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ABSTRACTS OF ACTIVE CONTRACTS. AIR FORCE MATERIALS LABORATORY.(U)
SEP 76 T G PURNHAGEN

UNCLASSIFIED AFML-TR-76-66 NL

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ABSTRACTS OF ACTIVE CONTRACTS - AIR FORCE MATERIALS LABORATORY

SCIENTIFIC AND TECHNICAL INFORMATION OFFICE
OPERATIONS OFFICE

SEPTEMBER 1976

TECHNICAL REPORT AFML-TR-76-66
FINAL REPORT FOR PERIOD APRIL 1975 - FEBRUARY 1976

Approved for public release; distribution unlimited

AIR FORCE MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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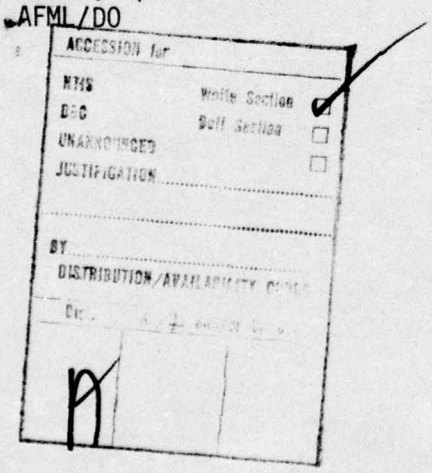
This technical report has been reviewed and is approved for publication.

TOM G. PURNHAGEN, Lt Col, USAF
AFML/DO/STINFO

FOR THE COMMANDER

WARREN P. JOHNSON
Chief, Operations Office
AFML/DO



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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Abstracts of Air Force Materials Laboratory Contracts that were active on 05 February 1976 are reported. The abstracts are indexed by contractor, contract number, and project task number. Each abstract entry provides the title of the contract, contractor, duration, AFML project engineer, objective and progress or approach in the case of new contracts where there is no progress to report yet.

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FOREWORD

This report is to inform Government Agencies, contractors, and perspective contractors of basic research, exploratory development, advanced developments and manufacturing technology contracts monitored and supported by the Air Force Materials Laboratory and active on 05 February 1976.

The Divisions sponsoring research are as follows: Materials Support Division (MX), Advanced Development Division (LC), Metals and Ceramics Division (LL), Nonmetallic Materials Division (MB), and Electromagnetic Materials Division (LP). The technology contracts are sponsored by Manufacturing Technology Division (LT).

Inquiries relative to contracts listed in this report should be addressed to the attention of the Division responsible for the contract as follows:

Air Force Materials Laboratory

ATTN: AFML/LC
AFML/LL
AFML/LP
AFML/LT
AFML/MB
AFML/MX
Wright-Patterson AFB, Ohio 45433

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PROJECT NO. 0000 - NOT AVAILABLE

TITLE. SHORT TERM INTERMITTENT RESEARCH TASKS

CONTRACTOR.	TECHNOLOGY INC
CONTRACT.	F33615-73-C-4155
CONTRACT DURATION.	JUN73-
AFML PROJECT ENGINEER.	DAACK MARTIN
PROJ/TASK/WK UNIT.	0000-00-00

Objective - 05 SEP 73

(U) AF FUNCTION - Research and Development. DEFICIENCY - Inability to obtain military or civil service personnel with highly specialized skills on a short term basis. RESEARCH - Basic research in the physical and engineering sciences. HOW RESEARCH CONTRIBUTES - Provides professional competence and utilizes unique ARL equipment for thorough investigations and knowledgeable evaluations. Offers the opportunity for basic research in the areas of chemistry, solid state physics, plasma physics, applied mathematics, metallurgy and ceramics, hypersonics, energetics and fluid dynamics within the directed ARL approved mission projects.

Progress-F 06 DEC 74 To 28 FEB 75 (Interim-F)

(U) Submission of requests for ARL utilization of this service from 6 Dec 74 to 28 Feb 75 was for a total of 3 participants with a total of 56 participants now requested from the contractor.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. INFORMATION RETRIEVAL

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5005
CONTRACT DURATION.	JUL74-JUN75
AFML PROJECT ENGINEER.	WISNOSKY DENNIS
PROJ/TASK/WK UNIT.	7381-03-28

Objective - 18 APR 74

(U) Improve the present information processing system and continue storing technical reports on materials, their properties, processes and applications so that answers to questions brought to the system can be based on as nearly complete access to all existing information as possible. This information system helps maximize utilization of materials for all AF systems.

Progress-A 01 JUL 74 To 11 APR 75 (Interim-A)

(U) Keyword out of context (KWOC) indexing has been fully implemented. The indexing rate is approximately 500 documents per month. Keywork in context (KWIC) searching service has been accelerated from five (5) day to one (1) day routine turn around by executing the appropriate programs locally. Information retrieval capability has been greatly improved through real time access (by computer terminal) to 26 world wide data bases. The scientist and/or engineer now truly has a world of information at his finger tips. As one immediate result of this availability and an agressive education program, the number of request has quadrupled over the previous calendar year.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. INTERMITTENT RESEARCH ON MATERIALS AND ASSOCIATED PROBLEMS

CONTRACTOR. UNIVERSAL TECHNOLOGY
CONTRACT. F33615-74-C-5043
CONTRACT DURATION. OCT73-JUL75
AFML PROJECT ENGINEER. HARSACKY FRANK J
PROJ/TASK/WK UNIT. 7381-03-31

Objective - 18 JUL 73

(U) To provide research analysis on highly important materials and associated problems which suddenly develop and must be attacked immediately. This requires that a strong potential of highly specialized technical authorities be available for assignment to the problem when it is recognized. Many of the problems are service related.

Progress-A 01 OCT 73 To 11 APR 75 (Interim-A)

(U) To date, approximately 80 individual problems have been addressed under this contract. Approximately 55 of these efforts have involved research requiring a quick reaction capability and have ranged in duration from a few days to several weeks. The remaining problems were solved through lectures and workshops and activities on various technical subjects as required to support the AFML mission.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. LASER HARDENED SUBSCALE CANOPY DEVELOPMENT

CONTRACTOR.
CONTRACT.
CONTRACT DURATION. JUN75-JUN76
AFML PROJECT ENGINEER. GRIFFITH GORDON H
PROJ/TASK/WK UNIT. 2100-00-01

Objective - 09 DEC 74

(U) The objective of this program is to develop processing and fabrication techniques for laser hardened transparent plastics which will be suitable for fabricating laser hardened aircraft canopies. Integral to this program is the fabrication of subscale canopy shaped articles for validating fabrication feasibility and for evaluating structural performance, environmental resistance and laser hardness.

Progress-A 02 JUN 75 To 15 OCT 75 (Interim-A)

(U) A subscale canopy shape has been fabricated and delivered to AFML. Selection of materials and laminate concepts is in progress along with accompanying screening tests for optimizing performance.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. DMSP FILTER DEMONSTRATION

CONTRACTOR.	WESTINGHOUSE ELECTRIC CORP
CONTRACT.	F33615-75-C-5210
CONTRACT DURATION.	APR75-JUN75
AFML PROJECT ENGINEER.	BABJAK STEPHEN J
PROJ/TASK/WK UNIT.	2100-00-02

Objective - 03 DEC 74

(U) Demonstrate new filter for DMSP Optical System.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. HARDENING APPLICATIONS STUDY OF AIRCRAFT

CONTRACTOR.	R AND D ASSOCIATES
CONTRACT.	F33615-75-C-5247
CONTRACT DURATION.	JUN75-APR75
AFML PROJECT ENGINEER.	GRIFFITH GORDON H
PROJ/TASK/WK UNIT.	2100-00-06

Objective - 28 FEB 75

(U) The objective of this study is to evaluate the potential payoff of material hardening concepts for protecting Air Force aircraft and missile systems from high intensity radiation.

Progress-A 15 JAN 75 To 15 OCT 75 (Interim-A)

(U) Background data on target and threat models is being collected to update codes being utilized by contractor. Also, data on material hardening concepts is being collected for use in later tasks of this program.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. HARDENED FILTER/MIRROR DEVELOPMENT

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-75-C-5198
CONTRACT DURATION.	FEB75-JAN76
AFML PROJECT ENGINEER.	GRIFFITH GORDON H
PROJ/TASK/WK UNIT.	2100-00-07

Objective - 17 DEC 74

(U) To develop infrared transmitting materials and concepts which have improved resistance to the damaging effects of laser radiation at specified wavelengths, but yet are highly transparent to the desired target radiation.

Progress-A 15 FEB 75 To 15 OCT 75 (Interim-A)

(U) A number of multi-layer coatings have been fabricated and are currently undergoing extensive environmental testing and evaluation both at Honeywell and AFML.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. HARDENED INFRARED MATERIALS

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5220
CONTRACT DURATION.	APR75-FEB76
AFML PROJECT ENGINEER.	GRIFFITH GORDON H
PROJ/TASK/WK UNIT.	2100-00-08

Objective - 01 APR 75

(U) To fabricate IR domes which have improved resistance to the damaging effects of laser radiation and specified wave lengths and yet are highly transparent to the desired target radiation.

Progress-A 01 MAR 75 To 15 OCT 75 (Interim-A)

(U) IR domes with good mechanical integrity have been fabricated by the contractor. Current efforts are directed at improving the marginal optical properties of these domes.

PROJECT NO. 2100 - LASER HARDENED MATERIALS

TITLE. COATINGS FOR IR MATERIALS

CONTRACTOR.	OPTICAL COATING LABORATORIES INC
CONTRACT.	F33615-75-C-0135
CONTRACT DURATION.	JUL75-JUN76
AFML PROJECT ENGINEER	GRIFFITH GORDON H
PROJ/TASK/WK UNIT.	2100-00-10

Objective - 07 APR 75

(U) To purchase six IR transmitting samples with special optical coatings applied to reject selected wavelengths.

Progress-A 30 JUN 75 To 15 OCT 75 (Interim-A)

(U) Six (6) IR domes have been coated and shipped to AFML for tests and evaluation.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. COMPOSITE WING FLIGHT TEST PROGRAM

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-71-C-1536
CONTRACT DURATION.	MAY71-JUN74
AFML PROJECT ENGINEER.	ROSELIUS DAVID A
PROJ/TASK/WK UNIT.	69CW-00-86

Objective - 12 APR 72

(U) OBJECTIVE- Develop the required technology and design, manufacture, and validate through ground and flight test the primary load carrying wing structure of the F-15 aircraft fabricated with advanced composite materials.

Progress-E 01 SEP 74 To 01 APR 75 (Interim-E)

(U) All testing efforts on the Static Test Wing have been satisfactorily completed during this month. The wing was subjected to four 75 percent limit load tests, one 115 percent limit load, two 100 percent limit load tests, and 500 hours of quasi-real time fatigue. During this portion of the test phase no problems were experienced. On 18 Nov 74 the static test wing was tested to the first of two ultimate load conditions. The test was negative bending to 150 percent limit load, and the wing successfully withstood the load with no problems. On 22 Nov 74, the second ultimate load condition was applied to the F-15 composite wing. This test was positive bending. In the morning, the load was applied to 133 percent limit load, whereupon, one of the load jacks ,bottomed out.. The test was halted and fixes were implemented to preclude this problem from happening again. In the afternoon the test was restarted. The F-15 composite wing failed at 145 percent design limit load. The failure was initiated by crippling of the titanium rear spar flange and upper cover, where the two are bolted together, in the area of station 96. The failure went across the complete box chord fracturing the upper cover in the area of station 96 only. The resulting substructure damage was also localized. Each spar was buckled only in the area of the failure, and the rib at station 96 was the only rib receiving significant damage. The final weight savings for the composite torque box was 17.1 percent.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. EUTECTIC COMPOSITE TURBINE BLADE DEVELOPMENT

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-73-C-5050
CONTRACT DURATION.	APR73-JAN76
AFML PROJECT ENGINEER.	SCHULZ WILLIAM J
PROJ/TASK/WK UNIT.	69CW-00-92

Objective - 09 NOV 72

(U) To develop the materials, design, and fabrication technology required for the application of eutectic composite materials in turbine blade components in gas turbine engines.

Progress-E 01 APR 75 To 15 OCT 75 (Interim-E)

(U) All process development has been completed. Data generation has been completed. Final design has been initiated. All blade castings have been produced by the subcontractor. These are now being inspected and machined for bench testing.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. EVALUATION OF HYBRID COMPOSITE MATERIALS

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5074
CONTRACT DURATION.	JUN74-JUN76
AFML PROJECT ENGINEER.	KOSMAL BRIAN A
PROJ/TASK/WK UNIT.	69CW-01-11

Objective - 08 AUG 73

(U) To derive useful engineering and design data on hybrid composite systems.

Progress-C 01 APR 75 To 21 OCT 75 (Interim-C)

(U) Phase I, the materials screening, is complete and resulted in the selection of the S-Glass/T-300 and T-300/PRD-49 materials systems for engineering data generation in Phase II. Phase II materials have been purchased, all test coupons have been laid-up and cured, and testing is proceeding on schedule. The program is on schedule and within cost.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. DEVELOPMENT OF IMPROVED ENVIRONMENTAL RESISTANT ORGANIC-REINFORCED MATERIALS SYSTEMS

CONTRACTOR.	WHITTAKER CORP
CONTRACT.	F33615-74-C-5142
CONTRACT DURATION.	JUN74-
AFML PROJECT ENGINEER.	HOLLINGSWORTH GARY D
PROJ/TASK/WK UNIT.	69CW-01-13

Objective - 13 AUG 73

(U) The objective of this program is to investigate the combination of boron and graphite fibers with commercially available resin systems to provide material combinations with increased environmental resistance compared to that offered by the presently used expoxy and modified epoxy resin systems.

Progress-B 01 APR 75 To 22 OCT 75 (Interim-D)

(U) The candidate resins were used as matrix with T-300 graphite fiber to fabricate laminate test specimen. Initial results in flex and short beam shear showed that although the resins were not degraded by moisture their strength values were well below epoxies, especially at temperature (300 degrees F plus). Attempts at optimization to improve high temperature properties, while showing improvement, either failed to show enough strength improvement or induced cracking. The program is currently being downward redirected to preclude further activity excepting a final report.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. PROOF LOADING METHODOLOGY FOR COMPOSITE STRUCTURES

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-74-C-5165
CONTRACT DURATION.	JUN74-DEC74
AFML PROJECT ENGINEER.	DAVIS ANDREW W
PROJ/TASK/WK UNIT.	69CW-01-19

Objective - 01 APR 75

(U) The objective of this program is the development and demonstration of the necessary technology to achieve the same philosphical damage tolerant goals in structural criteria for advanced composites as are being implemented for metallic structures. The new structural criteria standards MIL STD-1530 and MIL-A-XXXX were developed for metallic structures to obtain Safety-of-Flight for aircraft structures. This program includes the development and demonstration of the basic methodology for achieving fracture control in advanced composite structures.

Progress-A 22 JUN 74 To 01 APR 75 (Interim-A)

(U) Material characterization has begun, test fixtures have been built, preliminary specimens have been tested. Based on poor materials, properties, a temporary stop-work order has been issued. Efforts will be undertaken to clarify the impact of materials, properties on program objectives and to determine an appropriate material procurement specification.

PROJECT NO. 69CW - ADVANCED COMPOSITES

TITLE. ANALYSIS OF HYBRID COMPOSITE MATERIALS

CONTRACTOR.	MATERIALS SCIENCES CORP
CONTRACT.	F33615-74-C-5174
CONTRACT DURATION.	JUN74-JUN75
AFML PROJECT ENGINEER.	KOSMAL BRIAN A
PROJ/TASK/WK UNIT.	69CW-01-20

Objective - 20 JUN 74

(U) To derive useful engineering and design data on hybrid composite systems.

Progress-C 01 APR 75 To 21 OCT 75 (Interim-C)

(U) The program technical effort is complete. A rewritten draft of the final report has been approved. Submission of a reproducible copy of the final report, AFML-TR-75-92, is the only contractual task remaining. The report provides data that will enable the structural designer to make a preliminary assessment of cost and weight tradeoffs for numerous interply hybrid composite material systems by comparing them to aluminum and single-reinforcement composites for several generic structural applications over a wide range of loadings. The method by which these comparisons are made is detailed in the report.

PROJECT NO. 8809 - NUCL VUL/HARDENING TECH

TITLE. DMSP TRANSIENT THERMAL ANALYSIS

CONTRACTOR.	R C A CORP
CONTRACT.	F33615-75-C-5122
CONTRACT DURATION.	DEC74-JUN75
AFML PROJECT ENGINEER.	BABJAK STEPHEN J
PROJ/TASK/WK UNIT.	8809-00-01

Objective - 16 MAY 75

(U) To examine the thermal response of the DMSP spacecraft in the normal and simulated weapon environments.

Progress-A 16 DEC 74 To 01 MAY 75 (Interim-A)

(U) Seven computer runs have been completed. The program is on schedule.

PROJECT NO. 7021 - STRUCTURE AND PROPERTIES OF SOLIDS

TITLE. THE UNDERSTANDING AND EXPLOITATION OF ALLOYS BASED ON (TIAL)

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-74-C-1140
CONTRACT DURATION.	MAY74-JUN75
AFML PROJECT ENGINEER.	LIPSITT HARRY A
PROJ/TASK/WK UNIT.	7021-01-64

Objective - 01 FEB 74

(U) AF FUNCTION - Advanced Aerospace Vehicles. DEFICIENCY - Reliability of Structural Materials at High Temperatures. RESEARCH - Understand and exploit intermetallic compounds. HOW RESEARCH CONTRIBUTES - Phase relationships, alloying behavior and properties of castings are necessary to allow more exact design with consideration of a wider range of operating conditions. If some room temperature ductility can be introduced in TiAl a whole new class of materials may become available to the Air Force

Progress-Z 01 NOV 74 To 30 JUN 75 (Final)

(U) It has been shown that the basic principles for inert crucibles developed for titanium alloys do not apply to alloys based on TiAl chiefly because of the reactivity of the aluminum in the melt. Thus, systems based on Al sub 2 O sub 3 and Al sub 2 O sub 3 plus Y sub 2 O sub 3 have been under study and show some promise of providing a tractable crucible material. The alloying studies have shown some strong and surprising negative interactions and have identified some mildly promising alloy systems. However, it cannot be claimed at this stage that any breakthrough has occurred in the room temperature ductility problem. One positive aspect of this work has been that the prediction of solubility and structural modifications possible in this system have been proven by experiments. For example, it has been possible to produce mixed L1 sub 0 and L1 sub 2 structures in the Ti-Al-Cu and Ti-Al-Cu-Mn systems which show profuse slip at room temperature but at this time limited indications of ductility. Due to the disestablishment of the Aerospace Research Laboratories (ARL), this contract is being transferred to the Air Force Materials Laboratory (AFML).

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. METALLURGICAL FACTORS AFFECTING CRACK GROWTH RATE IN HIGH STRENGTH ALUMINUM ALLOYS

CONTRACTOR.	ALUMINUM COMPANY OF AMERICA
CONTRACT.	F33615-74-C-5079
CONTRACT DURATION	MAY74-
AFML PROJECT ENGINEER.	SANTNER JOSEPH
PROJ/TASK/WK UNIT.	ILIR-00-61

Objective - 26 JUL 73

(U) Determine those metallurgical factors which affect the crack growth rate in high strength aluminum alloys and processing schemes needed to control these factors in commercial ingot production.

Progress-B 15 AUG 74 To 15 MAR 75 (Interim-B)

(U) Test data for 25 different alloy microstructures was obtained in the stress intensity range for relatively rapid fatigue crack growth. Very little difference in crack growth rate was observed from one microstructure to the next. The next phase of the program will involve measuring fatigue crack growth rates at lower stress intensities where microstructural variations may be more important to the fatigue behavior.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. INFLUENCE OF METALLURGICAL FACTORS ON THE FATIGUE CRACK GROWTH RATE IN ALPHA-BETA TITANIUM ALLOYS

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-74-C-5067
CONTRACT DURATION.	APR74-
AFML PROJECT ENGINEER.	BIDWELL LAWRENCE R
PROJ/TASK/WK UNIT.	ILIR-00-63

Objective - 31 JUL 73

(U) The aim of this program is to identify those factors that influence or control fatigue crack growth kinetics in alpha-beta titanium alloys and to establish their relative importance.

Progress-D 01 MAR 75 To 30 SEP 75 (Interim-D)

(U) Phase I FCP tests in air and salt water as a function of stress intensity ratio and stress intensity range have been completed. Phase I mechanical and physical property measurements are nearly complete except for the fracture toughness, stress-corrosion cracking, and cyclic stress-strain determinations, which are roughly 50 percent complete. Six microstructures for Phase II FCP testing have been selected based on the results of Phase I. Material suitable for use in Phase III has been located and ordered.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. PROPERTY SCREENING AND EVALUATION OF CERAMIC VANE MATERIALS

CONTRACTOR.	I T T RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5196
CONTRACT DURATION.	JAN75-JUN76
AFML PROJECT ENGINEER.	RUH ROBERT
PROJ/TASK/WK UNIT.	ILIR-00-69

Objective - 23 DEC 74

(U) The objective of this program is to assess candidate ceramic materials for application as turbine vanes or other components in a small limited life RPV turbine engine. Physical and mechanical property data shall be supplied on a timely basis in order to perform material screening and evaluation to effectively input a concurrent (AFAPL) program which will accomplish the design and rig testing of components for the above application.

Progress-A 01 JUL 75 To 30 SEP 75 (Interim-A)

(U) The test matrix for Phase I of the program has been finalized and approved by AFML. Specifications for test samples have been obtained and procurement initiated.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. CHARACTERIZATION OF SURFACES PRIOR TO ADHESIVE BONDING (TASK II)

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-75-C-5235
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	CRANE ROBERT L
PROJ/TASK/WK UNIT.	ILIR-00-76

Objective - 15 MAR 75

(U) To develop nondestructive inspection (NDI) procedure and instrument to determine the surface quality of Al prior to adhesive bonding.

Progress-A 15 MAR 75 To 31 JUL 75 (Interim-A)

(U) A list of common contaminants has been established. Work has started on measuring the effect of these contaminants on the anodized surface.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. CHARACTERIZATION OF SURFACES PRIOR TO ADHESIVE BONDING

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-75-C-5143
CONTRACT DURATION.	MAR75-JUN76
AFML PROJECT ENGINEER.	REMMEL T P
PROJ/TASK/WK UNIT.	ILIR-00-77

Objective - 15 MAR 75

(U) To develop nondestructive inspection (NDI) procedures to determine the surface quality of Al prior to adhesive bonding.

Progress-A 15 MAR 75 To 31 AUG 75 (Interim-A)

(U) Initial surface characterization for phosphoric and chromic anodizing systems has been completed. Investigation of the effects of varying the anodizing parameters is in progress.

PROJECT NO. 7021 - STRUCTURE AND PROPERTIES OF SOLIDS

TITLE. STUDY OF INTERMETALLIC COMPOUNDS

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-75-C-1166
CONTRACT DURATION.	FEB75-JUN75
AFML PROJECT ENGINEER.	LIPSITT HARRY A
PROJ/TASK/WK UNIT.	7021-01-66

Objective - 17 FEB 75

(U) The objective of this program is to determine the suitability and potential of titanium aluminum (TiA1) base materials for use in aircraft turbine engines. It is of specific importance to study the response of this material, as an example of a class of materials, to the stresses, strains, and environment found in a gas turbine engine.

Progress-A 17 FEB 75 To 03 DEC 75 (Interim-A)

(U) A first generation powder composition Ti-36A1-5Nb has been compacted in several ways and the solid product characterized. The results are sufficiently encouraging to select a second composition and to determine whether TiA1 will be suitable for rotating applications.

PROJECT NO. 7021 - STRUCTURE AND PROPERTIES OF SOLIDS

TITLE. STUDY OF INTERMETALLIC COMPOUNDS

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-75-C-1168
CONTRACT DURATION.	FEB75-JUN75
AFML PROJECT ENGINEER.	LIPSITT HARRY A
PROJ/TASK/WK UNIT.	7021-01-67

Objective - 17 FEB 75

(U) The objective of this program is to establish fabrication procedures and resulting properties for titanium aluminide base alloys rolled to sheet of varying thickness, formed into complex shapes, and joined together into scaled component assemblies typical of those used in aircraft turbine engines.

Progress-A 17 FEB 75 To 03 DEC 75 (Interim-A)

(U) Sheet materials of Ti-16A1-10Nb have been successfully rolled and characterized. Ti-36A1-5Nb has been rolled but contains many cracks.

PROJECT NO. 7021 - STRUCTURE AND PROPERTIES OF SOLIDS

TITLE. OXIDE SCALE ADHERENCE MECHANISMS

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-72-C-1702
CONTRACT DURATION.	JUN72-JUN75
AFML PROJECT ENGINEER.	GRAHAM HENRY C
PROJ/TASK/WK UNIT.	7021-03-62

Objective - 09 NOV 73

(U) AF FUNCTION - High Temperature Propulsion Materials. DEFICIENCY - Physical and chemical property degradations of alloys due to oxidation at high temperatures. RESEARCH - The adherence mechanism(s) of alumina on NiCrAl and CoCrAl alloys with and without yttrium additions will be determined under normal oxidizing conditions and in the presence of applied tensile and compressive loads. HOW RESEARCH CONTRIBUTES - An understanding of the affect on scale adherence of the alloy structure and composition and the resulting oxide growth mechanisms and morphology can lead to controlling the adherence of oxide scales and thereby to the use of desirable alloys previously discounted because of poor scale adherence. The evaluation of the effect of applied stress during oxidation may well lead to a better understanding of alloy behavior during actual use, since in practice most high temperature alloys are subjected to loads during exposure to the degrading environment.

Progress-Z 01 JAN 74 To 30 JUN 75 (Final)

(U) The rates and mechanism of alumina growth on NiCrAl and CoCrAl alloys have been determined. Alumina is shown to spall from these alloys during thermal cycling because the applied stresses exceed the strength of the alumina-alloy interfacial bond and the development of voids at the interface is not necessary. While it was shown that yttrium additions do not alter the growth mechanism of alumina, the yttrium oxidizes to form particles and stringers of yttria which are incorporated into the inward growing alumina scale and act as macro and micropegs. These mechanical keys significantly improved the adhesion of alumina. Work has been transferred to AFML because of the disestablishment of ARL.

PROJECT NO. 7021 - STRUCTURE AND PROPERTIES OF SOLIDS

TITLE. HOT CORROSION OF COBALT ALLOYS

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-72-C-1757
CONTRACT DURATION.	JUN72-MAY75
AFML PROJECT ENGINEER.	GRAHAM HENRY C
PROJ/TASK/WK UNIT.	7021-03-63

Objective - 09 NOV 73

(U) AF FUNCTION - High Temperature Propulsion Materials. DEFICIENCY - Mechanical and chemical property degradation of alloys due to induced accelerated oxidation at high temperatures. RESEARCH - The hot corrosion mechanisms of several cobalt-base alloys will be determined and compared to the mechanisms for similar nickel-base alloys to define the reasons for the increased resistance to hot corrosion by cobalt alloys. HOW RESEARCH CONTRIBUTES - An understanding of the oxidation and hot corrosion mechanisms of cobalt-base alloys and a comparison to the mechanisms for nickel-base alloys can lead to improving the resistance of one or both alloys types and thereby to longer life of these alloys as gas turbine components.

Progress-Z 01 JAN 75 To 30 JUN 75 (Final)

(U) The results to date indicate that the features developed during the hot corrosion of cobalt-base and similar nickel-base alloys (NiCrAl, CoCrAl, NiCrAl y, CoCrAl Y) are virtually identical. At present it is still not possible to formulate the hot corrosion degradation mechanism for these alloys. The mild degradation which precedes the much more severe degradation does not appear to occur as the result of fluxing of the alumina. Indications are that aluminum depletion or the mechanical destruction of protective alumina contribute significantly to the degradation process. The transition from mild to severe degradation may be associated with the formation of a liquid sulfide phase. Results indicate that chromium depletion is required before the liquid sulfide can develop and the cobalt-base alloys are more resistant than the nickel-base alloys to the development of the liquid sulfide. The results for sodium sulfate induced hot corrosion of Co Al Mo and Co Cr Mo alloys show that molybdenum prevents the onset of accelerated oxidation induced by basic fluxing. However, if sufficient molybdenum was introduced into the sodium sulfate from the alloy, catastrophic oxidation occurred. The results for similar Co-Al and Co-Cr alloys containing tantalum showed that tantalum does not significantly affect the oxidation of sodium sulfate-coated specimens. This work has been transferred to the AFML due to the disestablishment of ARL.

PROJECT NO. 7312 - SURFACE FINISHES

TITLE. USE OF THE EXPERIMENTAL POURBAIX DIAGRAM FOR D6AC STEEL TO INTERPRET CREVICE CORROSION BEHAVIOR IN AQUEOUS MEDIA

CONTRACTOR.	FLORIDA UNIVERSITY OF
CONTRACT.	F33615-73-C-5007
CONTRACT DURATION	NOV72-AUG74
AFML PROJECT ENGINEER.	LYNCH CHARLES T
PROJ/TASK/WK UNIT.	7312-02-15

Objective - 25 SEP 72

(U) To establish the Experimental Pourbaix Diagram for D6aC high strength steel in 0.1 molar NaC1. The diagram will be used to interpret crevice corrosion behavior of D6aC, and provide a means for predicting corrosion behavior of candidate materials for future aerospace systems applications.

Progress-C 16 APR 74 To 30 APR 75 (Interim-C)

(U) Crevice corrosion experiments have been conducted to determine the critical concentrations of several inhibitors which are necessary to retard crack growth. Inhibitors considered were hydrazine, sodium sulfite, and sodium dichromate. Effects of 0.1M chloride ions on crevice conditions on D6AC, and the protective nature of the chromate and nitrite ions under these conditions have been determined. A final report is in preparation.

PROJECT NO. 7351 - SUPPLIES

TITLE. SYNTHESIS AND RELATED MICROSTRUCTURE AND PROPERTIES OF ALLOY SYSTEMS

CONTRACTOR.	CINCINNATI UNIVERSITY OF
CONTRACT.	F33615-73-C-5084
CONTRACT DURATION.	APR73-
AFML PROJECT ENGINEER.	SRP OSCAR O
PROJ/TASK/WK UNIT.	7351-01-71

Objective - 26 OCT 72

(U) To identify various means of obtaining property and stability improvement in alloy systems, as bases for approaches to the development of alloys with enhanced mechanical properties and structural reliability in aerospace systems applications.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) Information has been obtained on the microstructures and tensile properties of titanium alloys consolidated from prealloyed powders by swaging and extrusion at varied temperatures and reductions, and after various subsequent heat treatments, including Ti-6246, Ti-662, and beta-III alloys. Swaging of beta-III alloy powder in mild steel tubes from 1.5 inches to 0.937 inch and less at temperatures of 1350 F and above showed 100 percent density. Quantitative metallography was used to determine crack paths through or around microstructural particles in Ti-6246, as well as to examine inclusions and porosity in aluminum, silver-nickel, and superalloys. Precracking calibration and metallographic examinations of fatigue fracture surfaces in D6ac steel, were made, in preparation for an investigation of inhibitors to mitigate corrosion fatigue. Heat treatments to obtain various proportions of banite, pearlite, and martensite in the microstructure, and dilatometry studies of phase transformations have been initiated in an investigation to improve the reliability properties of 10 nickel modified steel through control of microstructure.

PROJECT NO. 7351 - SUPPLIES

TITLE. FEASIBILITY OF OXIDE DISPERSION STRENGTHENED NICKEL ALLOY EXTRUDED HOLLOW TURBINE VANES

CONTRACTOR.	POLYMET CORP
CONTRACT.	F33615-74-C-5069
CONTRACT DURATION.	MAR74-MAR75
AFML PROJECT ENGINEER.	O HARA WILLIAM T
PROJ/TASK/WK UNIT.	7351-01-72

Objective - 03 JUL 73

(U) To demonstrate the feasibility of economically making oxide dispersion strengthened nickel chromium alloy hollow turbine vanes to net shape using filled billet extrusion methods.

Progress-C 01 MAY 75 To 30 SEP 75 (Interim-C)

(U) All experimental work has been completed. The formulation of process specifications for production scale-up is underway. The final report is being prepared.

PROJECT NO. 7351 - SUPPLIES

TITLE. OXIDE DISPERSION STRENGTHENED COBALT ALLOY EXTRUDED SHAPES

CONTRACTOR.	CABOT CORP
CONTRACT.	F33615-75-C-5061
CONTRACT DURATION.	SEP74-
AFML PROJECT ENGINEER.	O HARA WILLIAM T
PROJ/TASK/WK UNIT.	7351-01-73

Objective - 15 AUG 73

(U) To establish the relationships among thermal-mechanical history, micro-structure, recrystallization behavior, and mechanical properties of extruded shapes of oxide dispersion strengthened (ODS) cobalt alloys.

Progress-B 01 MAY 75 To 30 SEP 75 (Interim-B)

(U) A third series of twelve extrusions has been made representing two each from six heats of attrited powder. These billets were extruded at 2100 F using two combinations of extrusion ram speed and reduction ratio(2 inches per second at 16 - 1 and 10 inches per second at 20 - 1).

PROJECT NO. 7351 - SUPPLIES

TITLE. LOW-TEMPERATURE LARGE-AREA BRAZING OF TITANIUM STRUCTURES

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-73-C-5161
CONTRACT DURATION.	JUL73-DEC74
AFML PROJECT ENGINEER.	METZGER QUINN E
PROJ/TASK/WK UNIT.	7351-02-22

Objective - 29 JAN 73

(U) To demonstrate the feasibility of producing large aircraft structures of titanium alloys in the solution-treated and aged condition with improved fatigue life and fracture toughness.

Progress-D 17 SEP 74 To 11 APR 75 (Interim-D)

(U) Various brazing filler metals were identified and brazing processes established for producing large-area damage-tolerant laminates ofTi-6Al-4V, Ti-6Al-6V-2Snm and Ti-3Al-8V-6Cr-4Mo-4Zr (Beta C) for service between 227K and 422K (minus 50 F and 300 F). Low melting-temperature filler metals were identified to permit the fabrication of laminates in the STA condition. Brazing filler metals were screened based upon their flow temperature and behavior, lap shear strength, bend deflection, and corrosion resistance. The most attractive filler metals were aluminum brazing sheet 22 and alloys from the Al-Cu-Ag system. The brazing sheet was placed between the lamina and the Al-Du-Ag alloys were placed alongside the lamina and flowed into the joints. Fracture toughness and fatigue-crack propagation (FCP) tests on the laminates showed that, in the crack arrest orientation, the Al-Cu-Ag filler metals stopped all cracks from propagaing by delamination through the filler metal. Filler metal 22 produced a reduction in crack propagation rate for some cases and provided crack arrest in all other cases. Fracture toughness and FCP behavior in the crack divider orientation were similar to the behavior of monolithic material. The results of this program indicate that damage tolerant titanium structures can be produced in the STA condition with excellent damage tolerant properties in the crack arrest orientation and with no reduction in properties in the crack divider orientation. Considering properties and producibility, the brazing filler metal 22 is the most attractive system for producing these laminates.

PROJECT NO. 7351 - SUPPLIES

TITLE. HIGH TEMPERATURE BRAZE ALLOY DEVELOPMENT FOR TITANIUM ALLOYS

CONTRACTOR.	INTERNATIONAL HARVESTER CO
CONTRACT.	F33615-74-C-5118
CONTRACT DURATION.	MAY74-
AFML PROJECT ENGINEER.	BECKER DONALD W
PROJ/TASK/WK UNIT.	7351-02-23

Objective - 09 NOV 73

(U) To develop a high temperature (500-900 degrees F) brazing system for joining titanium and its alloys, and to define the performance characteristics of this system.

Progress-A 01 MAY 74 To 09 SEP 74 (Interim-A)

(U) Exploratory alloying studies are being conducted at this time on Phase I, Braze Alloy Design and Screening. To date 133 alloy compositions have been designed arc-melted and screened to assess potential as low melting, tough, corrosion-resistant braze materials, compatible with titanium substrates. The number of low-hardness, terminal solid-solution bases has been expanded to include Ti-30V, Ti-50Zr and Ti-(X)Zr as well as Zr-30V-20Ti. Pure titanium and pure zirconium bases are also being studied. Copper appears at this time to be the most promising melting point depressant investigated to date. Liquidus temperatures in the desired brazing temperature range of 1600-1750 degrees F are being sought through select alloying additions to the above bases.

PROJECT NO. 7351 - SUPPLIES

TITLE. LOW COST HIGH TEMPERATURE BRAZE FOR SUPERALLOYS

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5094
CONTRACT DURATION.	APR75-
AFML PROJECT ENGINEER.	HOROWITZ MARTIN H
PROJ/TASK/WK UNIT.	7351-02-29

Objective - 02 AUG 74

(U) To develop a high temperature (1975 degrees F brazing), low cost, superalloy brazing system to replace the high gold alloy 70 percent Au-8 percent Pd-22 percent Ni), and to define the performance characteristics of that system.

PROJECT NO. 7351 - SUPPLIES

TITLE. WELDABILITY OF 10 NICKEL-MODIFIED TYPE STEEL

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-75-C-5091
CONTRACT DURATION.	DEC74-
AFML PROJECT ENGINEER.	HOROWITZ MARTIN H
PROJ/TASK/WK UNIT.	7351-02-30

Objective - 05 AUG 74

(U) To develop the most total cost effective method of arc welding 10 Nickel-Modified high strength steel to satisfy structural property requirements for advanced aerospace applications.

PROJECT NO. 7351 - SUPPLIES

TITLE. SUPERALLOY WELD FILLER WIRE ALLOY DEVELOPMENT

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-75-C-5114
CONTRACT DURATION.	FEB75-
AFML PROJECT ENGINEER.	GREENFIELD MICHAEL A
PROJ/TASK/WK UNIT.	7351-02-31

Objective - 27 AUG 74

(U) The purpose of this program is to study the relationship of filler wire alloy properties to weld heat-affected zone (HAZ) cracking in nickel-base superalloys and to apply the results of this study in the development of improved filler wire for superalloy welding. The objectives of the work are as follows - (a) To determine critical properties of selected experimental filler alloys and compare them with selected commercial filler wire alloys. (b) To determine the relationship of those critical filler alloy properties to weld HAZ cracking in nickel-base superalloys. (c) To select the four most promising experimental filler-wire alloys and generate the initial information needed to evaluate their potential value in engineering applications.

PROJECT NO. 7351 - SUPPLIES

TITLE. CHARACTERIZATION OF THE STRUCTURE AND PROPERTIES OF VARIOUS METALLIC AND NONMETALLIC MATERIALS

CONTRACTOR. MONSANTO RESEARCH CORP
CONTRACT. F33615-74-C-5068
CONTRACT DURATION. MAR74-
AFML PROJECT ENGINEER. SRP OSCAR O
PROJ/TASK/WK UNIT. 7351-03-52

Objective - 31 JUL 73

(U) To obtain information about the microstructural characteristics and composition of samples of materials of concern. The data obtained from this work are incorporated into and essential to the various in-house research and development programs of the AFML which are directly concerned with new and better materials for aircraft, military space vehicles and/or ground equipment.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) Hardness measurements and thin foil electron microscopy examinations have provided the selected heat treatments to be applied to specimen blanks in an effort to correlate microstructure with the fatigue crack growth rate in Ti-6246 plate. Similar measurements, as well as scanning electron microscopy of the fracture surfaces, have provided correlation between microstructure and the hardness, tensile, and compression properties of variously heat treated titanium aluminide materials investigated to date. A specimen configuration has been designed to successfully tensile test this relatively brittle material. The beta transus has been determined on several heat treatments of eight beryllium modified high temperature Ti-5522S alloys. Conventional metallography and suboptical techniques (EM, SEM, EMP) have been applied to various current aircraft structural metals undergoing failure analysis. Equipment design and refinement has been continued in an effort to adapt a previously observed two phonon absorption effect as an acoustic detector for the characterization of energy- structure interrelationships in materials.

PROJECT NO. 7351 - SUPPLIES

TITLE. METALLURGICAL FACTORS CONTROLLING STRUCTURE IN HIGH STRENGTH ALUMINUM P/M PRODUCTS

CONTRACTOR. ALUMINUM COMPANY OF AMERICA
CONTRACT. F33615-74-C-5077
CONTRACT DURATION. APR74-
AFML PROJECT ENGINEER. GRIFFITH WALTER M
PROJ/TASK/WK UNIT. 7351-05-63

Objective - 25 JUL 73

(U) To investigate factors which effect/control the microstructure property relationships in high strength aluminum powder metallurgy products. The findings to be applied to direct 6.3 programs on P/M forgings and to aid the development of plate and extrusions as supported by the U. S. Army.

Progress-B 27 AUG 74 To 11 APR 75 (Interim-B)

(U) Task I has been completed. The optimum parameters for MA87 powders concening densification and toughness were found to include atomization in air to form a fine, topographically irregular powder particle, and hot compaction at a fairly high (90 Ksi) pressure. The as hot-presses billets were found to be 100 percent dense but further fabrication improved toughness. Task II has begun with atomization of powders containing 0, .33, and .79 percent cobalt.

PROJECT NO. 7351 - SUPPLIES

TITLE. DEVELOPMENT OF 10 NICKEL (MODIFIED) WELDABLE, HIGH-STRENGTH STEE WITH HIGH TOUGHNESS FOR AIRCRAFT STRUCTURES

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-73-C-5093
CONTRACT DURATION.	MAR73-
AFML PROJECT ENGINEER.	OATES ROBERT P
PROJ/TASK/WK UNIT.	7351-05-65

Objective - 17 OCT 72

(U) To develop a weldable, high-strength steel (UTS#230-250 ksi) possessing high levels of fracture toughness and stress corrosion resistance based on chemistry modifications of the 10-Ni-Cr-Mo-C alloy system. The steel shall be compatible with airframe structural requirements.

Progress-C 16 MAR 74 To 30 APR 75 (Interim-C)

(U) Task III and Task IV of the program have been completed. The task III ingot (which represents the optimum composition) exhibit the following mechanical properties (a) U.T.S. equals 255 KSI, (b) Y.S. equals 230 KSI, (c) K sub IC equals 140 KSI square root inches, (d) K sub ISCC equals 95-100 KSI square root inches. Their properties exceeded all program goals. The material proved to be weldable (good mechanical properties) with both cold wire GTAW and hot wire GTAW processes. Unstable weld puddle during EB welding resulted in low fusion toughness in the single EB weld produced on this program.

PROJECT NO. 7351 - SUPPLIES

TITLE. CRYSTALLOGRAPHIC TEXTURE ON MECHANICAL PROPERTIES OF TITANIUM ALLOYS

CONTRACTOR.	DEL WEST ASSOCIATES INC
CONTRACT.	F33615-74-C-5107
CONTRACT DURATION.	JUN74-
AFML PROJECT ENGINEER.	FUJISHIRO SHIRO
PROJ/TASK/WK UNIT.	7351-05-68

Objective - 23 OCT 73

(U) The aim of this program is to determine how and to what degree the properties of titanium alloys are affected by crystallographic texture as well as the interrelationships of texture and other metallurgical factors.

Progress-B 24 OCT 74 To 30 APR 75 (Interim-B)

(U) The 6A1-4V ELI grade alloy currently being tested under the auspices of Phase II was produced by thermomechanical treatment. The following properties have been evaluated in the rolling and long transverse directions of 1/4 inch thick plate - - Young.s modulus (dynamically), - tensile properties at 70 degrees F and 700 degrees F, - cyclic stress - strain at 70 degrees F, - da/dn vs. delta K in lab air, - R curve, - da/dn vs. delta K in 3.5 percent NaC1 water solution. The static tensile properties are sensitive to basal plane orientation in the textured 6A1-4V Ti ELI grade with the product.s static strength increasing approximately 25 percent at 70 degrees F if one compares tests conducted parallel to the major concentration of basal poles as opposed to a direction orthogonal to this basal pole concentration, at 700 degrees F, the increase in short time yield strength in the direction of major basal pole concentration as opposed to 90 degrees F from it was even more dramatic than at RT (F equals 61 percent). Work is continuing to generate a strong basal transverse texture in 6A1-2Sn-4Zr-6Mo Ti. The last rolling experiment called for a 4 1/2 inch thick block to be heated to 1760 degrees F (beta transus plus 25 degrees F) and rolled without reheating to 1/4 inch. Elastic constant measurements for this product in the mill annealed and recrystallized annealed condition offer (at best) 19 x 10 super 6 psi in width direction and the differential between the width and the rolling directions is merely 3 x 10 super 6 psi. The unusual feature of the present results is the virtual equivalence of basal pole concentration in both the rolling and long transverse directions. This behavior is in conflict with previous 6A1-4V Ti results.

PROJECT NO. 7351 - SUPPLIES

TITLE. FORMABLE TITANIUM SHEET ALLOYS

CONTRACTOR.	TITANIUM METALS CORP OF AMERICA
CONTRACT.	F33615-74-C-5063
CONTRACT DURATION.	MAR74-FEB75
AFML PROJECT ENGINEER.	KERR WILLIAM R
PROJ/TASK/WK UNIT.	7351-05-70

Objective - 07 AUG 73

(U) To further develop three promising beta titanium experimental sheet alloys and compare their properties, uniformity, and formability with existing commercial alloys. The end objective is to develop a cold formable alloy exhibiting greater consistency of properties, sheet-to-sheet gage-to-gage and with direction in the same sheet than currently available to aerospace users of titanium.

Progress-B 17 SEP 74 To 11 APR 75 (Interim-B)

(U) Mill processing of the forged sheet bars of the three alloys has been completed. A total of nine processing sequences including cold rolling, and hot plus cold rolling were used to produce nine product forms for each alloy. Two sheet thicknesses, 0.100 inches and 0.050 inches are included in the nine products. Tests to determine aging characteristics, mechanical properties, formability and formageability have begun.

PROJECT NO. 7351 - SUPPLIES

TITLE. APPLICATION OF ADVANCED FRACTURE MECHANICS TO CRACK GROWTH IN TURBINE DISKS

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-75-C-5097
CONTRACT DURATION.	FEB75-
AFML PROJECT ENGINEER.	REIMANN WALTER H
PROJ/TASK/WK UNIT.	7351-06-A2

Objective - 28 JUN 74

(U) To define the influence of the operating environment on the growth of fatigue cracks in turbine disk alloys and to establish analytical techniques, based on fracture mechanics concepts, to permit accurate predictions to be made of subcritical crack growth in turbine disks.

Progress-A 03 FEB 75 To 04 JUN 75 (Interim-A)

(U) Contract with PWA was awarded with Feb 3, 1975 start date. To date IN-100 disk forgings have been procured and specimen machining is underway.

PROJECT NO. 7351 - SUPPLIES

TITLE. OPTIMIZATION OF STRUCTURAL RELIABILITY ANALYSIS PROCEDURE

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5037
CONTRACT DURATION	FEB74-JUN75
AFML PROJECT ENGINEER.	DONAT ROBERT C
PROJ/TASK/WK UNIT.	7351-06-84

Objective - 11 APR 75

(U) To develop the analytical techniques necessary for the implementation of the AFML Materials/Structure Reliability Analysis Method into the structural design system.

Progress-A 15 FEB 74 To 11 APR 75 (Interim-A)

(U) An MLE solution for a three-parameter distribution function is being investigated as well as the STAR estimator. The results tend to substantiate the hypothesis that the flexure parameter, which reflects the early failure in the population of crack initiated data, can be respectively for the alloy system under consideration (Al, Ti and Steel).

PROJECT NO. 7351 - SUPPLIES

TITLE. RESEARCH TO INVESTIGATE THE MICROSTRUCTURE PROPERTIES, AND BEHAVIOR OF METALS, ALLOYS AND METAL MATRIX COMPOSITES

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-73-C-5028
CONTRACT DURATION.	DEC72-JUN75
AFML PROJECT ENGINEER.	SRP OSCAR O
PROJ/TASK/WK UNIT.	7351-06-88

Objective - 31 MAR 73

(U) To establish the relationships between microstructure and properties of metal alloy and composite materials as functions of processing, fabrication and test parameters, and to determine the behavior of these materials under high rates of deformation and in damped aerospace structural elements.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) The vibration response and model damping have been experimentally determined for three different configurations of the Exducer-Turbine assembly of the J-5 cooling turbine, and a viscoelastic damping treatment has been recommended to reduce vibratory stress levels in the system. The best available damping treatment material has been identified by a new computer program, verified experimentally, and selected for application to the B-1 test structure for sonic fatigue testing. The resonant frequencies and mode shape data have been established for a boron-epoxy composite F-4 rudder in support of a full-scale sonic fatigue test to be conducted on the structure. Investigations of innovative approaches to making low cost metal matrix composites have continued to show that powder infilitration of alumina and graphite fibers produces the best specimens of reinforced aluminum alloy composites from the standpoint of volume-percent of fibers, however, tensile strengths were low due to uneven fiber distribution with the extremely small diameter fibers used (0.1 to 0.5 mil). Larger diameter fibers are being investigated to effect optimum fiber-to-fiber spacing and to reduce handling and fiber alignment problems using a powder metallurgy hot pressing fabrication procedure.

PROJECT NO. 7351 - SUPPLIES

TITLE. RESPONSIVE MATERIALS TO IMPULSIVE LOADING

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-73-C-5027
CONTRACT DURATION.	DEC72-NOV75
AFML PROJECT ENGINEER.	HOPKINS ALAN K
PROJ/TASK/WK UNIT.	7351-06-89

Objective - 25 SEP 72

(U) This effort is to study the behavior of various solid materials under impulsive loading at strain rates typical of ballistic impact. These specific problem areas are to be addressed (a) the ballistic response of candidate materials for jet engine compressor blades, inlets and wing loading edges to impacts by real and simulated foreign objects. (b) the response of homogeneous, laminated and fiber reinforced composite materials to planar impact and (c) the response of both matrix materials and composites to rain, ice and dust erosion.

Progress-D 16 APR 74 To 30 APR 75 (Interim-D)

(U) Characterization of dynamic properties of birds is nearly complete. Gelatin and ZTV-560 (foamed to specific gravity of 0.7) give identical dynamic behavior to real birds. Dynamic cuttability studies to determine edgewise loading on blades has begun. Waterdrop/ bow wave interaction studies are nearly complete for Mach No range from 3-13, drop sizes from 30nm to 200nm. Fan blade impact studies have been initiated.

PROJECT NO. 7351 - SUPPLIES

TITLE. FUNDAMENTAL INVESTIGATION OF FATIGUE CRACK GROWTH RETARDATION IN ALUMINUM ALLOYS

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-74-C-5126
CONTRACT DURATION.	JUN74-
AFML PROJECT ENGINEER.	SHIMMIN KENNETH D
PROJ/TASK/WK UNIT.	7351-06-97

Objective - 02 NOV 73

(U) To conduct a fundamental investigation of retardation of fatigue crack growth in aluminum alloys in order to provide a basis for improvement of prediction of fatigue life under non-constant amplitude loading conditions.

Progress-A 17 JUN 74 To 11 APR 75 (Interim-A)

(U) The two aluminum alloys to be investigated have been procurred and heat treated to produce the following alloy/heat treatment combinations. 2024-T3, 2024-T8, 7075-T6, and 7075-&73. Static mechanical properties including fracture toughness have been determined for all alloy conditions as well as cyclic stress-strain curves for each alloy/heat treat combination. Baseline constant amplitude fatigue crack propagation curves have been determined in an air environment for the 20204-T3 and 2024-T8 alloys. Studies of the effect of single overloads on fatigue crack propagation are being initiated.

PROJECT NO. 7351 - SUPPLIES

TITLE. MATERIALS EVALUATION AND MECHANICAL PROPERTY TESTING TECHNIQUES

CONTRACTOR. SYSTEMS RESEARCH LABORATORIES INC
CONTRACT. F33615-73-C-5076
CONTRACT DURATION. MAY73-
AFML PROJECT ENGINEER. SRP OSCAR O
PROJ/TASK/WK UNIT. 7351-06-90

Objective - 18 SEP 72

(U) To develop new or improved experimental methods for investigation of the mechanical behavior of metals, alloys, and other structural materials and to produce experimental data required for AFML programs.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) The tensile properties of vacuum- induction-melted and conventional 7075-T6 aluminum alloy were determined and compared. The vacuum-induction-melted materials possessed better strength but lower elongation. Techniques for successive restarts of cracking and the monitoring of crack progression via ultrasonic detection have been successfully devised for studying crack retardation in 2024 aluminum alloy. Results to date indicate that monentary stress overloads do result in crack retardation at subsequent normal test stress levels. A technique was developed for testing threaded beryllium tensile specimens in the Hopkinson bar. Tensile tests were made on beryllium after prestressing to various levels in compression, and also after prestressing to the same stress levels in tension followed by compressive prestressing at matching stress levels. The prestressing was found to have very little effect on the total strain or stress-strain relations of the beryllium. Techniques were developed for testing to be conducted to determine the effects of various corrosion inhibitors on the corrosion-fatigue of D6ac steel.

PROJECT NO. 7351 - SUPPLIES

TITLE. EFFECT OF INCLUSIONS ON THE MECHANICAL BEHAVIOR OF BERYLLIUM

CONTRACTOR. BRUSH-WELLMAN INC
CONTRACT. F33615-74-C-5172
CONTRACT DURATION. JUN74-MAY75
AFML PROJECT ENGINEER. NICHOLAS THEODORE
PROJ/TASK/WK UNIT. 7351-06-99

Objective - 22 MAR 74

(U) To determine the effects of inclusions on the mechanical behavior of thin-walled beryllium.

Progress-A 22 MAR 74 To 11 APR 75 (Interim-A)

(U) Inclusions in production pressings have been identified. Salted billets having both soft and hard particle inclusions have been fabricated. The salted inclusions have been compared with production inclusions and found to be very similar. Mechanical test specimens having inclusions are being fabricated.

PROJECT NO. 7351 - SUPPLIES

TITLE. SOLID SOLUTION STRENGTHENING OF SAPPHIRE VIA DOPING

CONTRACTOR.	LITTLE ARTHUR D INC
CONTRACT.	F33615-72-C-1956
CONTRACT DURATION.	JUN72-JAN73
AFML PROJECT ENGINEER.	CRANE ROBERT L
PROJ/TASK/WK UNIT.	7351-07-19

Objective - 31 MAR 73

(U) Improve high temperature strength and creep resistance of sapphire fibers VIA selective doping.

Progress-Z 27 JUN 72 To 06 APR 73 (Final)

(U) Testing has shown that the Ti doped fibers are not superior to undoped fibers with respect to strength. However, Cr doped Alumina exhibits superior abraded strength levels at high temperatures. Results presented in AFML-TR-73-2.

PROJECT NO. 7351 - SUPPLIES

TITLE. DEVELOPMENT OF IMPACT RESISTANT METAL MATRIX COMPOSITES

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-74-C-5062
CONTRACT DURATION.	MAR74-JUN75
AFML PROJECT ENGINEER.	JOSEPH ERWIN
PROJ/TASK/WK UNIT.	7351-07-20

Objective - 24 JUL 73

(U) To develop and characterize an impact resistant composite. Both aluminum and titanium metal matrix composites will be examined.

Progress-B 27 AUG 74 To 11 APR 75 (Interim-B)

(U) All instrumental Charpy tests have been completed. These test results will be compared and evaluated in light of ballistic impact tests being performed at AFML. Conclusions are to be drawn based on these comparisons.

PROJECT NO. 7351 - SUPPLIES

TITLE. DEVELOPMENT AND EVALUATION OF LOW COST BORON ALUMINUM COMPOSITES

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-5082
CONTRACT DURATION.	MAR74-JUN75
AFML PROJECT ENGINEER.	SANTNER JOSEPH S
PROJ/TASK/WK UNIT.	7351-07-26

Objective - 17 JUL 73

(U) To develop and demonstrate the technical merit and utility of high strength boron aluminum composite material designed for lower cost. The cost of the material coming from the primary fabrication process shall be projected to be less than $50 a pound at an annual volume of 20,000 pounds.

Progress-B 27 AUG 74 To 11 APR 75 (Interim-B)

(U) Studies were undertaken to determine the best nitrider speed. It was concluded that a rapid traverse of the nitrider (about 60 ft/min) provided a coating which would offer sufficient fiber protecion but still promoted a good fiber to matrix bond. Similarly it was determined that application of the aluminum was best at a melt temperature of 1400 degrees F and speed of 80 ft/min. Composite plate has been fabricated having moderately high strength (180 to 200 Ksi) with transverse strengths to 17 Ksi. To date, however, these results have been spotty. Efforts are, therefore, underway to establish precise processing variables to provide consistent composite properties.

PROJECT NO. 7351 - SUPPLIES

TITLE. DEVELOPMENT OF IN-SITU COMPOSITES FOR USE AS HIGH PRESSURE TURBINE BLADES

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-74-C-5083
CONTRACT DURATION	MAY74-
AFML PROJECT ENGINEER.	DUNCO ROBERT M
PROJ/TASK/WK UNIT.	7351-07-27

Objective - 11 NOV 74

(U) To develop an improved directionally solidified Ni-TaC eutectic alloy for high-pressure turbine blades. A goal for the improved material is the capability to operate for long time to 1976 degrees F (1080 degrees C) and occasional exposure to 2282 degrees F (1250 degrees C).

Progress-B 12 NOV 74 To 30 APR 75 (Interim-B)

(U) Series II alloys have been directionally solidified. Test speimens have been prepared, and testing is partially complete. Bars of MgO and Y sub 2 O sub 3 showed no reaction to molten Ni-TaC-13 after being immersed for about 24 hours.

PROJECT NO. 7351 - SUPPLIES

TITLE. WORKABILITY THEORY OF MATERIALS IN DEFORMATION PROCESSES

CONTRACTOR.	CALIFORNIA UNIVERSITY OF
CONTRACT.	F33615-72-C-1645
CONTRACT DURATION.	JUN72-APR75
AFML PROJECT ENGINEER.	DE PIERRE VINCENT
PROJ/TASK/WK UNIT.	7351-08-08

Objective - 31 MAR 73

(U) A method for selection of mechanical processing conditions which avoid the occurrence of defects in the processed material and which insure production of sound products with improved mechanical properties for use in aircraft structures.

Progress-D 16 MAR 74 To 11 APR 75 (Interim-D)

(U) The following technical reports have been printed and distributed. (a) AFML-TR-74 159. ,Fracture Criterion for Materials in Plastic Deformation Processes. dated August 1974. (b) AFML-TR-74-160. ,Formulation of the Limiting Ductility in Metalworking Processes. dated August 1974. A material fracture criterion was established for occurrence of free-surface cracks during upsetting and rolling deformation processess. Analytical solutions of local stress and strain states existing in materials during upsetting and rolling operations have been developed and experimentally verified. Combination of the above material fracture criterion with the analytical solutions provides quantitative guide lines for prevention of free-surface cracks in upsetting and rolling processes. Present efforts are directed towards formulation of a material fracture criterion for occurrence of internal cracks and towards analytical solutions for internal local stress and strain states in deformation processes such as extrusion and drawing.

PROJECT NO. 7351 - SUPPLIES

TITLE. FEASIBILITY OF DISPERSION STRENGTHENED NICKEL ALLOY EXTRUDED AIRFOIL SHAPES

CONTRACTOR.	NUCLEAR METALS INC
CONTRACT.	F33615-73-C-5037
CONTRACT DURATION.	MAY73-AUG74
AFML PROJECT ENGINEER.	O HARA WILLIAM T
PROJ/TASK/WK UNIT.	7351-08-12

Objective - 09 NOV 72

(U) To demonstrate the feasibility of economically making oxide-dispersion strengthened nickel-chromium alloy hollow airfoil net shapes using filled billet extrusion methods and direct extrusion from powder.

Progress-D 12 NOV 74 To 30 APR 75 (Interim-D)

(U) Review and publication of final report is in progress.

PROJECT NO. 7351 - SUPPLIES

TITLE. HIP TECHNIQUES FOR PRODUCING HIGH QUALITY BILLET FROM TITANIUM ALLOY POWDER

CONTRACTOR.	NUCLEAR METALS INC
CONTRACT.	F33615-73-C-5092
CONTRACT DURATION	JUL73-SEP74
AFML PROJECT ENGINEER.	ADAIR ATTWELL M
PROJ/TASK/WK UNIT.	7351-08-13

Objective - 26 SEP 72

(U) To determine the extent of microstructural control and mechanical properties attainable in wrought products prepared from prealloyed Ti-6Al-6V-2Sn powders and correlate them with the variables associated with compacting the powder into billet form.

Progress-D 10 SEP 74 To 30 APR 75 (Interim-D)

(U) All phase II powder billets have been prepared. The parameters for the extrusion consolidated billets were alpha-beta temperature range and a 6.25 to 1 reduction ratio. Four hot isostatic pressing cycles were chosen- an alpha-beta and a beta cycle for both a fast HIP and a conventional autoclave. An unfortunate accident during the alpha-beta fast HIP cycle resulted in the loss of those fillets. The subcontractor then refused to do the fast beta cycle, however, a portion of that material was able to be included in the beta cycle for the conventional autoclave. The draft copy of the final report has been reviewed and this effort will close out in the near future.

PROJECT NO. 7351 - SUPPLIES

TITLE. PARAMETERS INVOLVED IN METAL PROCESSING OPERATIONS FOR AF HIGH STRENGTH METALLIC PARTS

CONTRACTOR.	WESTINGHOUSE ELECTRIC CORP
CONTRACT.	F33615-74-C-5059
CONTRACT DURATION.	DEC73-
AFML PROJECT ENGINEER.	ADAIR ATTWELL M
PROJ/TASK/WK UNIT.	7351-08-17

Objective - 26 JUL 73

(U) To provide a quantitative basis for the selection of parameters in metallurgical processing operations for the economical and timely production of desired shapes from high performance alloys which have a high degree of reliability in Air Force structural and engine applications.

Progress-C 10 SEP 74 To 11 APR 75 (Interim-C)

(U) The subcontract for isothermal forging lubricant development for titanium alloys has been awarded and work is underway. Various formulations have been prepared and lubricant-die material compatibility evaluation has been performed for IN-100 die material. Lubricant shear resistance tests have also been performed. The depths of the lubricant-workpiece reaction zones of a number of additional candidate isothermal forging lubricants are being evaluated in combination with Ti6Al-4V and Ti6Al-6V-2An alloys over the temperature range of 1350-1800 degrees F. Modified tooling has been obtained for use in determining the adhesion characteristics of lubricants in contact with typical die-workpiece combinations. Candidate ceramic materials for use as isothermal forging dies continue to be screened for evaluation. Relatively low cost, hot pressed alumina (not completely dense) is currently being evaluated.

PROJECT NO. 7351 - SUPPLIES

TITLE. DEVELOPMENT OF TITANIUM ALLOY CASTING TECHNOLOGY

CONTRACTOR.	GARRETT CORP
CONTRACT.	F33615-74-C-5055
CONTRACT DURATION.	FEB74-
AFML PROJECT ENGINEER.	KERR WILLIAM R
PROJ/TASK/WK UNIT.	7351-08-18

Objective - 27 JUL 73

(U) To develop a titanium alloy - crucible, mold combination which will permit the production of high quality, low cast titanium alloy castings by conventional precision casting techniques.

Progress-C 17 SEP 74 To 11 APR 75 (Interim-C)

(U) Material Development (Phase I of the program) has been completed. Titanium alloy and crucible material selections have been made for Phase II, Casting Development. The alloys chosen are Ti-13Cu which has a relatively high melting point (2613 degrees F) but good properties and tolerance for contamination from crucible materials and Ti-13Cu-4.5Ni which has a lower melting point (2425 degrees F) less tolerance for contamination, and lower ductility (still within program requirements). Crucible materials for Phase II will be yttria plus 15 weight percent titania which has good thermal shock resistance, and pure yttria plasma sprayed on a material with good thermal shock resistance. Mold materials will consist of currently used mold materials, a zircon facecoat, and HREMO (Heavy Rare Earth Mixed Oxides) which have shown lower contamination as crucible material.

PROJECT NO. 7351 - SUPPLIES

TITLE. AMORPHOUS GLASSY METAL ALLOYS

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-74-C-5179
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	GEGEL HAROLD L
PROJ/TASK/WK UNIT.	7351-08-19

Objective - 03 APR 74

(U) To search for new possible alloy glass compositions having specific strength properties approaching those of boron or graphite filaments and to characterize the elastic and plastic properties of these materials by relating them to their structure and thermal stability of each system.

Progress-B 17 SEP 74 To 11 APR 75 (Interim-B)

(U) Research to manufacture Ti-6Al-4V powder using the pendant drop melt extraction (PDME) process is progressing as planned. Powder has been made using electron beam heating of a machined rod on a laboratory scale. Plasma arc melting will be used as an alternative method to prevent loss of high vapor pressing alloying elements such as aluminum. Packing parameters are being investigated and they are observed to be a function of the length-to-diameter ratio (L/D). Scale-up concepts are also being considered. The advantages of L/D powder over conventional titanium powder appears to be (a) free from extraneous tungsten contamination, (b) starting material can be scrap in a green compact form, (c) very homogeneous.

PROJECT NO. 7351 - SUPPLIES

TITLE. COMPUTERIZED ULTRASONIC INSPECTION SYSTEM

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-72-C-1828
CONTRACT DURATION.	JUN72-FEB75
AFML PROJECT ENGINEER.	ALLISON JOHN E
PROJ/TASK/WK UNIT.	7351-09-34

Objective - 04 OCT 72

(U) The program seeks to (a) Improve the ultrasonic inspection of forged shapes to provide 100 percent material inspection with a minimum of machining; (b) To minimize equipment and operator error as a source inconsistent forging flaw detection; and (c) To use state-of-the-art computer capability to accomplish these goals as well as provide future capacity for additional improvements and use with other scanning NDT techniques.

Progress-C 26 SEP 73 To 30 APR 75 (Interim-C)

(U) The scanning system has been completed and integrated with the ultrasonics system and the PDP 11/45 minicomputer. The ultrasonic contour following device has allowed the inspection of objects with tapers, fillets, holes and large radii (greater than 2-3 inches) at a scan rate of six inches per second. At slower rates smaller radii (3/4 - 1 inch) can be scanned. A specially designed multiple flaw gating system has been developed to detect multiple, in-line flaws and to reduce (but not to eliminate) problems with the loss of the bottom surface reflection. Inspection results are displayed in real-time on a tektronix 4010 Graphics Terminal. Post-inspection data analysis includes data filtering, amplitude discrimination, flaw signal homing, spectral analysis of the flaw signals rf-waveform, and further data display. The system was demonstrated on 6-7 February 1975 to representatives from both the Air Force and the aerospace industry. In the inspection of aircraft engine disks it was shown to have the potential of reducing the inspection time by a factor of four over conventional ultrasonic systems. The disk was inspected in the longitudinal (normal incidence pulse-echo) mode as well as the radial and circumferential shear modes. Various features of the system were shown including computer controlled flaw gating, computer control of all five degrees of freedom of transducer manipulation, adaptive contour following, data filtering and analysis and the ability to angulate the transducer about a flaw signal to maximize its ultrasonic response. An F-111 landing gear fitting was scanned in a stand-off (normal C-scan mode. This was only minimally satisfactory and subsequent data filtering appeared inadequate to give a completed unambiguous depiction of the simulated flaws present.

PROJECT NO. 7351 - SUPPLIES

TITLE. PRACTICAL SENSITIVITY LIMITS OF PRODUCTION NONDESTRUCTIVE TESTING METHODS IN ALUMINUM AND STEEL

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-72-C-2202
CONTRACT DURATION.	MAR73-SEP74
AFML PROJECT ENGINEER.	MULLINS FREDDY D
PROJ/TASK/WK UNIT.	7351-09-37

Objective - 31 MAR 73

(U) The overall objective of this program is to increase the safety, reliability and integrity of Air Force aircraft structures and propulsion systems by developing reliable nondestructive inspection techniques to locate and assess defects in materials. (Surface Flaws Only).

Progress-B 26 SEP 73 To 01 MAR 74 (Interim-B)

(U) Specimen fabrication is nearing completion and the completed specimens are being inspected both in laboratory and production facilities with ultrasonics, eddy currents, penetrants, radiography, and magnetic particles. Several of these inspected samples have been optically examined so as to fully characterize the flaws present. Preliminary statistical data has been compiled.

PROJECT NO. 7351 - SUPPLIES

TITLE. ADAPTIVE SIGNAL PROCESSING OF ULTRASONIC WAVEFORMS

CONTRACTOR.	ADAPTRONICS INC
CONTRACT.	F33615-74-C-5122
CONTRACT DURATION.	MAY74-
AFML PROJECT ENGINEER.	BUCKLEY MICHAEL J
PROJ/TASK/WK UNIT.	7351-09-42

Objective - 14 NOV 73

(U) The identification of .defect, size directly from Ultrasonic Nondestructive Testing (UNDT) data.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) The first task is complete. The adaptive signal processing system was 96 percent successful in determining the size of flat bottom holes independent of the particular aluminum sample or transduce employed in collecting the data. The samples for task 2 are fabricated and data collection is underway.

PROJECT NO. 7351 - SUPPLIES

TITLE. INTERDISCIPLINARY PROGRAM FOR QUANTITATIVE FLAW DEFINITION

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-74-C-5180
CONTRACT DURATION.	JUN74-JUN75
AFML PROJECT ENGINEER.	BUCKLEY MICHAEL J
PROJ/TASK/WK UNIT.	7351-09-43

Objective - 08 MAY 74

(U) Development of significantly improved ultrasonic nondestructive evaluation system. Particularly in the area of quantitative flaw definition.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) The proceeding of this workshop have been published as AFML-TR-74-238. An onsite review by the DOD executive advisory board was held at the Science Center on 11 FEB 75. Progress to date has been excellent on the majority of the tasks.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. EFFECT OF PURITY ON RELIABILITY CHARACTERISTICS OF HIGH STRENGTH STEELS

CONTRACTOR.	UNITED STATES STEEL CORP /RSCH LAB/
CONTRACT.	F33615-75-C-5137
CONTRACT DURATION.	MAY75-
AFML PROJECT ENGINEER.	GRIFFITH WALTER M
PROJ/TASK/WK UNIT.	7353-02-17

Objective - 25 SEP 74

(U) The objective of this program is to define the role played by residual elements in determining the reliability of various classes of aerospace structural steels.

Progress-A 26 SEP 74 To 30 SEP 75 (Interim-A)

(U) The normal-purity heats of 4340, 18Ni Maraging, and AF1410 (formerly known as 10Ni-Mod) have been melted and processed. Mechanical testing on these steels is underway. The ultra-high purity steels are being melted and processed at this time.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. THE EFFECTS OF MINOR ALLOYING ELEMENT ADDITIONS ON MECHANICAL PROPERTIES OF TITANIUM ALLOYS

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-75-C-5089
CONTRACT DURATION	DEC74-
AFML PROJECT ENGINEER.	BANIA PAUL J
PROJ/TASK/WK UNIT.	7353-02-18

Objective - 26 JUL 74

(U) To determine individual and interaction effects of the minor alloying elements Si, Bi, Fe, S and Mo and similar effects of the interstitials H sub 2 & O sub 2 on the mechanical properties of a titanium alloy. The interaction studies will also include heat treatment/structure effects.

Progress-B 01 MAR 75 To 29 SEP 75 (Interim-B)

(U) Creep tests of Task I alloys have been completed along with room and elevated temperature property determinations. Results indicate Si and Bi to be effective creep strengtheners while Fe is detrimental. Sulphur, in small quantities, is also shown to improve creep resistance. Optical and electron microscopy have also been conducted on the Task I alloys. Silicon effects on fatigue crack propagation are being determined at room and elevated temperatures. Material fabrication for Tasks V and IV has also been completed.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. THE INFLUENCE OF SUBSURFACE DEFECTS ON FATIGUE PROPERTIES OF TITANIUM ALLOYS

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-75-C-5138
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	KERR WILLIAM R
PROJ/TASK/WK UNIT.	7353-02-20

Objective - 16 SEP 74

(U) To determine the effect on mechanical properties, with special attention to fatigue properties of two types of small scale defects - .Cleavage Rosettes, and .Beta Flecks, - identified in alpha-beta titanium alloys.

Progress-A 31 JUL 75 To 14 OCT 75 (Interim-A)

(U) A diffusion bonding technique which incorporates defects and various contaminants has been developed. Fracture at the bonding surface will permit comparison of the synthesized defects with cleavage rosettes previously identified. Rosette defects found in IMI 685 alloy and Ti-6Al-2Sn-4Zr-2Mo are being subjected to Auger spectroscopy in an attempt to identify the contaminant responsible for these defects. Ti-6Al-4V material containing beta flecks has been obtained and is being characterized macroscopically and microscopically. Characterization includes quantitative metallography, hardness and microprobe analysis.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. PREDICTION OF MECHANICAL PROPERTIES OF METALS USING PHOTOMICROGRAPHIC INFORMATION

CONTRACTOR.	DREHER JOHN J DR
CONTRACT.	F33615-75-C-5169
CONTRACT DURATION.	FEB75-
AFML PROJECT ENGINEER.	SANTNER JOSEPH S
PROJ/TASK/WK UNIT.	7353-02-21

Objective - 08 JAN 75

(U) To examine the feasibility of predicting the properties of metals and alloys from their microstructure using quantitative analysis techniques.

Progress-A 08 JAN 75 To 17 OCT 75 (Interim-A)

(U) Color separation stroboscopy was used to obtain 13 standing pattern parameters. It appears parameters characterizing the number of standing patterns have a higher correlation with toughness, ductility, and fatigue while parameters characterizing the geometric shape of the standing patterns carry no property information. In addition, the correlation of one parameter suggests the different particles may be playing different roles in controlling fracture toughness. Optical-to-auditory translation of photomicrographs (acoustigram) of 14 specimens were analyzed to quantize the color stroboscopy observations. Major effects on certain properties are seen to be associated in the spatial distribution of secondary alpha particles. A third approach to classify microstructures involves the generations of optical Fourier power transform patterns by illuminating micrograph transparencies with coherent light. The experimental apparatus is being assembled.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. STRENGTHENING OF TITANIUM ALLOYS BY PRECIPITATION HARDENING

CONTRACTOR.	RUTGERS UNIVERSITY
CONTRACT.	F33615-72-C-1566
CONTRACT DURATION.	APR72-JUN75
AFML PROJECT ENGINEER.	FUJISHIRO SHIRO
PROJ/TASK/WK UNIT.	7353-02-54

Objective - 05 OCT 73

(U) AF FUNCTON - Aerospace Primary Structure and Propulsion Systems. DEFICENCY - Structural instability and loss of ductility on exposure. RESEARCH - Strengthening of Ti-MoAl system by second phase dispersion.

Progress-F 16 APR 75 To 30 SEP 75 (Interim-F)

(U) The final report has been reviewed by the project engineer and AFAL/TSR editorial staff and the reproducible copy has been returned to the contractor with a distribution list and DD form 1473 and Form 257 for printing on 18 July 1975. The technical report was assigned to be AFML-TR-75-118. After its printing and distribution the present contract will be completed. The highlights of the results obtained under this contract are as follows - Step-aging programs, based on principles of particle-dislocation interactions were developed systematically to obtain increases in the high-temperature strength and ductility properties of a Ti-7 at percent Mo-16 at percent Al alloy. A triple-step aging program produced a yield stress of about 1,500 MN/m super 2 at room temperature and 900 MN/m super 2 at a deformation temperature of 600 degrees C. Preliminary results achieved by thermomechanical treatments, consisting of deformation in the Beta plus Ti sub 3 Al phase field prior to aging in the Beta plus alpha plus Ti sub 3 Al phase field, show reasonable high-temperature deformation properties, but a brittle behavior at lower test temperatures.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. CORROSION FATIGUE OF HIGH STRENGTH AIRCRAFT STRUCTURAL MATERIALS

CONTRACTOR.	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CONTRACT.	F33615-72-C-1288
CONTRACT DURATION.	APR72-NOV73
AFML PROJECT ENGINEER.	LYNCH CHARLES T
PROJ/TASK/WK UNIT.	7353-03-01

Objective - 30 AUG 73

(U) To investigate the mechanisms of corrosion fatigue of high strength aluminum and titanium alloys, with emphasis on metallurgical and mechanical aspects of crack initiation and growth. Investigate the corrosion mechanisms within a propagating corrosion fatigue crack.

Progress-C 08 APR 74 To 01 MAY 75 (Interim-C)

(U) The rate of fatigue crack propagation of Ti-6Al-6V-2.5n and Ti-6Al-4V in aqueons environments has been found to have three types of frequency functional dependency. Crack growth rates increase with decreasing frequency in distilled water, are independent of frequency in sodium sulfite solutions and show a reversal in frequency dependence in chloride containing solutions. In the latter case, crack growth rates decrease with decreasing frequency at very low K levels and then revert to increasing with decreasing frequency at higher k levels. A study of the Bauschinger effect in precipitation strengthened aluminum alloys was conducted, and the corrosion fatigue behavior of 2024 Al and 7075 Al after various heat treatments determined in humid air and after various heat treatments determined in humid air and inert atmospheres. A final report is in preparation.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. METALLIC COMPOSITES PRODUCED BY UNIDIRECTIONAL SOLID-SOLID TRANSFORMATIONS

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-73-C-5083
CONTRACT DURATION.	MAY73-AUG75
AFML PROJECT ENGINEER.	DUNCO ROBERT M
PROJ/TASK/WK UNIT.	7353-06-04

Objective - 08 NOV 72

(U) The objectives are threefold - (a) Produced aligned composite structures by unidirectional transformations in a system with a transformation temperature of 1400 degrees C or higher, and offers potential to be used coated as a gas turbine blade material. (b) Define the important problem areas that must be investigated if a composite structure is to be capable of being used as a gas turbine blade material with the inherent thermal, mechanical, and environmental problems that such materials must withstand. (c) Make preliminary tests to see if the materials produced can survive the problems identified in (b).

Progress-D 01 NOV 74 To 01 JUL 75 (Interim-D)

(U) Work in this period was concentrated on the hafnium chromium eutectoid. Numerous casting trials have been made to produce a homogeneous structure suitable for directional transformation. Reaction with crucibles has caused some ingot contamination. Though some directional structure has been produced, further work on directional transformation was not promising. The effort has been redirected to a study of oxidation of directionally solidified in situ eutectic composites such as Ni-TaC, Ni-10Cr-TaC, Ni-TaC-B and Ni-19.7Nb-6Cr-2.5Al. Final Report, AFML-TR-75-133, is being finalized and will soon be printed and distributed.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. OPTICAL DETECTION OF ULTRASOUND IN PARAMAGNETIC MATERIALS

CONTRACTOR.	ILLINOIS UNIVERSITY OF
CONTRACT.	F33615-73-C-5048
CONTRACT DURATION.	JAN73-JUN75
AFML PROJECT ENGINEER.	BUCKLEY MICHAEL J
PROJ/TASK/WK UNIT.	7353-08-02

Objective - 09 NOV 72

(U) To determine the sensitivity of quantum emission from excited spin states to ultrasound perturbations and consequently the suitability of quantum detection of microwave and ultrasonic electron spin resonance as a method of materials evaluation

Progress-E 01 APR 75 To 28 OCT 75 (Interim-E)

(U) Excellent results down to 5MHz with Ge detectors have been obtained. Further experiments and theoretical analysis are currently underway to determine the bandwidth, sensitivity and frequency response of those devices.

PROJECT NO. 7353 - METALLIC AND CERAMIC MATERIALS FOR ADVANCED AEROSPACE

TITLE. NON-DESTRUCTIVE MEASUREMENT OF ADHESIVE BOND STRENGTH

CONTRACTOR.	MICHIGAN UNIVERSITY OF
CONTRACT.	F33615-75-C-5134
CONTRACT DURATION.	JAN75-JUL75
AFML PROJECT ENGINEER.	PANOS RODNEY M
PROJ/TASK/WK UNIT.	7353-08-09

Objective - 30 SEP 74

(U) Determination of applicability of ultrasonic pulse/echo information to adhesive bond strength measurements.

Progress-A 19 DEC 74 To 01 APR 75 (Interim-A)

(U) Adhesively bonded samples have been supplied to the contractor by AFML. Initial set-up and preliminary studies are under way.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. HIGH PRESSURE FURNACE GROWTH OF MERCURY CADMIUM TELLURIDE

CONTRACTOR.	LITTLE ARTHUR D INC
CONTRACT.	F33615-73-C-5155
CONTRACT DURATION.	JUN73-
AFML PROJECT ENGINEER.	HICKMOTT ROBERT L
PROJ/TASK/WK UNIT.	ILIR-00-39

Objective - 26 JAN 73

(U) Establish techniques for growing single crystal mercury cadmium telluride (HgCdTe) based on separately controlling total pressure and mercury partial pressure in the growth apparatus as well as controlling temperature.

Progress-E 31 MAR 75 To 01 OCT 75 (Interim-E)

(U) Five detectors with X equals 0.2 have been delivered to SAMSO for test.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. DEVELOPMENT OF THE HGCDSE ALLOY SYSTEM FOR IR SENSOR APPLICATIONS

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-74-C-5167
CONTRACT DURATION	JUL74-
AFML PROJECT ENGINEER.	HICKMOTT ROBERT L
PROJ/TASK/WK UNIT.	ILIR-00-66

Objective - 12 APR 74

(U) Established the feasibility of developing selected compositions from the HgCdSe alloy system for infrared sensor applications.

Progress-C 01 MAR 75 To 01 OCT 75 (Interim-C)

(U) The phase diagram for HgCdSe is lens shaped like that of HgCdTe but lies about 150 degrees C above it Liquidus and solidus are closer together for HgCdSe than for HgCdTe. The properties of carefully processed HgCdSe are comparable to those of HgCdTe of the same carrier concentration. Funding on this program is being completed by AFAL.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. INTERCALATED GRAPHITIC MATERIALS

CONTRACTOR. PENNSYLVANIA UNIVERSITY OF
CONTRACT.
CONTRACT DURATION. JUN75-MAY76
AFML PROJECT ENGINEER. DIMIDUK PAUL W
PROJ/TASK/WK UNIT. ILIR-00-75

Objective - 06 JAN 75

(U) The objective of this program is to prepare, characterize, and develop intercalated graphitic materials which exhibit high reflectance in the infrared. The characterization information that will be needed includes reflectance and/or absorptance measurements, strength properties, and stability information in various anticipated ambient environments. The successful completion of this program is expected to yield candidate materials which have improved high energy laser hardness.

Progress-A 06 JAN 75 To 24 SEP 75 (Interim-A)

(U) The contract for this program started on 30 JUN 75. Preliminary results on several newly prepared intercalates indicate that their reflectances have indeed increased as a result of the intercalation process.

PROJECT NO. 2071 - PHASE EQUILIBRIA

TITLE. STUDY OF PHASE EQUILIBRIA IN THE SYSTEMS TL-AS-S AND TL-AS-SE

CONTRACTOR. WESTINGHOUSE ELECTRIC CORP
CONTRACT. F33615-72-C-1976
CONTRACT DURATION. JUL72-JUN75
AFML PROJECT ENGINEER. DONLAN VINCENT L
PROJ/TASK/WK UNIT. 2071-00-01

Objective - 30 AUG 72

(U) The objectives of this program are to continue studies of device applications of single crystals in the Tl-As-Se and Tl-As-S systems and to investigate the phase relations of the Tl-P-S and Tl-P-Se sytems.

Progress-F 01 SEP 74 To 31 MAR 75 (Interim-F)

(U) Further phase diagram study in the Tl-P-S system led to a new crystal growth composition and a Tl(3)PS(4) crystal with improved optical transparency. As yet, no oscillation has been obtained in the 2 micron pumped Tl(3)AsSe(3) parametric oscillator. A large single crystal of Tl(3)AsS(3) was grown, x-ray studies indicate that this crystal has 2/m monoclinic symmetry.

PROJECT NO. 2387 - LASER COUNTER MEASUREMENTS

TITLE. DEVELOPMENT OF SPECIAL INFRARED FILTERS

CONTRACTOR.	PERKIN ELMER CORP
CONTRACT.	F33615-74-C-5168
CONTRACT DURATION.	JUN74-NOV75
AFML PROJECT ENGINEER.	CONRAD PHILLIPI M
PROJ/TASK/WK UNIT.	2387-00-08

Objective - 10 JUN 74

(U) The objective of this work is the development of special infrared hardening filters for a classified application.

Progress-C 01 APR 75 To 17 SEP 75 (Interim-C)

(U) Selectively absorbing and reflecting filters have been fabricated which approach, and in some cases, meet, design goals. Scattering measurements and other performance tests have been completed. Final report is in preparation.

PROJECT NO. 2612 - HALIDE GROWTH

TITLE. CHEMISTRY OF HALIDE WINDOW GROWTH

CONTRACTOR.	HUGHES RESEARCH LABORATORIES
CONTRACT.	F33615-74-C-5115
CONTRACT DURATION.	APR74-JUN76
AFML PROJECT ENGINEER.	FENTER JOHN R
PROJ/TASK/WK UNIT.	2612-00-01

Objective - 23 OCT 73

(U) To develop Reactive Atmosphere Processes (RAP) for single crystal halides to serve as laser window starting materials.

Progress-D 01 APR 75 To 01 OCT 75 (Interim-D)

(U) Studies have indicated that both CBr(4) and CF(4) are not useful RAP agents for bromides and fluorides. However, CF(4) does convert water to HF efficiently. If the process temperature is above 1000 degrees C, then CF(4) should be used for RAP in the gas phase. HF should be used in the condensed phase.

PROJECT NO. 317J - ADVANCED RADIATION TECHNOLOGY

TITLE. DEVELOPMENT AND CHARACTERIZATION OF PROTECTIVE-ANTIREFLECTION T FILMS FOR POLYCRYSTALLINE POTASSIUM CHLORIDE LASER WINDOWS

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-75-C-5228
CONTRACT DURATION.	APR75-
AFML PROJECT ENGINEER.	OHMER MELVIN C
PROJ/TASK/WK UNIT.	317J-00-17

Objective - 16 OCT 74

(U) Antireflective thin film systems shall be developed for polycrystalline alkali halide high power infrared laser window materials. Moisture passivation of the alkali halide material shall be provided by chemical processes and/or incorporated into the AR thin film design.

PROJECT NO. 317J - ADVANCED RADIATION TECHNOLOGY

TITLE. INFLUENCE OF SUBSTRATE CRYSTAL ORIENTATION ON THIN FILM ANTI-REFLECTION COATINGS FOR CAF2 LASER WINDOWS

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-75-C-5190
CONTRACT DURATION	MAR75-
AFML PROJECT ENGINEER.	OHMER MELVIN C
PROJ/TASK/WK UNIT.	317J-00-18

Objective - 22 OCT 74

(U) The relationship between the crystalline nature of the substrate and the structure-optical properties of thin film coatings applicable to antireflection coated windows for lasers operating in the 3-6 micron region will be investigated. Antireflection thin film systems shall be developed for single crystal and polycrystalline calcium fluoride substrates.

Progress-A 01 APR 75 To 30 SEP 75 (Interim-A)

(U) Quarter wave coatings of ThF(Sub4), MgF(Sub2), BaF(Sub2(and SrF(Sub2) for 2.8, 3.8 and 5.3 microns were deposited on oriented single crystal CaF(Sub2) substrates. The index of refraction of PbF(Sub2) and ThF(Sub4) showed no orientation dependence indicating that these materials are excellent choices for antireflection coatings of polycrystalline fluorides. SrF(Sub2) shows the strongest tendency to prefer the orientation of the substrate. Absorption measurements on AR coated sample typically had fractional absorptions of .0004 at 5.3 microns, a figure substantially lower than for AR coatings at 10.6 microns which are typically .002. The AR design was a double quarter wavelength coating with PbF(Sub2) next to the substrate. A final report describing the results will be written by 30 Sep 75.

PROJECT NO. 2387 - LASER COUNTER MEASUREMENTS

TITLE. THERMAL CONTROL MATERIALS

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5160
CONTRACT DURATION.	FEB75-AUG75
AFML PROJECT ENGINEER.	VANVLIET ROBERT M
PROJ/TASK/WK UNIT.	2387-00-09

Objective - 26 SEP 75

(U) To determine thermal control materials for satellites which are able to withstand a transient heat load and still function as designed.

Progress-B 31 MAR 75 To 26 SEP 75 (Interim-B)

(U) Heat stable insulating blanket developed. Also, a heat resistant quartz fiber thermal control coating developed. Device to measure effective emmittance in vacuum was developed.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. REFLECTIVE COATING DEVELOPMENT

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-75-C-5164
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	VAN VLIET ROBERT M
PROJ/TASK/WK UNIT.	627A-00-26

Objective - 27 NOV 74

(U) To develop a reflective coating for use on Pen Aids (details classified). Supports ADP 627A.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. MECHANISMS OF ABLATION OF SILICONE PLASTICS AND ELASTOMERS EXPOS TO HIGH INTENSITY LASER RADIATION

CONTRACTOR.	AVCO-EVERETT RESEARCH LAB
CONTRACT.	F33615-75-C-5153
CONTRACT DURATION.	APR75-APR76
AFML PROJECT ENGINEER.	RONDEAU ROGER E
PROJ/TASK/WK UNIT.	7342-02-23

Objective - 10 OCT 74

(U) To determine the mechanisms of ablation of optically transparent silicone plastics and elastomers exposed to high intensity 10.6 CW laser radiation and to relate these mechanisms to materials composition and performance.

Progress-A 23 APR 75 To 23 SEP 75 (Interim-A)

(U) Contractor still in information gathering stage. Experiments have been defined experimental set-ups prepared and materials processed. Some initial laser tests have been made but results have not yet been reported.

PROJECT NO. 7350 - CERAMICS AND GRAPHITE

TITLE. INVESTIGATE THE SYNTHESIS, PROPERTIES, AND MICROSTRUCTURES OF REFRACTORY CERAMICS AND OTHER NONMETALLIC MATERIALS

CONTRACTOR.	CINCINNATI UNIVERSITY OF
CONTRACT.	F33615-73-C-5097
CONTRACT DURATION	APR73-
AFML PROJECT ENGINEER.	ROLINSKI EDMUND J
PROJ/TASK/WK UNIT.	7350-01-38

Objective - 29 SEP 72

(U) To establish methods of synthesis of ceramic and other non-metallic materials, the relationships between the structural characteristics and the resulting physical properties, the kinetics of structural and property changes, and the interactions between these materials and various environmental conditions, in order to define approaches to new structural, electrical, and optical matrials for advanced systems applications.

Progress-C 16 MAR 74 To 09 SEP 74 (Interim-C)

(U) Sodium lithium aluminate precursor powder of the propper composition was prepared from sodium and lithium alkoxides reacted with aluminum isopropoxide. Anhydrous potassium rubidium chloride was successfully prepared also by the alkoxy process. Initial work was begun in cold pressing and sintering of silicon nitride powders. Isostatic pressing to 40 ksi and sintering to 1600-1800 degrees C has shown little success in densification thus far with the doping agents used. Excellent results previously obtained in preparing yttria crucibles (for containing molten Ti) using titania or magnesia additives, were followed by attempts to make the crucibles without additives. The perfect crucibles coming from the dies cracked on heat treatment, and different heating-cooling schedules will be tried. Considerable effort is underway in the closely related area of metal oxidation, particularly at high heating rates encountered in laser heating.

PROJECT NO. 7360 - CHEMISTRY AND PHYSICS OF MATERIALS

TITLE. CHARACTERIZATION OF ORGANIC MATERIALS

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-72-C-1666
CONTRACT DURATION.	APR72-JUN74
AFML PROJECT ENGINEER.	DIMIDUK PAUL W
PROJ/TASK/WK UNIT.	7360-01-35

Objective - 29 SEP 72

(U) To investigate the thermophysical and thermodynamic behavior of selected solid materials at high temperatures and to synthesize and characterize selected organic molecules that exhibit lasing properties.

Progress-E 02 MAR 74 To 27 AUG 74 (Interim-E)

(U) The contractor has been notified that this effort will be terminated at the convenience of the government. Remaining FY74 funds will be used to achieve as orderly a termination as possible and to prepare a final report. Many additional organic dye laser materials and liquid crystal materials were synthesized, characterized and tested. The results will be reported in the final TR to be issued at the termination of this program.

PROJECT NO. 7360 - CHEMISTRY AND PHYSICS OF MATERIALS

TITLE. DEVELOPMENT OF LOW-COST HARDENED ZNSE FOR IR WINDOWS

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-75-C-5131
CONTRACT DURATION.	MAY75-
AFML PROJECT ENGINEER.	FISCHER DAVID W
PROJ/TASK/WK UNIT.	7360-01-40

Objective - 17 SEP 74

(U) To develop a low cost technique for producing hardened ZnSe infrared windows, nominally 12 inch x 24 inch x 3/4 inch in dimensions, for use with multisensor systems on high performance aircraft.

PROJECT NO. 7367 - CHARACTERIZATION AND PROPERTIES OF AEROSPACE MATERIALS

TITLE. SPECTROSCOPIC TECHNIQUES FOR MOLECULAR STRUCTURE AND INTERACTIONS

CONTRACTOR.	OHIO STATE UNIV RESEARCH FOUNDATION
CONTRACT.	F33615-72-C-1912
CONTRACT DURATION.	MAR72-MAR75
AFML PROJECT ENGINEER.	BENTLEY FREEMAN F
PROJ/TASK/WK UNIT.	7367-02-08

Objective - 04 OCT 72

(U) Updating the performance of a one-of-a-kind infrared spectrophotometer, and develop techniques to help determine the molecular structure of intractable materials.

Progress-D 02 JUL 73 To 01 MAR 74 (Interim-D)

(U) The contractor continues to use the infrared spectrophotometer in support of his inhouse research. A unique capability to characterized biological materials has been established. Through the use of an increased flow of dry air purge in the optical system, useful infrared measurements have been made down to 250 cm super minus 1. Studies of optically dense materials have continued in order to optimize signal/noise in the spectral regions of interest.

PROJECT NO. 7367 - CHARACTERIZATION AND PROPERTIES OF AEROSPACE MATERIALS

TITLE. CORRELATION OF SUPERCONDUCTING PROPERTIES WITH SURFACE PROPERTIES IN BOTH THIN FILM AND BULK SUPERCONDUCTORS

CONTRACTOR.	OKLAHOMA UNIV RESEARCH INSTITUTE
CONTRACT.	F33615-73-C-5049
CONTRACT DURATION.	MAR73-NOV75
AFML PROJECT ENGINEER.	OHMER MELVIN C
PROJ/TASK/WK UNIT.	7367-03-09

Objective - 25 SEP 72

(U) The characterization of surfaces of superconductors by standard surface analysis techniques and the establishment of a correlation of the superconducting properties of the material with its surface condition. The properties of primary interest are T sub c, J sub c, and the AC loss characteristics of the material, either in a thin film or in the bulk.

Progress-E 01 APR 75 To 01 OCT 75 (Interim-E)

(U) Three areas were emphasized in the last six months, thin film deposition, superconducting properties measurement apparatus and sputtered copper contacts. Initial sputtered niobium films had high oxygen and carbon contamination. Contamination has been eliminated by reducing total pressure, cooling chamber walls with dry ice, increasing sputter target cooling and substituting xenon for argon. Binary gas mixtures of xenon and nitrogen were used to produce Nb(sub. 3) N(sub.7). The sensitivity of the ac loss apparatus was increased by a factor of 400 with a photo-resist spiral sample and micrographs of sputtered copper sample contacts indicate best adhesion. A final report covering this effort will be available within 2 months.

PROJECT NO. 7367 - CHARACTERIZATION AND PROPERTIES OF AEROSPACE MATERIALS

TITLE. RESEARCH TO MEASURE ABSOLUTE ELECTRON IMPACT IONIZATION CROSS SECTIONS

CONTRACTOR.	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CONTRACT.	F33615-71-C-1420
CONTRACT DURATION.	APR71-MAR75
AFML PROJECT ENGINEER.	DIMIDUK PAUL W
PROJ/TASK/WK UNIT.	7367-04-01

Objective - 12 APR 72

(U) To measure the electron impact ionization cross sections of selected refractory vapor molecules. The single-crossed beam technique with a modulated atomic beam, an electron monochrometer, and a thin film thickness monitor will be used to conduct these studies. Low temperature elements whose vapor compositions are relatively simple will be investigated first. These are materials such as silver, gold, aluminum, and titanium.

Progress-F 01 SEP 74 To 01 APR 75 (Interim-F)

(U) Contractor has refused to give an estimated date for submission of the final report. A letter from the Director of AFML has been sent to the contractor requesting an estimated submission date of the draft final report. However, data on the following positive ions have been submitted to the project monitor- Iron (1, 2, 3). Gold (1, 2, 3). Chromium (1, 2).

PROJECT NO. 7367 - CHARACTERIZATION AND PROPERTIES OF AEROSPACE MATERIALS

TITLE. STABILITY OF GASEOUS MOLECULES AND CONDENSED PHASES MASS SPECTROMETRY

CONTRACTOR.	NEW YORK STATE UNIVERSITY OF
CONTRACT.	F33615-72-C-2123
CONTRACT DURATION.	SEP72-JAN76
AFML PROJECT ENGINEER.	DIMIDUK PAUL W
PROJ/TASK/WK UNIT.	7367-04-02

Objective - 23 JUN 72

(U) To determine the stabilities of selected molecules in both the gaseous and condensed phase by means of high temperature mass spectrometry. The program is to be conducted in exchange for the contractor,s use of certain Government Furnished Equipment at no additional cost to the Air Force. Silicides, borides, monocarbides and alloys will be studied.

Progress-D 01 SEP 74 To 01 APR 75 (Interim-D)

(U) Prospects for the contractor to accomplish any useful work under this program grow increasingly dim A four-day service call by Nuclide Corp. (costing $700 to $800 dollars) succeeded in repairing some of the mass spectrometer systems but the contractor has still been unable to obtain an ion beam. It appears that the university will be unable to make available additional repair funds in the immediate future. The contractor was thus forced to assign the graduate student to another project so that he could make some progress on his thesis. Papers submitted in lieu of progress reports include- ,Vaporization Behavior of Au sub 2, P sub 2 and AgP sub 2., ,A Case for Covalent Bonding in Lanthanide Trihalides, and ,A Partial Thermodynamic Analysis of the Ta-O Phase Diagram.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. HARDENED CVD ZNSE FOR FLIR WINDOWS

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-74-C-5145
CONTRACT DURATION.	APR74-MAY75
AFML PROJECT ENGINEER.	FISCHER DAVID W
PROJ/TASK/WK UNIT.	7371-01-46

Objective - 07 JAN 74

(U) To increase the surface hardness and modulus of rupture of zinc selenide to provide a hard, strong and optically superior multispectral (0.5 to 14 micrometers) window for use with multisensors on high performance aircraft.

Progress-B 24 OCT 74 To 11 APR 75 (Interim-B)

(U) Good quality hardened ZnSe doped with Al or Si has been obtained. Some degradation of transmission is experienced beyond 10 microns when the Al concentration exceeds approximately 1 percent. At this concentration a hardness of 300 to 400 Knoop can be obtained. A second technique of increasing hardness by depositing a thin layer of ZnS onto bulk ZnSe is being investigated.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. LEAD TIN TELLURIDE FILMS BY SPUTTERING FOR INFRARED SENSOR APPLICATIONS

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-72-C-1042
CONTRACT DURATION.	AUG71-OCT74
AFML PROJECT ENGINEER.	HICKMOTT ROBERT L
PROJ/TASK/WK UNIT.	7371-02-19

Objective - 04 OCT 72

(U) The PbSnTe variable band gap alloy system may prove superior to the HgCdTe variable band gap alloy system for some applications. A thin film approach to IR detector arrays might have economic advantages over the bulk approach. HgCdTe cannot be deposited in thin film form due to the high vapor pressure of mercury. PbSnTe can be deposited in thin film form. This program is to determine whether thin film PbSnTe can be processed to compete with HgCdTe.

Progress-E 02 MAR 74 To 09 SEP 74 (Interim-E)

(U) Films have been produced using the ion beam sputtering system and controlling substrate temperature, sputtering rate, and substrate bias. This has permitted growth of p-type material on n-type material during a single deposition.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. MERCURY CADMIUM TELLURIDE IMPROVEMENT, PHASE II

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-74-C-5041
CONTRACT DURATION.	JAN74-JUN75
AFML PROJECT ENGINEER.	HICKMOTT ROBERT L
PROJ/TASK/WK UNIT.	7371-02-22

Objective - 05 JUN 73

(U) Alleviated a potential shortage of HgCdTe for AF requirements by increasing the yield. This is to be done by bringing the current growth methods under better control which involves deliberate doping by adding electrically active impurities combined with improved quenching and annealing schedules.

Progress-C 10 SEP 74 To 11 APR 75 (Interim-C)

(U) Copper and silver are acceptors in HgCdTe and are probably singly ionized. Acceptor impurities are not important in HgCdTe but are swamped by native defects (mercury vacancies). These are best annealed out by a charge of powdered HgCdTe. Their ionization energy is between .01eV and .024eV. Silicon is a donor but its source (if present) in undoped ingots is still to be determined.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. AC MEASUREMENTS OF EXCESS NOISE IN MERCURY CADMIUM TELLURIDE

CONTRACTOR.	MINNESOTA UNIVERSITY OF
CONTRACT.	F33615-74-C-5104
CONTRACT DURATION.	APR74-
AFML PROJECT ENGINEER.	HICKMOTT ROBERT L
PROJ/TASK/WK UNIT.	7371-02-30

Objective - 25 JUN 73

(U) Identify mechanisms responsible for excess noise in HgCdTe. Examine procedures for reducing excess noise to improve the signal to noise ratio in photoconductive infrared sensors.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) AC modulation techniques now work satisfactorily and will be put to use. A detector with a grain boundary is ready for test.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CLOSE TOLERANCE, THIN WALLED TITANIUM SHAPES FOR AIRCRAFT STRUCTURAL APPLICATIONS-162-0

CONTRACTOR.	REM METAL CORP
CONTRACT.	F33615-70-C-1410
CONTRACT DURATION.	FEB70-JUN74
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-00-15

Objective - 15 MAY 72

(U) To improve the precision casting process for manufacturing titanium alloy parts to obtain reliability and reproducibility for jet engine and airframe structural applications by using consumable electrode vacuum arc skull melting and refractory metal faced molds.

Progress-G 15 APR 75 To 07 OCT 75 (Interim-G)

(U) Draft of final report was approved by letter dated 19 Aug 75. Contractor is delinquent as usual in distributing the Final Report. PCO and ACO have been notified.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MANUFACTURING METHODS REQUIREMENTS, ASSESSMENT AND UTILIZATION-191-0

CONTRACTOR.	UNIVERSAL TECHNOLOGY
CONTRACT.	F33615-75-C-5100
CONTRACT DURATION.	SEP74-JUN75
AFML PROJECT ENGINEER.	MATTICE JAMES J
PROJ/TASK/WK UNIT.	MTP1-00-29

Objective - 15 JUL 74

(U) To provide a continuing external assessment and analysis of the manufacturing methods program with the purpose of providing Air Force program management maximum visibility, as to program direction, requirements and completed effort utilization by industry in terms of contributions to production base capability and system acquisition cost reduction.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PROGRAMMABLE ELECTRON BEAM MASKING PROCESS-507-0

CONTRACTOR.	RADIANT ENERGY SYSTEMS INC
CONTRACT.	F33615-71-C-1387
CONTRACT DURATION.	MAR71-SEP76
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-00-36

Objective - 15 MAY 72

(U) To establish an electron optical recording facility for the fabrication of high resolution masks for integrated circuit production. The system will be capable of generating a family of complex integrated circuit masks directly from a computer.

Progress-E 08 APR 74 To 31 MAR 75 (Interim-E)

(U) The electron beam mask system has been fabricated and debugging of the system is in progress. Demonstrations for forming mask pattern displays are in progress.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. HIGH INTEGRITY FORGINGS OF ALUMINUM AND TITANIUM ALLOYS-224-1

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-71-C-1693
CONTRACT DURATION.	JUL71-FEB76
AFML PROJECT ENGINEER.	KLARQUIST NORMAN E
PROJ/TASK/WK UNIT.	MTP1-00-59

Objective - 15 MAY 72

(U) To establish the manufacturing methods for producing large, close tolerance, high integrity, structural forgings of aluminum alloys and titanium alloys.

Progress-H 01 APR 75 To 01 SEP 75 (Interim-H)

(U) Contract has been extended by Amendment P00003 dated 22 Aug 75. The first titanium castings were made by TiTech. The castings were generally satisfactory, some modifications to the pattern being required. The completion of the castings is expected in October 1975.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MANUFACTURING METHODS FOR AN IMPROVED METHOD OF ULTRASONIC INSPECTION OF TI ALLOY-225-1

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-71-C-1712
CONTRACT DURATION.	JUL71-FEB76
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-00-63

Objective - 15 MAY 72

(U) To establish improved ultrasonic testing methods for billets, on a production basis, which will improve cleanliness standards and quality of aircraft titanium alloys.

Progress-G 31 JUL 74 To 07 OCT 75 (Interim-G)

(U) Contract was extended to provide opportunity for interested parties (Titanium producers, forgers and turbine engine builders) to evaluate the capabilities of the advanced system as compared to their existing NDI. Various sizes of titanium billet stock containing known and unknown defects have been inspected by three participants on two teams. All members are to meet at TRW to compare and interpret results.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. COMPLEMENTARY BIPOLAR TRANSISTOR STRUCTURES-502-1

CONTRACTOR.	TEXAS INSTRUMENTS INC
CONTRACT.	F33615-71-C-1944
CONTRACT DURATION.	JUN71-JAN74
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-00-70

Objective - 15 MAY 72

(U) To establish advanced manufacturing methods required for economically producing complementary (NPN-PNP) transistor structures on the same chip.

Progress-F 01 SEP 74 To 31 MAR 75 (Interim-F)

(U) All of the hardware items have been delivered to WPAFB. These hardware items consist of operational amplifier circuits, voltage regulator circuits, PNP-NPN device structures and test structures. Tests performed by AFIT Co-Op Lab on some of these items indicates that they correlate with contractor,s claims. The rough draft of the final report has been reviewed by AFML and returned to the contractor for corrections.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. EFFECT OF BEARING DEFECTS-743-1

CONTRACTOR.	M P B CORP
CONTRACT.	F33615-72-C-1243
CONTRACT DURATION.	NOV71-JAN75
AFML PROJECT ENGINEER.	HARRIS WILLIAM A
PROJ/TASK/WK UNIT.	MTP1-00-80

Objective - 15 MAY 72

(U) Determine the relationship between defects in miniature ball bearing ball track and performance and life.

Progress-F 06 DEC 74 To 01 APR 75 (Interim-F)

(U) This program determined the relationship between selected raceway surface defects and performance and the life of miniature ball bearings. The final report AFML-TR-75-6 has been reviewed and approved for printing.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MFG METHODS TECHNIQUES AND AUTOMATED CONTROLS FOR THE CONTINUOU EPITAXIAL PROCESSING OF SILICON INTEGRATED CIRCUITS-512-1

CONTRACTOR.	MOTOROLA INC
CONTRACT.	F33615-72-C-1242
CONTRACT DURATION.	NOV71-DEC76
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-00-91

Objective - 31 MAR 75

(U) The objective is to establish advanced epitaxial processes for continuous processing of special integrated circuit wafers which will result in greater yields at lower costs and, thus, improve the reproducibility and availability of many integrated circuits structures.

Progress-D 08 APR 74 To 31 MAR 75 (Interim-D)

(U) All the hardware concepts for the automatic epitaxial system have been firmly established and the phase of converting design into hardware is in progress. The software designs have not been finalized. The system modules have been fabricated and debugging is in progress. To further enhance the epitaxial process, additional effort is underway to incorporate a gas sampling probe in the epitaxial reactor for realtime control for the epitaxial film gaseous reactants and undesirable contaminants.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. IMPROVEMENT OF RELIABILITY AND THE MECHANICAL PROPERTIES OF TITANIUM ALLOY FORGINGS-120-2

CONTRACTOR.	ALUMINUM COMPANY OF AMERICA
CONTRACT.	F33615-72-C-1030
CONTRACT DURATION.	MAY72-FEB75
AFML PROJECT ENGINEER.	KLAROUIST NORMAN E
PROJ/TASK/WK UNIT.	MTP1-01-02

Objective - 06 NOV 72

(U) To establish controlled thermomechanical processing procedures which will improve the mechanical properties and the reliability of titanium alloy forgings.

Progress-G 01 APR 75 To 01 SEP 75 (Interim-G)

(U) Amendment P00002 dated 75 Aug 13 extended the contract to 19 Nov 75. All die forgings for Phase II were produced and testing is in progress. Some delays in testing have occurred because poor business conditions have caused a shutdown by a subcontractor. Alcoa is attempting to pick up the testing with a resulting overload in their facilities.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCED SANDWICH PANEL CONSTRUCTION-842-2

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-72-C-2151
CONTRACT DURATION.	JUL72-OCT75
AFML PROJECT ENGINEER.	INOUYE SHINGO
PROJ/TASK/WK UNIT.	MTP1-01-03

Objective - 31 MAR 73

(U) To establish fabrication methods, and demonstrate applicability of engine hardware, for an unconventional sandwich panel.

Progress-D 15 MAR 74 To 01 APR 75 (Interim-D)

(U) Three divergent nozzle flaps have been completed and sent to engineering to schedule in test stand. This completes Ph Ic. All sandwich panels for Ph II testing have been fabr cated. Geometry C core fabrication was accomplished in vacuum hot press. Core segments to be used in the construction of the aft fan duct are being fabricated. Design drawings for the sandwich panel duct segment are nearly complete.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. IMPROVED PRODUCTION PROCESS FOR TITANIUM HYDRAULIC TUBING-109-2

CONTRACTOR.	UNIVERSAL OIL PRODUCTS CO
CONTRACT.	F33615-72-C-2170
CONTRACT DURATION.	SEP72-MAR76
AFML PROJECT ENGINEER.	BLAU PETER J
PROJ/TASK/WK UNIT.	MTP1-01-05

Objective - 31 MAR 73

(U) To establish and define manufacturing methods for the production of seamless, welded, and worked aircraft quality hydraulic tubing suitable for use in a 4000 PSI hydraulic system using the HPTR tube reducer mill.

Progress-E 01 APR 75 To 24 SEP 75 (Interim-E)

(U) Phase III is completed and Phase IV, Manufacturing Process for New Alloy Tubing, is underway. Three billets of Ti-10-2-3 were extruded without difficulty. Tensile and ductility properties were measured and metallography was performed to examine extrusion microstructures. Attempts to achieve target final tubing reductions failed due to cracking problems. These problems will be attacked in the next reporting period and a new processing schedule may be developed after materials limitations are more clearly defined.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MOS-FET BIPOLAR INTEGRATED CIRCUIT-506-2

CONTRACTOR.	FAIRCHILD CAMERA AND INSTRUMENT CORP
CONTRACT.	F33615-72-C-1522
CONTRACT DURATION.	JUN72-JUL74
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-01-06

Objective - 31 MAR 73

(U) To establish manufacturing processes for the production of compatible MOS-FET/bipolar devices on the same wafer and produce two circuits using these parts in a monolithic structure.

Progress-D 08 APR 74 To 31 MAR 75 (Interim-D)

(U) Test structures, operational amplifier circuits, and sample-hold circuits have been fabricated in the production facilities. Draft of final report has been submitted for AFML review.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CAPABILITY AND A SUPPLIER OF RELIABLE LONG LIFE ALKALI VAPOR LAMPS-519-2

CONTRACTOR.	I L C INDUSTRIES INC
CONTRACT.	F33615-72-C-1735
CONTRACT DURATION.	JUN72-JAN76
AFML PROJECT ENGINEER.	TARRANTS ELIZABETH H
PROJ/TASK/WK UNIT.	MTP1-01-07

Objective - 31 MAR 73

(U) To establish manufacturing processes for the volume production of alkali vapor lamps with particular emphasis on reliable, long life metal to ceramic seals and lower costs.

Progress-F 31 MAR 75 To 17 SEP 75 (Interim-F)

(U) The second piece of government furnished test equipment became inoperative and has not responded to treatment. The contractor has worked out plans to complete the contract expeditiously without this equipment. The design details of the lamps were finalized. The required production run was completed in August with the lamps undergoing evaluation. Preliminary data indicate the lamps are meeting all the goals of the contract.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PRODUCTION OF TITANIUM ALLOY COMPRESSOR DISKS FROM POWDER BILLETS-174-2

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-72-C-1390
CONTRACT DURATION.	JUN72-JAN76
AFML PROJECT ENGINEER.	KLARQUIST NORMAN E
PROJ/TASK/WK UNIT.	MTP1-01-20

Objective - 31 MAR 73

(U) Establish manufacturing methods for producing higher quality cost-effective compressor disks from titanium alloy powder billets.

Progress-E 01 APR 75 To 01 SEP 75 (Interim-E)

(U) Two hundred fifty pounds of powder were cleaned by the AVCO Ferrofluid process. The tungsten inclusions introduced by the powder production method were completely removed. Tests conducted on compacts made from the cleaned powder show acceptable properties. The contractor is proceeding to produce billets for subsequent forging into full size discs for testing.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PRODUCTION OF EXTRUSIONS FROM ALUMINUM ALLOY 7050-244-3

CONTRACTOR.	ALUMINUM COMPANY OF AMERICA
CONTRACT.	F33615-73-C-5015
CONTRACT DURATION.	MAR73-MAR76
AFML PROJECT ENGINEER.	FELKER TED S
PROJ/TASK/WK UNIT.	MTP1-01-30

Objective - 01 APR 75

(U) To establish mill practices for ingot casting and extrusion of the 7050 aluminum alloy for direct substitution of 7075-T6XX extrusions. The use of 7050 extrusions in current and new design will result in higher reliability and decreased maintenance by the use of an alloy more resistant to general and stress corrosion.

Progress-D 01 MAR 73 To 01 OCT 75 (Interim-D)

(U) ALCOA is continuing to test extrusions fabricated of 25-inch and 35-inch ingot of 7050 Aluminum alloy. Data secured to date confirms previous indications that 7050-T73510 extrusions develop a high resistance to stress-corrosion cracking at stress levels of 45 and 52 KSI. The 35-inch ingot referred to above were of the group cast in the time period of Dec. 1974 - Jan 75 which were of satisfactory quality. Contractor attempted to repeat this casting success in April-May 1975 but produced 38 consecutive ingots which failed by cracking. This casting effort was suspended for a technical review by the AFML. The review resulted in a determination that the casting problems can be solved. It was decided to add $57,654 to the contract to continue the work and this is presently being negotiated by procurement. Work should continue in late Oct 1975.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SLIDING SEAL ELECTRON BEAM WELDING-846-3

CONTRACTOR.	GRUMMAN AEROSPACE CORP
CONTRACT.	F33615-73-C-5030
CONTRACT DURATION.	FEB73-DEC75
AFML PROJECT ENGINEER.	ELLISON H
PROJ/TASK/WK UNIT.	MTP1-01-34

Objective - 25 SEP 72

(U) To increase the flexibility of the sliding seal election beam welding process by equipment improvement, generation of welding data, and selected applications.

Progress-D 01 APR 75 To 20 OCT 75 (Interim-D)

(U) Welding was performed on titanium using the Flat Plate Welding Fixture. Selected titanium weldments were subjected to tensile testing. Aluminum and titanium tee sections were welded using the Special Shapes Welding Fixture. A heating study was conducted using the Preheat Steel Weld Fixture. Weldments were made on HY 130 and D6AC steel plate using the Preheat Steel Weld Fixture and slot welding technique. Lengthy flat plates have been butt welded, T shapes have been welded and welding of a cylinder has been demonstrated. Wing beams of an F14 aircraft design have been welded as an added demonstration component.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. HIGH DIELECTRIC CONSTANT MATERIALS-607-3

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-73-C-5018
CONTRACT DURATION.	FEB73-MAY75
AFML PROJECT ENGINEER.	TARRANTS ELIZABETH H
PROJ/TASK/WK UNIT.	MTP1-01-35

Objective - 30 AUG 72

(U) Establish manufacturing processes and a commercial source of high dielectric constant (greater than twenty-five) materials, with low electrical loss, temperature stability and suitable surface characteristics for use in microwave applications.

Progress-E 31 MAR 75 To 17 SEP 75 (Interim-E)

(U) All deliverable samples and the display have been received. The edited rough draft final report was returned to the contractor on 4 Aug 75. This dielectric (K equals 38) has proved to be excellent for the fabrication of small beam forming networks to be used in the phased array radar. Two of the networks are being evaluated by the Avionics Laboratory. Production techniques for forming large tiles, 9 inch by 9 inch and 12 inch by 12 inch, were demonstrated.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCED COMBUSTOR FABRICATION-862-3

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-73-C-5031
CONTRACT DURATION.	APR73-FEB75
AFML PROJECT ENGINEER.	WILLIAMSON JOHN R
PROJ/TASK/WK UNIT.	MTP1-01-38

Objective - 24 JUL 72

(U) To improve performance of advanced gas turbine engines for AF systems by providing combustors with significantly higher metal temperature capability than now available.

Progress-D 15 SEP 74 To 01 MAY 75 (Interim-D)

(U) The program has encountered some manufacturing problems in the fabrication of the outer shingles. Investigations into various ways of working with the lower-than-expected room-temperature ductility in the EB-weld zone of the columbium shingles are proceeding, earlier attempts at forming an EB-weld ring resulted in cracks in the weld zone. The areas being investigated include flash welding, mechanically working the welds to grain ductility, and different weld geometries to reduce the stress in the weld during the expansion operation. All the weld samples have been completed, and tensile tests of the various methods will proceed as soon as tensile test bars can be machined. The transient temperature analysis is partially completed. Analysis of the data will proceed to determine any possible thermal growth or thermal stress problems. The pyrometer design is complete. All the hardware is on order. Preliminary calibrations of coated columbium bars show that the emissivity of the alloy is fairly constant over a wide temperature range after the initial oxide coating is formed. Spinning of the inner liner shingles was not successful and welding proved difficult resulting in cracking. It does not appear that program objectives can be met within the program scope.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SILICON ON INSULATING SUBSTRATE DEVICES-516-3

CONTRACTOR.	R C A CORP
CONTRACT.	F33615-73-C-5043
CONTRACT DURATION.	JUL73-NOV76
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-01-39

Objective - 09 NOV 72

(U) Establish and demonstrate new manufacturing methods and techniques applicable to volume production of high performance MOS arrays using silicon on insulating substrate technology.

Progress-D 01 SEP 74 To 31 MAR 75 (Interim-D)

(U) A silicon-gate C-MOS on sapphire pilot line has been established. Two types of SOS integrated circuits (the register array and the floating point scaler array) were processed. Fifty arrays of each type were packaged, evaluated, and delivered.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCED COMPOSITES PRODUCTION/SERVICE EXPERIENCE-471-3

CONTRACTOR.	L T V AEROSPACE CORP
CONTRACT.	F33615-73-C-5066
CONTRACT DURATION.	JUN73-DEC74
AFML PROJECT ENGINEER.	TANIS CHARLES
PROJ/TASK/WK UNIT.	MTP1-01-40

Objective - 31 AUG 72

(U) To establish /a/ manufacturing technology and production experience for advanced composite aircraft structures, (b) a cost accounting system for manufacturing costs, operational and maintenance costs for advanced composites, (c) identify high cost centers for the manufacturing operations involved, (d) compare total costs of advanced composite structures to metal structures, (e) instill industry confidence in highly loaded advanced composite structures.

Progress-E 31 MAR 75 To 01 OCT 75 (Interim-E)

(U) During this reporting period a complete analysis of the failure of S/SNo.1, which failed prematurely 1 Nov 1974 during static test, has been made. The cause of the failure has been determined, redesign of the critical area has been done, design verification specimens of the redesigned area have been made, tested and approved by means of a critical design review. These redesigns were also checked out functionally by .scabbing, the fix onto S/SNo.2 which has subsequently been used for lighting strike tests. S/SNo.3 has been completely fabricated and instrumented and static tests are scheduled to resume on 23 Sep 75 and continue until approximately 15 Oct 75. S/SNo.4 has also been completely fabricated but will not be completely assembled until completion of S/SNo.3 static tests. S/SNo.4 is scheduled to be used for flight and fatigue testing. Contractual action is currently being initiated that will reflect the impact on quantity, time and costs that this failure delay has caused.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SUPERALLOY POWDER PRODUCTION AND CONSOLIDATION-271-3

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-73-C-5040
CONTRACT DURATION.	MAY73-AUG75
AFML PROJECT ENGINEER.	CLARK LARRY P
PROJ/TASK/WK UNIT.	MTP1-01-43

Objective - 09 NOV 72

(U) To establish more economical powder production methods and consolidation methods for making superalloy forgings and/or finished parts for engine applications.

Progress-E 01 MAY 75 To 01 SEP 75 (Interim-E)

(U) No work has been accomplished due to the negotiations on the contract modification.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MINATURE TWT-616-3

CONTRACTOR.	VARIAN ASSOCIATES
CONTRACT.	F33615-73-C-5032
CONTRACT DURATION.	OCT73-APR76
AFML PROJECT ENGINEER.	MEULEMANS JOSEPH I
PROJ/TASK/WK UNIT.	MTP1-01-44

Objective - 29 SEP 72

(U) To provide a manufacturing capability for the low cost production of microwave tubes required for the B-1 ECM equipment.

Progress-E 30 SEP 75 To 14 OCT 75 (Interim-E)

(U) The tube design has been established. Power output of 26 watts, gain of 45 dB and a bandwidth of 5.2 to 10.4 GHz have been established. Electrical tolerances have been determined. Mechanical tolerances are near completion. Thirty-two tubes have been built. The tube to tube variation in electrical performances is extremely small. Preparations are being initiated for life testing of several of these devices.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ELECTROSLAG CAST HOLLOWS FOR SUPERALLOY RINGS-262-3

CONTRACTOR.	CABOT CORP
CONTRACT.	F33615-73-C-5046
CONTRACT DURATION.	JUN73-AUG76
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-01-46

Objective - 09 NOV 72

(U) To establish a manufacturing process to produce high strength and temperature resistant rolled turbine engine rings disks, spacers and hollow shafts of rotating part quality and at a lower cost.

Progress-D 15 APR 75 To 07 OCT 75 (Interim-D)

(U) Contractor has been consistantly delinquent in submission of interim reports and is currently three (3) months delinquent. It has been verbally reported that a series of five 20 inch O.D. hollow ingots were cast repetitively. A water cooled copper mold to produce 16 inch O.D. hollows has been delivered and attempts are under way to duplicate the results of the larger size prior to holding a program review with AFML and the subcontractors to discuss more complex alloys.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. DEVICE APPLICATIONS FOR LOW OCST RARE EARTH COBALT MAGNETS-610-3

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-73-C-5059
CONTRACT DURATION.	JUL73-MAR75
AFML PROJECT ENGINEER.	GARRETT HAROLD J
PROJ/TASK/WK UNIT.	MTP1-01-49

Objective - 31 AUG 73

(U) To demonstrate the applications of low cost rare earth cobalt magnets in jet fuel starter and acturator pump motor.

Progress-E 01 APR 75 To 15 SEP 75 (Interim-E)

(U) Problems were encountered in the assembly of the permanent magnet status of the pump motor. However, the problems were solved and testing of the unit is expected to be completed before 30 Oct 75. The use of the high energy product samarium cobalt magnets enabled substantial size reductions of the motors while allowing the achievement of the characteristic high efficiency of permanent magnet motors.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. QUALITY STANDARDS FOR PRODUCTION TITANIUM ALLOY CASTINGS-261-3

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-73-C-5039
CONTRACT DURATION.	MAY73-APR76
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-01-50

Objective - 09 NOV 72

(U) To improve the manufacturing methods for producing sound, close tolerance, titanium alloy cast shapes for engine and airframe applications.

Progress-C 01 APR 75 To 07 OCT 75 (Interim-C)

(U) A request for a program modification and request for approval to order long lead time materials submitted to 4950/PMRB in August 1974 was eventually acted upon and the amendment became effective in February 1975. During this inexcusable delay both material prices and labor rates increased necessitating additional submittals, evaluations and funding. The chemistry optimization scheduled for phase II was cancelled. Additional castings and evaluation of hot isostatic pressing were substituted for the deleted effort. The program completion date has been extended to accommodate the procurement delay.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOWER COST TOOLING FOR SHELL STRUCTURES-474-3

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-73-C-5119
CONTRACT DURATION.	JUN73-JUN75
AFML PROJECT ENGINEER.	LITVAK SIDNEY
PROJ/TASK/WK UNIT.	MTP1-01-51

Objective - 30 OCT 72

(U) To establish new and/or improved manufacturing processes for large, highly-contoured complex tools that can produce shell-type aircraft structures, preferably fuselage-type, having sufficient accuracy to meet both aerodynamic and production mating requirements and in addition, result in reduced initial and recurring component costs.

Progress-E 01 APR 75 To 15 SEP 75 (Interim-E)

(U) Phase I - Component Tool Selection and Subscale Component Fabrication (Task A-Material and Process Evaluation, Task B-Component Selection) -- Completed. Phase II - Fabrication of Full-Scale Tool and Components (Task A - Full-Scale Tool Design and Manufacture Full-Scale Verification, Task B- Component - Three Articles, Full-Scale Tool Life Determination) - Completed. Phase III - Full-Scale Component Evaluation and Component Testing - Completed. Phase IV - Production Analysis - Completed. Final report being corrected by GD/FW prior to publication and distribution. Contractual movie is in final stages of production.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCED ISOTHERMAL FORGING LUBRICATION AND TOOLING PROCESS-128--

CONTRACTOR.	WYMAN GORDON CO
CONTRACT.	F33615-74-C-5011
CONTRACT DURATION.	MAR74-APR77
AFML PROJECT ENGINEER.	KLAROUIST NORMAN E
PROJ/TASK/WK UNIT.	MTP1-01-53

Objective - 22 JUN 73

(U) Establish economical and reliable manufacturing methods for the production of isothermally forged aircraft quality components using improved forging lubricants and a modular design concept accommodating part sizes up to 600 square inch plan area.

Progress-C 01 APR 75 To 01 SEP 75 (Interim-C)

(U) Phase II procurement of materials and design of tooling is in progress. Wyman-Gordon is working closely with McDonnell Aircraft and Battelle during this phase to assure that all requirements in the forging designs are coordinated. Procurement is processing a request for contract extension of Phase II.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. AUTOMATED DIRECTIONAL SOLIDIFICATION OF SUPERALLOYS-867-4

CONTRACTOR.	GENERAL MOTORS CORP
CONTRACT.	F33615-74-C-5007
CONTRACT DURATION.	JAN74-JUL75
AFML PROJECT ENGINEER.	GLENN GEORGE M
PROJ/TASK/WK UNIT.	MTP1-01-55

Objective - 01 JUL 73

(U) Establish automated processes for directionally solidified castings of conventional superalloys.

Progress-B 01 SEP 74 To 17 OCT 75 (Interim-B)

(U) This program was completed in Oct 75. The Final Tech Rpt., AFML-TR-75-150 will be distributed in Nov. 75. The results of this program support the following conclusions. (a) The DDA (exothermic pack process) for directional solidification is suitable for automated production of blade and vane castings at significant cost savings over the most widely used commercial practice. (b) The production base for a wide variety of directionally solidified airfoils can be readily and inexpensively expanded through simple modification of conventional casting equipment. (c) Mechanical property test results indicate that exothermic processed nickel-base DS castings have significant stress rupture life and ductility advantages over equiaxed castings. Such property improvements are particularly obvious in thin sections.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. BRAZED TITANIUM HYBRID STRUCTURES-848-4

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5047
CONTRACT DURATION.	FEB74-
AFML PROJECT ENGINEER.	KOLLMORGEN L
PROJ/TASK/WK UNIT.	MTP1-01-58

Objective - 03 JUL 73

(U) To develop manufacturing technology for redundant brazed titanium hybrid structure.

Progress-C 31 APR 75 To 17 OCT 75 (Interim-C)

(U) Subscale components have been fabricated and tested. Electron beam frames were welded and tested with mechanical properties of the welds determined acceptable for application to the full-scale components. Fay surface braze techniques were established for the particular joint designs of the selected component. Braze cycles were established and subscale panels were fay surface brazed. Two full scale (24 inch by 60 inch) engine support beams have been brazed. Inspection revealed a problem with conversion to titanium aluminide in the shear web, face sheet to honeycomb core braze. In both components a special effort is now being made to identify the cause of the TiAL sub 3 conversion which results in a brittle structure. A third component will then be fabricated and tested.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MULTI-LAYER FASTENER SYSTEMS-752-4

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5014
CONTRACT DURATION.	APR74-JAN76
AFML PROJECT ENGINEER.	HAGER JOSEPH W
PROJ/TASK/WK UNIT.	MTP1-01-59

Objective - 21 JUN 73

(U) The objective is to assess and minimize or eliminate necessity for destack and deburr operations during hole generation in thick sections of multiple layered material, develop and evaluate auxillary equipment in destack and deburr operations and establish cost effective methods of manufacturing.

Progress-B 01 SEP 74 To 31 MAR 75 (Interim-B)

(U) Due to a projected cost overrun of $82,000, AFML anticipates cost reduction modifications to the original contract and possible completion of Phase IV Production Evaluation by a subcontractor.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CONSOLIDATION OF BLENDED ELEMENTAL TITANIUM POWDER TO NEAR NET SHAPES-179-4

CONTRACTOR.	PRATT AND WHITNEY INC
CONTRACT.	F33615-74-C-5028
CONTRACT DURATION.	DEC73-MAR76
AFML PROJECT ENGINEER.	CLARK LARRY P
PROJ/TASK/WK UNIT.	MTP1-01-60

Objective - 01 MAR 74

(U) To establish manufacturing methods for the consolidation of blended elemental titanium powder to near net shapes for engine applications using the press and sinter consolidation technique.

Progress-C 01 APR 75 To 01 SEP 75 (Interim-C)

(U) Discussions with several proposed new subcontractors were held with Gould Laboratories of Cleveland being selected as the new subcontractor. Pratt and Whitney Aircraft has prepared a proposal for contract modification and submitted it to procurement for approval. In the interim the contract has been in a .hold. status.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. REDUCED COST PROCESSING FOR DIRECTIONALLY SOLIDIFIED EUTECTIC AIRFOILS-868-4

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-74-C-5018
CONTRACT DURATION	FEB74-MAY76
AFML PROJECT ENGINEER.	ELBAUM JEROME K
PROJ/TASK/WK UNIT.	MTP1-01-61

Objective - 21 JUN 73

(U) To establish automated processes for directionally solidified castings of high temperature eutectics.

Progress-B 01 SEP 74 To 17 OCT 75 (Interim-B)

(U) All master heats have been poured and evaluated for chemical composition and cleanliness. Both alumina-silica and magnesia crucibles resulted in exceptionally clean master melts when vacuum casting was employed. Directionally solidified microstructure and creep-rupture properties compared favorably with laboratory grown material. A second sequence of JTDE hollow blade casting trials using a three blade per mold configuration and previously established optimum thermal parameters showed significant improvements in overall non-destructive quality with no change in microstructural or compositional quality due to vacuum processing. Commercial grade alumina-silica melt crucibles and master alloy melt charges had no significant impact on overall casting quality. Creep rupture properties at 1800 degrees F/40 ksi were in excess of PWA 1422. 1400 degrees F.100 ksi creep rupture results in turbine blade root sections exceeded current root attachment property requirements. Evaluation of the NiTaC-13 eutectic alloy trials cast in the F100 blade configuration showed reduced non-destructive quality when compared to the F100 blade trials. A control/monitor program for the casting process has been incorporated into the process control computer system. Instrumentation for computerized control has been installed in the furnace system.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PLASMA ARC WELDING-849-4

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-74-C-5036
CONTRACT DURATION.	JAN74-SEP75
AFML PROJECT ENGINEER.	MILLER FREDERICK R
PROJ/TASK/WK UNIT.	MTP1-01-62

Objective - 25 JUN 73

(U) To develop the plasma arc welding process for joining thick sections up to one (1) inch or greater.

Progress-C 01 APR 75 To 22 OCT 75 (Interim-C)

(U) Under Phase II material thickness limits were established for each of the three program materials. Ti 6AL-4V. HY180 Steel, and 9Ni-4Co-.20C steel using the baseline headboard plasma arc welding system. Mechanical property test specimen plates were welded and evaluated nondestructively using radiographic and dye penetrant inspection techniques. Phase III was initiated to fabricate a simulated airframe wing. Carry through upper cover by plasma arc welding.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. STRATEGIC MATERIALS RECLAMATION-162-4

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-74-C-5019
CONTRACT DURATION.	MAR74-NOV76
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-01-63

Objective - 31 OCT 73

(U) To establish processes for the economical reclamation of titanium, superalloy scrap, and the valuable alloying elements that are now downgraded or not recycled.

Progress-B 15 APR 75 To 03 OCT 75 (Interim-B)

(U) Without presenting results of several important phase I tasks, contractor submitted request for approval of a modified phase II. In the absence of these results there is insufficient data on which to base a decision. Program is approximately 3 months behind schedule. Data has been promised and arrangements for meeting with PCO will be scheduled for mid October to decide on phase II efforts.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ESTABLISHMENT OF PRODUCTION MACHINABILITY DATA-755-4

CONTRACTOR.	METCUT RESEARCH ASSOCIATES INC
CONTRACT.	F33615-74-C-5025
CONTRACT DURATION.	NOV73-AUG75
AFML PROJECT ENGINEER.	HARRIS WILLIAM A
PROJ/TASK/WK UNIT.	MTP1-01-64

Objective - 25 JUN 73

(U) This program will establish machinability data that can be used to reduce cost and increase productivity in manufacturing of present and future Air Force systems.

Progress-D 15 APR 75 To 30 OCT 75 (Interim-D)

(U) The work effort is continuing on establishing the non-linear regressive analysis equations to describe face milling on Ti-6-4 and 4340 steel.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. RELAXED MANUFACTURING/DESIGN TOLERANCE CONCEPTS-866-4

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-74-C-5044
CONTRACT DURATION.	APR74-JAN76
AFML PROJECT ENGINEER.	WILLIAMSON JOHN R
PROJ/TASK/WK UNIT.	MTP1-01-66

Objective - 03 JUL 73

(U) To identify design/manufacturing concepts for cost reduction through relaxation of manufacturing tolerance requirements.

Progress-C 01 MAY 75 To 23 OCT 75 (Interim-C)

(U) Machining studies to establish tolerances (dimensional) vs. machining speed, depth of cut, cutter diameter, etc. have been completed for aluminum and design guidelines established. These guidelines are now being applied on F-16 drawings. Titanium guidelines are being established. Fatigue testing for surface integrity of as-machined versus hand finished surfaces is progressing. Studies indicate a slight effect of surface finish in aluminum, none on titanium. Design changes on F-16 parts will save about 14 percent Higher machine speeds may save another 14 percent.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. HIGH QUALITY GALLIUM ARSENIDE PRODUCTION-538-4

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-74-C-5031
CONTRACT DURATION.	MAR74-MAY76
AFML PROJECT ENGINEER.	TARRANTS ELIZABETH H
PROJ/TASK/WK UNIT.	MTP1-01-67

Objective - 06 JUL 73

(U) To provide the manufacturing processes that will supply the required type and quality of gallium arsenide, epitaxial layers needed for the fabrication of efficient, reproducible microwave devices. An additional facet of the objective is to establish a commercial source of the high quality gallium arsenide layers resulting from this project.

Progress-C 31 MAR 75 To 25 SEP 75 (Interim-C)

(U) A number of runs have been made in the production reactor using a four or quadra-wafer holder. There were difficulties in adjusting the gas flows particularly. A series of baffles have been prepared to adjust the flow pattern. An undesirable flow pattern degrades the quality of the epitaxial layer or may prevent it from depositing. During the next quarter the flow velocity will be lowered and the source area will be increased by adding two additional boats of gallium with the intention of improving the quality of the deposited layers. This contractor has had difficulty in obtaining both Te doped and semi-insulating substrates. The vendor of substrates (also an AF contractor) had difficulty during the last three months in growing semi-insulating gallium arsenide. This condition has been corrected and semi-insulating gallium arsenide is now available. Substrates have been ordered both from Japan and England.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MICROWAVE LIMITER FOR RADAR RECEIVER PROTECTION MICROWAVE LIMITER-621-4

CONTRACTOR.	HUGHES AIRCRAFT CO
CONTRACT.	F33615-74-C-5102
CONTRACT DURATION	APR74-NOV76
AFML PROJECT ENGINEER.	MEULEMANS JOSEPH I
PROJ/TASK/WK UNIT.	MTP1-01-68

Objective - 10 JUL 73

(U) To establish economical and reliable manufactory methods for the production of Microwave Limiters for Radar Receiver Protcetion.

Progress-B 30 SEP 74 To 31 MAR 75 (Interim-B)

(U) The multipactor limiter has been scaled to a bandwidth of 9 to 10.2 GHz. The multipactor limiter is a passband device. 2nd and 3rd harmonic suppression is at least 50dB. The multipactor plus diode tandem limiters have shown recovery time of less than 15 manoseconds. The mechanical design has been selected as a multipactor unit nested in a U shaped liquid cooled heat sink. The heat sink can be changed to air blast cooling without redesign of the multipactor limiter.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST METAL MATRIX COMPOSITE MATERIAL-365-4

CONTRACTOR.	COMPOSITE MATERIALS CORP
CONTRACT.	F33615-74-C-5066
CONTRACT DURATION.	JUN74-FEB76
AFML PROJECT ENGINEER.	ANDERSON CHARLES S
PROJ/TASK/WK UNIT.	MTP1-01-70

Objective - 19 JUL 73

(U) To establish lower cost processing methods for the production of metal matrix composite material.

Progress-C 31 MAR 75 To 15 SEP 75 (Interim-C)

(U) A tape manufacturing line has been constructed to produce three-inch wide continuous (in excess of 100 ft) accurately collimated, binderless diffusion bonded boron/aluminum tape. Overall, the operation of the tape line using air atmosphere was good. When operating in vacuum the tape along with the stainless steel separator foils did not pull smoothly through the cooling jacket. The channel through the cooling jacket is being enlarged. The initial results indicate no degradation of filament tensile strength under the conditions used. The results also suggest that the time required to compact the monolayer tape adequately will be on the low end of the times scheduled for evaluation.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. RESISTANCE SPOT WELD-ADHESIVE BOND JOINING OF TITANIUM-408-4

CONTRACTOR.	GRUMMAN AEROSPACE CORP
CONTRACT.	F33615-74-C-5073
CONTRACT DURATION.	MAR74-NOV75
AFML PROJECT ENGINEER.	STARKS DOUGLAS F
PROJ/TASK/WK UNIT.	MTP1-01-72

Objective - 23 JUL 73

(U) To establish a reliable manufacturing method for weldbonding titanium aircraft structure.

Progress-C 31 MAR 75 To 01 OCT 75 (Interim-C)

(U) This program is in its third and final phase of operation, which is scheduled for completion November 1975. Task being conducted now are the preparation of demonstration articles, e g., fuselage, tail section, and nacelle representative of aircraft structures. Preparations are now underway for an industry demonstration for mid November 1975. It is anticipated that this program will be completed with the time and funds allotted.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST MANUFACTURING CONCEPTS FOR ADVANCED COMPOSITE PRIMARY AIRCRAFT STRUCTURES-406-4

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-74-C-5153
CONTRACT DURATION	MAY74-SEP75
AFML PROJECT ENGINEER.	REINERT HARRY S
PROJ/TASK/WK UNIT.	MTP1-01-74

Objective - 27 JUL 73

(U) To demonstrate the cost competitiveness of advanced composite with with advanced aluminum technology in primary aircraft structures.

Progress-Z 02 APR 75 To 22 OCT 75 (Final)

(U) Camera Ready Copy of final report AFML-TR-75-145 received 10 Oct 75 and in publication.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST FOD RESISTANT ORGANIC MATRIX FAN BLADES-413-4

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-74-C-5072
CONTRACT DURATION.	MAR74-JUN76
AFML PROJECT ENGINEER.	PIRRUNG PAUL F
PROJ/TASK/WK UNIT.	MTP1-01-75

Objective - 01 AUG 73

(U) The objective of this program is the development of FOD resistant hybrid composite fan blades which can be manufactured in production quantities on a reliable and reproducible basis at costs lower than their metallic counterparts. Successful completion of this program would allow the application of composite fan blades to future Air Force engines with improved performance and reduced acquisition costs.

Progress-C 31 MAR 75 To 01 OCT 75 (Interim-C)

(U) The hybrid screening phase of the program (Phase I) was completed. The local impact damage problems which surfaced in late 1974 were solved by the use of high shear strength materials. The 80AS/20S-glass material system selected for manufacturing demonstration has been judged capable of meeting FAA FOD requirements. With the exception of the design validation testing. Phase II - Blade Design was also completed. Phase III - Manufacturing Methods Improvement is complete with the exception of fabricating blades with the final tooling. Phase IV - Manufacturing Fabrication Demonstration was initiated. Blade mold tooling has been completed and product of the die checkout is complete and acceptable. Blade process evaluation, including the manufacture of six blades, is in process.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CHARGE COUPLED DEVICE MEMORY ARRAYS-528-4

CONTRACTOR.	FAIRCHILD CAMERA AND INSTRUMENT CORP
CONTRACT.	F33615-74-C-5088
CONTRACT DURATION.	MAY74-AUG76
AFML PROJECT ENGINEER.	GARRETT JACK A
PROJ/TASK/WK UNIT.	MTP1-01-76

Objective - 12 OCT 73

(U) To establish manufacturing processes, controls and materials for economical volume production of Large Charge Coupled Device (CCD) digital memory arrays.

Progress-B 31 MAR 75 To 30 SEP 75 (Interim-B)

(U) A meeting was held with the Fairchild program manager on 4 September 1975. The LTE program has not met initial program delivery requirements for the 16,000 bit CCD memory, but it now appears delivery of these devices can be made in October of 1975. Three (3) process runs of these 16,000 bit memory devices have been obtained in the last 2 months. Two of these runs were fabricated from an earlier mask set, which required a minor mask change to correct a problem observed on the input circuit to the CCD register. Control of the amplitude and uniformity of dark currents continues to receive much attention on this program. This dark current control is essential for achieving desired operation at higher temperatures. Fairchild plans to market these CCD memory devices and will make a formal announcement of this 16,000 bit memory after delivery of required devices to LTE. A detailed specification will accompany this announcement and also be provided to LTE.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SURFACE INSPECTION TECHNIQUES FOR LSI PRODUCTION-503-3

CONTRACTOR.	TEXAS INSTRUMENTS INC
CONTRACT.	F33615-73-C-5047
CONTRACT DURATION.	JUN73-JUN76
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP1-01-78

Objective - 08 APR 74

(U) To establish rapid manufacturing process controls in Large Scale Integrated (LSI) circuit manufacturing fabrication related to process induced damage, contamination, and geometric variations or flaws.

Progress-B 08 APR 74 To 31 MAR 75 (Interim-B)

(U) Process controls are being established to minimize induced damage for the manufacturing operations related to (1) slice preparation, (2) diffusion and epitaxial processing, and (3) metallization, overcoating and assembly. Contamination process controls are being established for the areas of slice preparation, epitaxial and thermally grown oxide films, photoresist and photomask, metallization and packaging. Varing the improved wafer slicing machine parameters (stroke speed and blade speed) did not yield less process induced damage. With respect to contamination control a single nozzle molecular beam-mass spectrometer system has been designed, constructed, and is being applied to the analysis of plant gases and furnace ambients. Photoresist process control as related to geometric variation or flaws is in progress.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. IMAGE INTENSIFIER TUBES WITH 40MM DIAMETER OR GREATER MICROCHANN PLATES-604-4

CONTRACTOR.	NI-TEC INC
CONTRACT.	F33615-74-C-5101
CONTRACT DURATION.	JUN74-MAR76
AFML PROJECT ENGINEER.	TRINKLE HAROLD K
PROJ/TASK/WK UNIT.	MTP1-01-82

Objective - 31 JUL 73

(U) To establish manufacturing processes and techniques for economical production of image intensifier assemblies utilizing a microchannel plate amplification stage.

Progress-C 30 SEP 75 To 14 OCT 75 (Interim-C)

(U) Two tubes have been produced and limited test and evaluations performed on these devices. Neither tube has been completely characterized to date. Limited test data is contained in reports.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PRODUCTION OF POWDER METALLURGY NICKEL-BASE SUPERALLOY TURBINE DISKS-178-4

CONTRACTOR.	PRATT AND WHITNEY INC
CONTRACT.	F33615-74-C-5108
CONTRACT DURATION.	DEC73-APR76
AFML PROJECT ENGINEER.	CLARK LARRY P
PROJ/TASK/WK UNIT.	MTP1-01-86

Objective - 30 NOV 73

(U) Establish manufacturing methods for the production of Turbine Disks of powder metallurgy nickel-base alloys to provide capability of higher operating temperature and/or reduce engine costs.

Progress-C 01 APR 75 To 22 OCT 75 (Interim-C)

(U) Federal Mogul was selected as the source for the Astroloy powder production and consolidation. The preforms were successfully forged by Ladish. The forged discs have been heat treated and testing is in progress. Hot spin pot testing of the AF2-1DA disc is still in abeyance because of heavy test schedules.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCE RADOME PRODUCTION-492-4

CONTRACTOR.	BRUNSWICK CORP
CONTRACT.	F33615-74-C-5132
CONTRACT DURATION.	APR74-OCT76
AFML PROJECT ENGINEER.	LITVAK SIDNEY
PROJ/TASK/WK UNIT.	MTP1-01-87

Objective - 18 DEC 73

(U) To establish new and /or improved manufacturing processes for the utilization of polyimide resin/quartz fabric prepregs and polyimide-based syntactic foams in fabricating advanced, high-performance plastic aircraft high temperature radomes.

Progress-C 01 APR 75 To 15 SEP 75 (Interim-C)

(U) Phase I - Evaluations and Selection of Materials and Processes - Completed. Phase II - Fabrication, Analysis and Testing of Radomes - The first full-scale polyimide foam sandwich configured B-1 radome has been fabricated. This is the structural test and environmental evaluation radome, and minimal electrical range testing will be performed prior to environmental testing.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PRODUCTION OF METAL MATRIX STRUCTURAL COMPONENTS-304-4

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-74-C-5151
CONTRACT DURATION.	JUN74-JUN76
AFML PROJECT ENGINEER.	ANDERSON CHARLES S
PROJ/TASK/WK UNIT.	MTP1-01-90

Objective - 14 JAN 74

(U) To establish economical manufacturing methods for the production of metal matrix structural components.

Progress-C 31 MAR 75 To 16 SEP 75 (Interim-C)

(U) The boron/aluminum (B/Al) shear web concept was chosen as best meeting the design loads for the B-1 wing rib. An economic analysis was conducted that compared the production costs for B/Al wing rib panel with those for the machined and diffusion bonded titanium baseline wing rib panel. Weight savings of 36 percent and cost savings of 49 percent have been projected. Development of the capability at Rockwell International to consolidate unidirectional boron/aluminum plate or sheet with minimum average longitudinal and transverse tensile strengths of 200 ksi and 20 ksi has been demonstrated. The subcomponent specimens have been fabricated and tested. A linear finite element analysis of the B-1 wing rib has previously been run and the output is currently being analyzed in light of the subcomponent and coupon test data. Fabrication of the full size composite wing rib component has been started.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CONSOLIDATION OF PREALLOYED TITANIUM POWDER TO NEAR NET SHAPES-171-4

CONTRACTOR.	CRUCIBLE STEEL CORP
CONTRACT.	F33615-74-C-5114
CONTRACT DURATION.	FEB74-NOV76
AFML PROJECT ENGINEER.	CLARK LARRY P
PROJ/TASK/WK UNIT.	MTP1-01-92

Objective - 22 MAR 74

(U) To establish manufacturing methods for the consolidation of prealloyed titanium powder to near net shapes for engine and airframe applications using the Hot Isostation Pressing (HIP) method of consolidation.

Progress-C 01 APR 75 To 23 OCT 75 (Interim-C)

(U) The first compacts of the higher oxygen powder have been made and evaluation is being conducted. Additional keel-splice fittings have been made and sent to MCAIR for evaluation. The neck iteration of the subscale stub shaft was HIP.ed in August. The part will be decanned and sent to General Electric for evaluation.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MULTI-AXIS LASER CUTTING-753-4

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5091
CONTRACT DURATION.	FEB74-AUG75
AFML PROJECT ENGINEER.	WILLIAMSON JOHN R
PROJ/TASK/WK UNIT.	MTP1-01-93

Objective - 20 APR 73

(U) To establish laser cutting manufacturing techniques and equipment for cutting and trimming titanium and other difficult-to-machine alloy contoured parts.

Progress-C 01 MAY 75 To 24 OCT 75 (Interim-C)

(U) A manual router-type laser cutting system has been fabricated and cutting tests are being conducted. Testing indicates that the optical path retains fidelity throughout manipulation. A minor focal length problem has slowed tests. Mirror is being replaced. Sample parts will be trimmed during the next period. The contract is technically complete. A final report draft has been received.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST MANUFACTURING CONCEPTS USING ADVANCED COMPOSITES BROADGOODS-419-4

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-74-C-5156
CONTRACT DURATION.	MAY74-JUL75
AFML PROJECT ENGINEER.	REINERT HARRY S
PROJ/TASK/WK UNIT.	MTP1-01-98

Objective - 07 JUN 74

(U) To establish draping as a viable low cost manufacturing techniques for fabrication of advanced composite aircraft structure.

Progress-C 01 APR 75 To 01 OCT 75 (Interim-C)

(U) Industry review as conducted. Draft of final report was received and reviewed and is in editing. Processing Specification and Materials Specifications have been delivered.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. BORON ALUMINUM PREFORM TAPE-316-4

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-5123
CONTRACT DURATION.	MAY74-APR75
AFML PROJECT ENGINEER.	ANDERSON CHARLES S
PROJ/TASK/WK UNIT.	MTP1-01-99

Objective - 22 FEB 74

(U) To establish significantly lower cost manufacturing methods for the production of metal matrix composite material.

Progress-C 31 MAR 75 To 15 SEP 75 (Interim-C)

(U) The contract has been technically completed with the production of ten pounds of six inch wide continuous boron aluminum tape using polyisobutylene fugitive binders. The tape was found to be layable similar to boron/epoxy, and based upon its performance in hand layup operations, it was projected to be applicable for future machine lay ups and automatic ply generation. Physical properties of consolidated boron/aluminum by diffusion bonding are being confirmed by the distribution of the ten pound sample to potential users. The draft final report was lacking in numerous areas of technical, non-technical and contractural requirements and has been returned to the contractor for revisions.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. GALLIUM ARSENIDE MICROWAVE SUBSTRATES-526-5

CONTRACTOR.	LASER DIODE LABORATORIES INC
CONTRACT.	F33615-75-C-5006
CONTRACT DURATION.	AUG74-NOV76
AFML PROJECT ENGINEER.	TARRANTS ELIZABETH H
PROJ/TASK/WK UNIT.	MTP1-02-21

Objective - 15 APR 74

(U) To provide the manufacturing processes that will supply the required type and quality of gallium arsenide substrates needed for the fabrication of efficient, reproducible microwave devices. In addition a commercial source for these substrates will be established.

Progress-B 31 MAR 75 To 16 OCT 75 (Interim-B)

(U) Difficulty has been experienced with the semi-insulating gallium arsenide, in that it was no longer high resistivity. Every possible source of contamination was investigated. Within the last month good material has been prepared without the cause of the trouble being pinpointed. A bad lot of gallium and/or contamination by the quartz is suspected. Materials have been provided to the Naval Research Laboratory, Avionics Laboratory, and Cornell University.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. PRODUCTION INSPECTION OF NEAR NET TURBINE DISK SHAPES

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-75-C-5193
CONTRACT DURATION.	JUN75-SEP77
AFML PROJECT ENGINEER.	WHEELER EDWARD
PROJ/TASK/WK UNIT.	MTP1-02-30

Objective - 18 JUN 74

(U) To establish a production compatible inspection system for reliably inspecting contoured near net turbine disk shapes of high temperature engine turbine disk alloys with emphasis on powder metallurgy parts.

Progress-A 18 JUN 74 To 24 OCT 75 (Interim-A)

(U) Major design decisions have been made. Subcontracts have been signed with General Dynamics and TRW. Effort is now underway in all appropriate areas. The contract was predated 28 days from the mailing date and this reduces the first quarter year effort. Efforts and expenditures should be on schedule in a reasonable time.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. MANUFACTURING COST/DESIGN GUIDE-870-5

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-75-C-5194
CONTRACT DURATION.	MAY75-JUL76
AFML PROJECT ENGINEER.	WILLIAMSON JOHN R
PROJ/TASK/WK UNIT.	MTP1-02-31

Objective - 15 MAY 74

(U) To establish the format and data requirements for an aircraft airframe structural Manufacturing Cost/Design Guide. The purpose will be to make manufacturing cost information readily available and variable by the designer in making design decisions involving manufacturing cost, performance, and reliability tradeoffs.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SUPERALLOY ENGINE COMPONENT-260-5

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5084
CONTRACT DURATION.	FEB75-OCT76
AFML PROJECT ENGINEER.	GLENN GEORGE M
PROJ/TASK/WK UNIT.	MTP1-02-32

Objective - 11 JUL 74

(U) To reduce aircraft turbine engine manufacturing costs through use of advanced state-of-the-art superalloy precision castings.

Progress-A 29 SEP 75 To 20 OCT 75 (Interim-A)

(U) An engineering drawing for a cast frame was accomplished concurrently with trade-off studies on consideration of using a segmented mold approach for the casting of a one piece F101 fam frame. Prior to the one piece casting demonstration, the frame was studied for symmetry and divided into segments for casting individual parts using segmented molding procedures. Molds representing 1/6 hub segments with inserts to allow for different configurations of strut bosses were constructed and two castings poured. The first hub casting did not have complete fill in two thin panel areas but the second casting was complete and sound with a uniform microstructure except for one small area exhibiting some columnar grains. Casting studies for the outer ring and strut assemblies have been completed and tooling is being made prior to casting.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. COMPUTER DESIGN ISOTHERMAL FORGING-228-5

CONTRACTOR. BATTELLE MEMORIAL INSTITUTE
CONTRACT. F33615-75-C-5049
CONTRACT DURATION. JUL74-JUL77
AFML PROJECT ENGINEER. KLARQUIST NORMAN E
PROJ/TASK/WK UNIT. MTP1-02-33

Objective - 28 MAY 74

(U) Improve the efficiency and cost effectiveness of Isothermal Forging as a production process through the application of Computer-Aided Design and Computer-Aided Manufacturing.

Progress-B 01 APR 75 To 01 SEP 75 (Interim-B)

(U) Software development of the preform designs is proceeding satisfactorily. Battelle is working very closely with Wyman-Gordon to coordinate their designs with the forging outline being developed by W-G. W-G is preparing to adopt the computer programs to a mini computer in-house.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. HIGH QUALITY, LOW COST TITANIUM POWDER PRODUCTION-274-5

CONTRACTOR. NUCLEAR METALS INC
CONTRACT. F33615-75-C-5197
CONTRACT DURATION. MAY75-MAY77
AFML PROJECT ENGINEER. CLARK LARRY P
PROJ/TASK/WK UNIT. MTP1-02-34

Objective - 28 MAY 74

(U) To establish Manufacturing Methods for the production of High Quality, Low Cost Prealloyed Titanium Powder for use in airframe and engine applications.

Progress-A 05 JUN 75 To 01 SEP 75 (Interim-A)

(U) Most of the titanium bar needed for the program has been received. Experiments have shown that the existing long-bar seat design can be
CONTRACT. F33615-75-C-5211
CONTRACT DURATION. MAY75-APR78
AFML PROJECT ENGINEER. WHEELER EDWARD
PROJ/TASK/WK UNIT. MTP1-02-36

Objective - 19 JUN 74

(U) To establish low cost manufacturing methods for the fabrication of aircooled integrally-bladed turbine wheels of advanced superalloys.

Progress-A 19 JUN 74 To 24 OCT 75 (Interim-A)

(U) Phase IA activities are proceeding on schedule and are expected to be completed on time with funding on schedule. The FY76 funds for options I and II have been obligated.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. TITANIUM ALLOY ENGINE CASTINGS-261-5

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-75-C-5263
CONTRACT DURATION.	MAY75-SEP76
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP1-02-37

Objective - 24 MAY 74

(U) To reduce aircraft turbine engine manufacturing costs through use of advanced state-of-the-art titanium alloy precision castings.

Progress-A 24 MAY 74 To 24 OCT 75 (Interim-A)

(U) Plans for outer ring wax injection tooling have been finalized and machining of aluminum component parts is in progress. The first interim report due 15 Aug 75 has not been submitted.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SHROUDED BLADE FABRICATION-871-5

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5053
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	INOUYE SHINGO
PROJ/TASK/WK UNIT.	MTP1-02-38

Objective - 29 MAY 74

(U) The objective of this program is to reduce significantly the cost of shrouded titanium blades and vanes for turbine engines by establishing a reliable manufacturing process for joining midspan and tip shrouds to shapes less complex than conventional forgings.

Progress-A 14 JAN 75 To 15 APR 75 (Interim-A)

(U) Ti-6-4 and Ti-8-1-1 are being machined into mechanical test specimens and bonding blanks. Process drawings for F101 stage 2 blades and vanes are completed. Bonding tooling has been designed and engineering drawings are being prepared. Pressure bonder is operational except for checkout of instrumentation and modification of hydraulic cylinder to achieve increased head travel.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST NONROTATING TITANIUM ENGINE COMPONENTS-875-5

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5079
CONTRACT DURATION.	DEC74-MAY76
AFML PROJECT ENGINEER.	HARRIS WILLIAM A
PROJ/TASK/WK UNIT.	MTP1-02-39

Objective - 09 JUL 74

(U) This program will establish manufacturing parameters and processes to fabricate nonrotating titanium engine components form sheet, bar, and plate stock.

Progress-A 05 DEC 74 To 01 APR 75 (Interim-A)

(U) All Ti 6-4 sheet (.125 inch and .063 inch thickness) and plate (1/4 inch, 3/8 inch, and 1/2 inch thickness) ordered for the contract have been received. The friction testing test bed has been completed and is being shipped to General Electric from the machining vendor. Diffusion bonding specimens have been prepared and initial vacuum hot press diffusion bonding cycles have been made. The diffusion bonding study is being conducted as a two-phase statistical study.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ADVANCED PRESS DIFFUSION BONDING-874-5

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-75-C-5016
CONTRACT DURATION.	SEP74-JUN76
AFML PROJECT ENGINEER.	MILLER FREDERICK R
PROJ/TASK/WK UNIT.	MTP1-02-40

Objective - 30 MAY 74

(U) To advance the press diffusion bonding process for bonding closer to net dimensions for cost effective aircraft components.

Progress-B 31 MAY 75 To 24 OCT 75 (Interim-B)

(U) The evaluation to determine the potential of minimizing time under pressure to produce diffusion was continued. Tensile tests and metallographic examinations conducted to date to evaluate bond quality indicate that bond parameters of 15 minutes 10 ksi are adequate for producing complete diffusion bonding at 1700 degrees F. Monitoring of retort atmosphere was continued for diffusion bonding runs, with vacuum level, temperature, and gas analysis data being recorded on tape throughout the diffusion bonding cycle. This data was digitized for computer processing required to obtain exposure factors. Comparison of exposure factors with quality ratings as determined by specific metallographic evaluation was initiated. Studies to develop and evaluate ultrasonic inspection techniques required to evaluate bond quality in high deformation areas were continued. Results of the evaluation of tooling oxidation and leveling treatments up to 50 simulated diffusion bonding cycle exposures are presented. The first subscale diffusion bond test part used to demonstrate press utilization and net part technology improvements has been fabricated and partially evaluated. All titanium details and tool modification for the second part have been completed. The fabrication status of the tooling and titanium details required for the first full-scale demonstration part is presented.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LAMINATED STRUCTURES-851-5

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	
CONTRACT DURATION.	JUN75-SEP77
AFML PROJECT ENGINEER.	WHEELER EDWARD
PROJ/TASK/WK UNIT.	MTP1-02-41

Objective - 21 MAY 74

(U) To extend the application of multilayer, adhesively bonded, laminated components into built up structure representative of an advanced design aircraft. To verify new low cost manufacturing methods and demonstrate their adequacy for advanced aircraft structures.

Progress-A 21 MAY 74 To 24 OCT 75 (Interim-A)

(U) The F-16 wing is the baseline article chosen to demonstrate advanced manufacturing techniques. Effort is proceeding in structural design. The PABST program is being reviewed and an adhesive selected. Element concept formulation and evaluation is narrowing the selection of design concepts. Final loads and criteria for the F-16 baseline wing are not available as yet. There is under consideration a parallel program to be subcontracted to LTV for a hybrid structure with materials optional. The design phase only would be initially funded by AFFDL. The contract was predated 1 month from the mailing date. This put the contractor 1 month behind schedule when work started. Efforts and expenditures should be on schedule in a reasonable time.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ISOTHERMALLY FORGED TITANIUM ALLOY WHEELS-230-5

CONTRACTOR.	LADISH CO
CONTRACT.	F33615-75-C-5257
CONTRACT DURATION.	MAY75-
AFML PROJECT ENGINEER.	FELKER TED S
PROJ/TASK/WK UNIT.	MTP1-02-43

Objective - 11 JUN 74

(U) To establish processing techniques for isothermally forging 23 inch diameter main landing gear wheels.

Progress-A 01 MAY 75 To 01 OCT 75 (Interim-A)

(U) The Bendix Corporation (South Bend, Ind.) provided wheel and forging drawings to the Ladish Company in June 1975. Bendix performed this wheel design under a Contract with ASD for the sum of approximately $98K. Material selected for the wheel was the titanium alloy 6-22-22 which is a Reactive Metals alloy. Several meetings were conducted between Bendix, Ladish, ASD and AFML to review all aspects of the project. Several minor engineering changes were made to the wheel and the forging to improve the manufacture and revised prints were provided to Ladish during Sep. 1975. Design of forging dies and related tooling is being performed. Die material is being ordered.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST AUTOMATED FABRICATION OF COMPOSITE STRUCTURES-421-5

CONTRACTOR.	MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT.	F33615-75-C-5155
CONTRACT DURATION.	APR75-APR77
AFML PROJECT ENGINEER.	PIRRUNG PAUL F
PROJ/TASK/WK UNIT.	MTP1-02-44

Objective - 29 OCT 74

(U) The objective of this program is to establish low cost manufacturing methods for automated fabrication of composite aircraft structural components.

Progress-A 29 OCT 74 To 29 OCT 75 (Interim-A)

(U) Prepreg braiding tows of glass/epoxy, Kevlar/epoxy, and graphite/epoxy have been braided. Chemical analysis of the prepreg material is under way to fingerprint the material and to establish an optimum cure cycle. Tension and compression properties for braided glass and Kevlar/epoxy laminates have been determined at room temperature and 350 degrees F. Work on a braiding mandrel for a F-15 rudder spar has begun.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST AUTOMATED MULTI-PLY CONTINUOUS BROADGOODS-420-5

CONTRACTOR.	HERCULES INC
CONTRACT.	F33615-75-C-5111
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	STARKS DOUGLAS F
PROJ/TASK/WK UNIT.	MTP1-02-46

Objective - 22 AUG 74

(U) To establish more economical methods for the production of multi-ply broadgoods from single ply unidirectional tapes of any width.

Progress-A 22 AUG 74 To 17 OCT 75 (Interim-A)

(U) This program in its sixth month of scheduled operation is continuing satisfactorily as scheduled. Orders for the procurement of materials needed for the construction of the 4-ft ply wrap machine have been placed. It is anticipated that the machine will be operable by mid November 75. Rockwell International is conducting tests for verification of tests conducted at Hercules, Inc. This program is proceeding satisfactorily and is within the time and funding schedule.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. STRUCTURAL FABRICATION GUIDE FOR ADVANCED COMPOSITES-426-5

CONTRACTOR.	LOCKHEED AIRCRAFT CORP
CONTRACT.	F33615-75-C-5009
CONTRACT DURATION.	NOV74-FEB76
AFML PROJECT ENGINEER.	REINERT HARRY S
PROJ/TASK/WK UNIT.	MTP1-02-48

Objective - 28 MAR 74

(U) To establish a production manufacturing guide for the fabrication of advanced composite aircraft and engine structure.

Progress-B 01 APR 75 To 01 OCT 75 (Interim-B)

(U) Format of the First Edition of the Fabrication Guide has been drafted by Lockheed with support of Grumman, Pratt and Whitney, ARAP, and the AFML Project Engineer. Additional data has been acquired from industry and placed in the Data Bank. Plans have been made to extend the contract for an additional ten months.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. AUTOMATED ASSEMBLY FIXTURE DRILLING-806-5

CONTRACTOR.	GRUMMAN AEROSPACE CORP
CONTRACT.	F33615-75-C-5192
CONTRACT DURATION.	MAY75-JUL76
AFML PROJECT ENGINEER.	HARRIS WILLIAM
PROJ/TASK/WK UNIT.	MTP1-02-49

Objective - 06 JUN 74

(U) The objectives of the program are to reduce the number of man-hours required to perform the manual assembly drilling operations in aircraft manufacturing and depot rework, to keep the cost of captial equipment for performing this task to a minimum to assure realistic economic benefits, and to provide a capability to assure proper structural integrity. The program will evaluate, develop and establish manufacturing methods for automating conventional aircraft assemly drilling operations.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. CARBON MONOFILAMENT PRODUCTION-424-5

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-75-C-5046
CONTRACT DURATION.	NOV74-JUL76
AFML PROJECT ENGINEER.	KOPELL LAWRENCE L
PROJ/TASK/WK UNIT.	MTP1-02-51

Objective - 18 JUN 74

(U) The refinement and scaleup of a process to produce large diameter carbon monofilament for use as a substrate in the boron deposition process.

Progress-B 31 MAR 75 To 01 AUG 75 (Interim-B)

(U) Modules and holes in the carbon monofilament were greatly reduced by agitation of the pitch under vacuum during the spinning process. High temperature treatment of carbon monofilament at 2500 degrees C eliminated tar deposits on the boron reactor entrance electrodes. All major equipment for the 100 lb/yr pilot plant facility were designed and ordered.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. ALUMINUM WELDBOND-854-5

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-75-C-5083
CONTRACT DURATION.	NOV74-OCT76
AFML PROJECT ENGINEER.	HAGER JOSEPH W
PROJ/TASK/WK UNIT.	MTP1-02-52

Objective - 03 JUL 74

(U) The objective of this project is to establish a production method of weldbond process control which optimizes surface preparation, adhesive application procedure and spot welding variables to assure environmental durability and consistent spot weld quality.

Progress-A 05 JUN 75 To 24 SEP 75 (Interim-A)

(U) After procuring 2219-T81 aluminum alloy and five candidate film adhesives, melting point measurements and tension shear tests were performed on the adhesives. Preliminary weldability tests on the three best adhesives were performed using deoxidized 7075-T6 sheet. No appreciable weldability differences were observed. Crack growth wedge tests on several adhesively bonded specimens are showing good resistance to cracking after 24 hours exposure to 120 degrees F at 90 percent relative humidity. Further studies of flowability of paste and film adhesives, temperature effects on lap joints, and tests on peel strength are scheduled for the next reporting period.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. SUPERPLASTIC FORMING/DIFFUSION BONDING PROCESS-798-5

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-75-C-5058
CONTRACT DURATION.	JAN75-APR77
AFML PROJECT ENGINEER.	BLAU PETER J
PROJ/TASK/WK UNIT.	MTP1-02-53

Objective - 11 JUN 74

(U) The objective of this program is to establish manufacturing methods to concurrently superplastically form and diffusion bond titanium sheet material to titanium structural elements.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. AVIONICS SYSTEMS COST REDUCTION-521-5

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-75-C-5042
CONTRACT DURATION.	AUG74-NOV76
AFML PROJECT ENGINEER.	YARRINGTON LARRY I
PROJ/TASK/WK UNIT.	MTP1-02-54

Objective - 01 OCT 74

(U) To improve or develop new fabrication and assembly techniques for the system or subsystem showning the best promise of having the greatest possibility of cost reduction potential. To identify the specific areas which offer greatest potential of cost reduction and develop and apply new or improved manufacturing methods to demonstrate the cost reduction.

Progress-B 31 MAR 75 To 30 SEP 75 (Interim-B)

(U) A complete initial review of acquisition and life cycle cost drivers identified several areas which could lead to significant cost reductions through improved manufacturing techniques and processes. Work on these areas is proceeding. Application of the hot forging process for alkali halide lenses is showing excellent progress as the process parameters which affect bulk and surface defects are being analyzed for optimization. Aspheric singlet lenses are showing promise of replacing spherical doublets at significant cost savings. This is made possible by means of N/C controlled machines for diamond turning germanium. Honeywell is presently analyzing proposals from companies which employ the advanced technology. Graphite/Epoxy substrates are being studied for use in applying the replication process for mirrors. Feasibility depends on surface control and tolerance over temperature. Honeywell is continuing to evaluate test and evaluation techniques with an emphasis on automation. Tropel will rent equipment necessary to determine the cost advantages in automated evaluation of IR systems. Subtasks are being pursued towards obtaining long life vacuum dewars, scanner housing vacuum integrity improvement, total evaporated lead attachments to detector arrays and non-destructive testing of detector slabs.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. IMAGE INTENSIFIER TUBES WITH 40MM DIAMETER OR GREATER MICROCHANNE PLATES-604-4

CONTRACTOR.	INTERNATIONAL TELEPHONE & TEL CORP
CONTRACT.	F33615-74-C-5178
CONTRACT DURATION.	JUL74-MAY76
AFML PROJECT ENGINEER.	TRINKLE HAROLD K
PROJ/TASK/WK UNIT.	MTP1-02-55

Objective - 19 JUL 74

(U) The objective is to establish or redesign tooling and to establish simplified processing for economical and reliable production of improved image intensifier assemblies.

Progress-C 31 MAR 75 To 30 SEP 75 (Interim-C)

(U) Parts, tooling, fixtures, etc., are being purchased and/or fabricated in preparation for prototype production of microchannel plates (MCP,s) and image intensifier tubes. Tube design is being finalized and some pre-prototype MCP,s have been fabricated and tested. The contractor is currently concentrating on 10 micron center to center spacing for the 40 mm MCP. Some problems are being experienced with warping in processing the solid rim glass MCP. The first tube has been built and subjected to limited test and evaluation.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. VERIFICATION OF PRODUCTION HOLE QUALITY-760-5

CONTRACTOR.	METCUT RESEARCH ASSOCIATES INC
CONTRACT.	F33615-75-C-5173
CONTRACT DURATION.	AUG75-APR77
AFML PROJECT ENGINEER.	HARRIS WILLIAM A
PROJ/TASK/WK UNIT.	MTP1-02-56

Objective - 08 JAN 75

(U) The objectives of this program are (1) establish quantitative hole quality data for a aluminum alloy and forms (2) correlate the established quantitative data to present NDE techniques and (3) identify the ranked order of hole quality characteristics as a function of the impact on the fatigue life of non-interference fastener system and joint.

Progress-A 08 JAN 75 To 16 OCT 75 (Interim-A)

(U) The material to be used on the program has been ordered. Presently, the techniques are being developed to prepare the needed surface integrity and metrology characteristics.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. RIVET QUALIFICATION OF ALUMINUM ALLOY 7050-808-5

CONTRACTOR.	ALUMINUM COMPANY OF AMERICA
CONTRACT.	F33615-75-C-5117
CONTRACT DURATION.	FEB75-AUG76
AFML PROJECT ENGINEER.	KOJOLA KENNETH L
PROJ/TASK/WK UNIT.	MTP1-02-57

Objective - 26 AUG 74

(U) The objective of this project is to establish manufacturing methods for the production of aluminum alloy 7050 rivets by determining suitable aging practices and a range of purity level for which 7050 equals or exceeds the strength, heading, hole-filling and stress corrosion resistance characteristics of 2024-T31 (.ice box.) rivets.

Progress-A 26 AUG 74 To 20 OCT 75 (Interim-A)

(U) Ingots of the 7050 alloy containing two different levels of iron and silicon were cast. These ingots were converted into 0.092, 0.184 and 0.372 inch diameter rivet wire in the H13 temper. Universal head and countersunk head rivets were produced from each diameter using normal manufacturing practices. No difficulties were encountered in producing the 7050-F rivets from the H13 temper wires. Current work is directed toward evaluating heat treatment schedules and effect on mechanical properties.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. DUAL MODE TRAVELING WAVE TUBES-643-5

CONTRACTOR.	MICROWAVE ASSOCIATES INC
CONTRACT.	F33615-75-C-5175
CONTRACT DURATION.	JUN75-NOV75
AFML PROJECT ENGINEER.	MEULEMANS JOSEPH I
PROJ/TASK/WK UNIT.	MTP1-02-58

Objective - 03 SEP 74

(U) To establish the manufacturing technology necessary to make Dual Mode Traveling Wave tubes available for systems use at reasonable costs.

PROJECT NO. MTP1 MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. NEAR TERM, NEAR NET SUPERALLOY DISKS-278-5

CONTRACTOR.	PRATT AND WHITNEY AIRCRAFT
CONTRACT.	F33615-75-C-5184
CONTRACT DURATION.	MAY75-MAY77
AFML PROJECT ENGINEER.	CLARK LARRY P
PROJ/TASK/WK UNIT.	MTP1-02-59

Objective - 22 OCT 74

(U) To establish manufacturing processes for the production of near net superalloy disk shapes by isothermal forging and to refine established NDI techniques for inspecting the disk shapes.

Progress-A 19 MAY 75 To 01 SEP 75 (Interim-A)

(U) Design and fabrication of the subscale forging dies for the 1st and 4th stage turbine discs have been completed. Die design for 2nd and 3rd stage turbine discs, 1st-2nd turbine spacer and 13th compressor cone seal have been completed. Forging trials for the 4th stage turbine subscale dies were conducted. Some deficiencies in the preform design caused forging laps.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. INDIUM ANTIMONIDE DETECTORS-535-5

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-75-C-5154
CONTRACT DURATION.	JUN75-AUG77
AFML PROJECT ENGINEER.	HUTCHENS ROBERT D
PROJ/TASK/WK UNIT.	MTP1-02-60

Objective - 01 OCT 74

(U) Provide cost effective manufacturing processes for the fabrication of long life indium antimonide detectors and dewar packages. These processes shall be generic and easily translated to solving yield, cost and life problems in infrared detectors.

Progress-A 01 JUN 75 To 30 SEP 75 (Interim-A)

(U) Indium antimonide arrays of five elements have been fabricated and packaged in miniature dewars. Testing is proceeding on the expected lifetime of these packages. Work has been initiated on ten element arrays.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. FEEDBACK CONTROLLED SPOTWELDING FOR ALUMINUM WELDBOND APPLICATI(-817-5

CONTRACTOR.	GENERAL DYNAMICS CORP
CONTRACT.	F33615-75-C-5229
CONTRACT DURATION	MAR75-AUG75
AFML PROJECT ENGINEER.	SZABO R
PROJ/TASK/WK UNIT.	MTP1-02-61

Objective - 27 JAN 75

(U) The objective of this project is to establish a production method of feedback controlled Spotwelding which provides consistent spotweld quality under the variable conditions of aluminum weldbonding.

Progress-A 25 JUN 75 To 24 SEP 75 (Interim-A)

(U) Aluminum alloys 2024 and 7075 were procured in thicknesses of 0. 063 and 0.080 inches. Cleaning facilities for surface preparation have been established and welding parameters are being optimized for alloy 2024 in the 0.063 inch thickness.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. LOW COST RADAR SIGNAL PROCESSOR-541-5

CONTRACTOR.	HUGHES AIRCRAFT CO
CONTRACT.	F33615-75-C-5242
CONTRACT DURATION.	SEP75-JUN77
AFML PROJECT ENGINEER.	BELLEM RAYMOND D
PROJ/TASK/WK UNIT.	MTP1-02-62

Objective - 18 FEB 75

(U) Establish the manufacturing techniques required to incorporate an established large scale integrated circuit technology to on-line manufacturing capability of modules for the F-15 Radar Signal Processor.

Progress-A 15 SEP 75 To 16 OCT 75 (Interim-A)

(U) Contract has just started. No reportable progress at this time.

PROJECT NO. MTP1 - MANUFACTURING TECHNOLOGY-AIRCRAFT

TITLE. FLUXLESS ALUMINUM BRAZED ANTENNA-816-5

CONTRACTOR.	HUGHES AIRCRAFT CO
CONTRACT.	F33615-75-C-5266
CONTRACT DURATION.	MAY75-DEC76
AFML PROJECT ENGINEER.	MILLER FREDERICK R
PROJ/TASK/WK UNIT.	MTP1-02-63

Objective - 20 MAR 75

(U) To advance the fluxless aluminum brazing process and establish cost effective joining methods for the production of complex aluminum planar array antenna assemblies for use in airborne radar systems.

Progress-A 20 MAR 75 To 24 OCT 75 (Interim-A)

(U) A detail design review of the APG63/64 production planar array antenna was conducted. The detail component parts and assembly layouts for adaptation of fluxless aluminum brazing were identified. A stress analysis was conducted to assure that the brazed aluminum can sustain the spectrum of applied stresses in critical areas of the antenna array. Four test panels (quadrants) were fluxless brazed and evaluated. A full scale (36 inch diameter) panel array will be brazed in the next month. The full size array will be inspected, mechanically and electrically tested to assure that the desired electrical and mechanical properties are obtained.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. ESTABLISHMENT OF MANUFACTURING METHODS FOR THE PLASMA MELTING OF HIGH QUALITY STRUCTURAL MATERIALS-262-1

CONTRACTOR.	CARNEGIE-MELLON UNIVERSITY
CONTRACT.	F33615-71-C-1681
CONTRACT DURATION.	JUN71-DEC74
AFML PROJECT ENGINEER.	LOVE KENNETH L
PROJ/TASK/WK UNIT.	MTP2-00-11

Objective - 09 JAN 73

(U) To investigate and establish new, high efficiency melting techniques to process aerospace materials.

Progress-H 01 APR 75 To 20 OCT 75 (Interim-H)

(U) After review of draft final report, contractor was notified that it was unacceptable due to exaggerated claims of process, metallurgical, and cost benefits which were not supported by program results. Revised sections for the draft were submitted the last of Sept. which render the report suitable for distribution. Contractor has requested that the Air Force provide reproduction and distribution though not called for in the contract. The request will be discussed with PCO.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. MFG PROCESSES TO INCREASE THE YIELD AND PERFORMANCE OF METAL NITRIDE OXIDE SEMICONDUCTOR MEMORY ARRAYS-526-2

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-72-C-1706
CONTRACT DURATION.	DEC72-
AFML PROJECT ENGINEER.	GARRETT JACK A
PROJ/TASK/WK UNIT.	MTP2-00-12

Objective - 20 NOV 73

(U) The objective of this project is to establish manufacturing processes, controls and materials for economical production of Metal-Nitride-Oxide Semiconductor (MNOS) memory arrays. These MNOS memory arrays will be utilized in Electrically Alterable Read Only Memory (EAROM) random access semiconductor memory arrays to be used in USAF systems. Manufacturing processes will be advanced to increase the yield and achieve reproducible manufacture of MNOS memory arrays.

Progress-E 31 MAR 75 To 24 OCT 75 (Interim-E)

(U) Progress on the 1024 bit MNOS memory has been delayed as a result of delays in providing additional funds to complete the program. Some of the MNOS 1024 bit memory chips have been processed with the new mask set, however complete test results are not yet available. These devices must be packaged before performance parameters can be fully determined. Processing being used does not appear to provide the desired voltage separation of the memory cell logic states and excessive threshold voltages are being experienced in some of the percipheral circuits on the memory chips. Processing is being pursued to optimize these parameters.

AD-A032 506 AIR FORCE MATERIALS LAB WRIGHT-PATTERSON AFB OHIO F/G 5/2
ABSTRACTS OF ACTIVE CONTRACTS. AIR FORCE MATERIALS LABORATORY.(U)
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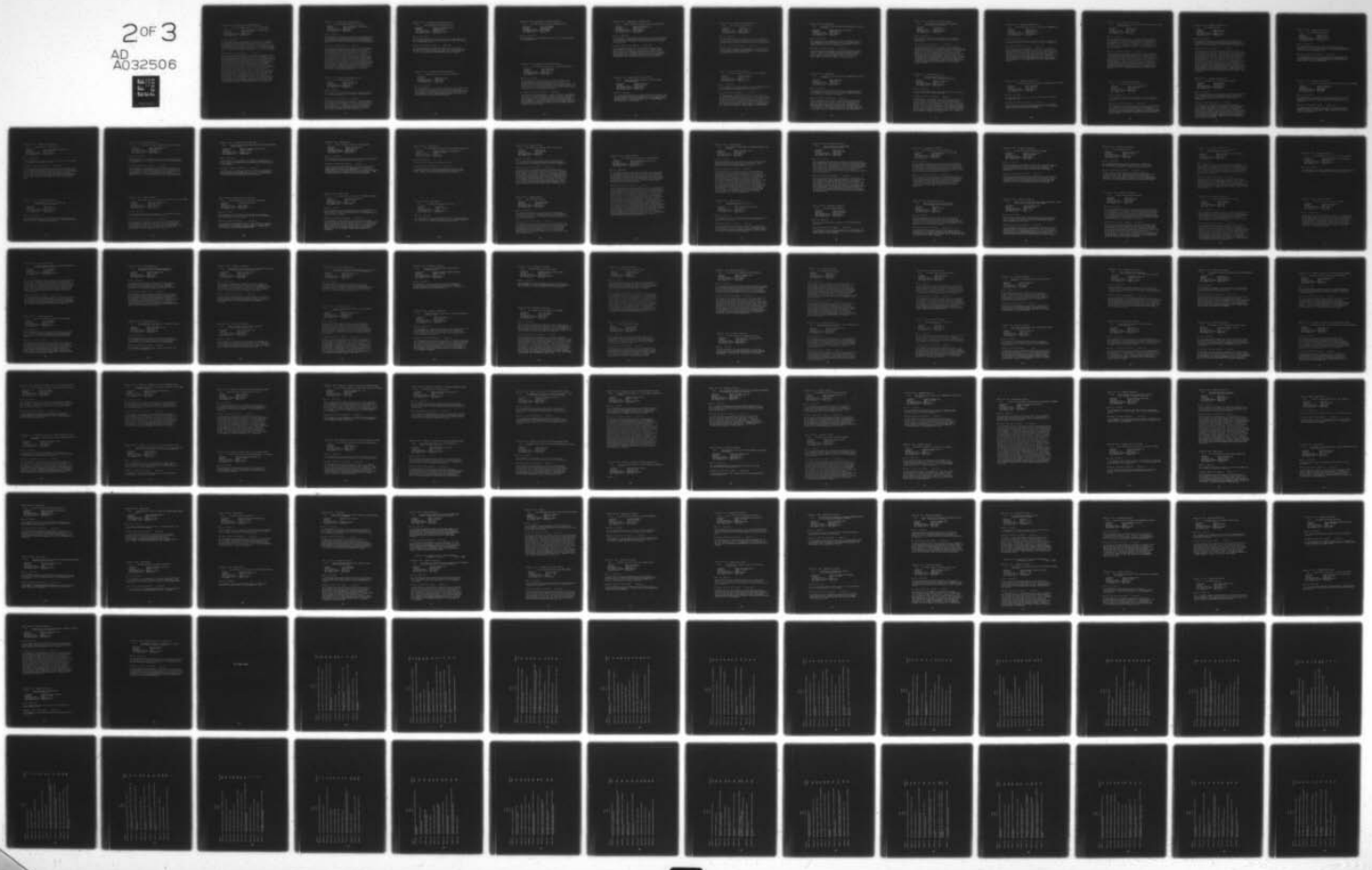

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. RADIATION HARDENED MULTIPLE IC CHIP PACKAGE-505-1

CONTRACTOR.	FAIRCHILD CAMERA AND INSTRUMENT CORP
CONTRACT.	F33615-72-C-1125
CONTRACT DURATION.	MAY72-JUL75
AFML PROJECT ENGINEER.	GARRETT JACK A
PROJ/TASK/WK UNIT.	MTP2-00-18

Objective - 06 NOV 72

(U) Establish manufacturing processes and techniques to achieve an optimized IC metallization system on existing radiation - hardened integrated circuits. This IC chip metallization system will incorporate the aluminum anodization process. This process will also be applied to complex radiation hardened TTL medium scale integrated circuits. Processes will also be established to reliably interconnect these IC chips in a hermetically-sealed multiple-chip ceramic package.

Progress-C 10 JAN 75 To 31 MAR 75 (Interim-C)

(U) A major problem area was encountered which involved passivation of the thin film resistors utilized in the radiation hardened IC,s. A process was developed which enabled silicon nitride to be utilized to passivate the resistors, but the high deposition temperatures required cause undesired effects in the doping profile of the transistor structures. Silicon dioxide has been utilized instead to passivate the thin film resistors and achieved desired circuit operation. Applicability of the aluminum anodization process to two level metalization systems for more complex IC,s has been demonstrated. The two level metalization system uses the aluminum anodization process advanced on this program for the first level and conventional processing to implement the second level of metalization. The contractor is encouraged with the results of the aluminum anodization process when applied to either single or dual level IC metalization systems. 60 ceramic substrates for interconnection of either beam lead or bump IC devices have been fabricated and checked out electrically. Fully implemented substrates with 16 good IC chips should be available shortly with IC chips utilizing aluminum bump for interconnecting to the substrate. Difficulty has been encountered fabricating aluminum beam leaded IC devices and it is unlikely this interconnection approach will be pursued to successful completion.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. RADIATION HARDENED INTEGRATED CIRCUITS-500-1

CONTRACTOR.	FAIRCHILD CAMERA AND INSTRUMENT CORP
CONTRACT.	F33615-72-C-1200
CONTRACT DURATION.	JUN72-JAN75
AFML PROJECT ENGINEER.	GARRETT JACK
PROJ/TASK/WK UNIT.	MTP2-00-19

Objective - 27 AUG 73

(U) The purpose of this project is to establish and to demonstrate new manufacturing methods and techniques applicable to the production of radiation hardened bipolar integrated circuits with MSI/LSI complexity levels and to demonstrate the compatibility of the new processes and techniques when combined with existing processes in a pilot production facility.

Progress-D 31 MAR 75 To 20 OCT 75 (Interim-D)

(U) A review was held with Mr. Myers, the Fairchild program manager, on 14 May 1975 to discuss the technical results of this program. Fairchild stated they have been operating on internal funds for several months and would like to either obtain more funding to pursue program objectives or bring the program to a close. Subsequent to discussions with SAMSO, it was decided to bring this program to a close. The processing of these circuits is very involved and difficult to achieve. Ten (10) masking steps are required to achieve desired dielectric isolation of circuit components. Recent process control techniques have revealed reduced collector to base breakdown voltages when current is increased in this C-B diode in order to simulate the radiation environment. It is considered the severity of this problem may take considerable time and effort to correct and more funds. It was also learned a mask redesign would be required for the counter and shift register circuits in order to achieve reasonable yields. It appears program requirements will be met on the 2 multiplexer circuits and 25 have already been received. Fairchild is now working on the final report and will deliver a display and available parts fabricated on this contract.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. RESIN MATRIX PROCESSING-410-2

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-72-C-1486
CONTRACT DURATION.	JAN73-JUL75
AFML PROJECT ENGINEER.	MATERNE HARRY P
PROJ/TASK/WK UNIT.	MTP2-00-23

Objective - 25 AUG 72

(U) To establish manufacturing technology resin impregnation methods for high quality frustra and cylindrical shaped three-dimensional fiber reinforced composites.

Progress-E 16 SEP 74 To 30 OCT 75 (Interim-E)

(U) The structural housing for the large centrifuge is being completed and installation of the centrifuge is underway. A method has been established for repeated manufacture of low void composites in a one-step impregnation cycle. Improvemnt in the fiber volume content will improve the reduction in void content. Composites obtained from centrifugal impregnation procedures exhibit minimal to no cracking after the post cure cycle. Efforts are directed to achieveing composite materials repeatedly with a 1.4 v/o porosity.

PROJECT NO. MTP2 · MANUFACTURING TECHNOLOGY-MISSILES

TITLE. ADVANCED BUBBLE DOMAIN MATERIALS-540-5

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-75-C-5010
CONTRACT DURATION.	SEP74-DEC75
AFML PROJECT ENGINEER.	TARRANTS ELIZABETH H
PROJ/TASK/WK UNIT.	MTP2-00-40

Objective - 22 APR 74

(U) To extend the manufacturing processes evolved under F33615-73-C-1299 for the production of high quality garnet thin magnetic films for use in bubble mass memories.

Progress-B 31 MAR 75 To 16 OCT 75 (Interim-B)

(U) The work has been completed with the exception of the final deliverables and the final technical report. It is anticipated the contract will be approximately 30 days delinquent occasioned by the delivery of more complex devices than was originally planned.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. HIGH QUALITY LOW COST TITANIUM TUBING-240-5

CONTRACTOR.	
CONTRACT.	F33615-75-C-5120
CONTRACT DURATION.	JUN75-DEC77
AFML PROJECT ENGINEER.	FELKER TED S
PROJ/TASK/WK UNIT.	MTP2-00-46

Objective - 23 AUG 74

(U) The objective is to refine two or more processes to the production of high quality low cost thin-wall titanium alloy tubing for application to the hydraulic system of missiles and aerospace systems. Such tubing may also be used on aircraft such as the F-15 and B-1. One process will be the present commercial method while one or more others will be an advanced innovative method.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. HI DENSITY ANALOG TO DIGITAL CONVERTERS-503-5

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-75-C-5135
CONTRACT DURATION.	APR75-AUG78
AFML PROJECT ENGINEER.	MILLER EUGENE
PROJ/TASK/WK UNIT.	MTP2-00-47

Objective - 04 SEP 74

(U) The objective is to manufacture low cost 10 bit Hi density analog to Digital converters.

PROJECT NO. MTP2 - MANUFACTURING TECHNOLOGY-MISSILES

TITLE. SHEAR SPIN/FORM FABRICATION OF TITANIUM TANKAGE-799-5

CONTRACTOR.	BELL AEROSPACE CO
CONTRACT.	F33615-75-C-5232
CONTRACT DURATION.	JUN75-AUG76
AFML PROJECT ENGINEER.	KOJOLA KENNETH L
PROJ/TASK/WK UNIT.	MTP2-00-48

Objective - 16 JAN 75

(U) The objective of this project is to establish manufacturing methods for the production of titanium alloy (Ti-6Al-4V) pressurization and propellant tankage by the combination of room temperature shear spinning and subsequent shaping by hot forming. The emphasis is to provide a lower cost fabrication method and to minimize input material for producing spherical and cylindrical titanium alloy tankage utilized in strategic missile systems.

Progress-A 16 JAN 75 To 01 OCT 75 (Interim-A)

(U) Titanium - 6 percent aluminum - 4 percent vanadium in thicknesses of 0.10 to 1.2 inches were procured from two producers. Spinnability tests on all thicknesses are almost complete. Excellent spinnability was obtained with 30 to 50 percent cold reduction before material failure occurred. Tests were performed on a hemispherical mandrel and machine parameters were mandrel speed, roller feed, roller radius and gap settings. This data will be used for optimizing shear spinning parameters on subscale cones.

PROJECT NO. MTP3 - MANUFACTURING TECHNOLOGY-OTHER

TITLE. SURFACE INSPECTION TECHNIQUES FOR LSI CIRCUITS-503-3

CONTRACTOR.	CANADIAN COMMERICAL CORP
CONTRACT.	F33615-73-C-5175
CONTRACT DURATION.	JUL73-JUL76
AFML PROJECT ENGINEER.	MILLER EUGENE H
PROJ/TASK/WK UNIT.	MTP3-00-14

Objective - 09 NOV 72

(U) To establish rapid manufacturing surface inspection of Large Scale Integrated (LSI) circuits operating under dynamic conditions using a scanning electron microscope in the voltage contrast condition and stroboscopic mode.

Progress-B 08 APR 74 To 31 MAR 75 (Interim-B)

(U) An automated electron beam voltage contrast system is being constructed for LSI analysis. This system will produce voltage waveforms and voltage maps of a device which is operating under dynamic conditions. The computer system to be used for the automatic operation of the stroboscopic voltage contrast system is presently being characterized. Electronic circuitry for operation of the stroboscopic system has been partially constructed and tested.

PROJECT NO. MTP3 - MANUFACTURING TECHNOLOGY-OTHER

TITLE. PRODUCTION PROCESS FOR LOW COST DEPLETED URANIUM PENETRATORS-264-5

CONTRACTOR.	NUCLEAR METALS INC
CONTRACT.	F33615-75-C-5174
CONTRACT DURATION.	JUN75-JUN76
AFML PROJECT ENGINEER.	INOUYE SHINGO
PROJ/TASK/WK UNIT.	MTP3-00-31

Objective - 08 JAN 75

(U) Timely establishment of an integrated manufacturing process, from uranium derby to finished configuration, which will provide low cost depleted uranium penetrators suitable for Air Force armament needs. Penetrator alloy will be uranium plus 0.75 Ti, two penetrators configurations will be evaluated.

PROJECT NO. MTP3 - MANUFACTURING TECHNOLOGY-OTHER

TITLE. ZINC SULFIDE FLIR WINDOW-327-5

CONTRACTOR.	RAYTHEON CO
CONTRACT.	F33615-75-C-5129
CONTRACT DURATION.	JAN75-JUL76
AFML PROJECT ENGINEER.	KOPELL LAWRENCE
PROJ/TASK/WK UNIT.	MTP3-00-33

Objective - 20 SEP 74

(U) The establishment of a manufacturing process for the fabrication of large (12 inch x 18 inch x 1 inch) plates of zinc sulfide which will significantly reduce the acquisition costs and increase the commercial availability of IR windows for application of FLIR systems.

Progress-A 15 JAN 75 To 15 JUL 75 (Interim-A)

(U) Work was begun on scaling up the deposition of 34 inch by 34 inch plates. Process parameters were established for controlling the thickness profile and the successful operation of multiple hydrogen sulfide gas input nozzle by flow units.

PROJECT NO. 2487 - CUTTING TOOL TECHNOLOGY

TITLE. DIAMOND AND BORAZON COMPACT CUTTING TOOL TECHNOLOGY

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-73-C-5180
CONTRACT DURATION.	MAY73-
AFML PROJECT ENGINEER.	HARRIS WILLIAM A
PROJ/TASK/WK UNIT.	2487-00-01

Objective - 09 AUG 73

(U) This program will establish borazon and diamond compact technology as a viable manufacturing method for the timely application to selected DOD materials and metal removal processes.

Progress-D 15 APR 75 To 16 OCT 75 (Interim-D)

(U) Advanced Borazon CBN compact tools turning Inconel 718 at recommended speeds exhibit one-half the DCL notching wear of earlier CBN tools. The advanced tools also turn HIP.d Rene.95 at 1200 SFM.3X the speed found optimum for forged superalloys. CBN compacts can be used to mill sand gray iron but are not yet adequate for milling Inconel 718. Turance - brazed drills, however, show great promise for drilling the same superalloy. Inconel 718 workpiece hardness varies, particularly at the machined surface. Removal of the work-hardened skin does not reduce the DCL - notching tendency of CBN compacts.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. FABRICATION OF BERYLLIUM STRUCTURAL COMPONENTS FOR TEST AND EVALUATION

CONTRACTOR.	KAWECKI BERYLCO INDUSTRIES INC
CONTRACT.	F33615-75-C-5041
CONTRACT DURATION.	JUL74-AUG74
AFML PROJECT ENGINEER.	KOJOLA KENNETH A
PROJ/TASK/WK UNIT.	627A-00-11

Objective - 28 MAY 74

(U) To obtain structural components for test and evaluation in support of a SAMSO/AFWL/AFML sponsored program known as the Carbon-Carbon Design Program (CCDP) for the evaluation of carbon-carbon heatshield concepts using beryllium as the substructure material.

Progress-B 01 APR 75 To 01 OCT 75 (Interim-B)

(U) A major modification by SAMSO in the Carbon-Carbon Design Program (CCDP) eliminated the requirement for beryllium hardware from this contract. The work which was actually accomplished was consolidation of the initial billets and a limited machineability study. The contract has been modified to prepare a final report on the work actually performed within the limits of available funding.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. FABRICATION OF BERYLLIUM STRUCTURAL COMPONENTS FOR TEST AND EVALUATION

CONTRACTOR.	BRUSH-WELLMAN INC
CONTRACT.	F33615-74-C-5119
CONTRACT DURATION.	JUN74-MAY75
AFML PROJECT ENGINEER.	KOJOLA KENNETH L
PROJ/TASK/WK UNIT.	627A-00-15

Objective - 19 MAR 74

(U) To obtain structural components for test and evaluation in support of a SAMSO/AFWL/AFML sponsored program known as the Carbon-Carbon Design Program for the evaluation of carbon-carbon heatshield concepts using beryllium as the substructure material.

Progress-B 02 APR 75 To 02 OCT 75 (Interim-B)

(U) A major modification by SAMSO in the Carbon-Carbon Design Program (CCDP) reduced the amount of beryllium hardware required from this contract. Rather than furnishing finished machined components, the contractor was directed to supply beryllium structural blanks to a SAMSO contractor for subsequent final machining. Preparation and delivery of these blanks have been accomplished. The remaining effort is to develop a machining process criteria to prevent machining damage during lathe turning of long thin-walled reentry body substructures.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. IMPROVEMENT OF CVD FOR DEPOSITING PASSIVATION LAYERS ON INTEGRATED CIRCUITS

CONTRACTOR.	R C A CORP
CONTRACT.	F33615-74-C-5146
CONTRACT DURATION.	APR74-JUN75
AFML PROJECT ENGINEER.	HUTCHENS ROBERT D
PROJ/TASK/WK UNIT.	7371-02-31

Objective - 23 JAN 74

(U) To gain an increase in the understanding of the material requirements for successfully glass passivating silicon planar metallized IC,s.

Progress-B 17 SEP 74 To 11 APR 75 (Interim-B)

(U) A variety of PSG films for use in self-limiting dielectric breakdown studies and for electrochemical corrosion tests were prepared and characterized. The effects of deposition temperature on the quality of the PSG films have been investigated. Etch rates of Si super O (2) and PSG have been determined as a function of film deposition rate and of storage conditions after chemical vapor deposition. PSG films of low phosphorous content at various oxygen-to-hydrogen ratios have been prepared. The feasibility of low-temperature catalytic densification has been demonstrated. The sheet resistance of PSG has been studied as a method which could be useful for compositional quality control. A survey has been made that compared all types of passivation systems for silicon devices. This survey was presented at the Fall meeting of the Electrochemical Society in New York.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. PLASMA POLYMERIZATION COATINGS FOR INTEGRATED CIRCUIT ENVIRONMENTAL PROTECTION

CONTRACTOR.	MISSOURI UNIVERSITY OF
CONTRACT.	F33615-74-C-5169
CONTRACT DURATION.	JUN74-
AFML PROJECT ENGINEER.	HUTCHENS ROBERT D
PROJ/TASK/WK UNIT.	7381-01-33

Objective - 26 MAR 74

(U) To produce a thermetically sealed integrated circuit using recent advances in the area of polymeric coatings.

Progress-B 17 SEP 74 To 11 APR 75 (Interim-B)

(U) 100 dual-in-line integrated circuits have been delivered by AFML to the contractor. Initially surface cleaning techniques were devices, using an argon plasma. The initial studies were on the effects of the RF field on the electronics components. Six IC,s were coated with polychlorotrifluoroethylene - three in the RF field and three out of the RF field. These devices were transferred to RADC for testing. The initial results indicate that no appreciable degradation occurred in the presence of the RF field. Work is continuing on the physical characterization of the polymers, particularly studying the size of the voids present in the cross-linked pattern. This work is being studied by low angle x-ray analysis.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. ANTISTATIC COATINGS FOR USE ON AIRCRAFT TRANSPARENCIES

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-74-C-5050
CONTRACT DURATION.	APR74-MAR76
AFML PROJECT ENGINEER.	PETERSON TIMOTHY L
PROJ/TASK/WK UNIT.	ILIR-00-41

Objective - 25 JUL 73

(U) To develop and characterize permanent, stable, thin, optically transparent antistatic coatings for plastic aircraft transparencies.

Progress-D 01 APR 75 To 31 JUL 75 (Interim-D)

(U) Studies of oxide semiconductor film properties as a function of vacuum vapor deposition properties has continued. Non-crazed, adherent, conducting multilayer films have been deposited on plastic substrates. A new technique which involves subjecting vacuum vapor deposited tin oxide films to an oxygen glow discharge has been developed for obtaining conductive films on plastic substrates. The antistatic coating systems developed to date offer good abrasion, solvent and thermal cycling resistance, but suffer deterioration in coating adhesion with prolonged humidity and accelerated weathering exposure.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. INTERLAMINAR STRENGTH OF LAMINATED POLYMERIC MATRIX COMPOSITES

CONTRACTOR.	DREXEL UNIVERSITY
CONTRACT.	F33615-73-C-5146
CONTRACT DURATION.	JUN73-FEB74
AFML PROJECT ENGINEER.	PAGANO NICHOLAS J
PROJ/TASK/WK UNIT.	ILIR-00-50

Objective - 02 FEB 73

(U) Development of a failure criterion for delamination of fibrous composite laminates.

Progress-C 01 MAR 74 To 31 MAR 75 (Interim-C)

(U) Final report submitted, but data taken were not of the highest quality which made definitive conclusions difficult. Will close out contract as soon as the report is processed.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. CORROSION RESISTANT SURFACE TREATMENTS FOR ALUMINUM ALLOYS FOR SPOT-WELD BONDING

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-74-C 5027
CONTRACT DURATION.	FEB74-JUN76
AFML PROJECT ENGINEER.	APONYI TED J
PROJ/TASK/WK UNIT.	ILIR-00-57

Objective - 20 JUN 73

(U) To develop and characterize new, improved surface treatments for aluminum alloys which will provide surfaces having a high level of corrosion resistance, high affinity for adhesives, thereby providing high bonded joint strengths and be amenable to spot-weld bonding processes, that is, will assure the formation of high-quality, crack-free, occlusion-free nuggets with no expulsion, so that the weld-bonding process can be exploited for use in structural components of AF flight vehicles.

Progress-C 15 MAR 75 To 21 OCT 75 (Interim-C)

(U) The required crystallographic surface characteristic of aluminum alloys for the assurance of long term corrosion resistance has been identified as alpha alumina mono-hydrate. This surface can be formed by anodizing and by immersing the aluminum part in boiling aqueous solutions. During the first year an immersion treatment was developed which provided a weldable, bondable corrosion resistant surface at ambient conditions. However, specimens exposed to high humidity in a stressed state failed due to inception of corrosion. Subsequent work has led to the development of an acidic anodize which shows good potential for success. Corrosion inhibiting chromates were added to the weldbond adhesive and provided significant improvement in the resistance to corrosion of weldbonded specimens. Reference AFML-TR-75-27.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. UNIFIED ANALYSIS OF ABLATIVE MATERIALS

CONTRACTOR.	ACUREX CORP AEROTHERM DIV
CONTRACT.	F33615-74-C-5030
CONTRACT DURATION.	MAR74-DEC75
AFML PROJECT ENGINEER.	FARMER REX W
PROJ/TASK/WK UNIT.	ILIR-00-60

Objective - 05 JUL 73

(U) To develop a cohesive and unified ablation analysis for guiding the exploratory development of future ablative thermal protection materials.

Progress-C 01 APR 75 To 03 OCT 75 (Interim-C)

(U) 1D CMA and 2D charring ASTHMA computer code analses were conducted for a representative rocket nozzle problem. Acceptable accuracy was found for the 2D code. A typical flight test vehicle case was selected for 1D CMA and discrete fiber/resin mode (2D charring ASTHMA) analysis of carbon/phenolic heatshield response. Necessary SAANT/EROS code modifications were made and trajectory environment predictions were initiated.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. NON-SPECULAR COATINGS

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-74-C-5070
CONTRACT DURATION.	FEB74-
AFML PROJECT ENGINEER.	WEAVER JAMES H
PROJ/TASK/WK UNIT.	ILIR-00-59

Objective - 26 JUL 75

(U) To develop and optimize aircraft coatings having low diffuse reflectance, low specular reflectance and low retroreflectance in the 0.7 to 5.0 micrometer region of the electromagnetic spectrum with capability of color tailorability in the 0.4 to 0.7 micrometer region.

Progress-Z 01 MAR 75 To 15 OCT 75 (Final)

(U) The main objective of this program was to develop aircraft coatings having low diffuse reflectance and low specular reflectance in the infrared (0.7 to 5.0 micrometer) and color tailorability in the visible (0.4 to 0.7 micrometer). Such coatings were to be developed without sacrificing the normal serviceability expected of coating systems for USAF aircraft. Paint coating systems were developed with high-visible and low-IR reflectance using WO sub 3 as the basic pigmenting material. Color tailorability, while retaining low-IR reflectance, was achieved with the addition of various organic tinting pigments. Three coating systems, a light grey polyurethane, an olive drab polyurethane and an olive drab acrylic, were investigated in detail. Flatting agents were used to improve gloss, durability and handling characteristics. Coated test panels were prepared with each coating system and subjected to environmental durability tests with optical performance measured before and after. Comparative tests with commercially available low gloss paints demonstrated the feasibility of significant improvements with the newly developed coatings. (AFML-TR-75-146).

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. EXTENDED FLOW LIFE LAMINATING RESIN SYSTEM

CONTRACTOR.	WHITTAKER CORP
CONTRACT.	F33615-74-C-5181
CONTRACT DURATION.	OCT74-DEC75
AFML PROJECT ENGINEER.	APONYI THEODORE J
PROJ/TASK/WK UNIT.	ILIR-00-65

Objective - 31 MAR 75

(U) To develop laminating resins that exhibit seventy-five days shelf life at ambient conditions in prepreg form that will result in a structural composite exhibiting properties equivalent or superior to state-of-the-art graphite epoxy composites for 350F service temperatures.

Progress-B 31 MAR 75 To 21 OCT 75 (Interim-B)

(U) The use of curing agents which possessed latency and were pulverized to micron size did not prove to be successful because the finely powdered curing agent caused an excessive increase in the viscosity of the impregnating resin solution so as to preclude preparation of prepregs. An aromatic amino-sulfone was found to be both latent and capable of providing uniform cures. This hardener has provided high quality prepregs which have exhibited 70-day flow lives. Initial composite strength properties were comparable to the best state-of-the-art 350 F capability epoxy resin at ambient temperature, but slightly inferior at 350 F. Resin modification is underway to improve the 350 F properties.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. HIGH PERFORMANCE THICKENERS

CONTRACTOR.	PENNWALT CORP
CONTRACT.	F33615-75-C-5187
CONTRACT DURATION.	MAR75-JUN76
AFML PROJECT ENGINEER.	CHRISTIAN JOHN B
PROJ/TASK/WK UNIT.	ILIR-00-72

Objective - 23 DEC 74

(U) To develop and evaluate thickeners and additives for high temperature, antiwear, extreme pressure, high performance greases. This effort will provide support to Air Force weapon systems including the B-1, F-15, F-16 and T-38 Aircraft.

Progress-A 01 JUL 75 To 01 OCT 75 (Interim-A)

(U) Products ranging from viscous liquids and low melting solids to infusible materials with very high decomposition temperatures have been synthesized. Many of these materials are thermally stable at temperatures in excess of 800 degrees F.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. DEVELOPMENT OF TEMPERATURE CONTROLLED QUARTZ CRYSTAL MICROBALANCES

CONTRACTOR.	FARADAY LABORATORIES
CONTRACT.	F33615-75-C-5171
CONTRACT DURATION.	JUN75-AUG76
AFML PROJECT ENGINEER.	WINN ROBERT A
PROJ/TASK/WK UNIT.	ILIR-00-71

Objective - 07 JAN 75

(U) Development of a contamination measurement capability for use in the space environment to identify sources of contamination and its effects on thermal control costings, solar cells and other satellite components.

Progress-A 02 JUN 75 To 15 SEP 75 (Interim-A)

(U) Design has been received for conformance to SCATHA Space Vehicle requirements and no problems are foreseen. Components are being ordered for assembly of the TQCM.s. Thermal modeling of the radiant cooler is being done now.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. STRESS ANALYSIS OF PLASTIC BAND

CONTRACTOR.	CALIFORNIA RSCH AND TECHNOLOGY INC
CONTRACT.	F33615-75-C-5206
CONTRACT DURATION.	APR75-SEP75
AFML PROJECT ENGINEER.	TSAI STEPHEN W
PROJ/TASK/WK UNIT.	ILIR-00-73

Objective - 15 NOV 74

(U) Determination of stresses in a plastic band as it tunnels through a rigid barrel at a high rate of speed.

Progress-A 01 APR 75 To 30 SEP 75 (Interim-A)

(U) Stress analysis of plastic band undergoing rapid contraction by a finite-difference code has been completed. The specific cases solved involve a specific GAU-8 barrel with entrance velocity of 500 feet per second. Two levels of friction factor were assumed. The zero-friction case appears more realistic. A difference band geometry with zero friction was also solved to show the flexibility of the stress analysis code. The code is now ready for any design improvement study.

PROJECT NO. ILIR - LABORATORY DIRECTORS FUND

TITLE. EROSIN RESISTANT ANTISTATIC THERMAL FLASH RESISTANT POLYMERIC COATINGS

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-75-C-5260
CONTRACT DURATION.	MAY75-MAY76
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	ILIR-00-74

Objective - 07 MAR 75

(U) To develop coatings for aircraft radomes and antenna covers which are rain erosion resistant, antistatic, thermal flash resistant, and possess dielectric transmission properties.

PROJECT NO. 2079 - IMPROVED 20MM PRB

TITLE. ENGINEERING CRITERIA FOR BONDED PLASTIC ROTATING BANDS

CONTRACTOR.	DEBELL AND RICHARDSON INC
CONTRACT.	F33615-75-C-5226
CONTRACT DURATION.	MAY75-DEC75
AFML PROJECT ENGINEER.	HUSMAN GEORGE E
PROJ/TASK/WK UNIT.	2079-01-01

Objective - 07 JAN 75

(U) The objective of this program is to develop engineering criteria for materials selection and performance prediction for bonded plastic rotating bands.

Progress-A 01 MAY 75 To 01 SEP 75 (Interim-A)

(U) The parameters for band performance have been reviewed and a general analysis of the stresses and rates of strain have been made. The high strain-rate shear and compression test apparatus have been designed and built, and initial tests have been performed to demonstrate its use. The simulated gun-fire test apparatus has been designed , however, safety requirements are delaying its construction.

PROJECT NO. 2079 - IMPROVED 20MM PRB

TITLE. DEVELOPMENT OF PLASTIC MATERIALS FOR 20MM PLASTIC ROTATING BANDS

CONTRACTOR.	DEBELL AND RICHARDSON INC
CONTRACT.	F33615-75-C-5225
CONTRACT DURATION.	MAY75-MAR76
AFML PROJECT ENGINEER.	BROWNING CHARLES E
PROJ/TASK/WK UNIT.	2079-01-00

Objective - 03 JAN 75

(U) To develop plastic materials suitable for use as plastic rotating bands on thin-wall, high-velocity 20mm projectiles.

Progress-A 03 JAN 75 To 29 OCT 75 (Interim-A)

(U) Several potential materials systems including both plastics and primers have been researched. Materials currently being evaluated include polyamides, urethanes, nylons, specialty elastomers, and thermoplastic elastomers. Initial projectiles have been banded. Test programs have been studied and initiated. Screening tests will include tensile adhesion and actual gunfire testing.

PROJECT NO. 486U - ADVANCED METALLIC STRUCTURES

TITLE. DEFINITON AND NONDESTRUCTUVE DETECTION OF CRITICAL ADHESIVE BONDLINE FLAWS

CONTRACTOR.	MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT.	F33615-75-C-5209
CONTRACT DURATION.	JUN75-
AFML PROJECT ENGINEER.	HUSMAN GEORGE E
PROJ/TASK/WK UNIT.	486U-01-08

Objective - 23 OCT 74

(U) The objective of this program is to determine the severity of commonly occurring adhesive bond-line flaws and to assess the ability of NDI techniques to detect and discriminate between critical and non-critical defects.

Progress-A 27 JUN 75 To 01 SEP 75 (Interim-A)

(U) Phase I of the program is in progress. Materials selection and specimen designs are being defined. Initial reviews of experience with flaws and methods of detection are continuing. Techniques for introducing flaws into specimens are being developed.

PROJECT NO. 486U - ADVANCED METALLIC STRUCTURES

TITLE. FRACTURE MECHANICS FOR STRUCTURAL ADHESIVE BONDS

CONTRACTOR.	LOCKHEED AIRCRAFT CORP
CONTRACT.	
CONTRACT DURATION.	MAR75-JUN76
AFML PROJECT ENGINEER.	JONES WILLIAM B
PROJ/TASK/WK UNIT.	486U-00-09

Objective - 18 NOV 74

(U) The objective of this program is to develop the methodology required to determine the failure loads and service life of adhesive bond lines containing initial cracks.

Progress-A 18 NOV 74 To 30 OCT 75 (Interim-A)

(U) Analytical and experimental effort is being conducted to measure energies for Mode I and Mode II Fracture. Mode III type specimens are in development. Selected Materials and Processing include AF-55, 7075-T6 with Phosphoric Acid-anodized surface.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. NOSETIP MATERIALS EROSIN AT HIGH VELOCITIES

CONTRACTOR.	SCIENCE APPLICATIONS INC
CONTRACT.	F33615-75-C-5182
CONTRACT DURATION.	JAN75-SEP75
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	627A-00-25

Objective - 14 NOV 74

(U) To determine the erosion mass loss and comparative resistance of advanced carbon-carbon composite nosetip materials.

Progress-A 16 JAN 75 To 18 SEP 75 (Interim-A)

(U) Erosion data has been obtained on six advanced carbon carbon composite materials utilizing single particle tests at room temperature, 4000 degrees F and 5500 degrees F. The fine weave spacing materials with a high percentage of fiber loading in the axial direction were found to posess the best erosion resistance. These improvements were also maintained at elevated temperatures.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. HEAT SHIELD MATERIALS EROSION AT HYPERSONIC VELOCITIES

CONTRACTOR.	SCIENCE APPLICATIONS INC
CONTRACT.	F33615-75-C-5181
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	627A-00-24

Objective - 14 NOV 74

(U) To evaluate RV heat shield design concept erosion performance in particulate environments using state-of-the-art technology to establish the existing level of balanced erosion performance relative to nose tip design concepts.

Progress-A 16 JAN 75 To 18 SEP 75 (Interim-A)

(U) Assessment of 3 baseline nose tip materials and a current operational heatshield material has been conducted using specification weather environments and two different trajectories. The erosion of the nosetip was sensitive to trajectory angle while the heatshield erosion was sensitive to cone frustrum angle. Erosion data on 8 advanced heat shield materials has been obtained and analyzed. Assessment of the performance of these advanced materials is proceeding.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. OPTIMIZED FABRICS FOR ELECTRICAL PENETRATION AID DEVICES

CONTRACTOR.	MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT.	F33615-75-C-5195
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	SCHULMAN S
PROJ/TASK/WK UNIT.	627A-00-28

Objective - 09 DEC 74

(U) Develop Hybrid fabrics for EREP Decoy Systems.

Progress-A 09 DEC 74 to 24 OCT 75 (Interim-A)

(U) Samples were fabricated from bi-component materials with and without heat elements. Optical properties were measured for each sample. Samples were prepared and submitted for Husky Pup.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. INFLATABLE EXOATMOSPERIC OBJECT (IEO)

CONTRACTOR.	L'GARDE INC
CONTRACT.	F33615-75-C-5205
CONTRACT DURATION.	FEB75-
AFML PROJECT ENGINEER.	SIERON JERRY K
PROJ/TASK/WK UNIT.	627A-00-27

Objective - 09 DEC 74

(U) To develop, optimize, and demonstrate flexible bladder materials/ constructions for inflatable penetration aids with properties meeting the requirements of SAMSO.S IEO concept/configuration.

PROJECT NO. 7320 - FIBROUS MATERIALS

TITLE. HIGH STRENGTH, HIGH MODULUS, BORON NITRIDE FIBERS

CONTRACTOR.	CARBORUNDUM CO
CONTRACT.	F33615-74-C-5092
CONTRACT DURATION.	APR74-MAR76
AFML PROJECT ENGINEER.	ROSS JACK H
PROJ/TASK/WK UNIT.	7320-01-37

Objective - 24 SEP 73

(U) To conduct exploratory development leading to potentially low cost, high strength, high modulus boron nitride fiber for use as reinforcements in structural and in structural-dielectric composites.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) The new 450 hole stainless steel bushing has been put into operation with partial success. The fine diameter (3-4 micron) boric oxide precursor fibers were achieved on the initial runs. The problem of tip flooding was found to occur as has in the past with the 100 hole stainless steel bushing. An analysis of the problem revealed the flooding to be caused by poorly located fin heaters around the tips of the bushing and operator inexperience. Preliminary modifications in the fin heater placement has resulted in longer runs (up to 5 minutes) with a reduction in the number of broken filaments. The final solution to this problem is the use of a platinum bushing. A supply of the precious metal (180 troy ounces) has been supplied to the contractor the design and fabrication of a 450 hole bushing initiated.

PROJECT NO. 7320 - FIBROUS MATERIALS

TITLE. GRAPHITE FIBERS FROM PITCH

CONTRACTOR.	UNION CARBIDE CORP
CONTRACT.	F33615-71-C-1538
CONTRACT DURATION.	JUN71-MAR75
AFML PROJECT ENGINEER.	GLOOR WALTER H
PROJ/TASK/WK UNIT.	7320-01-35

Objective - 12 APR 72

(U) OBJECTIVE- Development of low-cost high performance graphite fibers for reinforcement in structural composites from commercially available pitch materials. The high carbon content of these materials will provide the capability of forming fibers, yarns and ribbons in a variety of configurations.

Progress-G 10 SEP 74 To 11 APR 75 (Interim-G)

(U) Emphasis during this reporting period has continued to be on fiber fine internal structure and its dependence on pitch rheology, spinning conditions, and specifics of preoxidation and pyrolysis schedules. Techniques for etching of fracture surfaced (fiber ends) have been developed which provide valuable fine structure information as a function of primary processing parameters, particularly type and degree of preoxidation. Fiber characterization via the Sinclair loop test has been initiated.

PROJECT NO. 7320 - FIBROUS MATERIALS

TITLE. HEAT RESISTANT AND NONFLAMMABLE FIBROUS MATERIALS

CONTRACTOR.	FABRIC RESEARCH LABORATORIES INC
CONTRACT.	F33615-73-C-5034
CONTRACT DURATION.	JAN73-DEC74
AFML PROJECT ENGINEER.	SCHULMAN STANLEY
PROJ/TASK/WK UNIT.	7320-02-17

Objective - 08 AUG 72

(U) To develop thermally stable flexible fibrous materials suitable for protection of AF aircrew members. The goals will include the thermal response of fabrics, evaluation of the environmental effects on polymeric and inorganic materials and the effect of aerodynamic load-extension response of fabrics and new experimental yarns. These evaluations will include woven and knitted fabrics for life support applications including flight clothing, restraint systems, cabin accessories and decelerator components.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) Tensile properties of Kevlar and PBI yarns at low (0.167 percent/sec) and high (8000 percent/sec) strain rates over the temperature range of minum 65 degrees F to 800 degrees F. Single fiber properties were measured for Kevlar 29 and 49, including tensile properties, the effect of bending, twisting and lateral compression. The tensile properties of wet Kevlar yarns were measured at 70 degrees and 190 degrees F as well as the response of Kevlar 29 yarn to low speed tensile strain cycling at 70 degrees and 400 degrees F. The bending recovery of Kevlar filaments was measured for different imposed curvatures and different times under strain. Measurements of the tensile properties of Durette and HT-4 fabrics under radiant heat flux were made. The morphology of Kevlar 49 fibers subjected to various types of mechanical working was examined using a scanning electron microscope. The initial fabrics, webbings, tapes, ribbons, braids and sewing threads have been designed using Kevlar 29 and 49 continuous multifilament yarns. Initial weaving trials using 200, 400, 1000 and 1400 denier Kevlar 29 have resulted in webbings, braids and ribbons 50 percent lighter in weight than the currently used nylon 6-6 decelerator materials. Space or bulk reduction of 50 - 60 percent over the presently used nylon 6-6 materials will result in significant savings in storage space in current and planned aircraft is anticipated when decelerators are required.

PROJECT NO. 7320 - FIBROUS MATERIALS

TITLE. POLYESTER/WOOL UNIFORM FABRICS WITH IMPROVED DURABILITY AND APPEARANCE

CONTRACTOR.	GEORGIA INSTITUTE OF TECH
CONTRACT.	F33615-72-C-1822
CONTRACT DURATION	MAY72-NOV74
AFML PROJECT ENGINEER.	MAY DONALD R
PROJ/TASK/WK UNIT.	7320-02-24

Objective - 23 JUN 72

(U) Develop polyester/wool Blue 1549 uniform fabrics (tropical, serge, gabardine) having improved drape, handle, fabricability, wear and resistance to frostings over current Air Force fabrics. This objective is based on CSAF TWX RD 32225Z Nov 71 ZEX.

Progress-E 10 SEP 74 To 11 APR 75 (Interim-E)

(U) Upon completion of the evaluation of twelve prototype fabrics, incorporating selected variables, appropriate specifications were defined for the six 500 yard lengths of fabric to be produced for uniform wear tests and evaluation. Subsequently the six fabrics were produced by four commercial organizations in the worsted business utilizing standard mill practices. This industrial, rather than a Laboratory or specialized manufacturer facility, approach was undertaken to demonstrate processing and production feasibility while conclusively illustrating that future fabrics could be produced commercially in volume in response to procurement requirements. The six woven fabrics have been delivered to the Air Force and upon completion of sampling and Laboratory evaluation will be provided the Clothing Branch, Aeronautical Systems Division, Wright Patterson Air Force Base, Ohio for fabrication of uniforms which will undergo a three year test. Specifications, which defined and specify those physical properties, characteristics, and related attributes, to insure future fabrics are manufactured identical to the ones undergoing test, are currently in preparation.

PROJECT NO. 7320 - FIBROUS MATERIALS

TITLE. IR REFLECTIVE COATED FABRICS FOR FIRE PROTECTIVE GARMENTS

CONTRACTOR.	FABRIC RESEARCH LABORATORIES INC
CONTRACT.	F33615-74-C-5117
CONTRACT DURATION.	APR74-JUN74
AFML PROJECT ENGINEER.	SCHULMAN STANLEY
PROJ/TASK/WK UNIT.	7320-02-28

Objective - 13 NOV 73

(U) Develop techniques for applying a binder-pigment coating system to nonflammable fabrics to provide improved thermal protection and durability at lower weight.

Progress-B 10 SEP 74 To 30 APR 75 (Interim-B)

(U) Two improvements were developed (a) substituting a viton/bronze coating for the aluminum, and adding a topcoat of pigmented urethane to improve wear resistance, (b) adding a topcoat of pigmented urethane to the aluminized fabric to improve wear resistance. Sample lengths of both types of coated fabric were produced.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. LOW COST ORTHOGONAL CARBON/CARBON COMPOSITES FOR HEATSHIELDS

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-5042
CONTRACT DURATION.	APR74-JUL75
AFML PROJECT ENGINEER.	FARMER REX W
PROJ/TASK/WK UNIT.	7340-01-34

Objective - 17 JUL 73

(U) High performance missile entry systems will be required, which have improved penetration and lower vulnerability characteristics for future AF missions. Improved missile heat shields with lower ablatior rates, higher load carrying capabilities, higher shock hardness, and compatibility with signature control devices. This program provides for the development and characterization of orthogonal ablative/ structural pyrolyzed plastic composites having properties significantly superior to state-of-the-art pyrolyzed felt/CVD graphite heat shield composites.

Progress-B 10 SEP 74 To 30 APR 75 (Interim-B)

(U) The reinforcement screening, radial material development, and later material development tasks were completed. The optimized low cost composite was selected (T50 laterals/WCA radials/SC1008 processing) and cylinder fabrication was initiated (9 inch OD x 12 inch length x 1/2 inch wall, A sub-r/ A sub-t ratio of 0.5). The density of a reference ring (T50 laterals/WYB 40 1/0 radials) was nearly stabilized at the 5th cycle (1.59 g/cc) with synthetic pitch (cinnamylideneindene, CAI) processing. High pressure (2000 psi) furfuryl alcohol impregnation on the 8th cycle gave a significant improvement (1.62 up to 1.70 g/cc). CAI/CVD (2nd cycle) processing was less successful.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. REVERSE BAILMENT AGREEMENT

CONTRACTOR.	OWENS-ILLINOIS INC
CONTRACT.	F33615-74-C-5008
CONTRACT DURATION.	FEB73-FEB78
AFML PROJECT ENGINEER.	SCHULMAN STANLEY
PROJ/TASK/WK UNIT.	7340-01-36

Objective - 05 JUN 73

(U) To spin continuous glass filaments with improved mechanical properties.

Progress-B 10 SEP 74 To 01 APR 75 (Interim-B)

(U) Proprietary glass formulations were spun by IITRI producting a uniform diameter fiber with moduli over 17 x 10 super 6 PSI with moderate to high tensile strength.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. SINGLE PHASE FIBROUS ABLATIVE MATERIALS

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-73-C-5131
CONTRACT DURATION.	JUN73-AUG75
AFML PROJECT ENGINEER.	FARMER REX W
PROJ/TASK/WK UNIT.	7340-01-48

Objective - 09 SEP 74

(U) Exploratory development shall be continued to provide improved single phase fibrous ablative materials for future Air Force thermal protection uses. These materials are expected to provide a dense structure, controllable microstructure orientation, a low ablative recession rate in severe thermostructural environments, high strength, low fabrication costs, and fast processing times as compared to state-of-the-art graphites and carbon/carbon composites.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) Continuous Dralon T precursor material was processed using a radial compression technique. Preliminary flexural strength/modulus results were (53,000/53,000,000) psi. Fracture strain enhancement investigations were initiated. Alternate precursor investigations (chopped/continuous PBI and Kelvar-49, PBI braid, and unoxidized Dralon T) were completed. PBI braid gave gave an excellent microstructure, reduced Dralon T oxidation generally improved properties.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. AROMATIC-HETEROCYCLIC RESIN MATRIX/CARBON FIBER REINFORCED HEATSHIELDS/COMPOSITES

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-73-C-5128
CONTRACT DURATION.	APR73-
AFML PROJECT ENGINEER.	FARMER REX W
PROJ/TASK/WK UNIT.	7340-01-50

Objective - 01 NOV 72

(U) Exploratory development shall be continued on carbon fabric reinforced composites utilizing aromatic-heterocyclic resinous matrices. High performance heatshield composite materials shall be developed, which exhibit significantly improved properties as compared to state of the art carbon/phenolic, and which are suitable for potential use as entry missile heatshields.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) Fabrication studies were continued on carbon fabric/aromatic-heterocyclic resin composites. Scale-up, flat wrapping, flexural property evaluation, and air arc heater test activities were initiated for Thornel 300 woven fabric reinforced PH (SC1008), PI (NR-150B), PIQ (AF-R-520), and PP (L-Resin) composites.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. ABLATIVE PLUG NOSETIP MATERIALS DEVELOPMENT

CONTRACTOR. MCDONNELL DOUGLAS CORP
CONTRACT. F33615-74-C-5048
CONTRACT DURATION. MAY74-JUL75
AFML PROJECT ENGINEER. CRAIG ROBERT D
PROJ/TASK/WK UNIT. 7340-01-52

Objective - 16 JUL 73

(U) To develop a high performance, ablative plastic composite material in conical configuration, which will exhibit a significantly lower ablation, improved insulation and more tailorable mechanical properties as compared to state-of-the-art carbon fiber/phenolic composites.

Progress-B 31 AUG 74 To 11 APR 75 (Interim-B)

(U) Three resins were evaluated and a modified phenolic was selected as the matrix on the basis of its good thermal performance. Four flat preforms were woven, and the ablation screening of the preforms was completed. The model to be used for the thermostructural test was designed, and the skirt weaving mandrels have been fabricated.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. GRADED PYROLYTIC GRAPHITE/SILICON CARBIDE COATINGS FOR THROAT INSERTS OF SOLID PROPELLANT ROCKET NOZZLE"

CONTRACTOR. ATLANTIC RESEARCH CORP
CONTRACT. F33615-74-C-5103
CONTRACT DURATION. APR74-APR75
AFML PROJECT ENGINEER. LATVA JOHN D
PROJ/TASK/WK UNIT. 7340-01-57

Objective - 11 OCT 73

(U) To develop a graded PG/SiC coating having the required structural capability and overall erosion capability approaching that of pure pyrolytic graphite for use on solid rocket nozzle throat inserts of advanced ICBM propulsion systems.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) The process-study deposition runs have been completed. The recent runs provided additional data to determine the effect of deposition temperature and trichloromethane concentration on the SiC composition and microstructure of codeposited coatings. The results will serve as guidelines in establishing temperature schedules for depositing selected graded coatings for the thermal stress and erosion specimens.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. LASER BARRIER MATERIALS

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-74-C-5120
CONTRACT DURATION.	MAY74-
AFML PROJECT ENGINEER.	FARMER REX W
PROJ/TASK/WK UNIT.	7340-01-58

Objective - 03 DEC 73

(U) Exploratory development shall be conducted on high thermal performance ablating and insulating materials for internal laser barrier protection of advanced AF weapon systems applications.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) Specimens of thirty-eight (38) candidate materials were analytically sized (areal weight/thickness for a backface temperature of 500K) and fabricated. Laser heating characterizations were conducted. A preliminary analysis of heat of ablation, peak backface temperature rise, areal weight, thickness, and ablative mechanisms was completed. The barrier parametric optimization task was initiated.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. IMPROVED FATIGUE STRENGTH ADHESIVES

CONTRACTOR.	DEXTER CORP
CONTRACT.	F33615-73-C-5133
CONTRACT DURATION.	JUN73-MAY75
AFML PROJECT ENGINEER.	APONYI TED J
PROJ/TASK/WK UNIT.	7340-02-15

Objective - 27 NOV 72

(U) To develop and characterize reinforced structural adhesives which will have significantly improved load bearing capabilities in fatigue than that attainable with state-of-the-art adhesives and, preferably, will provide bonded joint S/N curves which approach the S/N curves of the adherends thereby enabling the design of bonded components on AF flight vehicles to be of minimum weight and maximum fatigue resistance and possessing durability characteristics at least equivalent to those components bonded with state-of-the-art adhesives.

Progress-E 24 OCT 74 To 11 APR 75 (Interim-E)

(U) A fifty-to-ninety fold increase in fatigue life at equal stress levels was achieved when a woven high modulus graphite fabric was substituted for the conventional nylon knit support in the adhesive glue-line. The highest level of fatigue life improvement was found using a woven graphite fabric as the adhesive support. A study of the effects of thin versus thick glue-lines and variations in reinforcement cloth density did not provide any positive results. The contractor plans to make at least one adhesive with improved fatigue resistance commercially available in the near future. Reference AFML-TR-74-169, Improved Fatigue Strength Adhesives.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. CHARACTERIZATION OF SOLID SURFACES AND SURFACE INTERACTION PHENOMENA

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-73-C-5099
CONTRACT DURATION.	MAR73-FEB76
AFML PROJECT ENGINEER.	DAVIS KENNETH A
PROJ/TASK/WK UNIT.	7340-02-17

Objective - 01 MAR 73

(U) To establish investigative techniques and required apparatus, and obtain research information on the chemistry, morphology, and topography of solid surfaces and on the interaction of these surfaces with liquids such as monomers and polymers, and with gases, such as thosein the ambient atmospheric environment. Information obtained will guide development of composites, adhesives, coatings, lubricants and reinforced elastomers having improved engineering properties, durability, and reliability.

Progress-D 12 NOV 74 To 11 APR 75 (Interim-D)

(U) Work continued on forming improved oxide films on metallic surfaces in order to ellucidate proper procedures to be followed to insure more durable and reliable adhesive bonded joints. Auger spectroscopy was used to fully characterize the oxide surfaces. A BET Adsorption system was used to measure surface areas and pore size distribution of samples. Work continued to characterize the surfaces of graphite fibers in an attempt to promote adhesion between fiber and matrix materials.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HIGH TEMPERATURE ADDITION CURED ADHESIVES

CONTRACTOR.	HUGHES AIRCRAFT CO
CONTRACT.	F33615-73-C-5062
CONTRACT DURATION.	MAR73-FEB75
AFML PROJECT ENGINEER.	APONYI TED J
PROJ/TASK/WK UNIT.	7340-02-20

Objective - 01 MAR 73

(U) To develop high temperature capability structural adhesives which cure by addition mechanisms (evolving no volatiles) at moderate temperatures and which will provide high levels of strength in metal-to-metal bonded and spot-weld bonded titanium constructions after long-time exposure to elevated temperatures for use in the construction ofbonded structural components for AF flight vehicles having improved reliability and durability.

Progress-D 24 OCT 74 To 11 APR 75 (Interim-D)

(U) The addition reaction curable acetylene terminated modified polyimides have exhibited continued improvement in strength properties. A more recent polymer, HR-650, which is a more ductile resin when cured, has yielded tensile lap shear strengths greater than 4000 psi at room temperature with titanium adherends and retained 75 percent of that value at 500 degrees F. The new adhesives are adaptable to spot-weld bonding titanium alloys. Erratic results with titanium adherends cleaned by the phosphate-fluoride etch has necessitated an investigation of the effect of other commercially available treatments on bonded joint strengths. Test results are being gathered. Reference technical report AFML-TR-74-88, Development of High Temperature Addition-Cured Adhesives.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. DEFECT/PROPERTY RELATIONSHIPS IN COMPOSITE LAMINATES

CONTRACTOR.	VIRGINIA POLYTECHNIC INST & STATE UNIV
CONTRACT.	F33615-75-C-5119
CONTRACT DURATION.	JAN75-JUN76
AFML PROJECT ENGINEER.	PAGANO NICHOLAS J
PROJ/TASK/WK UNIT.	7340-03-A1

Objective - 03 SEP 74

(U) Exploration of the nature of damage induced in composite laminates and its influence on time-dependent residual strength and life.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. MOISTURE EFFECT ON EPOXY-MATRIX COMPOSITES

CONTRACTOR.	MICHIGAN UNIVERSITY OF
CONTRACT.	F33615-75-C-5165
CONTRACT DURATION.	MAR75-JUN76
AFML PROJECT ENGINEER.	TSAI STEPHEN W
PROJ/TASK/WK UNIT.	7340-03-A5

Objective - 12 SEP 74

(U) To predict the long-term effect of moisture on the structural properties of graphite and boron-epoxy composites. Transient and steady-state exposures to moisture, stress and temperature shall be simultaneously imposed on the composites. Effects on structural properties shall include changes in complex moduli and residual strengths. Result of this research should lead to real- and accelerated-time property evaluation, and guidelines to materials improvement. It may then be possible to assess the long term durability of composites in service.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. PROCESSABLE LAMINATING RESINS WITH IMPROVED TOUGHNESS AND MODERATE TEMPERATURE CAPABILITY

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-72-C-2122
CONTRACT DURATION.	JUN72-AUG75
AFML PROJECT ENGINEER.	PICKLESIMER LEWELLYN G
PROJ/TASK/WK UNIT.	7340-03-79

Objective - 25 AUG 72

(U) To develop improved laminating resins having a high resistance to moisture, a high degree of toughness, moderate temperature capability (365 degrees to 450 degrees F) and processability equivalent to epoxies. Current standard graphite and boron fiber reinforced epoxy composite materials are deficient in strength properties at moderately elevated temperature after high humidity exposure. The resins are marginal for use at temperatures of 365 degrees F and above. Also tougher resins than the current relatively brittle resins and are expected to improve the composites as to strength properties and fracture toughness.

Progress-E 10 SEP 74 To 11 APR 75 (Interim-E)

(U) The polymerization of monomeric reactants is being used as a means of laminating large panels using methanol as a low boiling solvent. A new diamine, 3,3 inch -sulfonyldianiline, has been used to produce a varnish of forty weight percent solids. The varnish was stable and did not form a precipitate as did several other diamines investigated. The varnishes are being used to form laminates for evaluation.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. LOW FLOW, LOW PRESSURE CURE LAMINATING RESIN SYSTEM

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-73-C-5094
CONTRACT DURATION.	MAY73-JUL75
AFML PROJECT ENGINEER.	BROWNING CHARLES E
PROJ/TASK/WK UNIT.	7340-03-87

Objective - 25 OCT 72

(U) To develop a low-flow, low-pressure cure laminating resin system that will uniformly wet graphite filaments, possess some degree of tack, will flow very slightly under moderate temperatures and low pressure, and will result in an adequately performing structural laminate.

Progress-C 10 SEP 74 To 11 APR 75 (Interim-C)

(U) Low resin flow, vacuum bag moldable graphite fiber prepregs have been developed using a Hysl modified epoxy resin system. These prepregs have provided composites possessing mechanical properties equivalent to state-of-the-art epoxies. Fabrication was carried out in an oven using vacuum bag pressure only and no bleeder plies. Pseudoisotropic composites have been fabricated and mechanical property data is being obtained. Photomicrographs show excellent compaction and low voids. Fabrication procedures are being developed for cocured honeycomb sandwich structures.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. MECHANICAL, PHYSICAL AND CHEMICAL PROPERTIES OF EXPERIMENTAL OPTICALLY TRANSPARENT MATERIALS

CONTRACTOR.	GOODYEAR AEROSPACE CORP
CONTRACT.	F33615-74-C-5071
CONTRACT DURATION.	APR74-
AFML PROJECT ENGINEER.	ARVAY EDWARD A
PROJ/TASK/WK UNIT.	7340-03-93

Objective - 09 SEP 74

(U) To identify, prepare, and characterize experimental optically transparent materials, presently available only in research quantities, that show promise for use in aircraft transparent enclosures. To identify approaches or new polymer structures for development of new and improved transparent materials.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) An extensive literature and personal conduct survey to identify possible candidate materials has been completed. A screening of available property data on plastics, elastomers and glasses has been conducted and many materials have been eliminated from further consideration. Candidate materials have been acquired and synthesized (polyurethanes) in sufficient quantities to permit comprehensive testing to transparent materials requirements. Significant improvements have been attained with the GAC 574, polyurethane, type materials. Testing is continuing on ten plastics and elastomers while others are being reserved for future work.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. THREE-DIMENSIONAL STRESS ANALYSIS OF A COMPOSITE LAMINATE CONTAINING AN ELLIPTICAL CAVITY

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-74-C-5096
CONTRACT DURATION.	DEC73-MAY75
AFML PROJECT ENGINEER.	PAGANO NICHOLAS J
PROJ/TASK/WK UNIT.	7340-03-94

Objective - 30 AUG 73

(U) To formulate and solve the elasticity problem of a composite laminate weakened by an elliptical cavity under applied tractions and thermal strains. Of particular interest are the nature of the interlaminar stresses in the region of the elliptical boundary.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) Numerical results became available. Program is now working as part of AFML in house capability.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HEAT RESISTANT ELASTOMERIC SHEET INTERLAYERS FOR LAMINATING TRANSPARENT WINDSHIELD/CANOPY ASSEMBLIES

CONTRACTOR.	MONSANTO RESEARCH CORP
CONTRACT.	F33615-75-C-5090
CONTRACT DURATION	JAN75-DEC75
AFML PROJECT ENGINEER.	ARVAY EDWARD A
PROJ/TASK/WK UNIT.	7340-03-97

Objective - 11 APR 75

(U) New improved, transparent, elastomeric interlayer material(s) based upon an improved ethylene terpolymer shall be developed for laminating various rigid transparent sheets into windshield and canopy constructions. Thermal stability, optical clarity, high elongation and strong adhesion to various materials shall be inherent in the material. Such materials will be provided in sheet form.

Progress-A 02 JAN 75 To 11 APR 75 (Interim-A)

(U) The various raw material for synthesizing and modifying the basic polymeric system has been obtained. Available polymer of slightly different composition has been evaluated at 400 degrees F, to provide buidelines for modification and an indication of mechanical properties.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. BIAXIAL TESTING OF GRAPHITE/EPOXY COMPOSITES CONTAINING STRESS CONCENTRATIONS

CONTRACTOR.	I I T RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5113
CONTRACT DURATION.	APR75-APR76
AFML PROJECT ENGINEER.	WHITNEY JAMES M
PROJ/TASK/WK UNIT.	7340-03-98

Objective - 19 AUG 74

(U) The purpose of this program is to experimentally ascertain the effect of biaxial loading on the static strength of flat laminated graphite/epoxy plates containing stress concentrations in the form of circular holes and through-the-thickness cracks. Notch size effects, as well as biaxial load ratio, are to be investigated.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. THE EFFECT OF COMPRESSIVE LOADING ON THE FATIGUE LIFETIME OF GRAPHITE/EPOXY LAMINATES FOR STRUCTURAL APPLICATIONS

CONTRACTOR.	LOCKHEED AIRCRAFT CORP
CONTRACT.	F33615-75-C-5118
CONTRACT DURATION.	FEB75-JUN76
AFML PROJECT ENGINEER.	WHITNEY JAMES M
PROJ/TASK/WK UNIT.	7340-03-99

Objective - 03 SEP 74

(U) To experimentally and analytically ascertain the effect of compressive loading on the fatigue response of graphite/epoxy laminates. Experimental results obtained on unnotched laminates shall be used as a basis for developing an analytical fatigue model which accounts for compressive loading. The main thrust of the program, however, shall be placed on the experimental work.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. SYNTHESIS OF INTERMEDIATES REQUIRED FOR HIGH TEMPERATURE STABLE POLYMERS

CONTRACTOR.	MIDWEST RESEARCH INSTITUTE
CONTRACT.	F33615-72-C-1314
CONTRACT DURATION	JAN72-MAR76
AFML PROJECT ENGINEER.	ROSENBERG HAROLD
PROJ/TASK/WK UNIT.	7340-04-49

Objective - 15 NOV 72

(U) Advanced aircraft and ballistic missiles require nonmetallic materials, e.g. seals, sealants, fluids, structural and ablative composites, etc. having superior resistance to high temperature exposure for long periods of time. Current materials lack the required stability. This program is for the synthesis of starting materials for several improved polymers which are the base materials required to provide improved capability in elastomers for seals and sealants; fluids; composites; etc, at higher temperatures and long term operation.

Progress-D 02 MAR 74 To 11 APR 75 (Interim-D)

(U) Work on the synthesis of a number of chemical intermediates and monomers for use in the preparation of high-temperature stable polymeric materials was completed. The newly synthesized compounds include 4-iodophenyl acetate, 2,2 inch -diiodo-5,5 inch - dinitrobenzidine, 2,8-diamino-3,7-dinitrobenzothiophene-5,5-dioxide, 4-bromonaphthalic anhydride, 1,3-dinitro-4, 6-(p-totuenesulfamido) benzene, meta-fis(4-phenoxyphenylglyoxalylbenzene, 2,2 inch - diiodobenzidine, 4-bromo-perfluoroalky-tetrafluorobenzene, 1,5-bis-(3,4-dinitrophenoxy)naphthalene, 4,4 inch -dinaphthalic anhydride, and 1,2-dinitro-4-fluorobenzene. (AFML-TR-69-326, Part V, .Exploratory Development on the Synthesis of Intermediates Required For High-Temperature Stable Polymers., August 1974).

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. POLYMERIC AND OTHER NONMETALLIC MATERIALS FOR AEROSPACE VEHICLES

CONTRACTOR. DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT. F33615-75-C-5095
CONTRACT DURATION. MAR75-
AFML PROJECT ENGINEER. DAVIS KENNETH A
PROJ/TASK/WK UNIT. 7340-04-56

Objective - 02 AUG 74

(U) Synthesis, formulation, processing, specimen fabrication characterization, and evaluation of polymeric base and other nonmetallic materials shall be performed to create, investigate, and validate new concepts for aerospace vehicles.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. RESEARCH ON CROSS LINKING REACTIONS FOR HIGH TEMPERATURE AROMATIC POLYMERS

CONTRACTOR. ARIZONA UNIVERSITY OF
CONTRACT. F33615-74-C-5113
CONTRACT DURATION. MAR74-APR76
AFML PROJECT ENGINEER. LOUGHRAN GERARD A
PROJ/TASK/WK UNIT. 7340-04-61

Objective - 05 OCT 73

(U) To conduct basic research in chemistry related to the crosslinking of high temperature stable polymer systems by means of addition reactions which do not give rise to the evolution of volatile by-products and produce crosslinks with stabilities comparable to the molecular backbone structures.

Progress-A 01 MAR 74 To 09 SEP 74 (Interim-A)

(U) New Polyarylether-ketone-sulfone polymers with a higher percentage of 4,4.diphenoxydiphenylsulfone incorporated into the polymer backbone have been synthesized in order to obtain resins of better solubility and higher molecular weight. These resins contain from 8 percent to 20 percent of (2.2)paracyclophane units along the polymer chain as crosslinking sites and are soluble in 1,1,2,2 tetrachloroethane. Modification of curing sites and determination of curing capabilities are now being investigated.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. CHEMICAL COMPOSITION OF EPOXY RESINS

CONTRACTOR.	LOCKHEED MISSILES & SPACE CO INC
CONTRACT.	F33615-75-C-5136
CONTRACT DURATION.	MAR75-MAR76
AFML PROJECT ENGINEER.	HELMINIAK THADDEUS E
PROJ/TASK/WK UNIT.	7340-04-62

Objective - 12 SEP 74

(U) To determine the chemical composition of epoxy resins used in advanced fiber reinforced composites and adhesives and to establish testing methods for monitoring these chemical compositions.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. ELASTOMERS FOR LIQUID PROPELLANT CONTAINMENT

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-74-C-5099
CONTRACT DURATION.	MAR74-SEP75
AFML PROJECT ENGINEER.	SIERON JERRY K
PROJ/TASK/WK UNIT.	7340-05-31

Objective - 15 MAR 74

(U) To develop and evaluate new elastomeric materials for use as seals, valve seats, and positive expulsion bladders/diaphragms for the containment or transport of very energetic liquid rocket propellants. Primary program objective is to develop N sub 2 O sub 4 compatible materials for ballistic missile post boost propulsion systems or high thrust maneuvering propulsion systems for spacecraft.

Progress-C 10 SEP 74 To 11 APR 75 (Interim-C)

(U) AF-E-124D type perfluoroelastomers have clearly emerged as outstanding materials for N sub 2 O sub 4 resistant components. With Du Pont.s assistance, a modified more easily processed version of 124D identified as AF-E-124T has been developed by TRW. A 4-inch diameter diaphragm molded from 124T was successfully cycled 3600 times with N sub 2 O sub 4 with no evidence of damage. The material has low compression set and was unaffected by N sub 2 O sub 4 after 56 days at 160 degrees F. AF-E-124D O-rings have been qualified and are being installed on Titan II Transtage vehicles as N sub 2 O sub 4 pressure switch seals. Based on the above technology, AFRPL has initiated Contract F04611-75-C-0023 with TRW to qualify AF-E-124T bladders (9.5 inch diameter) and valve seats for systems applications. This program should be successfully completed by April 1976.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. LONG LIFE ELASTOMERIC HYDRAULIC SEALS

CONTRACTOR.	PARKER HANNIFIN CORP
CONTRACT.	F33615-73-C-5122
CONTRACT DURATION.	FEB73-
AFML PROJECT ENGINEER.	GRAHAM TOM L
PROJ/TASK/WK UNIT.	7340-05-32

Objective - 15 MAR 74

(U) Initial objectives are to develop longlife hydraulic dynamic seal material for operation in a minus 65 degrees F to 325 degrees F temperature range hydraulic system at 4000 psi pressures. Longer term objectives are for the development of longlife dynamic hydraulic seal materials to operate in a minus 50 degrees F to 400 degrees F temperature range hydraulic system at 4000 psi pressures.

Progress-C 16 MAR 74 To 11 APR 75 (Interim-C)

(U) A low compression set E-60-C fluoroelastomer compound was tested as a candidate O-ring seal material to satisfy the minus 50 degrees F to 400 degrees F temperature range requirement. Results of dynamic piston rod seal evaluations in MIL-H-83282 hydraulic fluid at 4000 psi using the cast-iron/ modified Teflon back-up ring system showed this compound to be an effective seal material at temperature as low as minus 20 degrees F and as high as 350 degrees F. Emphasis was recently shifted to the attainment of an O-ring seal to fill the minus 65 degrees F to 325 degrees F temperature range gap. A composition based on experimental nitrile polymer containing a bound antioxidant successfully completed the 1000 hour dynamic test cycle at these temperature extremes in a closed environment. Polyacrylic based compounds have not looked promising thus far. A modification of the nitrile rubber based composition (a high modulus version) which has been proven to be effective at temperatures up to 275 degrees F is scheduled for screening on the O-ring chew test rig.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. ELEVATED TEMPERATURE ELASTOMERS

CONTRACTOR.	DOW CORNING CORP
CONTRACT.	F33615-74-C-5046
CONTRACT DURATION.	FEB74-FEB76
AFML PROJECT ENGINEER.	GRIFFIN WARREN R
PROJ/TASK/WK UNIT.	7340-05-33

Objective - 10 JUL 73

(U) To develop new and improved broad temperature range (minus 65 degrees F to 600 degrees F) elastomers required for the severe operating conditions of advanced aircraft. Elastomers developed will be used as base materials in integral fuel tank sealants which are critical in the developemnt of a long life, reliable, maintainable high speed (above Mach 2.5) aircraft.

Progress-B 24 OCT 74 To 11 APR 75 (Interim-B)

(U) A 300 gram batch of formulated RTV sealant was prepared from the fluorocarbon fluorosilicone hybrid/fluorosilicone copolymer using the reversion resistant chain extending and crosslinking agents. Channel sealant base material of the hybrid copolymer series has a rapid loss of viscosity as the temperature is increased. This effect will be correlated with molecular structure to determine the polymer configuration with the flatest viscosity-temperature slope.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HIGH PERFORMANCE ELASTOMER REINFORCING MATERIALS

CONTRACTOR.	GENERAL TECHNOLOGY CORP
CONTRACT.	F33615-74-C-5085
CONTRACT DURATION.	MAR74-MAR76
AFML PROJECT ENGINEER.	SIERON JERRY K
PROJ/TASK/WK UNIT.	7340-05-37

Objective - 30 AUG 73

(U) To develop new classes of reinforcing materials which have extreme chemical stability and are compatible with high performance elastomers such as fluoroelastomers. Such reinforcing materials will impart necessary strength and temperature stability to seals and gaskets which are needed for high temperature and pressure fluid containment systems on high speed (above Mach 3) Air Force aircraft and missiles.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) A novel method for determining the static-extrusion resistance of O-ring seals was developed. MgO, CaF sub 2, and carbon fiber reinforced fluoroelastomer O-rings as well as control materials over-spec gland were subjected to 400 degrees F and 4000 psi, and extrusion resistance was measured as a function of pressure decay. Under these conditions, O-rings filled with particulate MgO or carbon black failed completely in a few minutes while very little pressure decay, if any, was observed in random fiber reinforced seals. Seals reinforced with radially oriented microfibers tended to extrude more than random reinforced varieties. All seals were molded inhouse by AFML and the 8 micron diameter MgO and CaF sub 2 fibers imparted the best physical properties. MgO fiber reinforced compounds also had outstanding resistance to temperatures up to 600 degrees F.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. PHYSICAL BEHAVIOR OF ELASTOMERS AND PLASTICS

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5093
CONTRACT DURATION.	MAR75-JUN76
AFML PROJECT ENGINEER.	DAVIS KENNETH A
PROJ/TASK/WK UNIT.	7340-05-47

Objective - 12 JUL 74

(U) Develop, characterize, and predict behavior of structural, thermally protective, fluid containment materials having improved performance in natural and hostile environments, simpler and lower cost processing characteristics, and improved durability and reliability.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HIGH TEMPERATURE TIRE MATERIALS

CONTRACTOR.	UNIROYAL INC
CONTRACT.	F33615-72-C-1881
CONTRACT DURATION.	SEP72-SEP75
AFML PROJECT ENGINEER.	SIERON JERRY K
PROJ/TASK/WK UNIT.	7340-05-49

Objective - 30 JUN 73

(U) Development, testing, and functional evaluation of materials for aircraft tires capable of withstanding brake heat soak back temperatures with a maximum thermal profile of 2 hrs/450 F at the wheel/tire bead interface. Current aircraft tires fabricated from natural rubber and nylon tirecord are limited to 300 F capability primarily because natural rubber reverts (softens) and nylon tirecord is subject to fatigue failure above this temperature. Carbon brake systems are being introduced into Air Force systems and, although offering many advantages, they operate at temperatures up to 40 percent higher than conventional brakes. Development of high temperature aircraft tire materials is required to upgrade the overall capabilities ofthe tire/titanium wheel/carbon brake package for future aircraft systems.

Progress-D 10 SEP 74 To 11 APR 75 (Interim-D)

(U) Dynamometer evaluations of off-the-shelf 7.50 x 14/10 P.R. tires to establish baseline performance capabilitites under hot bead conditions have been completed. Experimental 7.50 x 14 tires featuring heat resistant NR or NR/SBR blends and Nylon 66 toe strip fabric are now being evaluated over the baseline cycle of 100 landings with 5 interspersed hot wheel cycles of 80 min/450 degrees F. In addition, 2 sets of experimental tires featuring heat resistant, chopped Kevlar reinforced bromobutyl bead materials have been fabricated and will also be tested as above. The two most promising materials/constructions will be incorporated in 26 x 6.6/14 P.R. tires which will also be heat cycled and subjected to dynamometer qualification programs.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. SYNTHESIS OF ELASTOMERIC POLYMERS, POLYMER INTERMEDIATES AND SPECIALTY ELASTOMERIC COMPOUNDS

CONTRACTOR.	PENINSULAR CHEMICAL RSCH INC
CONTRACT.	F33615-74-C-5032
CONTRACT DURATION.	FEB74-JAN76
AFML PROJECT ENGINEER.	COCHOY ROBERT E
PROJ/TASK/WK UNIT.	7340-05-53

Objective - 27 JUN 73

(U) To develop new broad temperature range, fluid resistant elastomers and to synthesize new or unavailable monomers, crosslinking agents, and chain extension compounds in support of several AFML efforts such as high temperature seal and sealant programs and seals and bladders for strong oxidizers. Development of high performance seals, sealants and bladders is dependent upon the availability on a timely basis of new broad temperature range liquid polymers, elastomers, and crosslinking agents.

Progress-C 24 OCT 74 To 11 APR 75 (Interim-C)

(U) Fluorocarbon ether oligomers containing methylene groups have been synthesized for inhouse development of a peroxide curable, broad temperature range seal materials. Fluorocarbon ether diacetylene oligomers have been synthesized for inhouse development of a thermally stable polyisoxazole elastomer system for hydraulic seal applications. Technical report covering work during period 01 FEB 74 to 30 JAN 75 currently in preparation.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. ELECTRICALLY CONDUCTIVE COATING MATERIALS

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-72-C-1657
CONTRACT DURATION.	JUN72-JUN75
AFML PROJECT ENGINEER.	WEAVER JAMES H
PROJ/TASK/WK UNIT.	7340-07-50

Objective - 06 NOV 72

(U) To develop special nonmetallic pigment materials for use in the preparation of conductive or antistatic polymeric coatings. White conductive pigmented coatings are needed to complement the presently available carbon black pigmented coatings for thermal flash protection. These pigments would be used in polymeric coatings over plastic composite radomes and aircraft components to prevent static charge buildup or to reduce damage caused by lightning strike.

Progress-F 31 AUG 74 To 11 APR 75 (Interim-F)

(U) The best results obtained so far have been with tin oxide doped with 1 percent antimony oxide and heated in oxygen at 1150 degrees C for 30 minutes. A number of coatings have been prepared with such pigments having resistivities in the range of 0.5 to 15 megohms/square and reflectivities between 0.4 and 1.0 microns as high as 69 percent. The resistance of these coatings to rain erosion is significantly less than that of state-of-the-art carbon black filled antistatic polyurethane coatings, but is remarkably good considering the high pigment loading required for adequate conductivity in the tin oxide system. Reference AFML-TR-73-207, Part II.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. MATERIALS RESISTANT TO SUPERSONIC RAIN, SAND, AND ICE EROSION

CONTRACTOR.	TEXTRON INC
CONTRACT.	F33615-73-C-5057
CONTRACT DURATION	MAR73-JUL75
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	7340-07-52

Objective - 12 SEP 72

(U) To investigate erosion resistant transparent plastic and inorganic material for optical and infrared missile domes. To conduct supersonic (Mach 1 - 3) rain, sand and ice erosion evaluations on advanced materials developed in-house at AFML and on other contractual efforts for use in aircraft and missile radomes, nose cones, leading edges and engine compressor blades.

Progress-D 31 AUG 74 To 11 APR 75 (Interim-D)

(U) Investigations of the erosion of transparent acrylic, polycarbonate and polysulfone plastics have been completed. These materials were determined to exhibit different mechanisms of damage due to droplet impingement and this varied with velocity. Experiments on infrared window inorganics including zinc sulfide and zinc selenide have begun. The means whereby transmission through these materials is reduced has been determined to be intersecting fracture surfaces diffraction of the energy. The damage is ring fractures which are propagated by succeeding droplet impacts.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. INVESTIGATION OF CONTAMINATION EFFECTS ON THERMAL CONTROL COATINGS

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-73-C-5091
CONTRACT DURATION.	MAY73-AUG75
AFML PROJECT ENGINEER.	PRICE BRIAN C
PROJ/TASK/WK UNIT.	7340-07-58

Objective - 26 OCT 72

(U) To investigate the effects of contamination on the optical properties of various satellite thermal control and other optical surfaces. Contamination from the outgassing of adhesives, seals and sealants, insulation, and other polymeric species including the binders used for thermal control paints have been cited by SAMSO as a potential cause of reduced performance and failure of satellite optical and thermal control surfaces.

Progress-E 11 APR 75 To 15 AUG 75 (Interim-E)

(U) Effort is completed except for final reporting. Work during this final period was directed towards comparing the outgassing rates of commercial and distilled RTV602 and SR585. Additionally the effects of contamination on cross polarization and the effect on a multi layer stalked dielectric mirror were determined.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. CARBON/CARBON COMPOSITE MATERIALS HAVING IMPROVED HYPERSONIC PARTICLE EROSION RESISTANCE

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-73-C-5140
CONTRACT DURATION.	JUN73-AUG74
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	7340-07-59

Objective - 04 JAN 73

(U) To develop and investigate carbon/carbon nose tip materials resistant to rain, dust or ice erosive environments by assessing the influence of materials parameters as they govern the erosion behavior of these materials.

Progress-Z 12 APR 75 To 30 SEP 75 (Final)

(U) The optimum erosion resistant carbon-carbon construction requires a balanced 3-D orthogonal weave which includes square X-Y yarn bundles and fine spacing of Z bundles. An initial resin impregnation step to fill voids is indicated with CVD and pitch impregnations thereafter. Improved compressive strength through higher transverse yarn volume fractions is desired. A 40 percent improvement in erosion resistance over the state-of-the-art 2-2-3 carbon carbon construction. Reference - AFML-TR-75-157, Volumes I, II, III and IV.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. EVAL AND MODELING OF CARBON/CARBON COMPOSITES RESISTANT TO HYPERSONIC PARTICLE EROSION

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-74-C-5163
CONTRACT DURATION	APR74-
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	7340-07-59

Objective - 04 DEC 73

(U) To develop and investigate carbon/carbon nose tip materials resistant to rain, dust or ice erosive environments by assessing the influence of materials parameters as they govern the erosion behavior of these materials.

Progress-C 01 MAY 75 To 30 SEP 75 (Interim-C)

(U) Final processing of three improved construction carbon carbon composites has begun. A 1-1-13 3-D orthogonal and a 1-1-1-4 pseudo 4D construction carbon-carbon have undergone initial low pressure pitch and CVD impregnation. The high pressure pitch cycle will begin as soon as the new autoclave is fully operational. Two billets of 2-2-6 construction have been essentially completed and sectioning of the billets will begin shortly to be followed by mechanical properties. ablation and erosion tests.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HYPERSONIC PARTICLE EROSION-ABLATION PROCESS INTERACTION ANALYSIS

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-5049
CONTRACT DURATION.	FEB74-MAY76
AFML PROJECT ENGINEER.	KESSLER WILLIAM
PROJ/TASK/WK UNIT.	7340-07-61

Objective - 23 JUL 73

(U) To develop an analytical model of the interaction between hypersonic particle erosion and ablation processes including effects of in-depth composition and temperature profile on cratering processes in graphite and carbon/carbon materials and coupling of surface roughness effects with ablation processes.

Progress-D 12 APR 75 To 30 SEP 75 (Interim-D)

(U) Hugoniot properties for the 2-2-3 carbon carbon composite have been obtained and incorporated into the 2-D numberical computer code for modeling impact in the material. A separate loading function routine has been developed to model the loading as a function of time for a water droplet impact. Incorporation of damaged material characteristics determined by the impact code into the ablation analysis code is underway.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HEAT RESISTANT ABRASION RESISTANT COATINGS FOR TRANSPARENT PLASTIC

CONTRACTOR.	HONEYWELL INC
CONTRACT.	F33615-74-C-5080
CONTRACT DURATION.	APR74-APR76
AFML PROJECT ENGINEER.	PETERSON TIMOTHY L
PROJ/TASK/WK UNIT.	7340-07-62

Objective - 28 AUG 73

(U) To develop and characterize, high performance, heat resistant, thin, optically transparent abrasion resistant coatings for high temperature transparent plastic materials.

Progress-C 12 APR 75 To 30 SEP 75 (Interim-C)

(U) Accomplishments during this period have included deposition of adherent, abrasion resistant glow discharge polymerized hexamethyldisiloxane films on polycarbonate and stretched acrylic and deposition of adherent, craze-free ceramic films of total thickness greater than three microns. Efforts are also being directed at improving the adhesion between the plastic surface and the coating materials using surface etching procedures so as to maintain good adhesion after prolonged humidity exposure.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. DEVELOPMENT OF HIGH TEMPERATURE FUNCTIONAL FLUIDS

CONTRACTOR.	PENINSULAR CHEMICAL RSCH INC
CONTRACT.	F33615-71-C-1406
CONTRACT DURATION.	JUN71-
AFML PROJECT ENGINEER.	SNYDER CARL E
PROJ/TASK/WK UNIT.	7340-08-14

Objective - 06 NOV 72

(U) To synthesize new candidate high temperature gas turbine engine lubricants and hydraulic fluids which will be required for use in advanced Air Force aircraft systems. Target objectives for these fluids are (a) thermal stability to 800 degrees F; (b) operational liquid range from minus 40 to plus 700 degrees F; and (c) nonflammability.

Progress-F 31 AUG 74 To 31 APR 75 (Interim-F)

(U) Synthesis of larger samples of candidate fluids has facilitated the correlation of physical properties including oxidative, thermal, and hydrolytic stabilities with chemical structure. New moieties have been synthesized which when incorporated into the S-Triazine molecule provide improved low temperature rheological properties with no sacrifice in their excellent stability at elevated temperatures.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. SYNTHESIS OF THERMALLY STABLE TRANSPARENT MATERIALS

CONTRACTOR.	WRIGHT STATE UNIVERSITY
CONTRACT.	F33615-75-C-5073
CONTRACT DURATION.	NOV74-
AFML PROJECT ENGINEER.	ARNOLD FRED E
PROJ/TASK/WK UNIT.	7342-01-06

Objective - 01 JUL 74

(U) To synthesize novel, thermally stable polymer systems molecularly structured to be transparent and display a high degree of impact and abrasion resistance as candidate transparent plastics for development as windshield materials.

Progress-A 01 NOV 74 To 01 SEP 75 (Interim-A)

(U) A series of carboxylated polyphenylenes have been prepared by the Diels-Alder reaction of biscyclopentadienones with various diethynylaromatics. The carboxylated polyphenylenes have been hydrolyzed with Group I metal hydroxides to yield transparent aromatic ionomers. Transparent aromatic phenylated polyimides have also been prepared with glass-transition temperatures in the 200 degrees - 250 degrees C range. The high molecular weight, completely cyclized polyimides are soluble in low-boiling chlorinated solvents.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. THE SYNTHESIS OF HIGHLY FLUORINATED POLYETHER ALIPHATIC COMPOUNDS

CONTRACTOR.	P C R INC
CONTRACT.	F33615-75-C-5075
CONTRACT DURATION.	FEB75-JUN76
AFML PROJECT ENGINEER.	EVERS ROBERT C
PROJ/TASK/WK UNIT.	7342-01-16

Objective - 01 MAR 75

(U) To derive new synthesis methods for oxygen containing di-functional perfluoraliphatic ether monomers and other types of fluorocarbon compounds and intermediates. The molecular structures will be tailored for eventual use as monomers, monomer precursors, etc. in research to synthesize low Tg, high temperature and oxidation resistant polymers with exceptionally good stability so that physical properties can be retained at elevated temperatures. Polymers of this type are needed to provide candiate materials for subsequent development of seals, sealants, etc.

Progress-A 01 FEB 75 To 15 SEP 75 (Interim-A)

(U) Research leading to an improved method for the synthesis of fluorocarbon ether diiodides has been initiated. Variations in reaction conditions involving higher pressures and alloy reaction vessels were unsuccessful and resulted in incomplete reactions. Reactions run in glass reaction vessels proceeded smoothly to give high yields of the desired compounds.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. DYNAMIC BEHAVIOR OF LAMINATED POLYMERIC MATRIX COMPOSITES

CONTRACTOR.	DREXEL UNIVERSITY
CONTRACT.	F33615-73-C-5102
CONTRACT DURATION.	MAR73-MAR76
AFML PROJECT ENGINEER.	TSAI STEPHEN W
PROJ/TASK/WK UNIT.	7342-02-01

Objective - 12 SEP 74

(U) To assess applicability of numerous existing codes for transient stress analysis for gross behavior of structures and local stresses at point of impact of laminated composites. The most efficient code shall be chosen and modified to describe practical laminates under both soft and hard impactors.

Progress-E 01 APR 75 To 01 OCT 75 (Interim-E)

(U) Both ample-ply and cross-ply laminates under in-plane and shearbending modes of loading of a cantilever plate were tested. The measured transient stress agreed well with those predicted using a modified laminated plate theory.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. MECHANISMS OF ADHESION FAILURE BETWEEN POLYMERS AND METALLIC SUBSTRATES

CONTRACTOR.	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-72-C-1641
CONTRACT DURATION.	JUN72-JUL75
AFML PROJECT ENGINEER.	ARVAY EDWARD A
PROJ/TASK/WK UNIT.	7342-02-04

Objective - 28 APR 72

(U) OBJECTIVE- To investigate fundamental structural/property relationship of polymeric adhesive films and non-polymeric substrates to ascertain primary adhesion failure mechanisms.

Progress-F 01 APR 75 To 01 JUL 75 (Interim-F)

(U) Aluminum and titanium surface studies continue using various instrumental techniques to investigate the affect of contamination and the nature of surfaces upon the resultant joint strength and durability. The combination of contamination and water vapor on the surface governs the reactivity toward the adhesive and accelerates degradation. Surface changes occur preferentially at the periphery of etch pits in aluminum , the entire titanium surface is involved in changes with this metal. Interpretation of experimental findings are being reviewed prior to publication of AFML-TR-74-73, Part II.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. RELATIONSHIP OF STRUCTURE TO PROPERTIES IN GRAPHITE FIBERS FROM POLYMERIC PRECURSORS

CONTRACTOR. RENSSELAER POLYTECHNIC INSTITUTE
CONTRACT. F33615-72-C-1422
CONTRACT DURATION MAY72-MAY74
AFML PROJECT ENGINEER. ROSS JACK H
PROJ/TASK/WK UNIT. 7342-02-08

Objective - 06 NOV 72

(U) To investigate the morphology of graphite fiber reinforcements for lightweight structural composites. Knowledge of the relationship between morphology and the mechanical properties of graphite fibers will provide the basis for development of lower weight and improved structural composites.

Progress-E 01 SEP 74 To 01 APR 75 (Interim-E)

(U) Studies of the effect of various forms of abrasion on graphite fibers have been conducted and the following conclusions drawn - 1. Since the abrasion did not effect tensile strength or a propensity for failure in the abraded zone, either the abrasion did not cause significant flaw damage or the flaws introduced did not substantially increase the flaw concentration. 2. Rough handling of the graphite fibers during prepregging did not decease composite properties drastically. 3. Fiber breakage was the only optical indication of severe abrasion. any flaws introduced were probably beyond the resolution of the optical microscopy. Final report is delinquent.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. RELATIONSHIP OF INTERLAMINAR STRESSES TO THE DYNAMIC FRACTURE BEHAVIOR OF FIBER REINFORCED POLYMERIC MATRIX COMPOSITES

CONTRACTOR. PURDUE UNIVERSITY
CONTRACT. F33615-73-C-5112
CONTRACT DURATION. MAY73-JUL75
AFML PROJECT ENGINEER. WHITNEY JAMES M
PROJ/TASK/WK UNIT. 7342-02-10

Objective - 15 NOV 72

(U) To investigate analytically the interlaminar stresses induced in fiber reinforced polymeric matrix composites by an impact load. Analytical results will be compared against static fracture data and a dynamic .correction factor, determined.

Progress-E 01 MAR 75 To 31 AUG 75 (Interim-E)

(U) Impact work completed. Model developed relating impact energy to damage energy. Final report in process.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. MORPHOLOGY OF HIGHLY ORIENTED POLYMERIC FILMS

CONTRACTOR.	AKRON UNIVERSITY OF
CONTRACT.	F33615-73-C-5113
CONTRACT DURATION.	APR73-JUN75
AFML PROJECT ENGINEER.	WERETA ANTHONY
PROJ/TASK/WK UNIT.	7342-02-11

Objective - 28 NOV 72

(U) To examine the potential of high degrees of high molecular orientation in polymeric films to provide high modulus of elasticity and tensile strength properties, and to relate these properties to macromolecular morphology and approaches to achieving controlled morphology.

Progress-D 01 MAR 75 To 01 OCT 75 (Interim-D)

(U) Additional film of Marlex 50 were prepared in the stirred crystallizer at temperatures ranging from 96-102 degrees C and shear rates between 500 and 900 secs minus super 1. Tensile strength on the order of 2,000 kg/cm super 2 were obtained annealing gave moderate improvement of tensile strengths and WAXS orientation. Addition of pressure during stirred crystallization was not as effective as anticipated. Two-and three-ply laminates of orthogonally crossed Mylar T films were made and tested at 0, 30, 45, 60 and 90 degrees to a given orientation axis. While maximum tensile strengths were found at 0 and 90 degrees it was surprising to find that values at 45 degrees exceeding those at either 30 or 60 degrees. More rigid polymer including Kevlar, polybutyl- and polyactylisocyanates were examined for the possibility of obtaining high orientation and strength under less rigid crystallization conditions. Final results of this program will appear in an AFML TR now in preparation.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. INTERACTIVE STRESS STATES AND EROSION MECHANISM IN IR MATERIALS

CONTRACTOR.	CALIFORNIA RSCH AND TECHNOLOGY INC
CONTRACT.	F33615-75-C-5081
CONTRACT DURATION.	DEC74-
AFML PROJECT ENGINEER.	SCHMITT GEORGE F
PROJ/TASK/WK UNIT.	7342-02-13

Objective - 27 JUN 74

(U) To calculate the stresses and subsequent failures induced in IR transparent materials by rain droplet impact and to determine the mechanisms whereby transmission losses through these materials are occuring after rain exposure.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. BIAXIAL FATIGUE BEHAVIOR OF GRAPHITE/EPOXY COMPOSITE LAMINATES

CONTRACTOR.	SOUTHWEST RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5115
CONTRACT DURATION.	FEB75-JUN75
AFML PROJECT ENGINEER.	PAGANO N J
PROJ/TASK/WK UNIT.	7342-02-14

Objective - 27 AUG 74

(U) To investigate both experimentally and analytically the effect of biaxial loading on the fatigue strength of bidirectional graphite/epoxy compoite laminates. Experimental data, which shall be obtained on tubular specimens, shall form the basis for developing an analytical fatigue model for predicting lifetime under a given biaxial load history. In addition, mechanisms of biaxial fatigue damage shall to investigated with special emphasis on determining the effect of first-ply failure.

Progress-A 27 AUG 74 To 16 OCT 75 (Interim-A)

(U) High quality tubular specimens with volume fractions comparable to flat laminates have been fabricated. Only preliminary experimental work has been conducted at this time.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. INVESTIGATION OF ANODIC OXIDE FILMS OF ALUMINUM ALLOYS

CONTRACTOR.	NORTHROP CORP
CONTRACT.	F33615-75-C-5121
CONTRACT DURATION.	APR75-JUN75
AFML PROJECT ENGINEER.	MCDEVITT NEIL T
PROJ/TASK/WK UNIT.	7342-02-15

Objective - 06 SEP 74

(U) To investigate anodic surface treatments for aluminum alloys that will provide high corrosion resistant oxides for adhesive bonding.

Progress-A 06 SEP 74 To 17 OCT 75 (Interim-A)

(U) Specimens of bare and clad 7075-T6 and bare and clad 2024-T3 aluminum have been anodized in a phosphoric acid electrolyte at 10, 20, 30, 40, and 50 volts for 20 minutes at room temperature. These surfaces have been chemically, physically and crystallographically characterized. Surface contaminants and their concentration throughout the anodic oxide layer have been determined. Impurities found on the anodic oxide surfaces are explainable in terms of chemical constituents of the electrolyte.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. MECHANISM OF EPOXY MOISTURE EFFECTS

CONTRACTOR. MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT. F33615-75-C-5144
CONTRACT DURATION. MAR75-
AFML PROJECT ENGINEER. GOLDFARB IVAN J
PROJ/TASK/WK UNIT. 7342-02-21

Objective - 16 SEP 74

(U) To determine the mechanism by which exposure to environmental moisture influences the elevated temperature mechanical properties of epoxy resins utilized for high performance composite matrix materials and adhesives.

Progress-A 26 MAR 75 To 01 AUG 75 (Interim-A)

(U) Reproducible specimen preparations method has been established and impurity levels in commercial epoxy resins been determined. internal reflectance infrared spectra using Fourier Transform Spectroscopy has shown preliminary evidence of changes with moisture.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. NATURE OF POLYMER SOLVENT INTERACTIONS REQUIRE TO ENHANCE POLYMER SOLUBILITIES

CONTRACTOR. TEXAS TECHNOLOGICAL UNIVERSITY
CONTRACT. F33615-75-C-5072
CONTRACT DURATION. DEC74-
AFML PROJECT ENGINEER. HELMINIAK THADDEUS E
PROJ/TASK/WK UNIT. 7342-03-02

Objective - 01 JUL 74

(U) To discover and predict molecular structure of solvents and/or solvent systems for aromatic and heterocyclic polymers which exhibit resistance to dissolution by common solvents and are not adaptable to current polymer solution techniques and processes.

Progress-A 02 DEC 74 To 15 SEP 75 (Interim-A)

(U) Sample preparation and instrumental techniques have been established for the study of aromatic heterocyclic polymers as well as elastomeric polymers. A test battery of solvents has been selected and used for solubility verification for a known polymer system to establish the suitability of the battery for solvent searches. Preliminary solvent searches for new polymers have been successful.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. THE MEASUREMENT OF PROPERTIES AND RESPONSE FUNCTIONS OF LIQUID LUBRICANTS RELATED TO TRANSIENT VISCOELASTIC REGIMES

CONTRACTOR.	RENSSELAER POLYTECHNIC INSTITUTE
CONTRACT.	F33615-75-C-5105
CONTRACT DURATION.	APR75-JUN76
AFML PROJECT ENGINEER.	BROOKS FREDRICK C
PROJ/TASK/WK UNIT.	7342-03-06

Objective - 23 AUG 74

(U) To determine and measure those liquid lubricant properties and response functions for viscoelastic processes which will permit definition of fluid behavior in elastohydrodynamic lubrication (EHL) regimes.

Progress-A 01 APR 75 To 25 SEP 75 (Interim-A)

(U) The high pressure diamond cell has been received and the microscope is being located and fixed for viewing. An order is being placed for the laser. The micrometer spheres have shown a tendency to aggregate after a period of time. This is not considered a serious problem.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. INFLUENCE OF CROSSLINKING ON THE MECHANICAL PROPERTIES OF HIGH TG POLYMERS

CONTRACTOR.	LEHIGH UNIVERSITY
CONTRACT.	F33615-75-C-5167
CONTRACT DURATION.	MAY75-JUN76
AFML PROJECT ENGINEER.	WERETA ANTHONY
PROJ/TASK/WK UNIT.	7342-03-07

Objective - 18 OCT 74

(U) To determine the influence of crosslinking on the mechanical properties of polymers exhibiting high glass transition temperatures.

Progress-A 01 MAY 75 To 31 AUG 75 (Interim-A)

(U) A literature survey and preliminary lab work were conducted and the selection of materials was made. A system based on polystyrene was selected for producing well-defined network structures via Bamford synthesis techniques. In addition a bisphenol-A epoxy resin with a straight chain diamine curing agent will constitute a system of more applied interest. Synthesis of model compounds is now in progress. Epoxy samples prepared from a series of epoxy amine ratios are currently being characterized in a DSC for variations in Tg.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYSTEMS

TITLE. PHYSICAL CHEMICAL PROPERTIES OF COMPLEX AROMATIC-HETEROCYCLIC POLYMERS

CONTRACTOR. CARNEGIE-MELLON UNIVERSITY
CONTRACT. F33615-70-C-1058
CONTRACT DURATION. FEB70-
AFML PROJECT ENGINEER. HELMINIAK THADDEUS E
PROJ/TASK/WK UNIT. 7342-03-86

Objective - 17 JAN 75

(U) To elucidate and interrelate aggregation phenomena and mechanical properties of new complex aromatic-heterocyclic polymers in order to develop new and improved approaches for processing these polymers. Such polymers would be expected to lead to new high-temperature polymeric materials with superior mechanical properties.

Progress-H 15 MAR 74 To 01 APR 75 (Interim-H)

(U) Creep and recovery measurements have been used to study the thermal-mechanical properties of polybisbenzimidazobenzophenanthrolinedione (BBB) over the temperature interval 30 to 500 degrees C (in vacuo). The creep measurements were augmented by x-ray diffraction isothermal contraction, and solubility measurements. It is found that extensive intermolecular association giving a supramolecular structure with (nearly) planar polymeric repeat units stacked in a .graphite-like. array dominate the properties of BBB and that this structure is not melted out at temperatures as high as 500 degrees C. The principal mode of creep gives rise to fully recoverable Andrade creep for which the strain is proportional to the cube-root of time. Rheological studies on solutions of poly-p-phenylene bibenzoxazole (PBO) in methane sulfonic acid were analyzed to obtain criteria for the shear rate necessary to induce non-Newtonian flow behavior and consequent molecular orientation in flow. Additional studies on concentrated solutions of PBO have shown that the viscosity of these solutions passes through a maximum in the concentration interval 4 to 8 percent polymer by weight. Rheological studies on a moderately concentrated solution of BBL in methane sulfonic acid as a function of temperature and water content of the acid have shown that the wet solution can form a weak gel, and that the intermolecular aggregation responsible for the gel is shear degradable but will reform in the quiescent solution thus adversely affecting solution processing.

PROJECT NO. 7342 - NONMETALLIC MATERIALS FOR ADVANCED AEROSPACE SYS

TITLE. PHYSICAL CHEMICAL PROPERTIES OF COMPLEX AROMATIC-HETEROCYCLIC POLYMERS

CONTRACTOR. CARNEGIE-MELLON UNIVERSITY
CONTRACT. F33615-75-C-5227
CONTRACT DURATION. JUN75-MAY76
AFML PROJECT ENGINEER. HELMINIAK THADDEUS E
PROJ/TASK/WK UNIT. 7342-03-86

Objective -

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. NEW AND IMPROVED LUBRICANTS AND EFFECTS OF EXTREME ENVIRONMENTS ON THE BEHAVIOR OF FLUIDS AND LUBRICANTS

CONTRACTOR.	MIDWEST RESEARCH INSTITUTE
CONTRACT.	F33615-72-C-1374
CONTRACT DURATION.	JAN72-DEC74
AFML PROJECT ENGINEER.	BROOKS FRED C
PROJ/TASK/WK UNIT.	7343-01-14

Objective - 15 JAN 73

(U) To develop high temperature and less flammable hydraulic fluids and to characterize the physical and engineering properties of liquid and solid lubricants for applications in current and advanced aircraft and aerospace systems.

Progress-E 31 AUG 74 To 11 APR 75 (Interim-E)

(U) The final report of the contract has been sent to technical editing. No report number has been assigned at this date. The following technical reports have previously been distributed in defining the results of this effort. AFML-TR-73-39, ,The Effect of Wear on the Compressive Stress in the Sphere-On-Plane and Multiple-Flat-On-Curve Configurations,, AFML-TR-73-121, ,Graphite Fluoride - A Proposed Solid Lubricant, and AFML-TR-74-181, ,Performance of Lubricant Compact Materials in Ball Bearings,,

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. INVESTIGATION OF HEAVY LOAD ANTI-WEAR GREASES IN HELICOPTER TRANSMISSIONS

CONTRACTOR.	UNITED TECHNOLOGIES CORP
CONTRACT.	F33615-72-C-2031
CONTRACT DURATION.	AUG72-SEP75
AFML PROJECT ENGINEER.	CHRISTIAN JOHN B
PROJ/TASK/WK UNIT.	7343-01-15

Objective - 30 JUN 72

(U) To lubricate and S-61 main helicopter transmission with AFML developed MCG-68-63 grease lubricant.

Progress-D 31 AUG 74 To 11 APR 75 (Interim-D)

(U) Baffles for the main S-61 transmission have been designed and are now being fabricated.

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. THERMOCHEMICAL BEHAVIOR OF GREASES AND FLUIDS

CONTRACTOR.	PHOENIX CHEMICAL LABORATORY INC
CONTRACT.	F33615-73-C-5103
CONTRACT DURATION.	APR73-MAY76
AFML PROJECT ENGINEER.	SNYDER CARL E
PROJ/TASK/WK UNIT.	7343-03-09

Objective - 02 APR 73

(U) To determine the thermochemical behavior of advanced fluids, lubricants and greases when they are subjected to simulated environments of anticipated future aerospace systems. Particular emphasis will be placed on their flammability characteristics, oxidative degradation and lubricity characteristics

Progress-C 31 AUG 74 To 11 APR 75 (Interim-C)

(U) The micro hot manifold flammability characterization technique developed under this contract demonstrated excellent reproducibility and correlated well with data obtained on the same fluids using the full-scale method. An oxygen absorption apparatus was developed which can be used to determine the kinetics of fluid oxidation at any selected temperatures and the effectiveness of antioxidant additive effectiveness. Several candidate fire resistant hydraulic fluids were characterized by methods developed under this contract.

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. DEGRADUATION MECHANISMS OF ADVANCED LUBRICANTS

CONTRACTOR.	PENNSYLVANIA STATE UNIVERSITY
CONTRACT.	F33615-73-C-5101
CONTRACT DURATION.	MAY73-APR76
AFML PROJECT ENGINEER.	MORRIS GEORGE J
PROJ/TASK/WK UNIT.	7343-03-10

Objective - 01 NOV 72

(U) To investigate the degradation mechanisms of advanced lubricants under varying environmental conditions and to provide longer life and more reliable lubricants. Specifically thermal and oxidative effects as well as wear mechanisms relative to lubricant stability/degradation will be explored.

Progress-C 31 AUG 74 To 11 APR 75 (Interim-C)

(U) An operational porous media viscometer has been developed. This viscometer is designed to determine the nature of a fluid film near the surface which appears to be quite different from the bulk fluid present in any system. The presence of such a film is indicated by changes in the flow characteristics of a given fluid through these media which are calibrated as viscometers by the use of saturated hydrocarbons with known viscosity characteristics. Preliminary studies show that polar constituents which can be added or result from thermal or oxidation degradation products alter the flow characteristics of the fluid. This behavior indicates they are measurable near surface films equivalent to multi-layer adsorption on the surface. Such studies should be directly applicable to elucidating gear and bearing lubrication of gas turbine lubricants and instrument oils by providing a better insight into the surface phenomena occuring at the wear surfaces.

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF MINUS 40 TO 465 DEGREES F

CONTRACTOR. MONSANTO RESEARCH CORP
CONTRACT. F33615-73-C-5079
CONTRACT DURATION. APR73-
AFML PROJECT ENGINEER. MORRIS GEORGE J
PROJ/TASK/WK UNIT. 7343-03-11

Objective - 15 SEP 72

(U) To perform exploratory development to provide finished gas turbine engine oil (GTO) formulations having proven bulk oil stability in the temperature range of minus 40 to 465 degrees F.

Progress-D 31 AUG 74 To 30 APR 75 (Interim-D)

(U) The five gallon formulation was evaluated at AFML and most properties were verified with the exception of oxidation-corrosion stability. This is currently being investigated at the contractor and at AFML. Important rig type tests in conformance with MIL-L-27502 such as Ryder gear loading, the 100 millimeter bearing deposition and the simulated high altitutde foaming were performed by AFAPL and considered satisfactory. Reference AFML-TR-74-247.

PROJECT NO. 7343 AEROSPACE LUBRICANTS

TITLE. EXPERIMENTAL MEASUREMENT OF LUBRICANT FILM THICKNESS

CONTRACTOR. SOUTHWEST RESEARCH INSTITUTE
CONTRACT. F33615-73-C-5123
CONTRACT DURATION. JUN73-
AFML PROJECT ENGINEER. WARD WAYNE E
PROJ/TASK/WK UNIT. 7343-03-15

Objective - 30 OCT 72

(U) To develop technique for the experimental measurement of, and analysis of, the lubricant film thickness in a slow speed, lightly loaded, elastohydrodynamic contact. Relationships will be developed to explain lubricant film thickness in terms of lubricant and system parameters significant to long term performance.

Progress-C 10 SEP 74 To 19 JUN 75 (Interim-C)

(U) Bearing endurance tests to investigate the influence of lubricant properties on film thickness in an operating bearing are continuing. Two of the endurance test bearings have failed (locked-up). Both bearings were lubricated with Apiezon A oil and had the rough and standard surface finishes respectively in that order. The third test bearing which also has a rough surface finish and is lubricated with Apiezon C is still operating normally.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. HANDBOOK OF NONFLAMMABLE FIBROUS MATERIALS FOR AIRCRAFT INTERIORS

CONTRACTOR.	MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT.	F33615-75-C-5142
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	OPT PRESTON C
PROJ/TASK/WK UNIT.	7381-06-90

Objective - 10 SEP 74

(U) Preparation of a handbook or technical manual on fire resistant/retardant textile materials for use by Air Force and contractor personnel involved in the selection of materials intended as interior refurbishments in military aircraft.

Progress-A 10 SEP 74 To 11 APR 75 (Interim-A)

(U) A substantial effort is continuing in the failure analysis area in support of aerospace operational weapon systems. Determination of the compatibility of various alloys used for fasteners with high strength composite materials is continuing. The evaluation of weld-bond joints for resistance to corrosion and the effect of severe environments on joint strength is in progress. Suitable waterbase coating materials for exterior application to aerospace equipment is a continuing goal to reduce demand on petroleum derived solvents and meet air pollution regulations. More extensive flight tests are in progress on B-52 aircraft to evaluate the flexible polysulfide primers. An extensive effort is continuing in the area of visual camouflage/infrared suppression coatings for new aircraft. An evaluation effort is in progress to identify non-skid retroreflective marking paints and materials for aircraft runway application. An environmental exposure program is in progress to evaluate the corrosivity of graphite and molybdenum disulfide lubricants on various coupled metallic substrates. An evaluation of long term effects of decontaminants on aircraft structural materials is continuing. Considerable emphasis is continuing to be placed on identifying non-polluting paint strippers for difficult to remove coatings and surface treatment chemicals for field maintenance of aircraft. Considerable effort continues toward preparation of new and revision of old specifications in the area of failure analysis and corrosion control. A new specification on white thermally reflective rain erosion resistant materials has been issued. A new specification for a thermally reflective general exterior aircraft coating has been issued. Three additional specifications for corrosion prevention and thermal energy control are in preparation. Considerable participation and input on space environment protective materials for several satellite systems has been accomplished and is continuing.

PROJECT NO. 7343 - AEROSPACE LUBRICANTS

TITLE. INVESTIGATION OF CAGE AND BEARING INSTABILITY DUE TO CHANGES IN LUBRICANT PROPERTIES

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-74-C-5012
CONTRACT DURATION	FEB74-JAN76
AFML PROJECT ENGINEER.	BENZING ROBERT J
PROJ/TASK/WK UNIT.	7343-03-16

Objective - 13 JUN 73

(U) To analyze the influence of lubricant properties on cage and bearing instability in a slow speed lightly loaded elastohydrodynamic contact.

Progress-A 01 FEB 74 To 09 SEP 74 (Interim-A)

(U) A numerical simplification of bearing - dynamics computations has been addressed. A block diagram has been generated. The simplified program is 75 percent complete.

PROJECT NO. 486U - ADVANCED METALLIC STRUCTURES

TITLE. CRACK GROWTH CORRELATION SPECIMEN FOR QUALITY CONTROL

CONTRACTOR.	DEL WEST ASSOCIATES INC
CONTRACT.	F33615-75-C-5106
CONTRACT DURATION.	APR75-JUN76
AFML PROJECT ENGINEER.	GUNDERSON ALLAN W
PROJ/TASK/WK UNIT.	486U-01-07

Objective - 07 AUG 74

(U) To develop a rapid, inexpensive test and procedure for correlating to the fatigue growth rate of a material. A test procedure useable as a quality control test is desired.

Progress-A 01 APR 75 To 15 SEP 75 (Interim-A)

(U) The analysis efforts on the various specimens is continuing. Materials have been procured and the specimen machining is in progress.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. HYPERSONIC SHOCK LAYER-ICE PARTICLE INTERACTION RESEARCH AND ANALYSIS

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-5143
CONTRACT DURATION.	APR74-APR76
AFML PROJECT ENGINEER.	ORMBREK GLEN
PROJ/TASK/WK UNIT.	7340-07-65

Objective - 03 JAN 74

(U) To investigate the interactions between shock waves and ice crystals to determine drag behavior, dispersion, acceleration, break-up, spin-up and stipping so that the state of the eroding particle when striking the vehicle surface can be defined.

Progress-D 12 APR 75 To 30 SEP 75 (Interim-D)

(U) Water drops with diameters of 50 microns, characteristic of clouds, as well as larger drops have been subjected to flow behind shock waves up to Mach thirteen. Breakup time is ascertained from x-ray and shadow images of the drops. The reduction in drop mass prior to breakup is measured from the xradiographs and drop trajectories are determined from the shadowgraphs. Analysis of the unstable wave development on the front surfaces of the drops is used to provide correlations parameters for the time to breakup. Data from several sources are correlated over the Weber number range shown to be important in flight, from the cricital value of eight, below which no breakup occurs, to about one million. The data and correlations have been applied to flight and representative calculations of flight cases illustrate the practical importance of drop breakup. The erosion protection is shown to be significant. Ballistic range tests were conducted to verify that the breakup criterion developed in the shock tube tests does, indeed, correspond to the condition in flight at which the drops no longer damage the vehicle surface. A device for forming ice crystals has been fabricated and installed in the shock tube. Dendritic crystals about one millimeter in size have been grown and dropped across the test section. A Beckman and Whitley high speed camera is being used to study the breakup and acceleration of these ice crystals in the region behind passing shock waves. (Reference - AFML-TR-75-71)

PROJECT NO. 627A - ABRES SUPPORT

TITLE. HEAT SHIELD MATERIALS SINGLE PARTICLE EROSION DATA

CONTRACTOR.	EFFECTS TECHNOLOGY INC
CONTRACT.	F33615-75-C-5214
CONTRACT DURATION.	MAR75-OCT75
AFML PROJECT ENGINEER.	HEINONEN EVERETT
PROJ/TASK/WK UNIT.	627A-00-29

Objective - 02 JAN 75

(U) To charcterize the erosion behavior of current and advanced heat shield materials at hypersonic velocities.

Progress-B 03 MAR 75 To 18 SEP 75 (Interim-B)

(U) Eight advanced construction heat shield composites and six baseline composites were investigated for low angle erosion using single impacts at velocities up to 18,000 feet per second. The influence of tape wrap angle in 2-D carbon phemolics was determined and higher wrap angles provide more erosion resistance. Analysis of the specimens indicates that residual damage effects at low angle are a key factor in the erosion behavior of these materials.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. PURCHASE OF CARBON-CARBON BILLETS, CONE, AND RING

CONTRACTOR.	AVCO CORP
CONTRACT.	F33615-74-C-0089
CONTRACT DURATION.	FEB74-NOV75
AFML PROJECT ENGINEER.	ROSS ERIC M
PROJ/TASK/WK UNIT.	627A-00-03

Objective - 04 FEB 74

(U) To purchase thermal protection materials for test and evaluation.

Progress-B 06 MAY 74 To 30 NOV 74 (Interim-B)

(U) Contract redirected to include another class of carbon-carbon billets in Sep 74. Delivery of final items not later than Sep 75. Some billets have been delivered.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. DEVELOPMENT OF A CONTROLLED QUALITY CARBON-CARBON MATERIAL FOR TESTING AND EVALUATION

CONTRACTOR.	GENERAL ELECTRIC CO
CONTRACT.	F33615-75-C-5076
CONTRACT DURATION.	OCT74-
AFML PROJECT ENGINEER.	ROSS ERIC M
PROJ/TASK/WK UNIT.	627A-00-10

Objective - 20 JUN 74

(U) To provide sufficient controlled quality material for initial evaluation.

Progress-B 16 OCT 74 To 25 SEP 75 (Interim-B)

(U) The processing and NDT of all billets is nearly complete. Post test correlation has shown significant advances in the ability to detect, by NDT, low density core material which has poor ablation material, and has thus resulted in identified needs for further process controls. Good capability has been developed for determining the quality of the carbon preform.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. DESIGN CRITERIA FOR CARBON/CARBON COMPOSITES

CONTRACTOR. MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT. F33615-74-C-5130
CONTRACT DURATION. JUN74-JUN76
AFML PROJECT ENGINEER. HINNERICHS TERRY D
PROJ/TASK/WK UNIT. 627A-00-14

Objective - 27 NOV 73

(U) To explore the extent of physical property change induced in carbon/carbon composites during thermostructural or weapons effect loading which was not catastropic.

Progress-B 01 APR 75 To 24 SEP 75 (Interim-B)

(U) Underground-Tested-Mod 3a nosetip has been examined for x-ray degradation. Little damage was noted but x-ray ntensity of UGT was relatively low. Analytical effort has been progressing for implementing damage functions into a finite element computer program to model locallized material degradation, due to thermostresses, x-ray effects etc.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. MULTIAXIAL THERMOSTRUCTURAL TESTING OF ADVANCED RVNT MATERIALS THERMOSTRUCTURAL TEST FACILITY

CONTRACTOR. SOUTHERN RESEARCH INSTITUTE
CONTRACT. F33615-75-C-5148
CONTRACT DURATION APR75-
AFML PROJECT ENGINEER. HINNERICHS TERRY D
PROJ/TASK/WK UNIT. 627A-00-16

Objective - 16 SEP 74

(U) To develop a multiaxial thermostructural test facility. The test facility will be used to evaluate the thermostructural performance of advanced reentry vehicle nosetip materials in a high heat flux environment.

Progress-A 15 APR 75 To 24 SEP 75 (Interim-A)

(U) Shipment of the AFML supplied 400 KVA Heater to So. R.I. has been accomplished. Installation has been progressing on schedule and power-on status will be shortly.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. THERMOSTRUCTURAL TESTING OF INSTRUMENTED CARBON-CARBON NOSETIP MODELS

CONTRACTOR.	ACUREX CORP AEROTHERM DIV
CONTRACT.	F33615-75-C-5219
CONTRACT DURATION.	FEB75-
AFML PROJECT ENGINEER.	HINNERICHS TERRY D
PROJ/TASK/WK UNIT.	627A-00-17

Objective - 01 JUL 74

(U) To obtain temperature and strain data for carbon-carbon shell tips subjected to a reentry environment.

Progress-A 03 FEB 75 To 24 SEP 75 (Interim-A)

(U) The rocket engine facility optimization study is essentially complete indicating that the R.P.L. 42 atm nozzle configuration appears to offer the best compromise between severity of thermostructural loading and instrumentation requirements. Instrumentation research and development for the c-c nosetip has been very limited due to nonavailability of G.E. 2-2-3 material.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. NONLINEAR DEFORMATION OF GRAPHITIC MATERIALS

CONTRACTOR.	SOUTHERN METHODIST UNIVERSITY
CONTRACT.	F33615-75-C-5212
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	HINNERICHS TERRY D
PROJ/TASK/WK UNIT.	627A-00-19

Objective - 27 DEC 74

(U) The objective of this program is to finalize a new material model for the inelastic multiaxial response of graphitic materials. Then this model will be extended so that it will be valid for carbon-carbon materials.

Progress-A 01 MAR 75 To 24 SEP 75 (Interim-A)

(U) Revision of the existing Jones-Nelson material model for graphite to include temperature dependent behavior is now in progress.

PROJECT NO. 627A - ABRES SUPPORT

TITLE BIAXIAL FAILURE OF 994 GRAPHITE

CONTRACTOR.	MCDONNELL DOUGLAS ASTRONAUTICS CO
CONTRACT.	F33615-75-C-5216
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	HINNERICHS TERRY
PROJ/TASK/WK UNIT.	627A-00-21

Objective - 27 DEC 74

(U) The objective of this study is to investigate the with and across grain failure statistic of 994 graphite under biaxial and uniaxial loading. Also volume effect will be investigated.

Progress-A 01 MAR 75 To 24 SEP 75 (Interim-A)

(U) Test planning, specimen design and stress analysis, test fixture design, specimen preparation for checkout have been accomplished. Bar, elliptical, and circular disk specimens are planned. The elliptical disk specimens will provide various stress ratios states depending on minor to major axis ratios of the ellipse when tested in the spin pit facility used in this program.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. ABLATION/EROSION EVALUATION OF REENTRY VEHICLE MATERIALS

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-75-C-5186
CONTRACT DURATION.	JAN75-
AFML PROJECT ENGINEER.	JUMPER GEORGE Y
PROJ/TASK/WK UNIT.	627A-00-23

Objective - 09 DEC 74

(U) To obtain comparisons of candidate nosetip and heatshield materials for possible reentry vehicle operational use.

PROJECT NO. 627A - ABRES SUPPORT

TITLE. BIAXIAL STRAIN MEASUREMENT OF NOSETIP AND SUBTIP MATERIALS USING SURFACE LINE INTERFERENCE

CONTRACTOR.	MICHIGAN STATE UNIVERSITY
CONTRACT.	
CONTRACT DURATION.	MAY75-
AFML PROJECT ENGINEER.	HINNERICHS TERRY D
PROJ/TASK/WK UNIT.	627A-00-30

Objective - 09 JAN 75

(U) The objective of the program is to evaluate and investigate the use of surface line interference on the surface of polycrystalline graphite and tungsten specimens to determine the surface strain field in a high heat flux environment.

Progress-A 01 MAY 75 To 24 SEP 75 (Interim-A)

(U) Analysis of various reflective surfaces are being made for adequacy at elevated temperatures (i.e., 2500 degrees F). Indentations made directly in the graphite have been unsuccessful. Tungsten samples have possibilities for good reflectance if the high temperature oxidation can be stopped. Various bonding techniques are being evaluated for bonding platinum coupons to graphite specimens for reflective surfaces as platinum provides an adequate refletivity for the surface line interferometry strain measurement technique.

PROJECT NO. 7340 - NON-METALLIC MATERIALS

TITLE. CARBON/CARBON SUBSTRATES FOR THROAT INSERTS OF SOLID PROPELLANT ROCKET NOZZLES

CONTRACTOR.	T R W INCORPORATED
CONTRACT.	F33615-74-C-5162
CONTRACT DURATION	JUN74-OCT75
AFML PROJECT ENGINEER.	LATVA JOHN D
PROJ/TASK/WK UNIT.	7340-01-56

Objective - 31 AUG 73

(U) To develop a carbon/carbon composite substrate that is thermally and structurally compatible with pyrolytic graphite coatings for use as solid rocket nozzle throat inserts of advanced ICBM propulsion systems.

Progress-B 10 SEP 74 To 11 APR 75 (Interim-B)

(U) The objectives of the Task I analysis/ requirements definition activities of identification of property goals for the initial materials development were achieved. The target properties were defined and the four approaches to be pursued to achieve the properties in carbon/carbon composite substrates were outlined. They consist of two coated and two substrated approaches. A selection of the two concepts will be made for more detailed property characterization and scale-up for fabrication of the 7-inch diameter nozzle throat inserts. A revised program schedule is being defined. The tentative test date for the first 15 second firing has been slipped nine months to May 1976.

PROJECT NO. 7350 - CERAMICS AND GRAPHITE

TITLE. RESEARCH ON DEVELOPMENT OF MULTIDIRECTIONAL REINFORCED GRAPHITE COMPOSITES FOR ADVANCED RV APPLICATION

CONTRACTOR. GENERAL ELECTRIC CO
CONTRACT. F33615-71-C-1436
CONTRACT DURATION. MAR71-AUG74
AFML PROJECT ENGINEER. LATVA JOHN D
PROJ/TASK/WK UNIT. 7350-02-09

Objective - 26 OCT 71

(U) TO PROVIDE THE NECESSARY TECHNOLOGY INFORMATION LEADING TO THE DEVELOPMENT OF IMPROVED HIGH MODULUS FIBER-REINFORCED GRAPHITES (CARBON-CARBON COMPOSITES) SUITABLE FOR REENTRY VEHICLE APPLICATIONS. SPECIFICALLY SOUGHT ARE COMPOSITES WHICH HAVE IMPROVED STRENGTH AND STRAIN-TO-FAILURE IN CRITICAL DIRECTIONS WITHIN COMPONENTS AND TOUGHNESS WHICH PREVENTS CATASTROPIC FAILURE FROM HIGH THERMAL GRADIENTS.

Progress-E 10 SEP 74 To 30 APR 75 (Interim-E)

(U) The C-Cap post-test evaluations have been completed. The ,fine spacing, GE 2-2-3 modification for the CERA program,(GE 1-1-3), was densified by the combined CVD&High Pressure pitch (Y-12) process. In recently completed ramp and high pressure ablation tests conducted in the AFFDL 50 MW facility, this material exhibited the highest transition pressure and lowest ablation rate of any SOA C/C nosetip material. The final report is being prepared.

PROJECT NO. 7350 - CERAMICS AND GRAPHITE

TITLE. INVESTIGATION OF PROCESSING VARIABLES WHICH CONTROL THE STRUCTUR AND PROPERTIES OF CVD SIC/C FOR NOZZLE COATINGS

CONTRACTOR. ATLANTIC RESEARCH CORP
CONTRACT. F33615-74-C-5098
CONTRACT DURATION. APR74-JUN75
AFML PROJECT ENGINEER. LATVA JOHN D
PROJ/TASK/WK UNIT. 7350-02-14

Objective - 05 OCT 73

(U) To formulate theoretical models which can be used to predict and control the codeposition of Pyrolytic graphite and silicon carbide. The sensitivity of properties to structure will also be modeled and investigated.

Progress-B 24 OCT 74 To 11 APR 75 (Interim-B)

(U) Work has been completed on the flow analog tests which were aimed at obtaining visualization of flow in atmospheric pressure deposition furnaces. Through use of the water analog it has been possible to obtain a qualitative characterization of flow patterns to identify major causes of flow instability and to identify regions where eddies form. The reduced pressure coating work is concluding with attemps to coat a realistic nozzle component shape. Initial runs have been made on a simulated one-half scale MX nosecap substrate. The information being obtained in this program has greatly aided AFRPL in resolving their large-scale nozzle deposition problems. The final report is being prepared.

PROJECT NO. 7351 - SUPPLIES

TITLE. ARREST MECHANISMS FOR DYNAMIC UNSTABLE PROPAGATING CRACKS

CONTRACTOR.	ROCHESTER UNIVERSITY OF
CONTRACT.	F33615-74-C-5064
CONTRACT DURATION.	MAR74-
AFML PROJECT ENGINEER.	HINNERICHS TERRY D
PROJ/TASK/WK UNIT.	7351-06-95

Objective - 31 JUL 73

(U) To understand the mechanisms and variables responsible for arresting dynamic unstable propagating cracks and to provide a starting point for developing a crack arrest methodology for designing aircraft parts and structures.

Progress-A 01 MAR 74 To 11 APR 75 (Interim-A)

(U) Fast running cracks (i.e., greater than 100 feet/second) have been propagated in Mil Grade Ti-6Al-4V double-cantilever-beam specimens at room temperatures. The specimen is rigidly supported at its uncracked end and the crack is wedged open by a moving wedge (5 feet/second) at the precracked end. Data reduction showed KId equal to 70 Ksi the square root of inch. Also no strain rate dependence was evident in evaluating KId at crack velocities from 10 super 3 to 10 super 4 cm/second. Side grooves of 1/4 the thickness per side were required to maintain the crack along the DCB specimen centerline. Ti-6Al-4V as received from an Air Force titanium scrap reclamation program has been chosen as a potential crack arrestor material due to very high toughness as indicated by charpy impact tests. The scrap titanium absorbed 3 to 4 times more energy in the transverse direction as did the Mil Grade titanium at temperatures from 25 to minus 196 degrees C. Microstructural examination showed the scrap titanium to have a much finer microstructure than the Mil Grade titanium. Mechanical tensile data has also been gathered on both materials.

PROJECT NO. 7371 - RESEARCH IN ELECTRICAL MATERIALS

TITLE. PHYSICAL PROPERTIES OF RARE EARTH-COBALT MAGNETS

CONTRACTOR.	DAYTON UNIVERSITY OF
CONTRACT.	F33615-74-C-5056
CONTRACT DURATION.	APR74-
AFML PROJECT ENGINEER.	HEINRICH JOHN P
PROJ/TASK/WK UNIT.	7371-03-30

Objective - 28 JUN 73

(U) To provide data on the physical properties of rare earth-cobalt magnets so that they may be more efficiently and expeditiously integrated in AF Systems.

Progress-B 01 AUG 74 To 11 APR 75 (Interim-B)

(U) Sample magnets have been obtained from Raytheon, the principal supplier for AF systems. Data on time- temperature cycles has been supplied by Pratt-Whitney from on-engine alternator tests done with the assistance of the F-15-SPO. The sample magnets are currently being tested under static load. An F-15 alternator has also been supplied by PWA and simulation tests using the time-temperature characteristics supplied are currently under way.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. RESEARCH EFFORT TO IMPROVE BULK GRAPHITE MATERIALS

CONTRACTOR.	STACKPOLE CARBON CO
CONTRACT.	F33615-75-C-5080
CONTRACT DURATION.	OCT74-SEP77
AFML PROJECT ENGINEER.	PRATT CLARENCE A
PROJ/TASK/WK UNIT.	7381-02-48

Objective - 17 JUL 74

(U) To provide an effective means for assisting the contractor in optimizing corporate efforts to develop an improved graphite.

Progress-A 01 OCT 74 To 11 APR 75 (Interim-A)

(U) Contractor,s internal research effort has been inactive during this period. A technical meeting will be scheduled to provide information exchange relative to AF requirements

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. INCREMENTAL PLASTICITY ANALYSIS OF GRAPHITIC RVNT

CONTRACTOR.	WEILER RESEARCH INC
CONTRACT.	F33615-72-C-1934
CONTRACT DURATION.	JUN72-MAR74
AFML PROJECT ENGINEER.	BUDDE CHARLES L
PROJ/TASK/WK UNIT.	7381-02-66

Objective - 01 MAR 74

(U) To develop elastic-plastic multimodulus material model for graphite. Also to compare incremental plastic, deformation plastic, and linear elastic solutions for thermostructural response of graphitic materials during a reentry trajectory.

Progress-E 24 OCT 74 To 11 APR 75 (Interim-E)

(U) An incremental plasticity thermostructural analysis is being conducted on the B3C trajectory. Difficulties with the OASIS computer code are being investigated.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. FAILURE CRITERIA OF POLYCRYSTALLINE GRAPHITE

CONTRACTOR.	PROTOTYPE DEVELOPMENT ASSOCIATES INC
CONTRACT.	F33615-74-C-5033
CONTRACT DURATION.	FEB74-
AFML PROJECT ENGINEER.	HINNERICHS TERRY D
PROJ/TASK/WK UNIT.	7381-02-74

Objective - 12 JUN 73

(U) Development of a failure criteria, which given the stress and/or strains fields produced by thermostructural loading will result in a statistical prediction of the failure probability based on uniaxial data.

Progress-B 02 MAR 74 To 23 OCT 74 (Interim-B)

(U) A Weibull type of analysis has been used as the basis for the analysis, however the initial flaw distribution and severity is critical to the prediction. Such phenomena is biaxiality, statistical effects, and volume dependence mathematically are derived from this approach.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. VAPORIZATION OF GRAPHITIC MATERIALS AT HIGH MASS TRANSFER RATES

CONTRACTOR.	ACUREX CORP AEROTHERM DIV
CONTRACT.	F33615-74-C-5094
CONTRACT DURATION.	APR74-
AFML PROJECT ENGINEER.	JUMPER GEORGE Y
PROJ/TASK/WK UNIT.	7381-02-79

Objective - 03 OCT 73

(U) To obtain high quality engineering data of the mass loss of graphite. To determine by definitive experiment if sublimation kinetics can be significant in the ablation of graphitic materials for reentry conditions.

Progress-B 24 OCT 74 To 11 APR 75 (Interim-B)

(U) Survey of existing arc heater facilities revealed that the probability of providing any significant improvement to the graphite mass loss data base was not sufficient to warrante experimentation at this time. An increase in total enthalpy of the air stream and improved pyrometer view angle are required. Modification of NASA Ames AEHS facility is near completion.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. PREPARATION OF A TRANSMISSION ELECTRON MICROSCOPY/SCANNING ELECTRON MICROSCOPE FRACTOGRAPH HANDBOOK

CONTRACTOR.	MCDONNELL DOUGLAS CORP
CONTRACT.	F33615-74-C-5004
CONTRACT DURATION	OCT73-MAR75
AFML PROJECT ENGINEER.	HENDERSON RUSSELL L
PROJ/TASK/WK UNIT.	7381-03-35

Objective - 25 APR 73

(U) Obtain high quality, high magnification TEM and SEM pictorial representations of known fracture modes.

Progress-A 15 OCT 73 To 30 APR 75 (Interim-A)

(U) All selected alloys have been tested and the fractures pictorially recorded bythe SEM. and TEM, and their fracture modes characterized. A two-month no-cost time extension was added to the contract. The final report is being prepared for review.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. PREPARATION OF AERONAUTICAL STANDARDS FOR MATERIALS AND PROCESSES

CONTRACTOR.	SOCIETY OF AUTOMOTIVE ENGINEERS
CONTRACT.	F33615-75-C-5007
CONTRACT DURATION.	JUL74-
AFML PROJECT ENGINEER.	MAROLO SAM A
PROJ/TASK/WK UNIT.	7381-03-37

Objective - 01 JUL 74

(U) To provide updated and new specification on various emerging materials and processes for use in systems.

Progress-A 01 JUL 74 To 11 APR 75 (Interim-A)

(U) A total of twelve rough drafts of specifications have been prepared and received. Approved drafts are currently being coordinated with designated government agencies and selected industrial organizations.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. DESIGN CRITERIA ON THE RESPONSE OF TRANSPARENT AIRCRAFT WINDSHIELD MATERIALS TO BIRD IMPACT

CONTRACTOR.	GOODYEAR AEROSPACE CORP
CONTRACT.	F33615-72-C-1896
CONTRACT DURATION.	JUN72-JUN75
AFML PROJECT ENGINEER.	MAROLO SAM A
PROJ/TASK/WK UNIT.	7381-06-69

Objective - 30 AUG 72

(U) To obtain engineering data on the capabilities of emerging transparent materials such as polycarbonates, glass-plastic composites, acrylic clad polycarbonates, polyarylsulfones, and laminates utilizing ethylene terpolymer interlayers when subjected to bird strikes.

Progress-E 27 AUG 74 To 11 APR 75 (Interim-E)

(U) AFML-TR-74-234 entitled, .Bird Strike Capabilities of Transparent Aircraft Windshield Materials,, dated December 1974 was published. It presents and assesses the response of 289 aircraft windshield material panels. The effect of panel temperature, curvature, width, impact angle, and variation in bird weight are evaluated over a speed range from 70 to 630 knots. Additional panels are being fabricated for bird impact testing to evaluate other influential factors which affect bird penetration resistances of monolithic and composite windshields.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. MECHANICAL PROPERTY DATA SHEETS ON NEW ALLOYS

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-73-C-5073
CONTRACT DURATION.	APR73-JUN75
AFML PROJECT ENGINEER.	HARMSWORTH CLAY L
PROJ/TASK/WK UNIT.	7381-06-75

Objective - 08 SEP 72

(U) To obtain comparative engineering data on new materials and existing materials in new forms or produced by new processes. Data is presented in the form of engineering data sheets to reduce the time lag between the development of a new material and its use in a weapon system.

Progress-D 04 SEP 74 To 11 APR 75 (Interim-D)

(U) Testing on contract F33615-73-C-5073 has been completed. Materials which were evaluated were 7049-T7351 plate, Incoloy 903 sheet, 7475-T7351 plate, 2419-T851 plate, Ti-6-2-2-2-2 bar, Ti-6-2-1-1 plate, Inconel 617 sheet, Ti-6Al-4V Beta annealed plate, Ti-6Al-4V Isothermal forging, Ti-6Al-4V casting, and 201.0 aluminum castings. A new evaluation effort has been initiated under Contract F33615- 75-C-5065. Materials currently being considered are 7050-T7351 large extrusions, Ti-6Al- 6V-2Sn Beta processed, Ti-6Al-4V isothermal forgings, Mod. 10 Ni Steel, Ti-10V-2Fe-3Al, Ti-6Al-4V powder met component, and approximately four other materials not yet selected.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. ADHESIVE BONDED AEROSPACE STRUCTURES, STANDARDIZED REPAIR HANDBOOK

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-73-C-5171
CONTRACT DURATION.	OCT73-
AFML PROJECT ENGINEER.	SCARDINO WELDON M
PROJ/TASK/WK UNIT.	7381-06-77

Objective - 20 FEB 73

(U) Standardization of adhesive bonding repairs and establishing limits and methods for adhesive repairs at depots.

Progress-C 17 SEP 74 To 11 APR 75 (Interim-C)

(U) Phase I - Review and catalogue existing documentation, visit repair depots - completed. Phase II - Evaluate materials and processes- completed, report received and being reviewed. In December, an A.F./industry workshop was held to review progress, proposed format, problems, etc. A unique development of the phase II M&P work has been the successful demonstration of hand applied phosphoric acid anodizing which gives aluminum surfaces an extremely durable surface. This could be used to prepare aluminum surfaces in-situ with readily available equipment. Phase III work has commenced. This includes (1) completion of initial handbook draft for small area repairs, (2) verification of small repairs on test components, (3) development of methods for large area repairs, and (4) demonstration of large area repairs.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. QUICK REACTION EVALUATION OF MATERIALS FOR SYSTEMS AND HARDWARE APPLICATION

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-74-C-5024
CONTRACT DURATION.	JAN74-
AFML PROJECT ENGINEER.	OLEVITCH ALBERT
PROJ/TASK/WK UNIT.	7381-06-78

Objective - 05 MAR 73

(U) To provide quick reaction evaluations and analyses for the investigation of materials aspects involved in failures involving aircraft and missiles. To provide quick ,fixes, to hardware materials problems and to provide data in support of materials selection for Systems Project Offices in SAMSO, ASD, ESD, Eglin AFB and other AF organizations.

Progress-D 27 AUG 74 To 11 APR 75 (Interim-D)

(U) A promising primer for securing good bonds of sealant to concrete and steel has been identified and will be recommended to SAMSO for their dynamic (high strain rate) testing. Compatibility of sealants with JP-4 having high mercaptan sulfur contents is being investigated in support of an Aeropropulsion program to relax present fuel specification. Hydrolytic stability and fuel resistance of an integral tank foam for fire and explosion suppression was determined. Testing to find improved primers for user in repair of leaking integral tanks of the C-130 is in progress. Durability testing of candidate structural adhesive was initiated. Storage life tests of several sealants were conducted.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. DESIGN DATA ON JOINTS USING FATIGUE IMPROVEMENT FASTENERS

CONTRACTOR.	BATTELLE MEMORIAL INSTITUTE
CONTRACT.	F33615-73-C-5111
CONTRACT DURATION.	JUN73-
AFML PROJECT ENGINEER.	BRISBANE ALTON W
PROJ/TASK/WK UNIT.	7381-06-80

Objective - 03 NOV 72

(U) To provide engineering and design data on fastener joints using fatigue improvement fasteners. This information is intended for inclusion in Chapter 8 of MIL-HDBK-5. In addition, these data must be presented so that yet to be designed fasteners, can be evaluated fairly in fatigue for comparison with current fastener designs.

Progress-C 04 SEP 74 To 11 APR 75 (Interim-C)

(U) To date, all test specimens which include smooth, notched, reverse dogbone and simple lap joint have been fabricated. The reverse dogbone and simple lap joint specimens allocated for testing at AFML/MBE have been received. Fatigue and tension testing of these specimens have been started. The contractor has completed test series 1, 2 and 4. Test series one is for obtaining tensile properties of the base materials. Test series two and four are for obtaining fatigue data on 0.625 inch thick 7075-T73 aluminum reverse dogbone specimens. The fasteners used in the reverse dogbone specimens are TaperLok and Hi Tigue.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. ENVIRONMENTAL RESISTANCE OF COATED AND LAMINATED POLYCARBONATE TRANSPARENCIES

CONTRACTOR.	GOODYEAR AEROSPACE CORP
CONTRACT.	F33615-74-C-5005
CONTRACT DURATION.	NOV73-JUN75
AFML PROJECT ENGINEER.	MAROLO SAM A
PROJ/TASK/WK UNIT.	7381-06-81

Objective - 11 APR 73

(U) To determine and define the environmental resistant characteristics of slected coated and acrylic laminated polycarbonate aircraft windshield materials when exposed to critical aggressive environments.

Progress-C 27 AUG 74 To 09 JUN 75 (Interim-C)

(U) Candidate coated and laminated polycarbonate materials were exposed to accelerated laboratory weathering environments and to three and six months outdoor weathering at Phoenix, Arizona and Miami, Florida. Their physical and mechanical have been evaluated and the results are currently being assessed. Outdoor weathering specimens will be evaluated after 9 and 12 months of exposure.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. STRESSED DURABILITY OF ADHESIVE BONDED JOINTS

CONTRACTOR.	BOEING CO
CONTRACT.	F33615-74-C-5065
CONTRACT DURATION.	FEB74-
AFML PROJECT ENGINEER.	SCARDINO WELDON M
PROJ/TASK/WK UNIT.	7381-06-82

Objective - 11 APR 75

(U) To evaluate the stressed durability of aluminum bonded assemblies and surface preparation methods, and to determine the validity of durability test methods.

Progress-B 17 SEP 74 To 11 APR 75 (Interim-B)

(U) The literature survey and selection of test specimen configuration is being published as AFML-TR-75-3. Thick adherend lap shear specimens for Phase III (Tasks 1 and 6), verification of test method and influence of test temperature, encountered technical difficulties resulting in specimens being remade at no cost to the AF. For this, a 5 month no-cost extension has been granted. Phase III, Stressed Durability Testing, is in progress. Many of the specimens require one-year,s exposure to heat and humidity. The program was amended to include several new tasks to support the PABST program.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. CRACK GROWTH TESTING

CONTRACTOR.	WESTINGHOUSE ELECTRIC CORP
CONTRACT.	F33615-75-C-5064
CONTRACT DURATION.	MAY75-JUN75
AFML PROJECT ENGINEER.	GUNDERSON ALLAN W
PROJ/TASK/WK UNIT.	7381-06-86

Objective - 29 MAY 74

(U) To develop a standard test methodology for obtaining crack growth data. To develop data on selected alloys and to analyze, evaluate and select a method of data consolidation and presentation for use in the Damage Tolerant Design Handbook and other handbooks.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. DATA SHEETS ON ADVANCED COMPOSITES

CONTRACTOR.	DAYTON UNIVERSITY RESEARCH INSTITUTE
CONTRACT.	F33615-75-C-5085
CONTRACT DURATION.	MAR75-
AFML PROJECT ENGINEER.	KNIGHT MARVIN
PROJ/TASK/WK UNIT.	7381-06-87

Objective - 06 JUN 74

(U) To develop engineering data sheets on advanced composite materials.

Progress-A 06 JUN 74 To 11 APR 75 (Interim-A)

(U) The contractor,s principal investigation has visited AFML to discuss the program with the AFML project engineer. Another meeting has been scheduled for 14 March 1975.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. DAMAGE TOLERANT DESIGN DATA FOR PROPULSION SYSTEMS

CONTRACTOR.	UNITED TECHNOLOGIES CORP /RSCH LABS/
CONTRACT.	F33615-75-C-5130
CONTRACT DURATION.	APR75-JUN75
AFML PROJECT ENGINEER.	GUNDERSON ALLAN W
PROJ/TASK/WK UNIT.	7381-06-89

Objective - 06 SEP 74

(U) To obtain crack propagation, fracture toughness, thermal fatigue, and strain cycled-low cycle fatigue data under engine environmental conditions.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. PROPERTIES OF COATINGS, SURFACE TREATMENTS, PROCESSING CHEMICALS, AND METALLURGICAL FAILURE ANALYSIS

CONTRACTOR	ROCKWELL INTERNATIONAL CORP
CONTRACT.	F33615-72-C-1376
CONTRACT DURATION	APR72-
AFML PROJECT ENGINEER.	CHILDERS SIDNEY
PROJ/TASK/WK UNIT.	7381-07-35

Objective - 15 NOV 72

(U) To determine applications, establish properties, obtain design data and develop evaluation tests for new experimental or proprietary coatings and surface preparation materials for operational and future weapon systems; conduct metallurgical failure analysis.

Progress-D 16 FEB 74 To 11 APR 75 (Interim-D)

(U) Evaluation of high temperature coatings for jet engine test cell noise suppressors has been completed. Strippers are being evaluated for use in removing sealant materials from F-111 aircraft. The elevated temperature capability of polysulfide primer has been determined from the standpoint of protection against corrosion after exposure to temperatures of 150 degrees F through 350 degrees F in 25 degree increments. A program is in progress to determine the durability of abrasive filled paints for runway markings. Work is in progress to evaluate the efficiency of new strippers for removing rain erosion coatings from radomes and any detrimental effect on mechanical properties. An evaluation is in progress to identify coatings for use on fire trucks that are resistant to new type fluorinated fire extinguishing fluids. An extensive effort on failure analysis of failed aerospace structural parts was accomplished. Considerable data have been derived on non-polluting paint strippers which will be utilized in preparation of a specification. A program has been completed on the stress crazing effect of detergents on polycarbonate transparancies.

PROJECT NO. 7381 - RESEARCH APPLICATIONS

TITLE. STRUCTURAL ALLOYS IN REPRESENTATIVE AIRCRAFT ENVIRONMENTS

CONTRACTOR.	ALUMINUM COMPANY OF AMERICA
CONTRACT.	F33615-74-C-5089
CONTRACT DURATION.	MAY74-
AFML PROJECT ENGINEER.	GUNDERSON ALLAN W
PROJ/TASK/WK UNIT.	7381-07-43

Objective - 26 AUG 74

(U) To obtain environmental property data on several production wrought aluminum alloys.

Progress-B 27 AUG 74 To 11 APR 75 (Interim-B)

(U) The materials have procured and the machining and testing efforts have started.

PROJECT NO. 7360 - CHEMISTRY AND PHYSICS OF MATERIALS

TITLE. EXPERIMENTAL MATERIALS OF INTEREST TO THE AF USING INSTRUMENTAL AND CHEMICAL TECHNIQUES

CONTRACTOR.	MIAMI UNIVERSITY
CONTRACT.	F33615-73-C-5013
CONTRACT DURATION.	DEC72-
AFML PROJECT ENGINEER.	HOUSTON CHARLES D
PROJ/TASK/WK UNIT.	7360-05-42

Objective - 12 JUL 72

(U) The development of techniques and equipment necessary to establish the compositional and structural analysis of Air Force materials. Application of these capabilities to the evaluation and analysis of research and conventional materials.

Progress-C 10 SEP 74 To 11 APR 75 (Interim-C)

(U) R and D efforts produced the following papers. ,The Vibrational Spectra and Structure of Chloroacetic Acid.. ,The Vibrational Spectra and Structures of Organic Acids and their Derivative.. and ,The Vibrational Spectra of a-Bromoacetaldehyde Dimethyl Acetal and Related Molecules.. It also established the structure and/or compositional analysis of approximately 650 samples.

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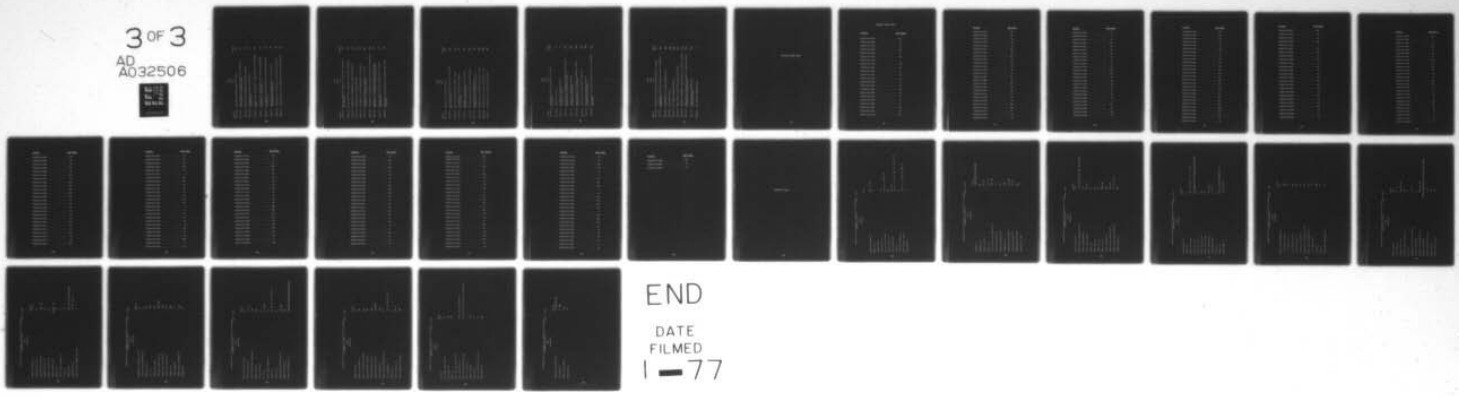

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