Japanese Aerospace Literature This month: *Spacecraft Equipment*

A94-30715 Mechanism of built-in heat pipe for onboard equipment. A. KOBAYASHI and T. OKAMOTO (Space Communications Research Co., Tokyo, Japan), *AIAA and ASME, Joint Thermophysics and Heat Transfer Conference*, 6th, Colorado Springs, CO, June 20–23, 1994, p. 5. Documents available from Aeroplus Dispatch.

A high thermal conductive mechanism for the L-band solid state power amplifier (SSPA) has been developed. The mechanism has been tested analytically and experimentally on a trial model of the SSPA. The advantages of the mechanism in terms of FET junction temperature and heat spot problems are described. (Author)

N94-15001 Development of Japanese Earth Resources Satellite-1 (JERS-1; FUYO-1) and it's operational results (Chikyuu shigen eisei 1 gou (JERS-1) no kaihatsu oyobi sono seika). National Space Development Agency, Tokyo (Japan). Documents available from Aeroplus Dispatch.

Various aspects of development progress from the policy decision to the launch and early orbit phase operation of the JERS-I (Japanese Earth Resources Satellite-I) are presented. The items presented are as follows: the fundamental development policy, related organizations, and the system for the development; the master schedule and the progress of the development; the outline of JERS-I including its missions, the structure and characteristics of the system, and the operation plan; satellite mission and the system design analyses; the system development, including that of subsystems and components, production and test of the system development model, the integration and test of the system PFM (Proto-Flight Model), and the modification and post-modification test of the PFM; interfaces with other programs; program control; satellite operation in the launch and early orbit operation phase and the analysis and evaluation of the operation results; and the initial examination on on-orbit failures. (Author)

N94-14277 Research and development of space transportation systems in ISAS. J. ONODA, Tokyo Univ., Sagamihara (Japan), Inst. of Space and Astronautical Science, *In Science and Technology Agency, Asia-Pacific ISY Conference*, Vol. 2, pp. 356–359 (SEE N94-14209 02-43). Documents available from Aeroplus Dispatch.

An overview of the research and development activities in the ISAS (the Institute of Space and Astronautical Science) focusing on the Mu-5 launch vehicle, the winged space vehicle, and the ATR (Air Turbo Ramjet) engine is presented. The design guidelines, characteristics, dimensions, and subsystems, such as rocket motor, nose fairing, and attitude control subsystem of the Mu-5 launch vehicle, one of the versions of Mu series rocket, which is capable of launching 1.8 tons of payload into LEO (Low Earth Orbit) are outlined. The research and development activities on winged space vehicle called the HIMES (Highly Maneuverable Experimental Space) Vehicle and the ATR propulsion system are outlined. (Author)

N94-13660 The study on test of docking mechanism system, part 1 and 2 (Dokkingu kikou shisutemu shiken no kenkyuu Technical Progress Report, FY 1990–1991). National Space Development Agency, Ibaraki (Japan), Thermal and Structural Engineering Lab. Documents available from Aeroplus Dispatch.

An overview of the study of docking mechanism system test is presented. The following aspects of the research and development are outlined: (1) overall scheme of the research and development; (2) research and development in each FY (Fiscal Year); (3) research and development in FY 1990, including total assembly of the docking mechanism system test model, test equipment, mechanism system test, and the results of the research and development; (4) research and development in FY 1991, including comparative evaluation of the system test and simulation analysis, and the conceptual design of the docking mechanism for the ETS-7 (Engineering Test Satellite-7); and (5) docking mechanism for ETS-7 composed of latching, umbilical connection, and separation mechanisms, and driving circuit section. (Author)

N94-13656 Conceptual design on H-2 Orbiting Plane (HOPE) (Heisei 3 nendo HOPE gaiken sekkei). Fuji Heavy Industries Ltd., Tokyo (Japan). Documents available from Aeroplus Dispatch.

An overview of the results of the studies on technical problems concerning the following subjects related to the HOPE (H-2 Orbiting Plane) is presented: (1) technical problems on system design, aerodynamic design, thermal structure design, thermal control system design, and guidance and control system design; (2) studies on designs for the system, aerodynamic characteristics, thermal structure, actuator system, thermal control system, payload support system, and guidance and control system; (3) studies on operational concepts and overall operation system; and (4) study of development program. (Author)

N94-13472 Survey and study on Environmental Control and Life Support (ECLS) technologies, part 2 (Kankyou Seigyo/Seimei Iji Gijutsu No Chousa Kentou). Japan Manned Space Systems Corp., Tokyo. Documents available from Aeroplus Dispatch.

The survey and study on ECLS (Environmental Control and Life Support) technologies aiming at an ECLS to which the advanced technology at the present time is incorporated focusing on the air renewal technologies (such as removal of carbon dioxide, reduction of carbon dioxide, oxygen production, and toxic gas removal) and water recycle technologies (such as distillation and filtration) taking into the consideration a manned engineering test satellite (assuming the launch around 2000) is presented. The reference model establishment, recycling type ECLSS (Environmental Control and Life Support System) total system study, survey and study on subsystem technologies, planning of research and development projects, and visiting survey of ECLSS oriented facilities in and out of the country, and survey of the ECLSS related references is presented. An integrated research project for manned platform recycling type life support equipment is shown. (Author)

N94-13425 Study on superconducting basic technology for space application, part 1 (Uchuuyou Choudendou Youso Gijutsu No Kenkyuu). Society of Non-Traditional Technology, Tokyo (Japan). Documents available from Aeroplus Dispatch.

Feasibility studies on application of superconductivity to the space technology have been made for three years, since FY (Fiscal Year) 1988. In FY 1991, three basic technology, i.e., SIS (Superconductor Insulator Superconductor) mixer, microwave circuit element and superconductive magnetic bearing, are selected as potential technology in the space, and the following further studies were performed: (1) a review of current R&D (Research and Development) status on the technology; (2) a survey on potential use in the space; (3) a survey on the required features of the technology in space use; and (4) a preliminary design study of the devices and/or systems used by the technology, applicable on a satellite. Review works have also made on the current status of R and D programs of superconductive material processing test in the micro gravity environment, and ASTROMAG (Particle Astrophysics Magnet Facility) project. (Author)

N94-13278 Trial manufacture model and in-space verification method of deployable antenna (Tenkai antena no shisaku moderu to uchuu jisshou houhou). T. EBISUI, T. ORIKASA, and T. OKAMOTO, Mitsubishi Electric Corp., Tokyo (Japan). Space Communications Research Div. *In NASDA, The Second Workshop on Deployment and Assembly Experiment of Large Space Structure on Orbit*, pp. 54–58 (SEE N94-13268 02-12). Documents available from Aeroplus Dispatch.

This report describes the 6 m hexa-link truss type scale model (4 GHz band offset parabolic antenna with a 6m diameter aperture and a 6m focal length) and 2 m TETRUS type scale model (12 GHz band offset parabolic antenna with a 1.7 m diameter aperture and a 2.2 m focal length). Each antenna has electrical and mechanical characteristics similar to those of the large truss-type mesh deployable antenna of the Geostationary Platform (GPF) mobile communication satellites. The antennas were chosen to satisfy the increasing communication demands and requirements for advanced and diversified communication. The microgravity performance verification of these scale models is discussed. Additionally, the following topics are discussed: examples of the structures of GPF-type mobile communication satellite, the hexa-link truss type scale model, and the TETRUS (Tetra Trigonal Prism Truss) type scale model; the orbit of the scale models; and their space verification. (Author)

N94-13274 Development of modular cable mesh deployable antenna (Mojurugata keburu messhu tenkai antena no kaihatsu). A. MEGURO, J. MITSUGI, and K. ANDOU, Nippon Telegraph and Telephone Public Corp., Yokosuka (Japan). *In NASDA, The Second Workshop on Deployment and Assembly Experiment of Large Space Structure on Orbit*, pp. 29–35 (SEE N94-13268 02-12). Documents available from Aeroplus Dispatch.

This report describes a concept and key technologies for the modular mesh deployable antenna. The antenna reflector composed of independently manufactured and tested modules is presented. Each module consists of a mesh surface, a cable network, and a deployable truss structure. The cable network comprises three kinds of cables, surface, tie, and back cables. Adjustment of tie cable lengths improves the surface accuracy. Synchronous deployment truss structures are considered as a supporting structure. Their design method, BBM's (Bread Board Model) and deployment analysis are also explained. (Author)

N94-13270 Thermal distortion measurement of TETRUS type thermal test model of large deployable antenna for mobile communications satellite (outai tsuushin eiseiyou oogata tenkai antena tetrus gata netsu moderu no netsuhizumi sokutei). T. ORIKASA, T. OKAMOTO, K. FURUKAWA (Toshiba Corp., Kawasaki, Japan.), and T. AISAKA (Toshiba Corp., Kawasaki, Japan), Mitsubishi Electric Corp., Tokyo (Japan). Space Communications Research Div.. *In NASDA, The Second Workshop on Deployment and Assembly Experiment of Large Space Structure on Orbit*, pp. 7–11 (SEE N94-13268 02-12). Documents available from Aeroplus Dispatch.

A thermal test model using TETRUS (tetra trigonal prism truss) composed of three equilateral triangular cylindrical trusses was trial produced and evaluated for the effects caused by thermal environments on the mirror surface. The following topics related to the thermal environmental test are described: TETRUS, the thermal environment test model, the analysis on thermal distortion of the TETRUS, the process and the results of the thermal environmental test, the estimate analysis of electric property at the ambient temperature, and a high and a low temperature, the test configuration, the results of mirror surface accuracy measurements, and electric performance estimation analysis. (Author)

N94-13269 Structural design of hexa-link truss deployable antenna (Hekisarinku torasu tenkai antena no kouzou sekkei). T. EBISUI, T. OKAMOTO, Y. OOKAWA, K. TANIZAWA, M. TABATA, and H. TANIAI, Mitsubishi Electric Corp., Tokyo (Japan), Space Communications Research Div.. *In NASDA, The Second Workshop on Deployment and Assembly Experiment of Large Space Structure on Orbit*, pp. 1–6 (SEE N94-13268 02-12). Documents available from Aeroplus Dispatch.

Structure of a 6 m deployable antenna mirror surface for communications satellite is designed paying attention to the following sections: the back structure section composed of 19 basic modules of hexagonal trapezoid shape, mirror mesh section composed of a cable net made from Al amide fiber with gold plated molybdenum mesh hung on it, and a deployment mechanism (sliding type and flexible type) of the deployable section for the offset parabolic antenna scale model of 6 m in aperture diameter. Deployment motion analysis was conducted with a hexagonal trapezoidal model of one module using the ADAMS (Automatic Dynamic Analysis of Mechanical System). (Author)

N94-13268 The Second Workshop on Deployment and Assembly Experiment of Large Space Structure on Orbit (Dai 2 Kai Kidoujou ni Okeru Oogata Uchuu Kouzoubutsu Tenkai Kumitate Jikken ni Kansuru Waku Shoppu). National Space Development Agency, Ibaraki (Japan). Documents available from Aeroplus Dispatch.

The following topics were discussed: spacecraft structures, spacecraft components, structural design, large space structures, space erectable structures, expandable structures, inflatable structures, trusses, beams, hexa-link truss, helical truss beam, dynamic stability, structural stability, numerical analysis, antenna design, expandable type satellite antennas, modular mesh deployable antenna, orbital assembly, spacecraft construction materials, CFRP (Carbon Fiber Reinforced Plastics), polyimide matrix composite, thermal resistance, mechanical properties, spaceborne experiments, space technology experiments, radiation tolerance, space robots, remote manipulator systems, Japanese spacecraft, JEM (Japanese Experiment Module), and HOPE (H-2 Orbiting Plane). For individual titles, see N94-13269 through N94-13282. (Author)

N94-12554 Research on two phase flow in microgravity (Bishou juuryokuka ni okeru nisouryuu ni kansuru kenkyuu). M. SAITOU, Osaka Univ., Suita (Japan). Faculty of Engineering. *In NASDA, The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 46–65 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

An overview of the results of the study on two phase flow in microgravity is described. Topics discussed include: estimation of air-water two phase flow characteristics in microgravity based on the conventional flow regime maps; two phase flow simulation using two liquids of the same specific gravity; two phase flow experiment in microgravity using free drop towers and airplanes; and the results of the experiments for assessing pressure losses and heat transmission properties in two phase flows. Various microgravity flow regime maps are introduced. (Author)

N94-12553 Devices related for thermal control systems used in microgravity (Uchuu kankyouka no netsu kanri shisutemu ni okeru kanren debaisu). E. BOELMAN and T. OOGUSHI (Mitsubishi Electric Corp., Tokyo, Japan.), Tokyo Univ. of Agriculture and Technology (Japan). *In NASDA, The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 39–44 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

The following aspects of activities to search for the system requirements for devices (including heat pipe, control unit, pump, separator, and accumulator) for high performance thermal control system used in microgravity are outlined: (1) collection of the related information from experiment proposals concerned with the devices, researchers on subsystems (such as two phase liquid loop, radiator, evaporator and condenser), and industrial circles; (2) coordinating the experiment proposals and the research and development needs; and (3) study of the system requirements to clarify the requirements, scopes, and problems of the proposed experiments and to grasp the needs of the user of the JEM (Japanese Experiment Module) in the different areas. This presentation is represented by viewgraphs only. (Author)

N94-12552 Two phase flow and isopycnic liquid-liquid two phase fluid in reduced gravity field (Tei juuryokuba no nisouryuu to toumitsudo eki eki nisouryuu). T. FUJII and J. OOTA, Kobe Univ. (Japan). Dept. of Mechanical Engineering. *In NASDA, The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 26–38 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

The possibility of applying the existent gas-liquid two phase flow behavior diagrams in the earth gravity to those in reduced gravity are described. Outlines of the results of free drop tower experiments, airplane experiments, free drop tower experiment and airplane experiment are reviewed. The result of the isopycnic two phase liquid flow experiments on the ground simulating the reduced gravity effects using silicone oil and water of the same specific gravity are outlined. (Author)

N94-12551 Developmental research of thermal control system in space environment (Uchuu kankyouka no netsu seigyo shisutemu no kaihatsu kenkyuu). M. ARITOMI and T. FUJII (Kobe Univ., Japan.), Tokyo Inst. of Tech. (Japan). *In its The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 21–25 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

An overview of the objectives and significance of the research on boiling two phase flow is presented. The essential functions for the system and research subjects are discussed. Topics discussed include: circulation; gas and liquid separation; condensation; heat rejection; pressure control; load heat rejection; void ratio; flow pattern transient; pressure loss; gas and liquid separation; boiling heat transmission rate and transmission limit; condensing heat transmission and transmission promotion; recombination of liquid phases; flow distribution in multi-group parallel flow channels and flow stability; flow characteristics in two phase header; and integrated test. (Author)

N94-12550 Condensation phenomena (Gyoushuku genshow ni tsuite). A. YABE and Y. HAYASHI (Kanazawa Univ., Japan.), Mechanical Engineering Lab., Tsukuba (Japan). Thermal Engineering Div.. *In NASDA, The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 18–20 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

The results of theoretical consideration about condensation phenomena in microgravity are described. Methods of condensation heat transfer promotion in microgravity by rejecting condensed fluid from the heat transfer surfaces to make condensed liquid films are described. Characteristics of condensers as components of two liquid phase systems (compatibility with gas and liquid separator after exiting from the condenser), and a method of equipment temperature control are outlined. The system requirements are shown. (Author)

N94-12548 Summary of studies on JEM utilization experiment projects (JEM riyou jikken keikaku kentou gaiyou). T. MATSUSHITA, National Space Development Agency, Tokyo (Japan). *In its The Third Workshop on Two Phase Fluid Experiment in the Space Environment*, pp. 1–12 (SEE N94-12547 01-34). Documents available from Aeroplus Dispatch.

The outlines of the international Space Station Freedom Program, configuration of JEM (Japanese Experiment Module), JEM utilization plan and its development schedule, and plan and configuration of the two phase fluid experiment system are introduced. Topics discussed include: schematic drawing of JEM; the original and revised space station structures; overall schedule; the progress of two phase fluid experiment equipment study; the common experiment equipment and infrastructure construction experiment equipment; JEM technology missions and space infrastructure; proposed themes by Tsukuba Space Center, NASDA (National Space Development Agency of Japan); two phase liquid common experiment configuration; and actions to be taken in the future. This presentation is represented by viewgraphs only. (Author)

N94-12547 The Third Workshop on Two Phase Fluid Experiment in the Space Environment (Dai 3 kai uchuu kankyouka ni okeru nisou ryuutai jikken ni kansuru waku shoppu). National Space Development Agency, Ibaraki (Japan). Documents available from Aeroplus Dispatch.

The following topics were discussed: Japanese spacecraft, JEM (Japanese Experiment Module), spaceborne experiments, space technology experiments, spacecraft equipment, microgravity, aerospace environments, two phase fluid, two phase flow, thermal control, flow stability, flow characteristics, heat transfer coefficient, heat flux, heat radiators, cold plate, heat pipes, boiling, evaporation, condensation, liquid-air separation, pressure losses, void ratio, drop towers, air-borne experiments, users requirements, mission planning, and equipment specifications. For individual titles, see N94-12548 through N94-12556. (Author)

N94-12280 The trial manufacture and test of critical components in docking mechanism (Dokkingo kikou: Kuritikaru youso shisaku shiken Technical Progress Report, FY 1991). National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.. Documents available from Aeroplus Dispatch.

An overview of the trial manufacture and test of critical elements for rendezvous and docking mechanism is presented. The following aspects of the research and development are outlined: (1) overall scheme of the research and development; (2) progress of the research and development from FY (Fiscal Year) 1976 through FY 1991; (3) the trial manufacture and test of critical elements, including the system design, design studies on mechanism section and driving circuit, the manufacture and test, docking mechanism system test, and simulation analysis; and (4) docking mechanism for ETS-7 (Engineering Test Satellite-7), including development specifications for ETS-7 docking mechanism, study on the development program and schedule, and microgravity simulation test equipment. (Author)

N94-12279 Flight data analysis of Japanese Earth Resources Satellite-1 (JERS-1) (Chikyuu shigen eisei 1 gou (JERS-1) tsuiseki kansei gijutsu shien oyobi hyouka kaiseki). Mitsubishi Electric Corp., Tokyo (Japan). Documents available from Aeroplus Dispatch.

A summary of the satellite operation conditions in the launch and early orbit operation phase and the results of the launch and early orbit phase operation and functional verification on the following subsystems of the JERS-1 (Japanese Earth Resources Satellite-1) is presented: (1) C&DH (Communication and Data Handling Subsystem); (2) EPS (Electrical Power Subsystem); (3) AOCS (Attitude and Orbit Control Subsystem); (4) RCS (Reaction Control Subsystem); (5) TCS (Thermal Control Subsystem); (6) SAR (Synthetic Aperture Radar); (7) OPS (Optical Sensor); (8) MDT (Mission Data Transmitter); and (9) MDR (Mission Data Recorder). (Author)