 62-961-45522-R1. In OTS. ASTIA: Code XX.   Unclassified

As a result of an earlier study of high speed electroluminescent-photoconductive logic elements, a materials improvement program was undertaken. Electroluminescence studies were concentrated on dc-pulse-excited thin film electroluminors, whose relevant properties such as response speed, quantum efficiency, spectral output, temperature dependence, and maintenance are summarized. Research on photoconductors was concerned with preparation techniques for high-purity single crystals and evaporated films of cadmium sulfide, and with performance improvements attainable in single crystals by optimizing trap distributions.   In spite of significant advances achieved in the program, it is concluded that the desired logic element speed is not likely to be attained with

simple, two-terminal electroluminors and photoconductors, but rather will require the use of devices incorporating additional gain, possibly three-terminal electroluminors.

2-536

ASD-TDR-62-536. VIBRATION AND SHOCK EXCITER USING ELECTRIC-FIELD MODULATION OF HYDRAULIC POWER. Final rpt, Aug 1962, 69p. incl illus., tables, 6 refs. P: 1309, T: 130904. C: AF 33(616)-8468. Stanford Research Inst., Menlo Park, Calif. J. J. Eige, E. C. Frazer. SRN: 3715. In OTS. ASTIA: AD 287846, Code AA.   Unclassified

A research project has led to the design and construction of a novel form of shock and vibration exciter. This shock-shaker is driven by hydraulic power, controlled by "valves" with no moving parts. These modulators consist of concentric cylinders, insulated from each other, and separated by narrow gaps through which a special dielectric fluid is pumped. Voltages applied between the cylinders control the fluid flow by their direct action upon the fluid, in what has been called the Winslow effect.   New information about the behavior of this electric fluid was developed in order that a mathematical model of a shock-shaker system could be formulated. The resulting equations allow scaling the system to fit specified output goals, given various fluid parameters. The electrical circuits developed during this project provide for acceleration feedback, to reduce distortion and to regulate acceleration level, and for position feedback to keep the output piston centered. Brief tests showed that this shock-shaker was capable of vibrating a 10-pound mass at 17 g peak. Maximum response was at about 150 cps, falling off at higher or lower frequencies, with usable response between about 20 cps and 3000 cps. More basic investigation of the fluid is recommended as essential to an evaluation of the limitations and practicality of devices, such as this shock-shaker, using electric fluids.

2-538

ASD-TDR-62-538. STUDY OF THE FLIGHT CONTROL REQUIREMENTS FOR A MANNED LUNAR VEHICLE. Final rpt, July 1962, 227p. incl illus., tables, and 29 refs. P: 8219, T: 82165. C: AF 33(616)-7626, Vought Astronautics, Dallas, Tex. M. C. Bean, P. C. Kramer. ASTIA: AD 331554, Code AA.   Secret

The basic flight control requirements for an unmanned vehicle are determined; the role of the human is determined using the same vehicle and control equipment; and specific problem areas are presented for further analysis. The mission phases which received primary consideration are the lunar landing, the lunar launch, and the earth return midcourse.

Trajectory studies are presented which establish landing, boost, and earth return midcourse trajectory conditions. Control and guidance laws are synthesized which minimize accuracy requirements while maintaining near optimum

fuel utilization. Simulated landing, using both automatic control and manual control, are reported.

A control system is mechanized using equipment of the type presently available or feasible.

2-540

ASD-TDR-62-540. A STUDY OF FREE RADICALS AND OTHER INTERMEDIATE SPECIES AND INTERNAL ENERGY TRANSFER PROCESSES IN IRRADIATED CHEMICAL SYSTEMS. Final rpt, Sept 1962, 45p. incl illus., tables and 20 refs. P: 7360, T: 736003. C: AF 33(616)-7587, Armour Research Foundation, Chicago, Ill. P. Y. Feng, et al. In OTS. ASTIA: Code XX.
Unclassified

This report describes a study of the role of internal energy transfer processes in radiation chemical reactions involving free radicals and other intermediate species, using a series of alkyl iodides with different carbon chain lengths as the experimental systems. It was found that, (1) with increasing size of the alkyl group in a homologous series, for example the 1-iodoalkanes, the extent of C-I bond rupture decreases regularly, whereas both the H_2 and the HI yields increase; (2) products with practically identical yields are formed in the radiolyses of two systems with similar elemental compositions, one consisting of pure $C_{16}H_{33}I$, and the other an equimolecular mixture of C_8H_{18} and $C_8H_{17}I$. Analysis of these results, together with those available in the literature, show that energy initially localized elsewhere in an alkyl iodide molecule cannot efficiently cause C-I bond breakage despite the latter's low bond strength, i.e. internal energy transfer does not play an important role in these reactions. Instead, it is concluded that the product yields are dependent on the effective electron fractions of the various groups in the irradiated system, a parameter which permits the quantitative correlation of the outcomes of the radiolytic reactions investigated in this program.

2-541

ASD-TDR-62-541. LUBRICATION IN SPACE ENVIRONMENTS. Final report, June 1962, 12p., incl tables and illus. P: 3044-04, -03, -05. Robert L. Adamczak, Robert J. Benzing, Herbert Schwenker. Not in OTS. ASTIA: AD 284165, Code AA. Unclassified

Solid, semi-solid, and liquid lubricants, hydraulic fluids, heat-transfer fluids, and novel lubrication techniques are discussed with respect to the current state of the art and the future capabilities of these various materials and/or their application. The severe environmental conditions of space are compared against both the current and future state of the art in the field of lubrication and energy-transfer media. Research efforts currently being pursued by the Nonmetallic Materials Laboratory of ASD to provide new and improved lubricants are described. A brief interpolation is also given of the overall lubricant picture with respect to space technology in terms of reliability and system design.

2-542 (Part I)

ASD-TDR-62-542, Pt. I. NEW AND IMPROVED MATERIALS FOR EXPANDABLE STRUCTURES. Final rpt, June 1962, 60p. incl illus., tables. P: 7320, T: 732002. C: AF 33(616)-7854, Goodyear Aircraft Corp., Akron, Ohio. D. M. Marco. Not in OTS. ASTIA: AD 282929, Code AA. Unclassified

Work performed during the first year of Contract No. AF 33(616)-7854, "New and Improved Materials for Expandable Structures," is presented. Details of specific research programs which have been initiated are not included. The objective of the program was to establish the general material requirements for expandable structures; review present material research activities in this area; and to recommend and generate specific program areas in which additional research is required. General approach used to fulfill these objectives was to review recent applicable technical publications and reports and to contact active researchers and organizations working in this field. Information thus obtained was reviewed and summarized along with information available at GAC from which recommendations were made as to research programs which should be initiated. Materials review was divided into two areas: (1) materials for space station and accessories and (2) re-entry materials. General environmental conditions to which expandable structures materials will be exposed; general material parameters, results of literature survey in the areas of textile materials, high temperature materials, elastomers, and ultra-violet degradation of polymers; the research review with respect to space station and accessories, and re-entry materials, have been summarized and are presented. Also reported is information obtained from contacts with various organizations and a bibliography of documents and references used in this program.

2-546

ASD-TDR-62-546. PULSED LIGHT INVESTIGATION. Final rpt, June 1962, 81p. incl illus., tables. P: 5043, T: 50723. C: AF 33(616)-7680, Motorola Inc., Systems Research Lab., Riverside, Calif. W. J. Nolan, Jr. RLF-3854-1. Not in OTS. ASTIA: AD 289419, Code AA. Unclassified

The possibility of decreasing the size and increasing the brightness of spark discharges by immersing the electrodes in oil has been investigated over the range of 0.05 to 20 joules stored energy and 1 to 10 kv initial voltage. At energy levels below one joule, discharges in oil showed increased brightness and longer duration than when in air. Above three joules, with initial voltages of five kv or less, the pulse in oil was shortened with respect to that in air and showed very fast rise and decay times, possibly as a result of refractive effects of a shock wave in the oil. The brightness in oil was in some cases less than in air, probably due in part to obscuring by the electrodes. At 10 kv, a discharge of 10

joules showed higher brightness in oil than in air (but not higher than an air discharge at 5 kv) and considerably decreased electrode wear, both effects being probably the result of the larger gap. Vinyl sleeving was the only material found mechanically and optically suitable for the envelope of the discharge chamber.

2-546a (Part I)

ASD-TR-61-546, Pt. I. INVESTIGATION OF A NET CREW SEAT CONCEPT FOR ADVANCED FLIGHT VEHICLES: Investigation And Design. Final rpt, June 1962, 160p. incl illus., tables, 26 refs. P: 1425, T: 142502. C: AF 33(616)-7934, Chance Vought Corp., Dallas, Tex. P. W. Wood, Jr. AST/EIR-13567. Not in OTS. ASTIA: AD 285088, Code AA. Unclassified

This report describes the investigation and design of a Net Crew Seat Support-Restraint System, for use in laboratory experiments to demonstrate the feasibility of using this concept in advanced flight vehicles. An investigation was conducted to determine seating and restraint requirements, and define solutions to certain support-restraint problems. Several design concepts for the solution of these problems were developed. Trade studies were conducted and the optimum solution to each problem determined. Experiments were conducted to determine some of the physical characteristics of Nylon and Dacron Raschel Knit cloth. Load-deflection curves and load-time curves were developed. A Net Crew Seat Support Restraint System was designed and analyzed structurally for the loads anticipated in vehicles which are recovered vertically or horizontally.

2-552a (Part I)

ASD-TR-61-552, Pt. I. FLIGHT PATH ERROR AND DISPERSION ANALYSIS GENERALIZED COMPUTER PROGRAM: Problem Formulation. Final rpt, Aug 1962, 73p. incl illus., tables, 16 refs. P: 1431, T: 14074. C: AF 33(616)-7899, McDonnell Aircraft Corp., St. Louis, Mo. Robert C. Brown, et al. Not in OTS. ASTIA: AD 286446, Code AA. Unclassified

The mathematical procedures and computational techniques necessary to perform automatic practical error and dispersion analysis of the trajectories of flight vehicles are described. The computation program is formulated for three alternate statistical methods ranging from the simple root-sum-squares combination of deviations to the more complex random sampling of the trajectory population. by computing trajectories with randomly generated multi-error-sources. The program is specifically oriented for computation on the IBM 7090 digital computer.

2-552a (Part II)

ASD-TR-61-552, Pt. II. FLIGHT PATH ERROR AND DISPERSION ANALYSIS GENERALIZED COMPUTER PROGRAM: User's Manual. Final rpt, Aug 1962, 215p. incl illus., 5 refs. P: 1431, T: 14074. C: AF 33(616)-

7899, McDonnell Aircraft Corp., St. Louis, Mo. Newell E. Usher. Not in OTS. ASTIA: AD 286079, Code AA. Unclassified

A computer program to perform practical error and dispersion analyses of the trajectories of flight vehicles is described. Three alternate methods for performing the statistical analysis have been programmed and complete information for program usage is included. These methods range from the simple root-sum-squares combination of deviations to the more complex random sampling of the trajectory population by computing trajectories with randomly generated multi-error sources. The computer program must be operated on an IBM 7090 data processing system within the SHARE Operating System, SOS.

2-552a (Part II, Suppl I)

ASD-TR-61-552, Pt. II, Sup 1. FLIGHT PATH ERROR AND DISPERSION ANALYSIS GENERALIZED COMPUTER PROGRAM: User's Manual: Program Listing. Final report, Aug 1962, 188p. P: 1431, T: 14074. C: AF 33(616)-7899, McDonnell Aircraft Corp., St. Louis, Mo. Newell E. Usher, Harold Axe. Not in OTS. ASTIA: AD 286085, Code AA. Unclassified

The program listing presented within this supplement was obtained on an IBM 7090 data processing system using the SHARE Operating system, SOS. This listing represents the contents of the Flight Path Error and Dispersion Analysis Generalized Computer Program SQUOZE Deck. The SQUOZE deck, also considered to be a part of this supplement, was prepared by the SOS system from a symbolic deck (SCAT deck) and a series of modifications to the program. The program listing gives both symbolic and octal representation of instructions and data along with corresponding absolute machine locations. The last part of the program listing presents a complete list of symbols which are used in the computer program, along with associated page numbers. Each page number references the particular page of the listing where the corresponding symbol is defined.

2-553

ASD-TDR-62-553. ALKALINE BATTERY EVALUATION. Interim rpt, June 1962, 111p. incl illus., tables, 5 refs. P: 8173, T: 817304. C: AF 33(616)-7529, Inland Testing Laboratories, Cook Electric Co., Dayton, Ohio. W. W. Clark, W. G. Ingling, and I. F. Luke. In OTS. ASTIA: AD 278647, Code AA. Unclassified

This report covers the first three periods of an alkaline battery applied research and failure analysis program. The purpose of this program is to establish a broad base of battery test data for use in the design of the electrical system of future space vehicles and to determine the actual failure mechanism of all new battery systems under varying environmental and cycle-life conditions so that improved space batteries can be developed. Another objective is to determine techniques and/or materials to

prevent these failures, while at the same time increas the usable watt-hours-per-pound capability and cycle life of the battery. To date, cycle-life tests have been conducted on one type of 12 ampere-hour, sealed nickel-cadmium cells in four temperature environments and four depths of discharge, in groups of 10 cells and in batteries of 20 cells.

Initial results in the program show that: (1) Cell cycle-life with shallow discharges is considerably longer than cycle-life at deep discharges and (2) Cycle-life is reduced by high and low ambient temperatures.

The program includes an evaluation of one type of 15 ampere-hour silver-cadmium and one type of 25 ampere-hour silver-zinc sealed cells, in addition to an evaluation of one type of 20 ampere-hour nickel-cadmium cells. The test results on these cells will be included in the next technical report.

2-553a

ASD-TR-61-553. STUDY AND EXPERIMENTAL INVESTIGATION ON SAMPLING RATE AND ALIASING IN TIME-DIVISION TELEMETRY SYSTEMS. Final rpt, June 1962, 161p. incl illus., 22 refs. P: 4107, T: 410718. C: AF 33(616)-8033, Aeronutronic, A Division of Ford Motor Co., Newport Beach, Calif. J. W. Capps, et al. U-1387. In OTS. ASTIA: AD 278515, Code AA.
Unclassified

A study to determine the effect of 1) data power spectrum and 2) system design parameters on aliasing and data interpolation error has been conducted. Results are applicable to time-division multiplexed telemetry systems. In particular, the results apply to the commonly used PAM-FM, PDM-FM and PCM-FM telemetry systems. Data was obtained on the basis of combined analysis and experiment with emphasis on the derivation of experimentally proven design parameters. The program consisted of three phases: 1) A survey was conducted to determine typical telemetry data spectra; 2) Analysis was performed to predict accuracy performance of practical data and interpolation filters using selected examples. Included is a more general analysis to determine optimum filter transfer functions, both realizable and non-realizable; 3) Experimental tests using data spectral models were performed to derive proven interpolation accuracy performance on the basis of practical filters and design parameters. The experimental tests utilized a PAM-FM system to derive an accurate measurement of attainable performance and to indicate when other equipment factors begin to impose a limit on data recovery accuracy.

2-558a

ASD-TR-61-558. SOLAR ABSORPTANCE AND TOTAL HEMISPHERICAL EMITTANCE OF SURFACES FOR SOLAR ENERGY COLLECTION. Final rpt, July 1962, 60p. incl illus., table, 13 refs. P: 7340, T: 734007. C: AF 33(616)-60-3, AF 33(616)-61-29, U.S. Naval Radiological Defense Lab., San Francisco, Calif. C. P.

Butler, R. J. Jenkins, W. J. Parker. Not in OTS. ASTIA: AD 284862, Code AA.   Unclassified

The solar absorptance and the total hemispherical emittance are reported between 200° and 800°C for 6 polished metals, 8 metals with porous surfaces, and 15 coated metals. The solar absorptance is determined from the rate of temperature rise when the specimen is exposed to the radiation of a cored carbon arc whose spectral distribution simulates sunlight. The total hemispherical emittance is determined from the rate of temperature decay when the arc radiation is removed. All measurements are made on specimens approximately 3/4 inches in diameter suspended in a black-wall evacuated chamber. The thermal conversion efficiencies of all surfaces as a function of temperature are reported.

2-560

ASD-TDR-62-560. LOW TEMPERATURE ADSORPTION OF CARBON DIOXIDE. Final rpt, Sept 1962, 44p. incl illus., tables. P: 6146, T: 614609. C: AF 33(616)-8323, AiResearch Manufacturing Co., Los Angeles 9, Calif. G. Christensen. SS-715-R. Not in OTS. ASTIA: Code XX.   Unclassified

A test program was conducted to study low temperature adsorption of carbon dioxide by synthetic zeolites for possible application to space vehicle environmental control systems. Type 5A molecular sieves and a 1 mole per cent carbon dioxide concentration were used for most of the tests. The range of the conditions included temperatures from 530°R to 300°R, and process air superficial velocities from 30 fpm to 150 fpm. Presented in the report are the results of the tests which include: (1) the effect of superficial velocity on adsorption, (2) the effect of bed length on adsorption, (3) the effect of low temperature on adsorption, (4) vacuum and thermal desorption of sieve adsorbed at low temperatures, and (5) miscellaneous data such as pressure drop, temperature rise, and pellet size. The experimental results are extensively presented and include adsorption curves showing sieve load as a function of time, as well as curves of sieve capacity and adsorption efficiency.

2-561

ASD-TDR-62-561. DIFFUSION IN TITANIUM AND TITANIUM ALLOYS. Final rpt, Oct 1962, 57p. incl illus., tables, 33 refs. P: 7351, T: 735105. C: AF 33(616)-7656, Armour Research Foundation, Chicago, Ill. Rodney P. Elliott. In OTS. ASTIA: Code XX.   Unclassified

The self-diffusion of Ti and the interdiffusion of Al, Zr, Mo, V, and O in Ti have been investigated in the temperature range 600°-1300°C. Diffusion couples were prepared by roll-bonding or press-bonding. Electron microprobe methods were used to determine the penetration of the substitutionall, dissolved penetration of interstitially dissolved oxygen.

The electron microprobe analysis could not be used to determine the penetration curves of Al in Ti because of the very high absorption of characteristic Al x-radiation by Ti.

The self-diffusion of Ti was investigated by studying penetration of Ti44, formed by bombarding scandium with protons. Diffusion couples were formed by dissolving Ti44-enriched TiO$_2$ into the Ti.

The diffusion equations for Mo and V in α-Ti, and for the self-diffusion of Ti must be considered preliminary.

2-562

ASD-TDR-62-562. EVALUATION OF COMMERCIAL RADIANT HEATERS. Sept 1962, 12p. incl tables. Weapon Systems 101A, 102A, and 119L. R. J. Feierstein. Not in OTS. ASTIA: AD 288292, Code AA. Unclassified

A program was undertaken to evaluate radiant heating equipment that was currently available. The equipments of five manufacturers were evaluated. The primary factors considered were: (1) operational hazards and personnel safety, (2) ease of equipment operation, (3) portability of equipment, and (4) feasibility of equipment for field use. As a result of tests, none of the items evaluated adequately met the minimum USAF requirements.

2-566a

ASD-TR-61-566. WIDE-RANGE-TEMPERATURE SPRINGS. Final rpt, May 1962, 96p. incl illus., table, 6 refs. P: 7351, T: 735106. C: AF 33(616)-6284, Univ. of Michigan, Ann Arbor, Mich. H. Gascoigne, et al. In OTS. ASTIA: AD 278801, Code AA. Unclassified

Bimetallic spring systems of 40% nickel-60% iron alloy combined with Inconel X and type 304 stainless steel exhibit characteristics suitable for applications from −65°F to 600°F. In this range the spring constant is held within ±0.25%.

The general theory of bimetallic, temperature independent helical coil and Belleville type springs is presented. The bimetallic systems tested show that a temperature independent spring is feasible although working stresses must be maintained at relatively low levels.

2-567a

ASD-TR-61-567. INDIUM ANTIMONIDE FOR SEMI-CONDUCTOR-DEVICE FEASIBILITY STUDIES. Final rpt, Dec 1961, 95p. incl illus., tables, 25 refs. P: 4159, T: 41652. C: AF 33(616)-6450, Battelle Memorial Inst., Columbus, Ohio. T. S. Shilliday, et al. Not in OTS. ASTIA: AD 273795, Code AA. Unclassified

InSb magnetoresistance voltage regulators designed as a bias source for tunnel diodes were constructed. Output specifications, 0.1 amp at 150 mv ±5 per cent, were met over most of the operating range.

Good agreement has been obtained between determinations of impurity concentration in InSb by analysis of electrical properties and determinations made by calculation from a knowledge of the amount of impurity added and its segregation coefficient.

To avoid anisotropic segregation of certain impurities which occur in pulling InSb crystals along the <111> direction, growth along <110> and <311> directions was studied. Good single crystals, radially homogeneous in impurity concentration, were obtained.

Fabrication of InSb p-n junctions by out-diffusion of antimony and by thin-film techniques was explored.

Both p- and n-type films of InSb were deposited by flash evaporation. Majority carrier densities were $10^{17}/cm^3$ or greater.

2-569

ASD-TDR-62-569. DEVELOPMENT OF FABRIC BASE MATERIALS FOR SPACE APPLICATIONS. Final rpt, June 1962, 112p. incl illus., tables. P: 7340, 7320, T: 734005, 732002. C: AF 33(616)-8250, Westinghouse Defense Center, Baltimore, Md. A. T. Hawthorn, C. N. Gosnell. Not in OTS. ASTIA: AD 282507, Code AA. Unclassified

This project was designed to produce new and improved coated fibrous structure materials for rigidizable expanded structures for future aerospace uses. Woven fiberglas is coated with polymeric compositions designed to retain flexibility until rigidization is required. Two techniques involving removal of part of the coating (normally a plasticizer) are evaluated and found satisfactory for producing a rigid structure. Inflatible structures are used to demonstrate the methods. A third procedure for rigidization is outlined from a theoretical viewpoint only.

The investigation is restricted to continuous filament glass yarn and coating compounds based on polyvinyl chloride and polyurethane polymers. The effects of yarns, weaves, and coating composition are investigated with respect to their rigidization capability. Criteria used to determine the relative merit of a coated fabric matrix are buckling strength under compression loading and a modification of the standard stiffness test for plastics. Relative rates of rigidization are measured for several candidate materials.

2-571

ASD-TDR-62-571. DEVELOPMENT OF RECEIVER OVERLOAD PROTECTION CIRCUIT FOR RADIO SET AN/ARC-34. Final rpt, July 1962, 42p. incl illus. P: 9057. C: AF 33(604)-37505, The Magnavox Co., Fort Wayne, Ind. SRN: 62-559. ASTIA: Code NC. Secret

This report describes the development of a circuit modification to Radio Set AN/ARC-34 to improve the operating characteristics of the Radio Set. This improvement ex-

tends the range of input antenna signal levels over which the receiver can properly operate.

The circuit modification is described physically and operationally. Evaluation tests verified the effectiveness of the circuit.

2-574

ASD-TDR-62-574. FLUIDS (FUELS, LUBRICANTS, HYDRAULIC FLUIDS, AND ELECTRONIC COOLANTS) FOR HIGH TEMPERATURE APPLICATIONS. Final rpt, Aug 1962, 26p. incl illus., tables, and 10 refs. P: 3044 and 3048, T: 304403, 304404, and 304405. M. P. Dunnam, Not in OTS. ASTIA: Code XX.   Unclassified

This report deals with the timely area of advanced fluids for high temperature applications. A review of the source and nature of high temperature fuels, lubricants, hydraulic fluids, and electronic coolants is given and the limitations of the more conventional fluids are discussed. Recent information on the types of advanced high temperature fuels, lubricants, hydraulic fluids, and electronic coolants and data on their properties are included.

2-575

ASD-TDR-62-575. VACUUM TECHNIQUES IN RADIATION CHEMISTRY. Final rpt, July 1962, 24p. incl illus., table, 4 refs. P: 7367-01. Roger E. Rondeau. In OTS. ASTIA: AD 284463, Code AA.   Unclassified

This report describes the high vacuum apparatus and methods used in the radiation-chemical studies of organic compounds. The design and use of high-vacuum systems for the purification, degassing, filling, and sealing of irradiation ampoules are explained. The post-irradiation techniques of removal, separation, measurement, and collection of the volatile products of radiolysis are also described.

2-586

ASD-TDR-62-586. ELECTROLUMINESCENT DISPLAY TECHNIQUES. Final rpt, June 1962, 78p. incl illus., tables, 5 refs. P: 4335, T: 433520. C: AF 33(616)-8065, General Telephone and Electronics Laboratories, Bayside, N.Y. M. S. Wasserman, S. Talesnick, S. Yando. TR62-707, 708.16. Not in OTS. ASTIA: Code XX.   Unclassified

The development of two types of solid-state electroluminescent (EL) display devices is described. The first device, discussed in Part A, is a compact, alphanumeric message display using EL display characters and photoconductive-electroluminescent (PC-EL) circuits to translate 6-bit binary input information to the display code, to gate the information to the selected characters and to store the displayed information on each character. Construction of a feasibility model that displays ten 3/8-inch-high characters in a line 3-3/4 inches long is described, and recommendations are made for improving the performance of the device with respect to uniformity of the PC-EL layers, circuit design and capacitive coupling problems introduced by close electrode spacings.

The second panel, discussed in Part B, combines certain unique properties of piezoelectric and electroluminescent materials. The basic panel requires only four properly timed electrical inputs to produce a spot of light. Operating principles are discussed and the timing relationships to position the spot of light at any desired point are derived. The development of an improved panel using special input transducers for higher brightness and employing a solid-state drive system for producing oscilloscope patterns is described.

2-587

ASD-TDR-62-587. CATEGORY II EXTREME TEMPERATURE EVALUATION OF A B-52H AIRCRAFT. Final rpt, Sept 1962, 449p. incl illus. P: 101A. W. A. Hawes, Capt, USAF, C. K. Sandstrom. Not in OTS. ASTIA: Code XX. ·   Unclassified

This report on extreme environmental tests of the B-52H aircraft describes test procedures, presents instrumentation data, discusses test results, analyzes extreme temperature deficiencies, and makes recommendations for their correction. Tests of extreme environmental effects on the B-52H aircraft determined that it will be operationally effective from −65° F through +105° F. The evaluation of the engine anti-ice system, a test of considerable importance, could not be accomplished since the production system was not installed in the test aircraft. The following modifications should be made to improve the reliability of the B-52H weapon system in extreme environmental conditions: Improve the cabin air conditioning system; improve the overall reliability of the ASG-21 fire control system; provide more reliable ALT-13 heat exchangers; decrease the noise level at the Offense and Defense Stations to comply with HIAD specifications; and provide a more reliable pneumatic engine starting system.

2-587a

ASD-TR-61-587. THE DRAG OF CONES, PLATES, AND HEMISPHERES IN THE WAKE OF A FOREBODY IN SUBSONIC FLOW. Final rpt, Dec 1961, incl illus., tables, 5 refs. P: 6065, T: 60252. C: AF 33(616)-8310. Dept. of Aeronautics and Engineering Mechanics, Univ. of Minnesota, Minneapolis, Minn. H. G. Heinrich and E. L. Haak. Not in OTS. ASTIA: AD 272766, Code AA.   Unclassified

The drag of a number of bodies having some resemblance to aerodynamic deceleration devices was measured in free stream and in the wake of an ogival cylinder. The diameter ratio of the wake producing body and the deceleration devices as well as the distance between the two bodies was varied. With the exception of the sphere, the drag of the deceleration device located in the wake is less than its free stream drag.

2-589

ASD-TDR-62-589. MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH. Interim rpt, Dec 6, 177p. incl illus., tables, 31 refs. P: 5237, T: 523701. C: AF 33(616)-7043, Ultramicrowave Section, Electrical Engineering Research Laboratory, Engineering Experiment Station, Univ. of Illinois, Urbana, Ill. P. D. Coleman, et al. Annual Report No. 2, Technical Note No. 3. Not in OTS. ASTIA: AD 282430, Code AA.   Unclassified

Design studies on a 35 kmc, 1 Mev electron accelerator and buncher are presented. The structure envisioned is a metal disk-loaded waveguide 25 centimeters long, operating with a field strength of the Order of 40 to 50 kv/cm, under a drive power of 100 kilowatts. The aim is to produce harmonic current frequencies in excess of 1,000 kmc to drive beam coupling structures and produce submillimeter wave power.

An alternative transverse deflection electron bunching scheme operating at 125 kv and 35 kmc is also being studied. This scheme has the advantage of requiring far less RF power than the longitudinal system and hence may be extended to an even higher base frequency.

Beam coupling schemes being considered are: 1) Cerenkov interaction couplers, 2) dielectric Fabry-Perot resonators, and 3) coherent deceleration radiators. Interaction resistances per wavelength in excess of 10^5 ohms in a plasma Cerenkov coupler appear feasible. Ferrite media yield value in excess of 10^3 ohms per wavelength. An interaction resistance of 140 ohms has been demonstrated for a de-celeration radiator using a metal target to abruptly stop a 1 Mev bunched beam.

2-589a (Vol I)

ASD-TR-61-589, Vol. I. THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS: General Description of Phase I Study and Phase II Program. Interim rpt, Jan 1962, 35p., 22 refs. P: 4335, T: 433509. C: AF 33(616)-7868, RCA Victor Co., Ltd., Research Laboratories, Montreal, Canada. F. G. R. Warren, et al. Research Report No. 6-400-1. Not in OTS. ASTIA: AD 276274, Code AA.   Unclassified

A survey of the state of development and of knowledge in the frequency range 10-300 Gc, with particular reference to possible uses in aerospace communications, is described. Information contained in Volumes II to VII is summarized, the subjects covered being:

Vol. II — Generation and High Level Amplification of Millimeter Waves
Vol. III — Components, Transmission Techniques and Materials
Vol. IV — Propagation and Absorption
Vol. V — Plasma Effects in Aerospace Communications
Vol. VI — System Considerations
Vol. VII — Applications (Classified)

The program for the second part of the project is discussed. Proposed experimental work covers four areas. These are studies of:

1. Millimeter wave detectors
2. Beam transmission techniques
3. Interaction of antennas with plasmas in this frequency region
4. Millimeter wave components using plasmas.

2-589a (Vol V)

ASD-TR-61-589, Vol. V. THE RADIO SPECTRUM FROM 10 Gc TO 300 Gc IN AEROSPACE COMMUNICATIONS: Plasma Effects in Aerospace Communications. Interim rpt, Mar 1962, 282p. incl illus., tables, 165 refs. P: 4335, T: 433509. C: AF 33(616)-7868, RCA Victor Co., Ltd., Montreal, Canada. I. P. French and M. P. Bachynski. RCA Victor Research Report No. 6-400-5(7-401-3). Not in OTS. ASTIA: AD 282610, Code AA.   Unclassified

A review of the role of natural and artificial plasmas in aerospace communications is presented.

The theory applicable to antenna breakdown at high altitudes and methods of estimating the breakdown r-f fields and powers for various microwave antennas, mainly in the frequency range above ten kilomegacycles (10 Gc), is given. The ionized shock wave of a re-entry vehicle is studied with special reference to the problem of propagating r-f energy through it. The properties of antennas operating in ionized regions are considered, together with the passive microwave radiation emitted by plasmas which appears as noise at a receiver. An attempt is made to evaluate the role of other natural and artificial plasmas such as the ionosphere, aurora, rocket exhaust, nuclear reactors and nuclear blasts, on communication.

2-591

ASD-TDR-62-591. STUDY OF ADVANCED FLIGHT-VEHICLE POWER-UTILIZATION SYSTEMS. Final rpt, Aug 1962, 98p. incl illus., tables. P: 8128, T: 812805. C: AF 33(616)-8179, General Dynamics, Fort Worth, Tex. SRN: FZX-148. Not in OTS. ASTIA: AD 278204, Code AA.   Unclassified

An unconventional approach toward utilization of vehicle power is presented. Brief mission profiles are given for six manned and unmanned air and space craft to give the schedule of operation of systems which utilize power. Greater detail is presented on the power utilization of two of these, the unmanned reconnaissance satellite and the manned lunar-landing and return vehicle. A general discussion is presented on power sources intrinsic and extrinsic to vehicles, and a forecast is shown for chemical, solar, and nuclear sources. The application of the morphological method to the development of new concepts is discussed and examples given in an appendix of several "morphological boxes." Some of the concepts that developed during the course of the study are also given in appendices. In addition, the appendices contain

general reviews of EWASERS, radio space communications, and electrical propulsion. It was concluded that a modified morphological approach offers a better framework for conceiving advanced concepts. Recommendations are made for further study and development of the method and new concepts.

2-593

ASD-TDR-62-593. IONIC THINNING OF SPECIMENS FOR ELECTRON MICROSCOPY. Final rpt, Aug 1962, 53p. incl illus., 6 refs. AFSC P: 7353, T: 735303. C: AF 61(052)-338, University of Paris, Orsay, France. Raymond Castaing. Not in OTS. ASTIA: AD 287992, Code AA.   Unclassified

The effect of very short ion bombardments on thin evaporated crystals of gold has been investigated by means of the electron microscope. The main effect is the production of a large number of very small loops and the disappearance of the pre-existing dislocations.

Annealing eliminates the small loops and dislocations appear again. This phenomenon is responsible for the roughness observed on samples of heavy metals thinned down by ionic polishing.

2-594

ASD-TDR-62-594. INVESTIGATION OF TANTALUM AND ITS ALLOYS. Final rpt, Oct 1962, 246p. incl illus., tables, 28 refs. AFSC P: 7351-01. C: AF 33(616)-7688, Battelle Memorial Institute, Columbus, Ohio. F. F. Schmidt, et al. In OTS. ASTIA: Code XX. Unclassified

Fabrication results, bend ductility, tensile properties at low and high temperature, high-temperature stress-rupture data, welding studies, metallurgical studies (both recrystallization behavior and heat treatment), and oxidation behavior of tantalum and tantalum-base alloys, are presented. Several tantalum-base alloys were found to have outstanding strength properties at temperatures to 1925C (3500F), combined in many cases with excellent room-temperature ductility. Particularly outstanding in this respect are alloys in the system Ta-Mo-W.

2-595

ASD-TDR-62-595. STRUCTURAL TEST PROGRAM B-58A AIRPLANE. Final rpt, Aug 1962, 110p. incl illus. and tables. P: 1417, T: 13865. John C. Grogan. Not in OTS. ASTIA: AD 288078, Code AA. Unclassified

Results of the structural tests conducted on the complete airframe of the General Dynamics B-58A airplane covering all critical flight, landing, take-off, and ground handling conditions are presented. Both room and elevated temperature conditions were considered in the program. Because of airplane gross weight growth and other considerations, four basic structural configurations were tested. The latest being the final structural configuration that will be employed by the using command. A descrip-

tion of each configuration and the structural modifications necessary for each are outlined in the Appendix.

Numerous structural failures and other design deficiencies were encountered during the test program and the corresponding recommended changes are discussed in the body of the report and tabulated in the Appendix.

With B-58A airplanes in the structural configuration of the using command, including the ASD recommended changes resulting from structural failures and deficiencies, the airplanes are structurally capable of withstanding the static ultimate loads generated by the conditions tabulated in the Appendix.

2-595 (Suppl I)

ASD-TDR-62-595, Suppl 1. STRUCTURAL TEST PROGRAM B-58A AIRPLANE. Final rpt, Aug 1962, 12p. incl illus. P: 1417, T: 13865. Allan M. Norton, 1/Lt USAF. Not in OTS. ASTIA: AD 287955, Code AA. Unclassified

The MB-1C free fall pod for the B-58A airplane was subjected to a complete static test program covering all of the critical captive flight, free fall, and ground handling conditions. The pod body, fins, pylon, and hooks satisfactorily supported the required ultimate loads for all pod design conditions. Therefore, the pod is considered to have full structural load capabilities for the parameters of the conditions specified in this report.

2-596

ASD-TDR-62-596. AN ELECTRONICALLY CONTROLLED HIGH SPEED STREAK CAMERA. Final rpt, July 1962, 21p. incl illus., 4 refs. P: 7360, T: 736003. O. Van P. Sessoms, III, Lt. T. W. Bailey. In OTS. ASTIA: AD 287531, Code AA.   Unclassified

This report describes the design and development of an electronically controlled high speed streak camera. The camera employs a magnetic suspension and drive mechanism which allows a prismatic mirror to be suspended frictionlessly in a magnetic field and to be driven to extremely high rotational velocities. This provides the streak camera with a time resolution and controllability which could not be achieved by more conventional means.

The design, development, and initial operation are described, but no performance data is available as administrative and technical problems forced termination of the project before it could be completed.

2-598

ASD-TDR-62-598. AN EVALUATION OF A CESIUM MAGNETIC TRIODE. Final rpt, June 1962, 130p. incl illus., tables, 3 refs. P: TEE-4011-15, T: 817305-3. C: AF 33(616)-8204, Thermo Electron Engineering Corp., Waltham 54, Mass. Dr. E. N. Carabateas, G. Miskolczy, and A. Wolpert. In OTS. ASTIA: AD 278844, Code AA. Unclassified

General equations are derived for a magnetic triode and design parameters are obtained. Experimental models were constructed with provisions to vary parameters. The models were fabricated using all metal-ceramic components to achieve uniform test conditions and to demonstrate the extent to which a device incorporating the magnetic triode features can be made practical both from the point of view of ruggedness and that of adaptability to a heat source. Extensive experimental results are obtained in an ignited and in an unignited mode. An analysis of the experimental results is presented.

2-598a

ASD-TR-61-598. SOME CONSIDERATIONS ON HARDENING OF SPACE VEHICLES AGAINST NEARBY NUCLEAR DETONATIONS. Final rpt, May 1962, 38p. incl illus., tables, 11 refs. P: 6906, T: 37551. C: AF 33(657)-7167, American Science and Engineering, Inc., Cambridge, Mass. O. R. Anderson and J. W. Carpenter. ASTIA: Code NC.   Secret-Restricted Data

2-600

ASD-TDR-62-600. DEVELOPMENT OF A PHOTOEMISSIVE SOLAR ENERGY CONVERTER. Final rpt, Sept 1962, 78p. incl illus., tables, 27 refs. P: 8173, T: 817301-9. C: AF 33(616)-8415, National Research Corp., Cambridge, Mass. Peter Fowler, et al. In OTS. ASTIA: Code XX.   Unclassified

The characteristics of a photoemissive solar energy converter were studied. The practical form of this device is a perforated sheet of a dielectric such as polyethylene terephthalate resin coated on one side with a photoemitter and on the other with a low work function conductor. Photoelectrons emitted from the front surface by solar radiation fall back through the holes and are collected on the back surface. The resulting charge transfer builds up a potential difference which may be used to perform useful work. Models were constructed and tested in evacuated glass envelopes of ultraviolet transmitting glass using a xenon arc as a solar simulator. The observed power conversion efficiency was of the order of $10^{-4}\%$. There was no correlation between converter efficiency and geometrical parameters. Measurements of spectral response showed good agreement with published values for Cs_3Sb. Life tests did not show any deleterious effects due to the evaporation which would be expected to occur in space. Calculation of rates of evaporation indicated a life of 0.8 year at 27°C and 70 years at 0°C. The effect of oblique incidence was found by experiment to be a decrease in output at a lower rate with respect to angle of incidence than would be predicted by the consine law. It was found that Cs-Sb surfaces can be formed at temperatures considerably below 120°C by co-deposition of cesium and antimony.

2-601

ASD-TDR-62-601. INTEGRATION OF PERSONAL EQUIPMENT. Final rpt, Sept 1962, 30p. incl illus. P: 6336,

T: 63619. C: AF 33(616)-8250, David Clark Co., Inc., Worcester, Mass. A. J. Kenneway, III. In OTS. ASTIA: Code XX.   Unclassified

Due to the variable environments United States Air Force personnel are subjected to, survival equipment reliability is becoming an urgent critical requirement. Work continues in design and fabrication of items which fulfill the requirements, are lightweight and will integrate easily with other flight equipment.

This report describes approach methods, problem areas and progress made in fabricating a one-man cold water survival raft, several underarm life preservers with and without parachute harness integration, and redesign approaches to the standard one-man life raft (PK-2 and MB-4). The problem of designing and integrating one item with another without compromising individual characteristics is discussed. Practical solutions were achieved in most areas.

2-601a

ASD-TR-61-601. STUDY OF HELICOPTER ROTOR-ROTOR INTERFERENCE EFFECTS ON HUB VIBRATION. Final rpt, June 1962, 79p. incl illus., 9 refs. P: 1370, T: 137009. C: AF 33(616)-6757, Mass. Inst. of Tech., Cambridge, Mass. J. F. Duvivier. In OTS. ASTIA: AD 284877, Code AA.   Unclassified

A study of the effect of spacing between tandem three bladed helicopter rotors on the vertical and in-plane shears transmitted at the rear rotor hub was made in a wind tunnel by exciting the rear rotor in resonance with the third harmonic airload. Theoretical third harmonic vertical shears based on Mangler's inflow distribution for a single rotor are compared with the experimental results measured on a single rotor and at the rear rotor of four tandem configurations. First harmonic vertical and in-plane shears and sixth harmonic vertical shears are also presented. Pressure measurements made at ten points of one blade were used for correlation with the measured vertical shears, and one case of harmonic airload distribution is presented. Harmonic analyses of the test data are included.

2-603a

ASD-TR-61-603. STUDY AND DEVELOPMENT OF AN ELECTRIC SIDE STICK CONTROLLER FOR AEROSPACE VEHICLES. Final rpt, May 1962, 128p. incl illus., tables, 14 refs. P: 8226, T: 822601. C: AF 33(616)-6610, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. H. C. Graves, A. J. Bailey, and D. L. Mellen. Not in OTS. ASTIA: Code XX.
Unclassified

This document describes the engineering program conducted under USAF sponsorship on an electric side stick controller for advanced aerospace vehicles. The immediate objective of the program was to develop an electric side stick controller for the X-15 Research Vehicle which

was compatible with the MH-96 Adaptive Flight Control System. A secondary and more general objective was to develop empirical data on 'the human engineering aspects of side stick controller design which would be applicable to more advanced aerospace vehicles.

The program included extensive flight test evaluations in a JF-101A aircraft. Excellent experimental results were obtained during the course of the program, leading to a concrete specification for an electric side stick for the X-15 Research Vehicle.

New areas of side stick performance which needed investigation became apparent during this study but they were outside the scope of this study. These areas, such as low L/D landings, pencil stick performance, and adaptive model variations, are discussed.

The development of the electric side stick was closely related to the features and characteristics of the Honeywell Adaptive Flight Control System; therefore, an Appendix, "Adaptive Flight Control Concepts," has been included in this report for background information.

2-605a

ASD-TR-61-605. THE DECAY OF ELECTROMAGNETIC RADIATION IN GASEOUS DISCHARGES. Interim rpt, Oct 1961, 47p. incl illus., tables, 24 refs. P: 4150, T: 41670. C: AF 33(616)-5479, Electrical Engineering Dept., Univ. of Minn., Minneapolis, Minn. A. D. Kaske and H. J. Oskam. In OTS. ASTIA: AD 273249, Code AA.
                                                    Unclassified

One of the important parameters determining the properties of gaseous plasmas is the value of the average electron energy. For instance, the phenomena occurring in disintegrating plasmas depend strongly on this energy and thus on the transient behavior of the average electron energy.

Calculations relating to the characteristic time constant of the electron energy for electron-neutral and electron-ion interactions are presented. A method is described for measuring this time constant and preliminary results are given.

2-606a

ASD-TR-61-606. SUBMILLIMETER WAVE MASER. Final rpt, Dec 1961, 19p. incl illus. P: 5237, T: 42016. C: AF 33(616)-6764, Lab. for Electronics, Inc., Boston, Mass. Jerome L. Altman. In OTS. ASTIA: AD 272231, Code AA.   Unclassified

A report an unsuccessful attempt to generate submillimeter waves (600 micron wavelengths) by Maser action, using sodium vapor as the medium, D_2 sodium line as the pump frequency, and a quartz tube as a resonator. The hypothesis, experimental approach and procedure, as well as the sodium cell, source of pumping frequency, and optical system are described. Possible reasons for failure are examined.

2-611 (Part I)

ASD-TDR-62-611, Pt. I. INFORMATION TRANSFER EFFICIENCY OF WIDEBAND COMMUNICATION SYSTEMS: Information Efficiency of Binary Communication Systems. Final rpt, July 1962, 121p. incl illus., tables, 15 refs. P: 4335, T: 433522. C: AF 33(616)-8283, Purdue Univ., School of Electrical Engineering, Lafayette, Ind. J. C. Hancock and E. M. Sheppard. In OTS. ASTIA: AD 284450, Code AA.   Unclassified

Most of the work which has been done with binary communication systems up until now has assumed operation in a symmetric mode. This work is concerned with the problem of evaluating various combinations of modulation and detection in both symmetric and non-symmetric modes of operation.

The most frequently used criterion for describing performance in a binary system is total probability of error. A discussion of this and other criteria is given.

Several types of conventional binary systems are analyzed and compared under the conditions that additive gaussian white noise is the only perturbing influence.

A similar type of analysis is given for a group of matched filter systems which includes both coherent and non-coherent matched filter detection of amplitude and frequency shift keyed signals in the face of gaussian white noise and the coherent matched filter detection of phase shift keyed signals.

All of the systems discussed are compared on the same basis by using a time bandwidth product which allows the signal-to-noise ratios on which the conventional system analysis is based to be converted to an energy per symbol to noise spectral density ratio, which is the basis for matched filter analysis.

2-611 (Part II)

ASD-TDR-62-611, Pt. II. INFORMATION TRANSFER EFFICIENCY OF WIDEBAND COMMUNICATION SYSTEMS: Binary Communication Systems Using Wideband Signals. Final rpt, July 1962, 151p. incl illus., 13 refs. P: 4335, T: 433522. C: AF 33(616)-8283, Purdue Univ., School of Electrical Engineering, Lafayette, Ind. J. C. Hancock, W. D. Wade. In OTS. ASTIA: AD 284451, Code AA.
                                                    Unclassified

It has been pointed out that communication systems having wideband signal waveforms have certain advantages over the conventional narrowband systems. This report describes the results of a research program which examined in detail the information efficiency of wideband systems.

The results presented in this report fall into three major categories: (1) analysis of systems utilizing linear receivers (i.e., synchronous receivers, etc.), (2) analysis of system utilizing nonlinear receivers, and (3) analysis and description of methods which can be used for realizing certain optimum and sub-optimum wideband receivers. The

development of these topics is based on the geometrical concept of a signal space.

From the consideration of the types of noise which one may expect to encounter when using wideband systems, it is apparent that a relatively sophisticated approach is required in order to obtain the required physical realizations. Because the nature of the interference, in general, will not be known in detail to the designer, certain adaptive techniques are incorporated.

2-611 (Part III)

ASD-TDR-62-611, Pt. III. INFORMATION TRANSFER EFFICIENCY OF WIDEBAND COMMUNICATION SYSTEMS: A Wideband Adaptive Communication System. Final rpt, July 1962, 218p. incl illus., 60 refs. P: 4335, T: 433522. C: AF 33(616)-8283, Purdue Univ., School of Electrical Engineering, Lafayette, Ind. J. C. Hancock, W. C. Lindsey. In OTS. ASTIA: AD 284452, Code AA.
Unclassified

Statistical methods are applied to the adaptive communication problem. Communicating through a random multipath channel with additive noise is considered.

Probability of error is evaluated in closed form for three different modes of operation. A major conclusion taken from these expressions is that the probability of error in no case depends directly on the channel gain, but rather is a function of the total average energy received from all propagation modes. It is shown that the information gain concerning the multipath structure increases rapidly for a few bands of identification time after which information build up begins to saturate. This is important because there will be available at the receiver only a finite time for which to identify this channel condition. The variance of the channel estimates are computed for maximum and minimum identification time. It is shown that the bandwidth of the transmitted waveform is the important parameter for accurate measurement of the multipath structure, while a sinusoid is sufficient for measuring the channel gain. By combining the channel measurement techniques and signal detection results, two Adaptive Receiver structures are formulated and their operation discussed. Finally, commentaries on future research are made and conclusions given about the above work.

2-613

ASD-TDR-62-613. CRITERIA FOR RUPTURE OF CERTAIN TEXTILE STRUCTURES UNDER BIAXIAL STRESS Final rpt, Aug 1962, 11p. incl illus. and 4 refs. P: 7320-02. P. Popper, 1st Lt, USAF. In OTS. ASTIA: AD 285798, Code AA. Unclassified

This report outlines a procedure for determining the combinations of biaxial stress which will cause failure in certain types of fabrics. Solutions are given for knitted fabrics and "diamond" structures, and are presented in the graphical form of a rupture envelope. Also, a com-

monly used rupture criteria for solid materials is included for comparison with the graphic results.

2-614

ASD-TDR-62-614. DYNAMIC RESPONSE AND TEST CORRELATION OF ELECTRONIC EQUIPMENT. Final rpt, Aug 1962, 123p. incl illus. P: 1309, T: 130904. C: AF 33(616)-7743, Bolt Beranek and Newman Inc., Cambridge, Mass. Denis U. Noiseux, et al. In OTS. ASTIA: AD 286862, Code AA. Unclassified

A new theory for estimating the response of a complex structure is reviewed in this report. This theory is based on a modal energy balance between the excitation and the structure. The theory is general enough to apply to vibration excitation as well as to acoustic excitation. The theory is applied to a simple structure, a box, simulating an electronic package excited by a reverberant acoustic field, and is verified for this case by experiments. Some refinements of the experimental technique are indicated.

A formulation of the equivalence between vibration testing and acoustic testing is offered. The importance of developing such a formulation is demonstrated by showing the economy resulting from its application. The report also presents criteria for specifying acoustic tests. In particular, the dimensions and power requirements of reverberant room test facilities are derived. Experimental results justify the derivations.

Finally, results of vibration tests of a micro-electronic circuit and a field effect transistor are given.

2-620a

ASD-TR-61-620. CREATURE COMMUNICATIONS. Final rpt, Dec 1961, 141p. incl illus., 299 refs. P: 4335, T: 40641. C: AF 33(616)-7724, Armour Research Foundation of Ill. Inst. of Technology, Chicago, Ill. E. F. Uretz. In OTS. ASTIA: AD 270802, Code AA. Unclassified

Review of biological literature is given and interpreted in terms of the goal of the program: the development of new communication components, techniques, and systems from ideas suggested by biological phenomena. Review includes field of animal migration, homing, and navigation; optical, olfactory, tactile, and acoustic generation and detection; and neural transmission and coding. Results of research in three major areas which were selected on the basis of literature review is described. Research on property sensitive photoconductive cells results in development of several property sensitive configurations, including an edge detector, convexity detector, and a contrast enhancing detector. Various systems which utilize these components are described. Functioning of neural networks was investigated using the threshold operator as an analytical tool, and several useful concepts and data processing techniques which resulted from this work are described. Cells synthesized from

bacterial chlorophyll were tested and found to be slightly sensitive to light.

2-625

ASD-TDR-62-625. PROCEDURES FOR THE DESIGN OF THERMAL PROTECTION SYSTEMS FOR MANEUVER-ABLE RE-ENTRY VEHICLES. Sept 1962, 73p. incl illus., tables, 17 refs. System 620A. Donald Turrentine. In OTS. ASTIA: AD 287957, Code AA.   Unclassified

Atmospheric re-entry of earth-orbital, hypersonic glide vehicles creates thermal problems. The heat affects not only the materials and construction of the airframe but also the crew and various subsystems of the vehicle. Successful solution of these problems depends upon the development of an effective thermal protective concept, which will also give the designer some latitude in his design philosophy. The role of the protective system is to significantly attenuate the influx of heat that is aero-dynamically generated within the surrounding boundary layer. Attenuation is accomplished by combining external radiation shielding elements with backup insulation materials and an appropriate cooling system.

Analytical procedures are presented for determining significant system parameters by transforming the differential heat conduction or diffusion equation into an algebraic expression by employing the calculus of finite differences. The adaptation of the resulting equation to digital computer programming is discussed, and numerical results are presented to indicate systems of minimum weight.

2-625a

ASD-TR-61-625. THERMODYNAMIC DATA ON OXYGEN AND NITROGEN. Final rpt, Sept 1961, 159p. incl illus., tables, and 239 refs. P: 1(1-3048), T: 30480w. C: AF 33(616)-8287, Air Products and Chemicals, Inc., Allen-town, Pa. Jerome Brewer. In OTS. ASTIA: AD 275728, Code AA.   Unclassified

The following data, which were compiled from published literature, are presented graphically as a function of temperature and pressure:

Viscosity of Nitrogen, Viscosity of Oxygen, Viscosity of Air, Viscosity of Saturated Liquid (Oxygen, Nitrogen, and Mixtures), Vapor-Liquid Equilibrium

Ratios: Oxygen-Nitrogen System, Dew
Points: Oxygen-Nitrogen System, Bubble
Points: Oxygen-Nitrogen System, Thermal Conductivity of Nitrogen, Thermal Conductivity of Saturated Liquefied Nitrogen and Oxygen, Density of Oxygen, Density of Nitrogen, Prandtl Number of Nitrogen, and Prandtl Number of Oxygen.

For each of the above properties a discussion of their critical evaluation was made. Two complete sets of curves were presented, one set with experimental and correlative data points and one set without data points. Bibliographical sources for each property as well as a

master bibliography of all sources consulted are given. Tabulated values used to construct the various graphs are also presented.

2-628

ASD-TDR-62-628.   RESEARCH ON AN ELECTRONIC INSTRUMENTATION SYSTEM FOR TESTING EMER-GENCY CREW ESCAPE SYSTEMS. Final rpt, Aug 1962, 45p. incl illus., tables. P: 1362, T: 136204. C: AF 33(616)-7440, Technology Inc., Dayton, Ohio. K. L. Rickey, T. W. Temple. Not in OTS. ASTIA: AD 286831, Code AA.   Unclassified

This report presents a complete instrumentation system for testing escape capsules ejected downward from a test vehicle traveling at supersonic speeds and high altitudes. The capsule, which contains an instrumented 95th percentile dummy, is installed in an inverted position in the test vehicle, a modified MB-1 Pod, carried by a B-58 aircraft. Instrumentation systems are located in both the pod and the capsules. Instrument readings and the ejection sequence are recorded photographically in the pilot's station. A ground support console for ground checkout of the systems and an instrumentation trailer for "quick-look" receiving station capability were also developed.

2-630a

ASD-TR-61-630.   RESEARCH ON SPONTANEOUS MAG-NETISM IN SOLID BODIES. Final rpt, Feb 1962, 49p. incl illus., tables, 81 refs. P: 7371, T: 737103. C: AF 33(616)-7396, General Electric Research Lab., Sche-nectady, N.Y. I. S. Jacobs, D. S. Rodbell, W. L. Roth. In OTS. ASTIA: AD 277380, Code AA.   Unclassified

A number of research projects dealing with fundamental interactions and the microstructure of internal fields in selected magnetic materials was carried out. The nuclear magnetic resonance of Co^{59} in metallic cobalt powders has been examined. In addition to the absorption characteristic of Co^{59} in face-centered cubic cobalt, there was found an additional group of absorptions, one of which is clearly associated with hexagonal close packed cobalt. The phenomenon of spin-flopping in antiferromagnetic MnF_2, in which the axis of antiferromagnetism is decoupled from the crystal axes, was observed by magnetism measurements in high pulsed magnetic fields. Its position coincided with the value, 93 kOe, predicted from measurements of antiferromagnetic resonance with millimeter microwaves. The temperature dependence of the magneto-crystalline anisotropy of face-centered cubic cobalt metal was examined by ferromagnetic resonance on single crystal thin films and submicron precipitate particles in Cu, at temperatures below the range in which this is the stable structure. Satisfactory agreement is obtained for a tenth power law between anisotropy and magnetism. A very brief review paper on pulsed field magnetization measurements in compounds was prepared. An investigation of magnetic exchange and structure in lanthanum manganite perovskite compounds spanning the transition between

antiferromagnetism and ferromagnetism was performed using neutron diffraction and high field magnetization techniques. Evidence favored the single-phase canted spin model for this region over the model of a mixture of two crystallographically similar but magnetically distinct phases. Seven additional exploratory projects were undertaken, some of which hold considerable promise for development.

2-633

ASD-TDR-62-633. A HIGH INTENSITY ARC PLASMA TUNNEL. Final rpt, Aug 1962, 19p. incl illus. and 23 refs. P: 7360-01. Edmund J. Rolinski. Not in OTS. ASTIA: Code XX. Unclassified

This report describes a design for a 200-kilowatt high-intensity arc-plasma tunnel. The design is intended to provide maximum versatility both in terms of operating the arc tunnel and in the experiments which would be seen in the tunnel. Specific requirements for arc-tunnel operation are indicated in the design parameters, i.e., power supply, gas supply, cooling water, vacuum, and gas, water, and electrical metering systems.

Shakedown runs of the arc tunnel indicated that the arc plasma is stable for periods of 6 min. Arc-plasma characterization studies will include determination of heat-flux rates, pressure and velocity profiles, mass flow rates, atomic and molecular species, and temperature of the arc-plasma environment. Heat transfer rates will be correlated for simulation of hypersonic flight conditions. Chemical kinetic studies on the arc plasma are possible future experiments.

2-635a

ASD-TR-61-635. RESEARCH ON ELECTRON GUNS FOR INTERMEDIATE HIGH-POWER TRAVELING-WAVE TUBES. Final rpt, Sept 1962, 136p. incl illus., 14 refs. P: 4156, T: 415603. C: AF 33(616)-6441, Watkins-Johnson Co., Palo Alto, Calif. R. D. Frost, O. T. Purl. W-J 61-330R33. Not in OTS. ASTIA: Code XX. Unclassified

This report describes experimental methods which have been used, in conjunction with the design procedures evinced by Pierce, Brewer and Muller, to obtain high convergence, high perveance solid beam electron guns. The technique of cathode shaping in combination with use of a multi-electrode focus electrode to optimize the beam boundary conditions has resulted in high perveance guns which produce extremely laminar beams. These beams have more uniform current density distribution and much higher area convergence ratios than have been obtained by other methods. These techniques have been used to obtain guns having microperveances of 1.2, 1.9, and 2.2 with beam area convergences of over 52:1, 27:1, and 300:1 respectively. All of these guns produce beams which have been focused with less than 1 to 2 percent circuit interception. At magnetic fields less than 1.4

Brillouin and drift tube dia. 1.5 to 2 times the beam dia. Also reported are a perveance 1.0×10^{-6} gridded gun, a perveance 6×10^{-6} gun and a very low perveance (0.1×10^{-6}) extremely high convergence $(1000:1)$ gun.

2-639

ASD-TDR-62-639. DEVELOPMENT OF IMPROVED SOLAR ENERGY CONVERTERS FROM GALLIUM ARSENIDE. Final rpt, Sept 1962, 213p. incl illus., tables, 22 refs. P: 8173, T: 817301. C: AF 33(616)-6615, Radio Corp. of America, Semiconductor and Materials Div., Somerville, N.J. M. F. Lamorte, G. W. McIver. Not in OTS. ASTIA: Code XX. Unclassified

A discussion of solar cell fabrication is presented; the discussion includes commentary on: (1) crystal used and crystal properties; (2) diffusion techniques used; (3) surface treatments used; (4) a comparison of Polystylene and silicon oxide antireflecting coatings; (5) data for n on p cells; (6) diffusion techniques for formation of gallium phosphide on gallium arsenide substrates; (7) methods for growing large area gallium arsenide single crystals; and (8) methods for epitaxial growing of gallium arsenide layers from the vapor phase. Experimental procedures employed are outlined and several analytical investigations are presented concerning optimum grid structure, solar cells with cascaded energy gaps, the effect of the built-in field, surface recombination, the optimum antireflecting coating, and the determination of short-circuit current from the spectral response curve.

2-641a

ASD-TR-61-641. STUDY AND EXPERIMENTAL INVESTIGATION OF THE SYNCHRONIZATION OF LONG AND SHORT RANGE COMMUNICATIONS. Final rpt, Nov 1961, 260p. incl illus., tables, 6 refs. P: 4335, T: 433508. C: AF 33(616)-6678, Hazeltine Research Corp., Little Neck 62, N.Y. D. Richman, C. E. Page, and R. Regis. Report 7687. ASTIA: AD 327678, Code AA. Secret

Synchronization theory and techniques applicable to spread-spectrum communications between moving terminals were investigated. The investigations were conducted in two successive phases. Phase I investigated synchronization concepts and fundamentals, measures of synchronizing system performance, and analysis of selected techniques and combinations of techniques. Methods were developed for defining the synchronization problem of specific missions in terms of synchronization fundamentals and mission constraints. A number of basic techniques applicable to synchronization problems were described. The techniques included novel and advanced concepts developed in this study. The use of these techniques and concepts was illustrated in terms of solutions to the synchronization problems of some representative Air Force missions.

In Phase II some of the principal concepts and techniques developed in Phase I were demonstrated experimentally.

A synchronizing system for a mission selected by the Air Force was designed, breadboarded and evaluated. This synchronizing system uses repeated transmission of a pseudo-random code baud as a preamble to a message. A sequential search technique is employed by the receiver to resolve time uncertainty between the binary digits of the received and receiver's reference code. Frequency uncertainty is resolved through the proper application of an APC loop. The experimental results achieved during Phase II verified the theoretical studies of Phase I.

2-643

ASD-TDR-62-643. CERENKOV RADIATION FROM AN ANTISOTROPIC PLASMA. Interim rpt, June 1962, 90p. incl illus., tables, 33 refs. P: 5237, T: 523701. C: AF 33(616)-7043, Ultramicrowave Section, Electrical Engineering Research Lab., Engineering Experiment Station, Univ. of Ill., Urbana, Ill. R. J. Kenyon. Technical Note No. 4. Not in OTS. ASTIA: AD 282445, Code AA. Unclassified

The Cerenkov radiation from an anisotropic plasma due to the passage of a spacially bunched, cylindrically shaped, extended beam of electrons is evaluated. Two problems are considered: one in which the plasma is bounded by an unbounded isotropic dielectric. Solutions for the power radiated, expressed in terms of an equivalent radiation resistance, are obtained by a consideration of the appropriate electromagnetic boundary value problem.

Numerical results were obtained by programming these solutions for computation by the University of Illinois digital computer, ILLIAC. An extensive set of curves of radiation resistance as a function of the several variables: plasma frequency, cyclotron frequency, beam velocity, and beam radius, is presented for the unbounded plasma problem. A few typical curves are presented for the bounded problem. The curves for the unbounded plasma show that the Cerenkov interaction in an anistropic plasma can be 1000 times stronger than that in conventional microwave tubes. The interference effect due to reflections at the plasma-dielectric interface in the bounded plasma can further increase this interaction by as much as an order of magnitude.

The study of an anisotropic plasma points out criteria to use in a search for other material that would yield high Cerenkov interaction.

2-643a

ASD-TR-61-643. A STUDY OF THE INFLUENCE OF LUBRICANTS ON HIGH-SPEED ROLLING-CONTACT BEARING PERFORMANCE. Final rpt, Aug 1962, 59p. incl illus., table, 28 refs. P: 3044, T: 30169. C: AF 33(616)-7257, Battelle Memorial Inst., Columbus, Ohio. Lewis B. Sibley et al. Not in OTS. ASTIA: AD 269512, Code AA. Unclassified

Lubrication processes at rolling contacts are being studied with a rolling-disk machine and X-ray system capable of measuring the dynamic oil-film thickness and deformation at rolling contacts. For low-viscosity lubricants operating under moderate conditions of load, speed, and temperature, measured film thickness correlated well with elasto-hydrodynamic lubrication theory including both the elastic deformation of the contact surfaces and the increase in viscosity of the lubricant under pressure. Measured film thickness decreased significantly below theoretical under increasing load, speed, viscosity, and ambient temperature, at times by as much as a factor of 40.

It is proposed that as the conditions of load, speed, and temperature at rolling contacts become more severe, flow properties of lubricants other than viscosity and pressure-viscosity become important in elasto-hydrodynamic lubrication. The data indicate that some form of reduced shear stress or "yielding" may occur in the high-pressure lubricant film at rolling contacts under these conditions.

2-650

ASD-TDR-62-650. ELECTROFLUIDMECHANICS: INVESTIGATION OF THE EFFECTS OF ELECTROSTATIC FIELDS ON HEAT TRANSFER AND BOUNDARY LAYERS. Final rpt, Sept 1962, 128p. incl illus., tables, 31 refs. P: 3141. H. R. Velkoff. In OTS. ASTIA: Code XX. Unclassified

A series of experiments were conducted on the influence of an electric field on free convection heat transfer. A heated plate was mounted in a Mach-Zehnder interferometer, and the effects of applied electrical fields were studied. Large changes in effective heat transfer were found. Analytical studies were made of this phenomenon. A suitable mathematical model was formulated on the basis of the Von Karman integral equations and the electrostatic field equations. Correlation between the interferometer test data and the mathematical model was achieved.

Exploratory tests of fluid orientation and motion under the influence of dielectric forces were also conducted, and the potential usefulness of the phenomenon is graphically portrayed in pictures showing the motion of water droplets in a "Zero-G" model when a field is applied.

2-660

ASD-TDR-62-660. GREEN'S FUNCTION OF RADIAL DISPLACEMENT IN A CIRCULAR DISC DUE TO UNIT NORMAL AND TANGENTIAL LOADS. Final rpt, Oct 1962, 13p. incl illus., 5 refs. P: 7342, T: 734202. C: AF 33(616)-8016, Rensselaer Polytechnic Inst., Troy, N.Y. C. W. Ng. In OTS. ASTIA: Code XX. Unclassified

Using the method of Muskhelishvili, the Green's function of radial displacement is obtained in a circular disc due to a unit normal and a unit shear traction at the boundary. This Green's function is useful in the study of contact problems in sliding as well as in rolling, i.e., included would be the important problem of elasto-hydrodynamics.

An example is carried out for the distribution of heat generation due to a rigid rider against an elastic slider which is in the form of a circular disc.

2-665

ASD-TDR-62-665. RADIO SET AN/ARC-27 MODIFICA-TION. Final rpt, Aug 1962, 47p. incl illus., tables. P: 9057. C: AF 33(604)-34291, Collins Radio Co., Cedar Rapids, Iowa. Wayne Walter. SDR-101. Not in OTS. ASTIA: Code NC.   Unclassified

The need has arisen, in some applications, for Radio Set AN/ARC-27 to operate normally when subjected to extremely high input signals. A modification was developed that allows normal receiver performance when subjected to input signals of at least seven volts. Extensive bench and flight tests were conducted. From these tests, the modification was quite satisfactory.

2-666

ASD-TDR-62-666. RESEARCH ON AN ION SOURCE INTEGRATED WITH A MICROWAVE GENERATOR. Final rpt, Aug 1962, 43p. incl illus., tables, 9 refs. P: 4122, T: 412206, C: AF 33(616)-7760, The Ohio State Univ. Research Foundation, Columbus 12, Ohio. R. M. Campbell, W. H. Cornetet, Jr. RF 1216. Not in OTS. ASTIA: Code XX.   Unclassified

Object of research was to investigate the possibility of using a Barkhausen-Kurz oscillator as a source of rf energy integrated with an ion source. When properly neutralized, ion source might be usable for space propulsion. It was desired to determine the effects on oscillator of introducing various gases into interaction region of oscillator and further to determine ion current possible by introduction of these gases.

A Barkhausen-Kurz oscillator having axial symmetry was the basic unit given the most attention in investigation. This tube was tested in helium, argon, and nitrogen atmospheres.

Brief test was made on a planar model Barkhausen-Kurz oscillator but results were not sufficient to evaluate the device. Another device which combines the two sources is also proposed and discussed. No experimental results have been obtained for this proposed device.

2-667

ASD-TDR-62-667. DEVELOPMENT OF IMPROVED VANADIUM-BASE ALLOYS FOR ELEVATED-TEMPERA-TURE USE. Final rpt, Oct 1962, 66p. incl illus., tables, 19 refs. P: 7351-03. C: AF 33(616)-7288, Crucible Steel Co. of America, Pittsburgh, Pa. V. C. Petersen and H. B. Bomberger. In OTS. ASTIA: Code XX.
Unclassified

Work was done to develop vanadium-base alloys having improved mechanical properties at elevated temperatures. The screening criteria included density-corrected hot hardness at 1800 F as well as forgeability performance 2300 F. The hot-hardness apparatus designed for the work permits loading up to 14 specimens at one time and testing up to 1800 F in vacuum. The validity of hot hardness as a hot strength parameter was established by a correlation with hot-strength data. In the exploratory work, 174 binary and multi-addition alloys were levitation-melted in 10-gram charges. Based on these studies of the microstructures, forgeability, and hot hardness of these alloys, 14 compositions were selected as most promising and were scaled up to larger melts. Screening data (rollability, hot hardness, and hot tensile properties) on the larger melts showed three compositions to be superior: V-20Cb-5Ti, V-25Mo-2.5Hf, and V-35Cr-1Zr. These alloys demonstrated better forgeability and superior 2000 F tensile strength than the well-known V-20Cb-5Ti alloy. Iron and tin were also found to be promising alloying elements for further study.

2-670

ASD-TDR-62-670. THE EXTRUSION, FORGING, ROLL-ING, AND EVALUATION OF REFRACTORY ALLOYS. Final rpt, Oct 1962, 105p. incl illus., tables. P: 7351, 7381, T: 73519, 73811. C: AF 33(616)-8325, Westinghouse Electric Corp., Blairsville, Pa. D. R. Carnahan, J. A. Visconti. In OTS. ASTIA: Code XX. Unclassified

During the present contract year metallurgical programs were conducted on the extrusion, forging, and rolling of arc cast Mo+25%W+0.1%Zr, Mo+0.5%Ti+0.08%Zr+0.02%C and W+0.57%Cb alloys. Each of the three alloys has been worked successfully by extrusion and subsequent reworking. The extrusion process, as established in previous work, has remained primarily the same. However, extrusion temperatures exceeding 4200° F have been reached in the working of a group of tungsten base alloys. The maximum temperature attained to date has been 4320° F. In addition, the extrusion process has been applied to a variety of refractory alloys in order to supply wrought material for other contractors and governmental agencies. The extrusion data are contained as a portion of the work, but the metallurgical evaluation is not included, as it is accomplished by the particular agency for which the work was performed.

2-672a (Vol I)

ASD-TR-61-672, Vol. I. LOW FREQUENCY PROPAGA-TION TEST. Interim rpt, Feb 1962, 231p. incl illus., tables, 52 refs. P: 4335, T: 433528. C: AF 33(657)-7047, The Boeing Co., Transport Div., Renton, Wash. Not in OTS. ASTIA: AD 278609, Code AA. Unclassified

Studies of long range air-to-ground communications systems have indicated the desirability of utilizing the propagation characteristics of the low frequency portion of the radio spectrum to fulfill certain critical communications requirements. Sufficient data and theory were not available at the beginning of this program to define the propagation characteristics of low frequency energy

radiated from an airplane. Therefore, it was necessary to complete experimental measurements and theoretical analyses of applicable low frequency propagation characteristics in order to develop appropriate design and performance parameters for a long range LF communication system.

To satisfy these needs, an air-to-ground low frequency propagation test program was conducted. The complete test program consisted of field measurement tests at 151 kc to obtain experimental data; theoretical studies of low frequency propagation phenomena related to the other objectives of the test program; a correlation of the results of the experimental measurements and theoretical studies, and the establishment of appropriate system requirements for a low frequency air-to-ground communications system.

A complete description of both the experimental and the analytical portions of the test program is presented in this report. The results obtained from these two portions of the program are correlated and conclusions given.

2-672a (Vol II)

ASD-TR-61-672, Vol. II. LOW FREQUENCY PROPAGATION TEST. Interim rpt, Feb 1962, 36p. incl illus., tables, 17 refs. P: 4335, T: 433528. C: AF 33(657)-7047, The Boeing Co., Transport Div., Renton, Wash. ASTIA: Code NC. Secret-Restricted Data

2-672a (Vol III)

ASD-TR-61-672, Vol. III. LOW FREQUENCY PROPAGATION TEST. Interim report, Feb 1962, 102p. incl illus., tables. P: 4335, T: 433528, C: AF 33(657)-7047, The Boeing Co., Transport Div., Renton, Wash. Not in OTS. ASTIA: AD 278610, Code AA. Unclassified

Studies of long range air-to-ground communications systems have indicated the desirability of utilizing the propagation characteristics of the low frequency portion of the radio spectrum to fulfill certain critical communications requirements. Sufficient data and theory were not available at the beginning of this program to define the propagation characteristics of low frequency energy radiated from an airplane. Therefore, it was necessary to complete experimental measurements and theoretical analyses of applicable low frequency propagation characteristics in order to develop appropriate design and performance parameters for a long range LF communication system.

To satisfy these needs, an air-to-ground low frequency propagation test program was conducted from July 31 to September 28, 1961. The complete test program consisted of field measurement tests at 151 kc to obtain experimental data; theoretical studies of low frequency propagation phenomena related to the other objectives of the test program; a correlation of the results of the experimental measurements and theoretical studies, and the establishment of appropriate system requirements for a low frequency air-to-ground communications system.

2-672a (Vol IV)

ASD-TR-61-672, Vol. IV. LOW FREQUENCY PROPAGATION TEST. Interim rpt, Feb 1962, 100p. incl tables. P: 4335, T: 433528. C: AF 33(657)-7047, The Boeing Co., Transport Div., Renton, Wash. In OTS. ASTIA: AD 278611, Code AA. Unclassified

Studies of long range air-to-ground communications systems have indicated the desirability of utilizing the propagation characteristics of the low frequency portion of the radio spectrum to fulfill certain critical communications requirements. Sufficient data and theory were not available at the beginning of this program to define the propagation characteristics of low frequency energy radiated from an airplane. Therefore, it was necessary to complete experimental measurements and theoretical analyses of applicable low frequency propagation characteristics in order to develop appropriate design and performance parameters for a long range LF communication system.

To satisfy these needs, an air-to-ground low frequency propagation test program was conducted from July 31 to September 28, 1961. The complete test program consisted of field measurement tests at 151 kc to obtain experimental data; theoretical studies of low frequency propagation phenomena related to the other objectives of the test program; a correlation of the results of the experimental measurements and theoretical studies, and the establishment of appropriate system requirements for a low frequency air-to-ground communications system.

2-673

ASD-TDR-62-673. HIGH ACUITY CONTINUOUS TONE DIAZO REPRODUCTION MATERIALS. Interim rpt, Apr 1962, 98p. incl illus., tables. P: 6272, T: 627209. C: AF 33(616)-8069, Photo and Repro Div., General Aniline and Film Corp., Johnson City, N.Y. Dr. M. L. Moskowitz. OZ-62-3(B1.186). Not in OTS. ASTIA: Code XX. Unclassified

Work was conducted resulting in the formulation and coating of low contrast, high density, positive working diazotype films on polycarbonate film base. The use of ultraviolet absorbing materials and diazonium salts of various spectral sensitivities and how they effect sensitometric characteristics of such films was investigated as was the effect of varying exposure wavelengths.

A negative working diazosulfonate formulation, on polycarbonate film base, was devised having greatly increased density over previously available materials.

2-673a (Vol I)

ASD-TR-61-673, Vol I. STUDY OF SPACE TESTS OF ELECTRIC PROPULSION ENGINES, VOLUME I—SUMMARY OF ELECTRIC PROPULSION FLIGHT TEST REQUIREMENTS AND RECOMMENDED PROGRAMS. Final rpt, Dec 1961, 52p. P: 3141. C: AF 33(616)-8241, Aerojet-General Corp., Azusa, Calif. M. C. Reder,

R. J. Sunderland, R. H. S. Toms. SRN: 2123, Vol I. ASTIA: AD 329409L, Code MD. Confidential

Information presented in this volume summarizes the results of a program which (1) evaluated the present state of the art in electric propulsion, (2) projected the development programs to the 1962-1967 time period, (3) identified the requirements for in-space testing, (4) provided conceptual designs of flight-test systems, (5) evaluated all necessary components and subsystems required for the synthesis of complete flight-test payload systems, (6) identified all required development areas, and (7) provided a flight-test program schedule. Electric propulsion systems evaluated included the contact ion engine, the thermal arcjet charged engine, the oscillating-electron-type ion engine, the duoplasmatron-type ion engine, and the plasma pinch engine.

2-673a (Vol II)

ASD-TR-61-673, Vol II. STUDY OF SPACE TESTS OF ELECTRIC PROPULSION ENGINES, VOLUME II—PRINCIPLES OF ELECTRIC ENGINE OPERATION AND THE NEED FOR FLIGHT TESTING. Final rpt, Dec 1961, 313p., 41 refs. P: 3141. C: AF 33(616)-8241, Aerojet-General Corp., Azusa, Calif. R. D. Buhler, R. J. Sunderland, J. M. Teem, R. S. H. Toms. SRN: 2123, Vol II. ASTIA: AD 329411L, Code MD.
Confidential

This volume presents background information on the theory of electric engine operations, along with estimates of performance attainable. The contact ion, thermal arcjet, oscillating electron, duoplasmatron, and the plasma pinch engines are discussed in detail. The need for space testing of each engine is established on the basis of the limitations of ground-test techniques.

2-673a (Vol III)

ASD-TR-61-673, Vol III. STUDY OF SPACE TESTS OF ELECTRIC PROPULSION ENGINES, VOLUME III—FLIGHT-TEST OBJECTIVES, TECHNIQUES, AND CAPABILITIES. Final rpt, Dec 1961, 220p. P: 3141. C: AF 33(616)-8241, Aerojet-General Corp., Azusa, Calif. M. C. Reder, J. D. Christensen, L. Doshay, W. G. Smith. SRN: 2123, Vol III. ASTIA: AD 329408L, Code MD. Confidential

This volume reports the results of the study program insofar as they have served as the basis for identifying the flight-test objectives which must be considered in establishing a flight-test program to support electric propulsion development. The volume also discusses the techniques which are considered feasible for measuring the parameters required to satisfy test objectives. In addition, evaluation and selection of test-flight-system components which might be employed to satisfy the needs of the system as a whole, and the acquisition of test data in particular, are described. Finally, the performance and cost data used in selecting appropriate launch vehicles are presented.

2-673a (Vol IV, Part I)

ASD-T R-61-673, Vol IV, Part I. STUDY OF SPACE TESTS OF ELECTRIC PROPULSION ENGINES: Flight-Test-System Conceptual Design and Analyses. Final rpt, Dec 1961, 330p. incl illus., tables. P: 3141. C: AF 33(616)-8241, Aerojet-General Corp., Azusa, Calif. M. C. Reder, et al. SRN: 2123, Vol IV, Part I. ASTIA: AD 329412L, Code MD. Confidential

Test-System concepts for obtaining in-space performance data on electric propulsion systems are discussed in detail. Constraints imposed on the mission profile and the payload configuration by the test objectives are considered, and feasible test system concepts are established. A series of conceptual flight-test payloads (ballistic and orbital) are then described, analyzed, and evaluated.

2-673a (Vol IV, Part II)

ASD-TR-61-673, Vol IV, Part II. STUDY OF SPACE TESTS OF ELECTRIC PROPULSION ENGINES, VOLUME IV—FLIGHT-TEST-SYSTEM CONCEPTUAL DESIGN AND ANALYSES, PART II (APPENDIXES). Final rpt, Dec 1961, 229p., 13 refs. P: 3141. C: AF 33(616)-8241, Aerojet-General Corp., Azusa, Calif. M. C. Reder, L. Doshay, D. A. Philipp, R. J. Sunderland. SRN: 2123, Vol IV, Part II. ASTIA: AD 329410L, Code MD.
Confidential

This volume contains the appendixes referred to in Part I, Vol IV. Detailed analyses associated with the following problem areas are presented: nose fairing separation from a spinning vehicle, Appendix A; structural analyses for the major components of the SLN$_1$ D-V capsule, Scout II installation, Appendix B; stage separation of a rolling missile, Appendix C; dynamics of engine extension, Appendix D; spring separation, Appendix E; motion during test period, Appendix F; error analysis, sun sensors, Appendix G; thermal control, Appendix H.

2-674

ASD-TDR-62-674. INVESTIGATION OF TECHNIQUES FOR 1000°F HYDRAULIC SYSTEMS. Final rpt, Sept 1962, 225p. incl illus., tables. P: 8128, T: 812807. C: AF 33(616)-7454, Republic Aviation Corp., Farmingdale, L.I., N.Y. F. Pollard et al. RAC 613-3 (ARD-695-610). Not in OTS. ASTIA: AD 285066, Code AA. Unclassified

This report covers the design, fabrication, and testing of components to be used in a hydraulic system where significant portions of the system operate at a fluid temperature of 1000°F in an ambient temperature of 1200°F, and the testing of a system combining these components at temperatures up to 1000°F. The characteristics of the mixed polyphenyl ether fluid have been determined. The testing of seals for these components is also included.

Based on the successful results of the investigations and experiments accomplished under the contract, it is concluded that the design and production of a hydraulic system to operate reliably at fluid temperatures up to 1000°F is thoroughly feasible. However, it is recommended that further investigations be carried out in the following subjects: fluid control, pump endurance, servo valve selection, actuator design, reservoir design, modularization, control loop compensation, and additional components not investigated under the scope of this contract. Such investigations will amplify the results already obtained to enable the development of more comprehensive and varied systems.

2-675

ASD-TDR-62-675. DESIGN CRITERIA FOR 1000°F HYDRAULIC SYSTEM. Final rpt, Sept 1962, 76p. incl illus., tables. P: 8128, T: 812807. C: AF 33(616)-7454, Republic Aviation Corp., Farmingdale, L.I., N.Y. F. Pollard et al. RAC 613-4 (ARD-695-613). Not in OTS. ASTIA: AD 285067, Code AA. Unclassified

This report covers criteria to be used in the design and fabrication of a hydraulic system and its components where significant portions of the system operate at a fluid temperature of 1000°F in an ambient temperature of 1200°F. The characteristics of the mixed polyphenyl ether fluid which must be considered in system and component design are stated, and the characteristics of the major materials used in the fabrication of the components are also discussed.

2-679

ASD-TDR-62-679. RESEARCH ON AROMATIC POLYMERS FOR THERMALLY-STABLE FIBERS AND FILMS. Final rpt, July 1962, 64p. incl illus., tables, 20 refs. P: 7340, T: 73404. C: AF 33(616)-8253. E. I. Du Pont de Nemours and Co., Wilmington, Del. A. H. Frazer, J. J. Kane, F. T. Wallenberger. Not in OTS. ASTIA: AD 284783, Code AA. Unclassified

Dimethlyacetamide and dimethylsulfoxide have been successfully employed as dry-spinning solvents for poly-2,2'-(m-phenylene)-5,5'-bibenzimidazole. The physical properties of both fibers appear to be comparable. The fibers exhibit remarkably high resistance to hydrolysis and thermal aging although under the more realistic condition of air aging the thermal properties are not nearly as impressive as under nitrogen. The N-H bond in polybenzimidazoles is suspect as the weak link leading to degradation in the hot oven. To test this hypothesis N-substituted polymers were prepared via the methylation of N-sodio polybenzimidazoles. Oriented and crystalline polyhydrazide fibers can be converted by a unique cyclodehydration reaction into oriented and crystalline fibers of poly(1,3,4-oxadiazoles). Conversion of fibers (T/E/Mi = 5/24/94) of the polyhydrazide derived from equimolar amounts of isophthalic dihydrazide and terephthaloyl chloride (OIOT) gave fibers (T/E/Mi =

2.6/3.1/124) of poly(1,3-/1,4-phenylene-2,5-(1,3,4-oxadiazole), PODZ-I/T, which have excellent retention of their fiber structure even when exposed to temperatures up to 400°C for prolonged periods of time. Such heat treatments afford a final polyoxadiazole fiber (T/E/Mi = 1.2/1.2/90). The chemical structure of model compounds containing up to 13 alternating rings consisting of 2,5-(1,3,4-oxadiazole), m-, and p-phenylene moieties was found to be stable up to 440°-500°C. This is in agreement with observed stabilities of the corresponding polymer towards thermal degradation.

2-680

ASD-TDR-62-680. AN EXPERIMENTAL INVESTIGATION OF THE RANDOM EXCITATION OF A TAILPLANE SECTION BY JET NOISE. Final rpt, July 1962, 33p. incl illus., tables, 4 refs. P: 7351, T: 735106. C: AF 61(052)-504, Univ. of Southampton, Southampton, Eng. B. L. Clarkson, R. D. Ford. SRN: A.A.S.U. 171. In OTS. ASTIA: AD 286834, Code AA. Unclassified

The response of a section of tailplane structure to both discrete and random noise pressures has been studied in detail. Initially the specimen was mounted behind a jet engine and the induced strains were analyzed with the object of determining both resonant frequencies and the corresponding modes of vibration. During these tests a survey was made of the spectrum and correlation pattern of the jet noise on the surface of the model. Secondly, the specimen was mounted in front of a loudspeaker in an acoustics laboratory and the structural resonances were excited by means of discrete frequency sound. The mode shapes were studied in detail with the aid of a stroboscope. It is concluded that tailplane skin on this particular piece of structure only responds to any significant degree in one structural mode. Although reasonable comparison has been obtained between the random and discrete tests, it was not possible to calculate the induced stresses using the observed mode shapes and measured pressure excitation.

2-681

ASD-TDR-62-681. FURTHER ANALYSIS OF THE RANDOM VIBRATIONS OF THE CARAVELLE TEST SECTION. Final rpt, July 1962, 23p. incl illus., tables. P: 7351, T: 735106. C: AF 61(052)-332, Univ. of Southampton, Southampton, Eng. B. L. Clarkson, R. D. Ford. SRN: A.A.S.U. 175. In OTS. ASTIA: AD 284886, Code AA. Unclassified

The vibrations, induced by jet-noise, of a row of skin panels in the side of the rear fuselage of a Caravelle aircraft have been analyzed. It has been found that up to three adjacent panels may couple together in the fundamental stringer-twisting mode in which adjacent panels are out-of-phase. The vibrations of the skin panels in the upper surface of the outboard elevator have also been studied and here it has been found that the ribs act as rigid supports. Any pair of panels between two ribs,

however, are vibrationally coupled although the mode-shapes have not been satisfactorily determined.

2-682a

ASD-TR-61-682. FLOW REGIMES FOR HYPER-VELOCITY VEHICLES. Final rpt, July 1962, 112p. incl illus., tables, 45 refs. P: 1366-14. C: AF 33(616)-7797, Republic Aviation Corp., Farmingdale, L.I., N.Y. Anthony Casaccio, Edgar Bendor. Not in OTS. ASTIA: AD 284884, Code AA. Unclassified

A theoretical and analytical investigation has been conducted to define the flow regimes encountered by hyper-velocity re-entry vehicles. Criteria has been established for the delineation of the various regimes and applicable theories for the estimation of aerodynamic characteristics in each of these regimes are indicated where possible.

The results of the flow regime delineation study are presented in chart form for a series of geometrical shapes subjected to several wall temperature conditions.

2-683

ASD-TDR-62-683. OBSERVATION OF MAGNETIC DOMAINS BY MEANS OF THE KERR EFFECT. Final rpt, Sept 1962, 13p. incl illus., 12 refs. P: 7371, T: 737103. Axel M. Stoffel, Karl J. Strnat. In OTS. ASTIA: Code XX. Unclassified

An experimental apparatus has been built which employs the magneto-optical Kerr effect for visual observation and photographic recording of magnetic domain patterns. The main objective of this work was to familiarize the investigators with the problems of the Kerr technique and thus provide the basis for designing a more sophisticated apparatus.

This report discusses the Kerr effect and its application to the study of magnetic domains and analyzes some of the optical problems incurred in this application. It describes the experimental set-up and presents pictures of domain structures observed on a thin film of Permalloy.

2-685

ASD-TDR-62-685. A STUDY OF EXPLOSIONS INDUCED BY CONTACT OF HYDRAZINE-TYPE FUELS WITH NITROGEN TETROXIDE. Final rpt, Sept 1962, 31p. incl illus., 1 table, 8 refs. P: 6075, T: 607507, C: AF 33(616)-6918, Atlantic Research Corp., Alexandria, Va. R. Friedman, W. P. Barnes, Jr., M. Markels, Jr. Final rpt: ARC 62-5038.05-F. In OTS. ASTIA: Code XX. Unclassified

The mechanism of explosions which may result when a hydrazine-type liquid is brought into contact with liquid nitrogen tetroxide, was studied. Falling-droplet experiments showed correlation between distance of fall and probability of explosion. Sudden injection of one liquid into the other, with high-speed photography, gave non-reproducible results. Occasional explosions occurred, preceded by bubble formation. Alternate theories of the explosion phenomenon are discussed.

2-687a

ASD-TR-61-687. THERMAL STABILITY OF EXPERI-MENTAL HIGH TEMPERATURE FUELS. Final rpt, Apr 1962, 15p. incl illus., tables, 5 refs. P: 3048, T: 30178. C: AF 33(616)-7667, Shell Dev. Co., Emery-ville, Calif. C. L. Mahoney. Not in OTS. ASTIA: AD 276942, Code AA. Unclassified

The high temperature stability of seven pure hydrocarbon fuels supplied by Wright Air Development Division were tested in the Shell Development Fuel Coker at 600°, 700°, and 800°F under recycle conditions. These fuels were: hexahydroindane, methyl hexahydroindane, pinane, bi-cyclohexyl, 9-methylperhydrofluorene, 2-ethylperhydro-phenanthane, and 1, 1-bis (4-methylcyclohexyl) ethane.

On the basis of very limited data two trends regarding the effect of structure on high temperature stability were noted. One, condensed polycyclic naphthenes form slightly more deposit than non-condensed structures. Two, the presence of a five-membered ring appears to have a detrimental effect on stability as measured by deposit formation.

2-693a

ASD-TR-61-693. RESEARCH AND DEVELOPMENT ON CORONA-RESISTANT MATERIALS. Final rpt, Mar 1962, 138p. incl illus., tables, 39 refs. P: 7371, T: 737101. C: AF 33(616)-7485, General Electric Research Lab., Schenectady, N.Y. J. C. Devins, et al. Not in OTS. ASTIA: AD 277378, Code AA. Unclassified

The shapes of individual corona pulses and the changes in the shape with the applied voltage were determined. It was found that as the overvoltage increased, the pulses change from a type characteristic of corona ava-lanches to one characteristic of streamer discharge. The change has been interpreted theoretically by con-sideration of the positive ion space change produced in the early stages of the discharge. The chemical re-actions have been studied in detail on polyethylene. On other insulation materials the gross reactions have been studied with an eye to a broad general method of testing. The work done in Phase II of the contract was in three general areas: A—Measurement of corona pulse size distributions in cylindrical corona cells, power measure-ments, and theoretical considerations. B—Assessment of physical and chemical damage as a result of cylindrical cell corona exposure on Mylar, nylon, and a Formvar varnish. C—Determination of damage to Mylar under various conditions of divergent field corona. Charge profiles and erosion are included.

2-697a

ASD-TR-61-697. SPACE RADIATOR STUDY. Final rpt, Apr 1962, 254p. incl illus., tables, 80 refs. P: 0(3-

3145), T: 60853. C: AF 33(616)-7368, TAPCO, A Div. of Thompson Ramo Wooldridge Inc., Cleveland, Ohio. R. J. Denington, et al. CRN: ER-4544. In OTS. ASTIA: Code XX.   Unclassified

Design techniques are presented for condenser-radiators for condensing mercury, sodium, potassium, and rubidium vapors, for Rankine cycle space power plants. Included in the design techniques are radiation heat transfer, fluid mechanics, meteoroid protection and materials considerations with the fluid mechanics stability aspects emphasized.

Parametric data for large alkali metal condenser radiators relating geometry to weight and area are presented.

2-700

ASD-TDR-62-700. INVESTIGATION OF SINTERABLE MgO POWDERS AND CERAMICS MADE FROM THEM. Final rpt, Oct 1962, 48p. incl illus., tables, 27 refs. P: 7350, T: 735001.   C: AF 33(616)-7733, Battelle Memorial Inst., Columbus, Ohio. M. J. Synder, et al. In OTS. ASTIA: Code XX.   Unclassified

The fabrication of dense reproducible specimens suitable for strength measurements and having controlled microstructural differences was attempted. A sinterable high-purity magnesia powder, developed in an earlier phase of the program, was used. Procedures used earlier to produce small, rather crude specimens, could not be applied directly to controlled production of the quantity of large specimens needed. The sintered densities of the larger specimens were lower, and the variability from one lot to the next was greater. The major source of variability appeared to reside in the isostatic pressing operation. This unexpected sensitivity to forming conditions other than pressure suggests the need for further research on processing effects in ceramics made from sinterable powders. A portion of the effort was devoted to analysis and development of the diametral-compression test wherein short cylinders are broken by applying a load across a diameter. Procedures were established for measuring a tensile strength by this method.

2-701

ASD-TDR-62-701. TORSIONAL VIBRATIONS OF A FREE RECTANGULAR PLATE. Final rpt, July 1962, 18p. incl illus., 3 refs. P: 7351, T: 735106. C: AF 61(052)-504, Univ. of Southampton, Southampton, Eng. D. J. Mead, R. F. Beresford. SRN: 197. In OTS. ASTIA: AD 284887, Code AA.   Unclassified

This report considers effect of bending distortion of cross-section on torsional modes and frequencies of a uniform rectangular plate. Bi-harmonic plate equation is integrated to yield the transcendential frequency equation for modes of any specified longitudinal wavelength, the effects of shear distortion and rotary inertia associated with bending being ignored. The long wavelength solution is shown to be well approximated to by the

results from the simple torsional theory based on the St. Venant and Wagner-Kappus torsion theories. At shorter wavelengths, the simple theory still gives a good approximation to the frequencies of vibration, but considerable distortion of the cross-section is found to occur. Certain limiting conditions of very short wavelength are also investigated.

2-705a

ASD-TR-61-705. RESEARCH ON HIGH-TEMPERATURE BEARINGS. Final rpt, Aug 1962, 71p. incl illus., tables, 15 refs.   P: 1315 and 3044, T: 131501 and 73314. C: AF 33(616)-7209, Southwest Research Inst., San Antonio, Tex. R. D. Brown, R. A. Burton, P. M. Ku. In OTS. ASTIA: Code XX.   Unclassified

This report describes the evaluation work performed on oscillating bearings of both plain journal and self-aligning types. Bearing substrate materials included cermets LT-1B and LT-2 and alloys F-48 and René 41. Lubricants receiving extensive evaluation were a clad silver-palladium alloy, molybdenum disulfide used in cavities, and bonded molybdenum disulfide. Results include those from friction and wear evaluations, radial load capacity tests on plain journal bearings, and axial and radial load capacity tests on self-aligning bearings.

The bearing specimens had a nominal diameter of 1/2 inch. Friction and wear tests were made at an oscillating frequency of 31 cpm, at temperatures generally ranging from –90 to 1750°F, and at pressures generally ranging from 10^{-6} to 10^{-5} mm Hg. The projected bearing load was in the range of 4,400 to 12,000 psi.

2-706 (Part I)

ASD-TDR-62-706, Part I. THE RESPONSE OF A MODEL STRUCTURE TO NOISE: Flat Panels. Interim rpt, July 1962, 22p. incl illus., tables, 5 refs. P: 7351, T: 06. C: AF 61(052)-504, Univ. of Southampton, Southampton, Eng. R. D. Ford. SRN: A.A.S.U. Rpt 181. In OTS. ASTIA: AD 287002, Code AA.   Unclassified

A model structure consisting of a large flat sheet, subdivided into small panels has been excited by discrete frequency noise in an acoustics laboratory. The response of the panels has been studied in detail and the mode shapes identified.

A Rayleigh-Ritz energy method has been used to calculate the frequencies of two of the modes that have been excited and also a number of regular modes that could theoretically exist.

Attempts have been made to calculate the response of the structure to the applied noise pressures in observed modes of vibration.

2-706a (Vol I)

ASD-TR-61-706, Vol I. BERYLLIUM COMPOSITE STRUCTURES: Design and Application. Final rpt,

May 1962, 169p. incl illus., tables, 44 refs. P: 1368, T: 136806. C: AF 33(616)-7050, Aeronca Mfg. Corp., Middletown, Ohio. J. N. Krusos, et al. SRN: ER-532. In OTS. ASTIA: AD 282003, Code AA.   Unclassified

Design information is presented for beryllium and ceramic composite structures for re-entry vehicle applications. The Volume includes a summary of materials and process developments for beryllium panels and heat shield ceramics, analytical evaluations, and discussion of application of insulated structural concepts to re-entry vehicle systems. Also, included are the results of panel tests in the severe environments of turbojet and ramjet exhausts. Data suitable for preliminary design considerations are presented for three reinforced heat shield ceramic foams: alumina, silica and zirconia. Beryllium sandwich panels constructed in the course of the program are described with regard to fabrication potential and performance features in aerospace structures.

2-706a (Vol II)

ASD-TR-61-706, Vol II.   BERYLLIUM COMPOSITE STRUCTURES: Materials and Processes. Final rpt, May 1962, 312p. incl illus., tables, 79 refs. P: 1368, T: 136806. C: AF 33(616)-7050, Aeronca Mfg. Corp., Middletown, Ohio. J. N. Krusos, et al. SRN: ER-532. In OTS. ASTIA: AD 278526, Code AA.   Unclassified

Processes were developed for fabricating beryllium structural shapes to operate in environments encountered by aerospace vehicles during re-entry. Beryllium sheet process development work included cutting, chemical milling, forming and brazing of sandwich panels consisting of stainless steel or superalloy honeycomb and beryllium faces.

Ceramic heat shields were developed to resist temperatures in excess of 3000°F. The combination of ceramic heat shields and beryllium or superalloy sandwich structure was used to fabricate lightweight insulated components including flat and curved panels, and leading edges. The ceramic materials used in the heat shield were developed under this contract and consisted of lightweight foams, alumina, silica and zirconia.

2-710

ASD-TDR-62-710.   STRAIN DISTRIBUTION ON NOTCHED PLATE SPECIMENS AT CREEP TEMPERATURES. Final rpt, Aug 1962, 50p. incl illus., tables, 11 refs. P: 7381, T: 73810. C: AF 33(616)-7416, The Univ. of Michigan, Ann Arbor, Mich. H. R. Voorhees, J. W. Freeman. In OTS. ASTIA: AD 288515, Code AA.   Unclassified

Resistance strain gages and grids of vapor-deposited metal were evaluated for measuring strains at loading and during creep in plates with edge notches. Foil strain gages mounted with thermal-setting cements remained usable to 0.5% or higher strain at 500°F, but indicated creep was first less than, and later more than,

optical-extensometer readings. Indications from gages mounted with ceramic cement drifted 10μ in./in./hr. at 1200° after several hundred hours at temperature, but agreed with the extensometer to 1% strain. Qualitative measurements were made during loading (K, 1.8 and 3.6) and for creep (K, 1.8) of M-470 alloy at 500°F. Plastic strains were too small to determine by the grid lines used.

2-711a

ASD-TR-61-711.   DEVELOPMENT PROGRAM FOR MICROWAVE RADIATING POWER SOURCE FOR SPACE VEHICLE TELEMETRY TRANSMITTER. Final rpt, June 1962, 64p. incl illus., tables. P: 4107, T: 42021. C: AF 33(600)-39392, Watkins-Johnson Co., Palo Alto, Calif. L. A. Roberts. W-J 61-336AR24. In OTS. ASTIA: AD 278713, Code AA.   Unclassified

A program is described for the development of a voltage-tunable microwave oscillator suitable for use as a space vehicle radiating power source. This device is built around an electrostatically-focused traveling-wave tube amplifier which can be designed to meet the various requirements of light weight, high efficiency, and long life required for space vehicle operation. It is made to function as a voltage-tuned oscillator by feeding-back a small fraction of its output power to its input through a microwave cavity. By using the phase shifting properties of the amplifier as a function of its beam voltage, the system exhibits a linear tuning curve. The tube uses a helix supporting structure which allows construction of a bifilar helix with a large voltage difference between the helices while maintaining low voltage gradients along surface of insulators in vacuum. Electrostatic focusing characteristics are discussed and compared to permanent magnet focusing. Measured operating performance of several tubes used as both amplifiers and oscillators is described and curves of power output, gain and efficiency are shown. Data on the performance of electrostatic focusing is compared to the present theory and is shown to be in disagreement with the predicted results. Some general conclusions on DC electric field gradient as a function of design power level, operating voltage and frequency are discussed.

2-717

ASD-TDR-62-717. RESULTS OF LOSS FACTOR MEASUREMENTS ON STEEL AND CONCRETE BEAMS USING A VISCOELASTIC OR SAND DAMPING SYSTEM. Final rpt, Sept 1962, 51p. incl illus., tables, 6 refs. P: 4437. Nelson D. Wolf. Not in OTS. ASTIA: AD 288079, Code AA.   Unclassified

The report contains the results of tests to measure loss factors on steel and concrete beams using a viscoelastic or sand damping system. The significance of the tests using the viscoelastic material was the rather large size of the system; for the sand damping system, data was obtained at frequencies down to 36 cps. Numerous con-

figurations are tested. For the sand damping case, loss factors are measured as a function of acceleration.

2-721

ASD-TDR-62-721. FILAMENTIZED CERAMIC RADOME TECHNIQUES. Final rpt, Aug 1962, 45p. incl illus., tables, 6 refs. P: 4161, T: 416103. C: AF 33(616)-7872, Horizons, Inc., Cleveland, Ohio. R. H. Kelsey, B. C. Raynes. Not in OTS. ASTIA: AD 283451, Code AA.
Unclassified

Fiber reinforced ceramic bodies capable of withstanding an environmental temperature of 2500°F for at least 8 hours have been developed. Evidence of mechanical reinforcement by short-staple inorganic fibers has been shown. Means have been evolved producing bodies of good electrical properties with low porosity and excellent mechanical stability. A system concept has been introduced and applied, by which the fiber-reinforced body is treated as a complete material rather than as a composite assembled from separate materials.

2-723a

ASD-TR-61-723. FEASIBILITY OF THE USE OF HOLLOW CATHODES FOR THERMIONIC ENERGY CONVERSION. Final rpt, 48p. incl illus., tables 29 refs. P: 3145, T: 60962. C: AF 33(616)-7912, Westinghouse Elec. Corp., Elmira, N.Y. I. Brodie, A. Niewold. In OTS. ASTIA: AD 278824, Code AA.   Unclassified

Theoretical and experimental studies are reported to determine the feasibility of applying "electron blackbodies" to thermionic energy conversion. The conclusion from this work is that the size of the effusing hole is governed largely, not by the size of the cavity to which it is the exit, but by the physical limitations imposed by the nature of the electron atmosphere within the cavity. It is shown that the density of the electron atmosphere within the cavity is only large in a region close to the surface of the emitting walls and may be characterized by a parameter d, which does not depend on the size of the cavity. A quantitative expression is given for the conditions under which the effusing hole behaves as an electron blackbody. It is shown that for the electron emission density to be large enough for useful thermionic energy conversion, the size of the effusing hole has to be too small for practical consideration.

2-724a

ASD-TR-61-724. SUPERSONIC LIFT AND DRAG CHARACTERISTICS OF A VARIABLE-SWEEP STOL AIRPLANE CONFIGURATION DESIGNATED THE WADD-63. Final rpt, Feb 1962, 60p. incl illus., tables, 11 refs. P: 324A. J. R. Carey, Capt., USAF. ASTIA: Code NC.
Secret

Supersonic lift and drag characteristics obtained from wind tunnel tests are presented for the WADD-63 airplane configuration. These characteristics are shown for a

Mach number range of 1.50 to 2.30. The preliminary design estimates for the WADD-63 are also presented and compared with the resulting wind tunnel test values. The results show good agreement between the estimated and test values for L/D$_{max}$ and, therefore, generally confirm the preliminary performance estimates made for the WADD-63.

2-727 (Part I)

ASD-TDR-62-727, Part I: ULTRA-FINE HIGH TEMPERATURE, HIGH STRENGTH METALLIC FIBERS. Final rpt, Aug 1962, 70p. incl illus., tables, 17 refs. P: 7320, T: 732001.   C: AF 33(616)-8366, Hoskins Mfg. Co., Detroit, Mich.   Clair A. Gorton, Clifford C. McMahon, John A. Rizzardi. Not in OTS. ASTIA: AD 287443, Code AA.   Unclassified

Eight superalloys; A-286, Elgiloy, Hastelloy B, M-252, René 41, U-500, U-700 and Waspaloy were processed to ultra-fine fibers of approximately .001 inch dia. and evaluated for drawability, room temperature, tensile strength and elongation and effect of reduction of area on tensile properties. The Elgiloy and Hastelloy B alloys processed more readily with less wear than the other alloys.

The tensile strength of all alloys except A-286 were in the range of 160,000 psi as solution heat treated. Alloy A-286 tensile strength was approximately 100,000 psi. The alloys in order of decreasing strengths were U-700, René 41, Hastelloy B, Waspaloy, U-500, M-252, Elgiloy and A-286

Yarns composed of seven, nineteen and thirty-seven filaments of Elgiloy and René 41 were successfully processed to less than .003 inch dia. when sheathed with Alloy Chromel C, but the sheath could not be removed without damage to the fibers. High temperature tensile tests of the sheathed yarn at 1600°, 1800°, and 2000°F in air and argon atmospheres indicated increased strength in order of increased filaments. The Chromel C sheath protected the core fibers from oxidation and improved the high temperature strength of the yarn at 1800° and 2000°F.

2-730

ASD-TDR-62-730.   AN APPLICATION OF LINEAR HARDENING PLASTICITY THEORY TO CYCLE AND PATH DEPENDENT STRAIN ACCUMULATION. Summary rpt, Aug 1962, 25p. incl illus., 24 refs. P: 7351, T: 73521.   C: AF 33(616)-8177, Univ. of Illinois, Urbana, Ill.   P. D. Schwiebert, G. J. Moyar. In OTS. ASTIA: AD 284851, Code AA.   Unclassified

This paper is a combination of four distinct but closely related topics. The first is a documentation of the existence of cycle and path dependent plastic deformation. The second is a resume of existing plasticity theories to determine if any existing theory in the realm of mechanics of solids can include the observed phenom-

enon. The third and essentially original section involves the specialization of an existing theory of inelastic deformation. Included is a discussion of the nature of the specialized theory from a plasticity viewpoint and the application of the theory to a particular complex cyclic stress history. Equations are developed that predict, as a function of cycles, the plastic strain accumulation under conditions of constant axial stress and alternating shear stress in a thin wall tube. The fourth topic is a discussion of present experimental results in the light of theoretical applicability and suggested modifications to include a greater range of material behavior.

2-732a

ASD-TR-61-732. THE PANCHROMATIC SENSITIZATION OF SINGLE CRYSTALS AND EVAPORATED FILMS OF SILVER BROMIDE. Final rpt, Jan 1962, 62p. incl illus., tables, 15 refs. P: 6272, T: 627201. C: AF 33(616)-6992, Technical Operations, Inc., Burlington, Mass. Gershon M. Goldberg, et al. TO-B 61-72. Not in OTS. ASTIA: AD 269756, Code AA. Unclassified

Report concerns experimental study of methods of achieving highest possible degree of red sensitization of single crystals and evaporated films of silver bromide. Problem was attacked from several angles. Variations in dye treatment, surface orientation, and surface area all failed to produce a reasonable level of panchromatic sensitization on crystals. It appears that surface area of crystals is too low to allow sufficient dye pickup for efficient sensitization. With evaporated films, two approaches were tried: (1) screening of various classes of dyes to determine their relative efficiency for sensitizing these materials and (2) improvement of the initial sensitivity of evaporated film samples by variation of the evaporation parameters. The latter approach proved to be the better. Dye sensitization of evaporated films having an initial sensitivity of ASA 0.1 when removed from evaporator produced materials having overall sensitivities of ASA 2 and red sensitivities (through a Wratten 25 filter) of 0.6. Thus, one of the primary objects of contract, the preparation of a material sensitized to an ASA Exposure Index of 10 (5500°K light source) with a Wratten 25 filter factor of not more than 5, is definitely within reach.

2-738

ASD-TDR-62-738. CONDENSATION OF SODIUM AND RUBIDIUM AT LOW HEAT FLUXES. Final rpt, Oct 1962, 16p. incl illus., tables, 4 refs. P: 7340, T: 08. John A. Roth, 1st/Lt., USAF. Not in OTS. ASTIA: Code XX. Unclassified

This report presents the design considerations and preliminary results of an experimental program to determine the condensing heat-transfer coefficients and to investigate the modes of condensation occurring with alkali liquid metals. Corrosion information was obtained on synthetic sapphire crystals in a sodium atmosphere.

Sodium and rubidium were condensed on a 304 stainless steel U-tube using air as a coolant. Overall heat-transfer coefficients for rubidium varied from 5.7 to 20.6 Btu/hr-ft^2-°F and sodium from 6.1 to 24.1 Btu/hr-ft^2-°F. The pressures for the sodium condensation varied from 0.7 to 44 psia and from 1.4 to 63 psia for rubidium condensation. Individual heat-transfer coefficients for the rubidium condensation ranged from 8.9 to 70.8 Btu/hr-ft^2-°F. These are preliminary results in a low heat flux range.

2-743

ASD-TDR-62-743. THE INFRARED SPECTRA OF SELECTED KETONES, ETHERS AND ALCOHOLS BETWEEN 15 AND 35 MICRONS. Interim rpt, Aug 1962, 36p. incl illus., 45 refs. P: 7360, T: 736005. C: AF 33(616)-8465, Monsanto Research Corp., Dayton, Ohio. J. E. Katon. In OTS. ASTIA: AD 287755, Code AA. Unclassified

The spectra from 15 to 35 microns of 45 ketones, 30 ethers and 12 alcohols have been analyzed and correlated. For identification purposes the data in this spectral region were shown to be useful as a supplement to data obtained in the 2-15 micron region. The spectra of ketones in the 15-35 micron region are very informative of their detailed structural features, and distinguish between aliphatic methyl ketones, ketones with and without alpha branching, aromatic methyl ketones and cyclic ketones. Tentatively, the ring size of cyclic ketones may also be determined. Study of these spectra indicates that the previous assignment of acetone is in error and a new assignment is proposed. The spectra of ethers and alcohols in the 15-35 micron region are less informative. Aliphatic ethers possess one fair group frequency, at 480-520 cm^{-1}. The broad absorption by alcohols 650 cm^{-1} was confirmed.

2-743a

ASD-TR-61-743. DESCRIPTION AND PERFORMANCE EVALUATION OF THE AEROSPACE MEDICAL RESEARCH LABORATORIES' VERTICAL ACCELERATOR. Final rpt, Dec 1961, iii + 23p. incl illus. P: 7210, T: 71703. C: AF 33(616)-2088, LAB Corp., Skaneateles, N.Y. Biomedical Lab. R. D. Lowry, W. M. Wolff. In OTS. ASTIA: AD 287996, Code AA. Unclassified

The Aerospace Medical Research Laboratories' Vertical Accelerator was developed for bioastronautics research to simulate vibration and buffeting encountered in aerospace operations. The design, motion capabilities, control and safety features are described. This Vertical Accelerator can be programmed with periodic or random acceleration patterns obtained from actual environmental measurements. It is a complex electromechanical device employing a unique type of friction drive to move a test platform with a 200-lb load capacity. The accelerator, for continuous operation, can produce peak to peak amplitudes of ±5 ft over the frequency range from 0.5 cps to 10 cps. The maximum acceleration output is

from 2.5 to 3G depending on load and permissible distortion.

2-760

ASD-TDR-62-760. A SUMMARY OF THE BASIC FACTORS IN THE FORMATION AND STABILITY OF NON-SOAP GREASE GELS AND OTHER DISPERSIONS. Final rpt, Aug 1962, 13p. incl illus., 19 refs. P: 3044, T: 304403. John J. Chessick, John B. Christian. Not in OTS. ASTIA: Code XX.   Unclassified

This report summarizes a research program of seven years duration conducted mainly at Lehigh University in cooperation with Aeronautical Systems Division. The major objective was to provide an understanding of the basic factors responsible for the formation and stability of non-soap lubricating greases to provide guides in the preparation of superior lubricants for use under extreme environmental conditions. General approaches to experimental procedures for all studies conducted are presented. Because of the large number of experimental procedures, detailed descriptions are not included. Published works revealing experimental details are referenced.

2-761

ASD-TDR-62-761. SUPERSONIC TRANSPORT FUELS AND LUBRICANTS. Final rpt, Oct 1962, 14p. incl illus., 7 refs. P: 3044, T: 304801. Cecil J. Johnson. Not in OTS. ASTIA: Code XX.   Unclassified

The Air Force has the responsibility for research and development of potential fuels and lubricants for Supersonic Transport. Thermal stability requirements of fuels are the most difficult to meet because of the severe operational limitations they impose on the fuel system. This report is a discussion of the potential problems and their elimination. Contractual and in-house effort by the Air Force in studying the causes of thermal instability in fuels is discussed. The responsibility of the Coordinating Research Council, Inc. in conducting large scale Mach 3 simulator tests under Air Force contract is included. The programs discussed will evaluate potential fuels and lubricants with varying capabilities and varying costs. This will allow the aircraft and engine designers a degree of latitude in their design and the selection of the optimum fuel hardware combination.

2-768

ASD-TDR-62-768. STUDY OF HF FREQUENCIES FOR EXO- AND ENDO-IONOSPHERIC COMMUNICATIONS. Final rpt, Oct 1962, 113p. incl illus., tables, 30 refs. P: 4335, T: 433505. C: AF 33(657)-7791, Raytheon Co., Missile and Space Div., Advanced Dev. Lab., Bedford, Mass. M. D. Grossi, et al. CRN: BR-2036. Not in OTS. ASTIA: AD 285968, Code AA. Unclassified

The report presents the results of a study of HF frequencies for exo- and endo-ionospheric communications, undertaken for evaluating the possible use of the HF

bands in satellite-to-satellite and satellite-to-ground communications.

Emphasis is placed on the analysis of the possibilities and limitations thereof, of communicating at HF between terminals imbedded into the ionosphere and located beyond line-of-sight.

The search for these long-distance propagation modes has been performed by using a Hamiltonian ray-tracing method programmed in a digital computer. The method allows the evaluation of the effect on the HF ionospheric propagation of the earth's magnetic field, of the collisions (when few) between electrons and other particles, of various models of ionospheric irregularities and discontinuities.

The results of the study have been that "circumferential transits" characterized by low path losses, wide bandwidth and good stability are possible at HF underneath the F_2 layer; that beyond line-of-sight propagation can take place at HF across the same layer with, however, worse performance in losses, dispersion and stability; and that long-distance propagation between terminals located above the F_2 layer has to rely upon a non-smooth nature of the upper-ionosphere.

2-771

ASD-TDR-62-771. INFRARED SPECTRA OF SOME OILS, GREASES, ADDITIVES, AND RELATED MATERIALS. Final rpt, Aug 1962, 43p. incl illus., 8 refs. P: 7360, T: 736005. C: AF 33(616)-7450, Univ. of Cincinnati, Cincinnati, Ohio. Michael S. Matta, Lee D. Smithson. In OTS. ASTIA: AD 287756, Code AA.   Unclassified

The infrared spectra from 2 to 16 microns of 82 oils, greases, additives, and related materials of current use in the Air Force are presented as an aid in the qualitative identification of lubricants.

2-778

ASD-TDR-62-778. ANALYSIS OF ASSET COMMUNICATION LINKS. Final rpt, Aug 1962, 168p. incl illus., tables, 36 refs. P: 1466. C: AF 33(616)-8106, McDonnell Aircraft Corp., St. Louis, Mo. J. W. Dean et al. McDonnell Aircraft Rpt 8744. Not in OTS. ASTIA: AD 287805, Code AA.   Unclassified

This report presents an analysis of the communication links for ASSET, a hypersonic, lifting, re-entry vehicle, in the form of an engineering solution restricted to: ASSET requirements and state-of-the-art hardware. The problem of shock induced plasma, peculiar to re-entry vehicles, is treated, within the above limitations, and within existing theory and methods for such analysis. The analysis determines mathematically the margins for each link, with and without plasma attenuation. It is concluded that, for ASSET: radar tracking by AN/FPS-16 radars aided by an airborne transponder is feasible; a VHF telemetry link will experience blackout for por-

tions of some flights because of plasma attenuation; a telemetry link at X-band will provide real-time data with no blackout, and a radio command link using existing test range transmitters will not satisfy range safety requirements. A communication system design is described which meets the requirements of ASSET and which is based on the above conclusions. The details of thresholds, peculiarities, radiation patterns, etc. are analyzed and the resultant data is presented.

2-779

ASD-TDR-62-779. RESEARCH AND DEVELOPMENT OF MICROWAVE MEMORY. Interim rpt, Feasibility Investigation, Oct 1962, 77p. incl illus., tables, 6 refs. P: 4040, T: 404002. C: AF 33(616)-8512, ITT Federal Labs., a div. of ITT, Nutley, N.J. L. M. Vallese. ASD-TN-62-2. ASTIA: AD 332601, Code AA.   Secret

A description of the design and performance of a laboratory breadboard model of a Microwave Memory System, designed as an application of a novel technique.

2-781

ASD-TDR-62-781. VACUUM ARC MELTING OF TUNGSTEN ALLOY (TUNGSTEN-MOLYBDENUM-COLUMBIUM). Final rpt, Oct 1962, 74p. incl tables, illus., 7 refs. P: 7351 and 7381, T: 73519 and 73811. C: AF 33(616)-7459, Westinghouse Electric Corp., Blairsville, Pa. G. A. Reimann. In OTS.   ASTIA: Code XX.   Unclassified

A satisfactory melting technique was established for the production of fine-grained, homogeneous, high quality, tungsten base alloy ingots. The 88W-6Mo-6Cb alloy originally selected for the program was discarded because of ingot cracking and replaced by a 92W-6Mo-2Cb alloy. The reduction of columbium from 6 to 2 percent permitted ingots, 6 to 9 inches in length. Macroexamination revealed a mixture of fine, equiaxed grains and short, thin columnar grains. Seven ingots of the 92-6-2 composition were extruded successfully at 4000°F, using ratios of 4.4:1, 5.7:1, and 7.5:1. The extruded material was forged and rolled to determine workability. A time, temperature, recrystallization study was conducted on forged specimens of the 92-6-2 alloy.

2-785

ASD-TDR-62-785. THE EFFECT OF SIZE AND STRESS HISTORY ON FATIGUE CRACK INITIATION AND PROPAGATION. Summary rpt, Aug 1962, 23p. incl illus., tables, 8 refs. P: 7351, T: 735106. C: AF 61(052)-522, Bockamöllan, Brösarps Station, Sweden. Waloddi Weibull. In OTS. ASTIA: AD 287962, Code AA.   Unclassified

This investigation deals with the effect of size and preloading on the duration N_1 of the crack initiation period, as well as the crack propagation period. Geometrically similar sheet specimens of two aluminum alloys were

used. Each size exhibited its individual S-N_1 curve. A static preload increased the N_1 from 11 to 205 kc.

Equations relating crack length to number of cycles are derived for constant stress cycle and constant load cycle. The formulas are verified by tests for various combinations of material, size and stress amplitude. For constant stress the rate of crack growth was found, independently of crack length, to be constant after a certain transition period which is dependent on the duration of the preceding initiation period. For constant load cycle the propagation period starts with a transition period followed by one or more stable propagation periods, their number depending on load magnitude. Failure analysis showed these periods corresponding to different fatigue mechanisms. It is concluded that total fatigue life cannot be predicted without considering separately the parts of which it is composed.

2-803

ASD-TDR-62-803. STUDY OF A MOLECULAR TUNABLE INFRARED AMPLIFIER. Final rpt, Nov 1962, 49p. incl illus., tables, 25 refs. P: 4159, T: 42006. C: AF 33(616)-8493, Electro-Optical Systems, Inc., Pasadena, Calif. M. Geller. EOS Rpt 1880-Final. Not in OTS. ASTIA: Code XX.   Unclassified

This report discusses a semiconductor, such as silicon, as a candidate for laser oscillation. The decay of the exciton state is considered as the radiative laser transition. At low temperature, when the lattice is depleted of phonons, the non-reversible character of absorption and emission processes imply the ready attainment of population inversion. Calculations on the basis of the half-width of the emission lines and the pumping band of silicon show that there is sufficient power in commercial Xenon flash lamps to sustain laser oscillations. The criterion for achieving this state is based on the selection of samples with the maximum value of nonradiative lifetime and the initiation of laser action in a time shorter than this nonradiative lifetime. The pulse operation of silicon in a laser configuration, at liquid nitrogen temperatures, revealed sharp discontinuities in the emission curve after 40 μsec beyond the onset of the pump light. It is suspected, but not as yet unequivocably established, that these radiation spikes were laser oscillations.

2-805

ASD-TDR-62-805. FLIGHT ENVIRONMENT DESIGN PARAMETERS FOR MARS AND VENUS. Final rpt, Sept 1962, 154p. incl illus., 30 refs. P: 6146, T: 6146-1. C: AF 33(616)-5914, The Ohio State Univ. Research Foundation. R. H. Zimmerman, C. D. Jones. In OTS. ASTIA: Code XX.   Unclassified

The physical characteristics of the planets Mars and Venus are assessed and probable quantitative limits are defined as minimum, representative and maximum probable values for application to environmental studies and equipment design. These data are applied to Chapman's

generalized analysis for bodies entering planetary atmospheres to produce probable minimum, representative and maximum flight environment design parameters. These planetary parameters are applied with body and trajectory parameters, using Chapman's analysis, to selected direct, multipass and graze entries.

2-811

ASD-TDR-62-811. THERMAL ANALYSIS OF A SUPER-CONDUCTING GENERATOR. Final rpt, Oct 1962, 19p. incl illus., tables, 3 refs. P: 8128, T: 812808. R. J. Smith. In OTS. ASTIA: Code XX.   Unclassified

The investigation was undertaken to establish heat transfer design data for a superconducting generator. An analysis was made of heat transfer via various leakage paths into the generator. Further, a method of computing the heat input from the load-connecting electrical leads was devised. The result was a set of calculations for one design and a method of optimizing the conductor for minimum heat transfer.

2-815

ASD-TDR-62-815. INORGANIC THICKENED GREASES. Final rpt, Sept 1962, 10p. incl illus., tables. P: 3044, T: 304403. John B. Christian. Not in OTS. ASTIA: Code XX.   Unclassified

Experimental inorganic thickened greases were synthesized and characterized using standard and specialized techniques. The greases were formulated from high melting inorganic solids, and polyphenyl ethers, high phenyl content silicones, inhibited silicones, and fluorosilicones. The thickening ability of several inorganic solids was determined. Many of the grease formulations show promise for such applications as anti-friction bearing lubricants, high temperature pneumatic greases, and lubricants for use in applications of sliding and rolling friction under heavy load conditions.

2-896

ASD-TDR-62-896. HIGH TEMPERATURE THERMO-ELECTRIC GENERATOR. Final rpt, Oct 1962, 81p. incl illus., tables. P: 8173, T: 817302-9. C: AF 33(657)-7387, Monsanto Research Corp., Dayton, Ohio. C. M. Henderson, et al. Not in OTS. ASTIA: Code XX.   Unclassified

Research and development of a laboratory type high-temperature thermoelectric generator having a nominal output of 5 watts at junction temperatures of 1200°C hot side and 700°C cold side in a vacuum is described. Based on the modular concept, the generator is comprised of 9 series-connected sections of three parallel-connected modules each.

The modules are made of MCC 50, a proprietary thermoelectric material, joined to graphite junctions.

Research leading to development of this type module is described. Sublimation losses for MCC 50 were less than 1% during 1000 hours at 1200°C and a vacuum of greater than 10^{-5} mm Hg. The generator was operated under these conditions for 100 hours continuously and withstood 106 thermal cycles from ambient temperature to 1200°C without failure.

3—AIR PROVING GROUND CENTER
Elgin AF Base, Fla.

3-52

APGC-TDR-62-52. PERFORMANCE EVALUATION OF APPRENTICE CHANNEL AND TECHNICAL CONTROL OPERATORS, Graduates of Air Training Command Course No. ALR29335A. Final rpt, Sept 1962, 19p. P: 0034Q-10. Donald I. McSheehy. ASTIA: AD 284579, Code AA. Unclassified

This test was conducted to determine the ability of graduates of ATC Course No. ALR29335A, Channel and Technical Control Operator, to perform the duties of their specialty. A 12-week job performance evaluation was conducted, using six apprentices assigned to the 2045th Communications Squadron, Andrews Air Force Base, Maryland, and four apprentices assigned to the 2047th Communications Squadron, Maxwell Air Force Base, Alabama. The results of the evaluation, together with conclusions and recommendations, are detailed in the report.

3-54

APGC-TDR-62-54. PERFORMANCE EVALUATION OF APPRENTICE DIAL CENTRAL OFFICE EQUIPMENT SPECIALISTS, Graduates of Air Training Command Course No. ABR36231. Final rpt, Oct 1962, 22p. P: 0034Q-12. Capt. John F. Blumer, USAF. ASTIA: AD 285332, Code AA. Unclassified

This evaluation was conducted to determine the ability of apprentices graduated from ATC Course ABR36231, Dial Central Office Equipment Specialist, to perform the duties of their specialty. A 12-week performance evaluation was conducted by rating the performance of five course graduates who worked in the dial central offices at Eglin and MacDill Air Force Bases, and two graduates who worked with the missile operations intercommunications system at Patrick Air Force Base. It was determined that the dial central office equipment course meets the proficiency specifications of the Job Training Standard except for training on basic electricity and trouble analysis, the main distribution frame, bay cards and DTA drawings, color codes, and soldering. The general effectiveness of the course training can be raised by increasing the use of operational equipment, transparent overlays, and daily quizzes; providing more training parts, hand tools, and study opportunities; and alternating classroom lectures and practical instruction as much as possible. Revisions to the Job Training Standard are needed to align it with the current job requirements pertaining to forms and records, test equipment, missile operations intercommunications systems, technical terminology, and safety precautions. It is desirable to establish separate career ladder branches for different types of equipment specialists and to study the feasibility of establishing an electronics aptitude percentile in the criteria for selecting the specialists.

3-56

APGC-TDR-62-56. F-101B EXTERNAL TOW SUBSYSTEM; A PRELIMINARY EVALUATION OF CERTAIN COMPONENTS. Oct 1962, 39p. incl illus., table. P: 7831. 1stLt. Wayne M. Kaser, USAF. ASTIA: AD 285936, Code AA. Unclassified

This test consisted of a preliminary engineering evaluation of certain components of the F-101B Tow subsystem in a restricted flight envelope. These components consist of the Aero 45A reel-launcher and TDU-9/B and TDU-17/B targets. The Aero 45A was adapted from the Navy Aero 45 reel-launcher to provide the F-101B aircraft with a supersonic tow capability for training with GAR and MB-1 weapons. The test was limited in scope because the F-101B aircraft was available for only three weeks. Eleven missions were conducted to test the tow subsystem compatibility with the F-101B aircraft, limited structural integrity, overall reel-launcher performance, and recovery techniques. The TDU-9/B target was launched and recovered 27 times with no target losses. The TDU-17/B target was launched three times and recovered once. Two TDU-17/B targets were lost during reel-out. Throughout the test 1/8-in. armored cable was used. Detailed operation procedures and limited training requirements were established. It is concluded that, with several modifications, the Aero 45A reel-launcher is adequate in design and is compatible with the F-101B aircraft. However, further testing is required using production targets and proper size tow cable for a complete tow subsystem evaluation.

3-61

APGC-TDR-62-61. PERFORMANCE EVALUATION OF DISASTER CONTROL INSTRUCTORS, Graduates of Air Training Command Course No. AZR24250. Final rpt, Nov 1962, 12p. P: 0034Q-13. Donald I. McSheehy. ASTIA: Code XX. Unclassified

This evaluation was conducted to determine the ability of personnel graduated from ATC Course AZR24250, Disaster Control Instructor, to perform the duties of the specialty. A four-month job performance test was conducted using six graduates of the course assigned to Seymour-Johnson and Pope Air Force Bases, North Carolina, and Auxiliary Field No. 9, Eglin Air Force Base, Florida. It was found that the course provides excellent instructor training and adequately prepares those attending the course for disaster control activities as-

sociated with chemical, biological, and radiological warfare. The course would benefit from inclusion of additional subject material on mobile command post operation; monitor duties; the calculation of fallout approach times, radiation dosages, and building residual counts; and a short indoctrination on natural disaster control. Although the graduates are well prepared, many make extremely limited use of the training due to the limited implementation of the disaster control training program at many bases. Also, as these personnel are carried in another primary AFS, they are frequently transferred in the other AFS. It is recommended that the additional subject material indicated in the report be included in the course, and that problems relating to limited use of the training and personnel attrition be studied.

3-63

APGC-TDR-62-63. PERFORMANCE EVALUATION OF APPRENTICE AIRCRAFT GROUND EQUIPMENT REPAIRMEN, Graduates of ATC Course No. ABR42133. Final rpt, Nov 1962, 19p. P: 0034Q-14. Capt. John F. Blumer. ASTIA: Code XX.   Unclassified

The course provides the graduates with an adequate foundation of theory and principles pertaining to the tasks of the specialty and meets the specifications of the Job Training Standard (JTS) except for operation of the equipment, trouble analysis, repairs of equipment, use of the loadbank, and interpretation of electrical diagrams. The deficiencies in the above areas can be overcome, if during the practical phases of course training, the students are provided with a maximum opportunity to operate personally the equipment and work on the components in order to increase their self confidence and ability to perform the practical tasks. Training aids of a type spe-

cifically described in this report should be used in the course to improve the effectiveness of instruction on trouble symptoms and gas turbine compressors. The course instruction should be included on the torque converter, fuel injection system, safety precautions while clearing a liquid lock, and use of T.O. 00-20A-1 for the preparation of forms. The JTS for the specialty is adequate, except for two tasks which should be added to meet the job requirements. These tasks "Orders Parts and Supplies" and "Uses Pneumatic Analyzer" should be included on the JTS with a proficiency code of 2b assigned to each.

3-66

APGC-TDR-62-66. COMPATIBILITY TEST OF THE A/A 37U-15 TOW SUBSYSTEM WITH THE F-100D AIRCRAFT. Final rpt, Nov 1962, 19p. incl illus., table. P: 7831. 1stLt. Robert J. Tracy, USAF. ASTIA: Code XX.   Unclassified

This test consisted of a compatibility test of the A/A 37U-15 tow subsystem with the F-100D aircraft. This subsystem was designed to provide the Tactical Air Command with a transonic tow target capability for gunnery training for the F-104C, F-100C/D, F86H, and F-84F aircraft. Missions were conducted to test the tow subsystem for ground and airborne compatibility with the F-100D aircraft. The operation of the tow subsystem during launch and tow and performance capabilities while flying typical mission profiles were evaluated. The THU-4/E rewind stand was also evaluated for use as ground support equipment. It was concluded from the test that the tow subsystem can be satisfactorily used in normal towing operations with the F-100D aircraft and that the THU-4/E rewind stand can be satisfactorily used for loading cable on the RMU-10A tow reel spool.

4-14

FTC-TDR-62-14. B-52H WEAPON SYSTEM EVALUA-
TION. Final rpt, Sept 1962, 548p. incl illus., tables.
P: 59-133. William R. Wronski, Maj., USAF, and
Charles F. G. Kuyk, Jr., Maj., USAF. ASTIA: AD
332109, Code AA.   Secret

The Boeing B-52H is a long range, high altitude, high
subsonic speed, strategic bomber designed to deliver con-
ventional or nuclear weapons. It is equipped with the
AN/ASQ-38(V) Offensive Weapons Control System with
Advanced Capability Radar for low altitude terrain avoid-
ance operation and the AN/ASG-21 Fire Control System
with 20mm Gatling guns. Augmented electronic counter-
measures are provided for operation in the VHF, UHF,
and SHF band frequencies. The aircraft is powered by
the Pratt and Whitney TF33-P3 turbofan engine.

The Category II/III Weapon System Evaluation was con-
ducted to discover and recommend corrections for design,
materiel, or operational deficiences in the Weapon Sys-
tem by means of qualitative evaluations and quantitative
engineering investigations. The test program consisted
of 968:10 hours of flying on 76 flights.

The test aircraft was operated in as realistic an environ-
ment as possible to accumulate the equivalent of 2½ to 3
years of SAC operational activity and evaluate the opera-
tional capability of the various systems and the inte-
grated Weapon System. All systems and associated aero-
space ground equipment were modified wherever possible
with approved fixes to upgrade the systems to the latest
possible configuration. Therefore, test results, conclu-
sions, and recommendations are applicable generally to
the entire B-52H fleet.

The TF33-P3 engine has significantly improved the
capability of the aircraft to perform its design mission.

The Offensive Weapons Control System can accurately
navigate and direct the aircraft at either high or low
altitude to the target and deliver weapons with satisfac-
tory accuracy. The high level capability of the system
has not been degraded by the addition of low altitude
terrain avoidance capability.

The ASG-21 Fire Control System was evaluated at high
and low altitude. Test results and conclusions are
classified.

The Electronic Countermeasures Subsystem, with wider
frequency coverage and improved display, was tested
against a variety of airborne and ground radars. Test
results and conclusions are classified.

The maintenance man-hours, numbers of personnel, and
skill level requirements to maintain the Weapon System

in an operationally ready condition are greater than in
previous model B-52's because of complex modifications
and improvements in the Offensive Weapons Control, Fire
Control, and Propulsion Systems.

4-14 (Suppl 1)

FTC-TDR-62-14. B-52H WEAPON SYSTEM EVALUA-
TION FOLLOW-ON PROGRAM. Final rpt, Oct 1962, 69p.
incl illus., tables. P: 59-133. Clarence L. Roberts,
Capt., USAF and Charles F. G. Kuyk, Jr., Maj., USAF.
ASTIA: AD 332573, Code AA.   Secret

The Weapon System Evaluation follow-on program was
conducted for systems testing in specific problem areas,
aircrew training, and accumulation of aircraft total flight
hours and lower wing surface equivalent hours.

Twenty-eight missions were flown during which 419:20
flight hours were accrued. The B-52H Test Force re-
turned the aircraft to Boeing, Wichita, with a total of
1500:00 flight hours and a total of 1618:38 lower wing
surface equivalent hours.

Eight flights were delayed beyond scheduled take-off
time, limiting the follow-on program to a successful
launch figure of 71.42 percent.

Low altitude Terrain Avoidance operation has improved
substantially.

The follow-on test program verified functional problem
areas of the airplane general system (see FTC-TDR-
62-14, dated October 1962) but developed no new major
problem areas. Tests conducted with the bomb bay doors
resulted in development of rigging procedures and limits
that allow successful door latching under all flight
conditions.

Maintenance problems encountered in the Airplane Gen-
eral Area were generally the same as noted during the
basic WSE.

Four "hot fan" engines (TF3-3P3) evaluated during the
follow-up testing were satisfactory. Modified cartridge
starters proved satisfactory; however, starter control
valves remained unacceptable.

The AN/ASQ 38 (V) Weapons Control System, Offensive
(WSCO) retained the excellent bombing and navigation
reliability described in the basic report.

Advanced Capability Radar calibration runs served to
evaluate not only local modifications (Variable Fuselage
Reference Line, in-flight boresight adjustments, and the
Negative Beta Angle Clamp) but also the effect upon
accuracy of the TC of varying operating frequency when
in TA.

ACR maintainability was measurably improved because of improvements in some equipment and components, more comprehensive alignment procedures and increased maintenance experience. The RF Alignment and Touch-up Procedure was used throughout the extension program with excellent results.

The AN/ASG-21 Fire Control System follow-on tests evaluated the defensive capability at low altitude and, in addition, investigated the high altitude performance of the radar tracking loop to confirm deficiencies reported in the basic report. The results are classified.

The ECM tests included an evaluation of the nose and tail ALR-18/ALT-6B systems against all-weather interceptor aircraft, inter-aircraft compatibility tests and a vibration study of the tail receiver. The results are classified.

4-18

FTC-TDR-62-18. RECOVERY OF LUNAR RE-ENTRY VEHICLE AT A PRE-SELECTED LANDING SITE. Final rpt, Sept 1962, 19p. incl illus. Everett W. Dunlap and Donald M. Caldwell, Jr. ASTIA: AD 284277, Code AA.   Unclassified

The successful recovery of a vehicle launched from the moon presents many problems, not the least of which is how the vehicle can be guided through the atmosphere to a pre-selected landing site on the earth's surface. This report presents an analysis of the significant factors in recovery from lunar return. The geometry of the earth-moon system is shown to affect the geographic location of entry points; an equation is derived for the range required from entry to landing as a function of the moon's declination, the inclination of the trajectory plane, and the landing site latitude. The influence of transit time from moon to earth on the location of entry points is discussed.

The dimensions of the corridor for entry at parabolic velocity are derived in terms of flight path angle. Nominal entry profiles involving deceleration at constant altitude following pull-out are presented, based on digital computer trajectory calculations. These show that the range available for a typical semi-ballistic vehicle varies between a minimum of about 900 statute miles to a maximum of 3400 miles. The importance of this range limitation is discussed with respect to the accessibility of landing sites at certain latitudes and the requirement for recovery on any day of the month. It is concluded that it is relatively easy to land in the continental United States during about half of the month, but that during the remainder of the month the necessary additional range must be achieved by skip maneuvers requiring rather precise guidance. Practical consideration is given to the predictability of corridor boundaries on the basis of aerodynamic heating and human tolerance to deceleration.

Control of the flight path within the atmosphere is analyzed, and an equation is derived for modulation of the bank angle of a self-trimming semi-ballistic shape to maintain constant altitude after pull-out. The use of controlled shipout maneuvers is discussed, showing range attainable and sensitivity of range to velocity and flight path angle. The range capability of a semi-ballistic vehicle and a lifting re-entry vehicle are compared.

4-20

FTC-TDR-62-20. X-15 PILOT-IN-THE-LOOP AND REDUNDANT/EMERGENCY SYSTEMS EVALUATION. Final rpt, Oct 1962, 162p. incl illus., tables. P: 653A. R. G. Nagel and R. E. Smith, Capt., USAF. ASTIA: AD 285943, Code AA.   Unclassified

This report presents the results of a comprehensive evaluation of the pilot-in-the-loop and redundant/emergency systems effects for all flights of the X-15 airplane through 15 January 1962. The results of this evaluation are considered timely and significant with regard to the current controversy among aerospace designers and planners on the values of the human pilot and redundant/emergency systems for the successful operation of space vehicles. The X-15 program, because of its currency and its similarities to the next generation of aerospace projects, provides a quantitative insight into the relative merits of piloted versus unmanned space vehicles and redundancy versus non-redundancy in systems design.

All flight attempts on which X-15/B-52 mated take-off occurred were analyzed in terms of safe aircraft recovery and mission success. The flights were quantitatively evaluated in several different groupings with respect to their pilot and redundancy effects. These various groupings will enable the results of this report to be applied to many types of aerospace systems and programs.

Even though the evaluation was purposely kept conservative, dramatic net benefits of having a pilot in the control loops and redundant/emergency systems were demonstrated. There have been no crashes of the actual X-15 in its first 47 free flights, but hypothetical unmanned, nonredundant X-15's would have been lost on 15 flights. Likewise, the actual X-15 has had a mission success rate of 96 percent for the same 47 free flights compared to only a 45 percent mission success rate if the X-15 were unmanned and nonredundant. The mission success and safe aircraft recovery rates improve just slightly with only the pilot or redundancy (but not both) in the X-15. This results from a high degree of interdependence between the pilot and redundancy for safely handling in-flight failures and problems, particularly because of the prevalence of multiple malfunctions and compounded problems on many of the flights.

Only five of the 34 aborted flights (mated flight but the X-15 not launched) were aborted because of pilot and redundancy detriments; whereas, on 12 free flights abort

was avoided by virtue of pilot and redundancy benefits. Thus, the net effect of the pilot and redundancy was definitely beneficial in terms of abort avoidance. The majority (76 percent) of the flights which aborted did so regardless of pilot and redundancy effects.

Subsystems maturity data is included as a by-product of the evaluation. The pilot and redundant/emergency systems have been significant factors in accelerating X-15 subsystems maturity. Seven of eight major subsystems show an apparent current maturity of 0.94 or better, with pilot-redundancy effectiveness for correcting in-flight subsystems failures averaging 57 percent. Without the pilot and redundancy only four subsystems would have a current maturity above 0.94. Additionally, significant operational and developmental aspects of the X-15's recallable slow boost (air launch) technique are discussed.

4-22

FTC-TDR-62-22. CATEGORY II RE-EVALUATION OF THE STABILITY AND CONTROL CHARACTERISTICS OF THE B-58A. Final rpt, Oct 1962, 94p. incl illus., tables. P: 58-6. Don O. Gobert and Kenneth K. Lewis, Lt. Col., USAF. ASTIA: AD 332672, Code AA.
Confidential

This report presents the results of Part II of a two part re-evaluation of the stability and control characteristics of the B-58A aircraft. Part I of the re-evaluation was published by the Air Force Flight Test Center in March of 1961.

The re-evaluation was necessitated by numerous modifications of the production B-58A aircraft flight control system subsequent to the initial AFFTC Category II Stability and Control Program (AFFTC-TR-59-18, dated July 1959).

The handling characteristics of the aircraft with the Return Component, Upper Component, or Lower Component are generally acceptable throughout most of the operational speed and altitude envelope. The lateral control characteristics of the production B-58A during sideslips and rolling maneuvers have been improved over those of the YB-58A while the longitudinal control remains essentially the same. The handling characteristics of the aircraft with the Upper Component or with the Lower Component are essentially the same as those of the YB-58A with the MB-1 pod.

4-23

FTC-TDR-62-23. B-58A CATEGORY II PERFORMANCE WITH THE TWO COMPONENT POD. Final rpt, Nov 1962, 130p. incl illus., tables. P: 60-187. Charles R. Haines and Kenneth K. Lewis, Lt. Col., USAF. ASTIA: Code XX.
Confidential

Follow-on Category II tests were conducted by the Air Force Flight Test Center to define the performance of the B-58A with a two component full fusing option pod, and

to obtain data not previously acquired for the aircraft without pod.

The two component pod consists of a lower fuel pod and an upper bomb pod. The lower pod can be jettisoned when empty of fuel, leaving only the small bomb pod to be carried to the target. This increase in capability has been achieved with approximately the same overall range as the MB-1 pod configuration. Handling characteristics of the aircraft with the MB-1 pod are similar to those with the complete TCP pod. Testing was accomplished with the complete pod, the upper pod, and without pod.

Flight Manual take-off performance is accurate for all conditions tested, but the climb-out distance to the 200 foot height is approximately 1500 feet short with afterburner power.

Military power climb data presented in the Flight Manual is accurate except that the cruise ceiling altitudes are too high.

The Flight Manual range at optimum subsonic cruise conditions is optimistic for the airplane without pod or with either the BLU-2/B-3 pod.

Supersonic acceleration and climb performance as shown in the Flight Manual is optimistic, and the published maximum power Mach 2.0 ceilings were found to be higher than the test data obtained. Wing heaviness, caused by spanwise shifting of fuel, is a major control problem at supersonic speeds, but a proposed flight control modification is adequate to relieve the problem.

Jet penetration descent performance in the Flight Manual is conservative, but landing distance is 500 to 750 feet shorter than actual at the conditions tested.

Landings in gusty crosswind conditions must be accomplished with caution. Capacity of the hydraulic system is inadequate to support control requirements under these conditions.

Aircraft systems reliability was poor. The major problems were with the fuel quantity indication and air conditioning systems.

4-31

FTC-TDR-62-31. PILOT'S QUALITATIVE EVALUATION OF THE DORNIER DO-28. Final rpt, Oct 1962, 14p. incl illus., tables. John K. Campbell, Maj., USAF. ASTIA: AD 286347, Code AA.
Unclassified

This report presents the results of a pilot's qualitative evaluation of the Dornier DO-28 conducted at the Dornier Company, Munich, Germany. The AFFTC test evaluation was requested by the Aeronautical Systems Division and required 7 flights totaling 7 hours and 45 minutes of flying time.

The DO-28 is a 6 to 8 place bi-plane with a large cantilever upper wing and a short stub lower wing on which the engines are mounted. Two Lycoming 0-540-A1D reciprocating engines rated at 250 horsepower drive Hartzell

constant speed full feathering propellers. A fixed conventional type landing gear is provided. The airplane is of relatively rugged construction. De-icer boots, propeller anti-icing, and a full complement of communication and navigation equipment is provided.

The DO-28 has excellent low speed characteristics and can take-off in less than 600 feet and land in less than 800 feet at the design gross weight of 5400 pounds. The maximum level flight speed attained at 5350 pounds gross weight, using rated power at 4,000 feet altitude on the test day, was only 138 knots IAS. Single engine rate of climb is low and could be improved by engines of increased horsepower. Several other discrepancies require correction to improve the operational usefulness.

4-32

FTC-TDR-62-32.   AP22S-2 FULL PRESSURE SUIT EVALUATION IN THE U-2 AIRCRAFT. Final rpt, Nov 1962, 8p. incl illus., tables. Budd F. Knapp, Capt., USAF. ASTIA: AD 287632, Code AA.   Unclassified

Qualitative testing was done in the altitude chamber and on two U-2 flights to determine the adaptability of the AP22S-2 full pressure suit to the U-2 mission. The suit was found to be very good in comfort and excellent for flight protection at altitude. It provided excellent mobility for normal flight conditions. Oxygen consumption rates were found to be unacceptably high. Further development to reduce these consumption rates seems possible. Further testing is recommended while efforts are being made to extend the oxygen endurance of the suit.

4-33

FTC-TDR-62-33.   TESTS OF PARACHUTE COMPONENTS. Final rpt, Nov 1962, 5p. incl illus., tables. P: 60-71. Robert J. Pranger, 1st/Lt., USAF. ASTIA: AD 287631, Code AA.   Unclassified

Tests were conducted to evaluate the functional reliability of the 50C7024-15 parachute assembly incorporating an experimental parachute pack opening device and canopy releases. The experimental pack opening cutter is suitable for use as a personnel parachute pack opener. The canopy releases are not suitable for use on personnel parachutes unless they are redesigned to eliminate premature opening of the safety covers.

4-34

FTC-TDR-62-34.   TESTS OF A BACK STYLE PARACHUTE ASSEMBLY WITH MODIFIED PACK SIDE FLAPS. Final rpt, Nov 1962, 5p. incl illus., tables. P: 60-122. Isadore Rosenberg, CWO, USAF. ASTIA: AD 287763, Code AA.   Unclassified

High speed tests were conducted to determine the effects of separating the side flaps of a style B-5 parachute pack upon the opening forces of the parachute assembly. The average opening forces for the modified B-5 parachute assemblies were not greater than the average opening forces for the standard B-5 parachute assembly. It was found that the quarter bag can deploy prematurely from the modified parachute pack and the parachute may fail to open.

5—AIR FORCE MISSILE DEVELOPMENT CENTER
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5-7 (Vol I)

MDC-TDR-62-7, Vol I. FINAL ENGINEERING REPORT DESIGN OF THE GUIDANCE EVALUATION MISSILE (GEM). Final rpt, May 1962, 358p. incl illus. P: 5177, T: 517703   C: AF 29(600)-3300, Space Technology Laboratories, Inc., Redondo Beach, Calif. SRN: 8640-6015-SUPDI. ASTIA: AD 287516, Code AA.

Unclassified

This report describes the results of the GEM preliminary design study. The purpose of GEM is to accomplish, through nondestructive flight testing, accuracy evaluation of guidance hardware.

The GEM recoverable features coupled with use of inexpensive boosters will provide significant savings in flight test program cost. GEM guidance error analysis was simulated via a digital computer, the results of which conclusively demonstrate the feasibility of the GEM technique in evaluating next generation guidance equipment.

5-7 (Vol II)

MDC-TDR-62-7, Vol II. FINAL ENGINEERING REPORT DESIGN OF THE GUIDANCE EVALUATION MISSILE (GEM). Final rpt, May 1962, 184p. incl illus. P: 5177, T: 517703.   C: AF 29(600)-3300, Space Technology Laboratories, Inc., Redondo Beach, Calif. SRN: 8640-6015-SUPDI. ASTIA: AD 331874, Code AA.

Confidential

This report describes the results of the GEM preliminary design study. The purpose of GEM is to accomplish, through nondestructive flight testing, accuracy evaluation of guidance hardware.

The GEM recoverable features coupled with use of inexpensive boosters will provide significant savings in flight test program cost. GEM guidance error analysis was simulated via a digital computer, the results of which conclusively demonstrate the feasibility of the GEM technique in evaluating next generation guidance equipment.

5-8

MDC-TDR-62-8.   DESIGN OF STELLAR-INERTIAL GUIDANCE TEST FACILITY. Final rpt, July 1962, 245p. incl illus. P: 5177, T: 517701. C: AF 29(600) 2984, Nortronics, Hawthorne, Calif.   T. R. Dibble. ASTIA: AD 283810, Code AA.   Unclassified

This report presents the results of an industry survey, suggested test programs, and the methods and equipment for accomplishing the test programs. The survey investigated all celestial referenced navigation systems now in existence or anticipated during the next ten years. The results were utilized to establish the methods and equipment required to accomplish the necessary test programs.

5-9

MDC-TDR-62-9. HOLLOMAN TRACK CAPABILITIES. Final rpt, Sept 1962. 82p. incl illus. This report supersedes AFMDC-TR-60-24, dated Nov 1960. Track Test Division. ASTIA: AD 286761, Code AA.   Unclassified

This report describes the capabilities of the Holloman Track and its role in the testing of missile and space vehicle systems and components. Detailed information on the facility, test vehicles, instrumentation complex and support facilities is presented.

6-5

MTC-TDR-62-5. AZUSA DATA REDUCTION MANUAL. June 1962, 103p. incl illus., table, 11 refs. RCA Work Order 810079. C: AF 08(606)3413, RCA Svc Co., Subcontr of PAA World Airways, Inc., Patrick AFB, Fla. R. L. Snodgrass, D. B. Gennery. RCA Math Svc TR-73. Not in OTS. ASTIA: Code XX. Unclassified

The AZUSA data reduction process at the Atlantic Missile Range is described. As background information, the AZUSA data acquisition is briefly described. This manual is intended to be used as a training manual for data reduction personnel and to acquaint others with the data reduction techniques for AZUSA.

6-6

MTC-TDR-62-6. MONITORING PHOTOGRAMMETRIC PLATE OBSERVATIONS. Final rpt, May 1962, 45p. incl 5 refs, Appendix. RCA Work Order 810546. C: AF 08(606)-3413, RCA Svc Co., Subcontr of PAA World Airways, Inc. G. H. Rosenfield. RCA Math Svcs TR-62-3. Not in OTS. ASTIA: Code XX. Unclassified

The raw observations on a photogrammetric plate are measurements made in the coordinate system of a precision comparator. Prior to use of these observations for photogrammetric purposes, it is necessary that they be transformed to correspond with the position of the latent image on the unprocessed emulsion. The monitoring operation, which performs this transformation, includes the processes of:

1. Correction for temperature fluctuations during measuring.
2. Computation of setting variance and average.
3. Correction for comparator calibration.
4. Correction for systematic disturbances of emulsion and base.
5. Transformation of corrected values to plate coordinate system.

This report primarily considers the monitoring operation as applied to precision photogrammetric plates for aerial survey and Ballistic Camera purposes. The monitoring of successive exposures from a single fixed camera is also presented. A method for editing of repetitive readings is given.

6-7

MTC-TDR-62-7. A TECHNIQUE FOR DETERMINING THE ACCURACY OF REDUCED DATA. Rpt, May 1962, 40p., 7 refs. RCA Work Order 996060. C: AF 08(606) 3413. RCA Svc Co., Subcontr to PAA World Airways, Inc., Patrick AFB, Fla. M. Yoshitsu. RCA Math Svc TR-61-1. Not in OTS. ASTIA: AD 285434, Code AA. Unclassified

A statistical technique of determining the accuracy of reduced data is developed in this paper. The accuracy is expressed in terms of the standard deviation of the total residual error. It is shown that the accuracy can be determined if there are two or more sets of reduced data, say, resulting from the application of as many instrumentation systems; whereas this is not possible if only one set of reduced data is available.

6-9

MTC-TDR-62-9. ACCURACY OF SINGLE-STATION TRACKING. Final rpt, Mar 1962, 41p. incl illus., tables. C: AF 08(606)3413. Systems Analysis, RCA Svc Co., Patrick AFB, Fla. Dr. P. S. Dubbeldam. ASTIA: AD 285516, Code AA. Unclassified

The report describes the tracking capabilities of a single station consisting of a UDOP station and a telemetry dish, for a given geometric configuration.

The errors in position and velocity relative to a local coordinate system are represented for several values of the input errors. The results show that the combination mentioned above promises a satisfactory solution to the tracking problem.

6-10

MTC-TDR-62-10. A UNIFIED APPROACH TO DATA SMOOTHING. June 1962, 62p. incl illus., 2 ref. RCA Work Order 810546. C: AF 08(606)3413. RCA/MTP Subcontr to PAA World Airways, Inc., Patrick AFB, Fla. R. F. Pavley. Math Svcs TR-62-1. Not in OTS. ASTIA: AD 286988, Code AA. Unclassified

Time invariant smoothing techniques for the classical least squares and the newer frequency analysis approaches are derived rigorously. Formulas for weights contrained to pass certain polynomial signals and attenuate the noise are given for the signal and for its first and second derivatives. Comparison of the two types of filters shows that, whereas the variance reduction is optimum for the least squares approach, frequency filters can be constructed having a variance reduction factor just slightly greater and having other optimum characteristics.

7-22

AFSWC-TDR-62-22. EXPERIMENTAL TESTING OF SHOCK ATTENUATING MATERIALS. Final rpt, Mar 1962, 174p. incl illus., tables, 13 refs. P: 5776, T: 577601. C: AF 29(601)4363, Stanford Research Inst. Menlo Park, Calif. G. R. Fowles, D. R. Curran. SRN: SRI-2-143. ASTIA: AD 331662, Code AA.   Secret

7-28 (Vol I)

AFSWC-TDR-62-28, Vol I. THE PENETRATION AND TARGET DAMAGE EFFECTIVENESS OF SINGLE AND MULTIPLE REENTRY VEHICLE SYSTEMS AGAINST AN ACTIVE TERMINAL DEFENSE. Vol I. DESCRIPTION OF THE AFSWC PENETRATION AND DAMAGE MODEL. 156p. incl illus., tables. Final rpt, Aug 1962. P: 5797, T: 57904. C: AF 29(601)4417, AVCO Corp. Research and Advanced Development Div., Wilmington, Mass. R. Blecher, M. Crommie, P. Lindsey, M. Eisenstein. SRN: RAD-TR-62-24 (V.I). ASTIA: Code NC.
Secret-RD

Two defense models are presented, one representative of current defensive systems and the other reflecting somewhat advanced defensive capabilities. The computer model, which simulates the engagement of various offensive threats and these defense models, is described. This computer model incorporates Monte Carlo techniques to analyze defense penetration and target damage effectiveness of reentry vehicle systems.

7-28 (Vol II)

AFSWC-TDR-62-28, Vol II. THE PENETRATION AND TARGET DAMAGE EFFECTIVENESS OF SINGLE AND MULTIPLE REENTRY VEHICLE SYSTEMS AGAINST AN ACTIVE TERMINAL DEFENSE. Vol II. AN EVALUATION OF THE DEFENSE PENETRATION AND TARGET DAMAGE EFFECTIVENESS OF SINGLE AND MULTIPLE REENTRY VEHICLE SYSTEMS. 274p. incl illus., tables. Final rpt, Aug 1962. P: 5797, T: 57904. C: AF 29(601)-4417. AVCO Corp. Research and Advanced Development Div., Wilmington, Mass. R. Blecher, M. Crommie, P. Lindsey, M. Eisenstein. SRN: RAD-TR-62-24 (Vol II). Code NC.   Secret-RD

An analysis of the penetration and target damage effectiveness of offensive payloads for Minuteman, Atlas/Titan I and Titan II is presented. Volume I describes the digital computer program used for the evaluation and the results obtained are presented in Volume II.

7-30

AFSWC-TDR-62-30. A THEORETICAL STUDY OF STRUCTURE–MEDIUM INTERACTION. Apr 1962,   p.

incl illus., tables, 8 refs. P: 1080, T: 10802. C: AF 29(601)-2838. National Engineering Science Co., Pasadena, Calif. A. M. Soldate, J. F. Hook. ASTIA: AD 285053, Code AA.   Unclassified

The study reported here is a continuation of a previous study described in AFSWC-TN-61-6 concerned with the plane strain problem of the interaction of a plane longitudinal wave of stress with a hollow cylindrical shell embedded in an infinite elastic medium. The shell is given finite dimensions (with the assumption of thin shell geometry) and finite density and elastic properties differing in general from those of the medium. Numerical results are presented in tabular and/or graphical form for the following problems.

1. Steady-State, tangential stress response of a cavity and thin shell to a harmonic stress wave input.
2. Transient displacement response of a rigid cylinder (shell) to a δ-function displacement wave input.
3. Transient tangential stress response of a cavity to a step function stress wave input.
4. Transient displacement and inner tangential stress responses of a thin shell to a step function stress wave input.

A specific result is obtained for the last problem with a shell thickness to cylinder radius ratio of 1/20, the shell having the properties close to those of steel and the medium having elastic properties representative of rock. In this case dynamic enhancement of the maximum status inner tangential stress by a step stress input was found to be approximately six percent.

7-33

AFSWC-TDR-62-33. THEORETICAL STUDY OF GROUND MOTION IN UNIFORMLY VARYING AND LAYERED ELASTIC MEDIA. Phase I: Propagation of Waves in Nonhomogeneous Elastic Media. Final rpt, Sept 1962, 19p. incl illus., tables, 1 ref. P: 1080, T: 108001. C: AF 29(601)-4283, Stanford Research Inst., Menlo Park, Calif. F. C. Gair and R. C. Alverson. SRN: SRI PU 3415. ASTIA: AD 287204, Code AA.
Unclassified

Uncoupled wave equations are developed for a nonhomogeneous half-space for two cases, (1) where Poisson's ratio is constant, and (2) where Poisson's ratio increases with depth in a nonarbitrary but realistic manner. The resulting wave equations are numerically solvable by the method of characteristics since they are identical to those for a homogeneous medium.

7-37

AFSWC-TDR-62-37. A PRELIMINARY EVALUATION OF THE USE OF NUCLEAR INDUCED RADAR BLACK-

OUT AS A PENETRATION AID. June 1962, 58p. incl illus., tables. P: 7812. Joseph S. Toma, Capt., USAF, Ronald R. Harrington, 1st/Lt., USAF, Jean R. Williams. ASTIA: Code NC.   Secret-RD

The disturbing effects of a nuclear detonation on electro-magnetic wave propagation and the resulting degradation of an AICBM system were investigated in a preliminary way. The use of these "blackout" effects as a penetration aid was examined for ICBM's representative of Minuteman and Titan II, assuming 5,500-nautical-mile minimum energy trajectory. The defensive system was assumed as a combination of the Nike-Zeus system and current estimates of the Soviet system. Radar guidance and control systems were assumed to be located either at or forward of the target area.

7-41

AFSWC-TDR-62-41. MRMU MOBILE REMOTE MANIPU-LATOR UNITS. Phase I. Final rpt, 386p. incl illus., tables, 23 refs, Sept 1962. P: 8171, T: 817102. C: AF 29(601)-2856, American Machine and Foundry Co., Engineering Div., Stamford, Conn. G. Grubelich. ASTIA: Code NC.   Secret-RD

An investigation was performed to develop an integrated system capable of fast response for the recovery and disposition of nuclear packages and radioactive elements associated with crashed flight vehicles, including nuclear ramjets, rockets, impulse devices, and SNAP units, both reactor and isotope types.

This investigation led to a system of six recovery vehicles, including four assault vehicles and a cask hauler, all operable by either direct or by remote control. RF transmission, utilizing an airborne reflector, links the assault vehicles to a command-control van. All are air transportable; the assault vehicles and command-control van are air droppable.

This study assures the feasibility of a reliable and simple recovery system that may also be used to perform support activities at nuclear test sites, facilities, and launch pads.

7-43

AFSWC-TDR-62-43. THEORETICAL STUDY OF EN-ERGY DISTRIBUTION IN A HALF-SPACE UNDER DYNAMIC LOADS. 153p. incl illus., tables, 25 refs. Final rpt, July 1962. P: 1080, T: 10801. C: AF 29(601)-2832, American Machine and Foundry Co., Mechanics Research Div., Niles, Ill. DASA WEB No. 13.004. ASTIA: AD 286485, Code AA.   Unclassified

An analytical procedure is developed for predicting free-field ground motions and stresses for use in the design of underground protective structures. Analytic expressions in integral form are obtained for the solutions to the problems of an elastic half-space and a viscoelastic half-space, each under an axisymmetric time-dependent normal loading possessing the essential features of a

nuclear burst. A computer code for the evaluation these expressions is developed through the use Fourier-Legendre series and other special analytic techniques. Graphs are presented for one case of t elastic problem.

7-47

AFSWC-TDR-62-47. A STUDY OF STRESS WAVE INTE ACTION WITH BURIED STRUCTURES. 167p. ir illus., tables, 18 refs. May 1962. P: 1080, T: 108C C: AF 29(601)-4312, Illinois Inst. of Tech., Chicaç Armour Research Foundation. W. F. Riley, I. M. Dani J. J. Carey. ASTIA: AD 283750, Code AA. Unclassifi

In a series of experimental programs which AFSWC h sponsored for a number of years at Armour Resear Foundation, dynamic photoelasticity and moire displac ment measuring techniques were developed for use solving two-dimensional dynamic stress problems. Durir the past several years a number of wave propagatic problems have been solved by using these method

In the current research program covered by this report, shock tube facility was developed for applying air bla: loadings to an edge of a photoelastic model. Thi facility was then used to determine the stress distribu tions which develop on the boundaries of circular hole and circular inclusions embedded in a plate when an o shock wave travels across an edge of the plate.

The results of the stress determinations indicate the dynamic-type loadings produce stress concentration which exceed the static concentrations for equivaler loadings by approximately 10 percent. After the wav front produced by the dynamic loading passes the dis continuity, the dynamic stresses approach the stati stresses asymptotically.

7-49

AFSWC-TDR-62-49. A MASS POINT TRAJECTOR\ PROGRAM FOR CDC 1604 COMPUTER. 118p. incl illus., tables, 6 refs. Aug 1962. P: 5797. Test Direc-torate, AFSWC, KAFB, NM. Louis T. Parker, Jr. ASTIA: AD 284499, Code AA.   Unclassified

A general-purpose trajectory program for a point mass moving in three degrees of freedom relative to a rotating oblate earth is described. Motion is expressed in terms of the earth coordinates latitude, longitude, and altitude. Outputs include time, range, velocity vector magnitude and orientation, g loading, dynamic pressure, and Mach number.

The basic inputs are altitude, latitude, longitude, veloc-ity (relative wind), flight path angle, heading, drag, lift, bank angle of lift, and thrust (in lift and drag directions). Table inputs may be used for drag, lift, thrust, and mass, and also for the input parameter "print interval." Other options include inertial velocity input, geodetic input/ output, nonrotating earth, and Runge-Kutta integration (Adams-Moulton is standard).

The program is written in the CODAP language and is designed to be compatible with the CO-OP Monitor. A subroutine (available separately) is used for the 1959 model atmosphere. Report includes description of program operation, equations used, CODAP listing, and sample cases.

7-50

AFSWC-TDR-62-50. A DATA SOURCE OF THE EF-FECTS OF INITIAL LATITUDE AND HEADING ON SHALLOW REENTRY BALLISTIC TRAJECTORIES. 233p. incl illus., tables, 5 refs. July 1962. P: 5798, T: 579802. Francis L. Pugh, 1st/Lt., USAF. ASTIA: AD 284893, Code AA.   Unclassified

A significant amount of source data is compiled to show the effects of initial latitude and heading on reentry range and impact point locations. Reentry conditions are related to orbital conditions via minimum energy transfer trajectories. The study is restricted to ballistic reentry and it includes a consideration of ballistic parameters from 100 to 6,000 lbs/ft². A discussion and interpretation of the apparent gross characteristics of shallow angle, "near orbital velocity" reentry concludes this report. The reentry path calculations are based on an analytical model which simulates a rotating, oblate earth, and utilizes the 1959 ARDC Atmosphere.

7-55

AFSWC-TDR-62-55. DESIGN OF A HIGH-SPEED CA-PACITIVE ENERGY STORAGE SYSTEM. 49p. incl illus., tables. May 1962. P: 4778. C: AF 29(601)-4568, Field Emission Corp., McMinnville, Ore. ARPA Order No. 6, Task 22. ASTIA: Code NC.   Unclassified

Under this study, the contractor undertook the design of an energy storage system capable of efficiently delivering energy variable in the range 100 to 1,000 joules. The total pulse length was to be 50 nanoseconds with a rise time of 8 nanoseconds and a voltage of the order of 100 kv. Preliminary design and discussions are presented.

7-56

AFSWC-TDR-62-56. HIGH-COMPRESSIVE-STRENGTH CONCRETE—A Review of the State of the Art. Aug 1962, 90p. incl illus., 70 refs. P: 1080, T: 10803. C: AF 29(601)-6104, Waterways Experiment Station, Vicksburg, Miss. Bryant Mather. ASTIA: AD 286522, Code AA.
                                                          Unclassified

This report presents the results of a review of relevant published and unpublished data pertaining to high-strength concrete, including consideration of factors affecting strength; high-strength concretes previously made; and applications, economics, and procurement of high-strength concrete. The data reviewed indicate that the practical, routine production of portland-cement concrete having a compressive strength consistently above 10,000 psi after 90 days moist-curing will require careful

selection of materials; mixture proportions; and mixing, placing, consolidating, and curing procedures. The most important single factor affecting the producibility of such concrete is the achievement of an adequately low water-cement ratio. The data reviewed indicate that high-strength concrete cannot be obtained from mixtures having water-cement ratios higher than 0.45 by weight; and that in order to provide adequate workability, it will usually be necessary to use at least seven bags of cement per cubic yard of mixed concrete. Although high-strength concrete may not be economically advantageous in conventional reinforced concrete construction, it will afford important economic advantages in underground arch and dome construction.

7-60

AFSWC-TDR-62-60. MAP F-100/Mk-28RE/Mk-43. WEAPON SYSTEMS EVALUATION. June 1962, 22p. incl illus., tables. P: 01223. Donald R. Peters, 1st/Lt., USAF. ASTIA: Code NC.   Secret-RD

This test consisted of a series of systems checkouts and drop tests to evaluate carriage of the Mk-28RE or Mk-43 bomb at the left intermediate wing station on MAP F-100 aircraft. Two aircraft, an F-100D and an F-100F, were utilized in this test program, in addition to a Type VIIIC pylon. All systems checkouts and loadings were accomplished at Kirtland AFB, New Mexico. Flight tests were conducted over the White Sands Missile Range, New Mexico.

It was found that the electrical resistance of several of the power circuits exceeded the specifications in several instances. The rest of the system proved satisfactory for carriage of the Mk-28RE bomb at the left intermediate wing station on MAP F-100 aircraft.

7-61

AFSWC-TDR-62-61. SURVEY AND EVALUATION OF DAMAGE EFFECTS PRODUCED BY LOW FLUXES OF SOFT X-RAYS. 185p. incl illus., tables. Final rpt, July 1962. P: 5776, T: 577601. C: AF 29(601)-4502, Aeronutronic, Div. of Ford Motor Co., Newport Beach, Calif. T. A. Bergstralh, D. C. Garwood, L. A. Johnson. DASA WEB No. 15.015. SRN: AERO SRD-1700. ASTIA: AD 331802, Code AA.   Secret

Results of a preliminary theoretical investigation of low intensity soft X-ray damage on materials are presented.

7-62

AFSWC-TDR-62-62. A THEORETICAL STUDY OF THE BETA RADIATION HAZARD ENCOUNTERED DURING AN ATOMIC CLOUD TRANSIT IN AN AIRCRAFT EQUIPPED WITH THE A/P22S-2 FULL PRESSURE SUIT. June 1962, 28p. incl illus., tables, 3 refs. P: 7806, T: 780601. Raymond H. Lee, 2nd/Lt., USAF, James O. Alderman, Maj., USAF. ASTIA: Code NC.
                                                          Secret-RD

The report is designed to determine the amount of particulate debris which might accumulate in the A/P22S-2 Full Pressure Suit during the transit of an atomic cloud. The purpose is to determine whether installation of particulate filters in aircraft equipped with the Full Pressure Suit is necessary.

Experimental data and theoretical data were compared to determine the beta dose under specified theoretical conditions. The calculations allow for predictions of dose and dose rates received for altitudes from 20,000 feet to 50,000 feet and times after detonation of 5 to 70 minutes.

7-63

AFSWC-TDR-62-63. TRANSIENT RADIATION EFFECTS IN PRESSURE TRANSDUCERS. 78p. incl illus., tables. Final rpt, June 1962. P: 7811, T: 781105. C: AF 29(601)-4953, General Atomic Div., General Dynamics Corp., San Diego, Calif. R. A. Poll, V. A. J. van Lint. SRN: GA-3130. ASTIA: AD 283993, Code AA.
Unclassified

The performance of two types of pressure transducers in a radiation environment has been evaluated by an experimental program. The devices were (1) a quartz piezoelectric crystal assembly and (2) a strain gauge transducer made by Armour Research Foundation. The most important perturbations of these transducers by a short pulse of radiation are the emission and absorption of secondary electrons by parts of the device and the conductivity of insulating materials, including quartz, cable connectors and cables. The experimentally measured results can be applied to evaluate the spurious signals and the perturbation of pressure-induced signals in a specified pulse radiation environment.

7-66 (Vol II)

AFSWC-TDR-62-66, Vol II. DETERMINATION OF HUGONIOT EQUATIONS-OF-STATE FOR POLYMERS AND REENTRY VEHICLE MATERIALS AND INVESTIGATIONS OF FRACTURE PHENOMENA. 46p. inci illus., tables. Final rpt, Aug 1962. P: 5776, T: 577601. C: AF 29(601)-1760, Aerojet-General Corp., Downey, Calif. M. H. Wagner, W. F. Waldorf, Jr., N. A. Louie. DASA WEB No. 15.018. ASTIA: Code NC. Confidential

The results of Hugoniot determinations for ten reentry vehicle materials are given. The experimental methods employed are discussed in Volume I.

7-66 (Vol I)

AFSWC-TDR-62-66, Vol I. DETERMINATION OF HUGONIOT EQUATIONS-OF-STATE FOR POLYMERS AND REENTRY VEHICLE MATERIALS AND INVESTIGATIONS OF FRACTURE PHENOMENA. 175p. incl illus., tables, 58 refs. Final rpt, Aug 1962. P: 5776, T: 577601. C: AF 29(601)-1760, Aerojet-General Corp., Downey, Calif. M. H. Wagner, W. F. Waldorf, Jr., N. A.

Louie. DASA WEB No. 15.018. ASTIA: AD 286345, Code AA.   Unclassified

Hugoniot equations-of-state have been determined for ten reentry vehicle materials: Chopped Nylon Phenolic, Series 124 Resin, Avcoat, AVCO Phenolic Fiberglas, Tape Wound Nylon Phenolic, GE Phenolic Fiberglas, Oblique Tape Wound Refrasil, RAD 58B, Avcoite, and Pyrolytic Graphite and six plastic materials: Polyethylene, Kel-F, Plexiglas, Nylon, Polystyrene, and Teflon by techniques utilizing high explosives. Complete tabulations of the data runs are included, except for the results of the Hugoniot determinations for the reentry vehicle materials, which are given in Volume II of this report.

A time dependent theory of fracture is presented based upon a stress-dependent, reaction-rate model of atomic bond rupture. This theory is compared to available fracture time delay data for homogeneous plastics and poly-crystalline metals. The theory is in excellent agreement with the data for loading times between 10^6 to 10^{-4} seconds and indicates a minimum time delay of about 10^{-8} seconds for very large stresses acting on metals. The applications to spallation are discussed. The introduction of this time delay appears to satisfactorily link the atomic and microstructure properties of materials to their fracture properties. A stress-dependent crack propagation velocity is also derived.

7-67

AFSWC-TDR-62-67. FINAL DATA, SNAP REENTRY FLIGHT TEST PROGRAM, TESTS 1250, 3751, 5462, 3752, 4501. July 1962, 46p. incl illus., tables, 3 refs. P: 1831, T: 183103. Floyd E. Creasey. ASTIA: AD 285444, Code AA.   Unclassified

The purpose of the SNAP Reentry Flight Test Program was to obtain experimental verification of the theoretical equations which have been derived to describe atmospheric reentry heating. Two types of test articles were designed to obtain the heat flux during reentry from a ballistic trajectory. Optical and telemetry data acquisition equipment was designed and located near the reentry position. Data obtained from this equipment are discussed herein. The Martin Marietta Corporation will perform the final engineering analysis of these data under USAEC contract.

7-69

AFSWC-TDR-62-69. EVALUATION OF DAMAGE TO MATERIALS SUBJECTED TO SIMULATED X-RAY EFFECTS. 164p. incl illus., tables, 18 refs. Final rpt, Sept 1962. P: 5776, T: 577601. C: AF 29(601)-4526, Avco Corp. Research and Advanced Development Div., Wilmington, Mass. G. J. Davis, J. C. Bolger, J. F. Richards, G. N. Wassil. SRN: RAD TR-62-39. ASTIA: Code NC.   Secret

A detailed examination has been carried out on ICBM materials which have been subjected to impulsive loads

induced by flying plate experiments. These experiments were designed to simulate certain nuclear weapon effects. Damage to the material have been related to ICBM operation.

7-70

AFSWC-TDR-62-70. LATE-TIME EFFECTS OF X-RAYS ON HEAT-SHIELD MATERIALS. 156p. incl illus., tables, 20 refs. Final rpt, Sept 1962. P: 5776, T: 577601. C: AF 29(601)-4526, Avco Corp., Research and Advanced Development Div., Wilmington, Mass. D. T. Morgan, J. C. Bolger, G. N. Wassil, H. J. Bixler. SRN: RAD-TR-62-38. ASTIA: Code NC.   Secret

A detailed examination has been carried out on ICBM materials which have undergone simulated nuclear weapons effects. Damage effects have been related to ICBM operation. Simulation techniques include gamma irradiation, plasma arc splash tests and electron beam irradiation.

7-71

AFSWC-TDR-62-71. FINAL REPORT ON PRELIMINARY FEASIBILITY STUDY OF ON-PAD DETECTION (OPDET) TECHNIQUES. Aug 1962, 158p. incl illus., tables, 138 refs. P: 4780. C: AF 29(601)-4744. ARPA Order 102-61. Bendix Systems Div., The Bendix Corp., Ann Arbor, Mich. ASTIA: Code NC.   Secret-RD

A study was conducted to determine the feasibility of a system to detect a nuclear weapon in a space vehicle prior to launch. Techniques were investigated for identifying nuclear materials and for discriminating between nuclear weapons and other nuclear devices. The methods of inspection are required to be such that no damage to equipment or personnel is involved. Operation of the system in the presence of countermeasures was also considered.

7-72

AFSWC-TDR-62-72. SCATTERING LOSS OF FISSION BETA PARTICLES FROM HIGH ALTITUDE EXPLOSIONS. 48p. incl illus. Aug 1962. P: 7811, T: 781102. Jasper A. Welch, Jr., Richard Kaufman, Jack Taylor, Wilmot Hess. National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md. ASTIA: Code NC.   Secret-FRD

The injection and loss of beta decay electrons from high altitude nuclear explosions are investigated using two models for the motion of fission fragments. These calculations are applied to specific tests scheduled in the current Pacific series.

7-74

AFSWC-TDR-62-74. FIREBALL CROSS SECTION STUDY. Final rpt, July 1962, p. incl illus., tables, 17 refs. P: 7811, T: 781101. C: AF 29(601)-4341, Aeronutronic, Div. of Ford Motor Co., Newport Beach,

Calif. E. Bauer, E. R. Buley, C. H. Humphrey, R. C. Stabler. SRN: U-1745. DASA WEB No. 07.003. ASTIA: AD 286344, Code AA.   Unclassified

Two processes have beem examined in detail in the 0.1-1 ev energy range: (1) electron-ion-atom three-body recombination and (2) dissociative recombination. Preliminary investigations have also been made of (3) electron-ion-ion three-body recombination, mainly to investigate the possible applicability of the quantum mechanical "perturbed stationary state" method to problems arising in this context. In fact the numerical calculations are so lengthy that the method is hardly feasible but qualitative estimates of the rate of (3) are made in section 2 of the report.

The physically important processes (1) and (2) are examined in detail by quantum mechanical methods in sections 3 and 4 respectively. The order of magnitude of the dissociative recombination coefficient for hydrogen (process (2)) in the 0.1 ev energy range is 10^{-10} cm^3/sec, while the three-body recombination coefficient for process (1) is 10^{-28} cm^6/sec for n = 6 and 10^{-26} cm^6/sec for n = 10, where n is the principal quantum number of the captured electron.

7-76

AFSWC-TDR-61-76. FIELD SHIFT IN HIGH-SPEED ROTATING MIRROW FRAMING CAMERAS. 27p. incl illus., table. Sept 1962. P: 5776. D. C. Wunsch, 1st/Lt., USAF and Dr. A. H. Guenther. ASTIA: AD 285127, Code AA.   Unclassified

High-speed framing cameras, which make use of rotating mirrors acting as field stops, exhibit a changing field of view and frame size as the mirror rotates. The use of the frame edge as a reference line in data analysis from the film required that the magnitude of these effects be known. A discussion of these effects and calculations of their magnitude for a Beckman and Whitley model 189 framing camera are given.

7-78

AFSWC-TDR-62-78. INVESTIGATION OF RECOVERED FRAGMENTS FROM ATLAS 109-D BOOSTER. Aug 1962, 48p. incl illus., tables. P: 1831, T: 183101. C: AF 29(601)-4893, General Dynamics/Astronautics, San Diego, Calif. J. J. Sheppard, Jr. ASTIA: AD 285616, Code AA.   Unclassified

This report presents some of the preliminary results of a current investigation of four recovered fragments of Atlas Booster 109-D which put the Mercury Capsule Friendship 7 into orbit in the NASAMA-6 Orbital Flight on 20 February 1962. The fragments were recovered in the Republic of South Africa and subsequently shipped to General Dynamics/Astronautics where the reported investigation is in progress.

Presented are some tracking data of the Atlas 109-D Booster on its passes over North America and on orbital

calculation by NASA to investigate the phenomena which were necessary to cause an impact in the Republic of South Africa. The fragments were subjected to physical, chemical, and visual examinations to determine features which could be related to the fragments' flight history. The fragments exhibit extensive cratering apparently as a result of hypervelocity impacts. The distribution of the cratering is presented in preliminary form.

7-81

AFSWC-TDR-62-81. THE HAZARD ASSOCIATED WITH THE DISPERSAL OF SMALL PARTICLES FROM RE-ENTERING REACTORS AS A FUNCTION OF PARTI-CLE SIZE. 58p. incl illus., 9 refs. Final rpt, Aug 1962. P: 1831, T: 183101. C: AF 29(601)-4893, General Dynamics/Astronautics Space Science Lab., San Diego, Calif. David Sowle. SRN: AE62-0658. ASTIA: AD 286169, Code AA.   Unclassified

The problem of dispersal of small particles released from a line source at high altitudes is considered.

An approximate upper limit on the areal concentration as a function of mean radius is evaluated for U-Zr-H and Be particles. Acceptable areal concentrations for the SNAP nuclear auxiliary power systems are found and compared to the calculated upper limits.

It is concluded that no hazard exists for high altitude release of small Be particles. For U-Zr-H it is found that no radiological hazard exists if the mean particle radius is less than 30-60 microns; and the probability of occurrence of a radiological hazard is less than 10% if the average particle radius is less than 100 microns.

7-82

AFSWC-TDR-62-82. RESPONSE OF CONVAIR POD TO IMPULSIVE LOADING. 60p. incl illus., tables. Sept 1962. P: 7811, T: 781106. C: AF 29(601)-5159, Stanford Research Inst., Poulter Labs., Menlo Park, Calif. G. R. Abrahamson. SRI Project PGU-4002. SRI 2-801. ASTIA: AD 332265, Code AA.   Confidential

Structural response of the Convair E-1 and E-2 (instrumentation) pods to impulsive loads anticipated in a nuclear environment is investigated. Experiments with simulated impulsive loads obtained with explosives are described in detail. Test results consist of dynamic strain gage records, accelerometer records, and numerous photographs.

7-84

AFSWC-TDR-62-84. HIGH ENERGY FAST PULSE SYS-TEM THEORETICAL STUDY AND EXPERIMENTAL PROGRAM. Aug 1962, 330p. incl illus., tables. P: 4778. C: AF 29(601)-2806, Radio Corp. of America, Missile and Surface Radar Div., Moorestown, N.J. ARPA Order 6-61. ASTIA: Code NC.   Unclassified

Investigation was made of a method to transfer stored energy in the range of 200,000 to 1,000,000 joules into a

very small wire or film load within a time interval of 5×10^{-8} seconds. The most favorable technique appeared to be a large high pressure gas coaxial capacitor. Of the charging circuits, the Cockroft-Walton type appeared most promising with respect to simplicity, flexibility, and cost. A spark gap utilizing high pressure gas as the dielectric provides the best promise of switching the stored energy into the load. More experimental work needs to be done to produce an overall confident design. Continuing investigation is needed in some areas already covered in this study program as well as in a few associated areas not yet touched.

7-85

AFSWC-TDR-62-85. BEHAVIOR OF PLASTICS UNDER IMPULSIVE STRESS. 75p. incl illus., tables, 22 refs. Interim Final rpt, Sept 1962. P: 5776, T: 577601. C: AF 29(601)-4418, General Electric Co., Missile and Space Div., Philadelphia, Pa. W. T. Barry, H. W. Semon, J. P. Berry, F. A. Lucy, D. G. Flom. DASA WEB No. 15.027. ASTIA: AD 287214, Code AA.   Unclassified

The impulsive loading of GE Century Resins revealed that for the glassy, more rigid materials well-defined, disk-shaped fractures were formed, approximately circular, having central initiation sites of irregular shape. For the rubbery compounds conically-shaped, rosette-type fractures were formed. In general, impact velocities for threshold fracture were greater for the rubbery materials than for the glassy materials.

The impacts were produced by compressed gas-driven flying plates. Where equation of state data were known, initial impact pressures (IIP's) were obtained.

For the rigid materials, studied in most detail, both the fracture disk and initiation site diameters increased with increasing driver thickness. Particles and discontinuities purposely introduced during specimen casting did not increase the number of fractures or change the IIP's for fracture. Detailed microscopic examination of initiation sites indicated the need for more knowledge about the shape of the stress pulse.

7-88

AFSWC-TDR-62-88. PHYSICS DIVISION PROGRAM DIGEST. 190p. incl illus. 30 June 1962. Physics Div., AFSWC, Kirtland AFB, N. Mex. ASTIA: Code NC.   Secret-RD

This document presents a semi-annual summary of in-house and contractual efforts of the Physics Division, AFSWC, in the area of nuclear weapon effects. The objective, progress, and future plans are included for each technical program.

7-93

AFSWC-TDR-62-93. DETECTION OF NUCLEAR MATE-RIALS. July 1962, 108p. incl illus., tables, 36 refs. Final rpt. C: AF 29(601)-4596, Hughes Aircraft Co.,

Fullerton, Calif. SRN: SDN 2-90474/10G. ASTIA: Code NC. Secret-RD

The results of a one-year study and experimental program concerned with the feasibility of detecting nuclear material aboard space vehicles are presented. The report includes a general survey of the physical principles that could conceivably be included in a detection system and the feasibility testing of several of the most promising methods.

7-102

AFSWC-TDR-62-102. KINETICS OF PLASTIC DECOMPOSITION. Sept 1962, 170p. incl illus., tables. Final rpt. P: 5776, T: 577601. C: AF 29(601)-4586, Avco Corp., Research and Advanced Development Div., Wilmington, Mass. DASA WEB No. 15.018. ASTIA: Code XX. Secret

This report describes the results concerning the development of a means for investigating very short time, high temperature reactions, where the deposition of energy was of the same order of magnitude as the deposition of X-ray energy in the same time interval.

The general methods of approach to this problem were the electron impact method, the plasma decomposition technique, and the low temperature steady state and effusion methods.

7-103

AFSWC-TDR-62-103. TACTICAL STORE SUSPENSION AND RELEASE WITH THE MAU-12/A UNIVERSAL BOMB RACK. 58p. incl illus., table, 5 refs. Sept 1962. P: 5704, T: 570402. Raymond J. Swaim. ASTIA: AD 285326, Code AA. Unclassified

This report discusses the problems of universal bomb rack design, the qualifying testing required, and the reasoning behind the MAU-12/A solutions that achieved a universal capability. It briefly explores the benefits to be derived from standardization and universal usage. The conclusion is reached that the MAU-12/A design fully meets the Air Force requirement for a single bomb rack; it can carry a wide variety of stores and can be used to support a number of different present and future aircraft systems.

7-105

AFSWC-TDR-62-105. PROTONS IN THE OUTER ZONE OF THE RADIATION BELT. 36p. incl illus., table, 17 refs. Oct 1962. P: 7811, T: 781106. S. J. Bame, J. D. Conner, H. H. Hill, F. E. Holly. ASTIA: Code XX. Unclassified

Measurements on the trapped protons in the outer zone of the Van Allen radiation belt were made on October 4, 1960, from a Scout rocket payload containing a two-crystal scintillation spectrometer. Protons with energies above 1 Mev were detected, with the intensity rising

above background at an altitude of 1,200 km. Representative intensities for $1 \le E_p \le 80$ Mev at 2, 3, 4, and 5×10^3 km, through a range of 37°N to 30°N geomagnetic latitudes, were 0.27, 0.90, 2.02, and 4.56×10^5 protons/cm^2-sec-ster. These intensities are averages for protons with pitch angles lying between 90° and ~60°. The proton energy spectrum at 5,000 km is $J(E) = 2.0 \times 10^6 E^{-5.2}$ protons/cm^2-sec-ster-Mev for $1.02 \le E_p \le 2.24$ Mev, and $J(E) = 0.71 \times 10^6 E^{-3.9}$ for $2.24 \le E_p \le 7.3$ Mev. The pitch angle distributions for altitudes of 4,600 km and 5,150 km were also obtained for angles between 90° and 58°. There was no evidence of a proton intensity maximum coincident with the E_2 maximum.

7-106

AFSWC-TDR-62-106. AN EARTH TRAJECTORY MODEL FOR SUBSURFACE BALLISTIC AND THRUSTED VEHICLES. 72p. incl illus., tables, 6 refs. Sept 1962. P: 5797, T: 579708. Phyllis B. Chisholm, Robert M. Pelzl, Francis L. Pugh, 1st/Lt. ASTIA: Code XX. Unclassified

A preliminary digital computer model is developed to describe the straight line motion of a body of revolution through the earth's subsurface. Drag forces resulting from soil displacement, time rate of soil strain, and kinetic friction are estimated. The following major assumptions are included:

1. The vehicle is a rigid undistorted body,
2. Major drag contribution is from the vehicle nose,
3. Homogeneous soil is subjected to plastic deformation,
4. Total soil pressure due to soil displacement and velocity acts normal to the vehicle surface, and
5. Any wave motion imparted to the soil is neglected.

Drag components of normal pressure are integrated over the vehicle nose at each time instant and the resulting motion integrated with time to obtain trajectory predictions.

7-108

AFSWC-TDR-62-108. STRATEGIC SUSPENSION AND RELEASE SYSTEMS: A SUMMARY OF THE STATE OF THE ART. 40p. incl illus., table, 6 refs. Sept 1962. P: 5704, T: 570404. Lee P. Tolman. ASTIA: Code NC. Secret-RD

This is a survey of internal suspension and release systems for strategic bombers. The Universal Clip-In Suspension System, now operational in Strategic Air Command aircraft, is described. Possible directions for future growth of this system are discussed.

7-110 (Phase I)

AFSWC-TDR-62-110, PHASE I STUDY OF REENTRY SYSTEM FOR MOBILE MID RANGE BALLISTIC MISSILE. Sept 1962, 122p. incl illus., tables, 18 refs. P: WS 398B. James P. Burke, Lt., USAF. ASTIA: Code NC. Secret-RD

This study provides information regarding the various trade-offs and interrelationships that exist between weapon system, re-entry system, and warhead parameters for the proposed Mobile Mid Range Ballistic Missile (MMRBM). These data are needed by the AEC as information on which to base warhead candidates for use with the MMRBM reentry system.

The report contains a description of the MMRBM Weapon System, an estimate of the defense environment to be encountered by the re-entry system, an analysis of targeting and weapon effects, a study of re-entry system design considerations, and a study of warhead design considerations

7-110 (Addendum—Phase I)

AFSWC-TDR-62-110 Addendum. PHASE I STUDY OF RE-ENTRY SYSTEM FOR MOBILE MID RANGE BALLISTIC MISSILE. Sept 1962, 14p. P: WS 398B. James P. Burke, Lt., USAF. ASTIA: Code NC.   Secret-RD

This addendum contains an estimate of the defense threat. The estimate was synthesized from information made available to us in February 1962 and was used to assist in evaluating problems associated with the study. The reader must recognize that the estimate may not be

current at the time of final publication and the information will be subject to continual updating.

7-115

AFSWC-TDR-62-115. PREPRODUCTION TESTING OF THE CANADIAN VICKERS BDU-8/B PRACTICE BOMB. Sept 1962, 20p. incl illus. P: 921X-01400-01. Lee W.. Short. ASTIA: AD 286148, Code AA.   Unclassified

Testing of the Canadian Vickers BDU-8/B was performed by AFSWC at the request of the Royal Canadian Air Force. The purpose of these tests was to establish the Vickers Sperry of Canada. Ltd., as a qualified producer of these practice bombs. Testing was performed using three samples produced by this company. These bombs were numbered CV-1, CV-2, and CV-3. To expedite testing, each of the bombs was subjected to a portion of the specified test requirements. Testing was performed in general accordance with MIL-B-25846A and MIL-B-27000, and included functional testing of the parachute deployment system initiator assembly, static load testing, shock testing, vibration testing, and exposure to certain climatic conditions which were considered critical to the operation of the bomb. The results of the test were, in general, satisfactory. However, a minor change is recommended to help assure that the bomb will perform all its intended functions satisfactorily.

8—ARNOLD ENGINEERING DEVELOPMENT CENTER
Arnold AF Station, Tenn.

8-147

AEDC-TDR-62-147. BASE HEATING AND BASE PRES-
SURE ON A SCALE MODEL SATURN SA-5 BOOSTER
AFTERBODY AT MACH NUMBERS 1.63 AND 3.07.
Oct 1962, 100p. incl 25 refs., illus., tables. AFSC Pro-
gram Area 921E, P: 9018. C: AF 40(600)-1000, ARO,
Inc., Arnold AF Sta, Tenn. Tom Peters, John G. Dawson,
Jr., and Hershel R. Melton. ASTIA: AD 332050, Code
AA.   Confidential

Base pressure and base heating data obtained during
tests of a 5.47-percent-scale model Saturn SA-5 booster
afterbody are presented. Data were obtained at altitudes
ranging from 33,000 to 50,000 ft at a free-stream Mach
number of 1.63 and at altitudes ranging from 61,000 to
80,000 ft at a Mach number of 3.07. The effects of fins,
flow deflectors, and air scoops on base heating and base
pressure were investigated. Hydrogen gas was used to
simulate the heat content of the fuel-rich turbine exhaust
gas discharged from the full-scale booster. Pressure
profiles in the region bounded by the inner four-nozzle
cluster were obtained at altitudes of 33,000 to 70,000 ft.
Convective heat transfer film coefficients for this region
are presented. The effects of operating the model with
one inboard engine inoperative on base pressure and
base heating were also determined.

8-150

AEDC-TDR-62-150. STALL LINE DETERMINATION OF
A MODIFIED J85-GE-5 TURBOJET COMPRESSOR. Sep
1962, 64p. incl 8 refs., illus., tables. AFSC Program
Area 420L, P: 3155. C: AF 40(600)-1000, ARO, Inc.,
Arnold AF Sta, Tenn. E. E. Turner and M. K. Lake.
ASTIA: AD 284275, Code AA.   Unclassified

A test program was conducted to define the stall line of
a modified J85-GE-5 compressor. Stall lines were deter-
mined for four compressor inlet distortion configurations
at Reynolds number indexes of 1.0, 0.6, and 0.2 at cor-
rected engine speeds ranging from 90 through 108 percent
of military rated speed. The compressor utilized for this
program was a modification of the production compressor.
The changes incorporated were designed to improve stall
characteristics and alleviate stresses in the second and
eighth-stage rotor blades. Compressor inlet distortion
tended to improve the stall line by as much as 2.5 per-
cent at less than rated airflow. For values of airflow
near military rated speed, however, compressor inlet dis-
tortion lowered the stall line by 1.3 to 2.6 percent. Com-
pressor pressure ratio at stall was reduced by as much
as 6.3 percent for Re_I 0.2 as compared to Re_I 1.0.

8-152

AEDC-TDR-62-152. ANALYTICAL AND EXPERIMEN-
TAL STUDIES TO DEVELOP ION ENGINE GROUND-
TESTING TECHNIQUES. Sep 1962, 34p. incl 8 refs.,
illus. AFSC Program Area 750G, P: 6950, T: 695003.
C: AF 40(600)-948, Hughes Research Laboratories,
Malibu, California. R. A. Hubach and G. B. Peppin.
In OTS. ASTIA: AD 284272, Code AA.   Unclassified

This report is a technical review of both the analytical
and experimental aspects of the ground simulation of
space conditions for ion engine testing. The conditions
assumed to be best for simulation are presented and the
means by which experimental studies will be conducted
are detailed. In particular, two new probes for beam
diagnostics are discussed together with a new technique
for studies of beam interactions with the test chamber
environment. Data from the new probes and techniques
are included where possible. A brief discussion of pos-
sible effects on ion engine operation by space phenom-
ena, with estimates of the magnitude of the manifesta-
tion on engine behavior, is included. Theoretical com-
puter studies of the behavior of the ion beam as it leaves
the engine are outlined, and the results expected from
such a program are discussed.

8-154

AEDC-TDR-62-154. EXPERIMENTAL STUDY OF AERO-
DYNAMIC PARAMETERS OF UNSYMMETRICAL NOSE
CONE CONFIGURATIONS AT MACH NUMBERS 0.8 TO
5.0. Oct 1962, 68p. incl 7 refs., illus., tables. AFSC
Program Area 750A, P: 8953, T: 95302. C: AF 40(600)-
1000, ARO, Inc., Arnold AF Sta, Tenn. W. G. Glover and
J. S. Deitering. ASTIA: AD 331911, Code AA.
                                          Confidential

This is a report on the initial phase of an experimental
study to determine the amount of aerodynamic control to
be gained during re-entry by modifying typical axisym-
metric nose cone configurations. These modifications
consist of physically altering the axisymmetric shape to
some asymmetrical form which will produce a modest
amount of lift, for example, changing a circular cross
section to an elliptical or triangular shape. Rolling
these bodies at constant angle of attack would provide
a variation in lift-to-drag ratio and hence aerodynamic
control. These initial tests were conducted at Mach
numbers from 0.8 to 5.0 and show that the elliptical dis-
tortion proved to be the more effective method of gaining
aerodynamic control, that is, provided a greater lift-to-
drag ratio range. Controllability was also determined in
terms of trajectory parameters (range, altitude, decelera-
tion, velocity, and Mach number) by using the aerody-

namic coefficients obtained during testing as inputs in a
trajectory computer program.

8-159

**AEDC-TDR-62-159.   ALTITUDE TESTING OF THE
THIOKOL TE-345 SOLID-PROPELLANT ROCKET MO-
TOR FOR TITAN II (QUALIFICATION PHASE).** Oct
1962, 41p. incl 5 refs., illus., tables. AFSC Program
Area 107C. C: AF 40(600)-1000, ARO, Inc., Arnold AF
Sta, Tenn. B. J. Lee and Capt. J. C. Kindel. ASTIA:
AD 331940L, Code MD.   Confidential

Twenty-four Thiokol TE-345, spherical, solid-propellant
rocket motors were tested at pressure altitudes of ap-
proximately 125,000 ft. The purpose of this Qualifica-
tion Phase of testing was to document at pressure alti-
tude: (1) ignition characteristics, (2) ballistic perform-
ance, (3) thrust termination characteristics, and (4) struc-
tural integrity of the TE-345 solid-propellant rocket
motor.   Seven of the motors contained a propellant-to-
liner separation sleeve at the aft end of the propellant,
and the remainder of the motors did not.

8-164

**AEDC.TDR-62-164.   CRYOPUMPING IN THE NEAR
FREE-MOLECULE FLOW REGION.** Oct 1962, 33p. incl
7 refs., illus., tables. AFSC Program Area 806A, P:
8951, Task 89107. C: AF 40(600)-1000, ARO, Inc.,
Arnold AF Sta, Tenn. E. S. J. Wang, J. A. Collins,
Jr., J. D. Haygood. In OTS. ASTIA: AD 285476, Code
AA.   Unclassified

Results are presented of an experimental study on the
cryopumping of CO_2 at liquid nitrogen temperature at
pressures where the mean free path is comparable to the
cryosurface dimensions. In this range, it is shown that
the pumping speed is no longer constant as it is in the
low pressure ranges (free-molecule flow), but increases
with increasing pressure through what is termed the
transition region and approaches a constant value in the
higher pressure ranges (continuum flow). The pumping
speed in the continuum region is shown to be as much
as three times that in the free-molecule region. ; Theo-
retical analyses of experimental results are presented,
including an explanation of the threefold increase in
pumping speed.

8-168

**AEDC-TDR-62-168.   FATIGUE TESTS AND CRACK
DETECTION ON SOME TYPES OF AXIAL-FLOW COM-
PRESSOR ROTOR BLADES.** Oct 1962, 40p. incl 2
refs., illus., tables. AFSC Program Area 040A. C: AF
40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. E.
Thomas. In OTS. ASTIA: AD 287410, Code AA.
                                             Unclassified

Fatigue data were obtained from several types of com-
pressor rotor blades that are in use in axial-flow com-

pressors at the von Kármán Gas Dynamics Facility. The
data provided a general comparison of "as manufactured"
endurance limits and were used as a verification control
in evaluating a supplementary method of detecting failed
blades during systematic maintenance inspections. By
the presentation of stress versus cycles to failure curves,
a comparison is made between AISI number-8630 cast
steel blades as originally furnished with the compres-
sors, AISI number-8630 cast steel shot-peened blades,
and AISI number-403 forged, heat-treated and machined
blades. A method is presented which may be used to
supplement the magnetic particle method for detecting
cracked rotor blades.

8-171

**AEDC-TDR-62-171.   A PRELIMINARY SURVEY OF
ALTITUDE PERFORMANCE OF A J85-GE-5A ENGINE
WITH AN E7-9F COMPRESSOR.** Oct 1962, 47p. incl
8 refs., illus., tables. AFSC Program Area 420L, P:
3155. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta,
Tenn. K. C. Faehl and J. H. Zimmerman. ASTIA: AD
285246L, Code MD.   Unclassified

A preliminary survey investigating the altitude perform-
ance of the J85-GE-5A with an E7-9F compressor was
conducted in an altitude test cell and the results com-
pared to the minimum specified performance. Testing
was conducted at sea-level-static conditions and at an
altitude of 36,089 ft at Mach numbers of 0.9 and 1.2
based on the standard ARDC model atmosphere. The
results show that net thrust and specific fuel consump-
tion were equal to or better than the minimum specified
performance.

8-176

**AEDC-TDR-62-176.   PRESSURE DISTRIBUTION TEST
ON A NIKE-ZEUS CONFIGURATION AT MACH NUMBER
8.** Sep 1962, 22p. incl illus. AFSC Program Area 921C,
P: 9010. C: AF 40(600)-1000, ARO, Inc., Arnold AF
Sta, Tenn. F. K. Hube, Jr., J. O. Rippey, R. L. Palko.
ASTIA: AD 284462, Code AA.   Unclassified

Selected results are presented from two pressure distri-
bution tests on 0.20-scale models of the Army-Douglas
Nike-Zeus anti-missile missile. The magnitudes and
variation of the maximum pressure coefficients in the
vicinity of the canard controls were investigated. Var-
ious configurations, canard deflections, and model atti-
tudes were tested at Mach number 8 and free-stream unit
Reynolds numbers from 2.1×10^6 to 3.5×10^6 per foot.
The angle-of-attack range was from -15 to $+15$ deg at
roll angles from -90 to $+90$ deg.

8-178

**AEDC-TDR-62-178.   UNSTEADY PRESSURES AND
SCALE EFFECTS ON MODELS OF THE TITAN B RE-
ENTRY BODY AT TRANSONIC SPEEDS.** Nov 1962,
39p. incl 8 refs., illus. AFSC Program Area 750A, P:
8953, T: 95307. C: AF 40(600)-1000, ARO, Inc., Arnold

AF Sta, Tenn. H. L. Chevalier and J. E. Robertson. ASTIA: AD 288041, Code AA. Unclassified

Tests on three models were conducted in the Propulsion Wind Tunnel Facility (PWT) to investigate unsteady pressures on the Titan B Mark 4 re-entry body at transonic Mach numbers. Static and unsteady pressure measurements were made on 0.240, 0.060, and 0.017-scale models to determine the scale effect and the essential characteristics of the various unsteady flow phenomena. The test results show that three basic types of unsteady flow phenomena exist on the re-entry body, with model size having some effect on two of these phenomena. The most severe unsteady flow condition resulted from an alternating boundary-layer separation and attachment at the shoulder of the re-entry body. The magnitude of these pressure fluctuations was as large as 65 percent of the free-stream dynamic pressure for the 0.240-scale model.

8-179

AEDC-TDR-62-179. HEAT TRANSFER AND PRESSURE DISTRIBUTION TESTS OF THE LEADING EDGE RE- GION OF A NIKE-ZEUS CANARD AT MACH 4, 6, AND 8. Oct 1962, 36p. incl 4 refs., illus., tables. AFSC Program Area 921C, P: 9010. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. M. E. Hillsamer, F. K. Hube, and R. L. Palko. ASTIA: AD 285625, Code AA.
Unclassified

Heat transfer and pressure distributions were obtained on a model of the leading edge region of the Nike-Zeus canard. Sufficient test data are presented to describe the effects of variations of Mach number, Reynolds number, and sweep angle. Data were obtained over the Mach number range from 4 to 8, the unit Reynolds number range from 0.45×10^6 to 5.7×10^6/ft, and sweep angles from 0 to 90 deg.

8-180

AEDC-TDR-62-180. AN ALTITUDE INVESTIGATION 18-DEG CANTED NOZZLES FOR THE FIRST-STAGE POLARIS MISSILE USING SUBSCALE MOTORS. Oct 1962, 48p. incl illus., tables. AFSC Program Area 921B, P: 9015. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. E. Harper. ASTIA: AD 332432L, Code MD.
Confidential

Twelve Aerojet 10KS2500 solid-propellant rocket motors were fired at simulated altitude to determine the performance of three canted nozzle configurations. Three motors were fired for each configuration, and three were fired with a conventional (no cant angle) nozzle. All canted nozzles had an 18-deg cant angle and were identical except for variations in nozzle inlet contour. To determine performance, measurements of side thrust (forward and aft), axial thrust, combustion chamber pressure, nozzle static pressure, and test cell pressure were made.

8-181

AEDC-TDR-62-181. ALTITUDE TEST OF A HERCULES WING I QUALITY ASSURANCE M-57 THIRD-STAGE MIN- UTEMAN MOTOR (MOTOR SERIAL NUMBER 1A5). Sep 1962, 50p. incl 11 refs., illus., tables. AFSC Program Area 133A. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. J. Byrd and R. C. Nygaard. ASTIA: AD 331630L, Code MD. Confidential

Hercules Powder Company (HPC) third-stage Minuteman Quality Assurance rocket motor 1A5 was fired in Rocket Altitude Cell J-2 on June 23, 1962, to determine motor ballistic performance, confirm motor hardware integrity, and evaluate conformance of motor performance to model specifications. This was the first test at Arnold Center of an operational third-stage Wing I motor produced at Air Force Plant 81.

8-182

AEDC-TDR-62-182. INVESTIGATION OF FIN GAP EF- FECTS ON STATIC STABILITY CHARACTERISTICS OF A FINNED OGIVE-CYLINDER MODEL AT TRAN- SONIC SPEEDS. Sep 1962, 71p. incl illus. AFSC Pro- gram Area 921C. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. W. E. White. In OTS. ASTIA: AD 285173L, Code MD. Unclassified

An investigation was conducted in the Transonic Model Tunnel of the Propulsion Wind Tunnel Facility to deter- mine static stability characteristics of a finned ogive- cylinder model. Three fin designs were evaluated with varied gap distance between the fins and body. The characteristic shape of the neutral point versus Mach number curve remained relatively unaffected by increas- ing the gap between the body and fins. Increasing the gap caused the neutral point to move forward and de- creased the normal-force and pitching-moment coefficient slopes.

8-183

AEDC-TDR-62-183. VACUUM PUMPING BY CRYOSORP- TION. Oct 1962, 28p. incl 15 refs., illus. AFSC Program Area 750G, P: 6950, T: 695001. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. S. M. Kindall and E. S. J. Wang. In OTS. ASTIA: AD 287182, Code AA.
Unclassified

A method of measuring and analyzing the variation in the rate of adsorption by activated charcoal at $77°K$ for con- tinuous inflow of nitrogen gas is presented. A set of adsorption parameters is developed for the analysis. Particular attention is given to the meaning of pumping speed for an adsorbent bed of charcoal pellets, and an equation is derived which describes the behavior of pressure in a chamber during continuous adsorption.

8-185

AEDC-TDR-62-185. INVESTIGATION OF FLEXIBLE PARACHUTE MODEL CHARACTERISTICS AT MACH

NUMBERS FROM 1.5 TO 6. Oct 1962, 29p. incl 2 refs., illus., table. AFSC Program Area 720F, P: 6065, T: 61525. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn., J. S. Deitering. ASTIA: AD 331941, Code AA.
Confidential

Tests were conducted in the 40-in. Supersonic Tunnel (A) of the von Kármán Gas Dynamics Facility to determine the stability and drag characteristics of a series of fabric parachutes over the Mach number range of 1.5 to 6. Various parachute designs employing porous and ribbon materials were tested at dynamic pressures corresponding to altitudes of approximately 63,000 ft to 143,000 ft for the above Mach number range, respectively. Drag modulation by reefing was successfully attempted on one parachute configuration at Mach numbers 1.5 to 3. Another configuration was tested for strength of construction at a higher pressure level corresponding to an altitude of 109,000 ft at Mach 6. The data obtained in these tests consisted of high-speed movies, both sideview and schlieren, and oscillograph drag traces.

8-187

AEDC-TDR-62-187. STATIC FORCE TESTS AT MACH 8 OF SHARP AND BLUNT 20-DEG HALF-ANGLE CONES AND A BLUNT 70-DEG SWEPT DELTA WING. Oct 1962, 21p, incl 2 refs., illus., table. AFSC Program Area 730E, P: 8219, T: 82159. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. G. H. Merz and O. R. Pritts. ASTIA: AD 285540, Code AA.   Unclassified

Results are presented from a static force test on sharp and blunt 20-deg half-angle cones and a blunt 70-deg swept delta wing configuration conducted for the Aeronautical Systems Division. The three configurations were tested at a nominal Mach number of 8 and a free-stream unit Reynolds number of 2.1×10^6 per foot. Force data were obtained at angles of attack from −3 to 45 deg on the two conical configurations and from −3 to 54 deg on the delta wing configuration at sideslip angles from −3 to 15 deg.

8-188

AEDC-TDR-62-188. ADDENDUM TO AN INVESTIGATION OF THE EQUILIBRIUM PRESSURE ALONG UNEQUALLY HEATED TUBES (ADDENDUM TO AEDC-TDR-62-26). Oct 1962, 39p. incl 6 refs., illus., tables. AFSC Program Area 750A, P: 8953, T: 895306. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. G. D. Arney, Jr. and A. B. Bailey. In OTS. ASTIA: AD 286166, Code AA.   Unclassified

This report presents results of an investigation of the error introduced in very low pressure measurements when small tubes with axial temperature gradients connect pressure transducer and the point where knowledge of the pressure is desired. The experiments reported in AEDC-TDR-62-26 were extended with air, argon, and helium to include higher Knudsen numbers and to include data taken with the pressure transducer at the hot end of the tube. Although the form of the pressure-temperature relationship was specified with good accuracy to a Knudsen number of 5.0, the degree of scatter for larger Knudsen numbers was such (±5%) that it was not possible to fix accurately the free molecule limit. Also in the present analysis, what is considered to be a more accepted definition of mean free path has been used, and the opportunity was taken to recalculate the earlier work using this definition.

8-189

AEDC-TDR-62-189. ALTITUDE PERFORMANCE EVALUATION OF AN XLR91-AJ-5 ENGINE USING A NEW CONTOUR THRUST CHAMBER ASSEMBLY. Dec 1962, 54p. incl 8 refs., illus., tables. AFSC Program Area 107C. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. B. Billings, N. R. Vetter, and J. F. DeFord. ASTIA: Code XX.   Confidential

Altitude performance of a new contour Aerojet-General XLR91-AJ-5 engine was evaluated by statically testing the engine in the Satellite Rocket Cell J-3 at Arnold Center. Fourteen firings of the engine were made at pressure altitudes up to 106,000 ft. The engine performance is compared to rated performance and to the old contour performance, and the differences are discussed. In addition to engine performance the design, durability, and performance of the uncooled nozzle extension were tested. No structural difficulties of the nozzle extension were encountered during testing.

8-190

AEDC-TDR-62-190. ALTITUDE TESTING OF A THIOKOL CHEMICAL CORPORATION TE-289 ROCKET MOTOR. Nov 1962, 38p. incl 2 refs., illus., tables. AFSC Program Area 770A, P: 7659. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. D. R. Frank and A. L. Connell. ASTIA: AD 332766, Code AA.   Confidential

One Thiokol Chemical Corporation TE-289 solid-propellant rocket motor was tested at an average pressure altitude of 95,000 ft. Objectives of the test were to determine motor performance, to evaluate the pyrogen igniter, to evaluate nozzle modifications, and to study motor operation during tailoff. Motor performance, ignition, and tailoff characteristics and nozzle wall temperature data are presented and discussed.

8-192

AEDC-TDR-62-192. SIMULATED ALTITUDE TESTS OF TWO THIOKOL TE-359 SOLID-PROPELLANT SURVEYOR RETROGRADE ROCKET MOTORS. Oct 1962, 34p. incl illus., tables. AFSC Program Area 921E. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. A. A. Cimino and M. A. Nelius. ASTIA: AD 332056L, Code MD.   Confidential

Two Thiokol Chemical Corporation TE-359 heavy-case solid-propellant rocket motors (Surveyor main retro-

prototype-rocket) were fired in an altitude test cell to determine altitude performance. The three primary objectives of the test were to determine ballistic performance after environmental temperature conditioning, to determine the time interval from first indication of thrust to the 40-lb$_f$ level during tailoff, and to determine the impulse accumulated during this time interval.

8-193

AEDC-TDR-62-193. PRESSURE DISTRIBUTION AND FORCE COEFFICIENTS MEASURED ON THE APOLLO COMMAND-MODULE RE-ENTRY CONFIGURATION AT MACH NUMBER 19. Oct 1962, 24p. incl 5 refs., illus., tables. AFSC Program Area 921E, P: 9071. C: AF 40 (600)-1000, ARO, Inc., Arnold AF Sta, Tenn. E. C. Knox. ASTIA: Code NC. Confidential

Pressure distribution and force tests were made on an Apollo command-module re-entry configuration in the 50-in. Hypervelocity Tunnel (HS-2) at Mach number 19 and a Reynolds number of about 85,000 based on model maximum diameter. Angle of attack ranged from 0 to 60 deg.

8-194

AEDC-TDR-62-194. SIMULATED HIGH ALTITUDE EVALUATION OF THE TE-375 SOLID-PROPELLANT ROCKET MOTORS FOR THE PROJECT SYNCOM MARK I SPACECRAFT (Phase I - Nozzle Evaluation). Oct 1962, 46p. incl 4 refs., illus., tables. AFSC Program Area 921E. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. A. F. Domal. ASTIA: AD 332146, Code MD. Confidential

The Thiokol TE-375 spherical, solid-propellant rocket motor was designed for use on the Project Syncom Mark I spacecraft. One motor will be used to add an incremental velocity to the spacecraft at the apogee of the transfer ellipse and thereby achieve a circular synchronous orbit. Four TE-375 solid-propellant rocket motors were tested in Rocket Altitude Cell T-4 at simulated altitudes ranging from 116,000 to 127,000 ft. The motors were tested to determine the vacuum total impulse and to verify motor structural integrity during operation at near vacuum conditions. The motors remained structurally intact throughout each firing, and the nozzle materials exhibited excellent durability.

8-195

AEDC-TDR-62-195. PRESSURES AND FORCES ON A MISSILE MODEL RESULTING FROM STAGE SEPARATION AT VERY HIGH ALTITUDES. Nov 1962, 32p. incl illus., table. AFSC Program Area 750A, P: 8953 T: 895301. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. T. W. Binion, Jr. and R. D. Herron. ASTIA: Code XX. Unclassified

Pressure and force measurements were obtained on models of two missile stages during stage separation.

The upper stage rocket engine exhaust was simulated with high pressure carbon dioxide. Data were obtained at seven separation distances with an upper stage nozzle exit pressure ratio variation from 52 to 8,066. The test cell pressure ranged from 1.25 to 750 microns of mercury which corresponds to an altitude range from 290,000 to 160,000 ft. The results indicate that the pressures and forces on the lower stage are independent of ambient pressure and are dependent on engine chamber pressure and stage separation distance. At separation distances less than two engine nozzle diameters, the lower stage will affect the pressures and forces on the upper stage.

8-197

AEDC-TDR-62-197. DYNAMIC STABILITY TESTS ON A SKYBOLT RE-ENTRY VEHICLE MODEL AT MACH 10 AND AT LOW OSCILLATION FREQUENCIES. Oct 1962, 13p. incl 4 refs., illus. AFSC Program Area 138A. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. L. K. Ward. ASTIA: AD 332057, Code AA. Confidential

Low amplitude (±2 deg) dynamic stability tests were conducted on a Skybolt re-entry vehicle model in the von Kármán Gas Dynamics Facility's 50-in. Mach 10 Tunnel (C). Measurements were made using a forced oscillation technique. Data were obtained at Reynolds numbers of 0.21×10^6 and 0.84×10^6 based on model base diameter and at angles of attack up to 12 deg. The tests were made at low model oscillation frequencies, and results are compared with representative data previously obtained at high model frequencies.

8-198

AEDC-TDR-62-198. DYNAMIC STABILITY TESTS OF SEVERAL MODELS OF THE ADVANCED MARK 6 RE-ENTRY VEHICLE AT MACH 10. Oct 1962, 16p. incl 3 refs., illus. AFSC Program Area 107C. C: AF 40 (600)-1000, ARO, Inc., Arnold AF Sta, Tenn. L. K. Ward and A. E. Hodapp. ASTIA: AD 332058, Code AA. Confidential

Low amplitude (±1.5 deg), forced oscillation, dynamic stability tests were conducted on several model configurations of the advanced Mark 6 re-entry vehicle in the 50-in. Mach 10 Tunnel (C) of the von Kármán Gas Dynamics Facility. Data were obtained at Reynolds numbers of 0.21×10^6 and 1.19×10^6 based on model base diameter and at angles of attack ranging from 0 to 12 deg.

8-199

AEDC-TDR-62-199. RESEARCH STUDY OF THE CRYOTRAPPING OF HELIUM AND HYDROGEN BY SOLID OXYGEN AND NITROGEN AT 20°K. Interim Report, Oct 1962, 70p. incl 12 refs., illus. AFSC Program Area 850E, P: 7778, T: 777801. C: AF 40(600)-945, Linde Co., Tonawanda, N.Y. R. A. Hemstreet, D. J. Webster, W. J. Wirth, J. R. Hamilton. In OTS. ASTIA: AD 286815, Code AA. Unclassified

A study of the variables affecting cryotrapping of helium and hydrogen during 20°K condensation of oxygen and nitrogen is presented. The mechanism of helium trapping appears to involve burying helium atoms in the solid oxygen or nitrogen. The process is most efficient at high condensation rates, but is not likely to find application for the removal of helium in a large space chamber. Experimental results indicate that hydrogen trapping occurs by adsorption of hydrogen molecules on the surface of the solid oxygen or nitrogen and is most efficient at low condensation rates and low heat flux to the solid surface. These conditions indicate that hydrogen trapping may be applicable for hydrogen removal in a large space chamber. Attempts to improve helium trapping by ionizing the atoms and collecting them on a charged 20°K surface were unsuccessful.

8-200

AEDC-TDR-62-200. THE CRYOSORPTION PUMPING OF HYDROGEN AND HELIUM AT 20°K. Interim Report, Oct 1962, 58p. incl 9 refs., illus., tables. AFSC Program Area 850E, P: 7778, T: 777801. C: AF 40(600)-944, Linde Co., Tonawanda, N.Y. S. A. Stern, J. T. Mulhaupt, F. S. DiPaolo, L. Marasco. In OTS. ASTIA: AD 286523, Code AA. Unclassified

The feasibility of pumping hydrogen and helium gases by adsorption at approximately 20°K to determine the application of this "cryosorption" technique to large space simulation chambers was investigated. Eight adsorbent materials were evaluated in terms of absorptive capacity and pumping speed under equilibrium conditions at temperatures between 20° and 40°K and at pressures from 3×10^{-8} to 1×10^{-3} torr. Cryosorption pumping under constant hydrogen gas leak was demonstrated for Molecular Sieves 13X, Pd-loaded ammonium Y, and coconut charcoal. The cryosorption of hydrogen gas on adsorbents refrigerated with liquid hydrogen was examined. Measurements of pumping speed showed that the adsorbents pumped at least 99.9% of the gas admitted to the cryosorption pumps, but only the adsorbent surface directly exposed to the gas flow was effective. The capacity and efficiency of this effective surface were strongly dependent on its temperature. Cryosorption of hydrogen at 20°K appears to be possible, but the cryosorption pumping of helium at this temperature does not appear practical.

8-202

AEDC-TDR-62-202. PARTICLE-SOLID IMPACT PHENOMENA. Nov 1962, 35p. incl 6 refs., illus., tables. AFSC Program Area 802A, P: 7342, T: 734202. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. C. D. Liles and E. H. Goodman. In OTS. ASTIA: AD 287808, Code AA. Unclassified.

High velocity impact tests have been made with high purity aluminum and copper projectiles and targets. Data are presented for impact velocities from 0.762 to 7.62

km/sec, and these are compared with various correlation formulas.

8-203

AEDC-TDR-62-203. FORCE TESTS ON FLAT, CAMBERED, AND TWISTED DELTA WINGS AT MACH NUMBER 8. Nov 1962, 22p. incl 4 refs., illus. AFSC Program Area 750A, P: 1370, T: 13474. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. J. D. Coats and J. C. Uselton. ASTIA: AD 332786, Code AA.
Confidential

A test was conducted in the 50-inch Mach 8 Tunnel (B) of the von Kármán Gas Dynamics Facility to determine the aerodynamic characteristics of a series of blunt leading edge, semi-span delta wings having a 70-deg leading edge sweep angle. This test, which was a continuation of an earlier investigation at Mach numbers 3, 4, and 6 in the 40-inch Supersonic Tunnel (A) of this facility, was done to obtain aerodynamic influence coefficients which are incorporated in a theory of flutter analysis for low aspect ratio wings. The angle-of-attack range was from –6 to +10 deg, and the Reynolds number for the test was 3×10^6 per ft. The 17 configurations included in this investigation were all derived from three basic wing shapes: a flat plate, a cambered surface and a twisted surface. Each wing configuration was comprised of triangular forward and tip wing panels which were supported from the rectangular main wing panel by internal strain-gage balances. The wings were mounted on a reflection plane, and the main wing panel was supported by an internal balance to measure the aerodynamic characteristics of the overall wing. The data included in this report are intended only to illustrate representative test results and to show gross variations in aerodynamic characteristics introduced by the maximum wing distortions investigated.

8-204

AEDC-TDR-62-204. ALTITUDE TEST OF A HERCULES WING I QUALIFICATION XM-57 THIRD-STAGE MINUTEMAN MOTOR (MOTOR SERIAL NUMBER B1-4-11). Oct 1962, 54p. incl 12 refs., illus., tables. AFSC Program Area 133A. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. C. Nygaard and R. J. Byrd. ASTIA: AD 332602, Code AA. Confidential

Hercules Powder Company (HPC) XM-57 third-stage Minuteman Qualification rocket motor B1-4-11 was fired in Rocket Altitude Cell J-2 on July 27, 1962. This was the fourteenth test of the HPC third-stage motor at AEDC and the sixth firing of a Wing I Qualification motor at high simulated pressure altitude. This was the first firing of an XM-57 motor with a pyrogen-type igniter. Mean ignition delay was less than the shortest time experienced in all previous altitude firings of XM-57 motors. A rupture of the test cell exhaust diffuser approximately 28 sec after ignition caused reverse flow into the test cell which rendered ballistic calculations impractical; how-

ever, motor performance compared satisfactorily with previous firings.

8-205

AEDC-TDR-62-205. THE DRAG OF SPHERES IN RAREFIED HYPERVELOCITY FLOW. Dec 1962, 58p. incl 36 refs., illus., table. AFSC Program Area 750A, P: 8953, T: 895306. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. Max Kinslow and J. L. Potter. In OTS. ASTIA: Code XX. Unclassified

Through use of the low-density, hypervelocity wind tunnel of the von Kármán Gas Dynamics Facility, drag of spheres has been measured under hypersonic, cold-wall ($T_w \ll T_o$), support-free conditions in a nonreacting (vibration frozen) flow. Data were obtained for a nominal free-stream Mach number of 11 and for Reynolds numbers from 1 to 10 based on conditions immediately downstream of the bow shock and sphere diameter. These data were supplemented by measurements at a nominal Mach number of 10 where a conventional balance was used, and Reynolds numbers downstream of the shock as high as 10^4 were investigated in the cold-wall condition. The experimental results have been analyzed both from the point of view of continuum flow with second-order viscous effects, and from the standpoint of a noncontinuum concept, taking account of first collisions between reemitted and free-stream molecules. In the former case, a drag coefficient representation of the form $C_D = C_{D_{inviscid}} + K_1/\sqrt{Re_2} + K_2/Re_2$ is shown to fit the data very closely when K_1 and K_2 are allowed to be functions of free-stream Mach number and wall-to-total enthalpy ratio. Data from investigations of the University of California, University of Toronto, and Jet Propulsion Laboratory have been used to enlarge the present study and, in particular, to support the evaluation of K_2 which represents the influences of vorticity, curvature, thick boundary layer, slip, and temperature jump. In all cases, K_2 was found to be negative in sign. The new first-collision analysis is numerically indeterminant because of the lack of a method for explicit calculation of mean free path in real, polyatomic gases with consideration of intermolecular forces. However, the form of the derived equation for $C_D/C_{D_{free\ molecular}}$ appears to fit the experimental data over a considerable range of Knudsen numbers if a free constant is used in the expression for mean free path. It is considered that this constant is influenced by the type of intermolecular and gas-solid interactions occurring. Fully accommodated, diffusely reflected surface interaction was assumed in the analysis.

8-206

AEDC-TDR-62-206. A CHECK CALIBRATION OF THE AEDC-PWT TRANSONIC MODEL TUNNEL. Oct 1962, 33p. incl 2 refs., illus. AFSC Program Area 040A. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. J. H. Nichols and F. M. Jackson. In OTS. ASTIA: AD 287183, Code AA. Unclassified

A brief investigation was conducted in the PWT Transonic Model Tunnel to check the validity of previous calibration results for two commonly used test section configurations. Static pressure measurements were made

along the tunnel centerline and along the centerline of the top wall of the test section; simultaneous measurements of stilling chamber and plenum chamber pressures were obtained. The results of this investigation showed that the previous calibration results for a test section having four perforated walls was still correct, but previous results obtained with two perforated and two solid walls did not agree with those obtained in this investigation. This disagreement was felt to be caused by refinements in wall fabrication techniques and inaccuracies in the instrumentation used for the earlier investigation.

8-207

AEDC-TDR-62-207. AN ANALYSIS OF THE ACCURACY OF LIQUID-PROPELLANT ROCKET ENGINE PERFORMANCE MEASUREMENTS IN THE SATELLITE ROCKET CELL J-3. Dec 1962, 58p. incl 4 refs., illus., tables. AFSC Program Area 107C. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. C. R. Bartlett. ASTIA: Code XX. Unclassified

Measurements obtained during testing at pressure altitudes in excess of 100,000 ft in the Satellite Rocket Cell J-3 are analyzed to determine the accuracy of measuring liquid-propellant rocket engine performance. The equipment and in-place calibration techniques used to obtain high quality data and the statistical methods employed are discussed. The results demonstrate that the error, in terms of one standard deviation, in measuring thrust, chamber pressure, and propellant flow rate is less than ±0.22 percent, ±0.20 percent, and ±0.28 percent, respectively. The accuracy of calculating three important performance parameters C_F, C^*, and I_{sp} is ±0.35 percent, ±0.39 percent, and ±0.36 percent (one standard deviation), respectively.

8-208

AEDC-TDR-62-208. FURTHER EXPERIMENTS ON IMPACT-PRESSURE PROBES IN A LOW-DENSITY, HYPERVELOCITY FLOW. Nov 1962, 31p. incl 8 refs., illus., tables. AFSC Program Area 750A, P: 8950, T: 895004. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. A. B. Bailey. In OTS. ASTIA: Code XX. Unclassified

An experimental investigation of the behavior of flat-faced, impact-pressure probes with a range of orifice-to-probe diameter ratios was made in heated argon under conditions where $M_\infty = 4$ to 14, $T_0 = 2700$ to 4300°K, and $Re_2/in. = 30$ to 430. At the lower Reynolds numbers the measured impact pressure was found to decrease with the pressure sensing orifice size. This result agrees with that found in heated nitrogen. As the Reynolds number increased this orifice effect became less significant, and at the higher Reynolds numbers no decrease in measured impact pressure was noted for the smallest orifice tested. This tends to confirm the assumption made in Ref. 1 that this behavior is caused by a thermomolecular flow effect. Because this effect is a function solely of pressure at a particular temperature, the greater the pressure the smaller the effect. When

$Re_2\sqrt{\rho_2/\rho_\infty}$ is less than 800 in argon the measured impact pressure was less than the true impact pressure and decreased to a minimum value, approximately 93 percent of the true value. As the Reynolds number decreased still further, the viscous effects became dominant, and there was a sharp increase in the measured impact pressure.

8-209

AEDC-TDR-62-209. SPACE ENVIRONMENTS AND SIMULATION REQUIREMENTS. Nov 1962, 59p. incl 18 refs., illus., tables. Donald D. Carlson, Lt Col, USAF. ASTIA: Code XX.   Unclassified

The purpose of this report is to present some of the space simulation parameters that must be analyzed to successfully and economically accomplish the task of space exploration. The first portion includes typical space missions that are considered feasible, a discussion of the space and earth environments, and the simulation requirements. This is followed by an evaluation of experimental tests to be conducted in aerospace environmental chambers.

8-210

AEDC-TDR-62-210. SIMULATED HIGH ALTITUDE EVALUATION OF THE TE-375 SOLID-PROPELLANT ROCKET MOTORS FOR THE PROJECT SYNCOM MARK I SPACECRAFT (Phase II - Flightweight Nozzle Evaluation). Nov 1962, 50p. incl 5 refs., illus., tables. AFSC Program Area 921E. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. A. F. Domal. ASTIA: Code XX.
                                                    Confidential

The TE-375 spherical, solid-propellant rocket motor was designed for use on the Project Syncom Mark I spacecraft. One motor will be used to add an incremental velocity to the spacecraft at the apogee of the transfer ellipse and thereby achieve a circular synchronous orbit. Four TE-375 solid-propellant rocket motors were tested in Rocket Altitude Cell T-3 at simulated altitudes ranging from 126,800 to 134,600 ft. The purposes of testing the flightweight motors were to determine the vacuum total impulse and to verify motor structural integrity during operation at near-vacuum conditions. The motors remained structurally intact throughout each firing, and the nozzle materials exhibited excellent durability.

8-211

AEDC-TDR-62-211. FLUTTER TESTS OF SEMI-RIGID WING MODELS AT MACH NUMBERS 5 TO 10. Nov 1962, 27p. incl 1 ref., illus., tables. AFSC Program Area 750A, P: 1370, T: 13470. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. Ronald H. Urban. ASTIA: Code XX.   Confidential

Flutter tests were conducted at Mach numbers 5 to 10 in the 12-In. Hypersonic Tunnel (E-2) and the 50-In. Mach 10 Tunnel (C) of the von Kármán Gas Dynamics Facility on semi-rigid, rectangular wing models. Three of the four models tested showed decreasing value of the flutter parameter with an increasing value of the model roll-pitch frequency ratio. Representative data are reported.

8-213

AEDC-TDR-62-213. MICROWAVE MEASUREMENT OF PROJECTILE KINEMATICS WITHIN LAUNCHER BARRELS. Nov 1962, 37p. incl 6 refs., illus. AFSC Program Area 750A, P: 8950, T: 895002. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. R. E. Hendrix. In OTS. ASTIA: AD 288923, Code AA. Unclassified

Microwave reflectometry has been applied successfully to the study of the kinematic behavior of projectiles within launcher barrels and pistons within compression (pump) tubes in the Hypervelocity Pilot Range of the von Kármán Gas Dynamics Facility. Well-defined mathematical treatment enables the calculation of an accurate time history of projectile position inside its launcher barrel. Microwave excitation in extraneous modes has been attenuated, resulting in an increase in the accuracy of the reflectometer system.

8-216

AEDC-TDR-62-216. SIMULATED ALTITUDE TESTING OF AN X-258 B-1 SOLID-PROPELLANT ROCKET MOTOR. Nov 1962, 20p. incl illus. AFSC Program Area 921E. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. M. A. Nelius and H. G. Davis. ASTIA: Code XX.
                                                    Confidential

A Hercules Powder Company, Allegany Ballistics Laboratory (HPC-ABL) X-258 B-1 solid-propellant rocket motor was fired at a simulated altitude of 100,000 ft to evaluate ballistic performance. Motor operation terminated approximately 0.5 sec after ignition because of a failure of the motor forward dome.

8-218

AEDC-TDR-62-218. MEASUREMENTS OF PRESSURE AND SPEED OF FLOW IN A SPARK-HEATED HYPERSONIC WIND TUNNEL. Nov 1962, 58p. incl 15 refs., illus. AFSC Program Area 750A, P: 8952, T: 895210. C: AF 40(600)-930, Stanford University, Stanford, Calif. Krishnamurty Karamcheti, Walter Vali, James B. Kyser, Maurice L. Rasmussen. In OTS. ASTIA: AD 288668, Code AA.   Unclassified

An account is given of several aspects of the experimental investigation directed at determining the nature of the flow and state of the gas in the nozzle and test section of the Stanford spark-heated hypersonic wind tunnel. Attention is given only to the pressure and speed-of-flow measurements. Results are presented for pitot pressures and wall static pressures. The speed of flow in the test section is derived from measurements made by spark-schlieren photographs of a disturbance

created in the flow by means of a spark discharge. On the basis of these measurements, it is concluded that the actual stagnation enthalpy of the stream is likely to be different from the enthalpy calculated according to current practice. As a consequence, it is shown that serious errors may occur in the calculated values for the state of the flow, and in theoretical estimates of quantities such as stagnation-point heat-transfer rates.

8-219

AEDC-TDR-62-219. PRESSURE DISTRIBUTION TEST OF A THIRD-STAGE NIKE-ZEUS CONFIGURATION AT MACH NUMBERS 6 AND 8. Nov 1962, 28p. incl illus., tables. AFSC Program Area 921C, P: 9010. C: AF 40 (600)-1000, ARO, Inc., Arnold AF Sta, Tenn. F. K. Hube, A. D. Ray, and R. L. Palko. ASTIA: Code XX.
Unclassified

Selected results are presented of a pressure distribution test on a 0.20-scale model of the Army-Douglas Nike-Zeus anti-missile missile. The magnitude and variation of the maximum pressure coefficients in the vicinity of the windward canard control were investigated. Various canard deflections and model attitudes were tested at Mach numbers of 6 and 8 and free-stream unit Reynolds numbers of 0.25×10^6 and 3.35×10^6 per foot. The angle-of-attack range was from -15 to +15 deg at roll angles from -90 to +180 deg.

8-223

AEDC-TDR-62-223. NOSE BLUNTNESS INFLUENCE ON 9-DEG CONE SURFACE PRESSURES AT M ~ 20. Nov 1962, 12p. incl illus., table. AFSC Program Area 107C. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. W. Wolny and J. F. Roberts. ASTIA: Code XX.
Confidential

Pressure measurements were made on the General Electric Advanced Mark 6 9-deg cone for three values of nose bluntness at a Mach number of about 20 and Reynolds numbers from 0.054×10^6 to 0.064×10^6 based on model base diameter. Selected data obtained during this investigation are presented.

8-226

AEDC-TDR-62-226. PRESSURE TESTS OF THE NIKE-ZEUS NOSE PROBE AT SUPERSONIC MACH NUMBERS. Nov 1962, 13p. incl 1 ref., illus., table. AFSC Program Area 921C, P: 9010. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. L. L. Trimmer, A. D. Ray, and R. L. Palko. ASTIA: Code XX.
Unclassified

Selected results are presented from pressure tests of a 300-percent-scale Nike-Zeus nose probe configuration at supersonic Mach numbers. The effects of Mach number, Reynolds number, and model attitude on the free-stream pressure measuring capabilities of the probe were investigated. The configuration was tested at Mach numbers 3.5, 4.0, 4.5, and 5.0 at unit Reynolds numbers from 0.14 to 0.53×10^6 per inch through an angle-of-attack range from 0 to 19.5 deg.

8-227

AEDC-TDR-62-227. DEVELOPMENT TRENDS IN ROCKET PROPULSION SYSTEMS. Dec 1962, 83p. incl 27 refs., illus. C: AF 40(600)-1000, ARO, Inc., Arnold AF Sta, Tenn. Goethert, B. H. and Lennert, A. E. ASTIA: Code XX.
Confidential

A brief historical review of chemical propulsion systems, of both the liquid and solid propellant type, is presented. Some of the significant design parameters, such as propellant combinations and additives, mechanical design features, single and multi-nozzle arrangements, are discussed with specific examples, and their influence on performance improvements and performance limitations are indicated. The influence of high-altitude and space environment on the operation of rocket systems is surveyed, and test results for some high-altitude effects are presented. In the field of electric propulsion, electrothermal, electrostatic, and electromagnetic systems are reviewed, and the construction and operational difficulties of each is presented. A suitable lightweight power source is required for the successful development of such systems. Possible advances in electric propulsion systems beyond the first generation engines under development are indicated, and a brief analysis of the fields of applications of electric propulsion systems is given.

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9-26

BSD-TDR-62-26. DOWNRANGE DATA REPORT – AFMTC TEST NO. 3803, ATLAS MISSILE 9E. Mar 1962, 31p. incl illus., 3 refs. C: AF 04(694)-33, Avco-Everett Research Lab., Everett, Mass. J. Brennan and J. Geanakos. SRN: 287. ASTIA: AD 329126, Code AA. Secret

9-58

BSD-TDR-62-58. MINUTEMAN-INFLUENCE OF TRAJECTORY UPON STRUCTUAL TEMPERATURES. Mar 1962, 32p. incl illus., tables, 19 refs. C: AF 04(694)-1, Space Technology Lab., Inc., Redondo Beach, Calif. R. Batt. SRN: 6120-7623-NC-000. ASTIA: Code XX. Confidential

9-83

BSD-TDR-62-83. MARK 4 RE-ENTRY VEHICLE THERMAL PROTECTION SYSTEM DESIGN AND ANALYSIS. 18 Apr 1962, 348p. incl illus. C: AF 04(647)-305, Avco Corp., Research & Advanced Development Div., Wilmington, Mass. H. Hurwicz, E. Rollo, J. Brown. SRN: RAD-TR-62-6. ASTIA: Code NC. Secret-Restricted Data

9-86

BSD-TDR-62-86. IONIZATION STUDIES. Fifth Quarterly Rpt., Jan 1, 1962 -Mar 31, 1962, 12p. incl illus. C: AF 04(647)-745, University of Utah, Salt Lake City, Utah. R. Grow. ASTIA: AD 330161, Code AA. Confidential

9-96

BSD-TDR-62-96. PRELIMINARY AERODYNAMIC CHARACTERISTICS OF THE LOW RADAR CROSS SECTION TEST VEHICLE. Technical Note, May 1962, 52p. incl illus., 25 refs. C: AF 04(694)-35, Chrysler Corp., Missile Div., Detroit 31, Mich. V. Kulwicki and P. Kuly. SRN: SAE-TN-14-62. ASTIA: Code XX. Secret

9-108

BSD-TDR-62-108. DATA SUMMARY AND TRAJECTORY REPORT, AFMTC TEST NO. 813, MINUTEMAN MISSILE NO. 414 (May 19, 1962). Jun 1962, 14p. incl illus. C: AF 04(694)-33, Avco-Everett Research Lab., Everett, Mass. R. Antill, J. Brennan and C. Petty. SRN: AERL 62-463. ASTIA: AD 331254, Code AA. Secret

9-112

BSD-TDR-62-112. EFFECT OF RE-ENTRY INDUCED PLASMA ON SIGNAL TRANSMISSION. 15 May 1962, 28p.

incl illus., tables, 14 refs. C: AF 04(647)-269 and AF 04(694)-18, General Electric, Missile and Space Vehicle Dept., Philadelphia, Pa. B. Rosenbaum, L. Sullivan and P. Friel. SRN: 62SD538. ASTIA: Code XX. Secret

9-122

BSD-TDR-62-122. RE-ENTRY RADIATION MEASUREMENTS: AMR TEST 5462. Supplemental Rpt., 31 May 1962, 12p. incl illus., 3 refs. C: AF 04(694)-13, General Electric Co., Missile & Space Vehicle Dept., Space Sciences Lab., Philadelphia, Pa. E. Branyan. SRN: TRAP-16S. ASTIA: Code XX. Secret

9-123a

BSD-TDR-62-123. LOW DENSITY HYPERSONIC SIMILARITY OF CONES AND SLIGHTLY BLUNTED SPHERE CONES. 15 May 1962, 34p. incl illus., tables, 51 refs. C: AF 04(647)-617 and AF 04(694)-18, General Electric, Missile and Space Vehicle Dept., Philadelphia, Pa. W. McCauley. SRN: 62SD540. ASTIA: Code XX. Confidential

9-126

BSD-TDR-62-126. GROUNDBURST RADAR FUZING FOR HIGH-PERFORMANCE RE-ENTRY VEHICLES. Technical Rpt., 21 Jun 1962, 222p. incl tables, illus., 86 refs. C: AF 04(694)-158, Avco Corp., Research and Advanced Development Div., Wilmington, Mass. N. Albrecht, C. Baker and L. Ehrman. SRN: RAD-TR-62-22. ASTIA: Code XX. Secret

9-127

BSD-TDR-62-127. IMPROVED STRUCTURAL COMPOSITES. 13 April 1962, 38p. incl illus., tables, 6 refs. C: AF 04(647)-617, General Electric, Missile and Space Vehicle Dept., Philadelphia, Pa. B. Rosen and A. Ketler. SRN: 62SD474. ASTIA: Code XX. Confidential

9-128

BSD-TDR-62-128. REINFORCED PLASTICS. 30 Mar 1962, 19p. incl. illus., tables, 10 refs. C: AF 04(647)-617, General Electric, Missile and Space Vehicle Dept., Philadelphia, Pa. P. Juneau and D. Flom. SRN: 62SD-475. ASTIA: Code XX. Confidential

9-131

BSD-TDR-62-131. INVESTIGATION OF AN AERODYNAMIC SPIKE IN HYPERSONIC FLOW. Final rpt., Jun 1962, 283p. incl illus., tables. C: AF 04(694)-29, Airborne Instruments Lab., Div. of Cutler-Hammer, Inc.,

103

Deer Park, Long Island, N.Y., and Mithras, Inc., Cambridge, Mass. SRN: 1198-1. ASTIA: Code XX. Secret

9-134

BSD-TDR-62-134. TARGET IDENTIFICATION STUDY. 2 Mar 1962, 27p. incl illus., 6 refs. C: AF 04(647)-617, General Electric Co., Light Military Electronics Dept., Advanced Electronic Center. SRN: 62SD455. ASTIA: Code XX. Secret

9-135

BSD-TDR-62-135. SHOCK IONIZATION STUDIES IN THE NOBLE GASES. 25 May 1962, 29p. incl illus., 21 refs. C: AF 04(647)-617, General Electric Research Lab., Schenectady, N.Y. D. White and R. Alpher. SRN: 62SD586. ASTIA: Code XX. Confidential

9-136

BSD-TDR-62-136. LEADING EDGE BLUNTNESS AND SLIP FLOW EFFECTS IN HIGH TEMPERATURE HYPERVELOCITY FLOW OVER A FLAT PLATE. 29 May 1962, 31p. incl illus., 43 refs. C: AF 04(647)-617, General Electric Research Lab., Schenectady, N.Y. H. Nagamatsu, SRN: 62SD593. ASTIA: Code XX.
Confidential

9-137

BSD-TDR-62-137. THEORETICAL STUDIES OF HIGHLY STRESSED GASES. 25 May 1962, 34p. incl illus., 15 refs. C: AF 04(647)-617, General Electric Research Lab. C. Muckenfuss, SRN: 62SD581. ASTIA: Code XX.
Confidential

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10-12

ESD-TDR-62-12. FINAL SUMMARY REPORT - TASK II.
28 Feb 62. C: AF19-(604)5881, General Electric Co.,
Santa Barbara, Calif. ASTIA: AD 328583, Code AA.
Secret

Problems in strategic control and its supporting areas
are defined and suggested research programs for the near
term and long term are delineated. This research is re-
ported in detail in the TEAS Task II, Final Report ESD-
TDR 62-11.

10-26

ESD-TDR-62-26. ACTIVITY REPORT - DET#4, NAFEC.
Aug 62, 28p. NAFEC, Atlantic City, N.J. ASTIA: AD
285276, Code AA. Unclassified

This report briefly describes some of the tasks and
studies conducted at National Aviation Facilities Ex-
perimental Center, which may be of interest to the Air
Force.

10-27

ESD-TDR-62-27. ACTIVITY REPORT - DET #4, NAFEC.
Sep 62, 30p., incl 4 figs. NAFEC, Atlantic City, N.J.
ASTIA: AD 287658, Code AA. Unclassified

This report briefly describes some of the tasks and stud-
ies conducted at National Aviation Facilities Experi-
mental Center, which may be of interest to the Air Force.

10-33

**ESD-TDR-62-33. SAGE/BIRDIE AN/GSG-6 INTEGRA-
TION REPORT.** 15 Apr 62, 61p., 34 figs., 2 Parts. C:
AF19(600)39852, MITRE Corp., Bedford, Mass. ASTIA:
AD 332001L, Code MD. Secret

This report contains the results of the SAGE/AN/GSG-6
integration test in the NOADS sector with the Turner
Anti-Aircraft Defense. The primary objective was to
verify the compatibility of equipment and operator pro-
cedures in the SAGE/AN/GSG-6 system.

10-34

**ESD-TDR-62-34. SAGE/BIRDIE AN/GSG-5 INTEGRA-
TION REPORT.** 30 Aug 1962, 101p., 30 figs., 2 Parts.
C: AF19-(600)39852, MITRE Corp., Bedford, Mass.
ASTIA: AD 332002L, Code MD. Secret

This report contains the results of the SAGE/AN-GSG-5
integration test in ESS with the Hartford/Bridgeport Air
Defense Area. The primary objective was to verify the

compatibility of equipment and operator procedures in
the SAGE/AN/GSG-5/NIKE system.

10-37

**ESD-TDR-62-37. ABSOLUTE JUDGMENTS OF VELOC-
ITY.** May 1962, 13p. G. P. Ganem. ASTIA: AD 278397,
Code AA. Unclassified

The present study was conducted to determine the max-
imum amount of information transmitted by observers in
the absolute judgment of velocity. The study was sub-
divided into a series of five experiments in which 2, 4,
7, 10 or 19 sweep velocities of a 4½ inch cathode ray
tube—ranging from .70 inches per second to 300 inches
per second (3.90° per second to 1688.70° per second of
visual angle)—were presented to four subjects who were
required to identify the stimuli with numbers ranging
from 1 to 19.

An information analysis indicated that as the amount
of stimulus information was increased the amount of
transmitted information also increased, but at a decreas-
ing rate, until a maximum of 2.23 bits of information was
transmitted.

Although anchoring effects occurred at both ends of
the stimulus continuum, the low velocities were more
accurately identified than were the high velocities.

10-39

**ESD-TDR-62-39. THE LINEAR ERROR ANALYSIS OF
A DIFFERENTIAL CORRECTION PROCEDURE.** Nov
1961, 36p. incl 3 Appendices. C: AF-19(604)8041, RCA.
Milton Grossberg. ASTIA: AD 278266, Code AA.
Unclassified

The differential correction procedure used for astrody-
namical data reduction is shown to be a method of solu-
tion of the unweighted least squares problem. A formula
for the covariance matrix of the parameters estimated by
this procedure is then found, by considering the gener-
alized least squares problem. It is shown that this
matrix has a larger determinant than does the matrix ob-
tained by solving the rigorous least squares problem.

10-40

**ESD-TDR-62-40. A TIME SERIES ANALYSIS OF RADAR
OBSERVATIONS OF SATELLITES.** Mar 1962, 26p. incl
11 graphs. C: AF-19(604)8079, RCA, Burlington, Mass.
A. Arcese. ASTIA: AD 277941, Code AA. Unclassified

A time series analysis was performed on observations
from satellite 59, Epsilon I, pass 3319. They were fitted
by a trend and autoregressive scheme and the covariance
matrix of the residuals were obtained. Fitting the ob-

servations in time by a trend and autoregression scheme better described the process than trend fitting alone. This gave rise to independence between the observations. It can be shown that best estimators for predicting orbital elements can be obtained with independent estimators of the observations that describe the process.

10-41

ESD-TDR-62-41. SCOPETRACE. May 1962, 6p., tables. AFSC P: 2806, T: 280607. J. R. Hayes. ASTIA: AD 283383, Code AA.   Unclassified

A computer program for the Digital Equipment Corporation PDP-1 computer, but applicable in principle to other computers, is described. The program is designed to facilitate the debugging of object programs by providing a geometrical representation of the operation of the object program.

10-44

ESD-TDR-62-44. LONG-RANGE ORBITAL ELEMENT SYSTEM AND ITS APPLICATION TO RECOVERY OF SATELLITE 1960 IOTA 4. 22p., incl 3 figs., 20 Nov 1961. C: AF19(604)8427, North American Aviation, Inc. ASTIA: Code XX.   Unclassified

In this report factors considered in the development of a long-range orbital element scheme are discussed. A new parameter-Nodal Revolutions of the Mean Satellite—is proposed as a solution to this problem.

10-48

ESD-TDR-62-48. HUMAN DATA PROCESSING LIMITS IN DECISION MAKING. July 1962, 50p., incl figs., tables, 8 refs. AFSC P: 2806, T: 280603. J. R. Hayes. ASTIA: AD 283384, Code AA.   Unclassified

Four experiments are described in which subjects were required to choose among alternatives on the basis of two, four, six, or eight relevant facts. Both decision quality and decision time were measured. Presenting more than four facts caused a decrease in decision making efficiency.

10-55

ESD-TDR-61-55. A QUASI-RANDOM SEQUENCE FOR MEMORY EXPERIMENTS. Nov 1961, 9p. AFSC P: 9674, T: 967406. R. S. Nickerson and C. R. Brown. ASTIA: AD 284784, Code AA.   Unclassified

A method is presented for constructing sequences with properties which make them useful in ordering stimuli for recognition memory experiments. A main feature of the method is the facility for controlling and efficiently manipulating the number of items occurring between the initial and subsequent occurrences of given items.

10-114

ESD-TDR-62-114. RADAR TECHNIQUES STUDY AND SIGNAL PROCESSING FOR TARGET DISCRIMINATION. 30 June 1962, 63p. C: AF19(604)7400, Lincoln Lab, Lexington, Mass. ASTIA: AD 331241, Code AA. Secret

This report covers phases of various fields such as: Radar, Varactor Studies, Radiometry, Target Discrimination and AMRAD Development, also experiments at Wallops Island.

10-116

ESD-TDR-62-116.   RADIO PHYSICS - QPR.   15 July 1962, 9p., plus introduction. C: AF19(628)500, Lincoln Lab, Lexington, Mass. ASTIA: AD 283035, Code AA.
                                              Unclassified

A Quarterly Progress Report on Solar Radar Studies, Launch Phase Studies, Radar Astronomy, Lunar Radar Studies, Elf Noise Observations Comm and Detection Theory, and Antennas.

10-117

ESD-TDR-62-117. OPTICAL OBSERVATIONS OF LINCOLN LAB. HYPERSONIC RE-ENTRY VEHICLES TRAILBLAZERS 1c & 1d. 16 May 1962, 19p., ref., 12 figs. C: AF19(604)7400, Lincoln Lab., Lexington, Mass. Sec Rpt 312G-7. F. A. Wilson, J. B. Bauer. ASTIA: AD 283416, Code AA.   Unclassified

Two Trailblazers I vehicles were fired from Wallops Island, Va. within a 3 hour period. The first vehicle, Trailblaze 1c, photographed between the heights of 152 KFT & 119 KFT. The reentry velocity computed from a Super Schmidt photograph, was about 19 KFT/Sec. No radar data were obtained for the re-entries of 1c and 1d.

10-118

ESD-TDR-62-118.   RE-ENTRY PHYSICS & PROJECT PRESS PROGRAMS. 30 June 1962. 4 Parts. C: AF-19(604)7400, Lincoln Lab., Lexington, Mass. ASTIA: AD 283478, Code AA.   Unclassified

This report is divided into 4 parts. Part I: Introduction and Summary. Part II: Hypervelocity Ballistic Range, Experiments and Wake Plasmas. Part III: Experimental Program at Wallops Island. Part IV: The PRESS Program.

10-119

ESD-TDR-62-119. SOURCES OF ERROR IN MICROWAVE TRANSMISSION MEASUREMENT OONIZED TRAILS. 3 July 1962, 75p., plus 19 figs. C: AF19(628)-500, MIT, Lincoln Lab., Lexington, Mass. C. Bressel, G. H. Price. 312G-10. ASTIA: AD 283563, Code AA.
                                              Unclassified

This report summarizes investigations performed in the period June through August, 1961 to determine the error present in the determination of electron distribution in

the trail of a pellet by means of microwave transmission and reflection measurements.

10-120

ESD-TDR-62-120. QUARTERLY PROGRESS REPORT - SYSTEMS, 15 Aug 1962, 8p. C: AF19(628)500, MIT, Lincoln Lab., Lexington, Mass. ASTIA: AD 283494, Code AA. Unclassified

This report reviews progress during the period 1 May 1962 through 31 July 1962 for the Command Control Information System (CCIS) Program and is also the final progress report on the CCIS.

10-121

ESD-TDR-62-121. A NOTE ON THE MULTIPLE ZEROS OF RANDOM POLYNOMIALS. 3 Aug 1962, 5p. C: AF-19(628)500, Lincoln Lab., Lexington, Mass. J. Fogarty. ASTIA: AD 283777, Code AA. Unclassified

The behavior of many physical systems is governed by linear differential or difference equations with constant coefficients. The solution of these equations generally requires two steps, the first step deals with algebraic equations and the second one with differential equations.

10-125

ESD-TDR-62-125. GENDARE (A GENERALIZED DATA REDUCTION SYSTEM). 22 Jan 1962, 133p., incl 5 chapters. C: AF19(604)7400, Lincoln Lab., Lexington, Mass. J. B. Williams, M. M. Marill. Sec Rpt TR-241. ASTIA: AD 284041, Code AA. Unclassified

This report contains design specifications for the GENDARE SYSTEM, a computer programming system that provides data reduction services easily and cheaply when large volumes of serial-access data are to be processed.

10-126

ESD-TDR-62-126. TIME OPTIMAL VELOCITY CONTROL OF A SPINNING SPACE BODY. 6 Sept 1962, 36p., incl illus. C: AF19(628)500, Lincoln Lab., Lexington, Mass. M. Athanassiades, P. L. Falb. ASTIA: AD 284207, Code AA. Unclassified

The controlled system is a body in space with a single axis of symmetry. Gas jets, with limited thrust, are used as controls. It is desired to determine controls which maintain a given velocity about the axis of symmetry and drive the velocities about the other 2 axes to zero in minimum time.

10-127

ESD-TDR-62-127. MAGNETISM AND CRYSTAL STRUCTURE IN NONMETALS. 24 Apr 1962, 42p. C: AF19-(604)7400, Lincoln Lab., Lexington, Mass. J. B. Goodenough. Sec Rpt No. 267. ASTIA: AD 284300, Code AA. Unclassified

The magnetic properties of matter are primarily determined by crystal structure and the number of outer electrons on the metal atoms. There is a discussion of the collective-electron and localized-electron descriptions which are two of the most widely used.

10-128

ESD-TDR-62-128. RADAR - QPR. 15 Aug 1962, 19p. C: AF19(604)7400, Lincoln Lab., Lexington, Mass. ASTIA: AD 331639, Code AA. Confidential

This report covers phases of Radar, Radar Receivers, Radar Transmitters, and Ground Radar Systems.

10-129

ESD-TDR-62-129. ERROR PROBABILITIES FOR ADAPTIVE MULTICHANNEL RECEPTION OF BINARY SIGNALS. 23 July 1962, 57p., 2 figs., incl App A-B-C. C: AF19(628)500, Lincoln Lab., Lexington, Mass. R. Price. Sec Rpt TR-258. ASTIA: AD 284651, Code AA. Unclassified

One major conclusion of the study is that the error probability does not depend directly on the signal strengths or phase shifts in the various channels, but is, instead, a function of the total average power received over all channels, exclusive of the noise.

10-130

ESD-TDR-62-130. MOVEMENT OF MILITARY CENTERS AS A SAFEGUARD AGAINST NUCLEAR ATTACK— PART II. 12 June 1962, 57p., incl 5 tables. C: AF19-(604)7400, Lincoln Lab., Lexington, Mass. J. H. Halberstein. Sec Rpt 22G-1. ASTIA: AD 285044, Code AA. Unclassified

Frequently it is proposed to move centers from one location to another at short intervals as protection against such attacks. This report shows it is possible to minimize the operation loss by judicious choice of the time of operation.

10-131

ESD-TDR-62-131. PROJECT 861 ORBIT PROGRAMS. 31 Aug 1962, 58p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. A. A. Mathiasen, W. R. Crowther. Sec Rpt 21G-4. ASTIA: AD 285045, Code AA. Unclassified

In the project 861 system a radar will make observations on the Project 861 orbit and record these on magnetic tape. The Coordinate Conversion program and the Orbit Fitting program are described in this report.

10-132

ESD-TDR-62-132. PROJECT 861 COMPUTER PROGRAM SYSTEM AUXILIARY PROGRAMS AND TECHNIQUES. 6 Sept 1962, 23p., incl ref. C: AF19(604)7400,

Lincoln Lab., Lexington, Mass. J. D. Drinan, A. A. Mathiasen. Sec Rpt 21G-3. ASTIA: AD 285046, Code AA. Unclassified

A system of computer programs was implemented for orbit computation and antenna pointing. The major programs are reported in various individual memoranda. A group of auxiliary programs and a variety of special data-handling techniques were developed and are herewith reported.

10-133

ESD-TDR-62-133. INFORMATION PROCESSING - QPR. 15 Sept 1962, 12p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. ASTIA: AD 285165, Code AA.

Unclassified

Contains studies on Digital Computers, Information Proccessing, Computer Design and Development and Magnetic Film Engineering. Also studies Psychology of Automatic Speech and Speaker Recognition, Automatic Language Processing and Human Information Processes.

10-134

ESD-TDR-62-134. SOLID STATE RESEARCH. 21 Sept 1962, 70p., 9 parts incl figs. C: AF19(628)500, Lincoln Lab., Lexington, Mass. ASTIA: AD 285456, Code AA.

Unclassified

This report contains work on the following: Solid State Device Design, Chemistry, Materials Research, Band Structure of Solids, Microwave and Magnetic Properties of Solids. Film Physics, UHF Transistor Developments.

10-135

ESD-TDR-62-135. AMPLITUDE AND PHASE DEVIATION IN WAVEGUIDES WITH SHUNT DEVICES. C: AF19(604)7400, Lincoln Lab., Lexington, Mass. Sec Rpt 46G-1. A. H. Kessler. ASTIA: AD 285628, Code AA.

Unclassified

This report examines the transmission coefficient of a system that consists of a waveguide with discrete linear devices situated along its length. Scattering and transmission matrices are the usual straight forward methods used.

10-136

ESD-TDR-62-136. LINCOLN LABORATORY LIBRARY - 13th REFERENCE BIBLIOGRAPHY - SOVIET BOOKS ON RADIOTECHNOLOGY AND ELECTRONICS IN 1962. 4 Sept 1962, 44p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. ASTIA: AD 285491, Code AA.

Unclassified

This report is a translation of the Russian book - Radiolekhnika i Elektronika, Vol. 7, No. 4 1962.

10-137

ESD-TDR-62-137. PROJECT 861 COMPUTER PROGRAMMING SYSTEM; Mathematical Analysis for Computation of Radar Pointing Data. 14 Sept 1962, 46p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. Sec Rpt 21G-2. ASTIA: AD 268547, Code AA. Unclassified

A system of computer programs for antenna pointing was designed and implemented. The required mathematical analysis was performed.

10-138

ESD-TDR-62-138. FOUNDATIONS OF A THEORY OF ALGEBRAIC CODES PART I: Local Theory. 20 Sept 1962, 19p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. S. S. Shatz. Sec Rpt 52G-4. ASTIA: AD 286548, Code AA. Unclassified

Error correcting codes are studied from a new point of view. The aim was to find a set of foundations for the theory of error correcting codes which would make this theory appear more like the usual algebraic theories occurring in mathematics. Affine precode is defined.

10-139

ESD-TDR-62-139. FOUNDATIONS OF A THEORY OF ALGEBRAIC CODES PART II: Global Theory. 20 Sept 1962, 20p. C: AF19(628)500, Lincoln Lab., Lexington, Mass. S. S. Shatz. Sec Rpt 52G-4. ASTIA: AD 286546, Code AA. Unclassified

Definition of precodes, and the category of precodes. Corollary: Every separated precode contains a code, and this code is maximal with respect to domination.

10-140

ESD-TDR-62-140. DEPOSITED CONNECTIONS AND WIRING. 7 Sept 1962, 45p., incl 31 figs. C: AF19-(628)500, Lincoln Lab., Lexington, Mass. E. A. Guditz. Sec Rpt 54G-3. ASTIA: AD 286545, Code AA.

Unclassified

Deposited connections and wiring are evaluated following application of the technique to various prototype electronic-computer equip. The process has been used chiefly in multi-layer transmission-line wiring and in pluggable circuit packages. The former has been successful.

10-159

ESD-TDR-62-159. DISTANT EARLY WARNING SYSTEM DEW EAST SEGMENT LATERAL COMMUNICATIONS SYSTEM EVALUATION REPORT. Feb 1962. C: AF19(600)36660, WECO, New York 13, N.Y. ASTIA: AD 283831, Code AA. Unclassified

10-191

ESD-TDR-62-191. THE CONCEPT OF AN AUTOMATED PSYCHOLOGICAL LABORATORY. July 1962, 16p. incl table. AFSC P: 9670 & 2806, T: 967011 & 280607. Charles R. Brown, John R. Hayes, William H. Sumby. ASTIA: AD 285610, Code AA. Unclassified

The concept of an automated psychological laboratory is discussed. A small, expandable, digital computer will be the nerve center of such automation. The advantages gained from the realization of the concept are discussed in detail.

10-209

ESD-TDR-62-209. PHOTOGRAPHIC TRACKING OF ARTIFICIAL SATELLITES WITH A K-37 AERIAL CAMERA. 15p., plus 6 figs. C: AF61(052)295, U. of Padova Asiago, Italy. Augusto Mammano. ASTIA: Code XX. Unclassified

Two methods of photographic recording are described, one with a fixed camera and the other with a moving film. Concerning the latter method, a procedure is given for the rapid calculation of any satellite's angular velocity relative to the observer.

10-211

ESD-TDR-62-211. INITIAL ORBIT DETERMINATION FROM INDEPENDENT OBSERVATIONS OF SATELLITE POSITION. Tech rpt., July 1962, 42p., incl diagrams, tables. C: AF19(604)7375, Aeronutronic Div. of Ford Motor Co., Newport Beach, Calif. J. E. Evans. SRN: U-1758. ASTIA: AD 286346, Code AA. Unclassified

A computer program has been developed to compute initial satellite orbits from two or more independent observations of satellite position which may be separated in time by up to two days. The technique combines other observations with the initial elements by means of a differential correction scheme to obtain a corrected initial orbit.

10-214

ESD-TDR-62-214. DISPLAY COLOR CODING FOR A VISUAL SEARCH TASK. June 1962, 13p., plus 4 figs., incl Appendix & Ref. C: AF33(600)39852, MITRE Corp., Bedford, Mass. S. L. Smith. Rpt. No. 7. ASTIA: AD 283971, Code AA. Unclassified

This report describes the results of an experimental study of the effects of display color coding on visual search time. Twelve subjects each viewed a series of 300 displays, which varied in display density, in number of colors used, in the particular color of the target with either a white or black background, under conditions where the subject either knew the color of the target in advance, or did not.

10-216

ESD-TDR-62-216. AIRFIELD OBSERVING SUBSYSTEM. 15 May 1962, 8 parts incl figs. C: AF19(626)16, United Acft. Corp., E. Hartford, Conn. ASTIA: AD 283923, Code AA. Unclassified

The increased requirements and present capability for making and reporting airfield observations have been considered in order to determine the improvements that are necessary.

10-217

ESD-TDR-62-217. SURVEY OF HIGH SPEED DATA COMMUNICATIONS. 22 June 1962, 5 parts incl tables. C: AF19(626)-16, United Acft. Corp., E. Hartford, Conn. ASTIA: Code XX. Unclassified

Result of preliminary investigation of techniques available for High-Speed Transmissions on large volumes of digital data.

10-218

ESD-TDR-62-218. TED: A Tape Editor. Sept 1962, 9p. AFSC P: 2806, T: 280604. C. R. Brown. ASTIA: AD 285472, Code AA. Unclassified

The principle and operation of a utility program for the PDP-1 computer are described. The program is an aid in the editing of modification of alphanumeric text in that the operator may communicate with the computer in the very alphanumerics of the text itself. It is a computer time-saver in that the modifications and the control instructions for their accomplishments may be prepared at an inexpensive, off-line machine.

10-283

ESD-TDR-62-283. ADVANCED DEVELOPMENT SUBDEPARTMENT. 31 Mar 62, 55p., incl 29 figs. C: AF 19(600)39852, MITRE Corp., Bedford, Mass. Sec Rpt PM22-#12. ASTIA: Code XX. Unclassified

During the quarter the experimental radar program was pursued with increased emphasis. All available resources were marshaled to bring the radar to an early operative status.

10-285

ESD-TDR-62-285. ADVANCED DEVELOPMENT SUBDEPARTMENT, DEPARTMENT D-22. 1 Apr 1962-30 June 1962, 48p., incl 25 figs. C: AF19(600)39852, MITRE Corp., Bedford, Mass. Sec Rpt PM22- ASTIA: AD 289383, Code AA. Unclassified

This report deals with Experimental Radar, E1 - A2 Mounts, Antenna Servo Systems, Receivers and Final Amplifier Assembly.

10-286

ESD-TDR-62-286. ORBITAL INTERSECTION PRO-
GRAM. May 1962, 55p., 14 figs. incl App. C: AF19-
(604)7375, Aeronutronic, Newport Beach, Calif. R. G.
Schinwerer. ASTIA: AD 286968, Code AA. Unclassified

The problem considered is that of determining the point
in position-time space where two orbits intersect.

12-2a

RADC-TR-62-2. **SPACE, TIME, RELATIVITY, AND COSMOLOGY.** Mar 1962, 248p. incl illus. C: AF 30 (602)-2521, Franklin Inst. Labs. for Research and Dev., Philadelphia 3, Pa. W. F. G. Swann. SRN: FI Rpt. F-B1859. ASTIA: AD 281922, Code AA.   Unclassified

This report attempts to clarify the meanings attached to the basic subject matter. Our concern with scientific theories is to the "how" of nature rather than the "why." Do relativistic phenomena have a practical significance to mankind? It is not likely. But, in atomic and cosmic ray phenomena we are concerned with speeds close to those of the velocity of light, and we might also perform an experiment with clocks which verges on the possibility of realizing a relativistic effect. More important, these concepts provide an understanding of space and time which play a role in almost everything we do.

Section 2 covers the concepts of space and time, the 3 dimensionality of space, the fundamentality of events, and the significance of experiments. In Section 3 we delve into the restricted theory of relativity, the Lorentz-Einstein transformation, and several of the apparent paradoxes which arise from these concepts, while in Section 4 we touch on space and time in relation to the general theory of relativity.

12-5

RADC-TDR-62-5, ADVANCED RECOGNITION-IDENTIFICATION TECHNIQUES EMPLOYING ULTRAVIOLET RADIATIONS. Final Rpt, 30 Aug 1962, 288p. incl illus. P: 5556, T: 555601. C: AF 30(602)-2274, HRB-Singer, Inc., State College, Pa. ASTIA: Code XX.   Secret

12-85

RADC-TDR-62-85. **FD RADAR RECEIVING SYSTEM RESPONSE VS TDDL OUTPUT SPECTRUM.** 8 Jan 1962, 79p. incl illus., tables. C: AF 30(602)-2445, HRB-Singer, Inc., State College, Pa. Fred A. Scheihing. SRN: 289.2F. ASTIA: Code NC.   Secret

Measurement Methods and Resulting Data are presented for tests performed on the AN/FPS-35, AN/FPS-24, and AN/FPS-28, Frequency Diversity Radar Receiving Systems. An analysis of Receiving System Interference caused by a collocated TDDL Transmitter Environment is also presented.

12-90

RADC-TDR-62-90, DYNAMIC COUPLING, OF MICRO-WAVE POWER WITH SHOCK PRODUCED PLASMAS. 13th Tech Note, June 1962, 12p. incl illus. P: 5561, T:

55209. C: AF 30(602)-1968, General Electric Space Sciences Lab., Syracuse, N.Y. G. W. Bethke, E. D. Frohman, A. D. Ruess. SRN: R62SD60. ASTIA: AD 282751, Code AA   Unclassified

Experiments using a two-inch shock tube to investigate the coupling of microwave power with a shock-produced plasma are described, and the results discussed.

Using medium microwave power levels, most of the microwave energy appears to be absorbed by the plasma. It was also found that the RF-enhanced electron cloud is still evident 270 microseconds after the power is turned off.

When the X-band microwave power is above some critical value, an RF-generated plasma detaches from the shock front and travels down the tube at a higher speed than the shock-produced plasma. The velocity of this "runaway" plasma is quite sensitive to the RF power level and was readily made too fast to measure.

12-116

RADC-TDR-61-116, HIGH POWER PULSE SWITCH TUBE. Aug 16, 1961, 54p. incl illus. C: AF 30(602)-2027, Nuclear Corp. of America, Denville, N.J. B. Bernstein, J. Glauber, H. Koch. ASTIA: AD 268338, Code AA.   Unclassified

The design of a 45 megawatt tetrode switch tube with water cooled grids, water cooled anode and matrix cathode is described. The choice of the matrix type cathode was made after consideration was given to all other popular types.

Preliminary experiments which led to the final assembly method are described.

The calculation of the tube characteristics is explained in detail. Drawings and sketches of the various parts, sub-assemblies and assemblies are included.

A simplified proposed design is mentioned.

12-118

RADC-TDR-62-118, HIGH POWER ANTENNA DESIGN. 12th Tech Note, June 1962, 18p. incl illus. P: 5561, T: 55209, 55184. C: AF 30(602)-1968, General Electric Co., Syracuse, N.Y. ASTIA: AD 331375, Code AA.   Secret

Design details of lenses for the broadside antenna are presented, and lens sealing problems are discussed. Radiation patterns and VSWR from tests are included. Associated microwave circuitry is described. Final design of the 45° antenna is discussed.

12-124

**RADC-TDR-62-124, SPECTRUM SIGNATURE OF RADAR
SET AN/FPS-20.** Final Rpt, Oct 1962, 168p. illus.,
tables. AFSC P: 4540, T: 454001. C: AF 30(602)-2536,
Order No. 2, Bendix F. E. Corp., T: 77314-03. ASTIA:
Code XX.   Unclassified

This report is made up of three sections, the collection
of data of the radar transmitter, receiver and antenna to
be used as an input to the DOD Analysis Center, spec-
trum signatures library. The task outlined in this report
has been performed and data submitted in accordance
with the requirements outlined in DODMCPSS, (Revised
1 Sept 1961)

12-136

**RADC-TDR-62-136, PASSIVE SPHERICAL SATELLITE
COMMUNICATIONS STUDY.** Final Rpt, Mar 1962, 360p.
incl illus. P: 4519, T: 55097. C: AF 30(602)-2222, Gen-
eral Electric Co., Defense Sys. Dept., Syracuse, N.Y.
SRN: DSD-ASER 6-62. ASTIA: AD 282713, Code AA.
                                    Unclassified

This report is the last in a series of technical notes
written to establish the feasibility aspects of a passive
satellite communications system. An analysis has been
made of the various methods that can be used to estab-
lish such a system. The interrelationships of the orbit,
ground sites, equipment considerations, and network
logic are delineated. It is concluded that many of the
details of analysis can be answered only when an oper-
tional configuration has been selected. There are, how-
ever, no technical reasons that precluded the establish-
ment of a communications system utilizing passive
spherical satellites and delivering useful bandwidths
within practical equipment limits.

12-137

**RADC-TDR-62-137, TARGET ACCURACY EXPERI-
MENT.** Feb 1962, 139p. incl illus. C: AF 30(602)-2084,
Smyth Research Associates, San Diego 23, Calif. SRN:
SRA-242. ASTIA: AD 276543, Code AA. Unclassified

The advent of the artificial earth satellites has made
possible the experimental investigation of the electro-
magnetic properties of the cis-lunar space. The effect
of the earth's atmosphere on one's ability to locate, by
radio means, an object in this space is the subject of
the reported investigation. Signals originating in both
artificial earth satellites and radio stars have been re-
viewed through the distorting atmospheric medium, and
analyses performed to define the observed distortions as
a function of space, frequency and time.

The apparent positions of the earth satellites, determined
by a vertically based interferometer indicated, in general,
bending effects much larger than would be expected from
standard atmospheric prediction. Other interesting fea-
tures of the data which were given attention were: (1)

Pre-rise or post-set radio signals (precursors) probably
associated with tropospheric ducting, (2) Periodicities
in null scintillation and (3) Faraday rotation effects ob-
served strongly on the low-frequency transmissions.

12-138

**RADC-TDR-62-138, STEERABLE ANTENNA FOCUSING
INVESTIGATION (STAFT).** Tech Note No. 7, 15 Mar
1962, 74p. incl illus., 4 refs. AFSC P: 4506, T: 450604.
C: AF 30(602)-2297, Electronic Communications, Inc.,
Research Div., Timonium, Md. ASTIA: Code XX. Secret

This technical note covers an investigation concerning
the focusing of large steerable antennas, in particular
the self-focusing of array type antennas. The Linear
Focusing Antenna Model (LFAM) was equipped with a
radome for cold weather operations, and an improved tar-
get tower was built. The LO source for the test receiver
was improved and a phase stable reference signal distri-
bution system is in construction. An array amplitude
distribution monitor is in design. Under the test program,
pattern data are given on self-focusing near the inner
Fresnel zone boundary, on the Fresnel zone field with
uniform illumination, and on very wide angle tracking of
a self focusing array. In the Engineering Investigation
results are given on generation and control of annular
ring patterns, on the possibility of generating such pat-
terns through the element pattern, on optimum aperture
distributions and on the problem of thinning out large
arrays.

12-140

**RADC-TDR-62-140, ECCM TEST OF RADAR SET AN/
FPS-27(XW-1) CAPTIVE JAMMER TESTS.** Nov 1961,
121p. incl illus. P: 1978, T: 45605. C: AF 30(602)-
1511, Westinghouse Electric Corp., P.O. Box 1897,
Baltimore 3, Md. SRN: 86-3345-62. ASTIA: Code NC.
                                    Secret

12-141

**RADC-TDR-62-141, THE INVESTIGATION OF RECOG-
NITION AND ANALYSIS TECHNIQUES.** Final Rpt, 26
Mar 1962, 200p. incl illus., 14 refs. P: 4506, T: 49776.
C: AF 30(602)-2359, Radio Corp. of America, Missile &
Surface Radar Div., Moorestown, N.J. SRN: MO-S-805.
ASTIA: Code NC.   Secret

The Radio Corporation of America, under its contract for
the Investigation of Recognition and Analysis Tech-
niques (IRT), has developed an extremely promising new
method of identifying satellites having angular motion
with respect to an observing radar. This approach, called
the inverse scattering analysis, uses a record of echo
cross-section and echo phase versus aspect angle as an
input to a computer program to produce a pictorial view
of the body profile and the location of its center of ro-
tation. The inverse scattering analysis approach has

revealed that the target-induced phase scintillation furnishes an invaluable characteristic signature. The inverse scattering solution is derived in this report. The report also describes experiments by which the validity of the inverse scattering analysis method was confirmed by actual measured data.

The successful demonstration of the inverse scattering analysis approach as a means toward automated target recognition suggests the desirability of some means of extracting radar target cross-section in real time. The accuracy of the results obtained from the integration of an analog computer with an AN/FPQ-4 radar indicated that the analog technique for computing radar cross-section is definitely compatible with the present art of target analysis and confirmed its usefulness in recognition analysis.

In an extension of the IRT contract, RCA successfully demonstrated the feasibility of using C-band precision range instrumentation on type tracking radars for satellite tracking and target recognition.

12-142

RADC-TDR-62-142, (U)SATELLITE TRACKING EXPERIMENT. Final Rpt, 26 Mar 1962, 166p. incl illus. P: 4506, T: 49776. C: AF 30(602)-2359, RCA, Defense Electronic Prod., Missile & Surface Radar Div., Moorestown, N.J. SRN: MO-S-813. ASTIA: Code NC. Secret

12-143

RADC-TDR-62-143, SUMMARY OF PROGRESS IN GENERAL LINEAR NETWORKS. 12 Jan 1962, 35p. P: 8505, T: 85014. C: AF 30(602)-2213, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. L. I. Smilen. SRN: PIBMRI 988-62. In OTS. ASTIA: AD 278463, Code AA. Unclassified

This report is a presentation of the research in network theory and practice with emphasis on unconventional techniques and circuit elements carried out for lumped, distributed, and active systems during the time interval from Oct 60 to Oct 61. The results reported in active network theory include a general synthesis method for the most general, rational, n X n immittance matrix. Methods for the synthesis of broadband solid state amplifiers are described. Various results in distributed parameter network theory are given and methods for their application to microwave filter theory are discussed.

The research has shown how many of the network concepts known for lumped parameter and passive systems can be extended to the domain of microwave and active networks. This in turn has lead to the solution of several theoretical, as well as practical, problems at microwave frequencies.

12-149

RADC-TDR-62-149, DEVELOPMENT OF AN/GRR-9(XW-1). Final Rpt, 1 Mar 1962, 43p. incl illus. C: AF 30-

(602)-1894, American Electronic Lab., Inc., Richardson Road, Colmar, Pa. Kenneth E. Walker. ASTIA: Code XX. Unclassified

This report covers the development of a superheterodyne panoramic receiver continuously covering the frequency range of 1 to 10 kmc in four bands at a rate of 15 or 60 times per second. IF frequency is 30 mc. No image rejection was incorporated. Four systems, each of which included a set of four dismounted antennas, were fabricated. CW sensitivities up to -95 dbm were achieved on 1- to 2-kmc and 2- to 4-kmc bands. Crystal-current leveling was found to be required in order to obtain sensitivity uniform to 3 db across each band. Sensitivity to pulse signals is affected by intercept probability, and is generally 6-db less.

12-150

RADC-TDR-62-150, COMPRESSION SCANNING ARRAY TECHNIQUES (COSAR). Quarterly Prog Rpt No. 2, 20 July 1962, 112p. incl illus. & tables. P: 4506, T: 450604. C: AF 30(602)-2567, Raytheon Co., Bedford, Mass. SRN: BR-1593. ASTIA: AD 330158, Code AA. Secret

12-161a

RADC-TDR-61-161, UTILIZATION OF DIGITALLY STORED STEREO DATA. Final rpt, 20 Sept 1962, 198p. incl illus. P: QRC 144 I. C: AF 30(635)-19455, Autometric Corp., 1501 Broadway, New York, N.Y. SRN: CR 41-FR. ASTIA: Code XX. Unclassified

This report describes the results of a study program conducted for the purpose of exploring and outlining the potential applications of digitally stored stereo data as output by an automatic double projection stereo plotter in terms of both conventional photogrammetric methods and more unconventional means. In addition, an exploration into other sources of digitized data was made and uses evolved for these mediums. The outcome of programming investigation studies is included. The studies discuss computers properties and how these affect the computer's usefulness, in regard to the requirements of stereo problems. In instances where the nature of computers and stereo problems conflict, recommendations are outlined to reduce these conflicts to the realm of feasibility.

A foundation has been laid for a library of programs in the form of eleven basic solutions which conform to the findings of the programming investigation study. These programs are designed so that, when used individually or in combination, they fulfill the major computational requirements for any given use.

12-164

RADC-TDR-62-164, TECHNIQUES FOR THE SUPPRESSION OF SPURIOUS ENERGY. Final Rpt, Mar 1962, 67p. incl illus. SRI P: 3478. C: AF 30(602)-2392, Stanford Research Inst., Menlo Park, Calif. L. Young, E. G.

Cristal, E. Sharp, and others. In OTS. ASTIA: AD 278-719, Code AA.   Unclassified

This final report summarizes the results obtained on high-power filter techniques to suppress the radiation of spurious frequencies from high-power sources.

The filters described cover the HF, VHF, UHF and microwave frequency bands. Design principles were described in 6 separate technical notes: in some cases new design concepts were presented. At least one filter in each band was constructed and experimental results for all of them are given. A harmonic power sampler developed at SRI was used to measure the harmonic content in the power output of the Eimac X-812 klystron.

Spurious energy and signal distortion that can be generated in a klystron transmitter were investigated under sub-contract to Eitel-McCullough, Inc. Particular attention is devoted to harmonic generations, mutual intermodulation between two transmitters, and long-line distortion in FM transmitters.

12-168

RADC-TDR-62-168, SPECIAL MODULATION STUDIES Final Rpt, 22 Mar 1962, 108p. incl illus. C: AF 30(602)-2432, The Bissett-Berman Corp., 2941 Nebraska Ave., Santa Monica, Calif. SRN: C7-3. ASTIA: Code XX.
Secret

12-171 (Suppl I)

RADC-TDR-62-171, Supplement 1, AN EVALUATION OF SPEECH COMPRESSION SYSTEMS. Interim Rpt, 1 Mar 1962, 7p. P: 4519, T: 45350. C: AF 30(602)-2235, Bolt Beranek and Newman, Inc., Cambridge, Mass. K. N. Stevens, M. H. Hecker, K. D. Kryter. SRN: BBN Rpt No. 914. ASTIA: Code NC.   Confidential

12-174

RADC-TDR-62-174, FUSED QUARTZ INVESTIGATION. Final Rpt, Mar 1962, 131p. incl illus., tables, 13 refs. P: 4506, T: 45359. C: AF 30(602)-1745, Englehard Ind. Inc., Amersil Quartz Div., 685 Ramsey Ave., Hillside, N.J. E. C. Mutschler. ASTIA: Code XX.   Unclassified

A plan of investigation is outlined by which testing methods could be developed for predicting the suitability of fused quartz blanks for high-performance, folded delay lines. A theoretical basis is derived for the use of the resonant frequency of free, flexural vibration to determine the elastic constants of fused quartz discs. The flexural vibration setup is described and the results are tabulated. Several ultrasonic and optical testing methods are also described. Results of these tests on 30 sample delay line blanks are also given. Plans for proving out the testing methods are outlined. These include the fabrication of delay lines from the samples and correlation of measured delay line parameters with the results from the various testing methods.

12-177

RADC-TDR-62-177, (U)SATELLITE RECOGNITION MANUAL. 19 Mar 1962, 170p. incl illus. C: AF 30(602)-2359, RCA, Aerospace Communications & Controls Div., Burlington, Mass. SRN: CR 588-60-S-5. ASTIA: Code NC.   Confidential

This Satellite Recognition Manual has been written to instruct personnel at the technician level with the art of manual pattern recognition as applied to satellites. The physical laws which determine the path of an earth satellite and the rotational motion of such a satellite about its center of mass are discussed. A procedure is described for obtaining calibrated radar cross-section signals from a monopulse radar system. The meaning of the radar cross section of a target is explained, curves of radar cross section versus aspect angle for some simple-shape objects is presented, and the time history of the radar cross section of bodies of known shape in prescribed orbits are shown for a radar sensor located on the surface of the earth. Finally, a technique is given for recognizing the size and shape of earth satellites from the time history of their radar cross section.

12-178

RADC-TDR-62-178, CROSS-SECTION ANALOG COMPUTER MANUAL. 26 Mar 1962, 72p. incl illus., 11 refs. P: 4506, T: 49776. C: AF 30(602)-2359, RCA, Defense Electronic Prod., Missile & Surface Radar Div., Moorestown, N.J. H. Scheuer. ASTIA: Code NC.
Unclassified

The object of this report is to demonstrate a technique for extracting radar target cross-section in real time. Sections 1 and 2 discuss some of the uses that can be made of the target cross-section data and the functional relationships used to obtain it. The most inexpensive method of solving for this target cross-section data is with an analog computer and two function generators. Implementation of the solution utilizing an analog computer is described in Section 3. The calibration procedure is described in Section 4. Experimental techniques using the AN/FPS-16 radar provide the data included in Section 5. The errors introduced by the computer are discussed in Section 6, and the main error sources are isolated. Suggested improvements are recommended. Section 7 is a preliminary analysis of digital techniques to determine the feasibility of applying digital equipment to cross-section computation.

12-179

RADC-TDR-62-179, PULSE STRUCTURES FOR EN-HANCED ACCURACY. Tech Rpt, 14 Mar 1962, 32p. incl illus., 3 refs. P: 4506, T: 45359. C: AF 30(602)-2417, General Atronics Corp., 1075 DeHaven St., West Conshohocken, Pa. R. K. Gardner, T. L. Williams, K. K. Zeiger. SRN: 994-242-16. ASTIA: AD 276238, Code AA.
Unclassified

General Atronics has previously extended the fundamental theory of radar measurements under Contract AF 30 (602)-2120. This theory resulted in a specification of a set of IF filters which are used to measure target amplitude range, doppler, and multiplicity in a near optimum manner. The present contract is concerned with the construction of equipment which will experimentally verify the theoretical results. Accordingly this report contains a description of equipment which has been built. The equipment can be used to verify the simultaneous accuracy of range and doppler measurements on a single radar pulse. In addition, the resolvability of two targets can be determined. Finally a controllable amount of noise can be added to the received waveform.

This report completes the work described in Item I of the present contract.

12-180

RADC-TDR-62-180, VERY LOW FREQUENCY ANTENNA TECHNIQUES. Tech Rpt No. 1, 1 Feb 1962, 21p. incl illus. C: AF 30(602)-2496, Sylvania Electronic Lab., 40 Sylvan Rd., Waltham 54, Mass. Janis Galejs. SRN: 149-2-14B. ASTIA: AD 330238, Code AA. Secret

This report was written to evaluate the progress in development of unique very-low-frequency antenna techniques. Several types of antennas are reviewed including Horizontal Dipole antennas, Slots in a Conducting Plane Above a Low-Conductivity Ground, Horizontal Ferrite Core antenna, Top Loaded Vertical Dipole, Unloaded Vertical Stub, Hemispherical Antennas and Cavity Backed Annular Slot antennas.

12-183

RADC-TDR-62-183, A HIGH-POWER WIDE-BAND WAFFLE-IRON FILTER. Tech Note 2, Jan 1962, 21p. incl illus. C: AF 30(602)-2392, Stanford Research Inst., Menlo Park, Calif. Eugene Sharp. SRI P: No. 3478. In OTS. ASTIA: 278718, Code AA. Unclassified

This report describes the design and measured performance of an L band model of a high-power wide-band low-pass waffle-iron filter. Three different waffle-iron filters with staggered stop bands are connected in series to give a combined stop-band which extends from 2.2 Gc to 13.7 Gc where the attenuation is 60 db or greater; this stop-band includes the second through tenth harmonic of frequencies in the pass band of 1.25 Gc to 1.35 Gc. The waffle-iron filter attenuates all waveguide modes which can propagate at frequencies in the above stop-band. In the pass-band, the waffle-iron filters are matched to full-size L-band waveguide using quarter-wavelength stepped transformers. The pulsed power handling capacity without breakdown is measured to be 1.4 megawatts peak power with air at atmospheric pressure filling the filters; the power capacity is measured using pulses 2 microseconds long and a repetition rate of 60 pulses per second.

12-184

RADC-TDR-62-184, COAXIAL ABSORPTION LEAKY-FILTER FOR HIGH POWER APPLICATION. Tech Note 4, Feb 1962, 32p. incl illus. SRI P: No. 3478. C: AF 30(602)-2392, Stanford Research Inst., Menlo Park, Calif. Edward G. Cristal. In OTS. ASTIA: AD 278716, Code AA. Unclassified

This report presents experimental data related to the design of a coaxial absorption leaky-wave filter. Power coupling coefficients of rectangular slots, dumbbell slots, and various slot combinations which couple a coaxial-line to a side waveguide, are determined. The effects on slot coupling of the dimensions of the side waveguide, and of a load mismatch in the side waveguide are investigated. An experimental coaxial leaky-wave filter and two modifications of this filter were constructed and tested for insertion loss and VSWR for a TEM wave over a 10:1 frequency band.

12-185

RADC-TDR-62-185, HF AND VHF NARROW-BAND FILTER CHARACTERISTICS. Tech Note 5, Feb 1962, 23p. incl illus. SRI P: No. 3478. C: AF 30(602)-2392, Stanford Research Inst., Menlo Park, Calif. J. F. Cline. In OTS. ASTIA: AD 272715, Code AA. Unclassified

Performance data are given for two experimental, high-power narrow-band, transmitter-output filters, one centered at 10 Mc and the other at 300 Mc, with particular emphasis on the insertion loss in the stop bands. The necessary compromises between selectivity, Q, center-frequency insertion loss, and the number of resonant circuits in a filter are discussed.

12-188 (Vol II)

RADC-TDR-62-188, Vol II, MICROWAVE APPLICATIONS OF SOLID STATE MATERIALS. Final Rpt, Aug 1962, 52p. C: AF 30(602)-2405, Syracuse University Research Inst., Syracuse, N.Y. Joseph V. Cornacchio, C. C. Chen, Harry Gruenberg. SRN: EE 850-6208F2. ASTIA: Code XX. Unclassified

This second part of the final report on Cont AF 30(602)-2405 consists of two sections: Section 4 gives a general analysis of the criteria for parametric amplification by the use of a ferrimagnetic material. While this problem has been discussed by a number of authors in varying degrees of completeness, the results given here present a unified treatment of all three types of operation. Some of the results are at variance with results quoted in the literature.

Section 5 gives a detailed analysis of an amplifier operating in the modified semistatic mode. An equivalent circuit is derived from first principles and the dependence of the threshold power on the geometrical and physical parameters of the system is obtained. It is shown that the threshold power may or may not depend on the

sample shape depending on the orientation of the sample with respect to the dc field. For certain ranges of parameters no amplification is possible.

12-190

RADC-TDR-62-190, INVESTIGATION OF FLUSH-MOUNTED ANTENNAS. Final Rpt, 31 Dec 1961, 106p. incl illus. P: 4506, T: 450604. C: AF 30(602)-2386, Aero Geo Astro Corp., Edsall and Lincolnia Roads, Alexandria, Virginia. K. S. Kelleher, D. M. Bowie, K. D. McDonald. ASTIA: Code XX. Unclassified

This report describes work which relates two general antenna techniques into an over-all antenna system. The antenna system is designed for high-resolution, flush-mounted applications. An antenna array configuration is assumed so that the techniques considered involve design of the individual elements and adaptations of these elements into an array. The individual elements were thoroughly studied on an experimental basis, while the array techniques involved several applications of synthetic aperture concepts.

The report considers flush-mounted elements in which the excited radiator is a few wavelengths in height and the surface-wave structures are many wave-lengths in length. Surface-wave structures considered include simple ground plane, ground plane with synthetic soil, corrugated surface structure, pin surface structure and diffraction obstacles. The synthetic aperture techniques include the multiple module system, as well as compound interferometer techniques of several varieties.

12-193

RADC-TDR-62-193, RADIATION WEAPON ANTENNA INVESTIGATION. Final Rpt, 10 Apr 1962, 247p. incl illus. C: AF 30(602)-2394, Systems Labs, 5121 San Fernando Rd., Los Angeles 39, Calif. D. L. Margerum, E. R. Ingersoll and others. SRN: 5-3026. ASTIA: Code XX. Secret

12-197

RADC-TDR-62-197, PLANTS STUDY. Final Rpt, 28 Feb 1962, 117p. incl tables & illus. C: AF 30(602)-2141, Southwest Research Inst., San Antonio, Texas. Herbert C. McKee. ASTIA: AD 331552, Code AA. Secret

12-205

RADC-TDR-62-205, STUDIES IN LIE DETECTION COMPUTER FEASIBILITY CONSIDERATIONS. June 1962, 161p. P: 5534, T: 553401. C: AF 30(602)-2270, Fordham University, New York, N.Y. Joseph F. Kubis. ASTIA: Code XX. Unclassified

The series of experiments which form the basis of this research program on various aspects of lie detection have special reference to feasibility considerations, namely,

the possible use of a computer in lie detection. The experiments involved: a Simulated Theft, Denial-of-Actual-Crime, Denial-of-Classified-Information, and Countermeasure Techniques. Cardiovascular, respiratory and psychogalvanic response systems were monitored, recorded, and evaluated for lie detection capabilities. Questionnaire, Peak-of-Tension, and Association techniques were employed.

12-211

RADC-TDR-62-211. NUMERICAL CONSTANTS RELATING GAIN AND BEAMWIDTH TO ANTENNA PARAMETERS. June 1962, 26p. incl illus., tables. P: 4519, T: 451901. A. F. Snyder. ASTIA: AD 283121, Code AA. Unclassified

The problem in relating the parameters used in calculating antenna gain and beamwidth is mainly associated with the chosen definition of beamwidth. A mathematical derivation of the constants relating antenna gain and beamwidth parameters for various values of defined beamwidth and aperture illumination patterns is included. The results are then presented in graphical form.

12-212

RADC-TDR-62-212, INVESTIGATION AND STUDY OF PROPAGATION IN AND PROPERTIES OF NON-UNIFORM PLASMAS. Final Rpt, Aug 1962, 83p. P: 5561, T: 55209. C: AF 30(602)-2447, Kane Engineering Lab., Palo Alto, Calif. ASTIA: Code XX. Unclassified

The study of the propagation of an electromagnetic wave through a plasma has been continued in the final quarter. The content of this report represents a brief summary of the overall effort but is primarily concerned with the work done in the last quarter of this study.

The report consists of a brief presentation of the problem of electromagnetic wave propagation in a non-uniform plasma, in the small signal limit. A section is also devoted to the development of the formalism which could be used to investigate the large signal effects at a sharp boundary. Finally, the last section is devoted to the discussion of statistical mechanics of plasmas in the presence of strong external fields.

12-213

RADC-TDR-62-213, DIGITAL PULSE CODING. Final Rpt, 17 Apr 1962, 103p. incl illus. C: AF 30(602)-2065, Sylvania Electronic Systems, 40 Sylvan Rd., Waltham 54, Mass. SRN: 94-2-7B. ASTIA: Code XX. Secret

This report covers the final portion of a study program concerning radar systems based on digital pulse coding. Included are the description of a practical technique for the implementation of a coded radar system, a discussion of the factors related to parameter selection, and a summary of recent theoretical and experimental coding studies.

12-221 (Vol I & II)

RADC-TDR-62-221, Vol I and Vol II, INTERFERENCE ANALYSIS OF NEW COMPONENTS AND CIRCUIT TECHNIQUES. Final Rpt, May 1962, Vol I-155p, Vol II-198p, incl illus. P: 4540, T: 454002. C: AF 30(602)-2384, Airborne Instruments Lab., Deer Park, Long Island, N.Y. S. Becker, J. A. Aichroth, F. G. Hanesman and others. SRN: 8899-1. In OTS. ASTIA: Code XX.
Unclassified

These reports develop the theoretical analyses necessary to provide an understanding of the nonlinear behavior and spurious responses of several solid-state-components and devices. These components and devices include masers, parametric amplifiers, transistors, tunnel diodes, and ferrite devices. On the basis of these analyses, the extent of interference effects in particular circuit applications are estimated. The interference effects treated are desensitization, cross modulation, intermodulation, spurious responses, gain stability, and gain recovery time. These effects are treated taking into account the inherent device characteristics, impedance matching, selectivity, automatic gain control (AGC), automatic frequency control (AFC), and temperature variation. Much experimental data are presented that show the degree of agreement with predictions of the interference effects. In the absence of predictable interference effects, the data obtained provide empirically derived bases for predictions.

12-224 (Vol II)

RADC-TDR-62-224, Vol II, SPECTRAL SUITABILITY, MODULATION AND DETECTION TECHNIQUES IN COMMUNICATION WITH WAVELENGTHS BETWEEN 30 AND 10,000 ANGSTROMS, PART II. Final Rpt, Apr 1962, 109p. incl illus., tables and 12 refs. P: 4519, T: 451905. C: AF 30(602)-2203, GPL Div., General Precision, Inc., 63 Bedford Rd., Pleasantville, N.Y. Sherman, Seymour and Bayley, D.S. SRN: A24-4. ASTIA: Code XX. Secret

An optical communication system between a re-entry vehicle and the earth is analyzed to determine source spectral radiances, and signal-to-noise ratios as functions of system parameters using conventional components, and transmitter power requirements for system using optical masers.

12-227

RADC-TDR-62-227, PREDICTION OF CIRCUIT DRIFT MALFUNCTIONS OF SATELLITE SYSTEMS. Final Rpt, 94p. incl illus., 5 refs. C: AF 30(602)-2418, FSD Space Guidance Center (for IBM), Oswego, N.Y. SRN: ARPA 168-61. ASTIA: Code NC. Unclassified

Conventional methods for achieving low probability of drift malfunctions in electronic circuits, such as "worst case" design, do not provide any measure of the expected circuit degradation during operating life. Statistical analysis techniques are available which permit

analytical prediction of probable circuit performance; however, these techniques have not achieved wide acceptance, perhaps due to the lack of sufficient evidence which would indicate technique feasibility and accuracy. During this study, three statistical analysis methods were applied to predict various performance characteristics of six typical circuits which are used in transistor electronics. The results were then compared with the measured performance after approximately 2000 hours of circuit test operation.

12-234

RADC-TDR-62-234, DESIGN OF BROADBAND TRANSMISSION LINE EQUALIZERS. Research Report, 5 June 1962, 42p. incl 24 figs. & 9 refs. C: AF 30(602)-2213, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. George I. Zysman. ASTIA: AD 282247, Code AA. Unclassified

This report is concerned with the design of microwave broadband equalizers consisting of cascaded transmission lines, to work between a resistive generator and an arbitrary load. The design criterion is optimized gain bandwidth performance.

Such performance is obtained by prescribing a flat power transfer characteristic, subject to the inherent restrictions of the load. The equalizer is then synthesized by the use of an approximation method devised by Carlin. Problems considered here are: (1) distributed parameter load, (2) lumped parameter load associated with microwave broadbanding of a tunnel diode amplifier.

12-235

RADC-TDR-62-235, RADIO LOCATION TECHNIQUES. Fifth Progress Rpt, 1 May 1962, 21p. incl illus. P: 4505, T: 45219. C: AF 30(602)-2214, Ohio State University Research Foundation, Columbus 12, Ohio. SRN: 1075-14. ASTIA: Code XX. Confidential

The progress made in the last quarter toward the completion and testing of both the short baseline and long baseline VLF direction finding systems is discussed. The discussion includes present status of systems, tests completed in the past interim, components yet to be assembled, and tests to be made in the next interim.

12-236

RADC-TDR-62-236, CORRELATION OF D/F ERRORS WITH IONOSPHERIC RADIO PROPAGATION PHENOMENA. Tech Rpt 2, 7 Mar 1962, 57p. incl illus. P: 4505, T: 55095. C: AF 30(602)-2413, Electrical Engineering Research Lab., University of Illinois, Urbana, Ill. E. C. Hayden. ASTIA: AD 282364, Code AA. Unclassified

The problem of estimating probable reliability or accuracy of specific sets of direction-of-arrival data and the problem of using knowledge of the ionosphere for the

correction of such data for use in radio location are considered in the light of proved state-of-the art techniques. The stated conclusions are that the solution to the first problem is dependent on the specific system involved, that no technique proposed for the solution of either problem has yet been adequately proved, and that further experimental and theoretical work on both areas is required.

A brief description is given of some aspects of an experimental program (those aspects with which this contract is directly involved) designed to provide answers to the above questions.

12-238

RADC-TDR-62-238, IMPROVED DELAY LINE TECHNIQUES. Final Rpt, June 1962, 97p. incl illus. P: 4506, T: 45359. C: AF 30(602)-2055, General Electric Co., Electronics Lab., Syracuse, N.Y. S. W. Theon, R. C. Roberts, W. C. Wang. ASTIA: Code XX.
Unclassified

Results are presented for a continued program on delay line development. Work was concerned with the two major areas of dispersive ultrasonic delay lines, and of thin ferroelectric ceramic sheet lines.
Ceramic sheet lines were studied theoretically and experimentally, and a number of novel configurations are presented. Ceramic sheet lines offer the possibility of building ultrasonic delay lines with relatively small time delay - bandwidth products having large numbers of taps. Tap spacing can be made less than the resolution time, and transducer reflections are minimal because transducers and delay path utilize the same material with the same acoustic impedance and with no intermediate bonds. Time - bandwidth product is limited at present by attenuation in ferroelectric ceramic materials suited to this application. One application is described, which provides an ultrasonic means for scanning an image area to provide a raster suitable for television cameras or image display.
Dispersive delay line development was continued from a previous RADC program. Bandwidths and operating frequencies were increased substantially, strip configurations have been developed, and practical lines suitable for pulse compression systems were built, both in breadboard form and in finished packages suitable for system use. The results of operation in a laboratory pulse compression system are presented.

12-240

RADC-TDR-62-240, MULTIPLE ANTENNA NULL INSERTION ADAPTIVE CORRELATOR (MANIAC). Final Rpt, Apr 1962, 113p. incl illus. C: AF 30(602)-2129, Advance Projects Dev. Sec., General Electsic Co., Syracuse, N.Y. Andrew Cokus. SRN: GE Rpt TIS R62EMH22. ASTIA: Code XX.   Secret

12-243

RADC-TDR-62-243, THEORETICAL AND EXPERIMENTAL INVESTIGATION OF LARGE-SIGNAL TRAVELING WAVE-TUBE. Qrtly Progress Rpt No. 7, 1 Apr 1962, 87p. incl illus. P: 5573, T: 557303. C: AF 30(602)-2303, University of Michigan, Ann Arbor, Mich. C. A. Brockett, S. K. Cho, G. T. Lonrad and others. ASTIA: AD 278569, Code AA.   Unclassified

The calculation of space-charge weighting functions for a finite diameter electron beam are presented for both the axial and radial space-charge forces. The beam is divided into six annual rings and forces on a particular electron due to other electrons in the same ring and in other rings are accounted for.

New experimental results on variable-pitch helix traveling wave tubes are presented and maximum efficiency figures of 45% are indicated. Saturation data indicate power limiting over a very wide range of drive powers.

Results on X-band elliptic cavity couplers indicate that low VSWR and insertion loss can be achieved over very wide bandwidths both with coaxial lines and with waveguide coupling.

Initial computer results on the potential distribution in a two-dimensional diode are presented and correlated with one-dimensional results.

12-244

RADC-TDR-62-244, PENETRATION AND THERMAL DISSIPATION OF MICROWAVES IN TISSUES. Final Rpt 14 June 1962, 116p. incl illus. P: 5545, T: 45466. C: AF 30(602)-2344, University of Pennsylvania, Electromedical Lab., The Moore School of Electrical Engineering, Philadelphia 4, Pa. A. Anne, M. Saito, O. M. Salati, H. P. Schwan. SRN: 62-13. ASTIA: Code XX.
Unclassified

Research on the scattering and absorption cross sections of lossy dielectric objects and their biological significance was carried out in two phases: (1) Theoretical and (2) experimental.

In the first, expressions were developed for the relative absorption and Mie scatter cross sections of homogeneous isotropic spheres, homogeneous infinite cylinders and a homogeneous sphere having a concentric shell of different material when the materials used had complex dielectric constants and the objects were exposed to uniform plane electromagnetic waves in air. The ranges of parameters explored were those characteristic of biological materials in the frequency range of 400 mc/s to 10 gc/s. Dispersion equations for extending the results to other frequencies are given.

In the experimental phase, measurements were made on spherical phantoms, as well as doll phantoms of humanshape. Electrolytes used in the phantoms were developed having electrical properties of biological tissue.

There was excellent agreement between the experimental and theoretical results on homogeneous spheres.

12-251

RADC-TDR-62-251, SPECTRUM SIGNATURE MEASURE-MENT ON AIR FORCE MOBILE COMMUNICATION VAN AN/GRC-27 (R-278B/GR, T-217A/GR) R-390A/URR, BC-610E AND BC-640B at GAINESVILLE, VA. Mar 1962, 252p. incl illus. C: AF 30(602)-2537, Jansky & Bailey, A Div. of Atlantic Research Corp., Washington, D.C. and Alexandria, Va. and Frederick Research Corp., Wheaton, Md. C. P. McCall. ASTIA: Code XX.
Unclassified

Detailed results are presented of spectrum signature measurements on communications equipment in an AF Mobile Communication Van stationed at Gainesville, Va. Measurement results are given in accordance with MC-PSS revised 1 Sept 1961.

12-252

RADC-TDR-62-252, PRECISE LONG RANGE RADAR DISTANCE MEASURING TECHNIQUES (Phase II). 1 July 1962, 198p., incl illus. P: 5703, T: 570302. C: AF 30(602)-2196, General Dynamics, Astronautics, San Diego, Calif. B. A. Beach, E. J. Matson, R. A. Bowers and others. SRN: AE62-0484. ASTIA: AD 281737, Code AA.
Unclassified

An evaluation and comparative analysis of several basic tracking techniques were recently conducted. The study results and predesign information of a selected tracking system are presented. The evaluation considered the use of various tracking systems in tracking and guiding satellite and lunar spacecraft.

A large-scale digital computer was programmed to simulate tracking of the missions. Tracking-system evaluation and comparative analysis were conducted using this computer simulation. The evaluation and comparative analysis results are presented and are used in the selection of the tracking system to be predesigned.

The earth-based tracking system selected as superior for the mission of major interest uses the multiple-ranging technique. The system is called PROCTOR, a Precise Range Only Cislunar Tracking and Orbit Reduction System.

12-256

RADC-TDR-62-256, SPACE SURVEILLANCE. July 1962, 55p. incl illus. F. I. Diamond. ASTIA: AD 331348, Code AA.
Secret

This report represents an investigation of space surveillance. The objective has been the determination of the applied research necessary and desirable to provide an improved space surveillance capability in the next decade.

Some general requirements, applicable to the areas of early-warning and reconnaissance, are developed. The

capabilities, limitations and potentialities of radar, infrared, reflected sunlight, ultraviolet, and coherent light are compared, and the efficiency of possible sensor locations such as the earth or earth satellites is studied.

A possible cislunar surveillance system configuration based on sensor and siting capabilities is described.

12-257

RADC-TDR-62-257, CARBON MONOXIDE TIME STAND-ARD. Final Rpt, Apr 1962, 88p. incl illus. C: AF 30 (602)-2249, National Co., Inc., Malden, Mass. ASTIA: AD 282246, Code AA.
Unclassified

This report covers the design and construction phase of the research and development program undertaken at National Co. to extend the precision and accuracy of molecular beam frequency standardization by increasing the transition frequency to the region of 100 kmc. The major objective of the program is to increase the frequency stability of the molecular beam time standard by one order of magnitude.

Emphasis in this phase of the program has been placed on construction of an experimental molecular beam tube and detector-ionizer to detect the presence of a $C^{12}O^{16}$ molecular beam and on a study of the rotational states of carbon monoxide to determine parameters required for subsequent phases.

A stabilized source of excitation radiation of frequency 115 kmc has been constructed and tested. Output power from this source should be sufficient to drive the molecular beam.

12-263

RADC-TDR-62-263, MACROSCOPIC EQUATIONS GOV-ERNING THE INTERACTION OF ELECTROMAGNETIC WAVES WITH NON-UNIFORM PLASMA FLOWS. 14th Tech Note, Aug 1962, 16p., 9 refs. P: 5561, T: 556103. C: AF 30(602)-1968, Advance Projects Dev. Sec., General Electric Co., Syracuse, N.Y. Dr. K. T. Yen. ASTIA: Code XX.
Unclassified

A method of analysis for the interaction between electromagnetic waves and a non-uniform plasma flow is presented. The electromagnetic waves are taken to be in the microwave range. By using a fully-ionized gas as a model, two coupled sets of macroscopic equations are obtained: the flow equations and the field equations. Special consideration is given to the case where diffusion and charge separation can be disregarded. It is shown that both sets of equations can be reduced to useful forms. Physical significance of these equations and extension of this method to include charge separation and partially ionized plasmas are briefly discussed.

12-264

RADC-TDR-62-264, INTERACTION OF MICROWAVE RADIATION WITH A WEAKLY IONIZED GAS. 15th Tech

Note, Aug 1962, 4 lp., 6 refs. P: 5561, T: 556103. C: AF 30(602)-1968, Advance Projects Dev. Sec., General Electric Cr., Syracuse, N.Y. Dr. A. Peskoff. ASTIA: Code XX. Unclassified

Propagation of intense microwaves in a plasma is studied. Simplified considerations are used to study the energy gain of an electron acted on by an alternating electric field, collisions with heavy particles, and collisions with other electrons. The conditions, under which each of these instances is important, are illustrated. The Boltzmann equation is applied to a plasma in which conditions vary slowly compared to the time-variation of the applied microwave field. Elastic, excitation, and ionization collisions are included in the analysis. The current-versus voltage relation is studied for several idealized collision cross sections under steady state conditions. The dispersion relation (dependence of the wave-number on the microwave frequency) is derived, and is found to depend on the electric field intensity. A variational principle is given which may prove useful in finding the ionization rate, using a trial function for the electron velocity distribution function.

12-269

RADC-TDR-62-269, ANALYSIS OF FAILURE MECHANISMS WITH HIGH ENERGY RADIATION. Qtrly Rpt No. 1, 1 Apr 1962, 32p. incl illus. P: 5519, T: 551902. C: AF 30(602)-2596, Hughes Aircraft Co., Fullerton, Calif. C. B. Schoch, V. R. Honnold. In OTS. ASTIA: Code XX. Unclassified

This program is being conducted to analyze and identify specific modes of failure in semiconductor materials, semiconductor devices, and insulating materials with the use of high-energy radiation. During the first three months of this contract a literature search was conducted with particular emphasis on radiation effects in semiconductors; a program outline for the remainder of the contract was established, and a preliminary experimental program on the effects of gamma radiation on germanium and silicon diodes was partially completed. Special tools for analysis of the structure of materials, such as nuclear-magnetic resonance and electron-paramagnetic resonance are under development and will be applied as soon as they become available.

12-276 (Vol I & II)

RADC-TDR-62-276, Vol I, Secret–Vol II, Unclass., INVESTIGATION OF OPTICS FOR A RADIATION WEAPON SYSTEM. Vol I–Qtrly Tech Note, Vol II–Appendices, 1 May 1962. Vol I 13p.; Vol II 75p. P: 5561, T: 556104. C: AF 30(602)-2638, Westinghouse Defense Center, Friendship International Airport, Box 1897, Baltimore 3, Md. Vol #I - ASTIA: AD 331200, Code AA. Vol #II - ASTIA: AD 282343, Code AA. Secret

The optical portion of a device for delivering high energy densities of optical frequency electromagnetic radi-

ation to a point in space is discussed. The energy is assumed generated in an active laser material. The problems of extracting this energy coherently and focusing it are considered. Limitations due to optical material considerations and fabrication restraints are investigated.

12-277

RADC-TDR-62-277, INTERACTION BETWEEN MICROWAVES AND IONIZED GAS BEHIND A NORMAL SHOCK WAVE. 16th Tech Note, Sept 1962, 24p., 9 refs. P: 5561, T: 556103. C: AF 30(602)-1968, Advanced Proj. Dev. Sec., General Electric Co., Syracuse, N.Y. Dr. K. T. Yen. ASTIA: Code XX. Secret

12-280

RADC-TDR-62-280, SECURE SPACE COMMUNICATIONS. Aug 1962, 83p. incl illus. A. A. Kunze, I. J. Gabelman. ASTIA: Code NC. Secret

This study examines the state of the art in secure communications in space and postulates the requirements, techniques and systems networks applicable for the 1965-1980 time period. The types of traffic and associated communications requirements are examined, with the aim of forecasting applicable security techniques. The study considers spread spectrum techniques such as frequency-time hopping and pseudorandom noise modulation, the role narrow beam geometry plays in secure space communications, and the effect this has on specialized requirements for equipment in microwave, millimeter and optical portions of the spectrum. Research and development areas which should be initiated or emphasized to permit realization of a secure space communications capability within the stipulated time period are delineated.

12-282

RADC-TDR-62-282, ANTENNA HARDENING STUDY. Final Rpt, May 1962, 287p. incl illus. and tables. P: 4519, T: 45541. C: AF 30(602)-2515, Melpar, Inc., Falls Church, Va. Paul E. Taylor. ASTIA: Code NC. Secret

This report presents the findings of the Antenna Hardening Study. The object of the study was to establish design criteria and engineering drawings for high-gain (50 db) antenna systems in the 2-10 gc frequency band possessing varying degrees of hardness. Degrees of hardness specified are 100 psi, and 500 psi overpressure regions.

Higher frequencies, 10 gc and higher, require smaller antennas than lower frequencies and the antenna systems, can be hardened in the same manner as present missile systems. If frequencies in the order of 2 gc are required a clear cut solution is not yet available. The array antenna is the only high-gain microwave antenna capable of continuous use, but for 50 db gain with an electronically steerable beam an enormous number of components are required, and they are very expensive.

12-283

RADC-TDR-62-283, CASCADED LINE TERMINATIONS WITH EQUAL RIPPLE RESPONSE. 23 Feb 1962, 43p., 3 refs. C: AF 30(602)-1984, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. Herbert Allen Stadmore. SRN: PIBMRI-971-61. ASTIA: Code XX.
Unclassified

The optimal broadband matching of a termination consisting of an arrangement of multiple sections of lossless, reciprocal transmission line and a resistor is considered. A design procedure using synthesis techniques is developed on a transmission line description using the transfer scattering matrix and an equal ripple response function. A design procedure is outlined and designs for a two, three and four section termination are obtained. An intermediary result is that for the greater bandwidth the transmission line in the short circuited stub should have as large a characteristic impedance as is possible.

12-284

RADC-TDR-62-284, MAGNETOHYDRODYNAMIC STABILITY OF A TOROIDAL PLASMA STRUCTURE. Research Rpt, 10 May 1962, 42p. C: AF 30(602)-2149, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. Jeffrey Freidberg. SRN: PIBMRI-1025-62 ASTIA: Code XX.
Unclassified

Before thermo nuclear energy can be safely and efficiently harnessed, the problem of confining the "hot plasma" must first be solved. The solution to this problem involves a complete investigation of both, the microscopic and macroscopic instabilities, which arise when the attempt is made to confine a plasma by magnetic fields.

The purpose of this report is to macroscopically treat the problem of stability in a specific plasma configuration. There are numerous possibilities for different types of stabilities and instabilities which can arise in the given configuration. However, only one mode of plasma motion is considered in this report. The results of the investigation indicate that for this mode the plasma is stable under a great variety of perturbations. Under certain conditions, nevertheless, the plasma is found to be unstable.

12-285

RADC-TDR-62-285, DYNAMIC PROGRAMMING TECHNIQUES. Final Rpt, 20 May 1962, 133p. incl illus. C: AF 30(602)-2421, Sylvania Electronic Sys., 40 Sylvan Rd., Waltham 45, Mass. ASTIA: AD 282170, Code AA.
Unclassified

This report consists of three parts. The first is a systematic discussion of dynamic programming as a technique for treating multivariable optimization problems as a sequency of single variable conditional optimizations.

Optimization problems involving stochastic elements, which we have termed Stochastic Programming are also considered. Stochastic Programming is rigorously defined as that field arising from Statistical Decision Theory when the underlying probability space is a product over the possible decisions of the classes of stochastic processes available. Representation theory is introduced into the stochastic programming framework to derive computationally as well as conceptually advantageous reformulations.

Part II presents applications of the ideas discussed in Part I, while Part III discusses idea of invariant embedding and its relationship to boundary values problems and the calculus of variations.

12-287

RADC-TDR-62-287, MILLIMETER WAVE RESEARCH. Tech Note No. 4, 31 May 1962, 23p. incl figs. AFSC P: 4506, T: 450602. C: AF 30(602)-2457, E.C.I., Timonium, Md. J. M. Cotton, M. Cohn. ASTIA: AD 278656, Code AA.
Unclassified

This report is concerned with transmission systems for use in the submillimeter wavelength region. An extension of the theoretical analysis of trough waveguide is given. The computed launching efficiencies using magnetic line source excitation are presented in normalized form. A discussion of oversized and highly overmoded waveguide structures is included. Theoretical attenuation characteristics for lossy wall and reflecting wall cases are compared. The present status of a measurement system for the submillimeter region is indicated.

12-288

RADC-TDR-62-288, THE DIFFUSION OF MAGNETIC FIELDS IN MOVING CONDUCTORS. Research Rpt, 4 June 1962, 42p. C: AF 30(602)-2149, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. Melvin Sandler. SRN: PIBMRI-1000-62. ASTIA: Code XX.
Unclassified

A source of high energy electrical pulses is needed in such fields as thermonuclear research and radar. An efficient method of producing these pulses is to directly convert mechanical energy into an electrical form. This process of electromechanical energy conversion requires strong interaction between a magnetic field and moving conductors. In this report, a model of an electromechanical pulser is studied with emphasis upon the process of diffusion of fields into the physical conductor.

12-290

RADC-TDR-62-290, PULSE GENERATION. Tech Note, 21 May 1962, 55p. 14 refs. C: AF 30(602)-2149, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y. Enrico Levi. SRN: PIBMRI-1007-62. ASTIA: Code XX.
Unclassified

The results of investigations on generation shaping and control of high-power electric pulses are summarized. The following topics are included: 1. Design of iron and air cored electromechanical pulsers. Strong interaction between electromagnetic fields and moving conducting media; 2. Magnetic flux pump, a device for generation of high intensity magnetic fields; and 3. Design of air-cored water-cooled magnets.

12-292

RADC-TDR-62-292, COHERENT OPTICAL SURVEIL- LANCE DEVICES. First Qtrly Rpt, 1 June 1962, 25p. incl illus. C: AF 30(602)-2710, Electro-Optical Sys., Inc., Pasadena, Calif. R. E. Bradely. SRN: EOS Rpt No. 2230-Q-1. In OTS. ASTIA: AD 283052, Code AA. Unclassified

Design considerations have been made and designs final- ized for a gas cell variable phase shifter to provide 180° phase shift of light at 7000 Å with a sensitivity of better than 1°. A study of the relative merits of double beam and multiple beam methods of calibrating the phase shifter using incoherent light (λ 5461) has been made. A survey of photomultiplier tubes has been made to se- lect that tube which will be most useful for calibration and evaluation purposes.

12-296

RADC-TDR-62-296, CALCULATION OF DISTRIBUTED CONSTANTS OF MULTIWIRE LINES. 10 May 1962, 31p. incl 7 refs. P: 8505, T: 85014. C: AF 30(602)-2213, Polytechnic Inst. of Brooklyn, Brooklyn 1, N.Y. Akio Matsumoto. SRN: PIBMRI-991-62. In OTS. ASTIA: Code XX. Unclassified

Synthesis with multiwire line has become a new tech- nique which is useful, in higher frequencies, in meeting broader requirements.

The characteristics of networks synthesized with multi- wire lines can be completely determined by the distrib- uted constants of the lines along with their lengths. Exact formulae for the distributed constants are known only for lines with very simple constructions such as coaxial, balanced pairs and star quads.

This report treats the method of calculating the distrib- uted constants of a line consisting of three conductors, one is the shield and the other two are inner conductors.

The method takes its origin from H. Kaden's, but a great deal of contrivances has been given to obtain fast con- vergence.

A short table is given for the distributed capacitances and inductances of the line, in which one of the two inner conductors is coaxial with the shield and the other off-axial. This configuration can easily be transformed into other configurations with both inner conductors off- axial with the shield.

Some approximate formulae are also given to allow a faster estimation of the distributed constants of the line.

Comments are also made on slot-coupled lines and sym- metrical two-wire lines.

12-298

RADC-TDR-62-298. THE MASKING OF SPEECH BY HIGH- AND LOW-PASS NOISE. July 1962, 7p. incl illus. P: 4519, T: 451905. W. R. Dyer. In OTS. ASTIA: AD 283122, Code AA. Unclassified

With increased requirements in the field of military com- munications, a greater need for information on noise in- terference is apparent. This is especially true in the light of current emphasis on systems integration, wherein communications play such an important role. This re- port is based on a continuation of research undertaken to determine the influence on speech communications of various forms of interference commonly encountered in sophisticated electromagnetic communications systems.

A study on the masking of speech with shaped random noise is described. Harvard phonetically-balanced word lists were mixed with noise at five intensity levels and eleven frequency cutoff limits. Five well-trained sub- jects listened in isolation to the composite signal pre- sented over headphones. Data are presented in both tabular and graphic form, showing the intelligibility re- maining under each masking condition.

Both high-pass and low-pass noise conditions resulted in complete masking at the lowest signal-to-noise ratio. An amplitude-related shift in the crossover points for the high- and low-pass masking functions was noted and is attributed to a "downward spread of masking" effect.

12-299

RADC-TDR-62-299, AN/FSS-1(XW-1) ELECTRONIC ALARM SET. 3 Aug 1962, Final Engineering Rpt, 105p. incl illus. P: 4537, T: 453703. C: AF 30(635)-19854, Sylvania Electronic Sys., Mountain View, Calif. SRN: 62R14. ASTIA: AD 331198, Code AA. Confidential

12-300

RADC-TDR-62-300, HIGH-POWER X-BAND AMPLIFIER SAX-195 DEVELOPMENT. Second Tech Note, May 1962, 17p. incl illus. P: 5573, T: 557303. C: AF 30(602)- 2526, Sperry Gyroscope Co., Great Neck, N.Y. SRN: NA-8240-8294-2. ASTIA: Code XX. Confidential

12-301

RADC-TDR-62-301, FEASIBILITY STUDY OF A HIGH PERFORMANCE ANTENNA TEST RANGE. 19 Oct 1962, 175p. incl illus., 22 refs. P: HRB, T: 4. C: AF 30(602)-2445, HRB-Singer, Inc., State College, Pa. A. J. Campanella, C. F. Douds, R. E. Wolfe. SRN: 289.4-F ASTIA: Code XX. Unclassified

A high performance antenna range.is needed to be able to provide adequate data about new and old systems for the RFI Compatibility Program of the DOD. The major problems in the design of a range are to provide adequate spacing for far field measurements and to provide sufficiently uniform illumination of the antenna under test. Analytical treatment is given to the Fraunhofer equation for antenna spacing, the deliberate use of the range surface reflection, and the use of a ramped surface and fences to avoid undesired scattering above L-band. Receiver gating and FM techniques are analyzed for eliminating scattering from beyond the range. A 6000-ft range with a movable transmitter unit and adjustable height transmitter antenna is recommended for installation on the RADC Verona, New York, test site.

12-304

RADC-TDR-62-304, PSEUDO RANDOM ARRAY INVESTIGATION. Tech Note No. 1, 14 May 1962, 35p. incl illus, 31 refs. P: 4506, T: 450604. C: AF 30(602)-2626, ECI, Research Div., 1830 York Rd., Timonium, Md. J. W. Sherman, M. I. Skolnik. In OTS. ASTIA: AD 282749, Code AA.   Unclassified

This technical note describes the work performed during the first quarterly period of an investigation concerning pseudo-random arrays. Particular emphasis has been placed on a review of the literature and on the development of several approaches to be used in this program. A "standard" array has been developed for comparison of other arrays investigated in this study. The field of this array has been computed and is included. Three distinct methods for attacking the problem are outlined, and the progress made under each approach is discussed.

12-305

RADC-TDR-62-305, APPLICATION OF SEMICONDUCTOR DEVICES TO HIGH POWER DUPLEXERS. First Qtrly Prog Rpt, 6 June 1962, 20p. incl illus. P: 4506, T: 450602. C: AF 30(602)-2656, Microwave Assoc., Inc., Burlington, Mass. Joseph White. ASTIA: Code XX.
                                          Unclassified

The purpose of this program is to recommend semiconductor duplexing techniques which show a promise for extending the power-handling capability of semiconductors when used as duplexers. The program for this last quarter had three particular aspects: (1) A calculation of the optimum junction parameters for an L-band duplexer. (2) Calculations of the junction temperature rise of packaged junctions under duplexing conditions. (3) An investigation of the circuit techniques requisite to perform measurements on the packaged and integrated junction. The progress that was made in this quarter on these aspects of the program will be described in the following report.

12-308 (Vol I & II)

RADC-TDR-61-308, Vol I & Vol II, ANTI-JAM TEST ON RADAR SET AN/FPS-35. Sept 1961, Vol I-105p.; Vol II-110p. incl illus. P: 1978. C: AF 30(635)-9544, Sperry Gyroscope Co., Great Neck, N.Y. Dale M. John, Gilbert Looec, James R. McMahon and others. SRN: EB-5295-0144. Vol I - ASTIA: AD 329912, Code AA. Vol II - ASTIA: AD 329913, Code AA.   Secret

Tests were performed on Radar Set AN/FPS-35, to evaluate its anti-jam capability. The performance of the AN/FPS-35 CFAR receivers, which include pulse compression and Dicke-Fix, is presented and compared to the performance of a simple linear receiver and a conventional logarithmic receiver. A captive jammer, QRC-114, located at the radar tower, was used to generate a jamming environment and obtain accurate test data under controlled conditions. Many of the tests were repeated with the jammer located at a distance from the radar to simulate airborne jamming under closely controlled conditions. Finally a series of airborne jammer tests were made to relate the captive tests to actual conditions. The anti-jam performance of the FPS-35 is presented through curves showing the minimum detectable signal sensitivity and false alarm rate in the presence of various jamming, such as, continuous wave, spot noise, barrage noise, and swept jamming.

12-310

RADC-TDR-62-310, DESIGN AND DEVELOPMENT OF COMMUNICATION TERMINAL "J". Final Rpt, 15 Aug 1962, 35p. incl illus., tables. P: 6502. C: AF 30(602)-2589, Sylvania Electronic Sys., 175 Great Arrow Ave., Buffalo 7, N.Y. F. Bidell, C. Herold, J. Lindholm. SRN: TR 34-62.2/A 85-9-5.0-20. ASTIA: AD 331224, Code AA.
                                          Secret

12-311

RADC-TDR-62-311, MEASUREMENT TECHNIQUES FOR OBTAINING TRANSMITTER SPECTRAL OUTPUT. Tech Note 2, 1 Dec 1961, 55p. incl illus. P: 4540, T: 454001. C: AF 30(602)-2159, Electro-Mechanics Co., P.O. Box 802, Austin 64, Texas. ASTIA: Code XX. Unclassified

Three-Dimensional Radiation Measurements were made of the AN/FPS-3A Radar at the United States Air Force Radar Station, Ozona, Texas.

This report summarizes the measurements made using the EMCO Sphere Technique. The data are presented in both the polar and Rectangular plots for the fundamental frequency of the AN/FPS-3A in the form of 360° azimuth cuts for each 5 degrees of elevation between 0 to 70 degrees. Polar plots of the data for the 2nd harmonic (0° - 20° elevation), 4th harmonic (0° elevation only), 5th harmonic (0° elevation only) and a spurious frequency (0° elevation only) are also shown. Information is given concerning the equipment arrangements, shielding techniques, and calibration techniques used.

12-312

RADC-TDR-61-312, INTERFERENCE ANALYSIS STUDY, Final Rpt, Jan 1962, 376p. incl illus. C: AF 30(602)-1934, Jansky & Bailey, Div. of Atlantic Research Corp., Alexandria, Va. J. J. Cronca, D. C. Ports, K. G. Heisler and others. ASTIA: AD 283371, Code AA. Unclassified

Results of studies directed toward a solution of the interference prediction problem through logical analysis are presented.

12-313 (Vol I)

RADC-TDR-61-313, PROPAGATION DATA FOR INTER-FERENCE ANALYSIS, Vol I. Jan 1962, 697p. incl illus. C: AF 30(602)-1934, Jansky & Bailey, Div. of Atlantic Research Corp., Wash, D.C. & Alexandria, Va. ASTIA: AD 282228, Code AA. Unclassified

The information contained in this volume on Propagation Data for Interference Analysis presents methods useful in the computation of propagation characteristics for persons involved in interference analysis and prediction. The data include theoretical equations, worked-out examples, and representative curves showing typical information for most all modes of propagation encountered.

12-313 (Vol II)

RADC-TDR-61-313, Vol II, PROPAGATION DATA FOR INTERFERENCE ANALYSIS. Jan 1962, 406p. incl illus. C: AF 30(602)-1934, Jansky & Bailey, Div. of Atlantic Research Corp., Wash, D.C. & Alexandria, Va. ASTIA: AD 282630, Code AA. Unclassified

The information contained in this second volume on Propagation Data for Interference Analysis is part of contract AF 30(602)-1934 to produce a codification of methods useful in the computation of propagation characteristics for person involved in interference analysis and prediction. Working curves only, are presented in this volume in order to enhance the value of Volume I by supplying the Radio Frequency Interference Engineer with data whereby he can make quick estimates to aid in the analysis of interference.

12-313x

RADC-TDR-62-313, STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER RECEIVER TECHNIQUES. Tech Documentary Rpt 1, 1 June 1962, 43p. incl illus., 32 refs. P: 4505, T: 45216. C: AF 30(602)-2456, Elec. Eng. Research Lab., University of Illinois, Urbana, Illinois. P. D. Coleman, W. H. Steier. ASTIA: Code XX. Unclassified

The purpose of this program is to develop video electromagnetic detection schemes which are usable in the millimeter-infrared region.

The analysis and evaluation of pyroelectric effect detectors and antiferromagnetic detectors is presented.

The pyroelectric effect detector lacks the sensitivity of conventional thin film bolometers and thermistors but has a response time which is several orders of magnitude better. Antiferromagnetic detectors appear feasible if their low temperature requirement is acceptable.

Other defection schemes which are discussed but which have not been fully investigated include Hall effect devices, photodetection schemes, electron heating in intrinsic semiconductors, and superconducting devices. Since the detector must be compatible with submillimeter wave transmission systems, a Goubau beam type waveguide with a design frequency of 75 kmc has been constructed for use in evaluating detection schemes. The design data for this transmission line is presented along with loss measurements. To aid in making measurements on the line, a resonator and a Michelson interferometer have been constructed. The problems associated with efficient launching of the beam modes and with focusing the beam waveguide distributions for detection purposes are also investigated.

12-315

RADC-TDR-62-315. CRITERIA FOR GROUP DISPLAY CHAINS FOR THE 1962-1965 TIME PERIOD. July 1962, 29p. incl illus., tables. E. J. Kennedy, A. P. Deminco, R. H. LaSalle. ASTIA: AD 283390, Code AA. Unclassified

The guide provides parameters for a single Group Display Chain that will meet most Command and Control Systems requirements for the 1962-1965 time period. Based on an evaluation as to the best available display state of the art, a film projection system is recommended. Modularity of components is also stressed to derive the benefits of intra- and inter-system interchangeability without extensive and costly redesign or retrofit.

Basically the display chain will provide: 15 sec updating; six colors plus white; 2400 optical line image resolution; as many as 256 different symbols in up to four different sizes; up to 28,800 symbols generated and displayed in a 120 × 240 format; and line generation for graphics. Discussion is also included on the availability, capabilities and limitations of light valve and electroluminescent techniques for systems application.

12-317

RADC-TDR-62-317, ON RANDOM REMOVAL OF RADIATORS FROM LARGE LINEAR ARRAYS. Task Rpt No. 1, June 1962, 26p. P: 4506, T: 450604. C: AF 30(602)-2646, Syracuse University, Research Inst., Syracuse, N.Y. Thomas M. Maher, David K. Cheng. SRN: EE957-6206T1. ASTIA: Code XX. Unclassified

The effects on the radiation pattern when N pairs of symmetrically located radiators are removed at random from a large $(2N_0 + 1)$-element linear array are studied as a statistical problem. It has been possible to determine

the limiting bounds of the radiation pattern, the probability that the main-lobe beamwidth is widened by not more than a given percentage, the probability that a certain side lobe does not deteriorate by a specified amount, and the probability that all side lobes are below a specified level. The general analysis is valid for arrays with an arbitrary amplitude distribution which is symmetrical with respect to the center element and with an arbitrary progressive phase shift. Curves showing computed statistical data for a 201 element array with both the uniform and a cosine-squared amplitude distribution are presented.

12-318

RADC-TDR-62-318, C-BAND, WIDEBAND SOLID STATE AMPLIFIER. Third Qtrly Tech Note, 15 Mar 1962, 27p. incl illus. P: 5573, T: 55011. C: AF 30(602)-2525, Micromega Corp., Venice, Calif., Harvey N. Endler, Conrad L. Nelson. ASTIA: Code XX.   Unclassified

This is the third quarterly report on a program to develop two experimental models of a low noise parametric amplifier. The first is a fixed tuned amplifier, broadband from 4000 to 6000 mcps; the second amplifier is electronically tunable from 4000 to 6000 mcps.

For the broadband amplifier, a microwave circuit was developed that reduces the diode lead inductance and simultaneously resonates the diode at the center signal and the center idler frequency with a minimum reduction in "available" bandwidth. Parallel tuned coaxial resonators have been developed to multitune the signal circuit. A wideband single-diode amplifier has been constructed with a bandwidth of 900 mcps. The absolute gain of the one-port amplifier and circulator varied between 9 and 12 mcps. The noise figure of the paramp-circulator varied between 2.9 and 3.1 db over most of the frequency range.

A tuned single diode amplifier has been developed which can be swept in single frequency over an 800 mcps frequency range with nearly constant amplifier gain and noise figure. A 1300 mcps tuning range is also possible with a deterioration in noise figure.

12-319

RADC-TDR-62-319, SURVEY OF CLOSED-CYCLE HELIUM-TEMPERATURE REFRIGERATORS. 24 May 1962, 47p. incl illus. P: 4505, T: 45264. C: AF 30 (602)-2414, The Martin Co., Baltimore, Md. J. A. H. Jacobs. SRN: ER 12449. ASTIA: AD 283101, Code AA.
                                                  Unclassified

The results of a survey of manufacturers of low temperature closed-cycle refrigerators are presented. It was found that three manufacturers are presently producing systems capable of achieving the desired temperature and of supplying the necessary cooling. All of these appear readily adaptable to the cooling of the Martin superconducting delay line. In addition, Martin is de-

veloping a closed-cycle helium refrigerator which will be more than adequate for use with the superconducting delay line. A summary is included which presents and compares the pertinent features of each system. The report concludes with a glossary of important technical terms occurring in the discussion.

12-323

RADC-TDR-62-323, HIGH FREQUENCY TUNNEL DEVICE STUDY. Tech Note #1, June 1962, 74p. incl illus., 20 refs. P: 4506, T: 450602. C: AF 30(602)-2673, Ratheon Co., Burlington, Mass. J. Lavine, W. Feist. ASTIA: Code XX.   Unclassified

Two approaches are being taken towards the development of a high frequency amplifier utilizing tunneling. The first is a solid state thin-film amplifier, the second utilizes a thin film tunnel cathode as an electron source for a conventional traveling-wave amplifier.

Effort on the solid-state thin-film amplifier has involved the design of a high-frequency amplifier which makes use of injection directly into the space-charge region of the Ge surface-barrier diode. Feasibility studies on some phases of the fabrication have been successfully carried out. The origin of the difficulty in evaporating 2 mil Al lines of the order of a few hundred angstroms in thickness appears to lie in the contaminants absorbed in the mask. Units involving a somewhat relaxed design are being assembled for electrical study—Four-terminal bridge measurements are being set up with these units. Optical studies of hot-electron effects in Cu, Au and Al have been initiated.

Efforts on the amplifier using the tunnel cathode have been concerned with methods of producing reproducible tunneling structures with a sufficiently high voltage breakdown strength to be useful. The major problem appears to be one of obtaining insulating films of a high degree of perfection in the extremely thin layers required for tunneling. A great deal of care has been taken in cleaning the substrates and in obtaining suitable base metal layers. Extremely fast evaporations in ultra-high vacua appear to yield superior results. Insulating films have been prepared by thermal oxidation and by anodization. Metal films have been prepared mostly by evaporation in ultra-high vacua. Emission into vacuum will be measured from typical cathode in the very near future.

12-327

RADC-TDR-62-327, DEVELOPMENT OF S-BAND LOW-NOISE PERIODIC PERMANENT MAGNET TRAVELING-WAVE TUBE. 20 June 1962, 15p. incl illus. P: 4506, T: 450602. C: AF 30(602)-2694, Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif. B. P. Israelsen, J. H. Foster. SRN: W-J 62-604R1. ASTIA: AD 282624, Code AA.   Unclassified

The principal problem areas in meeting each of the specifications are discussed. Lens effects in the gun region

are reduced by the use of larger anode apertures, contributing to improved operation in the 600-gauss field of a permanent magnet. A pin-seal input match has been tested which might make possible a considerable reduction in total beam length. Magnets have been designed for use in a reversed-field structure. A magnetic circuit for producing a PM-PPM field is described, and test results are cited.

12-332

RADC-TDR-62-332, HIGH STABILITY RADIO FREQUENCY SOURCE. Final Rpt, 10 Sept 1962, 78p. incl illus. P: 4506, T: 450601. C: AF 30(602)-2290, Hughes Aircraft Co., P.O. Box 90902, Airport Sta., Los Angeles 9, Calif. R. J. Ohst, T. L. Nichols, G. F. Johnson. ASTIA: Code XX.   Confidential

12-334

RADC-TDR-62-334, OPTIMUM APERTURE STUDY. Aug 1962, 43p. P: 4506, T: 450604. C: AF 30(602)-2676, Martin Co., Baltimore 3, Md. H. B. McClung. ASTIA: Code XX.   Unclassified

The objective of this contract is to study the applicability of the Wiener-Spencer theorem to antennas. This theorem states that minimum standard deviation of the far-field power pattern occurs when the illumination function corresponds to the lowest mode of vibration of a membrane stretched across the aperture opening.

This Quarterly Report reviews the first phase of this study in which various representative distributions and far-field power patterns for a linear and a square antenna are considered. A comparison of these distributions and the optimum distribution as determined by the Wiener-Spencer theorem is made. In addition, a survey is made of the known geometrical configurations in which Helmholtz's equation is separable.

12-335

RADC-TDR-62-335. FILTERED PSEUDO-RANDOM SEQUENCES USED FOR COMMUNICATIONS. Oct 1962, 41p. incl illus. P: 4519, T: 451903. A. S. Kobos, R. R. Menard. ASTIA: Code XX.   Confidential

The generation and filtering of pseudorandom binary sequences is described and illustrated. The autocorrelation and cross-correlation functions of sequences filtered with different cutoff frequencies have been computed and are presented. The density functions of the filtered sequences are also discussed.

A system employing the filtered sequence as a random source and stored reference is proposed and examined. The analysis of such a system indicates that it possesses the antijam advantage common to all spread spectrum systems, as well as being very difficult to demodulate by other than the intended receiver. The operation of

such a transmitter-receiver at X-band frequencies is assumed. It is indicated that further development in the solution of the synchronization problem is necessary.

It is concluded that such a system, employing filtered random sequences, will have application to the solution of some USAF communication problems.

12-336

RADC-TDR-62-336, INVESTIGATION OF FEASIBILITY STUDY OF GALLAGER CODE. Final Rpt, 15 June 1962, 103p. incl illus. P: 4519, T: 451903. C: AF 30 (602)-2587, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va. In OTS. ASTIA: Code XX. Unclassified

The Gallager low-density parity-check code was investigated to establish its error-correction capabilities and to evolve economical decoder designs.

Computer simulations produced experimental digit error rates for block-lengths ranging from 124 to 1008 and code rates between 1/4 and 2/3. Decoder output error rates were measured for a decision receiver with selected numbers of errors randomly distributed in a code block. Employing an approximate theory, this data was converted into expressions relating probability of error to SNR for coherent, incoherent, and Rayleigh-fading Gaussian channels. A likelihood receiver was simulated by drawing random samples from the distribution of likelihood ratios for coherent and Rayleigh-fading Gaussian channels. Digit error rates down to the region 10^{-3} to 10^{-4} were measured as function of SNR.

The dependence of error rate on two decoder parameters, the quantization accuracy and the number of iterations per block, was also investigated by computer simulation. The design studies evolved several feasible implementations distinguished mainly in operating speed and cost. High data rates (above 200 kilobits per second) can only be accommodated at the price of a large degree of parallel computation and consequent high cost. Two promising implementations for medium speed ($\sim$ 100 kb/sec) and low speed ($\sim$ 10 kb/sec) are described.

12-339

RADC-TDR-62-339. FIELD-STRENGTH MEASUREMENTS IN A MULTIPATH FIELD. Tech Note No. 1, 28 June 1962, 21p. incl illus. P: 4540, T: 45166. C: AF 30(602)-2385, U.S. Dept. of Commerce, Natl. Bur. of Standards, Boulder Labs, Boulder, Colo. Clark C. Watterson. SRN: 7600. ASTIA: Code XX. Unclassified

Field-strength measurements made in the VHF-UHF portion of the spectrum often are ambiguous because of the prevalence of multipath propagation. This report describes a method of making field-strength measurements in a multipath field from which it is possible to calculate the amplitude, polarization, relative time phase, and direction of arrival of each of the multipath components. The method is basically an aperture-synthesis technique

The device investigated is the bermutron. In this device, an electron stream is deflected by an r-f deflection system, so that the resulting pattern is similar to that traced out by a searchlight. When the deflected beam is passed through a region in which an electro-magnetic field of correct polarization can travel with a phase velocity equal to the beam sweep speed, power of a frequency that is a harmonic of the deflection frequency can be generated. The principle of operation has been demonstrated at microwave frequencies with low output.

12-354

RADC-TDR-62-354, SOLID STATE CIRCUITS. First Qtrly Prog Rpt, July 1962, 35p. incl illus. P: 4506, T: 450602. C: AF 30(602)-2699, Airborne Instruments Lab., Deer Park, Long Island, N.Y. J. Greene, W. W. Heinz, S. Okwit and others. SRN: 1654-1-1. ASTIA: Code XX.
Unclassified

AIL is investigating two types of broad-band solid-state limiters for protecting receivers operating in the 400 to 800 Mc range—ferrite limiters and varactor-diode limiters.

Gallium-substituted yttrium-iron garnet is being considered for use in the ferrite limiters. Two crossed strip-transmission-line half-wave resonators oriented at right angles to one another are being considered as the basic limiting structure.

Two types of varactor diodes were considered for use in nonparametric limiters—PN and PIN. The amount of receiver protection and the burnout properties of these diodes were investigated. Measurements made of the dynamic range, spike leakage, and insertion loss over an octave range in the UHF region yielded good verification of the theory.

The design equations for a 4 to 8 Gc strip transmission line Y-junction circulator were obtained but not verified experimentally.

12-356

RADC-TDR-62-356, ANTENNA COUPLER CU-613(XW-2)/GR SERVICE TEST MODEL. Final Rpt, Aug 1962, 15p. incl illus. P: 1980, T: 55130. C: AF 30(602)-2458, Airborne Instruments Lab., Deer Park, Long Island, N.Y. R. Sleven. SRN: 9349-1. ASTIA: Code XX.
Unclassified

Two service test models of the Antenna Coupler CU-613 (XW-2)/GR, which is designed to prevent intermodulation of an associated 25-kw transmitter, have met all electrical and environmental test requirements.

The antenna couplers, which are tunable from 225 to 400 Mc, provide a minimum rejection of 47 db to signals ±5 Mc from the resonant frequency with a maximum insertion loss of 0.63 db.

The antenna couplers were tested to the environmental requirements of military specifications. Environmental

conditions of extreme temperature, humidity, salt spray, shock, and vibration produced no degradation in the performance of the antenna couplers.

12-362

RADC-TDR-62-362, A NEW APPROACH TO RELIABLE DATA TRANSMISSION: ERROR LOCATION CODES. Aug 1962, 10p. P: 4519, T: 451903. Jack K. Wolf. ASTIA: AD 286422, Code AA. Unclassified

Error control in digital data communications is usually achieved by the use of error-detection and/or error-correction codes. In error-detection coding, the decoder is required merely to detect the presence of errors in a block of received digits while in error-correction coding the decoder must both detect and correct these errors. In this paper a technique is proposed which lies midway between these two common coding procedures. In this technique, referred to as error-location coding, errors are detected within the block of received digits and, in addition, the location of these errors is specified to within a sub-block of the over-all larger block of digits.

Upper and lower bounds are derived, for error-location codes, for the number of check digits required for a given error-location capability. A method is presented for constructing the parity check matrix for a large family of error-location codes, some of which are optimal in the sense that they satisfy the previously derived lower bound. Comparisons are made of the error-correction capability and error-location capability of codes. Also, applications of error-location codes are discussed: for example, the use of these codes in conjunction with a feedback channel.

12-364

RADC-TDR-62-364, ANTENNA FOCUSING SYSTEM STUDY. Final Tech Rpt, July 1962, 154p. incl illus. P: 5561, T: 55211. C: AF 30(602)-2532, Sperry Gyroscope Co., Div. of Sperry Rand, Great Neck, N.Y. SRN: EB-5297-0204. ASTIA: Code XX. Secret

12-366

RADC-TDR-62-366, APPLICATION OF THE INTERACTING LAMINAR SHELL CONCEPT TO ANTENNAS AND OTHER GROUND ELECTRONIC SYSTEM SUPPORT STRUCTURES. Final Rpt, July 1962, 285p. incl illus. P: 4506, T: 45389. C: AF 30(602)-2381, Charles Payne and Assoc., Consulting Engineers, Miami, Fla. Charles Payne, I. J. Waxman, H. A. Palmer. ASTIA: Code NC. Unclassified

Interacting Laminar Shell Construction is an arrangement of structural shells (laminar structural surfaces) permitting optimum utilization of high strength materials of exceptionally thin cross-section by inherent stabilization characteristics of the system.

The Interacting Laminar Shell System of construction is inherently panelized, permitting factory fabrication by

mass production techniques. This component articulation also permits universal adjustment of the relative positions of panels, even while under full structural loading such that precise regulation of antenna surface curvature can be maintained at all times by a simple electronic control system.

The range of applicability for the Interacting Laminar Shell System of construction is for large spans and heavy loading. As applied to antenna structures, large steerable reflectors of excellent structural efficiency and, through the Automatic Curvature Control System feature, of exceptional surface accuracy, may be constructed to function without randomes.

This document provides the results of experimental stress analysis upon a model of an Interacting Laminar Shell Antenna Structure, develops influence diagrams for design use, and gives preliminary designs for eight different antennas.

12-367

RADC-TDR-62-367, LOW NOISE TUNNEL DIODE MIXERS AND CONVERTERS. Tech Note #1, 1 Feb to May 31, 1962, 29p. 11 refs. C: AF 30(602)-2631, Micro State Elec Corp., 152 Floral Ave., Murray Hill, N.J. Raoul Pettai. ASTIA: Code XX.   Unclassified

A study of the existing literature on the tunnel diode converter has been made. While the basic theory of the device has been reasonably well established, a number of problems remain, the most important ones being the optimum operating point, the possibility of developing a diode with a specified I-V characteristic, and correlating theory with practice.

Calculations have been carried out to indicate that low noise figures are obtainable near the valley region. It is, however, necessary to have a sharp valley such that the ratio of conductance coefficients G_1/G_0 is high.

A satisfactory technique has been developed for measuring conductance coefficients of tunnel diodes at audio frequencies. The data obtained has been used in theoretical calculations. It is intended to extend the measurements to the UHF and microwave ranges.

Possible schemes of image cancellation are discussed. While there are techniques of outphasing any signal received at the image frequency, no scheme of eliminating the image noise in a wideband system has been found. An experimental tunnel diode converter was assembled and tested at 1300 mc. Measured results are described and briefly discussed.

12-368

RADC-TDR-62-368, CERAMIC-METAL SEALS FOR HIGH-POWER TUBES. Fourth Tech Note, June 1962, 25p. incl illus. P: 5575, T: 557303. C: AF 30(602)-2371, Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck,

N.Y.   C. Johnson, I. Waraska.   SRN: NA-8250-8268-4. ASTIA: Code XX.   Unclassified

The technology study of ceramic-to-metal seals for high-power tubes is a continuation of work started under Contract No. AF 30(602)-2047. Test results of experiment no. 3 (of Phase I) are recorded for 1425°C, 1500°C and 1575°C sintering and for 4-, 6-, and 8-hour temperature cycles. There does not appear to be a systematic increase in averages with an increase in temperature, nor does any temperature cycle show definitive results. Investigations are in progress to correlate eccentricity of the halves of test samples with changes in tensile strength. Experiment no. 5 has started, and data are recorded. A modified nonpumping ion gage has been designed which is expected to eliminate sputtering. Sixty ceramic-to-metal assemblies of a typical window design have been made, with a yield of 83-percent being vacuum-tight. The leakers are undergoing analysis.

12-370

RADC-TDR-62-370, HIGH RESOLUTION HEMISPHERICAL REFLECTOR ANTENNA TECHNIQUES. Fifth Qtrly Rpt, June 1962, 32p. incl illus. P: 4506, T: 450604. C: AF 30(602)-2415, Hughes Aircraft Co., Ground Sys., Fullerton, Calif. SRN: FR 62-14-23. ASTIA: Code XX.
                                                      Secret

12-371

RADC-TDR-62-371, HIGH RESOLUTION HEMISPHERICAL COVERAGE ANTENNA TECHNIQUES 'HIGHCAT', 6th Qtrly Rpt, 30 July 1962, 47p. incl illus., tables. P: 4506, T: 450604. C: AF 30(602)-2406, Philco Corp., Scientific Lab., Blue Bell, Pa. J. E. Tellier, L. J. Brown, J. A. Davis and others. SRN: 9030-6. ASTIA: Code XX.   Secret

12-372

RADC-TDR-62-372, A TEXTUAL ABSTRACTING TECHNIQUE (A Preliminary Development and Evaluation Support). 23 Aug 1962, 50p., 10 refs. w/a supplement vol 194p. P: 4594, T: 459401. C: AF 30(602)-2609, American Inst. for Research, Pittsburgh, Pa. Dan Payne, Sara Munger, James W. Altman, SRN: AIR C81-8/62-TR. ASTIA: Code XX.   Unclassified

Guidelines or rules for text reduction were developed and evaluated on a project to advance to its fullest the art of manually preparing informative abstracts. The objectives of the study were to: 1. Develop guidelines that result in abstracts which provide maximal support to abstract-users, 2. Develop these guidelines so that they result in reliable, i.e., consistent, abstracts of scientific/technical material.

In the approach to the development of the Abstract Form and Instructions, the literature and 276 abstracting organizations and services were surveyed for information concerning the preparation of informative abstracts.

From the results of these surveys, it was possible to collate and organize various principles for abstracting scientific/technical material.

12-382

RADC-TDR-62-382, OPTIMUM DUAL-REFLECTOR AN-
TENNA DESIGN INVESTIGATION. Tech Note No. 2,
26 July 1962, 20p. incl illus., 6 refs. P: 4506, T:
450604. C: AF 30(602)-2610, TRG, Inc., 400 Border St.,
East Boston 28, Mass. ASTIA: Code XX. Unclassified

The completion of the analytical phase of the computer program and its principal features are described.

12-385

RADC-TDR-62-385, STUDY AND INVESTIGATION OF
MILLIMETER AND SUBMILLIMETER RECEIVER TECH-
NIQUES. Qtrly Rpt No. 1, 14 July 1962, 14p. incl illus.,
3 refs. P: 4505, T: 450501. C: AF 30(602)-2456, Ultra-
microwave Sect., Electrical Engineering Research Lab.,
Univ. of Illinois, Urbana, III. ASTIA: Code XX.
Unclassified

The pyroelectric effect detector has been investigated in more detail. In order to measure crystal saturation and polarizability, hysteresis loop measurements have been made on several ceramic materials and on single crystal materials. The ceramic materials tested were found to be unsatisfactory for this application. A detector has been constructed using a $BaTiO_3$ crystal and initial testing has begun.

Frequency and impedance measurements have been made with the Michelson interferometer in conjunction with the beam waveguide.

An investigation was made into various resonator coupling techniques after the original coupling scheme was found to be very inefficient. A grating coupler was found to be the most efficient scheme.

12-387

RADC-TDR-62-387, ELECTRONIC INTERACTION THE-
ORY FOR TRANSVERSE-WAVE COUPLERS. Tech
Note, July 1962, 42p. 10 refs. P: 5573, T: 557303. C:
AF 30(602)-2575, Microwave Lab., W. W. Hansen Lab of
Physics, Stanford Univ., Stanford, Calif. T. Wessel-
Berg. SRN: 922. In OTS. ASTIA: Code XX.
Unclassified

This report is concerned with a general theoretical analysis of the interaction between transverse waves propagating on a filamentary electron beam and electro-magnetic circuits. The class of circuits considered is that which the transverse electric and magnetic fields are symmetric with respect to the z-axis. Aside from this restriction on the symmetry properties, the analysis is quite general in the sense that the transverse electric and magnetic field components are arbitrary functions of axial distance. The analysis is valid for a variety of

circuit configurations, ranging from simple coupler circuits, serving the purpose of coupling rf power in and out of the beam in rf and dc-pumped devices to transverse traveling-wave tubes and multi-cavity klystrons.

The transverse field components in pump circuits used for parametric pumping and dc pumping of transverse waves are all antisymmetric with respect to the z-axis and are therefore excluded from the present analysis. The material contained in the report deals almost exclusively with the electronic part of the interaction, that is, how the transverse beam waves are affected by a specified electromagnetic circuit field. The merit of this approach preserves generality, and leads to results which hold regardless of the details of the circuit configuration. Specifically, the analysis leads to the establishment of criteria for selective coupling to one or several transverse waves, expressed in terms of coupling integrals; — it deals with power relations and discusses various methods of calculating the exchange of power between the beam waves and transverse circuit fields; — it proves conclusively that the established form of the kinetic power conservation theorem is correct under the most general circumstance; — finally, the analysis deals with the question of whether or not the transverse waves are monoenergetic. It is shown that the waves generally are not monoenergetic, but carry a second-harmonic longitudinal modulation representing a spread in energy which under certain circumstances is comparable to the re energy carried by the waves.

12-388

RADC-TDR-62-388, EM INDUCED DAMAGE MECHA-
NISMS IN MATERIALS. Qtrly Rpt No. 1, July 1962, 52p.
14 refs. P: 5561, T: 556102. C: AF 30(602)-2751,
Armour Research Foundation of Illinois Inst. of Tech.,
Chicago 16, Illinois. Kenneth C. Tucker. SRN: ARF
1121-1. ASTIA: Code XX. Secret

The classical theory of conduction in metals is used to calculate the fraction of energy absorbed by metals at high incident power densities and microwave frequencies. The region of validity of the classical result is investigated by establishing its connection with the weak field theories involving Boltzmann's and Schrodinger's equations. The initial stages of development of a strong field theory are presented, which in the limit of weak fields will be consistent with the weak field theory. A theory of propagation of thermo-mechanical disturbances in materials using continuum theory is presented.

Finally, the instrumentation for measuring the reflection coefficient of highly conductive materials in the laboratory is discussed.

12-389

RADC-TDR-62-389, THE DESIGN AND DEVELOPMENT
OF THE R-1084 SINGLE-SIDE-BAND RADIO RECEIV-

ER. Sept 1962, 24p. incl illus. P: 4562, T: 45502. C: AF 30(635)-16150, Hallicrafters Co., Chicago, Ill. Paul D. Simpson. ASTIA: Code XX.   Unclassified

Radio Receiver R-1084 is a single-sideband equipment developed by the United States Air Force, adaptable to many different applications. This report reviews some of the design details and outlines a few of the final acceptance tests.

12-390

RADC-TDR-62-390, PHASED ARRAY RADARS IN A NUCLEAR ENVIRONMENT. Sept 1962, 42p. incl illus. System 496L. Major John C. Toomay, Donald Luczak. ASTIA: Code NC.   Secret

This report examines the effects of high-altitude nuclear bursts on high capacity, track-and-scan phased-array radars. Using data obtained from a survey of the literature on the subject, various nuclear blackout environments are postulated and their effects on a versatile phased-array radar analyzed. Methods of countering and circumventing blackout are discussed. The heuristic nature of the analysis is emphasized. Tentative conclusions are drawn and recommendations made.

12-391

RADC-TDR-62-391. A SATELLITE LOOK ANGLE CALCULATOR. Oct 1962, 13p. incl illus. P: 4519, T: 451901. R. C. Pratt. ASTIA: Code XX. Unclassified

The satellite look angle calculator is designed to be an aid to satellite tracking and a tool for engineers working with satellite configurations. To use the calculator, the position of a satellite must be known for some particular time, and from this information the following can be obtained:

1. Look angles for the satellite (azimuth and elevation) from a particular tracking station.
2. The satellite position above the earth for any time.
3. Satellite period and velocity.
4. Orbit traces from one revolution to the next.
5. Doppler shift information.
6. Slant range from tracking station to satellite.

12-398

RADC-TDR-62-398, CHEMICAL TRACER TECHNIQUES. Final Rpt, Aug 1962, 45p. incl illus., tables. P: 5534, T: 553402. C: AF 30(602)-2614, Armour Research Foundation, Chicago, Ill. Jan Rosinski, Robert Braman. SRN: ARF 3214-7. ASTIA: Code NC.   Secret

12-399 (Vol I)

RADC-TDR-62-399, Vol I, STRATEGIC AIR COMMAND CONTROL SYSTEM (SYSTEM 465-L) PARAMUS, N.J. Tech Note, 13 Apr 1962, 148p. incl illus., tables. P: 5570, T: 557001. C: AF 30(602)-2286, Natl Scientific Labs., 2010 Massachusetts Ave., N.W., Washington 6,

D.C. Howard A. Silber, Richard J. Byrd. ASTIA: Code NC.   Secret

12-400

RADC-TDR-62-400, ELECTRONICALLY STEERABLE ANTENNA-FEED TECHNIQUES. Aug 1962, 41p. incl illus. P: 4506, T: 450604. C: AF 30(602)-2657, Airborne Instruments Lab., Deer Park, Long Island, N.Y. W. D. White, L. K. DeSize, C. J. Wilson. SRN: 1142-1-2. ASTIA: Code XX.   Confidential

12-402

RADC-TDR-62-402, PERFORMANCE MEASUREMENTS ON THE AN/TRM7(XA-1) SERIAL NUMBER 1, FIELD-STRENGTH METER. Tech Note No. 2, 7 Aug 1962, 36p. incl illus., 7 refs. P: 4540, T: 454001. C: AF 30(602)-2385, U.S. Dept of Commerce, Natl. Bur. of Standards, Boulder Labs., Boulder, Colorado. A. H. Dove. SRN: NBS Rpt 7602. ASTIA: Code NC.   Unclassified

The Radio Field Intensity Meter AN/TRM7(XA-1) has been technically evaluated and compared with the T-A/NF105. The frequency range of the tests was 140 kc to 25 Mc/s. Performance measurements were conducted with the AN/TRM7(XA-1) to determine the accuracy of the indicator circuitry and its ability to furnish realistic data on radiated radio frequency fields. These tests show the accuracy to be ±5% for CW and sine wave signals within a closed circuit. The AN/TRM7(XA-1) contains two calibration sources, namely the impulse generator and the continuously tunable sine wave generator. These methods of calibration are adequate for average use. Operational limits are determined by the frequency and repetition rate of the signal to be measured. This can be a source of error perhaps. It is suggested that calibration charts be utilized to evaluate such sources of errors.

Variation in receiver gain with changes in line voltage, long and short term, was found to be less than 1%. Antenna transfer characteristics were found to be within 0.3 db at 5 Mc/s and within 0.5 db from 5 to 24 Mc/s.

Comparison of the AN/TRM7(XA-1) and the T-A/NF105 indicated that differences in the measurements of field strength were generally less than 1%.

The AN/TRM7(XA-1) performance measurements met all of the requirements specified in MIL-I-6181D.

12-403

RADC-TDR-62-403, THE DESIGN OF SURVIVABLE COMMUNICATIONS NETWORKS. Oct 1962, 24p. incl illus. Todd G. Williams, Lt. Col. ASTIA: AD 286421, Code AA.   Unclassified

This report is concerned with the design of communications networks that have a high probability of surviving the terminals which they serve when both the network and the terminals are subject to bombardment. The prob-

ability of survival of a communications network can be increased by either hardening the elements of the network, adjusting the location of the elements, or adding redundant elements to the network. The choice of technique in any given case is based on cost. The designer's problem is to specify the physical hardness and location of each element of the network so that the network cost is minimized and the network as a whole possesses a probability of survival which is compatible with that of its terminals. The purpose of this report is to suggest an approach to the design of such networks.

12-405

RADC-TDR-62-405, FAILURE MECHANISMS IN SILICON SEMICONDUCTORS. Qtrly Status Rpt No. 4, 9 July 1962, 45p. incl illus. P: 5519, T: 45155. C: AF 30 (602)-2556, Shockley Transistor, Unit of Clevite Transistor, Stanford Industrial Park, Palo Alto, Calif. Hans J. Queisser. ASTIA: Code XX. Unclassified

Grain boundary diffusion in silicon is studied. Conductivity measurements of diffused wedge-shaped structures along the boundary give information about the enhancement of the diffusion along the dislocations of the boundary. Investigations of secondary breakdown phenomena in silicon power transistors have been started. It is shown that this failure mechanism is produced by a localization of the current with a drastic temperature increase. These "hot spots" are observed with temperature-sensitive paint and potential probing techniques. The results are in agreement with the predictions of a two-dimensional theory on lateral thermal instabilities in semiconductor devices.

12-407

RADC-TDR-62-407, STUDY OF FAILURE MECHANISMS. Qtrly #3, Oct 1962, 138p. incl illus., 9 refs. P: 5519, T: 45155. C: AF 30(602)-2658, Westinghouse Elec. Corp, Air Aim Div., Baltimore, Md. S. M. Skinner, J. W. Dzimianski. SRN: 382A3. ASTIA: Code XX. Unclassified

The work under this contract is being conducted primarily to identify the particular mechanisms involved in the failure of electronic materials and electronic parts.

During the third quarter, failures from the assembly and testing of a second military data processing system were examined statistically and compared with the results of the first study. From the striking similarity that exists between the two systems, a degrees-of-freedom statistical approach to determining failure ratios of different devices under environmental and processing conditions similar to those studied was hypothesized. Results from, and an analysis of the instrumentation of the surface studies being undertaken in the investigation are given. The utility of the frictional probe in making precise surface measurements is demonstrated.

Progress on other studies is summarized and samples of transistor failure mechanism data caused by a surface charge on the transistor passivating surface are given.

The use of the loss factor to determine the frequency region in which significant damage may be expected because of internally generated heat during operation is discussed. Early results on the effects of transient breakdown voltages in transistor performance, and the progress and present results in the studies of the effect of high energy radiation on solid materials, both by the Mossbauer effect and by the study of the performance of solid state diodes, are given.

12-410

RADC-TDR-62-410, STUDY OF FAILURE MECHAN- ISMS IN HIGH POWER RADIO FREQUENCY GENERAT- ING DEVICES. Qtrly Prog Rpt No. 2, June 1962, 53p. incl 15 tables and 17 figs. P: 5519, T: 45155. C: AF 30(602)-2595, General Telephone & Electronics Labs., Bayside, N.Y. M. Friedman Axler, R. A. Hein, T. G. Polanyi, Scientist-in-Charge. ASTIA: Code XX. Unclassified

This investigation undertakes an examination of the gases in operating gridded power travelling wave tubes with a view to determining the causes of tube failures. Individual tube components, under conditions simulating an operating tube, are also investigated to learn the source and behavior of gases present. Gas analyses are made on both the operating tube and the tube components by means of a permanently attached omegatron mass spectrometer. Data are presented on two types of travelling wave tubes, one KIC getter, a sub-assembly (gun-tester) and coated heater coils. For knowledge of the total gas content of a material which can be released upon heating, a hot extraction method is used in conjunction with a commercial mass spectrometer. Kovar tube components are studied in this manner.

12-413

RADC-TDR-62-413, BEAM-TYPE PARAMETRIC AMPLI- FIER. 6th Tech Note, July 1962, 15p. incl illus., 2 refs. P: 5573, T: 55011. C: AF 30(602)-2433, Sperry Gyroscope Co., Great Neck, N.Y. R. Eng, I. Itzkan, E. Cheatham. SRN: NA-8210-8264-6. ASTIA: Code XX. Unclassified

The objectives of the program are to demonstrate the feasibility of two beam-type parametric amplifiers, one capable of narrowband voltage-tuned operation and the other capable of broadband untuned operation. The Kompfner dip experiment using two couplers was performed and the result is presented to verify the theoretical Kompfner dip length, beam-to-circuit synchronization, and theoretical power-transfer equation. The effects of axial beam velocity spread by controlling the cathode magnetic-flux linkage were investigated with respect to signal transmission and signal transfer. The narrowband characteristics of the Kompfner dip as a function of frequency is discussed, and the possible solution is shown. A low-frequency oscillation at synchronous voltage to the inphase mode was observed;

good termination at one end of the coupler is the solution to the problem.

The experimental result of a pump-circuit study is presented. Advantages as well as disadvantages of two pump circuits are discussed. A pump circuit has been designed for a specified gain.

12-418

RADC-TDR-62-418, PARALLEL IMPEDANCE VOLTAGE EQUALIZATION. Sept 1962, 30p. 3 refs. C: AF 30(602)-2213, Polytechnic Inst. of Brooklyn, Microwave Research Inst., 55 Johnson St., Brooklyn 1, N.Y. Dan Varon. In OTS. ASTIA: Code XX.　　　Unclassified

A current source is loaded by a parallel RC network. The voltage across the load terminals is equalized by a lumped, lossless, one-port impedance shunted across the load. The general shapes of physically realizable gain functions are found. An integral restriction is derived, and the necessary and sufficient condition for the realizability of the gain functions are formulated. A general analytic expression for an arbitrary realizable gain function is derived and the synthesis procedure is shown for realizing the equalizer's impedance from the given gain function.

12-420

RADC-TDR-62-420, COHERENT OPTICAL SURVEILLANCE DEVICES. Prog Rpt, 30 Aug 1962, 22p. incl illus. P: 4506, T: 450601. C: AF 30(602)-2710, Electro-Optical Sys. Inc., Pasadena, Calif. Richard E. Bradbury. SRN: EOS Rpt 2230-Q-2. In OTS. ASTIA: Code XX.　　　Unclassified

A gas cell phase shifter has been assembled and is undergoing preliminary tests. For the purpose of calibrating the phase shifter, a photomultiplier fringe detection system has been adapted to a Twyman-Green interferometer. Initial work has begun on the differential phase shift interferometer.

12-424

RADC-TDR-62-424, DEVELOPMENT OF AN E-BAND AMPLIFIER. Tech Note #6, July 1962, 11p. incl illus. P: 5573, T: 55011. C: AF 30(602)-2422, Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif. E. W. Kinaman, SRN: W-J 62-410R24. ASTIA: Code XX.
　　　　　　　　　　　　　　　　　　　Unclassified

Considerable progress occurred during the quarter on the tube and filter development. In the tube area the following took place: 99 percent transmission of the beam through the helix; stable emission of 4 amps/cm^2 from the cathode face; synchronous helix voltage within 5 percent of design; 30 db electronic gain at 78 Gc. In the filter area: 3 to 3.3 db resonant and insertion loss from 70 to 85 Gc at a 3 db bandwidth of 80 to 84 Mc.

12-425

RADC-TDR-62-425, INVESTIGATION OF ELECTRONIC INSTRUMENTATION AT LIQUID NITROGEN TEMPERATURE. Final Rpt, 20 Aug 1962, 141p. incl illus. P: 4519, T: 451904. C: AF 30(602)-2702, Martin Co., Baltimore 3, Md. J. S. Hildum, J. A. Jacobs, R. J. Allen. SRN: ER12518. In OTS. ASTIA: Code XX. Unclassified

This report describes the status and accomplishment of the investigation of the effects of liquid nitrogen temperature upon the operation of electronic instrumentation which has been carried out from 6 Mar 1962 to the present time.

The testing of components up to this time has included carbon thin-film, carbon composition, and nickel alloy thin-film resistors; paper capacitors, silicon diodes and field effect transistors.

Studies of supporting equipment, i.e., nitrogen liquefiers and cryostats, and the techniques of handling liquid nitrogen have been included.

A literature survey has been conducted and its results are summarized. Additional details may be found in the bibliography at the end of this report. A short summary of the effects of cooling upon the conductivity of conductors and semiconductors is included. Application of this theory to diode and transistor operations is made.

12-426

RADC-TDR-62-426, INDEXER CONSISTENCY UNDER MINIMAL CONDITIONS. Tech Note, Nov 1962, 83p. P: 4594, T: 459401. C: AF 30(602)-2616, Documentation Inc., 7900 Norfolk Ave., Bethesda, Md. J. Jacoby, V. Slamecka. In OTS. ASTIA: Code XX. Unclassified

In the first phase of the project, whose ultimate objective is an improvement of the quality of library indexing, a measure has been assessed of the consistency with which indexers tend to choose the same terms as being descriptive of the same documents. Under artificial indexing conditions which excluded the use of indexing tools, communication, and post-indexing editing, six indexers (three experienced, three beginners) using a Uniterm system of coordinate indexing were found to differ significantly in the number of terms used to index a group of 75 randomly selected chemical patents, as well as in the percent of matched terms any one indexer had with any other. The experienced indexers have attained a significantly higher degree of inter-indexer consistency, with less internal variation, than their inexperienced colleagues. Results of the intra-indexer reliability experiment show that, on the whole, each indexer tends to be consistent with himself when re-indexing "equated" documents and using a vocabulary of "general" (shared) terms; the selection of this vocabulary may have favorably biased these results, however.

12-431

RADC-TDR-62-431, DESIGN OF A PARALLEL PLATE MICROWAVE LENS. Qtrly Tech Note, 22 Aug 1962, 26p. P: 5561, T: 556103. C: AF 30(602)-2336, VARO Inc., Special Products Div., 2201 Walnut St., Garland, Texas. W. W. Salisbury, W. E. Flynt. ASTIA: Code XX.
Unclassified

Two parallel plate microwave lenses are used in the fulfillment of this contract. Such lenses operate on the principle that microwave energy will propagate between parallel conducting sheets with a phase velocity exceeding that of light; hence, this "medium" has an apparent index of refraction which is less than unity. When the bounding contours of such an assembly of plates are suitably shaped, then the assembly is analogous to an optical lens, and can be made to focus microwave energy. For the case under consideration here, the bounding contours have the form of ellipsoids of revolution, and the equations and parameters necessary to shape the contours properly are derived and discussed. A complete design is described for a 5 foot square lens with focal length of 5 feet and an index of refraction of 9/16, operated at a wavelength of 12.5 cm.

12-438

RADC-TDR-62-438, MICROWAVE AMPLIFICATION BY RESONANCE SATURATION. Tech Note No. 1, 9 Oct 1962, 25p. incl illus. P: 175. C: AF 30(602)-2744. TRG, Inc., 2 Aerial Way, Syosset, N.Y. Benjamin Senitzky, Gordon Gould. ASTIA: Code XX. Unclassified

Amplification centered about a frequency of 86 kMc has been attained in gaseous HCN^{15} by means of a new principle. The non linear properties required for amplification are obtained by microwave power saturation of this gas. A gain of 1.5 db in a travelling wave system has been measured. The bandwidth has been estimated at 3 Mc. The extension of this principle to practical devices at higher frequencies is found to be feasible.

12-442

RADC-TDR-62-442. SPACE SURVEILLANCE SYSTEM EVALUATION BY A METHOD OF PHOTOGRAMMETRIC RESECTION. Oct 1962, 16p. incl illus. P: 5535, T: 553502. D. C. Merchant. ASTIA: Code XX. Unclassified

The successful development at Syracuse University of efficient data-handling procedures in connection with photogrammetric computations using réseau type photography has suggested the feasibility of handling the large number of resection solutions necessary in an accuracy evaluation program for a space surveillance system. The report develops the procedure for correcting the significant systematic errors in the measured co-ordinates, describes an adjustment for application to stabilized aerial photography, and, finally, develops the method for calculating errors in the adjusted results.

Theoretical investigations indicate that an accuracy of one foot (standard error) in location of the target aircraft along each axis for each ten thousand feet of altitude above the control is likely.

12-443

RADC-TDR-62-443, SULFUR HEXAFLUORIDE IN HIGH-POWER MICROWAVE SYSTEMS. Nov 1962, 17p. incl illus., table. P: 4506, T: 450602. V. Vannicola. In OTS. ASTIA: Code XX. Unclassified

Sulfur hexafluoride (SF_6) is being used extensively as a means of obtaining high peak power performance in waveguide systems. There is reason to believe that optimum efficiency is not currently being achieved in waveguide systems using this electronegative gas. This report reviews the available data on the use of SF_6 in microwave systems. Inconsistencies in these data are noted. For example, power ratios (breakdown power of SF_6 over that of air at normal pressures with all other parameters constant) are reported from a low of 3 to a high of 40. The mechanisms of these inconsistencies are discussed in terms of geometric configuration, contamination, localized hot spots, localized corona discharge, etc. Areas of future investigation are discussed.

12-444

RADC-TDR-62-444, ULTRA HIGH POWER TRANSMISSION LINE TECHNIQUES. 2nd Tech Note, June 1962, 60p. incl illus., 6 refs. C: AF 30(602)-2545. Microwave Assoc., Inc., Burlington, Mass. In OTS. ASTIA: Code XX. Unclassified

Problems related to failure mechanisms in ultra-high power transmission lines are treated. A more general equation for breakdown is derived for non-uniform conditions using the Boltzmann transport theory and then an approximate solution is discussed for breakdown at a heated surface. Experimental verification including measurements up to pressures of several atmospheres is given for the transition from a localized breakdown at a small hemisphere to a main-volume breakdown. Finally the results of an experimental study of arc movement is given which includes several gases under a variety of conditions.

12-447

RADC-TDR-62-447, RADAR DATA TRANSFER SYSTEM AN/TRQ-10(XW-2) and RADIO REPEATER SET AN/TRQ-13. Final Engineering Rpt, June 1962, 166p. incl illus. C: AF 30(635)-11201, Motorola Inc., Military Electronics Div., Chicago Center, Chicago 51, Ill. ASTIA: Code XX. Unclassified

The AN/TRQ-10 is a fully militarized microwave radar remoting equipment operating in the 7125 to 8400 mc band, represents the latest configuration in a series of equipment developed for the Air Force by Motorola. Using a common waveguide-antenna configuration, it provides two-way transmission of wideband video and azimuth data so as to remote such radar sets as AN/CPN-

18, AN/FPN-34 and ASR-4. The AN/TRQ-13 provides range extension through the use of multiple hops.

The system design permits a high degree of flexibility by employing the building block concept. Basic system capability may be expanded by adding additional components already in the system or compatible control equipment from the AN/FRQ-11.

The equipment is contained in shelter S-118 and is transportable by truck, C-119 cargo aircraft or by helicopter. System design and packaging is such as to permit placing into operation quickly after placement at the operating sites.

Basic specialized test equipment has been incorporated into the equipment for ease of maintenance and increased reliability.

One AN/TRQ-10 system and two AN/TRQ-13 repeaters were produced on the contract demonstrating that the equipment substantially met the major requirements of the applicable specifications.

12-450

RADC-TDR-62-450, AN UNEXPECTED EFFECT IN AN EXPERIMENTAL TRANSVERSE-WAVE TUBE. 7 May 1962, Tech Note No. 5, 13p., 3 refs. C: AF 61(052)-531, Norwegian Defense Research Establishment, Kjeller - Lillestrom Norge. Kjell Blotekjaer, Bjarne Malsnes, Agne Nordbotten. ASTIA: Code XX.
Unclassified
In a tube consisting of two Cuccia-couplers separated by a long metallic drift-tube, gain in excess of 30 db has been observed. It is shown theoretically that the gain can be explained by a quadruple pump field set up in the drift-tube by the beam itself, provided the dc-beam performs a spiralling motion close to the wall of the drift-tube. This is also verified experimentally.

12-451

RADC-TDR-62-451, MINIMUM NOISE TEMPERATURE OF DC-PUMPED TRANSVERSE-WAVE ELECTRON BEAM AMPLIFIERS. Tech Note No. 6, 30 May 1962, 54p. incl illus. C: AF 61(052)-531, Norwegian Defense Research Establishment, Bergen, Norway. Tore Wessel-Berg, Kjell Blotekjaer. ASTIA: Code XX. Unclassified

This report is concerned with a general analysis of noise in dc-pumped amplifiers based on transverse waves. It is shown that any amplifier involving either the cyclotron waves or the synchronous waves has the same minimum noise temperature determined by the conditions at the cathode. The noise temperature can he reduced to an arbitrary small value by increasing the magnetic field at the cathode or by reducing the cathode diameter. It is also shown that the minimum noise temperature is reduced by the smoothing effect of the potential minimum near the cathode. The minimum noise temperature can be realized by inserting a suitable noise transformer between the cathode and the amplifier. In general, struc-

tures with electric or magnetic fields having rotational symmetry such as used in normal electron guns can perform the required transformation.

12-452

RADC-TDR-62-452, A δ-FUNCTION ANALYSIS OF TRANSVERSE WAVE INTERACTION IN PERIODIC STATIC FIELDS. Tech Note No. 8, 10 June 1962, 62p. incl illus. & 6 refs. C: AF 61(052)-531, Norwegian Defense Research Establishment, Bergen, Norway. Kjell Blotekjaer, Bjarne Malsnes. ASTIA: Code XX.
Unclassified
The interaction between transverse electron beam waves in periodic fields is usually analyzed by assuming a sinusoidal variation of the electric and magnetic fields. In this report another approach is used, assuming the fields to consist of δ-functions. Exact solutions can then be obtained by standard mathematical methods. The interaction in quadrupole fields, two-dimensional fields, and fields of rotational symmetry is considered and the results are shown to agree well with the sinusoidal-field theory.

12-453

RADC-TDR-62-453, TRANSVERSE WAVE INTERACTION IN ELECTRON BEAM DEVICES. Final Rpt, July 1962, 10p. C: AF 61(052)-531, Forsvarets Forskningsinstitutt, Norwegian Defense Research Establishment, P.O. Box 25, Kjeller, Norway. K. Blotekjaer, B. Malsnes, A. Nordbotten. ASTIA: Code XX. Unclassified

The investigations under this contract have been concerned with the interaction of transverse electron beam waves with external electromagnetic fields, and the application of this interaction in microwave devices. In particular, problems involving various aspects of the so-called DC-pumped electron beam amplifiers have been analysed. Interaction problems in the pump field have been analysed both theoretically and experimentally. Considerable attention has been devoted to problems of noise theory, and an expression for the minimum noise temperature of DC-pumped amplifiers has been derived. Research on the problem of designing suitable periodic structures for the input and output-coupler of transverse field devices has been performed.

The theory of a harmonic generator based on cyclotron waves has been presented.

Three tubes have been designed and tested. Two of them are cyclotron-wave amplifiers, and the third a synchronous wave amplifier.

12-455

RADC-TDR-62-455, AN EXPERIMENTAL SYNCHRONOUS-WAVE AMPLIFIER. Tech Note No. 7, 8 June 1962, 39p. C: AF 61(052)-531, Norwegian Defense Research Establishment, Bergen, Norway. ASTIA: Code XX.
Unclassified

This report is concerned with the amplification of the synchronous waves in an electrostatic quadrupole pump field. Abrupt reversals of the magnetic field between the pump and the input and output-couplers make it possible to use Cuccia-couplers coupling to the fast cyclotron wave.

The small-signal gain has been calculated under the assumption of a filamentary electron beam.

An experimental tube has been built, and measurements of gain and bandwidth performed. A maximum gain of 16 db has been observed.

12-456

RADC-TDR-62-456, A DC-PUMPED AMPLIFIER USING SPACE-PERIODIC MAGNETIC FIELD. Tech Note No. 9, 28 June 1962, 23p. incl illus., 8 refs. C: AF 61(052)-531, Norwegian Defense Research Establishment, Bergen, Norway. T. Wessel-Berg, Kjell Blotekjaer. ASTIA: Code XX.   Unclassified

This report describes an experimental amplifier based on coupling between cyclotron and synchronous waves in a periodic magnetostatic field. Beam expansion, which represents a major obstacle in synchronous-wave amplifiers, is overcome by means of a new focusing scheme. The tube was operated at 730 Mc/s with electronic gain of 8.6 db. The efficiency was relatively low, probably due to excessive velocity spread in the beam.

12-458

RADC-TDR-62-458. OPTIMUM APERTURE STUDY. 2nd Qtrly Rpt, Nov 1962, 34p. P: 4506, T: 450604. C: AF 30(602)-2676, Martin Co., Baltimore 3, Md. H. B. McClung, H. Rosenblatt. SRN: RM 229. ASTIA: Code XX.   Unclassified

The object of this contract is to study the applicability of the Wiener-Spencer theorem to antennas. This theorem states that minimum standard deviation of the far field power pattern occurs when the illumination function corresponds to the lowest mode of vibration of a membrane stretched across the aperture opening. This Quarterly Report presents the analytical solutions of optimum illumination distribution for two selected antenna aperture configurations, namely polygonal and elliptical. The respective expressions for far-field power diffraction pattern, the zeroth and second moments, are also presented.

12-468

RADC-TDR-62-468, DEVELOPMENT OF S-BAND LOW-NOISE PERIODIC PERMANENT MAGNET TRAVELING-WAVE TUBE. Tech Note No. 2, 20 Sept 1962, 11p. incl illus. P: 4506, T: 450602. C: AF 30(602)-2694, Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif. B. P. Israelsen. SRN: W-J 62-604R2. In OTS. ASTIA: Code XX.   Unclassified

The pin-seal rf input match has been evaluated, with excellent results. The match is better than 2:1 VSWR over an octave bandwidth. A noise figure of 3.2 db has been obtained at 3Gc using this type of match. Reversed magnetic fields have been studied, using two Alnico 5 permanent magnets. Several schemes for minimizing the reversal distance have been tried. The most successful uses two small Index I magnets at the reversal plane, opposed in the same manner as the primary magnets. With this type of assembly, beam transmission of 99 percent has been achieved in dc focusing tests.

12-469

RADC-TDR-62-469, APPLICATION OF MODIFIED ZERNIKE POLYNOMIALS TO THE ANALYSIS OF FRESNEL REGION FIELDS OF CIRCULAR APERTURES WITH NON-UNIFORM AND NON-SYMMETRIC ILLUMINATION. Task Rpt No. 2, 15 Sept 1962, 26p. P: 4506, T: 450604. C: AF 30(602)-2646, Syracuse Univ. Research Inst., College of Engineering, Syracuse, N.Y. Ming-kuei Hu. SRN: EE 957-6209T2. ASTIA: Code XX. Unclassified

In this report a modified form of Zernike polynomials and a set of generalized function, $W_m^\gamma (\gamma, u)$, are introduced. These polynomials and functions are applied to the analysis of the Fresnel-region field of circular apertures with non-uniform and non-symmetric illumination. With $m = 0$, the general result reduces to that for non-uniform but circularly symmetric illumination obtained previously. A general expression for the far field (Fraunhofer field) of circular apertures with general illumination is also derived. Finally, a simple example is given as an illustration.

12-471

RADC-TDR-62-471, RCA AUTOMATIC SWITCHBOARD FOR SECURE VOICE. Final Rpt, Aug. 1962, 42p. incl illus. P: 649P. C: AF 30(602)-2286, National Scientific Labs., Inc., Washington, D.C. Jack W. Hughes. ASTIA: Code NC.   Secret

12-473

RADC-TDR-62-473. H-F PROPAGATION SIMULATION. Nov 1962, 21p. incl illus. R. Mather, F. Wilson. ASTIA: Code XX.   Unclassified

An experiment is described in which high frequency electromagnetic wave propagation is to be simulated on an analog computer and compared with experimental data collected over a 3800-KM path. The experimental complex consists of a transmitter site located in the Panama Canal Zone and a receiver site at Stockbridge, N.Y. Vertical ionospheric sounders are located along the transmission path and are used to measure the spatial distribution of electron density in the volume of interest. A method is described whereby this spatial distribution of electron density is programmed into the analog computer in order that the Hamiltonian equations describing

ray paths may be solved. In addition to producing frequency vs. time plots for comparison with the experimental data, the simulator also gives results not easily measured in the field, such as take-off angle, angle of arrival, group time, phase time, off-path deviation, and height of reflection.

An alternate use for the simulator is also presented. By rescaling the problem and making use of its capability to generate functions of three variables, one can examine the effects of small-scale irregularities of ionization on electromagnetic waves.

12-476

RADC-TDR-62-476, MICROWAVE MEMORY TECHNIQUES PROJECT. Final Rpt, Sept 1962, 94p. incl illus., 22 refs. P: 4505, T: 45264. C: AF 30(602)-2414, Martin Co., Baltimore 3, Md. R. J. Allen. SRN: ER 12579. ASTIA: Code XX. Unclassified

The results of an 18-month study and experimental effort for development of a superconducting delay line are presented. While the experimental effort did not yield a delay line of the desired capabilities (4- to 12-kmc bandwidth, 2-db loss and 20-microsecond delay), considerable improvement was obtained over room temperature lines, resulting in lines of useful, although lessened, capabilities.

Lines were built which provided up to 2 microseconds delay with under 2-db total insertion loss above 200 mc. A one-microsecond line gave a total insertion loss, including connectors, etc., of 2.8 db at 400 mc.

Frequency-dependent losses precluded the fabrication of longer lines. The insertion loss encountered and the mechanisms producing it are described herein. The dielectric loss is considered to be one of the major contributors. The theoretical basis for the belief that dielectric losses should decrease with decreasing temperature is summarized.

Results of a survey of closed-cycle helium refrigerators are included.

The results of this program have indicated that the cryogenic delay line is feasible but that additional effort will be required in the areas of dielectrics, surface properties and fabrication techniques before lines which implement the desired design objectives more closely are realizable.

12-477

RADC-TDR-62-477, NEW METHODS FOR MEASURING SPURIOUS EMISSIONS. 5th Qtrly Rpt, Sept 1962. P: 1112. C: AF 30(602)-2511, Airborne Instruments Lab., A Div. of Cutler-Hammer, Inc., Deer Park, L.I., N.Y. D. Levinson, R. Sleven, O. Hinckelmann and J. Taub. SRN: 1112-I-5. ASTIA: Code XX. Unclassified

A voltage squaring circuit has been incorporated in the instrumentation for the fixed-probe multimode power meas-

ing equipment. In addition, the control panel & probe sampling unit have been completed. In a test of the overall instrumentation, the error in the automatic average of the probe-coupled power was 0.6 db.

12-480

RADC-TDR-62-480. GAS DUPLEXER (PINCH EFFECTS). 4th Qtrly Prog Rpt, 30 June 1962, 20p. incl illus. C: AF 30(602)-2401, Microwave Associates, Inc., Burlington, Mass. ASTIA: Code XX. Unclassified

Average electron theory has been used to find the ratio of discharge arc loss in a transverse magnetic field to discharge arc loss without a magnetic field, normalized to a constant electron density. It was found that no reduction in arc loss takes place unless the pressure and electron temperature are such that $\nu_c/\omega<1$, where ν_c is the electron-atom collision frequency and ω is the radian microwave frequency. Limited experimental results are given to support this theoretical conclusion.

Data is presented shown 35% reductions in recovery time for argon fill pressures in the millimeter range.

12-482

RADC-TDR-62-482, GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS. Status Rpt No. 3, Mar 1962, 25p. incl illus. C: AF 61 (052)-519, CSF Compagnie generale de telegraphie Sans Fil, Paris, France. ASTIA: Code XX. Unclassified

The aims of the contract are the study of the possibilities of the O-type Carcinotron as a submillimeter wave generator and the construction of experimental carcinotrons with the following design objectives: Center frequency - 350 KMc/s; Output power - 10 milliwatts CW; Bandwidth - 10%; and Maximum voltage - 10.000 volts. Power and frequency limits should be extended by using higher current densities. As an intermediate step, the study will include the design of very high beam density guns in the 1000 A.cm^2 range.

12-483

RADC-TDR-62-483, GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS. Status Rpt No. 4, June 1962, 16p. incl illus. C: AF 61 (052)-519, CSF Compagnie generale de telegraphic Sans Fil, Paris, France. ASTIA: Code XX. Unclassified

The aims of the contract are the study of the possibilities of the O-type Carcinotron as a submillimeter wave generator and the construction of experimental carcinotrons with the following design objectives: Center frequency - 350 KMc/s; Output power - 10 milliwatts CW; Bandwidth - 10%; and Maximum voltage - 10.000 volts. Power and frequency limits should be extended by using higher current densities. As an intermediate step, the study will include the design of very high beam density guns in the 1000 A/cm^2 range.

12-486

RADC-TDR-62-486, A THEORETICAL ANALYSIS OF THE NOISE PERFORMANCE IN PARAMETRIC CYCLO-TRON-WAVE AMPLIFIERS. Tech Note No. 10, 2 July 1962, 26p., 7 refs. C: AF 61(052)-551, Norwegian Defense Research Establishment, Bergen, Norway. Erling Sunde. ASTIA: Code XX.   Unclassified

This report is concerned with the calculation of noise in a parametric cyclotron-wave amplifier of the quadrupole type. The analysis is correct to second order in the pump amplitude. The calculated noise temperature of the amplifier consists of two terms, the first being proportional to the cathode temperature, and the second proportional to the factor γ^2 where γ^2 is the space-charge smoothing factor accounting for the smoothing of position noise taking place at the potential minimum in front of the cathode.

It is shown, by means of design parameters for three different tubes, that the noise temperature of the parametric quadrupole amplifier seems to increase rapidly with frequency. The noise temperature is also shown to be proportional to the pump power.

12-487

RADC-TDR-62-487, A PROPOSED HARMONIC GENERATOR BASED ON CYCLOTRON WAVES. Tech Note No. 11, 5 July 1962, 3p. C: AF 61(052)-531, Norwegian Defense Research Establishment, Bergen, Norway. Kjell Blotekjaer. ASTIA: Code XX.   Unclassified

A cyclotron wave on a rectilinear filamentary beam can interact with a TE circuit mode of cylindrical symmetry propagating in synchronism with the beam. The interaction results in a periodic variation of the cyclotron transit angle of the electrons, causing a type of circumferential bunching which gives rise to high harmonic content. Provided the RF-field is adjusted to maximize a certain harmonic, its output power increases approximately as the square root of the harmonic number.

The bunching is simply a redistribution of the relative positions of the various electrons constituting the original beam, and requires no supply of energy. All power delivered by the generator is therefore dissipated in the RF structure itself.

The interaction mechanism is analyzed in detail, using two different approaches leading to the same final results. One is based on a wave description, the other considers the motion of the individual electrons.

12-504

RADC-TDR-62-504, FEASIBILITY STUDIES FOR ELECTROMAGNETIC RADIATION WEAPON. Nov 1962, 22p. incl illus. Philip L. Sandler, Leonard Strauss. ASTIA: Code XX.   Secret

This report represents the latest in a continuing analysis and application of data taken in investigations on the technology and phenomenology of problems involved in an electromagnetic radiation weapon concept. These data are analyzed in relation to models for which this new, additional, or updated information provides the basis for modification or more detailed specification of a model system and, more important, of the feasibility of the weapon concept. In particular, an analysis in some detail is presented illustrating environmental constraints imposed on performance of a model system. The effect and purpose, then, of this continuous reworking of the model is the tangible delineation of the feasibility problems.

12-519

RADC-TDR-62-519, GENERATION OF INFRAMILLI-METRIC WAVES BY MEANS OF ELECTRONIC BEAMS. Status Rpt No. 5, Oct 1962, 7p. C: AF 61(052)-519, CSF Compagnie generale de telegraphie Sans Fil, France. ASTIA: Code XX.   Unclassified

The aims of the contract are the study of the possibilities of the O type carcinotron as a submillimeter wave generator and the construction of experimental carcinotrons with the following design objectives: center frequency — 350 KMc/s, output power — 10 milliwatts CW, bandwidth — 10%, Max. voltage 10.000V. Power and frequency limits should be extended by using higher current densities. As an intermediate step, the study will include the design of very high density guns in the 1000 A/cm^2 range.

12-527

RADC-TDR-62-527, ELECTRIC POLARIZATION OF CdS SINGLE CRYSTALS AND PHOTO-MAGNETO-ELECTRIC EFFECTS. Tech Note No. 3, 3 Oct 1962, 58p. C: AF 61(052)-166, Univ. of Louvain, Belgium. A. Luyckx. SRN: Rpt No. TN-3. ASTIA: Code XX.
                    Unclassified

The resistivity of the single crystals of CdS varies for same conditions of illumination, when a magnetic field is imposed. Sometimes this resistivity decreases or increases following the sign of the magnetic field, in other conditions we have always increase of resistivity whatever can be the sign of magnetic field. There are also cases for which magnetic field has no influence on the resistivity. An explanation of these effects is proposed. It is based on the work hypothesis of local electrical polarization of the crystals. Potential measurements have been done which confirmed this idea. In some experimental conditions these photovoltages depend on the action of a magnetic field. Quantitative results have been obtained for definite conditions which confirm our assumptions. Hysteresis diagrams of photovoltages have been plotted; they remind the ferroelectric phenomena of seignettoelectricity.

When the infrared radiations which are known to quench photoconductivity are removed, the photomagnetoelectric effects become independent of the sign of the magnetic field and of the current.

12-528

RADC-TDR-62-528, ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES, Phase J: Investigation of Interdependence of Absorbed Design Parameters. Tech Annual Rpt, 30 Sept 1962, 34p. incl illus, 3 refs. C: AF 61(052)-154, III. Phys. Inst., Gottingen, Germany. Dr. H. W. Helberg. ASTIA: Code XX.   Unclassified

Two ferrite materials, Ferramic E and Ferramic E 1960, were used as magnetic layer absorbers. The measured reflection coefficients were below 10% in the frequency ranges $4.2.10^7$ to $3.8.10^8$ cps (1:9.1) and $2.4.10^8$ to $7.6.10^8$ (1:3.2) respectively. The thicknesses of layers were 0.88 cm and 0.5 cm respectively. These measurements confirmed the reflection coefficients calculated from ϵ and μ.

Various materials were tested with respect to their applicability as absorber material.

12-529

RADC-TDR-62-529, ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES, Phase K: Multilayer Absorber. Tech Final Rpt, 30 Sept 1962, 39p. incl illus, 6 refs. C: AF 61(052)-154, Phy. Inst., Gottingen, Germany. Dr. H. W. Helberg, C. Wunsche. ASTIA: Code XX.   Unclassified

The equations for the reflection coefficient of a three layer absorber contain 15 free parameters. Because of this large number of parameters the equations were not discussed in general. Assuming values of ϵ and μ, which are independent of frequency, input impedance diagrams of three layer absorbers were calculated. By variation of certain parameters a favorable course of the reflection coefficient was aspired. With a thickness of layer $d = 0.21$. λ_{max} the reflection coefficient $|r|$ remains below 13% all at smaller wavelengths. The bandwidth for $|r| \leq 10\%$ is 1:2.5. This absorber contains three layers with ϵ and μ increasing step-wise from free space to the last layer.

For the experimental realization of such absorbers homogeneous mixtures of paraffin and carbonyl iron powder and regular arrangements of damping cylinders in a nondissipative dielectric are used. Free field measurements produced a bandwidth of 1:2.28 for $|r| \leq 10\%$ in the most favorable case. The necessary thickness of layer was $d \approx 0.25$. λ_{max}. At small wavelength the efficiency of the absorber is determined by the properties of the first layer only.

12-530

RADC-TDR-62-530, ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES, Phase L: Resonance Absorbers with Absorbing Structures In or behind a Metal Plate. Tech Final Rpt, 30 Sept 1962, 61p. incl illus, 14 refs. C: AF 61(052)-154, Phy. Inst., Gottingen, Germany. S. Luhmann. ASTIA: Code XX.   Unclassified

A number of resonance absorbers for electromagnetic waves are described, which serve for the reflectionless coating of a metal wall. The absorbers treated here are characterized by the fact that the absorbing structure is placed behind the metal wall to be protected. Coupling of the incident wave to the absorbing structure is made through small openings in the metal plate. Rectangular, triangular and circular ring slots were used as coupling holes. With a wedge absorber behind the metal plate the reflection coefficient r was below 0.1 within a frequency interval with a relative bandwidth of about 10%. Absorbing strip-line components were developed in order to achieve a thin absorbing structure and to compensate the frequency dependence of the impedance of the coupling holes. With these components an operating range r < 0.1 with a relative bandwidth of about 6% was attained.

The reflection coefficient was measured in the frequency range 8 to 14 kmcps. Its dependence on the number of coupling holes per unit area and on various parameters of the absorber elements was investigated.

12-531 (Vol I)

RADC-TDR-62-531, Vol I, ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES, Phase M, Part A: Combination of Magnetic Layer- and Wedge Type Absorbers. 30 Sept 1962, Tech Annual Rpt, 37p. incl illus, 5 refs. C: AF 61(052)-154, III. Phys. Inst., Gottingen, Germany. Dr. E. Pottel, E. Schunk. ASTIA: Code XX.   Unclassified

An absorption arrangement for electromagnetic waves is being designed incorporating a combination of magnetic layer absorbers and inhomogeneous absorbers. The amplitude reflection coefficient should be below 10% throughout the cm-waves range and also in part of the m-waves range. Matching conditions derived from transmission line theory are evaluated by quadripole measurements. Rib absorbers are used as inhomogeneous absorbers because they are produced with relative ease. The reflection coefficient of such rib absorbers is measured in a coaxial line as function of the frequency for a number of parameters like surface resistivity of the foil, length of the wedge-shaped transition and total length of the sample. The electrical contact between the ribs—consisting of graphite paper and the adjoining parts of the line was found to be of great significance. Measurements with combinations of ferrite and wedge absorbers have produced a number of useful results. More measurements have to be carried out with other thicknesses of

the ferrite layer and with higher surface resistivities of the foil.

12-531 (Vol II)

RADC-TDR-62-531, Vol II, ABSORPTION AND TRANS-MISSION OF ELECTROMAGNETIC WAVES, Phase M, Part B: Combination of Magnetic Layer- and Graphite Foil Absorbers. 30 Sept 1962, Tech Annual Rpt, 23p. incl illus., 4 refs. C: AF 61(052)-154, Phys. Inst., Gottingen, Germany. Dr. H. W. Helberg, N. Roy. ASTIA: Code XX.   Unclassified

The electromagnetic properties of a ferrite layer placed in front of a metal plate are investigated. For this purpose the reflection coefficient is measured as a function of the frequency with the thickness of the sample as parameter. The measurements are carried out in a coaxial line with Ferramic E 1960 as test substance.

In order to increase the bandwidth at larger thickness of layer the ferrite is electrically shunted with a resistivity foil and the reflection coefficient of this combination is again measured as a function of the frequency. Parameters are the thickness of the ferrite layer and the surface resistivity of the foil. With this combination the operating frequency range is extended towards lower frequencies. With a ferrite layer of 25.8 mm thickness and a surface resistivity of 880 Ω $|R| \leq 10\%$ is achieved within the range of frequencies 12 to 160 mc. This corresponds to a frequency bandwidth of about 1:13. Without resistivity foil the reflection coefficient remains above 10% in the entire range.

13-18a

SSD-TR-61-18. STUDIES PERTAINING TO BAMBI, BAL-
LISTIC-MISSILE-PLUME WIND-TUNNEL RESEARCH
PROGRAM. Final Technical Documentary Note, Apr
1962, 252p. incl illus. C: AF 04(647)644, General
Dynamics/Astronautics, San Diego, Calif. ARPA 153-60.
SRN: ZR-AP-061-24. ASTIA: AD 329136, Code AA.
Secret

13-25 (Vol I)

SSD-TDR-62-25. BAMBI PHASE II TECHNICAL INVES-
TIGATIONS, SINGLE INTERCEPTOR SATELLITE (Vol I).
Second Qtrly Tech Summary rpt, 2 Jan - 2 Apr 1962. 20 Apr
1962, 436p. incl illus., tables, 15 refs. C: AF 04(695)-10,
Space Technology Labs. Inc., Redondo Beach, Calif.
ARPA Order No. 177-61. SRN: 8637-6031-NQ-000.
ASTIA: AD 329264, Code AA. Secret

13-25 (Vol II)

SSD-TDR-62-25. BAMBI PHASE II TECHNICAL INVESTI-
GATIONS, SINGLE INTERCEPTOR SATELLITE, (Vol II).
Second Qtrly Tech Summary rpt, 2 Jan - 2 Apr 1962. 20 Apr
1962, 314p. incl illus., tables, 2 refs. C: AF 04(695)-10,
Space Technology Labs. Inc., Redondo Beach, Calif.
ARPA Order No. 177-61, SRN: 8637-6031-NQ-001. ASTIA:
AD 329298, Code AA. Secret

13-25 (Vol III)

SSD-TDR-62-25. BAMBI PHASE II TECHNICAL INVES-
TIGATIONS, SINGLE INTERCEPTOR SATELLITE.
(Vol III). Second Qtrly Tech Summary rpt, 2 Jan - 2 Apr
1962. 20 April 1962, 171p. incl illus., 2 refs. C: AF
04(695)-10, Space Technology Labs. Inc., Redondo Beach,
Calif. ARPA Order No. 177-61. SRN: 8637-6031-NQ-002.
ASTIA: AD 329297, Code AA. Secret

13-47 (Phase II)

SSD-TDR-62-47. LARGE SOLID ROCKET PROGRAM -
PHASE II. Second Tech Note, 1 Mar through 31 May
1962. June 1962, 76p. incl illus., tables. C: AF 04-
(611)8012, Aerojet-General Corp., Solid Rocket Plant,
Sacramento, Calif. ASTIA: AD 329800, Code AA.
Confidential

15—WRIGHT AIR DEVELOPMENT CENTER
Wright-Patterson AF Base, Ohio

15-191a (Part IV)

WADC-TR-59-191, Part IV. RESEARCH ON HIGH TEMPERATURE ADDITIVES FOR LUBRICANTS. Final rpt, Feb 1962, 124p. incl illus., tables, 20 refs. P: 3044, T: 304405. C: AF 33(616)7853, Phase II. Monsanto Research Corp., Everett, Mass. J. O. Smith, et al. Not in OTS. ASTIA: AD 281831, Code AA.   Unclassified

Tetraphenyltin and bis(p-phenoxyphenyl) diphenyltin perform very well as antioxidants for polyphenyl ethers at 600-650° F in Bearing Rig test ratings. p-Bis (triphenyl-stannoxy) benzene is a third member of the organotin compounds screened that is an effective anti-oxidant for polyphenyl ethers. Other anti-oxidants that are effective for polyphenyl ethers are the metal salts of N,N-diphenyl-dithiocarbamic acid, triphenylbismuth and the oxides of copper. The most outstanding EP additive, from among those screened for polyphenyl ethers, is diphenyltin bis(trichloroacetate) with an EP weld point > 720 kg. Testing a variety of lubricants in a modified Shell Four Ball apparatus (modified to detect metal-to-metal contact electrically) permits following the change from hydrodynamic to boundary type lubrication with increase in loading. A tentative mechanism is proposed to explain the results of controlled oxidations of m- and p-bis(phenoxy) benzenes — oxidation of polyphenyl ethers is accompanied by bond breaking (phenyl-oxygen) and coupling or condensation of intermediate to form higher molecular weight compounds.

15-294a (Part III)

WADC-TR-57-294, Part III. RESEARCH ON LIQUID METALS AS POWER TRANSMISSION FLUIDS. Final rpt, Aug 1962, 156p. incl illus., tables, and 62 refs. P: 1428, T: 73313. C: AF 33(616)5917. General Electric Co., Schenectady, N.Y. R. C. Kumpitsch, J. R. Granan. Not In OTS. ASTIA: AD 286881, Code AA. Unclassified

A liquid metals test loop, consisting of a low-pressure flow control and monitoring loop, and a high-pressure, high-temperature liquid metals pump were constructed and tested. The low-pressure loop was debugged and tested at temperatures up to 550° F. A total operating time of 103 hours was accrued. Techniques for loop repair and maintenance were developed.

A two-staged, gear-type pump, rated at 3,000 psi, 1,000° F and one gallon per minute was designed, built, and tested. The pump was first operated with petroleum ether (Stoddard solvent) to determine its capability. A total of ten hours running was accumulated during which the pump generated 3,000 psi and flows exceeding two gallons per minute at approximately half rated speed.

The pump was run for 3-1/2 hours on NaK-77 at pressures up to 640 psi and temperatures to 780° F. Rated flow was developed at half rated speed. Tests were terminated by failure of an outlet flange stud and incipient bearing failure. Limited data was obtained and over-all efficiency was calculated.

Material testing NaK-77 to determine compatibility, friction and wear tests, and a literature survey were also conducted.

15-316a (Part IV)

WADC-TR-59-316, Part IV. MECHANISM OF WEAR OF NONMETALLIC MATERIALS. Summary rpt, June 1962, 21p. incl illus., tables, 24 refs. P: 7022, T: 73663. C: AF 33(616)6920. Armour Research Foundation, Chicago, Ill. C. H. Riesz, H. S. Weber. In OTS. ASTIA: AD 284551, Code AA. Unclassified

Friction and wear of single-crystal sapphire surfaces were studied at 10^{-6} mm Hg over a temperature range of 25 to 1550 °C. Highest coefficients of friction were found at ambient temperature, particularly when basal planes were in sliding contact. Under certain conditions fracture tracks were produced. Orientation dependence was observed up to approximately 1300° C. Friction-related basal dislocations were detected at temperatures as low 600° C. A proposed mechanism of friction and wear suggests that two types of frictional junctions are formed. At ambient temperature the junctions are adhesive in nature, highly orientation dependent, and related to surface phenomena. At elevated temperature friction is only slightly influenced by orientation, and plastic deformation, based mainly on the highly active basal slip system, leads to "weld-junctions" and flow in bulk. The relative contributions of the two types of junctions provide anomalous coefficients of friction for sapphire at or around 600° C both under vacuum and in air.

15-329a (Part I)

WADC-TR-57-329, Part I. INVESTIGATION OF ESCAPE CAPSULE SYSTEMS FOR MULTI-PLACE AIRCRAFT. Preliminary Investigation. Interim rpt, Dec 61, 85p. incl illus., tables, 10 refs. P: 1362, T: 13438. C: AF 33(616)-5017. Goodyear Aircraft Corp., Akron, Ohio. J. J. Vorachek, et al. In OTS. ASTIA: AD 273625, Code AA. Unclassified

This report summarizes the findings of an investigation conducted by Goodyear Aircraft Corporation of four escape capsule systems for a hypothetical multi-place aircraft.

Four capsule configurations are evaluated: cockpit, nose section, tandem, and individual.

Evaluation is on the basis of the total ability to perform the escape function within the operational envelope requirements and compatibility with the aircraft and mission requirements. Pitch stabilization and acceleration loads are determined by solving performance equations by an IBM 650 digital computer.

It was found that all the configurations provide the required escape potential, necessary crew comfort and access to work areas, and adequate survival potential. The individual capsule concept was found to be the most desirable arrangement on the basis of this analysis.

15-329a (Part II)

WADC-TR-57-329, Part II. INVESTIGATION OF ESCAPE CAPSULE SYSTEMS FOR MULTI-PLACE AIRCRAFT. Preliminary Design and Wind Tunnel Testing of an Individual Escape Capsule. Final rpt, Dec 61, 282p. incl illus., tables, 26 refs. P: 1362, T: 13438. C: AF 33(616)-5017. Goodyear Aircraft Corp., Akron, Ohio. F. M. Milhoan, J. J. Vorachek, and J. D'Allura. In OTS. ASTIA: AD 273626, Code AA.   Unclassified

This report presents the preliminary design and dynamic model and wind tunnel model testing of an individual escape capsule as a part of a program for the investigation of escape capsule systems for a hypothetical multi-place aircraft. The capsule will provide safe escape over an aircraft performance envelope having an 800-knot EAS from sea level to 55,000 feet and Mach 4.0 from 55,000 to 100,000 feet. The preliminary design, including major components and subassemblies, is described in detail.

Major results from stress and weight analyses are included. A preliminary performance and stability analysis of three capsule stabilization systems, including fins, boom-balloon configurations, and trailing drag bodies, was made, and a system comprised of a variable sized inflatable drag body was selected from this analysis and further analyzed. Data used for the analysis was obtained from transonic and supersonic wind tunnel tests from Mach number 0.5 to 3.0.

15-331a (Part VI)

WADC-TR-56-331, Part VI. HIGH TEMPERATURE RESISTANT ELASTOMER COMPOUNDS. Final rpt, May 1962, 144p. incl illus., tables. P: 7340, T: 734005. C: AF 33(616)-6998, Firestone Tire and Rubber Co., Akron, Ohio. D. R. McGillvary, et al. Not in OTS. ASTIA: AD 282009, Code AA.   Unclassified

An extensive compounding investigation of ethylene-propylene elastomer, including some statistically designed experiments, was made. The best heat stabilizing system evaluated for ethylene-propylene elastomer was a combination of antimony trioxide and Hypalon. Compounding data on Diene, Coral, Zetafin, hydrogenated butadiene/methylmethacrylate, and blends of Diene with butyl, SBR, Coral and Hevea elastomers are reported. Stress relaxation measurements were made at 300 and 350°F on some

of the more heat resistant compounds. Silicone and Viton elastomers had the slowest relaxation rates. Exposure of certain vulcanizates to radiant heat of 1000°F and contact with an 800°F plate was accomplished and the results photographed. Static fatigue experiments on HT-1, polyester (Terylene) and nylon 66 tirecords were conducted. Additional adhesion data on HT-1 to resin-cured butyl was obtained. A new technique for measuring the inherent thermal stability of vulcanized compounds has been devised which utilizes a modified high temperature chromatograph. Ethylene-propylene elastomer was one of the most stable elastomers evaluated.

15-404a (Part III)

WADC-TR-59-404, Part III. DEVELOPMENT OF PARTIALLY VOLATILE BRAZING FILLER ALLOYS FOR HIGH-TEMPERATURE APPLICATION AND RESISTANCE TO OXIDATION. Final rpt, Jul 1962, 45p. incl illus., tables, 9 refs. P: 7351, T: 73516. C: AF 33-(616)-6882, Armour Research Foundation, Chicago, Ill. Nikolajs Bredzs, et al. In OTS. ASTIA: AD 285510, Code AA.   Unclassified

It has been shown thermodynamically and confirmed experimentally that a high vapor pressure constitutent of a given filler metal can be volatilized in a shorter time, or at a lower temperature, or to a greater extent, if to the given filler metal are added other constitutents, which have a larger free energy of solution in the given filler metal than the volatile constitutent has. Specifically, it has been experimentally demonstrated that additions of aluminum, chromium, silicon, and to a lesser extent iron and germanium, increase the rate of volatilization of indium from nickel. This order of effectiveness confirms, according to available thermo-chemical data, the above hypothesis. In a practical sense, the effects of the joint geometry on the ability to volatilize are discussed. Limitations on joint depth must be recognized if appreciable volatilization is to be obtained with reasonable times at temperature.

15-575a (Part III)

WADC-TR-59-575, Part III. OXIDATION OF TUNGSTEN AND TUNGSTEN BASED ALLOYS. Final rpt, Jul 1962, 58p. incl illus., tables, 21 refs. P: 7351, T: 735101. C: AF 33(616)-7888, Westinghouse Electric Corp. Research Labs., Pittsburgh, Pa. E. A. Gulbransen, et al. In OTS. ASTIA: AD 285588, Code AA. Unclassified

This paper describes new experimental work on the oxidation of tungsten and a 50 w/o tantalum-tungsten alloy. The rates of oxidation of tungsten were determined from 1150° to 1615°C in oxygen pressures of 2 to 100 Torr. Very high rates of oxidation or surface recession rates were found above 1200°C. An exponential temperature behavior for the rate of oxidation was found for all of the pressures studied. A heat of activation of 14,300 calories per mole was estimated from the data. A study of the effect of pressure on the rate of oxidation showed the fol-

lowing empirical equation could explain the weight loss data, $dw/dt = \kappa p 1.122$. A theoretical analysis of the data using the absolute reaction rate theory suggested that the rate of oxidation of tungsten was limited by a mobile adsorption process of oxygen onto a tungsten surface already covered by a surface layer of oxide. Oxidation of a 50 w/o tantalum-tungsten alloy was studied over the temperature range of 1068° to 1458°C at 152 Torr oxygen pressure. The results showed that a protective scale was formed on this alloy. A special 250 KV electron diffraction camera was developed for the study of the tungsten-gas reacting interface.

15-603a (Part III)

WADC-TR-59-603, Part III. FRICTION AND WEAR AT ELEVATED TEMPERATURES. Final rpt, Jul 1962, 40p. incl illus., tables, 8 refs. P: 7342, T: 734204. C: AF 33(616)-7648, Massachusetts Inst. of Technology, Cambridge, Mass. E. Rabinowicz, M. Imai. In OTS. ASTIA: AD 287458, Code AA.   Unclassified

A number of substances have been examined for suitability under sliding conditions in the range from room temperature to 2000 F. Low melting metals applied as surface coatings show a peak in their friction at the melting points, unless they form an oxide with good lubricating ability. Pyrolytic boron nitride and graphite have the same friction and wear properties as do ordinary forms of these materials. A discussion is presented of how information may be obtained systematically from friction-temperature runs, and examples of the various techniques are given.

15-627a

WADC-TR-59-627. RESEARCH STUDY ON GROUND EN-VIRONMENT LOADS CRITERIA FOR GUIDED MISSILES. Final rpt, Aug 1962, 82p. incl illus., tables. P: 1367, T: 13582. C: AF 33(616)-5794, Midwest Research Inst., Kansas City, Mo. M. B. Thompson, John B. Loser, Robert S. Brown. Not in OTS. ASTIA: AD 285852, Code AA.   Unclassified

A study program was initiated directed to formulation of recommended design criteria for ground environment load inputs to missiles. These loads include handling, transportation and storage loads experienced by the missile from manufacturer to launching. A review of technical literature was conducted to determine design methods and test data related to missile ground loads. Missile manufacturers were also surveyed to determine state-of-the-art and design practices employed to define missile ground environments. Based on limited available data and design experience obtained by this study, recommended missile ground load criteria are of peak or constant "g" limit load factor and an ultimate or design load factor. Load probability occurrence, spectra density, or other statistical methods of representing design loads are not recommended because of inadequate data.

15-645a (Part VI)

WADC-TR-56-645, Part VI. PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES. Interim rpt, Aug 1962, 89p. incl illus., tables, & 10 refs. P: 7381, T: 738103. C: AF 33(616)59-4, Nat'l Bureau of Standards, Wash., D. C. Matthew J. Kerper, T. G. Scuderi, E. H. Eimer. In OTS. ASTIA: AD 286892, Code AA. Unclassified

To establish realistic design criteria applicable to several special glasses certain physical properties have been determined throughout the useful temperature range of the glasses. Data is presented on several of the glasses in the program at the top temperature at which short time modulus of rupture testing can be conducted. The stress-rupture results for all seven glasses in the program are presented. The creep results obtained on PPG 6695 glass are also presented. Equations are given that have been developed to represent the mirror radius - modulus of rupture data. An analysis of the distribution of the strength values of glass is presented. A description of the apparatus used for determining the relationship between strength and size and some preliminary findings regarding the relationship are presented.

15-645a (Part VII)

WADC-TR-56-645, Part VII. PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES. Interim rpt, Aug 1962, 80p. incl illus., tables, & 14 refs. P: 7381, T: 738103. C: AF 33(616)59-4, Nat'l Bureau of Standards, Wash., D. C. Matthew J. Kerper. In OTS. ASTIA: AD 286893, Code AA.   Unclassified

A program was initiated to investigate the physical properties of several glasses that are candidates for glazing flight vehicles. The objectives of the program were: (1) Develop suitable test methods for determining the desired physical properties at room and elevated temperatures, and (2) determining the values of the desired physical properties of individual glasses over a wide temperature range.

This report contains a study and interpretation of several factors associated with the determination of Young's modulus and the modulus of rupture. The tests were performed on seven commercially available glasses and were conducted from room temperature to several degrees above their strain points.

15-762a (Part 4)

WADC-TR-59-762, Part 4. ULTRA-SHORT-TIME CREEP RUPTURE. Final rpt, Aug 1962, 203p. incl illus., tables. P: 7381, T: 738103. C: AF 33(616)-7632, American Machine & Foundry Co., Alexandria, Va. J. P. Knight, W. A. Cosby, H. W. Leavenworth. In OTS. ASTIA: AD 287528, Code AA.   Unclassified

This program involved the design and fabrication of ultra-short-time creep test equipment and utilization of the

equipment for determining the short time mechanical properties of a structural refractory metal sheet alloy at elevated temperatures. Tensile test specimens of National Research Corporation Ta-10%W alloy were strained at temperatures of 2000°F, 2500°F, and 3000°F in an argon atmosphere and in a vacuum (3000°F only). Heating of test specimens to maximum temperature was accomplished in approximately 60 milliseconds. Tensile loading of test specimens at each temperature was accomplished prior to attaining test temperature and 1/2 second, 2.0 seconds, and 5.0 seconds after attaining test temperature. A description of test apparatus, test procedures and complete test data are given by this report.

16—WRIGHT AIR DEVELOPMENT DIVISION
Wright-Patterson AF Base, Ohio

16-18b (Part II)

WADD-TN-61-18, Part II. RESEARCH AND DEVELOP-MENT ON ADVANCED GRAPHITE MATERIALS. Interim rpt, July 1962, 131p. incl illus., tables, 50 refs. AFSC P: 7350, 7381; T: 735002, 738102. C: AF 33(616)-6915, National Carbon Co., Div. of Union Carbide Corp., Lawrenceburg, Tenn. In OTS. ASTIA: AD 285284, Code AA.
Unclassified

A review is given of activities over the period October 15, 1960 to October 15, 1961 on a three year United States Air Force – Department of Defense program for the research and development of materials, experimental techniques, and equipment for development of premium quality, reproducible graphite-base materials suitable for missile and astronautic applications.

Progress is reported on research and development in the study areas of raw materials, fabrication, and material characterization and evaluation.

16-56a (Part I, Vol 4)

WADD-TR-61-56, Pt I, Vol 4. STUDY TO DETERMINE AERODYNAMIC CHARACTERISTICS ON HYPERSONIC RE-ENTRY CONFIGURATIONS: Experimental Phase, High Angle-of-Attack Force Studies on Two Hypersonic Configurations, Mach Number 8. Final rpt, Aug 1962, 34p. incl illus., tables, 11 refs. AFSC P: 1366, T: 136608. C: AF 33(616)-6649, Lockheed-California Co., Burbank, California. C. M. Onspaugh, P. J. Sullivan. LAC/565359. ASTIA: Code XX.
Confidential

This report presents the results of high-angle-of-attack experimental investigations to determine the longitudinal aerodynamic characteristics of two selected re-entry configurations at hypersonic speeds. Tests were conducted in Tunnel B at the Von Karman Gas Dynamics Facility, Arnold Engineering Development Center at Mach Number 8.0 and at angles of attack from 65° to 95°. The wind tunnel free-stream Reynolds number was 1.29 x 10^6 per foot. The configurations tested were a blunt-delta wing with 75° sweep-back and a winged conoidal body with a rectangular planform. These two configurations have been tested previously through an angle-of-attack range of -15° to 45° and reported in reference 3. Although the models tested in this series of tests were scaled-down versions of those tested previously and reported in reference 3, there is little or no scale effect apparent and a smooth continuous curve exists between the two sets of data.

16-56a (Part II, Vol 2)

WADD-TR-61-56, Pt II, Vol 2. STUDY TO DETERMINE AERODYNAMIC CHARACTERISTICS ON HYPERSONIC

RE-ENTRY CONFIGURATIONS: Analytical Phase, Design Charts. Interim rpt, Aug 1962, 281p. incl illus., tables. AFSC P: 1366, T: 136608. C: AF 33(616)-6649, Lockheed Aircraft Co., Burbank, Calif. Frank S. Malvestuto, et al. SRN: LAC/370285. Not in OTS. ASTIA: AD 286890, Code AA.
Unclassified

This volume presents charts and procedures for rapid engineering estimates of aerodynamic parameters for complete configurations and configuration components. Using the design charts and procedures presented herein, aerodynamic coefficients may be estimated for speeds covering the supersonic and hypersonic ranges of Mach number. The theoretical methods used in the preparation of this volume are discussed in Volume I of this report.

16-56a (Part III, Vol I)

WADD-TR-61-56, Pt III, Vol 1. STUDY TO DETERMINE AERODYNAMIC CHARACTERISTICS ON HYPERSONIC RE-ENTRY CONFIGURATIONS: Pressure Distribution Studies on Three Hypersonic Re-Entry Configurations, Experimental Report. Final rpt, Aug 1962, 133p. incl illus., tables, 9 refs. AFSC P: 1366, T: 136608. C: AF 33(616)-6649, Lockheed-California Co., Burbank, Calif. C. M. Onspaugh, W. L. Marcy. LAC/564291. ASTIA: AD 332072, Code AA.
Confidential

This report presents the results of wind tunnel pressure distribution studies of three hypersonic re-entry vehicle configurations at Mach numbers of 2, 5, and 8. The tests were conducted at free stream Reynolds number's of 2.0 x 10^6 to 6.0 x 10^6 per foot through an angle of attack range of -30 to +30 degrees at M = 2 and 5 and at free stream Reynolds numbers of .425 x 10^6 to 2.5 x 10^6 per foot through an angle of attack range of -45 to +45 degrees at M = 8. The configurations represented the basic delta wing, wing-body, and rectangular body from the re-entry vehicle force tests (Refs. WADD Technical Report 61-56, Part I, Vols. 1, 2, 3, and 4).

16-67a (Vol II, Suppl 1)

WADD-TR-61-67, Vol II, Sup 1. TELEMETRY TRANSDUCER HANDBOOK. Interim rpt, Feb 1962, 413p. incl illus., tables. AFSC P: 4107, Task 410719. C: AF 33 (616)-8309, Radiation, Inc., Melbourne, Fla. H. F. Fisher, Jr. Not in OTS. ASTIA: AD 276361, Code AA. Unclassified

Work has continued in bringing up to date and expanding data in WADD-TR-61-67, Vols I and II. A new "Telemetry Transducer Survey" was mailed to over 600 manufacturers. Literature search is continuing to obtain additional pertinent data for inclusion in the Handbook

Supplementary material has been prepared in standard format and is being distributed as supplements 1, 2, and 3 during 1962. The page numbering of each supplement is such that its pages are intended for insertion in Vol II of the Telemetry Transducer Handbook. Vol I will be completely rewritten. It is recognized that information on new transducer techniques developments, and related areas must be distributed rapidly to maintain an up to date amount of the state-of-the-art of Telemetry Transducers.

16-68a (Part II)

WADD-TR-61-68, Pt II. BASIC FACTORS IN THE FOR-MATION AND STABILITY OF NON-SOAP GREASES FOR HIGH TEMPERATURE APPLICATIONS. Interim rpt, Mar 1962, 35p. incl illus., tables. P: 3044, T: 304403. C: AF 33(616)-7120, Lehigh Univ., Bethlehem, Pa. John J. Chessick, A. C. Zettlemoyer. Not in OTS. ASTIA: AD 278827, Code AA. Unclassified

Principal efforts were devoted to the development of thickener solids with potential for use in non-soap greases at elevated temperatures. Next in importance was the initiation of a program to study parameters influencing the initial structural stability and use properties of inorganic solid-inorganic vehicle systems. Ion-incorporated, small diameter particles (silicas or other polar solids) were shown to have superior high temperature thickener prop-erties. Basic requirements revealed that the theoretically predicted had occurred during ion-incorporation. At tem-peratures close to the Tammann temperature of silica, for example, ionic diffusion of pre-selected inorganic com-pounds took place. As a result and without destruction of area, an outermost layer of the low free surface energy incorporating agent was made an integral part of the (surface) of silica particles. These treated solids pos-sessed far superior thickener properties based on tempera-ture and other stability test results than the untreated solids. Carbon blacks were also shown to posses good potential for use as high temperature non-soap thickeners. Initial studies of inorganic solid-inorganic vehicle sys-tems are reported.

16-71a

WADD-TR-61-71. CHEMICAL STRESS RELAXATION MEASUREMENTS ON POLYURETHANES. Final rpt, May 1962, 104p. incl illus., tables. P: 7360, T: 73615. C: AF 33(616)-7088, Armstrong Cork Co., Lancaster, Pa. S. J. Chlystak, et al. In OTS. ASTIA: AD 282837, Code AA. Unclassified

Three solid polyurethane elastomeric compositions were prepared and evaluated by static and high speed tensile tests, continuous and intermittent stress relaxation meas-urements, and also by ultrasonic techniques. This pre-liminary evaluation was conducted to evaluate chem-orheological stress relaxation as a means of characterizing polyurethane materials with regard to thermal and me-chanical stability. Energies of activation for bond scis-

sion were calculated. An annotated bibliography of stress relaxation phenomena was prepared.

16-72a (Vol II)

WADD-TR-61-72, Vol II. RESEARCH AND DEVELOP-MENT ON ADVANCED GRAPHITE MATERIALS: Appli-cations of Anisotropic Elastic Continuum Theory to Dis-locations in Graphite. Interim rpt, Jul 1962, 48p. incl tables, illus. P: 7350, T: 735002; P: 7381, T: 738102; P: 7-817. C: AF 33(616)-6915, Nat'l Carbon Co., Div. of Union Carbide Corp., Parma, Ohio. G. B. Spence. In OTS. ASTIA: AD 286090, Code AA. Unclassified

Eshelby, Read, and Shockley's theory of dislocations in an anisotropic elastic continuum has been used to derive formulas not involving complex numbers for the stress components of straight dislocations in certain symmetry directions. From these the dependence of stacking fault energy γ_F on the orientation of the Burgers vector and on the width of extended dislocations and triple partial rib-bons and dependence of γ_F on the radius of curvature of extended nodes have been calculated. The results are rigorous for hexagonal crystals and approximate for gen-eral directions in (111) planes of FCC crystals. The theory is applied to graphite and close-packed metals. All three methods of determining γ_F for graphite yield re-sults which are compatible with the value 0.6 ± 0.2 erg/cm^2. Several examples of the dependence of width of a dislocation on depth from a stress-free surface have been calculated.

16-72a (Vol VI)

WADD-TR-61-72, Vol VI. RESEARCH AND DEVELOP-MENT ON ADVANCED GRAPHITE MATERIALS: Creep of Carbon and Graphites in Flexure at High Temperatures. Final rpt, June 1962, 34p. incl illus., table, and 4 refs. P: 7350, 7381, and 7-817, T: 735002 and 738102. C: AF 33(616)-6915. Nat'l Carbon Co., Div. of Union Carbide Corp., Parma, Ohio. E. J. Seldin. In OTS. ASTIA: AD 284469, Code AA. Unclassified

Flexural creep tests have been made on molded carbons and several types of graphites over the temperature range from 2200° to 3000°C. The amount of creep was found to decrease for a carbon as the temperature of graphitization increased and as the holding time at graphitization tem-perature increased for times up to four hours.

Activation energies were determined for several standard and experimental grades of graphite from the steady state creep rates. The activation energies ranged from 23 to 92 kcal/mole and appeared to be constant for each graph-ite. The flexure experiments demonstrated a marked de-pendence of the creep on the grain orientation for the more anisotropic graphites. The grain orientation showing the highest room temperature strength shows the lowest high temperature creep. Some of the factors which influenced the creep behavior are density, crystallite size, and the orientation of the particles.

16-72a (Vol VII)

**WADD-TR-61-72, Vol VII. RESEARCH AND DEVELOP-
MENT ON ADVANCED GRAPHITE MATERIALS: High
Density Recrystallized Graphite by Hot Forming.** Interim
rpt, June 1962, 63p. incl illus., tables, 10 refs. P: 7350,
7381, 7-817, T: 735002, 738102. C: AF 33(616)-6915,
National Carbon Co., Lawrenceburg, Tenn. E. A. Neel,
et al. In OTS. ASTIA: AD 278603, Code AA. Unclassified

This report describes the mechanical and thermal proper-
ties of several types of ZT graphite. Grade ZTA is dis-
cussed in detail and its physical properties are compared
to those of other premium graphites, including pyrolytic,
over the range from room temperature to 3000°C. Specifi-
cations for Grade ZTA are established. The properties
of other grades of ZT graphite and the results from 79
subscale firings in solid fuel rocket motors at various lo-
cations, are tabulated.

16-72a (Vol VIII)

**WADD-TR-61-72, Vol VIII. RESEARCH AND DEVELOP-
MENT ON ADVANCED GRAPHITE MATERIALS: Elec-
tron Spin Resonance in Polycrystalline Graphite.** Interim
rpt, June 1962, 13p. incl illus. and 22 refs. P: 7350, T:
735002; P: 7381, T: 738102; P: 7-817. C: AF 33(616)-
6915, Nat'l Carbon Co., Div. of Union Carbide Corp.,
Parma, Ohio. L. S. Singer, G. Wagoner. In OTS. ASTIA:
Code XX. Unclassified

The electron spin resonance of polycrystalline graphite
is shown to be due to charge carriers, as for single crys-
tals. For lampblack-base graphite, the variation in g-
value with temperature agrees approximately with that for
single crystal graphite if it is assumed that the spins ef-
fectively average out the anisotropic interactions by rapid
intercrystallite diffusion. The magnitude and temperature
dependence of the spin susceptibility are found to be in
excellent agreement with McClure's theoretical predic-
tions for the charge carriers in perfect graphite. Compli-
cations of measuring these materials are discussed, in-
cluding effects of skin depth and microwave heating and
the dependence upon crystallite size and sample purity.
It is found that two types of impurities can affect the
resonance: those which become ionized and shift the
Fermi level, and large unionized atoms which do not shift
the Fermi level but act as efficient scattering centers for
shortening the spin-lattice relaxation time.

16-72a (Vol X)

**WADD-TR-61-72, Vol X. RESEARCH AND DEVELOP-
MENT ON ADVANCED GRAPHITE MATERIALS: Thermal
Reactivity of Aromatic Hydrocarbons.** Final rpt, Aug
1962, 41p. incl illus., tables, and 21 refs. P: 7350, 7381,
and 7-817, T: 735002 and 738102. C: AF 33(616)-6915,
Nat'l Carbon Co., Div. of Union Carbide Corp., Parma,
Ohio. I. C. Lewis and T. Edstrom. In OTS. ASTIA: AD
288075, Code AA. Unclassified

A general survey is given of the thermal reactivity of
aromatic hydrocarbons to provide information basic to the

understanding of the conversion of organic materials to
carbon. Differential thermal analysis was employed on
84 aromatic hydrocarbons to delineate the thermal se-
quences during pyrolysis to 750°C. Absorption spectra,
electron spin resonance, chromatography, and molecular
weight determinations have been used to determine the
mechanisms and structural changes which occur.

16-85a

**WADD-TR-61-85. DESIGN AND RELIABILITY STUDY
FOR A-C GENERATORS AND CONTROLS.** Final rpt,
Aug 1962, 51p. incl illus. and 9 refs. P: 0(2-3145), T:
61081. C: AF 33(616)-6871, Jack & Heintz, Inc., Cleve-
land, Ohio. P. M. Mueller, A. C. Osinck, and R. E. Keys.
Not in OTS. ASTIA: AD 286837, Code AA. Unclassified

The purpose of this study was to develop, design, and
test criteria for an A-C generator and the required asso-
ciated controls for aerospace applications. This genera-
tor system had a life requirement of one year. In order to
achieve the life objective, it was evident more conserva-
tive design techniques must be employed and components
exhibiting very low failure rates must be sought. In ad-
dition, the long life requirement created the problem of
demonstrating by life tests that the theoretical reliability
predictions for the generator system had been achieved.

Evidenced in this study is the necessity for early relia-
bility testing of components where there is not sufficient
data to support the life requirements for components. It
would appear testing of these components should com-
mence at least a year and a half in advance of the due
date for generator system prototype models.

The lack of sufficient life information on some compo-
nents and materials made it difficult to statistically show
a reasonable reliability figure was achievable. However,
through the extrapolation of known curves for components
and materials, a reliability of 95% was estimated for the
generator system for the one-year life requirement.

16-98a (Vol III)

**WADD-TR-61-98, Vol III. A SURVEY AND ANALYSIS
OF AIRBORNE ELECTRONIC SUBSYSTEMS AND CIR-
CUITS FOR MOLECULAR ELECTRONICS.** Final rpt,
Sep 1962, 323p. incl illus., tables. P: 4159, T: 42006.
C: AF 33(616)-7364, Melpar, Inc., Falls Church, Va.
C. L. Stansberry, W. Brown. Not in OTS. ASTIA: Code XX.
Unclassified

This report presents a survey and analysis of circuits in
subsystems and equipments now under development and
just emerging from the laboratories to determine the direc-
tion being taken in airborne electronic development. A
representative group of advanced systems was selected
from which to collect data. T.O.'s and manufacturers'
schematics and data files were used to collect and record
data. Data collection, reduction, and graphical presenta-
tion were performed using the same techniques and re-
strictions of the earlier phases. This new data was com-

pared with the results of the earlier phases to determine whether any significant changes had taken place.

Analysis of the plotted data shows that the most significant distribution maximums occurred for logic circuits, amplifiers, and pulse and wave shaper distribution, while amplifiers decreased 23.8 percent. Pulse and wave shapers decreased 16.8 percent. The plots for the circuit subgroups of each circuit type show, for example, that transistor logic circuits increased by 41.8 percent; that core memory circuits increased by 21.8 percent; flip-flops decreased by 19.5 percent; and that 79.4 percent of the oscillator-generator circuit class is composed of one-shot multivibrators and blocking oscillators.

16-123a (Part II)

WADD-TR-61-123, Part II. PROPERTIES OF YTTRIUM AND THE RARE EARTH METALS, EFFECT OF MINOR ADDITIONS TO NIOBIUM-BASE ALLOYS ON ELEVATED TEMPERATURE OXIDATION RESISTANCE. Final rpt, June 1962, 121p. incl illus., tables, 19 refs. P: 7351, T: 735103. C: AF 33(616)-6829, Research Chemicals, Phoenix, Ariz. C. G. Kirkpatrick. In OTS. ASTIA: AD 284425, Code AA.   Unclassified

Approximately 180 compositions in 19 niobium based alloy types were prepared for study. Atmospheric corrosion tests were completed for 9 series of alloys. Improved corrosion resistance is indicated for a niobium alloy containing 7% titanium, 20% tungsten, and 3% molybdenum when rare earth metals are added. Possible improvement, on the addition of rare earths, is also suggested for a niobium alloy containing 11.3% titanium and 7.9% molybdenum. Metallurgical investigations of two alloy series failed to indicate correlation between metal interface movement or microhardness values with corrosion resistance as established by weight gain measurements.

16-132a (Part II)

WADD-TR-60-132, Part II. REFRACTORY METAL CONSTITUTION DIAGRAMS. Final rpt, 185p. incl illus., tables, 43 refs. Sept 1962. P: 7351, T: 735101. C: AF 33(616)-7157, Nuclear Metals, Inc., Concord, Mass. E. J. Rapperport, et. al. SRN: 9237. In OTS. ASTIA: AD 287548, Code AA.   Unclassified

Data on six binary constitution diagrams and two ternary constitution diagrams of some of the refractory metals are presented. The binary diagrams include Mo-Os, Ta-Ir, Ta-Rh, Ta-Zr, W-Ir, and W-Rh; the ternaries are Mo-Hf-Re and Ta-W-Zr.

Care was taken to obtain reliable diagrams. In particular the purity of the constituents (99.9 percent plus) was protected at all times, and the temperatures were measured to an accuracy of ± 20°C.

16-167a (Part II)

WADD-TR-61-167, Part II. MOLECULAR CONFORMATION AND ULTIMATE PROPERTIES OF ELASTOMERS.

Mar 1962, 29p. incl illus., tables, and refs. P: 7342, T: 734203. C: AF 33(616)-6986, Akron University, Akron, Ohio. M. Morton, N. Bletso, I. Piirma. Not in OTS. ASTIA: AD 278424, Code AA.   Unclassified

Several investigations have been carried out in an effort to determine the effect of polymer-solvent interaction on the properties of bulk films cast from different solvents. Swelling, sol and stress-strain evaluations of pale crepe films, cast from the good solvents carbon tetrachloride and methyl cyclohexane and the poor solvent benzene, indicate that the films contained the same magnitude of physical entanglements. This work indicated that the differences initially obtained and previously reported were a result of chain scission processes occurring in the films cast from the good solvents. Critical entanglement molecular weights were determined from polymethylmethacrylate in good and poor solvents at 5.0% concentration. The results were in agreement with those previously determined at 1.5%. In order to determine the concentration at which polymer-solvent interaction is no longer in operation, the ratios of η good/η poor were determined at various concentrations. The data indicate that a concentration of approximately 35%, the polymer-solvent interaction is neutralized by polymer-polymer interaction.

16-181a (Part II)

WADD-TR-61-181, Part II. SUBSTRUCTURE AND MECHANICAL PROPERTIES OF REFRACTORY METALS. Final rpt, Oct 1962, 273p. incl illus., tables, 115 refs. P: 7351, T: 735101. C: AF 33(616)6838, Manufacturing Laboratories, Inc., Cambridge, Mass. B. S. Lement et al. In OTS. ASTIA: Code XX.   Unclassified

Coordinated program on substructural characteristics of W, Mo, Ta and Cb was carried out by ManLabs, M.I.T., Rutgers, U. Liverpool (Eng.) and U. Cambridge (Eng.) by means of advanced microscopic, x-ray diffraction, and mechanical testing techniques. Initial increase in hardness during recovery of heavily deformed W wire is ascribed to segregation of interstitials to dislocations and to microtwinning. Sharp drop in ductility on 1100°C anneal is attributed to rise in transition temperature to above room temperature due to increase in fiber width. Competing processes of polygonization and strain induced fiber boundary migration occur up to 1400°C. In Ta single crystals, the max. principal strain changes from positive to negative on deforming below and above the upper yield point respectively. Binding energy between dislocations and interstitials in Ta is about 0.53 e.v. For low interstitial contents, k_y increases as the dislocation density is decreased by higher annealing above recrystallization; for high interstitial contents, k_y is not affected. The activation energy for annealing-out of dislocation loops in Ta and Cb is about 3 e.v.

16-182a

WADD-TR-60-182. FEASIBILITY STUDY OF AN INFLATABLE TYPE STABILIZATION AND DECELERA-

TION SYSTEM FOR HIGH-ALTITUDE AND HIGH-SPEED RECOVERY. Final rpt, Dec 61, 151p. incl illus., tables, 30 refs. P: 6065, T: 61526. C: AF 33(616)-6010, Goodyear Aircraft Corp., Akron, Ohio. F. R. Nebiker. Not in OTS. ASTIA: AD 272754, Code AA.   Unclassified

On the basis of the theoretical and experimental wind tunnel test data obtained, it has been concluded that an inflatable sphere is a practicable stabilization and deceleration system for initial recovery from high-altitude, high-speed flight regimes (up to Mach 4.0 at 200,000 Inflatable spheres tested were fabricated utilizing standard manufacturing methods and readily available materials. The recovery system tested exhibited considerable potential as an initial stabilization and deceleration recovery system for a disoriented or tumbling high-altitude, high-speed payload. Included in this report are theoretical and wind tunnel test data on the effects of various shaped primary bodies on a secondary spherical body at various trailing distances. Also included is a limited amount of experimental data on flight testing of a full-scale operational unit.

16-184a (Part III)

WADD-TR-60-184, Pt. III. EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLICS. Final rpt, Jul 1962, 31p. incl figs., tables, 35 refs. P: 7350, T: 745001. C: AF 33(616)-7714, General Electric Co., Schenectady, N. Y. J. H. Westbrook, D. L. Wood. In OTS. ASTIA: AD 286880, Code AA.   Unclassified

Grain boundary hardening is found in this investigation to exist in many intermetallic compounds having a stoichiometric excess of active metal component and is shown to be associated both with anomalously high ductile-brittle transition temperatures common in these materials and with the "pest" phenomenon occurring in certain intermetallics. Although experiments show clearly that such grain boundary hardening is due to the adsorption of gaseous impurities such as oxygen and/or nitrogen and their segregation to grain boundary regions, the manner in which the resistance to plastic deformation is increased in these areas is not clear. The most likely mechanism is the formation of a dislocation network as found by Ainslie et al. in Fe-S alloys. Ternary additions as well as appropriate annealing treatments are shown to be a promising approach to alleviating intergranular brittleness in these materials.

16-199a

WADD-TR-61-199. CREEP-RUPTURE PROPERTIES OF SIX ELEVATED TEMPERATURE ALLOYS. Final rpt, Aug 1962, 66p. incl illus., tables. P: 7381, T: 738103. C: AF 33(616)-6200, New England Materials Lab., Inc., Medford, Mass. McBride, John G., Mulhern, Bradford, & Widmer, Robert. Not in OTS. ASTIA: AD 287486, Code AA.   Unclassified

Room temperature tensile properties, short time elevated temperature properties, and elevated temperature creep-rupture properties were determined for six widely used elevated temperature alloys. Representative commercial lots of Udimet 700 (Bar), R-235 (Bar), GMR-235 (Cast Bar), Rene '41 (Sheet), R-235 (Sheet), and Nicrotung (Cast Bar) were tested at each of three typical application temperatures. Tabulated tensile and creep-rupture data, stress versus rupture-life curves, creep versus time curves, and stress versus time to 0.2 and 1.0% total creep curves are presented.

16-251a

WADD-TR-61-251. SIMULATION OF THE TRANSIENT RE-ENTRY HEAT TRANSFER IN AN ARC WIND TUNNEL. Final rpt, Jul 1962, 91p. incl illus., tables, 21 refs. P: 1426, T: 13990. C: AF 33(616)-6874, Plasmadyne Corp., Santa Ana, Calif. P. S. Masser, Che-Jen Chen. Not in OTS. ASTIA: AD 284424, Code AA. Unclassified

An investigation of the application of an electric arc hyperthermal wind tunnel to the simulation of the aerodynamic time history of typical re-entry vehicles is presented. First the degree to which the time history can be simulated in a hyperthermal tunnel capable of making point by point tests along the trajectory is discussed and it is indicated that the transient simulation is practical with the following possible exceptions. It probably will not be possible to simulate the changes in Mach number which occur and therefore some accuracy in pressure distribution may be lost. If a high temperature arc head with appreciable heat capacity is used, it may not be practical to calibrate the gas enthalpy for the more rapidly varying trajectories. Next the engineering advantages of transient testing are discussed. General criteria for the presence of transient effects including heat penetration depth, time to establish steady state ablation, and thermal shock, are given. These results are then applied to several typical re-entry vehicles.

16-252a

WADD-TR-61-252. GROWTH AND MECHANICAL PROPERTIES OF FILAMENTARY SILICON CARBIDE CRYSTALS. Final rpt, Jun 1962, 32p. incl illus., tables, 17 refs. P: 7340, T: 73400. C: AF 33(600)-7005, Cornell Aeronautical Lab., Inc., Buffalo, N. Y. L. A. Yerkovitch, H. P. Kirchner. Not in OTS. ASTIA: AD 273997, Code AA.   Unclassified

In this investigation, silicon carbide whiskers were grown under various experimental conditions. The strength and modulus of elasticity of several whiskers were determined at room temperature. Methods of heating the whiskers for high temperature measurements were investigated. The specific gravity of the whiskers has been inferred from measurement of the unit cell dimensions by X-ray diffraction patterns. Silicon carbide whiskers were grown by pyrolysis of methyltrichlorosilane in hydrogen. In some

cases dense growths of whiskers from 1.2 to 1.5 centimeters in length and from 2 to 5 microns in diameter were observed. The longest whisker obtained thus far, was 5 centimeters in length. The tensile strength of these whiskers ranges from 100,400 to 1,650,000 psi. The elastic strain at failure varied from 0.41 to 1.10 per cent and the observed values of elastic modulus varied from 12,700,000 to 123,300,000 psi. These results indicate that silicon carbide whiskers can be strong, high modulus of elasticity materials. Much research remains to be done to improve the methods of measurement, and to define the conditions of measurement and the types of whiskers that will give the best performance as structural materials.

16-276b

WADD-TN-60-276. SOME RESEARCH EFFORTS RELATED TO PROBLEMS OF AERODYNAMIC DECELERATION. Final rpt, Nov 1961, 79p. incl illus., 23 refs. P: 6065, T: 60252. C: AF 33(616)-6372, Dept of Aeronautical Engineering, Univ. of Minnesota, Minneapolis, Minn. H.G. Heinrich. Not in OTS. ASTIA: AD 272404, Code AA. Unclassified

The status of research efforts designed to explain physical phenomena associated with the operation of aerodynamic decelerators, in particular textile type parachutes, is presented. A theoretical approach to calculate the velocity and pressure distribution in the turbulent wake of basic bodies of revolution

16-370a (Part II)

WADD-TR-60-370, Part II. THERMAL RADIATION PROPERTIES OF MATERIALS, Part II. Final rpt, Aug 1962, 72p. incl illus., tables. 12 refs. P: 7360, T: 736001. C: AF 33(616)-6630, Univ. of California, Berkeley, Calif. R. A. Seban. In OTS. ASTIA: AD 286863, Code AA. Unclassified

Spectral emittance data are presented for a number of oxidized and coated materials and these, combined with reflectances measured at low temperature, demonstrate the relative insensitivity to temperature of these spectral properties. The specification of the Hagen Rubens equation of the spectral properties of metals is investigated by comparison to data at high and low temperatures and its usefulness is shown to be due to a combination of photoelectric absorption and of possible effects of surface stress. These are described, and preliminary data are presented from a system for the measurement of emittance at high temperature, with the sample in an environment of inert gas.

16-463a (Part II)

WADD-TR-60-463, Part II. THE VAPORIZATION AND PHYSICAL PROPERTIES OF CERTAIN REFRACTORIES: Experimental Studies. Final rpt, Oct 1962, 85p. incl illus., tables, 39 refs. P: 4776, 7360, T: 736001.

C: AF 33(616)-6840, Avco Corp., Wilmington, Mass. A. A. Hasapis; et al. SRN Avco RAD-TR-60-15, Pt II. In OTS. ASTIA: Code XX. Unclassified

The vapor pressure-temperature relationships for iridium, rhodium, ruthenium, iridium plus carbon, alumina, thoria, and hafnia were studied by simple effusion and mass spectrometric methods. Vapor phase species were identified. The vapor pressure data and derived heats of vaporization and reaction are presented. The vaporization modes of the rare earth sesquioxides were studied mass spectroscopically and data which demonstrate that the mode of vaporization of these materials is strongly dependent upon the number of electrons in the 4f shell of the rare earth metal, is given. Continuously monitored effusion experiments conducted on the Mo-Si system yielded the following heats of dissociation in kcal/gm atom Si at 298°K: Liquid-$MoSi_2$, 117.8; $MoSi_2$-Mo_5Si_3, 121.5; Mo_5Si_3-Mo_3Si, 128.3; Mo_3Si-Mo, 132.9. Continuously monitored experiments on the W-Si system yielded the following approximate dissociation pressures in atms. at 1765°K: liquid-WSi_2, 3.5×10^{-6}; WSi_2-W_3Si_2, 2.6×10^{-6}; W_3Si_2-W, 1.7×10^{-6}. The surface tensions of silica and silica plus 1% oxide additives and zirconium plus uranium have been measured by a sessile drop technique. The viscosities of alumina, zirconium plus uranium, pure silica, silica plus 1% V_2O_5, silica plus 1% CoO and silica plus 1% Al_2O_3, have been determined.

16-502a (Part II)

WADD-TR-60-502, Pt II. GENERALIZED INTERPLANETARY TRAJECTORY STUDY. Final rpt, Aug 1962, 104p. incl illus., tables, 17 refs. P: 1431, T: 14014. C: AF 33(616)-6296, General Electric Co., Philadelphia, Pa. Not in OTS. ASTIA: Code XX. Unclassified

The report presents the IBM 7090 computer program for determining the initial velocity for an interplanetary trajectory when the departure and arrival date are specified, with the departure analysis maximizing the contribution derived from the rotation of the departure planet. Ephemeris positions of the Moon and all main planets, except Pluto, are used for perturbation computations. (Part I). The integration methods Cowell and Encke can be used.

16-502a (Part II, Suppl 1)

WADD-TR-60-502, Part II, Supplement 1. GENERALIZED INTERPLANETARY TRAJECTORY STUDY: Operational Procedure for the Interplanetary Trajectory Program. Final rpt, Aug 1962, 65p. incl illus. P: 1431, T: 14014. C: AF 33(616)-6296, General Electric Co., Philadelphia, Pa. Not in OTS. ASTIA: AD 286884, Code AA. Unclassified

This report describes an IBM 7090 computer program in detail and presents an operational procedure for the interplanetary trajectory program. This report discusses the input and the output of the interplanetary trajectory program and gives a computer flow chart, two sample runs

with input and output and a tabulation of Julian days, Calendar days and Table days for the years' 1960 to the end of 1964.

16-511a (Part II)

WADD-TR-60-511, Pt. II. INVESTIGATION OF THE HIGH SPEED IMPACT BEHAVIOR OF FIBROUS MATERIALS: Impact characteristics of Parachute materials. Final rpt, Feb 1962, 119p. incl illus. and tables. P: 8151, T: 73205. C: AF 33(616)-7627, Fabric Research Lab., Inc., Dedham, Mass. Robert J. Coskren, Chauncey C. Chu. Not in OTS. ASTIA: Code XX.   Unclassified

A technique has been developed which effectively characterizes the impact behavior of high strength parachute components. The present equipment will measure force and extension buildup in a webbing during impact. Further refinements in the test equipment are required to make precision measurement practical. One modification is the use of high-speed motion pictures rather than multiple-exposure stills.

Our results have shown that slow-speed (Instron) tensile behavior is not always indicative of impact response. Certain configurations are more efficient than others.

Further structural parametric studies of HT-1 materials in parachute components is recommended since results obtained during this program indicate a significant loss in energy absorption capability of the HT-1 webbings studied at impact velocities in excess of 500 feet per second.

16-517a (Vol I)

WADD-TR-60-517, Vol I. THERMO-STRUCTURAL ANAL-YSIS MANUAL. Final rpt, Aug 1962, 445p. incl illus., tables, refs. P: 1367, T: 14002. C: AF 33(616)-6066, Republic Aviation Corp., Farmingdale, L. I., N. Y. H. Switzky et al. SRN: RAC-679-1A (128A). In OTS. ASTIA: AD 286908, Code AA.   Unclassified

This Manual includes a compilation of methods of solution for thermal stress problems of the types frequently encountered by aircraft designers. Some of the methods represent original work done at Republic Aviation Corporation and others were obtained from the general literature. Where feasible, graphs and formulas are presented from which the user may obtain answers directly. These are presented in non-dimensional form to extend their applicability. In other cases, tables are furnished which describe methods of solution. Liberal use is made of illustrative problems and examples.

Within the limitations of linear elastic theory, the following problems are treated in detail: (1) Statically determinate beams, (2) Redundant beams and frames, (3) Riveted or bolted joints, (4) Plates, (5) Axially symmetric shells. For more complex linear problems, a general method of attack is presented which reduces the thermal stress problem to an equivalent mechanical loading problem.

This approach permits utilization of the great variety of analytical methods which have been developed for stress analysis of structures under purely mechanical loads. A brief review of some of these methods is included with pertinent remarks on their applicability to thermal stress problems. In many cases of practical interest, thermal effects introduce nonlinearity by causing large deflections, by affecting the mechanical properties of the material, or by introducing creep. Solutions for these problems are quite limited. However, they are discussed in some detail and a generalized stress-strain-time-temperature relationship is postulated which is applied to buckling of columns and plates.

16-540a

WADD-TR-60-540. BIBLIOGRAPHY AND TABULATION OF DAMPING PROPERTIES OF NON-METALLIC MA-TERIALS. Final rpt, Sept 62, 147p. incl illus., tables, 200 refs. P: 7351, T: 735106. C: AF 33(657)-7453, Univ. of Minnesota, Minneapolis, Minn. Sun Hwan Chi. In OTS. ASTIA: Code XX.   Unclassified

This bibliography was compiled as an aid for those people interested in damping research and related fields. It contains a nearly complete list of references on the damping properties of non-metallic materials for the period from 1929 to 1959, together with an index of nonmenclature, units, and test methods. Tabulations of the in-phase and out-of-phase components of Young's modulus and the shear modulus for the various materials are also shown, and graphical representations of experimental data indicate the loss factor values for different materials. Those values of the loss factor are compared to those of the representative structural metals.

A detailed code classification system for the field of damping is also described, and an abstract of each referenced article together with a coded supplement is also included in this report. The code is provided to aid those using the ASM-SLA punched-card system.

16-578a (Vol III)

WADD-TR-60-578, Vol III. PRELIMINARY REACTOR ANALYSIS OF A DIRECT BOILING REACTOR FOR A NUCLEAR MECHANICAL CONVERSION SYSTEM. Final rpt, Jul 1960, 211p. incl illus., tables, 3 refs. P: 3145, T: 61080. C: AF 33(616)-5815, AiResearch Mfg. Col of of Arizona, Div. of the Garrett Corp., Phoenix, Ariz. SY-5163-R. ASTIA: Code NC.   Secret-Restricted Data

A discussion of the analysis and evaluation conducted leading to a conceptual design of a small physical size direct boiling nuclear reactor for space application of a nuclear mechanical conversion system. A summary of recommendations and conclusions is included.

16-651a (Part IV)

WADD-TR-60-651, Pt IV. ADVANCED FLIGHT VEHICLE SELF-ADAPTIVE FLIGHT CONTROL SYSTEM: Notch

Filter Development. Final rpt, June 1962, 69p. incl illus., tables, 3 refs. P: 8226, T: 10889. AF 33(616)-6610, Minneapolis-Honeywell Reg. Co., Aero Div., 2600 Ridgway Road, Minneapolis, Minn. M. W. Reed, J. A. Wolfe, D. L. Mellen. MH Aero Rpt 2373-TR8. Not in OTS. ASTIA: AD 284565, Code AA.   Unclassified

The horizontal and vertical stabilizers of the X-15 rocket aircraft exhibit extremely low damped bending and torsional resonant modes. Owing to the mass unbalance of the stabilizers about their hinge lines, these modes may couple inertially with an automatic flight control system for sufficiently high system gains. Divergent oscillations possibly destructive to the aircraft can result. To prevent such coupling with the MH-96 Adaptive Flight Control System, Honeywell has developed a notch filter which provides sufficient attenuation at the resonant frequencies that these oscillations cannot occur. During this development, it was observed that inertial oscillations might also occur at lower, nonresonant frequencies. Considerable effort was expended in finding a solution to this aspect of the problem which would not compromise system performance or adaptive operation and yet would allow sufficient attenuation of the resonant frequencies to prevent coupling with the stabilizer bending or torsional modes. That a satisfactory solution has been found is evidenced by the two flights of the No. 3 X-15 with the MH-96 system that have been made prior to publication of this report. During both flights, aerodynamic performance was considered very good, and there was no evidence of inertial oscillations through any of the system rate loops.

16-734a

WADD-TR-60-734. HELICOPTER STRUCTURAL DESIGN CRITERIA ANALYTICAL SOLUTIONS OF FLIGHT AND LANDING MANEUVERS. Final rpt, June 1962, 101p. incl illus., tables, and 7 refs. P: 1367, T: 13908. C: AF 33(616)-6053, Kellett Aircraft Corp., Willow Grove, Pa. A. A. Perlmutter et al. Not in OTS. ASTIA: AD 284443, Code AA.   Unclassified

A need for analytical methods for specifying helicopter flight and landing maneuvers was established in a study of helicopter structural criteria.

The flight maneuver analysis presents methods for studying structural demonstration type maneuvers. This analysis can be used to: aid in defining the design maneuver conditions to be required by a military specification, accurately establish structural design loads for helicopters, determine such design loads for helicopter maneuvers below those which define the maximum load capability, show helicopter response to a control input, and provide a means to aid in the study of fatigue type loads. Sample calculations were performed for a number of maneuvers. Good agreement with test data was obtained for symmetric maneuvers.

In the landing maneuver analyses, equations of motion have been derived for skid type helicopter landing gears

which have an elastic-plastic property. The analysis describes the motion of the helicopter during landing and provides for the calculation of the second impact contact velocity. Sample calculations have been performed for several eccentric landing conditions. This analysis determines the information required for the calculation of load factors during landing and will be of use in establishing landing design criteria.

16-791a (Part 3)

WADD-TR-60-791, Pt 3. HIGH TEMPERATURE RESINS, ANALYSIS OF PROCESS PARAMETERS, AND EVALUATION PROCEDURES FOR FILAMENT WOUND COMPOSITES: Evaluation Procedures. Final rpt, Jun 1962, 217p. incl illus., tables. P: 7340, T: 73402. C: AF 33(616)-6737, Narmco Research & Development, Division of Telecomputing Corp., San Diego Calif. H. S. Daley, T. Siuta, S. Yurenka. Not in OTS. ASTIA: AD 282790, Code AA.   Unclassified

This report presents results of Phase III on "Evaluation Procedures for Filament Wound Composites," which was conducted for Aeronautical Systems Division under USAF Contract AF 33(616)-6737. The objective of the program was to determine the most significant basic mechanical properties of filament wound composites, and to provide optimum standardized test methods and procedures for defining them at both room and elevated temperatures. The program also included the design and fabrication of a versatile laboratory filament winding machine to fabricate these specimens. An account of the various test specimen configurations considered is presented along with a detailed discussion of those actually evaluated. The evolution and development of the various test configurations are described and construction details for each of the evaluation procedures are presented by drawings. The most satisfactory evaluation procedures for each mechanical property were determined on the basis of the data obtained. A standard cylindrical specimen was designed, from which all of the basic mechanical properties could be obtained. Detailed fabrication instructions for producing the basic specimen and some of its variations also were determined. Winding machine operating and maintenance instructions are presented in as much detail as possible. An account of the underlying theories and principles governing the design and use of this machine is given to facilitate understanding of operating instructions and the capabilities of the machine.

16-866a

WADD-TR-60-866. EXCITATION PROCESSES IN CERAMICS AND THE ANOMALOUS INCREASE IN THERMAL CONDUCTIVITY AT ELEVATED TEMPERATURES. Final rpt, Jul 1962, 10p. incl illus., table, and 16 refs. P: 7022, T: 73664. C: AF 33(616)-6194, Northwestern University, Evanston, Illinois. D. H. Whitmore. In OTS. ASTIA: AD 285283, Code AA.   Unclassified

The problem of the anomalous increase in the observed thermal conductivity on single-phase ceramics at high temperatures has been considered. At temperatures above the onset of this anomalous rise, account has been taken of the possibility that phonon, electronic, and radiative heat transfer, as well as transport of thermal energy by electron-hole pairs, excitons and dissociated gas molecules, may operate simultaneously and individually contribute significantly to the total heat flow. On the basis of reliable conductivity data on monocrystals of single-phase ceramics, estimations have been made on the magnitudes of these high-temperature components which reveal that excited states of low excitation energy may occur in certain ceramics. In these instances, such excited energy-carrying states are able to diffuse down the temperature gradient in the specimen thereby producing a non-negligible contribution to its observed thermal conductivity.

16-885a

WADD-TR-60-885. FLIGHT VEHICLE WHEEL TESTING METHODS. Final rpt, Jan 62, 88p. incl illus., tables. P: 1369, T: 13766. C: AF 33(616)-6819, Bendix Corp., South Bend, Ind.; General Tire & Rubber Co., Akron, Ohio; B. F. Goodrich Co., Troy, Ohio; Goodyear Tire & Rubber Co., Akron, Ohio. J. R. Bender, et al. Not in OTS. ASTIA: AD 273796, Code AA.   Unclassified

The purpose of this study was:

1. To establish new criteria for laboratory procedures for testing flight vehicle wheels to enable a more accurate prediction of wheel service life based on laboratory performance.

2. To determine laboratory testing methods and define any test equipment that differs from that presently used.

3. To describe means of accelerating the laboratory test procedures without undue loss of correlation with field service experience.

In accomplishing the above, a field survey was conducted, field service records were reviewed, numerous airframe manufacturers' wheel test specifications were studied, new test parameters were generated, a new wheel test specification was written, and several accelerated test methods were proposed along with a discussion of their relative merits.

Recommendations, as a result of this study contract, are that an improved system for determining the life and usage of aircraft wheels be adopted by the USAF, The Proposed New Test Specification contained herein be incorporated into Specification MIL-W-5013, and that follow-on contracts be let to determine the optimum method of test acceleration.

16-889a (Part II)

WADD-TR-60-889, Pt II. INVESTIGATION OF INTER-METALLIC COMPOUNDS FOR VERY HIGH TEMPERA-TURE APPLICATIONS. Interim rpt, July 1962, 82p. incl

illus., tables, 21 refs. P: 7350, T: 735001. C: AF 33(616)-6540. The Brush Beryllium Co., Cleveland, Ohio. Jonathan Booker, et al. In OTS. ASTIA: AD 284945, Code AA.   Unclassified

Three different areas were studied in a continuing investigation of intermetallic beryllides and silicides for very high temperature applications. The measured properties of Ta_2Be_{17} were unaffected by minor variations in stoichiometry between 800° and 3000°F, whereas best results for WSi_2 were obtained with a material slightly deficient in tungsten. WSi_2 exhibited poorest oxidation resistance at 2200°F.

Results are reported for oxidation-rate studies on $TaBe_{12}Be_{17}$, $ZrBe_{13}$, and Zr_2Be_{17} in the temperature range from 2300° to 2750°F. The vapor pressures for these same compounds were measured between 2300° and 2650°F. using the Knudsen cell technique. For $TaBe_{12}$ the activation energy for oxidation is lower than the vaporization energy in this temperature range. The oxidation products of Zr_2Be_{17} were found to be $ZrBe_5$ and BeO.

Ternary systems of beryllium and silicon with molybdenum, niobium, tantalum, tungsten, or zirconium were studied. The most promising material from these studies was a mixed-phase preparation with the stoichiometry of MoBeSi. This material exhibited less than 2 mils penetration when oxidized in air at 3000°F for 10 hours.

16-893a (Part II)

WADD-TR-60-893, Part II. RESEARCH AND DEVELOP-MENT ON HIGH-PRESSURE-HIGH-TEMPERATURE MET-ALLURGY. Final rpt, Aug 1962, 121p. incl illus., tables, 101 refs. P: 7351, T: 735103. C: AF 33(616)-6837, Man-Labs, Inc., Cambridge, Mass. S. A. Kulin et al. In OTS. ASTIA: AD 287200, Code AA.   Unclassified

The kinetics of recrystallization of polycrystalline copper (99.999% purity) cold-rolled to 98% reduction have been determined by means of an x-ray diffraction technique for the temperature range 80°-170°C at atmospheric pressure and at 42 kilobars. High pressure is found to retard both the initiation and rate of recrystallization. The effect of high pressure on the Hall voltage of cerium has been determined. A study of the pressure-temperature characteristics of the transformation of the hexagonal phase, $MoC_{0.67}$ to the cubic phase, $MoC_{0.67+x}$ has been completed. The role of carbon deficiency in the transformation was investigated. The results of a series of experiments designed to investigate pressure-quenching in several different iron-nickel alloys are reported. Thermodynamic data obtained at one atmosphere is used to correlate the high-pressure transitions in thallium and tin. Several iron-carbon alloys and plain carbon steels ranging from 0.08 to 1.23 wt percent carbon content have been subjected to various heat treatments at a pressure of 42 kilobars. A series of experiments in which pressure is used to enhance the mechanical properties of selected steels is described together with the apparatus employed.

17-5

ARL-TDR-62-5. THE ABO AND Pr BLOOD GROUP SYS-TEMS IN MAN AND CHIMPANZEE. Final rpt, July 1962, 71p. incl tables, 147 refs. P: 6892. R. H. Edwards, Capt, USAF, MC, E. S. Graff, A1C, USAF. ASTIA: AD 283424, Code AA.   Unclassified

The blood of 77 chimpanzees and individuals of five other subhuman primate species was investigated for the ABO and heterologous blood group characteristics in relation-ship to man's; the similarities and differences are pre-sented.   The Pr and anti-Pr characters are defined.

17-6

ARL-TDR-62-6. "MEGABOOM" LINEAR WINDBLAST TESTS ON SUBJECTS AND PROTECTIVE EQUIPMENT. Final rpt, July 1962, 94p. incl illus. P: 7930. C: AF 41(657)-405, Northrop Space Lab., Northrop Corp., Haw-thorne, Calif. J. P. Stapp, Col, USAF (MC), J. D. Mosely, Maj., USAF (VC), C. F. Lombard. ASTIA: Code XX.
Unclassified

This report presents information on 6 rocket sled experi-ments to investigate the effects of supersonic windblast upon personnel and personal protective equipment. Five chimpanzees and 1 human dummy were used as test sub-jects.   Velocities ranged from 1,330 to 1,922 ft/sec; stagnation pressures of 18 to 42 lbs/sq inch, or loads of 2,500 to 4,000 lbs/sq ft. Standard restraints and garments proved inadequate and extensive injuries established the need for improvements.   Restraints and garments were progressively improved until protection of the test subject was achieved.

17-16

ARL-TDR-62-16. CHIMPANZEE PERFORMANCE ON A TWO-DIMENSIONAL DISCRETE TRACKING TASK. Interim rpt, July 1962, 23p. incl illus.   P: 6893, T: 689301. M. E. Grunzke, Major, USAF, F. H. Rohles, Jr., Lt Col, USAF, R. E. Belleville.   ASTIA: 283425, Code AA.   Unclassified

A chimpanzee was trained to perform a two-dimensional discrete tracking task with 25 target positions in each dimension.   Performance required manipulation of two levers to align the tracking indicants with the target. Subsequent to this, the operation of a third lever resulted in the delivery of a food pellet reward and presentation of a new set of targets to be matched.

17-17

ARL-TDR-62-17. COUNTDOWN AND PROCEDURES FOR PROJECT MERCURY ATLAS-5 FLIGHT (CHIMPANZEE

SUBJECT).. Final rpt, Oct 1962, 90p. incl illus. Engi-neering Service Plan 921E-9039. N. E. Stingely, Capt, USAF. ASTIA: AD 288921, Code AA.   Unclassified

This report presents the countdown and detailed procedures followed to prepare the chimpanzee subject and couch for flight in the Project Mercury capsule, and the post-flight release and care of the subject.   It summarizes experi-ences gained during the Mercury Redstone-2 and the Mercury Atlas-5 flight programs.

17-18

ARL-TDR-62-18. THE EFFECT OF IMPACT UPON THE PATELLAR AND OTHER DEEP TENDON REFLEXES. Interim rpt, Aug 1962, 12p. incl illus. P: 7850, T: 785001. E. R. Taylor, Major, USAF, L. W. Rhein, Capt, USAF, James F. Ferguson III, SMSgt, USAF. ASTIA: Code XX.
Unclassified

Alterations of the deep tendon reflexes have been fre-quently observed in humans after impact. A series of experiments was conducted to study reflexes in humans undergoing a 15 seat G impact, with a control group under-going a 5 seat G impact. Using standard clinical examina-tion and notation techniques, no quantitative differences were noted between the experimental and control groups. In the opinion of the medical examiners, however, a slight increase in "briskness" was found in the experimental group in contrast with the control group. Development of a reflex sensor suitable for sled testing is necessary for further work in this investigation.

17-20

ARL-TDR-62-20. A MICRO TECHNIQUE FOR BLOOD GROUPING INVESTIGATIONS. Interim rpt, Sept 1962, 13p., 15 ref. P: 6892. E. S. Graff, A/1C, USAF, R. H. Edwards, Major, USAF. ASTIA: AD 284684, Code AA.
Unclassified

A micro method for hemagglutination reaction testing in-cluding hemagglutinin adsorption, titer determination, and elution with minute quantities of blood is described.

17-21

ARL-TDR-62-21. THE RELATIONSHIP BETWEEN SKIN TEMPERATURE AND PERFORMANCE IN THE JAVA MONKEY. Interim rpt, Aug 1962, 16p. incl illus., and tables. P: 6893, T: 689302. Robert D. Bush, A/1C, USAF, F. H. Rohles, Jr., Lt Col, USAF, H. H. Reynolds, Major, USAF. ASTIA: AD 286167, Code AA. Unclassified

Four male Java monkeys (macaque iris), trained to perform a continuous avoidance task, were used in an exploratory

study of diurnal skin temperature changes and their rela-
tionship to avoidance behavior. Significant diurnal skin
temperature changes were detected, and a relationship
with performance was shown to exist.

17-22

**ARL-TDR-62-22. HYGE SHOCK TEST FACILITY AT
6571ST AEROMEDICAL RESEARCH LABORATORY.**
Final rpt, Sept 1962, 25p. incl illus. P: 7850, T: 785001.
William F. Hock, A/1C, USAF. ASTIA: AD 286168,
Code AA.   Unclassified

The HYGE Shock Tester is a unit produced by the Con-
solidated Electro-Dynamics Corporation as a test device
to generate high acceleration (G) forces for short duration
time periods. The HYGE Shock Tester will also ac-
curately reproduce these shock pulses. A total of 90
preliminary runs was accomplished on the unit installed
at the 6571st Aeromedical Research Laboratory during
which time a detailed review of system operational char-
acteristics and vibrations throughout the system was
studied.

17-23

**ARL-TDR-62-23. A SIMPLE REFLEX SENSOR; A DE-
SCRIPTION AND TRIAL USE.** Interim rpt, Sept 1962,
16p. incl illus. P: 7850, T: 785001. E. R. Taylor,
Major, USAF, R. F. Chandler. ASTIA: AD 286850,
Code AA.   Unclassified

A simple device for the quantitative measurement of deep
tendon reflexes was designed with locally available ma-
terials. This device consists of a strain gage accelerom-
eter and mounting, a battery source, and an electrocardio-
graphic recorder. Preliminary clinical investigation with
this device indicates that the device has both practical
and theoretical advantages over other existing reflex
sensing and recording devices.

17-24

**ARL-TDR-62-24. MEASUREMENT OF SOLAR FLARE
PRODUCED COSMIC RADIATION.** Final rpt, Oct 1962,
77p. incl illus. and tables. P: 6892, T: 689206. dePaul
J. Corkhill, Major, USAF, R. A. Hollman, Capt, USAF,
R. J. Lockhart, S/Sgt, USAF. ASTIA: Code XX.
                                                Unclassified

To determine the intensity and energy spectrum of radia-
tion in the atmosphere following a solar flare, an instru-
ment package consisting of a scintillation telescope (for
protons), low and high energy neutron detectors and a
shielded Geiger Counter was designed and built. The
system was carried to altitudes of 120,000 to 130,000 feet
by polyethylene balloons on two occasions during July
1961. On a third flight, which took place during condi-
tions of very high radiation in the atmosphere due to a
solar flare, the balloon ruptured at 90,000 feet, so data
were obtained on this flight for only a short time.

18-4

PRL-TDR-62-4. VALIDATION OF PERSONALITY TESTS AS MEASURES OF TRAIT-RATING FACTORS. Final rpt, Apr 1962, v + 36p. incl illus., tables, 14 refs. P: 7717, T: 771706. C: AF 41(657)-269, Univ. of Mich., Ann Arbor, Mich. W. T. Norman. In OTS. ASTIA: AD 285184, Code AA. Unclassified

As the final phase of a test-development project 3 forced-choice self-report tests were administered to student groups to develop empirical scales predictive of peer-nomination personality ratings drawn from the same groups. Five factor scales were developed for each test. For the independent sample of a double cross-validation analysis, all of the scales correlated positively with their criteria. Combined scales for the 3 tests showed usefully high correlations. Multiple regression analyses demonstrated that scores from other personality tests administered to the students did not add appreciably to prediction of the peer-nomination scores. The self-report tests yield better prediction (.38 - .47) of 3 of the peer-nomination factors (Extroversion, Conscientiousness, Culture) than of Agreeableness (.31, .34) or Emotional Stability (.26, .29). From a second administration of the self-report tests with instructions to fake responses favorable for acceptance for officer training, detection keys were derived that identified a high percentage of faked performances, and factor scales were developed which reduced the occurrence of faked scores in the extremes of the distributions.

18-5

PRL-TDR-62-5. PREDICTION OF UNFAVORABLE DISCHARGE BY SEPARATE EDUCATIONAL LEVELS. Final rpt, Apr 1962, iv + 10p. incl tables. P: 7719, T: 771902. C: AF 41(657)-402. Service Bureau Corp. Mary Agnes Gordon, R. A. Bottenberg. In OTS. ASTIA: AD 284802, Code AA. Unclassified

Many airmen meet enlistment standards, but nevertheless are discharged for unsuitability or failure to advance. A more precise means of identifying men not likely to succeed in the Air Force is needed. This study tests the hypothesis that different combinations of tests might be needed for men with little schooling than for those at a higher level of education. Multiple regression analyses of the data for two large samples of airmen showed little gain in accuracy of prediction by separate composites for three educational levels. Of the individual predictors of Air Force success, amount of education proved the most valid, further justifying the Air Force in limiting recruitment to high school graduates.

18-6

PRL-TDR-62-6. CALIBRATION OF AIR FORCE SELECTION TESTS TO PROJECT TALENT NORMS. May 1962, iv + 20p. incl tables. P: 7717, T: 771705. C: AF 41(657)-324, American Inst. for Research, Washington, D.C. J. T. Dailey, Marion F. Shaycoft, D. B. Orr. In OTS. ASTIA: AD 285185, Code AA. Unclassified

To tie in norms for Air Force personnel tests with the full range of talent in the recruitment population, the Project TALENT test battery was given to a sample of basic airmen. The sample was split into halves, each numbering over 1200 airmen. By multiple regression techniques, applied separately to each half sample, composites of TALENT tests were selected to predict scores on each of 27 Air Force tests. Close agreement between the two samples on tests selected and regression weights derived gives confidence in the results. Tables were prepared of equivalent scores between each Air Force test and the best composite of TALENT tests.

18-7

PRL-TDR-62-7. DEVELOPMENT OF AIRMAN QUALIFYING EXAMINATION—62. May 1962, iv + 12p. incl tables. P: 7717, T: 771705. C: AF 41(657)-381, American Inst. for Research, Washington, D.C. Dorothy S. Edwards, C. P. Hahn. ASTIA: AD 284775, Code AA. Unclassified

This report describes the development and standardization of the 1962 form of the Airman Qualifying Examination (AQE-62) for use in the selective recruitment program. It was designed to parallel the AQE-F, its immediate predecessor, except that an unspeeded arithmetic test was substituted for two speeded tests to avoid difficulties in field administration of speeded tests. The AQE-62 and other airman selection and classification tests were administered to nearly 2500 basic airmen. Percentile scores for the aptitude indexes (Mechanical, Administrative, General, Electronics) were determined by the method of equipercentile conversion. The AQE-62 aptitude indexes correlated with the AQE-A indexes around .80, and the pattern of intercorrelations for the two forms was similar, indicating that the new form closely parallels its predecessor.

18-8

PRL-TDR-62-8. ATTITUDES AND CAREER INTENTIONS OF OFFICER TRAINING SCHOOL STUDENTS. May 1962, iii + 8p. incl illus. P: 7719, T: 771902. F. D. Harding, R. A. Bottenberg. In OTS. ASTIA: Code XX. Unclassified

Questionnaire responses indicating attitudes of students toward an Air Force career were analyzed for 12 Officer

Training School classes. Results indicate that about 35% of the students plan to make a career of the Air Force. The chief reasons for applying for OTS were identified as prestige and status of being an Air Force officer and the opportunities for travel and additional education. Using responses to selected items of the questionnaire which could become available at the time the candidate applies for OTS, it was possible to develop a Retainability Score which was highly indicative of the OTS graduate's intent to make the Air Force a career.

18-9

PRL-TDR -62-9. PREDICTION OF AIRMAN SUCCESS FROM RESPONSES TO ITEMS OF THE KELLEY AC-TIVITY PREFERENCE REPORT. Final rpt, June 1962, iii + 5p. incl tables. P: 7719, T: 771902. C: AF 41(657)-412, Service Bureau Corp., San Jose, Calif. B. Fruchter. In OTS. ASTIA: AD 289620, Code AA.
                                            Unclassified

Items from a self-report inventory of personal background and activity preferences were selected by various methods and combined to predict successful completion of first-term enlistment. Two samples of airmen (2000 each) were used, each divided into a success group and a nonsuccess group for item analysis and validation purposes. Selection and weighting of valid items was determined on the initial sample; the scoring procedures were cross validated on the second sample. Although optimal item weighting produced higher validity with the initial sample, unit weighting of the most valid items proved as effective in cross validation.

18-10

PRL-TDR-62-10. SOME APTITUDE DATA ON AIR FORCE ENLISTED ACCESSIONS. June 1962, iv + 12p. incl illus., tables. P: 7717, T: 771705. W. B. Lecznar. ASTIA: Code XX.   Unclassified

The Air Force uses information about the aptitudes of recruits in selecting and assigning enlistees. This report summarizes the data about enlistments during the past six years in terms of scores on Air Force tests. From year to year the trend in average scores has been upward, but with consistent cycles within each year in terms of monthly averages. Limited data on civilian means for Air Force tests and airman means on the Project TALENT tests yield some comparisons of Air Force talent with the general male population of high school seniors.

18-11

PRL-TDR-62-11. IMPORTANCE OF SITUATIONAL FACTORS IN THE MEASUREMENT OF OFFICER EF-FECTIVENESS. July 1962, iii + 10p. incl tables. P: 7717, T: 771701. F. J. Vanasek, R. A. Bottenberg. In OTS. ASTIA: Code XX.   Unclassified

The Officer Effectiveness Report is an important instru-ment in management of officer personnel. If factors not related to job performance affect the ratings, their influ-ence should be taken into account. This study investi-gates the extent to which officer specialty, command assignment, and military grade affect distribution and reliability of effectiveness ratings. By applying multiple linear regression and analyses of variance techniques to ratings of 1500 Air Force officers, variance of ratings was apportioned between performance and nonperformance factors. When the effects of the three nonperformance factors is removed, the reliability of the ratings is lowered, but relevance to differences in job performance is increased. The influence of military grade on effec-tiveness ratings is greatest of the three situational factors, but all contribute significantly. It is assumed that the relationships come about through a number of influences, including systematic selection for mission, assignment, and promotion.

18-12

PRL-TDR-62-12. PREDICTION OF TECHNICAL SCHOOL SUCCESS FROM HOMOGENEOUS BIOGRAPHICAL IN-VENTORY SCORES. July 1962, iii + 9p. incl tables. P: 7717, T: 771705. L. D. Brokaw. In OTS. ASTIA: Code XX.   Unclassified

A personal questionnaire, the Biographical Inventory, was part of the airman classification batteries up to 1959, with separate groups of items keyed for different job areas. This paper reports how the items of the most recent classification battery were assorted into 15 clusters on the basis of high correlations among items of each cluster. The scores for each group (homogeneous keys) were correlated with success in training for gradu-ates of 8 Air Force training schools. The keys for Economic Level and Educational Success were the most generally valid. By multiple regression techniques, it was found that prediction of training school grades was almost as good from a regression equation based on graduates from all 8 schools as from separate equations for schools in each job area. Composite scores combining the inventory scores and the aptitude index were signifi-cantly more valid than the aptitude indexes alone (average .43 vs .46); but a simplified combination of the 3 or 4 most valid inventory keys with the aptitude index proved equally valid. Under conditions existing at the time these data were collected, a short biographical inventory con-sisting of 4 or 5 of the homogeneous scales would add significantly to the validity of aptitude indexes derived from the last Airman Classification Battery.

18-13

PRL-TDR-62-13. OSCAR: OPTIMUM SELECTION, CLASSIFICATION, AND ASSIGNMENT OF RECRUITS. July 1962, iv + 11p. incl illus., tables, 10 refs. P: 7719, T: 771901. F. E. Holdrege. In OTS. ASTIA: AD 285186, Code AA.   Unclassified

Three mathematical models, adaptable for electronic processing machines, are described in nontechnical terms and illustrated by applications to personnel procurement and assignment problems. Emphasis is on capability for providing management with meaningful information for controlling a complex personnel system.

18-14

PRL-TDR-62-14. PREDICTING SUCCESS OF LOW APTITUDE AIRMEN. Aug 1962, iv + 10p. incl tables. P: 7719, T: 771902. Mary Agnes Gordon, E. S. Flyer. In OTS. ASTIA: Code XX. Unclassified

This study examines the performance characteristics of a group of low-aptitude airmen who entered the Air Force during the first 6 months of 1956 and who either completed successfully a 4-year enlistment or were discharged for unsuitability or nonadvancement. It was found that a brief composite of aptitude tests and preservice educational level differentiated the successes from the failures quite well. When it is necessary to recruit from low-aptitude airmen, the additional screening would select those most likely to be of value to the Air Force.

18-15

PRL-TDR-62-15. RANKORDER ESTIMATES OF THE TIME REQUIRED FOR CROSSTRAINING AMONG 98 AIRMAN SPECIALTIES. Aug 1962, iv + 19p. incl tables. P: 7734, T: 773402. Marion E. Hook, R. S. Massar. In OTS. ASTIA: Code XX. Unclassified

When data based on experience are not available, it is often possible to obtain estimates of the relative time required to crosstrain personnel qualified in one specialty to equal proficiency in a second specialty. This paper reports the first study on devising efficient methods for collecting and analyzing such estimates. A procedure was developed for collecting data to form a matrix describing the relative crosstraining-time demands for movements among a group of specialties. Rankorder estimates of the crosstraining-time requirements for the 9506 movements possible among the 98 5-level specialties were obtained from 477 Command and Staff College student officers. A computer program for hierarchical grouping was applied to these data to cluster specialties into groups such that crosstraining-time between specialties within groups is minimized. Mean crosstraining-time estimates were computed at each stage of the clustering procedure as a criterion for evaluating the cost of reducing the number of clusters. For illustrative purposes, the hierarchical structure at the 40-cluster stage is compared with the 40 career-field designations of the 98 specialties.

18-18

PRL-TDR-62-18. PREDICTION OF RETIREMENT OF AIR FORCE OFFICERS. Aug 1962, iii + 6p. incl tables. P(T): 6755(05). F. D. Harding, R. A. Bottenberg,

R. L. Downey, 1st/Lt., USAF. ASTIA: Code XX. Unclassified

Personal data such as age, family status, rate of promotion, type of duty, and educational achievement were used to predict whether officers of the Air Force Systems Command were retired or on active duty. Regression analyses were computed for a sample of regular officers to predict voluntary retirement, and for a sample of reserve officers to predict both voluntary and involuntary retirement. Prediction of reserve officer involuntary retirement was highest (R^2 = .55) with time in grade the most significant predictor. Prediction of voluntary retirement was less accurate (regular officers, R^2 = .32; reserve officers, R^2 = .15) with time in grade again the important predictor. For regular officers, flying status and time since last foreign service added significantly to prediction. A Retirement-Potential Score was developed to illustrate use of the data. As information of this kind is expanded and verified on other samples, it will aid in planning replacement of personnel losses.

18-20

PRL-TDR-62-20. CONTRIBUTION OF EDUCATION TO THE RATED EFFECTIVENESS OF OFFICERS IN SCIENTIFIC AND ENGINEERING ASSIGNMENTS. Sep 1962, iii + 7p. incl tables. P(T): 6755(02). C. J. Judy. In OTS. ASTIA: Code XX. Unclassified

Data on a sample of officers in scientific and engineering assignments were used to evaluate the role of selected educational variables as predictors of effectiveness ratings. Results, based on the solution of a series of multiple regression problems and the computation of mean effectiveness scores for subgroups of officers with different characteristics, show that variance in the ratings can be partially explained in terms of educational information on the ratees. Educational data compare favorably with data from the military record as information which can be used to foretell effectiveness scores. Data on educational level, rather than data on the completion of a designated college curriculum, are the aspects of educational information which generally serve to identify officers who will receive the higher effectiveness ratings.

18-21

PRL-TDR-62-21. COMPARISON OF INSTRUCTOR APTITUDE TEST SCORES AND GENERAL APTITUDE INDEXES ACHIEVED BY A SAMPLE OF BASIC AIRMEN. Sep 1962, iii + 3p. incl tables. P(T): 7717(05). C. J. Mullins. ASTIA: Code XX. Unclassified

The Instructor Aptitude Test, which was designed to screen applicants for instructor positions in the Air Training Command, has previously demonstrated validity for success in the technical instructor training schools. This report considers the possibility that the General Aptitude Index may be a practical substitute for the Instructor Aptitude Test. It gives intercorrelations of part

scores on the Instructor Aptitude Test and the four aptitude indexes derived from the Airman Qualifying Examination for a large sample of basic airmen, showing that the General Aptitude Index is highly correlated with the Instructor Aptitude Test. Tables give equivalent scores on the two measures and expected percentages that would achieve a given IAT score for each General AI level. This information makes it possible to screen airmen for instructor training on aptitude information available for all airmen.

19-19

MRL-TDR-62-19. HELMET IMPACT TESTS. Final rpt, Apr 1962, v + 24p. incl illus., 2 refs. P: 6301, T: 630104. C: AF 33(600)-39536, International Latex Corp., Dover, Del. H. D. Reihm, Jr. Life Support Systems Lab. In OTS. ASTIA: AD 283950, Code AA. Unclassified

Several helmets, designed and tested to determine which shell thickness and which type of suspension afford maximum protection during high-energy collisions and provide comfort during normal use, are discussed. There are many factors which influence the design of a satisfactory crash helmet; however, a combined analysis of three of its basic properties—reduction of acceleration, reduction of the rate of onset of acceleration, and the absorption of kinetic energy—is sufficient to reveal the relative performance of each helmet design. Tests which determine these basic properties are discussed. An analysis of the data correlated in graphical form shows an optimum helmet thickness and the most satisfactory suspension system of those studied.

19-20

MRL-TDR-62-20. TRYOUT OF A PRELIMINARY PROCEDURE FOR SYSTEMATICALLY DESIGNING PERFORMANCE AIDS. Final rpt, Apr 1962, iv + 63p. incl illus., 5 refs. P: 1710, T: 171004. C: AF 33(616)-7233, American Inst. for Research, Pittsburgh, Pa. J. D. Folley, Jr., H. H. Shettel. Behavioral Sciences Lab. In OTS. ASTIA: AD 283605, Code AA. Unclassified

Performance aids are devices or documents that facilitate task performance by humans in a system. A procedure for designing such aids was given a limited-scope tryout on a portion of the Atlas E system. No evidence was found to contradict the performance aids recommendations generated by the procedure. The major change made in the procedure as a result of the tryout is to require providing performance aids for every task in a system except for tasks in which use of an aid would result in too slow performance. Training programs in the auto-instructional format are recommended as a routine addition to the performance aids complement. Five specific aids are recommended for the Atlas E system. Three important research problems are suggested for future research on performance aids development.

19-21

MRL-TDR-62-21. ACOUSTICAL EVALUATION OF THE GENERAL SOUND CONTROL, INC., CLASS III JET GROUND RUNUP NOISE SUPPRESSOR. Final rpt, May 1962, viii + 49p. incl illus., tables, 11 refs. P: 7231, T: 71787. Biomedical Lab. C: AF 33(616)-5744, Western Electro-Acoustic Lab., Inc., Los Angeles, Calif. K. Eldred, J. Ortega. ASTIA: AD 285319L, Code MD. Unclassified

Two complete acoustical evaluations were made of a General Sound Control ground runup noise suppressor operating with an F-102 and F-105 aircraft at military power. Average far field reduction for the 0°-180° region varies from 0 to 12 db, depending on frequency and noise source. The suppressor is better at high frequencies with the F-105 than with the F-102. Negligible noise reduction is achieved in the first octave band for both. F-105 data levels off to 11 db between 75 and 1200 cps, then to slightly lower values in the last three octave bands. F-102 data has an 11 db peak in the 75-150 cps band, and decreases gradually to negligible values in the last two octave bands. The suppressed average far field spl's at military power for both aircraft are controlled by the noise emitted by the exhaust opening, the annular augmenter opening and the suppressor intake adaptor opening. The exhaust area controls the low frequency end of the noise spectrum, while the rest of the spectrum is controlled by the secondary air openings.

19-22

MRL-TDR-62-22. ACOUSTICAL EVALUATION OF THE AIR LOGISTICS CORPORATION JET GROUND RUNUP NOISE SUPPRESSOR MODEL 11000. Final rpt, May 1962, vii + 41p. incl illus., tables, 11 refs. P: 7231, T: 71787. Biomedical Lab. C: AF 33(616)-5744, Western Electro-Acoustic Lab., Inc., Los Angeles, Calif. K. Eldred, J. Ortega. ASTIA: AD 285320L, Code MD. Unclassified

A series of acoustical evaluations were made of an Air Logistics Corp. ground runup noise suppressor, Model 11000 operating with an F-100D aircraft at both military and afterburner powers. Results give acoustical performance of the suppressor in near and far fields. Average far field noise reduction at military power for the 0°-180° region varies from 10 to 13 db below 300 cps, from -3 to 4 db above 300 cps. Low values of noise reduction at higher frequencies are caused by the suppressor's large open area, which augments secondary air. A resonance condition in the suppressor produces an intense pure tone of 400 cps. Because of this resonance, the 300-600 cps octave band dominates the acoustic noise in both near and far fields. The noise reduction for afterburner operation is considerably higher than that for military power. This is attributed to the use of water in the suppressor during afterburner power operation and the disappearance of the resonance condition mentioned above.

19-23

MRL-TDR-62-23. ACOUSTICAL EVALUATION OF THE INDUSTRIAL ACOUSTICS CO., INC., TYPE I DURA-STACK AIRCRAFT NOISE SUPPRESSOR. Final rpt, May 1962, vi + 27p. incl illus., tables, 11 refs. P: 7231, T: 71787. Biomedical Lab. C: AF 33(616)-5744, Western Electro-Acoustic Lab., Inc., Los Angeles, Calif. K. Eldred, J. Ortega. ASTIA: AD 285420, Code AA. Unclassified

The results of an acoustical evaluation of an Industrial Acoustics Company, Inc., Type I Durastack aircraft noise suppressor are presented. Data were obtained for suppressor operation with an F-100F aircraft operating at military power. The far field average spectra are shown to be controlled by a resonance condition in the suppressor with a measured frequency of 197 cps. Hence, the 150-300 cps octave band level is 10 db higher than the next highest octave band level. The $0°-180°$ spectrum has a value of 82 db spl in the 18.75-37.5 cps octave band and rises rapidly to 107 db in the 150-300 cps octave band, then decreases to 73 db in the 4800-9600 cps octave band. The shape of the average near field spectrum is similar to that of the far field, with a peak value of 119 db spl in the 150-300 cps octave band. The suppressed far field average sound pressure levels at military power operation are shown to be controlled by the noise radiated from the suppressor walls with some contribution from the aircraft adaptor secondary air opening in the 150-300 cps octave band.

19-24

MRL-TDR-62-24. ACOUSTICAL EVALUATION OF THE KOPPERS CO., INC., MODEL 30-S CLASS II JET GROUND RUNUP NOISE SUPPRESSOR. Final rpt, May 1962, viii + 49p. incl illus., tables, 11 refs. P: 7231, T: 71787. Biomedical Lab. C: AF 33(616)-5744, Western Electro-Acoustic Lab., Inc., Los Angeles, Calif. K. Eldred, J. Ortega. ASTIA: AD 285321L, Code MD. Unclassified

Two complete acoustical evaluations were made of a Koppers Company, Inc., Model 30-S Class II ground runup noise suppressor operating with an F-102 and F-105 aircraft at military power. Average far field noise reduction with the F-102 for the $0°-180°$ range is greatest at low frequencies, decreasing gradually to negative values at high frequencies. Maximum value of average noise reduction is 10 db in the 75-150 cps band. Minimum average value is —5 db in the 2400-4800 cps band. Average noise reduction is greater with the F-105. Maximum value of average noise reduction is 13 db in the 75-150 cps band, minimum value is 3 db in 1200-2400 cps band.. Suppressed average far field spl's for both aircraft are controlled by the aerodynamic suppressor exhaust and suppressor intake adaptor noise sources. The aerodynamic and exhaust sources control in the low frequencies and the remainder of the noise spectrum is controlled by the exhaust source with some contribution

from the suppressor intake adaptor opening in the last two octave bands.

19-25

MRL-TDR-62-25. ACOUSTICAL EVALUATION OF THE KOPPERS CO., INC., CLASS III JET GROUND RUNUP NOISE SUPPRESSOR. Final rpt, May 1962, viii + 49p. incl illus., tables, 11 refs. P: 7231, T: 71787. Biomedical Lab. C: AF 33(616)-5744, Western Electro-Acoustic Lab., Inc., Los Angeles, Calif. K. Eldred, J. Ortega. ASTIA: AD 285587, Code AA. Unclassified

Two complete acoustical evaluations were made of a Koppers Company, Inc., Class III ground runup noise suppressor operating with an F-102 and F-105 aircraft at military power. Average far field noise reduction of the suppressor at military power with the F-102 for the $0°-180°$ region is greatest at low frequencies. Maximum value of average noise reduction is 16 db in the 75-150 cps band and minimum average value is 9 db in the 2400-4800 cps octave band. Average noise reduction is greater when the F-105 is used as the noise source with maximum value of average noise reduction of 20 db in the 75-150 cps band and minimum value of 14 db in the 1200-2400 and 2400-4800 cps octave bands. Suppressed average far field spl's at military power for operation with both aircraft are shown to be controlled by the exhaust and secondary air noise sources. The secondary air and exhaust sources control in low frequencies and higher frequencies are controlled by the secondary air sources.

19-26

MRL-TDR-62-26. CUTANEOUS TOXICITY EVALUATION OF AIR FORCE DEVELOPMENT MATERIALS— V. Final rpt, Apr 1962, iv + 12p. incl tables, 7 refs. P: 6302, T: 630201. Biomedical Lab. C: AF 33(616)-7931, Industrial Biology Research and Testing Labs., Inc. In OTS. ASTIA: AD 283982, Code AA. Unclassified

Ten Air Force development materials were studied via the prophetic patch test method on laboratory animals to determine the primary irritant effect, gross sensitization index, and gross percutaneous toxicity of these materials. The patch test studies with rabbits indicated that none of the materials was a primary irritant, sensitizer, nor gross systemic poison. Therefore, there was no contraindication to proceeding with a Shelanski repeated insult patch test on human volunteers. The results of the human patch test indicated that all of the materials were safe to use in contact with human skin.

19-30

MRL-TDR-62-30. ABSORPTION, DISTRIBUTION AND EXCRETION OF 1,1-DIMETHYLHYDRAZINE (UDMH). Final rpt, May 1962, iii + 13p. incl tables, 6 refs. P: 6302, T: 630202. Biomedical Lab. K. C. Back, Mildred K. Pinkerton, A. B. Cooper, A. A. Thomas. ASTIA: AD 283969, Code AA. Unclassified

The absorption, distribution, and excretion of 1,1-dimethylhydrazine (UDMH) have been studied in rats, rabbits, cats, dogs, and monkeys by use of radioactive tracer and colorimetric methods. The compound is rapidly absorbed and excreted regardless of route of administration. The vital organs of the body exhibit no preferential affinity for UDMH, and large amounts are excreted unchanged. Blood levels of UDMH could not be detected in animals receiving doses of less than 10 mg/kg. Urinary concentration is the most sensitive qualitative indicator of exposure to UDMH. If symptomatology, and blood and urine levels are carefully correlated, a diagnostic-prognostic estimate of exposure can be made.

19-33

MRL-TDR-62-33. MULTI-FIELD ELECTRONIC APPARATUS FOR STUDIES OF VISUAL PERCEPTION. Final rpt, June 1962, iii + 7p. incl illus., 4 refs. P: 7183, T: 718302. Behavioral Sciences Lab. P. A. Kolers. In OTS. ASTIA: AD 283943, Code AA. Unclassified

An apparatus is described that precisely controls intensity, duration, and order of firing of gas-discharge lamps. It can be used to illuminate visual stimulus objects for either long or short exposures, and in different viewing modes. Various methods of reducing the onset variability usually encountered with gas-discharge lamps are also described. Although designed primarily for the study of contour formation and visual masking, the apparatus can be used wherever a controlled sequence of separate stimulus presentations is required, as in studies of apparent movement, critical flicker frequencies, and time-dependent series.

19-35

MRL-TDR-62-35. INVESTIGATION OF COMPOUNDS OF HIGH CALORIC DENSITY. Final rpt, May 1962, viii + 71p. incl illus., tables, 13 refs. This is a continuation of work reported in WADD TR 60-575. P: 7163, T: 716304. Biomedical Lab. C: AF 33(616)-6008, Massachusetts Inst. of Technology, Cambridge 39, Mass. S. A. Miller, H. A. Dymsza, E. L. Wick, S. A. Goldblith. In OTS. ASTIA: AD 284004, Code AA. Unclassified

Synthesis of 2,4-dimethylheptanoic acid has been completed. Preliminary acute toxicity tests indicated that 2,4-dimethylheptanoic acid has a low order of toxicity (LD_{50}-5 gm/kg) similar to other short-chain fatty acids. To facilitate metabolic studies, synthesis of the compound labeled C^{14} has begun and techniques for quantitative identification of probable metabolic products have been developed. Further studies were made of the factors influencing the caloric bio-assay. A series of animal metabolic studies has indicated that odd-carbon fatty acids may be partly glucogenic. In addition, 1,3-butanediol was utilized for energy at approximately 6.0 cal/gm in high-fat diets. The slower growth of animals fed this compound at levels up to 20 percent of the diet was due to decreased food intake. Seven-month feeding tests have verified the effectiveness of 1,3-butanediol and high-fat levels for dietary use under various conditions.

19-45

MRL-TDR-62-45. SELECTED SPEECH DURING WEIGHTLESSNESS. Final rpt, May 1962, iii + 10p. incl illus., tables, 6 refs. P: 7231, T: 723103. Biomedical Lab. C. E. Waggoner, Capt., C. W. Nixon, Ph.D. In OTS. ASTIA: AD 284688, Code AA. Unclassified

Certain characteristics of human speech exhibited under 1-g conditions may be different under weightless conditions. If such differences exist, they might interfere with satisfactory speech communication under conditions of zero gravity. Standard speech materials recorded under conditions of 0 g, 1 g, and 2-1/2 g's were evaluated by both objective and subjective methods. Results indicate that speech production is not significantly altered by brief periods of zero gravity. Reception of speech also seems to be unaffected. Both speakers and listeners indicate good speech intelligibility under conditions of weightlessness.

19-46

MRL-TDR-62-46. THE DYNACELL AND FOCAL PLANE CONCEPTS OF PHOTOTROPIC SYSTEMS APPLICATION TO OPHTHALMIC NUCLEAR FLASH-PROTECTIVE DEVICES. Final rpt, May 1962, iii + 12p. incl illus., 1 ref. P: 6301, T: 630103. Life Support Systems Lab. C: AF 33(657)-7450, Polacoat Inc., Blue Ash, Ohio. In OTS. ASTIA: AD 284059, Code AA. Unclassified

Two concepts of phototropic systems application are presented in this report. These concepts, when considered individually or in combination, make possible the development of improved, directly or indirectly actuated, phototropic, ophthalmic, nuclear flash-protective devices. By the application of a phototropic filter at the focal plane of an optical system, the attenuation of the phototropic response due to distance is minimized. Using a renewable fluid filter, a concept is presented which offers the opportunity to use the more sensitive irreversible phototropic systems while still providing reversible characteristics. The operating characteristics of these concepts are presented along with some derived theoretical relationships.

19-48

MRL-TDR-62-48. PLASTIC PACKAGING FOR SPACE FEEDING OF HEAT PROCESSED AND FROZEN FOODS. Final rpt, May 1962, v + 111p. incl illus., 28 refs. P: 7164, T: 716408. Biomedical Lab. C: AF 33(616)-7361, Central Engineering Labs., FMC Corp., Santa Clara, Calif. D. C. Crawford, D. L. Brown, V. K. Viitanen. In OTS. ASTIA: AD 283571, Code AA. Unclassified

During a space flight, man will endure stresses of considerable magnitude and duration. Researchers have emphasized the psychological importance of supplying this man with foods which retain their earthlike identity. The objective of this research was to develop a practical flexible package system for space flight feeding of heat processed and frozen foods. Feeding concepts were evaluated with regard to a number of significant factors, the more important of these being system weight, ease of zero-gravity consumption, and disposal of waste food. The concept selected for complete development features a bite-size package with integral opening device for solid foods, and a serving-size package for liquid foods. The report discusses space feeding requirements, the advantages of flexible packaging, package design, package fabrication, food preparation, filling, thermal processing, quality control, space vehicle food storage, reheating and cooling for consumption, eating technique, and waste food disposal.

19-53

MRL.-TDR-62-53. ENCAPSULATION OF FOODS. Final rpt, May 1962, iv + 19p. incl illus., tables, 8 refs. P: 6373, T: 637303. Biomedical Lab. C: AF 33(616)-7717, Southwest Research Inst., San Antonio 6, Tex. C. E. Schuetze, W. E. McMahon, L. M. Adams, W. M. Barnes. SRN: 86-1040-1. In OTS. ASTIA: AD 284005, Code AA.   Unclassified

The objectives of the research program were to investigate barrier materials meeting Food and Drug Administration standards, which may be suitable for use in the encapsulation of foods, and to prepare sample capsules of food items for evaluation. The encapsulating material must be capable of maintaining its essential properties and those of the capsule contents under ambient conditions and also in high temperature and high vacuum environments. The food in the capsules must remain uncontaminated and highly stable for six months without refrigeration. Foods of low moisture content were encapsulated in two steps, using a soft-shelled capsule with an overwrap. Fudge, pound cake, and brownies were first placed in preformed containers; caramels and pecans were first spray coated. In each case the bite-sized portions were heat-sealed into plastic bags. Foods of moderate moisture content, exemplified by meat, and foods of high moisture content, such as vegetables and fruits, were encapsulated in laminated containers with an overwrap. Extensive development of capsule forms and equipment for filling and sealing will be required to permit manufacture in quantity with assurance of maintaining sterility.

19-55

MRL.-TDR-62-55. PERCEPTION OF THE VISUAL VERTICAL UNDER REDUCED GRAVITY. Final rpt, May 1962, iv + 13p. incl illus., tables, 31 refs. P: 7184, T: 718405. Behavioral Sciences Lab. Lois R. Hammer. In OTS. ASTIA: AD 284050, Code AA.   Unclassified

Judgments of the vertical in an unstructured visual field were obtained in flight under four levels of gravity ranging from 0 G to 1 G. Reduced- and zero-gravity conditions were produced in a cargo aircraft flying a parabolic trajectory. Each of 16 subjects made 6 judgments under each of the 4 G-conditions. Results indicate that, although error of judgment of the vertical is not large, it does increase as the G-level decreases, from 1.8 degrees at 1 G to 3.5 degrees at 0 G. Conditions associated with inflight research are discussed and suggestions for future research are presented.

19-56

MRL.-TDR-62-56. DEVELOPMENT OF A NOISE EXPOSURE METER. Final rpt, June 1962, vi + 46p. incl illus. P: 7231, T: 723104. Biomedical Lab. C: AF 33(616)-5947, Union Carbide Consumer Products Co., New York, N.Y. N. N. Estes, J. J. Moore. In OTS. ASTIA: AD 283922, Code AA.   Unclassified

The design and development of a small, portable noise exposure meter that provides a measure of the total cumulative acoustic energy it is exposed to during a specified time period is described. This instrument performs the following sound pressure-time integration:

$$W = K \int_{t_1}^{t_2} p^2 dt$$ where K is proportional to the acoustic energy, p is the sound pressure at the microphone and $t_2 - t_1$ represents the total integration time. The associated electronic circuitry, which uses transistorized amplifiers, squaring circuits, rectifying circuits, and coupling circuits, is described. The integrator, which performs the integration and stores the integral until such time as it is read out, is of the solion type. Performance data are given.

19-57

MRL.-TDR-62-57. WEIGHT LIFTING CAPABILITIES OF A SELECTED SAMPLE OF HUMAN MALES. Final rpt, June 1962, iii + 13p. incl table, 3 refs. P: 7184, T: 718403. Behavioral Sciences Lab. C: AF 33(616)-5624 and 7132, Miami Univ., Oxford, Ohio. J. O. Morrisette. In OTS. ASTIA: AD 284054, Code AA.
                                 Unclassified

Weight lifting capability of 75 young men was measured using standardized and controlled lifting procedures to simulate loading tasks. Varying amounts of weights were lifted with the right hand, the left hand, and straight in front from the floor up to platforms 18, 42, and 62-1/2 inches high. The short group (1-15 percentile AF stature group) averaged lifts of 123.99 lb, 72.71 lb, and 53.11 lb from the lowest to highest platforms. The medium stature group (45-60 percentile) averaged lifts of 138.22, 91.72, and 64.67 lb. The tall group (85-99 percentile) averaged lifts of 146.3, 96.17, and 67.1 lb.

19-58

MRL-TDR-62-58. HUMAN ENGINEERING IN REMOTE HANDLING. Final rpt, Aug 1962, iv +32p. incl table, 57 refs. P: 7184, T: 718407. Behavioral Sciences Lab. C: AF 33(616)-8028, Hughes Aircraft Co., Culver City, Calif. W. B. Knowles. In OTS. ASTIA: AD 287529, Code AA. Unclassified

This report presents an analysis of remote handling systems from the human engineering point of view. Examples of actual and anticipated remote handling applications are described. Current approaches to and expected trends in the design of remote handling systems equipment are presented. Human capabilities and limitations which should be carefully considered by designers of remote handling systems are specified. Research efforts regarded as essential to effective human engineering in this area are identified and discussed. Pertinent references are included in the last section and bibliography.

19-59

MRL-TDR-62-59. BARALYME AND MOLECULAR SIEVE PASSIVE AIR REGENERATION STUDIES FOR MANNED SEALED ENVIRONMENTS. Final rpt, May 1962, iv +8p. incl illus., tables. P: 6373, T: 637302, Life Support Systems Lab. D. A. Keating. In OTS. ASTIA: AD 283845, Code AA. Unclassified

The feasibility of using the solid chemicals Baralyme and Molecular Sieve to passively remove carbon dioxide and water vapor from sealed environments for life support in aerospace flight was investigated. Sealed environment research using human subjects demonstrated that the air can be regenerated with these chemicals without using blowers or fans. These experiments indicate that approximately 0.24 pound of Baralyme per hour per man is required for passive control of carbon dioxide, and 0.94 pound of Molecular Sieve per hour per man is required for passive control of water vapor.

19-60

MRL-TDR-62-60. STUDIES IN RESEARCH METHODOLOGY. III. Persistence of Sequential Effects Despite Extended Practice. Final rpt, iii + 10p. incl illus., table, 6 refs. P: 7184, T: 718401. Behavioral Sciences Lab. J. V. Bradley. In OTS. ASTIA: AD 283976, Code AA. This is the third report of a series. The first and second were published as Wright Air Development Center Technical Reports 58-574 (I) and 58-574 (II). Unclassified

Certain experimental designs are based upon the assumption that performance level becomes stabilized after a prolonged period of practice. This assumption was tested by taking a long series of repeated measurements upon a single subject for the performance of each of several constant tasks, each task being tested singly in a separate series of measurements. Results showed that after thousands of practice trials on a simple task a subject may still be learning or showing other sequential effects in performance. These effects may disappear on one day only to reappear on the next. Therefore it is extremely doubtful that "practice to an asymptote" should be regarded as either an efficient or an effective method of eliminating sequential effects from an experiment proper.

19-62

MRL-TDR-62-62. PHONOCARDIOGRAMS OF YOUNG ADULT MACACA MULATTA. Final rpt, June 1962, iii +6p. incl illus., tables, 2 refs. P: 7231, T: 723101. Biomedical Lab. F. R. Robinson, R. L. Hamlin, consultant, Ohio State Univ., Columbus, Ohio. In OTS. ASTIA: AD 285545, Code AA. Unclassified

Phonocardiograms were recorded and analyzed for thirteen healthy macaca mulatta. Lead aVF electrocardiograms and phonocardiograms were recorded simultaneously. Mean values and ranges for the following parameters were analyzed: RR interval, PR interval, duration between onset of P-wave and onset of first heart sound, duration between onset of QRS and onset of first heart sound, duration of first heart sound, number of vibrations in first heart sound, duration of mechanical systole, duration of second heart sound, number of vibrations in second heart sound, duration of mechanical diastole. The first heart sound had a mean duration of 0.074 second with a mean frequency of 90 cps. The second heart sound which was lower in magnitude and duration had a mean duration of 0.038 second with a mean frequency of 94 cps. Diastolic murmurs were recorded in four animals.

19-63

MRL-TDR-62-63. EFFECT OF SINUSOIDAL VERTICAL VIBRATION ON THE URINARY SEDIMENT IN MAN. Final rpt, June 1962, iii + 5p. incl table, 12 refs. P: 7231, T: 723101. M. J. Mandel, Capt., USAF, MC. Biomedical Lab. In OTS. ASTIA: AD 283844, Code AA. Unclassified

Experiments were conducted to determine whether sinusoidal, low-frequency vertical vibration for 1 minute at subjective tolerance levels could produce renal damage. Two groups of vibrated sitting subjects (frequency, 4 to 9 cps) were compared to a control group which had never been exposed to vibration experiments. One group had long experience, varying from 6 months to 2 years, with experimental sinusoidal vibration at subjective tolerance levels. The other group was experiencing its first shake at high levels (near subjective tolerance). No difference could be detected in the urinary sediment between the two experimental groups or between the vibrated groups and the control subjects. Although the data does not indicate renal damage, it might have occurred if the vibrations had been continued for a longer time period.

19-64

MRL-TDR-62-64. THE EFFECT OF UDMH INJECTION ON LEARNED BEHAVIOR IN THE JAVA MONKEY. Final rpt, June 1962, iv + 11p. incl illus., 8 refs. P: 6302, T: 630202. H. H. Reynolds, F. H. Rohles, Jr., J. Fineg, 6571st Aeromedical Research Lab., Holloman AFB, New Mex. K. C. Back, A. A. Thomas, Biomedical Lab., 6570th Aerospace Medical Research Lab., Wright-Patterson AFB, Ohio. In OTS. ASTIA: AD 283846, Code AA. Unclassified

Three experiments were conducted involving UDMH injection of the java monkey to study the effect of UDMH on performance of a learned task. The results of the three experiments indicated that a UDMH dosage of 30 mg/kg intraperitoneally is insufficient to produce significant changes in learned behavior.

19-65

MRL-TDR-62-65. DEVELOPMENT OF NEW TECHNIQUES FOR ANALYSIS OF HUMAN CONTROLLER DYNAMICS. Final rpt, June 1962, vi + 68p. incl illus., tables, 12 refs. P: 7183, T: 718301. Behavioral Sciences Lab. C: AF 33(616)-7969, Battelle Memorial Inst., Columbus, Ohio. R. E. Thomas. In OTS. ASTIA: AD 283826, Code AA. Unclassified

This report describes two new mathematical techniques suitable for analysis of human controller dynamics. The aims of this report are as follows: (1) to acquaint the reader with two recent developments in mathematical methods by illustrating some of the control problems which can be completely solved, (2) to indicate the kinds of studies involving a human controller which can be made using these methods, and (3) to furnish explicit mathematical solutions to a number of these control problems. The mathematical methods described are: Bellman's "dynamic programming" and Pontryagin's "maximum principle."

19-66

MRL-TDR-62-66. PHYSIOLOGICAL AND MECHANICAL RESPONSE OF THE HUMAN TO LONGITUDINAL WHOLE-BODY VIBRATION AS DETERMINED BY SUBJECTIVE RESPONSE. Final rpt, June 1962, iii + 13p. incl illus., tables, 3 refs. P: 7231, T: 723101. Biomedical Lab. E. B. Magid, Capt., USAF, MC, R. R. Coermann, R. D. Lowry, W. J. Bosley, SMSgt, USAF. In OTS. ASTIA: AD 288877, Code AA. Unclassified

The production of symptoms in specific body regions to whole-body vibrations is dependent upon physiological alterations resulting from the mechanical stimulation of various organ-tissue complexes of the body.

We investigated subjective response to gain an insight into the mechanical properties of the body. Fifteen subjects experienced with whole-body vibrations were included in a two-phase study in an attempt to measure qualitatively and quantitatively subjective response to

longitudinal vibrations from 1 to 20 cps in a sitting position. In the first phase the complexity of body response to whole-body vibration was demonstrated since the subjects usually experienced several symptoms for each frequency tested. The second phase suggested that the sensations were resonance-dependent. Mechanical and physiological responses were correlated.

19-67

MRL-TDR-62-67. SOME IMPLICATIONS OF TESTING PROCEDURES FOR AUTO-INSTRUCTIONAL PROGRAMMING. Final rpt, June 1962, iv + 74p. incl tables, 136 refs. P: 1710, T: 171007. Behavioral Sciences Lab. C: AF 33(616)-7795, Educational Testing Svc., Princeton, N.J. P. I. Jacobs. In OTS. ASTIA: AD 283359, Code AA. Unclassified

Although there are fundamental differences in the objectives of the two activities, the programming of instructional material bears many similarities to the construction of tests. A systematic comparison of problems and procedures reveals important implications for programming from the older field of testing. Theory and experience in test construction can be especially useful in the selection of valid criteria for assessing the effectiveness of a program, the ordering of instructional subject matter, the writing of instructional frames, and the formal evaluation of the program. Adaptive programming implies measurement of both aptitude and achievement in order to assign trainees to appropriate individual sequences of instruction. Possible applications resulting from examination of these and other issues are explored, and necessary further research is suggested.

19-68

MRL-TDR-62-68. SANITATION AND PERSONAL HYGIENE DURING AEROSPACE MISSIONS. Final rpt, June 1962, v + 54p. incl illus., tables, 36 refs. P: 6373, T: 637304. Life Support Systems Lab. C: AF 33(616)-7754, Spacelabs, Inc., Van Nuys, Calif. R. H. Mattoni, G. H. Sullivan. In OTS. ASTIA: AD 283841, Code AA. Unclassified

The purpose of this study was to determine a means of providing astronauts with facilities for performing the functions of personal hygiene and sanitation while on extended aerospace missions. Included is a definition and analysis of the sources of "dirt" arising as waste products in manned space vehicles and recommendations on how to control them. Man's sanitation and hygiene requirements are defined from both a biological and and psychological standpoint. A central hygiene station that provides for whole body immersion bathing, superficial bathing, dental hygiene, shaving, nail care, and laundry is described.

19-69

MRL-TDR-62-69. RELATION OF LOCAL SKIN TEMPERATURE AND LOCAL SWEATING TO CUTANEOUS

BLOOD FLOW. Final rpt, June 1962, iii + 21p. incl Illus. P: 7222, T: 722204. Biomedical Lab. C: AF 33(616)-7077, Physiology Lab., St. Louis Univ. School of Medicine, St. Louis, Mo. L. Senay, Jr., L. Prokop, A. Hertzman. In OTS. ASTIA: AD 284435, Code AA.
Unclassified

The relationship of local skin temperature and the onset of sweating to the local cutaneous blood flow was studied on the forearm and calf. The purpose of the investigation was to appraise the possible relation of sweat gland activity to the cutaneous vasodilatation which has been attributed to bradykinin or to intracranial temperatures. The onset of sweating was not marked by any apparently related increases in the rate of cutaneous vasodilatation. On the contrary, the onset of sweating was followed often by a stabilization or even a decrease in the level of cutaneous blood flow. The relations of the latter to the local skin temperature were complex, particularly in the forearm. There appeared to be additional unidentified influences, possible vasomotor, operating on the skin vessels during transitional phases in the relation of skin temperature to blood flow.

19-70

MRL-TDR-62-70.   GROUP PERFORMANCE DURING FOUR-HOUR PERIODS OF CONFINEMENT. Final rpt, June 1962, iv + 37p. incl illus., tables, 11 refs. P: 1710, T: 171002. Behavioral Sciences Lab. W. D. Chiles. C: AF 33(616)-7607, Lockheed-Georgia Co., Marietta, Ga. E. A. Alluisi, T. J. Hall. In OTS. ASTIA: AD 283842, Code AA.   Unclassified

This study was carried out to determine the test-retest reliability of a battery of six performance tasks. Four of these tasks were designed to assess individual performance, and the remaining two tasks were designed to measure crew or group-dependent performance. In each of these group tasks, successful performance required interactions among crewmembers in the form of exchanges of information, cooperation, and temporal coordination. Each of 5, 5-man crews was tested for 4 consecutive hours a day on each of 4 days after a 3-day training period. All testing was conducted with the crewmembers seated at work stations in an advanced-system crew compartment mock-up. All of the measures taken with the six tests exhibit satisfactorily high reliability coefficients.

19-73

MRL-TDR-62-73.   PSYCHOMOTOR PERFORMANCE UNDER CONDITIONS OF WEIGHTLESSNESS. Final rpt, June 1962, iii + 7p. incl illus., tables. P: 7184, T: 718405. Behavioral Sciences Lab. J. E. Wade, Capt., USAF. In OTS. ASTIA: AD 285549, Code AA.
Unclassified

Subjects operated three different sets of switches as they were flown through 0-G trajectories in a C-131B

aircraft. Push-button, toggle, and rotary switches were each paired with a master push-button switch to form the three sets used to turn an indicator light on and off. The subjects were instructed to perform the task as fast as possible by alternate actuation of the two switches of each set. Each subject also performed in straight and level flight with each set of switches for control data. Performance data, along with aircraft accelerative forces in three dimensions, was recorded on a high-speed oscillograph. Small but statistically significant decrements were found in speed of operation of all three sets of switches in the 0-G environment in comparison with performance at 1-G. The toggle switch set showed the greatest decrement, the rotary switch set the least decrement. The push-button switch set was operated most rapidly in both 1-G and 0-G conditions.

19-74

MRL-TDR-62-74.   VISUAL ACUITY IN RELATION TO BODY ORIENTATION AND G-VECTOR. Final rpt, July 1962, iii + 14p. incl illus., tables, 6 refs. P: 7184, T: 718406. Behavioral Sciences Lab. L. D. Pigg, Maj., USAF. In OTS. ASTIA: AD 285552, Code AA.
Unclassified

The Armed Forces Vision Tester, fitted with checkerboard targets, was used in tests of visual acuity under viewing conditions involving various combinations of gravity effects. Twenty-four subjects were tested for left, right, and binocular acuity of near and far vision in each of four body positions: standing upright, prone, supine, and inverted upright. The latter condition effectively produced -1 G acceleration. Intercomparisons of scores from these positions form the basis for useful generalizations concerning the effects on visual acuity of various acceleration environments, including 0 G. By comparison with their acuity at 1 G, subjects experience a decrement at -1 G of approximately 15 percent. This is comparable to the decrement found by other investigators at 3 G's. Since both -1 G and 3 G's are 2 G-units removed from 1 G, it appears that equal changes in either direction from the normal acceleration environment produce equal losses in visual acuity as a function of the amount of change. This conclusion is supported by results of a previous study of acuity at 0 G, in which a small but statistically significant decrement comparable to that at 2 G's was found.

19-75

MRL-TDR-62-75.   WATER RECOVERY FROM PHYSIOLOGICAL SOURCES FOR SPACE APPLICATIONS. Final rpt, July 1962, v + 27p. incl illus., tables, 42 refs. P: 6373, T: 637304. Life Support Systems Lab. A. R. Slonim, A. P. Hallam, D. H. Jensen, K. Kammermeyer. In OTS. ASTIA: AD 285220, Code AA.   Unclassified

Water recovery from urine and liquid wastes is reviewed beginning with general technological considerations,

such as use of space environments, quality of water, mechanical design problems, and integration of water recovery with other life support subsystems. Various water recovery techniques are described under the following categories: change of phase; membrane, diffusion, and combination processes. Logistics considerations for manned space systems are also discussed. Generally, all water recovery techniques are deficient in one or more factors for space vehicle applications. Some require orientation of space craft, much power, large radiation panels, replaceable parts, complex mechanical design and/or considerable chemical treatment of water. Physico-chemical treatments alone (e.g., solvent extraction), diffusion, and certain membrane processes are contraindicated. Several processes appear promising at present, such as vacuum pyrolysis, electrolysis combined with combustion, and freeze drying. Of these, the vacuum pyrolysis method, in which potable water was produced from mixed human wastes and wash water, is operationally most advanced. No fully operational process has been developed at this time.

19-76

MRL-TDR-62-76. MATHEMATICAL THEORIES IN PERFORMANCE, DECISION MAKING, AND LEARNING. A LITERATURE REVIEW. Final rpt, July 1962, viii + 113p. incl tables, 402 refs. P: 7183, T: 718306. Behavioral Sciences Lab. C: AF 33(616)-6179, Lehigh Univ., Bethlehem, Pa. A. L. Brody, S. Weinstock. In OTS. ASTIA: AD 285565, Code AA.   Unclassified

The experimental and theoretical literatures on mathematical theories in psychology between 1930 and 1959 are reviewed to provide an introduction to this area for the nonmathematically trained researcher. The review is restricted to information theory, game and decision theory, and probabilistic learning theories. Six criteria for evaluating theories are also presented in the review. We concluded that: (a) information theory has provided a language and an information measure but has not been used as a theory; the information measure and the noisy channel theorem are used heuristically; (b) applications of game and decision theory fail to satisfy any of the evaluative criteria; and (c) probabilistic learning theories have been developing soundly. However, the Estes theory needs to be extended to a broader variety of situations while the Bush-Mosteller theory needs a subsidiary learning theory to solve problems of coordination of theoretical terms with experimental variables and to define its range of application.

19-77

MRL-TDR-62-77. A WORKING BIBLIOGRAPHY ON THE EFFECTS OF MOTION ON HUMAN PERFORMANCE. Final rpt, July 1962, iv + 53p. incl 546 refs. P: 2710, T: 171003. Behavioral Sciences Lab. R. Buckhout. In OTS. ASTIA: AD 287530, Code AA.   Unclassified

In this bibliography a list of reports is compiled from a number of disciplines which bear on the problem of motion and its effects on human performance. Psychophysiological reports in the area of spatial orientation, perception, and receptor mechanisms provide background on the human organism in relation to motion stimuli. The effects of aerospace vehicle motion are represented by a compilation of studies of performance under acceleration, vibration and buffeting, tumbling, and weightlessness. Finally reports on training and motion simulation, equipment and methodology, and general analyses of the whole problem area are presented.

19-81

AMRL-TDR-62-81. INTERNAL BODY MOVEMENTS RESULTING FROM EXTERNALLY APPLIED SINUSOIDAL FORCES. Final rpt, July 1962, vi + 16p. incl illus., table, 14 refs. P: 7231, T: 723101. Biomedical Lab. C: AF 33(616)-6889. Chicago Medical School, Chicago, Ill. J. L. Nickerson, Chicago Medical School, and R. R. Coermann, 6570th Aerospace Medical Research Lab. In OTS. ASTIA: Code XX.   Unclassified

This report contains a description of an x-ray device designed to permit the observation of the movement of internal structures in the animal body subjected to sinusoidal oscillations. From the x-rays taken by this device, it has been possible to determine the resonance frequency and phase shift of regions within the abdomen and thorax set in motion by external oscillatory forces. The results of observations made on anesthetized dogs show that the visceral content of the abdomen and thorax appears to oscillate as a mass having a resonant frequency of 3 to 5 cycles per second and with damping of one-fifth to one-quarter of the critical value.

19-83

AMRL-TDR-62-83. SLEEP AND ALTERED PROPRIOCEPTIVE INPUT AS RELATED TO WEIGHTLESSNESS: WATER IMMERSION STUDIES. Final rpt, Aug 1962, iii + 12p. incl illus., 8 refs. P: 7222, T: 722201. Biomedical Lab. D. E. Graveline, Capt, USAF, MC, M. McCally, Capt, USAF, MC. In OTS. ASTIA: AD 286022, Code AA.   Unclassified

The "free-floating" condition of immersion is associated with substantial alterations in mechanoreceptive feedback to the central nervous system in a manner similar to the free-floating condition of weightlessness. One area having rather immediate operational application concerns sleep under these conditions. In this study electroencephalographic and electrooculographic recordings were made during sleep of completely immersed, neutrally buoyant subjects. Sleep records were obtained while using both tether and clamshell sleeping facilities and were compared to each subject's normal bedrest sleep records. The results are presented and their possible application to prolonged weightlessness is discussed.

19-84

AMRL-TDR-62-84. KINETIC STUDIES OF PHOTO-TROPIC REACTIONS OF TRIPHENYLMETHANE LEU-CONITRILES. Final rpt, Aug 1962, iii + 30p. incl illus., tables, 17 refs. P: 6301, T: 630103. Life Support Systems Lab. C: AF 33(616)-7636, Kent State Univ., Kent, Ohio. Glenn H. Brown, Ph. D. In OTS. ASTIA: AD 287451, Code AA. Unclassified

The mechanism of the phototropic reaction of triphenyl-methane leuconitriles is studied in considerable detail. For the reaction between methyl violet and cyanide ion in ethanol-water systems it is shown that the decoloriza-tion process can be explained as due to ion-pair forma-tion. Assuming that a specific ion-pair is the reaction intermediate, a simple equation, $k_{obs} = k*K/K[CN^-]+1$, where k_{obs} and $k*$ are the observed and the corrected rate constants, respectively, and K is the association constant for ion-pair formation, can be used to explain the interaction between the methylviolet and cyanide. Rate constants at $25.0°$, $35.0°$, and $42.3°C$ are given along with thermodynamic values for the reaction between methyl violet and cyanide. The leuconitrile formed by the reaction between methyl violet and cyanide is photo-tropic and on excitation with ultraviolet light will revert to the dye and cyanide. The role of the solvent in the phototropic process is considered. The excitation energy of the phototropic process is established.

19-85

AMRL-TDR-62-85. A STUDY OF THE AIR FORCE MAINTENANCE TECHNICAL DATA SYSTEM. Final rpt, Aug 1962, vi + 197p. incl illus., tables, 5 refs. P: 7184, T: 718406. Behavioral Sciences Lab. C: AF 33 (616)-8193, Republic Aviation Corp., Farmingdale, N.Y. J. E. Losee, R. H. Allen, J. W. Stroud, J. Ver Hulst. In OTS. ASTIA: AD 288636, Code AA. Unclassified

This report details the research on preparation, produc-tion, distribution, evaluation and verification of Air Force maintenance technical data. It highlights the im-pact of management on the procurement of accurate, timely, and economical data and identifies the areas in which management was found to be deficient. It points out the specific shortcomings in the data, in its preparation, dis-tribution, and use. Finally, the report recommends ac-tions considered necessary to first, improve management of the overall technical order system, and second, to en-hance the quality, usefulness, and timeliness of the data produced.

19-86

AMRL-TDR-62-86. SPACE RADIATION GUIDE. Final rpt, Aug 1962, xiii + 210p. incl illus., tables, 201 refs. P: 7165, T: 716503. Biomedical Lab. C: AF 33(616)-7631, American Machine & Foundry Co., Alexandria, Va. W. P. Saylor, D. E. Wiker, C. J. Eiwen, A. W. Carriker. In OTS. ASTIA: AD 287863, Code AA. Unclassified

The Space Radiation Guide is intended to be a reliable, easily understood handbook that will provide the reader with sufficient knowledge of the nature of space radia-tions to permit him to comprehend the total space radia-tion problem as it pertains to the hazards of manned space flight. The report is not intended to provide an-swers to all the problems, but, instead, to present much of the factual data currently known and to point out areas where information is sketchy and inconclusive. The ra-diations considered are cosmic rays, solar radiation, and the geomagnetically trapped (Van Allen) radiations. In-cluded are chapters on instruments used for measuring these radiations, on shielding techniques, and on bio-logical effects.

19-87

AMRL-TDR-62-87. HUMAN ENGINEERING CRITERIA FOR MANNED SPACE FLIGHT: MINIMUM MANUAL SYSTEMS. Final rpt, Aug 1962, viii + 227p. incl illus., tables, 42 refs. P: 7184, T: 718405. Behavioral Sci-ences Lab. C: AF 33(616)-8168, Hughes Aircraft Co., Culver City, Calif. D. K. Bauerschmidt, R. O. Besco. In OTS. ASTIA: AD 288513, Code AA. Unclassified

Analytical and experimental investigations were made of simple or minimum manual guidance and control systems. A complete three-degree of freedom static simulator was used to study the manual attitude control of space vehi-cles. Major controller, display and vehicle configuration parameters were compared experimentally. The system kinematics manual control and visual factors of space rendezvous and docking maneuvers were analyzed. Pro-cedures for manual participation in space navigation and guidance were studied and a preliminary design of a sim-ple computational aid was developed. The conclusions of all the studies are presented and recommendations are made for the design of manual guidance and control systems.

19-88

AMRL-TDR-62-88. CALIBRATION OF THE INFRARED OPTOMETER. Final Rpt, Aug 1962, vi + 10p. incl. illus., tables. Also see ASD TR 61-111, AD 264 937. P: 7163, T: 716303. Life Support Sys. Lab. C: AF 33(616)-6146, Indiana Univ., Bloomington, Ind. M. J. Allen. In OTS. ASTIA: Code XX. Unclassified

An infrared optometer for measuring the absolute status of accommodation is subject to a constant error not as-sociated with chromatic aberration or changes in fixa-tion. The reflections of infrared light within the eye cannot be considered to originate from the retina or pig-ment epithelium alone. Probably the choroid and sclera are involved giving a diffuse reflection and increased intraocular stray light. A schematic eye, using a retina of 2-mm. opalescent plexiglas with a sanded surface, approximately simulates the behavior of the human eye. Changes in fixation have only a slight effect on optom-

eter accuracy as long as the pupil does not vignette the optometer beam. A modification is described for calibrating the infrared optometer for an individual subject without using trial lenses or a subjective optometer.

19-89

AMRL-TDR-62-89. EXPLORATORY INVESTIGATION OF THE MAN AMPLIFIER CONCEPT. Final Rpt, Aug 1961, vi + 68p. incl illus., tables, 10 refs. P: 7184, T: 718406. Behavioral Sciences Lab. C: AF 18(600)-1922, Cornell Aeronautical Lab., Inc., of Cornell University, Buffalo, N.Y. D. C. Clark, N. J. Deleys, C. W. Matheis. SRN: VO-1616-V-1. In OTS. ASTIA: Code XX.
Unclassified

Preliminary investigations were conducted to ascertain some of major problems requiring more research before feasibility of Man Amplifier concept can be evaluated. Study areas included possible Air Force applications as basis for selecting maximum load-carrying capability, human factors from standpoints of body kinematics and physical anthropology, structures and mechanical design, and servosystem and power requirements. Dynamic response characteristics of elbow-joint amplifier, determined theoretically and experimentally, were compared. Comparison of position tracking tests performed with and without power boost provided by elbow-joint servo indicated that power boost did not increase tracking error above that exhibited by unaided operator. It was concluded: (1) duplication, in Man Amplifier, of all human joint motion capability is impractical; (2) experimentation is necessary to determine essential joints, motion ranges, and dynamic responses; (3) inability to counter overturning moments will, in many instances, limit load-handling capability; (4) conventional valve-controlled hydraulic servos are unsuitable for Man Amplifier; (5) particularly difficult problems will be encountered in general areas of mechanical design, sensors, and servo-mechanisms.

19-90

AMRL-TDR-62-90. LIFE SUPPORT SYSTEMS EVALUATOR INSTRUMENTATION. Final Rpt, Aug 1962, v + 52p. incl illus. P: 6373, T: 637305. Life Support Sys. Lab. C: AF 33(616)-8349, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. E. E. Beson, M. P. Dickey. SRN: MH Aero Rpt 2662-TR2. In OTS. ASTIA: Code XX.
Unclassified

The Life Support Systems Evaluator Console was built to monitor and record the changes in environmental parameters occurring during the test of men and life systems in an evaluator or space flight test chamber. The problems involved in furnishing the necessary instrumentation and displays were considered in a preliminary design investigation. The system design which evolved from the preliminary study embodies a four-module steel enclosure or console, with turret top section, work table surface, and rollaway table section, which contains the complete monitor system. The evaluator instrumentation includes

sensors, indicators, and recorders which enable the investigators to monitor the following: Absolute and differential pressures at six different stations in the test chamber, Temperatures at 24 stations within the forward and aft sections of the chamber, Relative humidity in forward and aft sections of the test chamber, Analyses of chamber atmospheric composition, Continuous recording of the variables.

19-91

AMRL-TDR-62-91. ENZYMATIC DIGESTION OF ALGAL CELLS. Final Rpt, Aug 1962, iii + 9p. incl illus., tables, 16 refs. P: 7164, T: 716403. Biomedical Lab. C: AF 33(616)-7964, Armour Research Foundation, Chicago, Ill. M. E. King, A. M. Shefner. In OTS. ASTIA: Code XX.
Unclassified

Untreated algal cells are incompletely digested in man's alimentary canal. Therefore, various enzymes were investigated in an effort to develop an enzyme supplement that would increase the nutritive value of an algal ration. Such an enzyme additive would function by directly degrading the algal cells or by making the cells more susceptible to the action of the normal digestive enzymes. Enzymes were evaluated by in vitro digestion for 2 hours in artificial gastric juice followed by digestion for 4 hours in artificial intestinal juice. The commercial cellulases were not effective. Favorable results were obtained with enzyme systems derived from the snail Helix pomatia and the mold Myrothecium verrucaria. Pectinase was also effective, both alone and in combination with the snail and the mold enzymes. These results are consistent with the studies of Northcote and others on the composition of the algal cell wall.

19-92

AMRL-TDR-62-92. RESEARCH ON ABSORBING INFRARED RAYS WITH PLASTICS AND ATTENUATING INFRARED RAYS WITH COATINGS. Final Rpt, Aug 1962, ix + 94p. incl illus., tables, 32 refs. P: 6301, T: 630103. Life Support Sys. Lab. C: AF 33(616)-8056, American Cyanamid Co., Bound Brook, N.J. P. V. Susi, H. C. Donoian. In OTS. ASTIA: AD 288669, Code AA.
Unclassified

With the specific objective of developing a plastic or coating composition having strong near-infrared attenuation and high visible transmittance, a number of organic compounds were prepared and along with many compounds from chemical files were examined spectrometrically in solution.

Those with near-infrared absorption were incorporated into plastics by one or more of the following methods: solution casting, milling and molding, monomer casting, burnishing, or dyeing. Absorption properties were then measured and light stabilities were determined after accelerated light exposure tests.

19-93

AMRL-TDR-62-93. PURSUIT AND COMPENSATORY MODES OF INFORMATION DISPLAY: A REVIEW. Final Rpt, Aug 1962, iv + 13p. incl illus., table, 19 refs. P: 7183, T: 718306. Behavioral Sciences Lab. C: AF 33 (616)-6107, The Ohio State Univ., Columbus, Ohio. G. E. Briggs. In OTS. ASTIA: AD 288888, Code AA.
                                                        Unclassified

This report is a review of the literature on pursuit vs. compensatory modes of display for continuous control (tracking) tasks. It covers published research on this topic to October 1961. The review is concerned only with those research studies in which a comparison was made of the two display modes. The review summarizes both the empirical data and the theoretical interpretations in this research area.

19-94

AMRL-TDR-62-94. RESEARCH ON THE ELECTROLYSIS OF WATER WITH A HYDROGEN-DIFFUSION CATHODE TO BE USED IN A ROTATING CELL. Final Rpt, Aug 1962, v + 61p. incl illus., tables, 39 refs. P: 6373, T: 637302. Life Support Sys. Lab. C: AF 33(616)-8431, Battelle Memorial Inst., Columbus, Ohio. J. Clifford, C. Faust. In OTS. ASTIA: Code XX. Unclassified

This study has shown that the concept of a hydrogen-diffusion cathode is technically feasible for use in a water-electrolysis cell for production of breathing oxygen under weightlessness. A cathode current density of 265 amp/ft^2 at a cell voltage of 1.76 v performed best while maintaining 100% transmission of hydrogen through a cathode of palladium-silver alloy foil for about 1 hr. Experiments with a stationary cell showed the importance of designing for minimum electrolyte contamination and the need for further study of activation of the cathode foil. To supply breathing system for 3 men, preliminary design indicated the need for a rotating electrolysis cell.

19-98 (Vol I)

AMRL-TDR-62-98 (I). TECHNIQUES OF PHYSIOLOGICAL MONITORING, I. Fundamentals. Final Rpt, Sept 1962, x + 120p. incl illus., tables, 69 refs. First in a series. P: 7222, T: 722203. Biomedical Lab. C: AF 33(616)-7750, RCA Service Co., Camden, N.J. In OTS. ASTIA: AD 288906, Code AA. Unclassified

This volume is the first of a three-volume handbook covering the applications of electronics in monitoring bioelectric physiological responses. The fundamental concepts and methods presented in this volume form a foundation for the detailed technical discussions in the succeeding volumes and, it is hoped, provide a common language and basis of understanding between the physiologist and electronic engineer engaged in this field. The data obtained by monitoring physiological responses in varied environments can be used to improve the efficiency and

increase the safety of a human subject in aircraft and spacecraft.

19-100

AMRL-TDR-62-100. SURVEY OF REMOTE HANDLING IN SPACE. Final Rpt, Sept 1962, iv + 42p. incl illus., tables, 9 refs. P: 7184, T: 718406. Behavioral Sciences Lab. D. F. Baker, 1st Lt., USAF (Compiler). In OTS. ASTIA: Code XX. Unclassified

A survey of industrial opinion on remote handling in space was undertaken to document early concepts and to identify areas of agreement, areas of conflict, and unique ideas relating to the subject. Seven industrial concerns and one military agency provided papers on the role of remote handling in space. These papers are discussed in terms of: (a) remote operations of which there are five major categories—maintenance, assembly, experimentation, transfer operations, and emergency operations; (b) space vehicle design—the manned lightweight capsule, with anthropomorphic gloves, stabilization arms, window ports, and two to three manipulator arms, being representative; (c) manipulator design—concerning actuation, configuration, control, and feedback systems; and (d) space environment factors—vision, weightlessness, temperature fluctuations, high-energy radiation, and micrometeorite collisions.

19-101

AMRL-TDR-62-101. RESEARCH AND DEVELOPMENT OF A LIQUID-GAS CONTACTOR FOR PHOTOSYNTHETIC GAS EXCHANGERS. Final Rpt, Sept 1962, v + 37p. incl illus., tables, 2 refs. P: 7164, T: 716403. Biomedical Lab. C: AF 33(616)-8008, General Dynamics/ Electric Boat, Groton, Conn. H. Wallman, J. L. Dodson, V. A. Speziali, A. E. Rabe, R. J. Nickerson, R. R. Cordeiro. SRN: U413-62-108. In OTS. ASTIA: Code XX. Unclassified

This study was conducted to design, fabricate, and test a liquid-gas contactor and liquid gas separator system capable of operation as a photosynthetic gas exchanger. The system is designed to handle the oxygen requirements of one man and to be capable of operation under weightless conditions. The gas exchange system consists of four major components: (1) a multi-pass light chamber, (2) an agitated liquid-gas contactor, (3) a centrifugal liquid gas separator, and (4) an instrument console. We have demonstrated that this system has the capability of supporting one man under normal gravity and should be capable of operation under weightless conditions.

19-102

AMRL-TDR-62-102. AN EVALUATION OF HIGH-PRESSURE OXYGEN SYSTEMS. Final Rpt, Sept 1962, viii + 85p. incl illus., tables, 41 refs. P: 6373, T: 637302. Life Support Sys. Lab. C: AF 33(616)-8267. Battelle

Memorial Inst., Columbus, Ohio. J. V. Baum, B. Goobich, T. M. Trainer. In OTS. ASTIA: Code XX. Unclassified

The safety of 7500-psi gaseous oxygen systems used as a source of breathing oxygen in aerospace vehicles was studied. These effects were studied: temperature, vibration, shock, extended storage, contamination, high pressure, high-velocity flow, and heating due to rapid compression. Results indicate that 7500-psi oxygen systems can be safe if proper precautions are taken. Stainless steel and Monel alloys were acceptable as construction materials. Teflon and Kel-F compounds were suitable for seals. Hydrocarbons in minute concentrations were found not to be dangerously reactive. Electrostatic charges due to high-velocity flow were small. Erosion could be a serious problem. No appreciable chemical reactions occurred during the program. 7500-psi oxygen systems must be treated as "new" and representing explosive possibilities. The combustion process should be studied further. Self-ignition temperatures for the materials and contaminants considered in this research should be investigated under static and dynamic conditions. Before these systems can be used extensively, reliability of the system and equipment used for handling the gas should be increased.

19-103

AMRL-TDR-62-103. WEIGHTLESS MAN: SINGLE-IM-PULSE TRAJECTORIES FOR ORBITAL WORKERS. Final Rpt, Sept 1962, iii + 9p. incl illus., table and 2 refs. P: 7184, T: 718405. Behavioral Sciences Lab. Capt D. D. Mueller, Capt J. C. Simons. In OTS. ASTIA: Code XX.   Unclassified

While performing maintenance and assembly tasks outside of space vehicles under weightless conditions, a worker may accidentally propel himself away from his vehicle. To determine the speed of such a single-impulse launch, subjects under weightless conditions in a zero-G Kc-135 aircraft propelled themselves away from a surface with their legs. They attained maximum velocities of approximately 10 mph. Using various launch speeds and directions, theoretical trajectories have been projected for both coplanar and noncoplanar launches. These trajectories indicate that any launch having a velocity component parallel to the direction of orbital motion will result in a trajectory such that the worker will never return to his vehicle.

19-105

AMRL-TDR-62-105. HUMAN-INITIATED MALFUNC-TIONS AND SYSTEM PERFORMANCE EVALUATION. Final Rpt, Sept 1962, vii + 47p. incl illus., tables, 17 refs. P: 7184, T: 718404. Behavioral Sciences Lab. C: AF 33(616)-7968, Battelle Memorial Inst., Columbus, Ohio. R. C. Van Buskirk, Battelle Memorial Inst., and W. J. Huebner, 6570th Aerospace Medical Research Lab. In OTS. ASTIA: Code XX.   Unclassified

This research project was concerned with determining whether a system's performance conforms to its design objectives from consideration of failure data, including human-initiated malfunctions collected during development testing. In addition, the usefulness of this data for predicting the system's reliability was examined. The report discusses the interaction of human factors activities with other developmental testing activities. The relationship of the human-initiated malfunction to the reliability growth in development is examined. A method for monitoring performance and reliability during development is presented as an aid to determining whether or not a system conforms to its design objectives.

19-106

AMRL-TDR-62-106. THE EFFECT OF BACK ANGLE, MOLDED SUPPORTS, AND STAGED EVISCERATION UPON INTRAPULMONARY PRESSURES IN DOGS AND A MONKEY DURING FORWARD (+G$_x$) ACCELERATION Final Rpt, Sept 1962, iii + 12p. incl illus., table, 25 refs. P: 7222, T: 722202. Biomedical Lab. A. S. Hyde, M.D., Ph.D. ASTIA: Code XX.   Unclassified

Static intrapulmonary pressures were recorded at accelerations from +2 to 16 G$_x$ in live (curarized) and dead dogs and a monkey during forward inclinations of 5° increments from 0° to 45°. The pressures primarily reflect shifts of the diaphragm due to acceleratory forces. The influence of staged evisceration and staged molded support systems were also studied. Essentially null displacement occurred between 10° and 15° of forward inclination. Above and below these angles, diaphragmatic displacement was proportional to acceleration and relatively uninfluenced by molded support systems. Staged evisceration clearly established the literal dependency of diaphragmatic movement upon the presence of the liver.

19-107

AMRL-TDR-62-107. THE EFFECTS OF TASK ORGANI-ZATION, TRAINING TIME, AND RETENTION INTER-VAL ON THE RETENTION OF SKILL. Final Rpt, Sept 1962, vi + 20p. incl illus., tables, 12 refs. P: 1710, T: 171003. Behavioral Sciences Lab. C: AF 33(616)-7269, Ohio State Univ., Columbus, Ohio. J. C. Naylor, G. E. Briggs, W. G. Reed. In OTS. ASTIA: Code XX.
                                          Unclassified

Three variables (amount of training, task organization, and length of the retention interval), each at two levels, were studied to evaluate their influence upon the long-term retention of skill. Subjects were assigned to each of the eight experimental conditions, and were given practice on the criterion task for 2 or 3 weeks. The criterion task was composed of two subtasks, a procedural task involving the learning of discrete responses to discrete stimuli and a tracking task which involved continuous control of a three-dimensional compensatory display. All subjects returned for a retention test either 1 or 4 weeks subsequent to the end of training. Amount

of training had a significant influence upon the degree of measured retention loss, as did task organization under conditions of lesser training. This was found for both tracking performance and for the number of omissive errors committed in performing the procedural task. Amount of absolute retention was generally related to (a) amount of training, (b) task organization, and (c) the length of the retention interval.

19-109

AMRL-TDR-62-109. RESE..RCH ON TOXIC HAZARDS OF PENTABORANE. Final Rpt, Sept 1962, v + 37p. incl illus., tables, 11 refs. P: 6302, T: 630205. Biomedical Lab. C: AF 33(616)-7728, Callery Chemical Co., Callery, Pa. G. Roush, M.D., B. M. Kent, M.D., H. A. Volz. In OTS. ASTIA: Code XX.   Unclassified

At a plant producing pentaborane, sixty workers were potentially exposed to the boranes. The purpose of this investigation was to measure these workers' exposure with the Blood Borane Test of Miller, to measure the contamination of the workers' environment, and to relate the data of observed biologic effects in the workers. The atmospheric monitoring revealed that the work area was usually not contaminated. Thirty-one cases of possible borane poisoning were seen. The Blood Borane Test was negative in each of these cases but these results may be due to the mild nature of the poisonings. The lung, liver, and kidney studies used revealed no abnormalities in these cases. A clinical evaluation on all of the exposed workers at the end of a year's production revealed no observable effects. The protective gear worn provided good, though not complete, protection. Further study of the hazards of the boranes will require a monitoring instrument of wider range of sensitivity to evaluate the acute poisonings and the protective gear worn.

19-110

AMRL-TDR-62-110. STUDY OF THE INTERMEDIARY METABOLIC PATHWAYS OF 1, 1-DIMETHYLHYDRA-ZINE (UDMH). Final Rpt, Sept 1962, iv + 22p. incl illus., tables, 9 refs. P: 6302, T: 630202. Biomedical Lab. C: AF 33(616)-8455, Melpar, Inc., Falls Church, Va. M. A. Mitz, F. L. Aldrich, B. M. Vasta. In OTS. ASTIA: Code XX.   Unclassified

The metabolic fate of 1,1-dimethylhydrazine (UDMH) was studied in female rats and dogs. The animals were given intraperitoneal injections of C^{14} labelled UDMH and, after an appropriate time, body tissues were examined by paper chromatography. Six compounds were found, although not all appeared in every tissue. Three major compounds were present in urine. Identification showed

one (3-10%) to be the glucose hydrazone of UDMH, and another appeared to be unreacted UDMH (50-60%). The structure of the third major component (20-25%) was not determined, although its chemical and chromatographic behavior suggested that it was a hydrazone or hydrazide of a compound of higher molecular weight than acetic or pyruvic acid. Various analytical procedures were employed for the determination of UDMH in urine, and the trisodium pentacyanoaminoferroate (TPF) procedure was found to be the most sensitive and most specific qualitative method of those tested.

19-119

AMRL-TDR-62-119. DETERMINATION OF 1,1-DIMETH-YLHYDRAZINE (UDMH) IN URINE. Final Rpt, Oct 1962, iii + 10p. incl illus., tables, 10 refs. P: 6302, T: 630202. Biomedical Lab. P. Diamond, A. A. Thomas. In OTS. ASTIA: Code XX.   Unclassified

The colorimetric determination of 1,1-dimethylhydrazine (UDMH) in urine using trisodium pentacyanoamino ferroate (TPF) has heretofore been hampered by interfering substances in urine which resulted in poor recovery and some false negative results. A procedure was developed which overcame this difficulty and was primarily designed to determine rapidly in an emergency situation the urinary concentration of UDMH in exposed personnel. The procedure involves a hydrogen peroxide treatment of the urine followed by a colorimetric complexing of UDMH with TPF. In vivo results are presented on dogs that received intraperitoneal doses of UDMH with urinary concentrations of UDMH being determined in spontaneously voided and 24-hour pooled specimens. The results give some indication of the relationship of dose to excretion levels. In vitro recovery in 100 human urine specimens is presented.

19-120

AMRL-TDR-62-120. ULTRA MICRO PROCEDURE FOR UDMH IN BLOOD. Final Rpt, Oct 1962, iii + 4p. incl 1 ref. P: 6302, T: 630202. Biomedical Lab. Mildred K. Pinkerton, A. A. Thomas. In OTS. ASTIA: Code XX.   Unclassified

An ultra micro procedure for the determination of 1,1-dimethylhydrazine (UDMH) in blood is described. The method uses 25 microliters of serum or plasma which can be collected as capillary blood in micro hematocrit tubes and does not require deproteinization. The color reaction between UDMH and trisodium pentacyanoamino ferroate (TPF) occurs after direct treatment of the serum sample. The selection of normal commercially available control serum as a suitable blank is also discussed.

20—SCHOOL OF AEROSPACE MEDICINE
Brooks Air Force Base Texas

20-70

SAM-TDR-62-70. **EFFECTS OF CHANGES IN BLOOD PCO2 ON BRAIN OXYGENATION AT 147 MM. HG AMBIENT PRESSURE (39,000 FEET).** June 1962, 17p. incl illus. P: 7756, T: 59692. C: AF 41(657)-16, Univ. of Pennsylvania. E. C. Pierce, Jr., C. J. Lambertsen, M. J. Strong. ASTIA: Code XX. Unclassified

Hyperventilation during the breathing of 100 percent oxygen elevates the PO_2 of alveolar gas by the same amount that it lowers its PCO_2. Since the development of arterial hypocapnia causes cerebral vasoconstriction, brain oxygenation is drastically decreased even while arterial oxygenation is improved by the hyperventilation. Administration of 30 percent CO_2 with oxygen at an ambient pressure equivalent to that at 39,000 feet altitude prevented alkalemia and, in spite of hyperventilation, restored central oxygenation to a level at least equivalent to that found when pure oxygen was breathed at rest at the same altitude. The respiratory minute volume during administration of CO_2 with O_2 was greater than when O_2 alone was breathed at the reduced ambient pressure. Since neither arterial PO_2 nor central PCO_2 values differed in these two experimental situations, the respiratory stimulation may represent the quantitative demonstration in man of a respiratory effect of carbon dioxide which is mediated solely by the chemoreceptors exposed to arterial blood and which acts in the absence of a change in direct central stimulation by CO_2.

20-77

SAM-TDR-62-77. **ENDOGENOUS BACTERIAL INVASION OF MACACA MULATTA FOLLOWING LETHAL CO^{60} IRRADIATION.** June 1962, 5p. P: 7753, T: 59656. A. C. Garner, E. S. Wynne, W. M. Sellers, J. E. Moyer. ASTIA: AD 287088, Code AA. Unclassified

Forty-nine Macaca mulatta monkeys were sacrificed 2, 5, 8, 11, and 14 days after exposure to Co^{60} gamma radiation approximating the $LD_{50}/30$. Bacteriologic cultures showed only one positive blood. Bacterial invasion of the submandibular node after 14 days and of the stomach wall at all postirradiation intervals of 5 days or more was statistically significant. Of the 15 Salmonella and Shigella organisms detected in animals succumbing or sacrificed, 5 or more days postirradiation, 10 were present in the stomach wall.

20-78

SAM-TDR-62-78. **COMBINED CHISEL-AIR TURBINE TECHNIC FOR IMPACTED MANDIBULAR THIRD MOLAR SURGERY.** June 1962, 8p. incl illus. P: 7756, T: 59725. L. Szmyd. ASTIA: AD 287089, Code AA. Unclassified

The chisel and air turbine technics have been combined for removal of impacted mandibular third molars. The basic steps are as follows: (1) to remove bone with the air turbine; (2) to limit use of the mallet and chisel to a single split and to use air turbine for additional sectioning of tooth; (3) before tooth is split, to remove bone adjacent to coronal element to be sectioned; (4) to use carbide bur on dentin and to use a diamond stone only when dividing tooth involving large segments of enamel.

20-84

SAM-TDR-62-84. **A MICRO METHOD FOR MEASURING CHOLESTEROL UPTAKE.** Aug 1962, 6p. incl illus. P: 7753, T: 775301. D. A. Clark, C. B. Haven. ASTIA: AD 289515, Code AA. Unclassified

A method has been devised by which the cholesterol uptake of serum can be measured on volumes as small as 1.2 ml. Equipment by which this procedure can be carried out is described. Key to the use of the small volumes is a flexible plastic incubation chamber and a unit in which filtration, centrifugation, and pipetting can be carried out without the necessity of transferring the filtrate to another vessel. The equipment is useful for other laboratory procedures which involve filtration of small volumes. The procedure used in micro measurement of cholesterol uptake is described.

20-87

SAM-TDR-62-87. **THE INFLUENCE OF HIGH ALTITUDES ON THE ELECTRICAL ACTIVITY OF THE HEART: ELECTROCARDIOGRAPHIC AND VECTOR-CARDIOGRAPHIC OBSERVATIONS IN ADOLESCENCE AND ADULTHOOD.** Aug 1962, 22p. incl illus. P: 7758, T: 59582. C: AF 41(657)249, Inst. of Andean Biology, Faculty of Medicine, Lima, Peru. D. Penaloza, R. Gamboa, E. Marticorena. ASTIA: Code XX. Unclassified

Electrocardiographic and vectorcardiographic observations were obtained in 550 normal subjects—300 at sea level and 250 in Morococha, 14,900 feet above sea level. A comparative study was made in three age groups ranging from 15 to 60 years.

The ventricular activation process shows important differences between subjects living in the two places studied. In adolescent and adult inhabitants of high altitudes the SÂQRS range is wide, the configuration of the QRS complex is highly variable, both in the limb and in the precordial leads, and the two-dimensional projections of the spatial QRS loop show wide diversity.

174

20-90

SAM-TDR-62-90. IDENTIFYING THE OVERLY ANXIOUS PATIENT IN IMPACTED THIRD MOLAR SURGERY. July 1962, 5p. P: 7756, T: 59725. E. H. Cromer, L. Szmyd. ASTIA: AD 289516, Code AA. Unclassified

Study was made of personality factors responsible for anxiety in individuals with impactions, in order to provide an effective method for identifying the patients most likely to be difficult during surgery. The personalities of 26 postoperative impaction patients were studied by means of psychiatric interview. Psychiatric data were scored in two ways. Results of one of the scoring methods had a significant correlation with the dental investigator's independent rating of the degree of cooperativeness during surgery.

Characteristic of hyperreactive patients was a past history of dental or medical trauma—as shown by case studies. It is concluded that, by specific inquiry about past dental and medical trauma, many of the difficult surgical patients can be identified in advance.

20-92

SAM-TDR-62-92. LABORATORY PERFORMANCE OF LOW CONCENTRATION AQUEOUS STANNOUS FLUORIDE PROPHYLAXIS PASTES. Sept 1962, 3p. P: 7756, T: 59713. I. L. Shannon, W. R. Hester. ASTIA: AD 289517, Code AA. Unclassified

Aqueous stannous fluoride solutions were added to silex, and the ability of the resulting prophylaxis pastes to prevent in vitro enamel decalcification was tested. Both the 10 and the 20 percent stannous fluoride solutions were significantly more effective than the 5 and the 1 percent preparations. In experiments with 10 percent aqueous stannous fluoride added to silex and to flour pumice as abrasives, protection ranged from 64.3 to 76.6 percent. In experiments ranging from 4 to 22 weeks in length, no deleterious effects of age were found.

20-93

SAM-TDR-62-93. SAM CONTOURATOR, MODEL B — AN INSTRUMENT FOR MEASURING CHANGES OF SURFACE CONTOURS. Aug 1962, 10p. incl illus. P: 7756, T: 59696. L. Szmyd, C. F. Schuessler, A. A. Brewer, C. M. McCall, Jr. ASTIA: AD 289286, Code AA. Unclassified

The SAM Contourator is an instrument developed to record topographic changes of the residual ridges after tooth extraction and to reveal dimensional behavior of dental materials. Model B, a modification of Model A, reduced the procedural requirements of the instrument by allowing for easier and more rapid recording. The pantographic apparatus magnifies the area under study. The contour arm of the machine and the articulator are more flexible and permit easier approach by the operator. Use of the machine with two patients is described.

20-95

SAM-TDR-62-95. STRESS IN DENTAL PATIENTS: EFFECT OF TIME OF DAY ON THE ADRENOCORTICAL RESPONSE TO ORAL SURGERY. Aug 1962, 4p. incl illus. P: 7756, T: 59680. I. L. Shannon, G. M. Isbell, ASTIA: AD 289518, Code AA. Unclassified

The effect of time of day on the serum 17-hydroxycorticosteroid response was studied in 120 healthy young adult males undergoing oral surgery. Urinary steroid excretion studies were carried out on an additional 117 comparable subjects.

The anticipation of tooth removal was again found to produce significantly increased serum steroid concentrations. The diurnal effect produced a significant decrease in serum 17-OHCS levels in these apprehensive patients when surgery was delayed until later in the day.

The capacity of the cortex to respond to the exodontic procedure was not decreased by delaying the operation until 1300 hours. The mean serum steroid concentration at 1300 hours, immediately before surgery, was virtually identical to our values found for 633 nonoperated control subjects at 0730 to 0800 hours.

The effect of the exodontic procedure on urinary steroid excretion was not positively established.

20-96

SAM-TDR-62-96. A CRITICAL VIEW OF THE SAL TEST. Aug 1962, 28p. incl illus. P: 7755, T: 59670. C: AF 41(657)-418. Northwestern Univ. T. W. Tillman. ASTIA: AD 287092, Code AA. Unclassified

The SAL test and conventional bone conduction tests were administered to two groups of subjects with sensorineural hearing losses, a group with conductive loss due to otosclerosis, and a group of normal subjects with simulated unilateral conductive hearing losses. SAL data were gathered under a conventional earphone and cushion as well as under a circumaural-type earphone.

Results of the two methods for the sensorineural groups agreed closely below 1000 cps, but above this frequency SAL levels were lower (better) than bone conduction hearing levels. In the conductive loss groups, the results of the two methods agreed closely at frequencies above 1000 cps, but at lower frequencies SAL yielded markedly higher (poorer) hearing levels than did conventional bone conduction tests. The discrepancy was reduced, but not eliminated, when SAL data were collected by using the circumaural-type earphone.

20-99

SAM-TDR-62-99. A COMPARATIVE STUDY OF HUMAN AND MONKEY LEUKOCYTES IN CULTURE. Sept 1962, 7p. P: 7757, T: 67010. C: AF 41(657)-357, Pasadena

Foundation for Medical Research, Pasadena, Calif. Y. Ohnuki, A. Awa, C. M. Pomerat. ASTIA: Code XX.
Unclassified

To develop a satisfactory culture procedure for rhesus monkey (Macaca mulatta) leukocytes, several technical variations of the routine method were investigated. Those included in the present study were (1) the use and the amount of different kinds of phytohemagglutinins, (2) the separation of erythrocytes after preservation or centrifugation, (3) sera derived from the horse, the calf, and the monkey for supplementing the culture medium, and (4) the ratio of host serum containing leukocytes to the nutrient fluid.

None of these factors gave satisfactory results for monkey samples, but all were useful for human cells. Such an unusual situation might possibly be caused by differences in the physicochemical and cellular properties of the blood of the monkey and of man.

20-100

SAM-TDR-62-100. EFFECTS OF CALCIUM DEFICIENCY AND EXCESS ON TRANSMEMBRANE POTENTIALS IN FROG HEART. Aug 1962, 12p. incl illus. P: 7758, T: 113. F. Ware. ASTIA: Code XX.   Unclassified

The effects of severe calcium deficiency and calcium excess upon transmembrane potentials in isolated frog ventricular strips have been investigated. Resting potential rose about 5 mv. above normal during perfusion with 3-times-normal calcium and fell about 4 mv. below normal during exposure to calcium-free Clark's solution. Mean overshoot rose about 3 mv. during calcium lack but was unaffected by excess calcium. Maximum depolarization rate increased about 20 percent during calcium deprivation and fell a similar amount during high calcium perfusion; however, the membrane potential at the moment of maximum depolarization rate was unchanged from normal by either experimental solution. High calcium augmented the "spike" and "plateau" during repolarization, while calcium deficiency abolished the "spike," producing "humpbacked" action potentials with prolonged membrane reversal. These results are discussed, especially in relation to possible changes in permeability during upstroke of the action potential.

20-101

SAM-TDR-62-101. CHECKING THE REGISTRATION OF CENTRIC RELATIONSHIP FOR COMPLETE DENTURES. Aug 1962, 5p. incl illus. P: 7756, T: 59703. A. A. Brewer. ASTIA: Code XX.   Unclassified

This paper presents a method for checking in the edentulous patient, the accuracy of the maxillomandibular registration in the centric relation position, subsequent to transfer of this record to an articulator.

A method is also presented for securing a new record when error is apparent in the record or transfer.

20-102

SAM-TDR-62-102. A METHOD FOR RECORDING DEFORMATION IN DOUBLE PROCESSING OF DENTURE BASES. Aug 1962, 7p. incl illus. P: 7756, T: 59703. A. A. Brewer, L. Szmyd, C. M. McCall, Jr. ASTIA: AD 288829, Code AA.   Unclassified

This paper describes a method for recording deformation in double processing of denture bases. The preliminary results obtained with this research method substantiate the clinical impression that relationship records for complete denture construction obtained on processed bases can be maintained until the dentures have been completed.

20-108

SAM-TDR-62-108. EFFECT OF PYROPHOSPHATES ON THE LABORATORY PERFORMANCE OF TOPICALLY APPLIED AQUEOUS STANNOUS FLUORIDE. Sept 1962, 4p. P: 7756, T: 59713. I. L. Shannon, T. R. Dirksen, W. R. Hester. ASTIA: Code XX.   Unclassified

Laboratory studies were carried out on 280 extracted human molars to determine the compatibility of pyrophosphates with stannous fluoride in aqueous solution. The ability of 0.4 percent stannous fluoride to function effectively in topical applications was negated by the addition of calcium pyrophosphate to the solution.

20-111

SAM-TDR-62-111. THE LIPID CONSTITUENTS OF WHOLE AND PAROTID SALIVA. Aug 1962, 4p. incl illus. P: 7756, T: 59680. T. R. Dirksen. ASTIA: AD 289519, Code AA.   Unclassified

Chloroform: methanol extracts of whole and parotid saliva were subjected to paper chromatography to further characterize their lipid components. The presence of cholesterol esters, triglycerides, fatty acids, cholesterol, diglycerides, monoglycerides, and various phospholipids was demonstrated in the sample materials. Whole and parotid saliva contained similar nonphosphatides, but differed in their phospholipid composition.

20-121

SAM-TDR-62-121. STUDIES WITH A SIMULATED MARTIAN ENVIRONMENT: BACTERIAL SURVIVAL AND SOIL MOISTURE CONTENT. Nov 1962, 3p. T: 775302. T. L. Roberts, E. S. Wynne. ASTIA: Code XX.
Unclassified

In a simulated Martian environment based on the latest available data, colony counts of a sporeforming bacterium increased. There were no changes in soil moisture. Multiple entry into Mars jars did not affect counts or soil moisture.

21-2

AAL-TDR-62-2. THE EFFECT OF COLD EXPOSURE ON THE SURVIVAL OF MICE INOCULATED WITH VIABLE OR HEAT-KILLED SALMONELLA TYPHIMURIUM. June 1962, 13p. incl tables, 9 refs. P: 8241-32. C: AF 41(657)-340, Bryn Mawr College, Bryn Mawr, Pa. J. J. Previte, L. J. Berry. In OTS. ASTIA: AD 288686, Code AA. Unclassified

Mice exposed to 5° C show an increased susceptibility to the lethal effects of Salmonella typhimurium, strain SR-11A, heat-killed S. typhimurium, or a relatively aviru-lent strain of Staphylococcus aureus Giorgio. This in-crease in susceptibility to infection at low environmental temperatures is masked in infections with a more virulent strain of viable S. typhimurium (SR-11). However, with lower doses of the latter, the 25° C exposed mice are at least temporarily more successful in resisting the lethal effects of the disease. The differences in results be-tween infection with SR-11 and SR-11A may be due to the genetic homogeneity and heterogeneity of the two re-spective cultures. Metabolic changes responsible for the increased susceptibility of the cold exposed animals re-main to be investigated.

21-29

AAL-TDR-62-29. CONSIDERATION OF AIRCRAFT AS EMERGENCY SHELTERS. June 1962, 10p. incl illus., 2 refs. P: 8242-1. Paul W. Barnett, 1st Lt. USAF. In OTS. ASTIA: AD 286515, Code AA. Unclassified

This study was performed to determine the feasibility of use of a downed aircraft as an emergency shelter, and to investigate the possibility of improvision of a petroleum burning stove. Profiles of temperatures of the occupied shelters, as well as of those with the improvised stove installed and operating, and of ambient temperatures are presented. Ambient temperatures range from −18° to 39° F. Pictures of the improvised stove and tools re-quired in its construction are shown. The uninsulated, unheated aircraft is not adequate shelter for extreme cold environments. Stove improvision is practical.

21-32

AAL-TDR-62-32. MILITARY SMALL GROUP PERFORM-ANCE UNDER ISOLATION AND STRESS—CRITICAL REVIEW. II. Dimensions of Group Structure and Group Behavior. June 1962, 42p., 21 refs. P: 8243-11. C: AF 41(657)-323, Texas Christian Univ., Fort Worth, Texas. S. B. Sells. In OTS. ASTIA: AD 288688, Code AA. Unclassified

This is the second of five reviews of psychological and sociological literature bearing on group behavior prob-lems of AC&W sites in Alaska. Fourteen basic dimen-sions of groups, described by Hemphill, are discussed in terms of their effects on group behavior, with particular reference to AC&W site problems. The results of a fac-tor analysis, based on 100 civilian organizations, which arrays the fourteen dimensions according to three factors: behavior regulation appearing as social structure, effec-tive group effort, and primary personal interaction, are presented and interpreted.

21-33

AAL-TDR-62-33. MILITARY SMALL GROUP PERFORM-ANCE UNDER ISOLATION AND STRESS—CRITICAL REVIEW. III. Environmental Stress and Behavior Ecol-ogy. June 1962, 23p., 50 refs. P: 8243-11. C: AF 41 (657)-323, Texas Christian Univ., Fort Worth, Texas. J. R. Braun, S. B. Sells. In OTS. ASTIA: AD 286516, Code AA. Unclassified

A critical research review of behavioral effects of isola-tion, cold, and general stress, with particular reference to AC&W sites in Alaska. On the basis of the literature, environmental stress does not appear as a major threat to adjustment of troops stationed at AC&W sites. Human engineering has contributed greatly to the comfortization and control of the environment, and there appears to be a wide difference between conditions of the area and con-ditions of the specific work and living environment, ex-cept in cases of emergency. The possibility of such emergencies may be a threat, but few have occurred. The positive values of motivation, training, and group dynam-ics (including leadership) as factors which offset the dis-organizing effects of environmental stress are pointed out.

21-34

AAL-TDR-62-34. MILITARY SMALL GROUP PERFORM-ANCE UNDER ISOLATION AND STRESS—CRITICAL REVIEW. IV. Selection, Indoctrination, and Training for Arctic Remote Duty. June 1962, 26p., 28 refs. P: 8243-11. C: AF 41(657)-323, Texas Christian Univ., Fort Worth, Texas. S. B. Sells. In OTS. ASTIA: AD 286517, Code AA. Unclassified

Theoretically, individual adaptability to remote, small site duty, involving isolation and environmental stress, such as at AC&W sites in Alaska, can be increased by selection of the most fit and by personnel improvement, through indoctrination, acclimatization, and training pro-grams, as well as by reduction of stress through human engineering and effective management. Review of the

research literature on selection, indoctrination, and training for Arctic remote duty indicates (a) that marginal airmen can be rather easily identified, although at the cost of a high false-positive rate and that such airmen could be tagged for exclusion from highly demanding, high-risk assignments, provided that other jobs could be found for them elsewhere in the Air Force; (b) that an experimental site briefing, now in use for indoctrination of airmen assigned to Alaskan sites, merits continuation, with care to maintain quality of presentation; and (c) that a number of individual and group training opportunities are worthy of exploitation.

21-35

AAL-TDR-62-35, MILITARY SMALL GROUP PERFORMANCE UNDER ISOLATION AND STRESS—CRITICAL REVIEW. V. Psychological Principles of Management and Leadership. June 1962, 43p., 31 refs. P: 8243-11. C: AF 41(657)-323, Texas Christian Univ., Fort Worth, Texas. S. B. Sells. In OTS. ASTIA: AD 286518, Code AA.   Unclassified

This presents a critical discussion and interpretation of principles of leadership and management with particular reference to the problems of AC&W sites in Alaska. It is based on a review of scientific research in the fields of psychology, sociology and management science, primarily. The major topics covered include relations of management and leadership, group-centered vs. production-centered management, organizational relations, organizational control, and leadership in formal organizations. Selected references are cited and reference is made to an annotated bibliography containing abstracts of significant studies: AAL Reports 61-18 to 61-24, incl.

21-36

AAL-TDR-62-36, SOLAR ILLUMINATED PHOTOSYNTHETIC GAS EXCHANGERS. June 1962, 30p. incl illus., tables, 13 refs. P: 8241-23. R. D. Gafford, Ph. D., J. D. Fulton, Col., USAF, MSC. In OTS. ASTIA: AD 288689, Code AA.   Unclassified

During recent years much effort has been expended in attempting to develop principles, techniques, and instrumentation leading to the ultimate goal of utilizing photosynthetic organisms for the support of man in an extraterrestrial environment. This study was designed to determine if solar illuminated photosynthetic gas exchange systems would be feasible, and to provide sufficient data to determine if further consideration of this approach would be warranted. Comparative growth and photosynthetic data of two species of algae under various conditions are presented. Chlorella pyrenoidosa, strain TX 71105, and the 52° C strain of Synechococcus lividus were cultured in thin films in hemispherical domes and solar oriented flat panels during the long Alaskan days of June and July 1961. Growth and photosynthetic rates

were measured in cultures having film depths of 1, 2 and 4 cm under solar illumination. The maximum production rate observed in the flat panels was over 50 grams of algae and approximately 100 liters (STP) of oxygen per square meter of illuminated surface per day. Based on the observed data, it is estimated that the illuminated area of algal suspension required for a one man gas exchanger will be six square meters or less. The maximum volume of the illuminator will be 60 liters. A small additional volume must be added for pumping and for gas exchange.

21-38

AAL-TDR-62-38, ALGAE FEEDING IN MICE: PRELIMINARY OBSERVATIONS. June 1962, 7p. incl table, 5 refs. P: 8241-23. J. Rehkemper, Lt. Col., USAF, VC. In OTS. ASTIA: AD 288690, Code AA.   Unclassified

As algae have long been considered a possible supplemental food source during space explorations, this study was designed to observe the effects on mice when fed Chlorella algae, cultivated in connection with a solar illuminated closed algae system experiment, as the sole diet. Three males and two females under various breeding conditions and at various ages were maintained solely on algae from 10 to 21 weeks, mated, and observed. Detailed histologic studies were made on one male and its control, and comparative observations were conducted on the other male mice. The males failed to sire litters. Although, histologically, no significant changes were observed, using hematoxylin and eosin tissue preparations, and spermatogenesis appeared to be proceeding normally, the seminal vesicles were only one-quarter as large as, and lacked the texture of, those of controls of the same age. One experiment male, 7½ months old, fed algae for five months, failed to sire although all four of its mates, never on algae, produced young when subsequently bred to nonexperiment males.

21-44

AAL-TDR-61-44, EFFECT OF COLD ACCLIMATION ON VITAMIN A METABOLISM. May 1962, 4p. incl 2 tables, 7 refs. P: 8237-02. C: AF 41(657)-321, Tufts Univ. School of Medicine, Boston, Mass. E. Porter and E. J. Masoro. In OTS. ASTIA: AD 285012, Code AA.
                                                    Unclassified

Hepatic vitamin A levels are much higher in cold-acclimated rats than in rats maintained at 25° C. This increase in hepatic vitamin A content does not stem from a sparing action induced by cold acclimation but is rather a simple corollary of the increased food consumption that accompanies cold exposure. Moreover, evidence is presented which suggests that the amount of vitamin A needed for rats to live at 0° to 2° C is not markedly greater than the amount needed to live at 25° C.

21-45

AAL-TDR-61-45, A STUDY OF THE LIPOGENIC INHIB-ITORY MECHANISMS INDUCED BY FASTING. May 1962, 18p. incl tables, 18 refs. P: 8237-02. C: AF 41 (657)-321, Tufts Univ., Boston, Mass. E. J. Masoro, H. M. Korchak, Edith Porter. In OTS. ASTIA: AD 285-013, Code AA. Unclassified

Cytoplasmic particles from livers of fasted rats inhibit fatty acid synthesis by the hepatic supernatant enzyme system. In contrast, the cytoplasmic particles from livers of fed rats stimulate lipogenesis by the supernatant system. The microsomes from livers of fasted rats have the most marked inhibitory activity, which is associated with a material that is protein in nature. The inhibition occurs at the acetyl carboxylase step. Restriction of the amount of ATP available for this reaction by means of an increased microsomal ATPase is probably an important part of the inhibitory action. A microsomal interation with the particle-free supernatant is also involved in the inhibitory action. The possible physiological significance of lipogenic inhibitors is discussed.

21-46

AAL-TDR-61-46, CHANGES IN THE LEVEL OF THE FATTY ACID SYNTHESIZING ENZYMES DURING STAR-VATION. May 1962, 5p. incl tables, 10 refs. P: 8237-02. C: AF 41(657)-321, Tufts Univ. School of Med., Boston, Mass. H. M. Korchak, E. J. Masoro. In OTS. ASTIA: AD 286519, Code AA. Unclassified

The activity of acetyl CoA carboxylase is depressed significantly in 24 hours of fasting and markedly by 72 hours of fasting, while the activity of fatty acid synthetase is not significantly depressed in 24 hours of fasting but is depressed at the end of a 72 hour fast. Evidence is presented that indicates changes in the enzyme levels during fasting do not cause the depressed lipogenesis of this condition but are more likely the result of the low rate of lipogenesis initiated by other factors such as the disappearance of lipogenesis stimulators and the appearance of lipogenic inhibitors.

21-47

AAL-TDR-61-47, BIOCHEMICAL MECHANISMS RE-LATED TO THE HOMEOSTATIC REGULATION OF LIP-OGENESIS IN ANIMALS. June 1962, 46p., 161 refs. P: 8237-38. C: AF 41(657)-321, Tufts Univ. School of Med., Boston, Mass. E. J. Masoro. In OTS. ASTIA: AD 286-514, Code AA. Unclassified

The physiologic regulation of lipogenesis is discussed. The site of regulation in the enzymatic sequence of fatty acid synthesis appears to be the acetyl CoA carboxylase step. The following have been excluded as having importance in this regulation: (a) intracellular acetyl CoA levels; (b) the rate of TPNH generation; (c) direct actions of hormones. The following mechanisms appear to play a role in the control of lipogenesis: (a) concentration of acetyl CoA carboxylase; (b) lipogenic inhibitors; (c) lipogenic stimulators; (d) the level of tricarboxylic acid intermediates; (e) the concentration of CoA; (f) the level of FFA. Instead of considering the mechanism controlling lipogenesis, it seems more likely that this problem can only be understood by considering the multiple nature of the specific chemical events controlling fatty acid synthesis.

21-48

AAL-TDR-61-48, FATTY ACID METABOLISM DURING NOREPINEPHRINE-INDUCED THERMOGENESIS IN THE COLD-ACCLIMATIZED RAT. May 1962, 15p. incl tables, 18 refs. P: 8237-02. John P. Hannon, Anna M. Larson. In OTS. ASTIA: AD 285014, Code AA. Unclassified

The biochemical mechanisms underlying norepinephrine-induced thermogenesis and the possible relationship of this hormone to nonshivering thermogenesis were investigated in cold-acclimatized rats. In these animals an intravenous infusion of l-norepinephrine caused a marked fall in the Respiratory Quotient, thus indicating a predominance of fat oxidation. Cold-acclimatized animals were observed to have higher liver and blood levels of nonesterified fatty acids (NEFA) than control animals, but norepinephrine infusions raised blood NEFA to the same level in both groups. Cold acclimatization was associated with an increased capacity to turn over NEFA, as indicated by an elevated capacity for the oxidation of NEFA in the liver tissue and an increased sensitivity of epididymal fat to a norepinephrine-induced release of NEFA. Continuous measurements of respiratory gas exchange during acute cold exposure (5° and -15° C) of cold-acclimatized rats showed the Respiratory Quotient to be reduced only during the transition stage from a lower to a higher metabolic steady state. It was concluded that norepinephrine is not the sole mediator of nonshivering thermogenesis. Rather, it probably acts through a stimulation of NEFA metabolism to rapidly increase the heat production during the acute stage of cold exposure or during severe cold stress.

21-50

AAL-TDR-61-50, INFLUENCE OF PRIOR COLD EX-POSURE ON PERIPHERAL VASCULAR REACTION ON RABBIT EAR INDUCED BY ABRUPT COLD EXPOSURE. May 1962, 9p. incl tables. P: 8237-39. C: AF 41(657)-335, Univ. of Kentucky, Lexington, Ky. N. Honda, W. V. Judy, L. D. Carlson. In OTS. ASTIA: AD 285015, Code AA. Unclassified

The influence of prior cold exposure on vasoconstriction induced by abrupt cold exposure has been studied in the rabbit ear. Dutch breed rabbits were individually caged outdoors (maximum temperature, 21° C; minimum, -7° C; average, 5.9° C) and a control group was kept at 27° C over a five month period. Three groups of New Zealand

rabbits were divided to be exposed to 27° C, 5° C, and 5° C day and 27° C night temperatures.

Rectal, ear and body surface temperatures, heat loss from the ear, and blood flow in the ear were recorded at 27° C, 23° C and 5° C. In general, at 23° and 27° C there was no difference between the groups of rabbits. After one hour exposure to 5° C, outdoor and 5° C groups had a low blood flow to the ear and had no decline in rectal temperature. Other groups, however, had a decrease in rectal temperature and higher ear blood flow. After 12 to 18 hours exposure to 5° C, rectal temperature returned to original values in the 27° C animals; blood flow to the ear decreased slightly. Ear blood flow in outdoor and 5° C rabbits increased during this period.

21-51

AAL-TDR-61-51, THE PROPERDIN SYSTEM IN HOST RESISTANCE. April 1962, 39p. incl table, chart, 128 refs. P: 8241-32. C: AF 41(657)-311, Univ. of Utah, Salt Lake City, Utah. F. Miya, W. Wu, S. Marcus. In OTS. ASTIA: AD 285016, Code AA.   Unclassified

Evidence is reviewed through 1960 that supports the existence in mammalian sera of the serum protein fraction named properdin. Characteristics of the controversy concerning the distinctions between antibody and properdin are reviewed. Methods of isolation and assay, as well as problems related to assay, are considered and evaluated. The interactions of properdin are described with various substances, such as polysaccharides, divalent cations, complement and complement fractions. The reported effects of properdin on different types of bacteria, viruses and neoplasms, in culture or in animals, are evaluated in conjunction with other nonspecific defense mechanisms which have been described. Absence of information of the mechanism of action of properdin in host resistance indicates need for investigation in this area.

21-53

AAL-TDR-61-53, PHYSICAL FITNESS IN TERMS OF MAXIMAL OXYGEN INTAKE OF NOMADIC LAPPS. June 1962, 32p. incl tables, illus., 25 refs. P: 8240-19. Grant AF-EOARDC-61-32, Inst. of Work Physiology, Oslo, Norway. K. L. Andersen, R. E. Elsner, B. Saltin. In OTS. ASTIA: AD 288684, Code AA.   Unclassified

Physical fitness in terms of aerobic working capacity was measured in nomadic Lapps living in the northern part of the Scandinavian peninsula. Forty-nine men be-

tween 10 and 55 years of age and 21 girls were studied. Aerobic capacity was determined by measuring oxygen consumption during exercise on a bicycle ergometer. Two or three submaximal loads were used. The maximal work lasted three to four minutes, during which time the subjects worked as hard as they could. Blood lactate taken after this heavy run showed that the oxygen requirement exceeded oxygen intake, thus indicating that maximal values for oxygen intake were achieved during this type of exercise.

The values for maximal oxygen intake of nomadic Lapps increased steadily from the age of 10 up to 18 years, from an average of 1.4 liters/minute to about 3.5 liters/minute. The latter value remained essentially unchanged up to the age of 30 in men. Maximum oxygen consumption then decreased to about 2.5 liters/minute at 50 years of age. No sex differences in maximum oxygen consumption were noted in subjects below 15 years of age.

21-55

AAL-TDR-61-55, INFLUENCE OF HYPOXIA ON THERMAL HOMEOSTASIS IN MAN. June 1962, 20p., incl tables, 12 refs. P: 8238-20. C: AF 41(657)-330, Lovelace Foundation for Medical Education and Research, Albuquerque, New Mexico. Thos. P. K. Lim, Ulrich C. Luft. In OTS. ASTIA: AD 288685, Code AA.
Unclassified

The influence of induced hypoxia on core and shell temperatures, metabolic rate, perspiration and other related cardiopulmonary parameters has been studied in six healthy subjects under neutral, cold and warm environmental conditions. Mean skin temperatures in all three thermal environments with room air breathing are not different from those in similar environmental conditions with hypoxia. It is concluded that a hypoxic level of tracheal $P_{O_2} = 65$ mm Hg does not appreciably influence mean skin temperature in a neutral, cold, or warm environment. Rectal temperature during hypoxia is not different from that during room air breathing in neutral and cold environments. However, this is not true in a warm environment, when rectal temperature is significantly higher during hypoxia than that during room air breathing. The mechanism of this phenomenon cannot be explained on the basis of thermal balance alone. No great influence of hypoxia on shivering or perspiration can be detected under the experimental conditions. The synergistic actions of hypoxic and thermal stresses on total ventilation and heart rate are demonstrated.

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