Contrails

BIBLIOGRAPHY:
ON-BOARD IN-FLIGHT CHECKOUT
PART II. LITERATURE CITATIONS

JAMES L. JOHNSON

*** Export controls have been removed ***

FOREWORD

This literature survey/bibliography was prepared by the Electronics Systems Center of the IBM Federal Systems Center of the IBM Federal Systems Division, Owego, N. Y., with the assistance of the Airplane Group of The Boeing Company, Seattle, Washington. It is submitted in fulfillment of the requirements of Item Ia of the Statement of Work of Contract AF33(615)-3700.

The IBM effort is sponsored by the Ground Support Branch, Support Technology Division of the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, under the direction of Mr. J. M. Ferguson.

This literature survey/bibliography covers work from January 1962 to mid-1966 and is issued in two documents: Part I includes KWIC and author indices; Part II, literature citations with comments. The report was submitted 6 December 1966.

This report has been reviewed and is approved.

R. Sherrill, Chief
Ground Support Branch
Support Technology Division

ABSTRACT

A literature search was made and an annotated bibliography prepared
during the course of a study of On-Board In-Flight Checkout (OBIFCO).
The bibliography covers documents of interest to the areas of on-board
computers, checkout techniques, automatic checkout equipment, and
related subjects and consists of more than 200 citations as well as KWIC
and author indices. The work covers the period from January 1962 to
mid-1966 and references reports, journal articles, and symposia.

(This abstract is subject to special export controls and each transmittal
to foreign governments or foreign nationals may be made only with prior
approval of Support Technology Division (APF), Air Force Aero Propulsion
Laboratory, Wright-Patterson AFB, Ohio.)

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INTRODUCTION

As a part of Contract AF33(615)3700, IBM has been studying the potential advantages and limitations of on-board in-flight checkout (OBIFCO) as applied to military aircraft.

The portion of this work included herein is an analysis of existing literature associated with OBIFCO techniques. Since very little work has been done on in-flight system monitoring, the search concentrated on aspects of related fields that would be of interest in designing an OBIFCO system. The following disciplines and practices are among those used as a guide in selecting related literature:

- Automated checkout of any aircraft, spacecraft, or missile systems

- Digital checkout techniques

- Fault isolation

- Trend analysis and failure prediction

Literature sources include published reports, symposia, technical journals, and magazines. Each source is evaluated on a separate sheet, which includes all publication data as well as the scope (generally an abstract) and a statement of applicability to OBIFCO. In those cases where the document was given as a reference but was not physically available, no applicability is given. Certain selections were not applicable to OBIFCO, but are included because of their general interest or pertinence to a related field, such as spacecraft checkout.

Emphasis has been placed on documents issued after 1961, because a similar literature search conducted by the Battelle Memorial Institute covered pre-1962 data. This report, "An Annotated Bibliography of Automatic Checkout for Weapons Systems and Astronauts," was published as ASD-TDR-62-376 in March 1962. The first 124 entries (those dealing with weapons systems) are included without comment as References 1 through 124.

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This document, when originally published on July 18, 1966, included 201 literature references. The current revision contains 227 references, and incorporates two indexes and a complete summary bibliography. The key-word-in context (KWIC) index is an alphabetical listing of significant words in the title, along with several words of context. Also included in this list are corporations, publications, and selected descriptors. The author index references articles alphabetically by author. Both indexes include articles cited in the Battelle document as well as those described on individual sheets.

References numbered in the 200's were published in 1962 or earlier, but not included in the Battelle document. The initial digit of the remaining documents indicates year of publication; for example, reference 301 was published in 1963.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 201

TITLE: Final Report on the Formulation of Automatic Checkout Techniques

AUTHOR: A. A. B. Pritsker, et al.

COMPANY: Battelle Memorial Institute for Aeronautical Systems Division,
Flight Accessories Laboratory, WPAFB, under contract
AF 33(616)-7761

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: ASD-TDR-62-291

DATE: March 1962   PAGES: 352

SCOPE: The report describes methods for using automatic checkout
equipment and manipulating the data. Techniques are developed
for estimating weapon system performance, predicting failures, setting
tolerance limits, and isolating faults. Examples are given, along with
discussion of programming language (PLACE), communications flow,
and display methods.

APPLICABILITY: This document contains information applicable to
several aspects of automatic testing that will be
considered in an OBIFCO design. Although it appears slanted toward
electronic systems to which a calibrated stimulus can be applied, the
results may be utilized for general systems monitoring.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 202

TITLE: Data Compactors For Space Vehicles

AUTHOR: Fred W. Ellersick

COMPANY: IBM Communications Systems Center, Rockville, Maryland

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference Proceedings

DATE: May 1961   PAGES: 6.2.6-1 to 6.2.6-5

SCOPE: Feasibility of data compression (compaction) for spaceborne
         PCM telemetry systems is discussed. Several compactor
designs are shown along with a quantitative statement of the advantages
of compaction and a review of run-length coding.

APPLICABILITY: The types of hardware and logic provided for compaction
                      are applicable to the OBIFCO study.

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TITLE: Factors Affecting degree of Automation in Test and Checkout
Equipment

AUTHOR:

COMPANY: Dunlap and Associates, for RAND Corporation

REPORT_x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: D and A-TR-60-36F

DATE: 1 March 1961   PAGES: 224

SCOPE: A survey was made of existing (1960-61) applications of automatic
checkout equipment.   Use was found to be inefficient due to lack
of a systems approach.   The report defines specific instances of ineffective-
ness, presents guidelines for optimum use of automation, and describes
selected design features which could materially improve operational
aspects of automatic checkout equipment.

APPLICABILITY: This report presents a candid evaluation of automatic
checkout techniques, with many criticisms still
pertinent.   It alerts the OBIFCO designer to subtle applications and
requirements that might otherwise be overlooked.   In particular, it
presents a perspective that might prevent incorporation of too much
automation, which often results in loss of adaptability.

TITLE: Operational Criteria for Missile Readiness Testing

AUTHOR: S. I. Firstman

COMPANY: The RAND Corporation, sponsored by USAF under contract
AF 49(638)-700

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: IRE Transactions on Military Electronics, 1962

DATE: March 1, 1962   PAGES: 251-259

SCOPE:

   This paper considers estimation of the probability that a missile
is operationally ready as a function of various test techniques. Continuous
monitoring is compared with periodic checks and scheduled replacement
without checking.

APPLICABILITY:

   Although the time scales chosen for this analysis apply more to
launch-ready missiles than to aircraft systems, the techniques could
be applied in selecting a philosophy for frequency of on-board tests.

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TITLE: Diagnosis in Automatic Checkout

AUTHOR: S. E. LaMacchia

COMPANY: Battelle Memorial Institute, sponsored by Aeronautical Systems
Division, AF Systems Command, USAF, under contract
AF33(616)-7761

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_x_   MAGAZINE___

NAME OR NUMBER: IRE Transactions on Military Electronics

DATE: March 1, 1962   PAGES: 302-309

SCOPE: This paper summarizes several approaches to the problem of
isolating faults in a complex system. Such a diagnosis involves
logical analysis techniques to interpret test results, plus optimizing
techniques for greater efficiency in sequencing tests and processing data.
Boolean methods applicable to digital computers are discussed.

APPLICABILITY: The techniques described could be useful if a
fault has appeared through normal testing and it is
desired to isolate the failed component, whether for replacement or
assessment of remaining capability. In this case the subroutines would
be entered only when the fault appears.

They might also be employed to locate a fault not
recognizable by single go-no go tests, but only
by specific combinations of results.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 206

TITLE: Buffer Length Requirements for a Telemetry Data Compressor

AUTHOR: J. E. Medlin

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM_X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference

DATE: May 1962   PAGES: 9

SCOPE: Purpose of analysis is to find the buffer length required to
            maintain a negligible loss of data caused by buffer overflow.
The assumption is made that buffer input statistics can be described by
a poisson distribution.

APPLICABILITY: OBIFCO will possibly record certain parameters
                        on tape. If compression techniques are used to
remove redundancy, a buffer will be required to store the sampled data
being accepted at an irregular rate by the compressor before being
provided to the tape for storage at a uniform rate.

TITLE: A Data Bandwidth Compressor For Space Vehicle Telemetry

AUTHOR: John R. Hulmes and Richard A. Schomburg

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference Proceedings

DATE: May 1962   PAGES: 14

SCOPE: A versatile data bandwidth compressor which inhibits transmission of redundant data is described. The system is self-adaptive to varying data traffic conditions. Independent control of tolerance of each channel and special channel priorities and functional charges may be specified upon command. Representative circuits and performance characteristics are given. Specific circuit design is discussed.

APPLICABILITY: This redundancy reduction technique is definitely applicable to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 208

TITLE: An Adaptive Nonlinear Data Predictor

AUTHOR: A. V. Balakrishnon

COMPANY: University of California, Los Angeles

REPORT___ SYMPOSIUM_X_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: National Telemetering Conference Proceedings

DATE: May 1962   PAGES: 14

SCOPE: A method and philosophy of prediction and/or extrapolation
for use with telemetry data is outlined.

APPLICABILITY: This method probably requires too much computer
time for OBIFCO application. Preference for
simpler methods is shown in later articles.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 209

TITLE: Digital Data Compressors

AUTHOR: Daniel Hochman

COMPANY: Lockheed Missiles and Space Company

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE x

NAME OR NUMBER: Space/Aeronautics

DATE: June 1962   PAGES: 64-68

SCOPE: The digital compression data system proposed is based on
transmitting data only if a significant change has occurred
since the last sampling period. Control tolerance limits, forced memory
readout and assignment of priorities are discussed.

APPLICABILITY: This information is applicable to the data compression
problem for OBIFCO.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 210

TITLE: Self-Testing and Verification Techniques as Applied to an Airborne Military Guidance Computer

AUTHOR: W. R. Pfeil and N. H. Quan

COMPANY: Nortronics

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL X MAGAZINE___

NAME OR NUMBER: IRE Transactions on Military Electronics

DATE: July 1962   PAGES: 268-275

SCOPE: This paper discusses self-check and verification techniques applied to a digital airborne military guidance computer. Four levels of test are considered: Depot, Field, Preflight, and InFlight.

APPLICABILITY: This is a rather general discussion with limited applicability. Only the pre-flight and in-flight paragraphs are useful, and these are slanted more toward self-test than toward use of an external monitor.

<u>ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 211</u>

<u>TITLE:</u>   Quantitative Test Techniques for Advanced Automatic Checkout

<u>AUTHOR:</u>   M. C. Peterson and R. A. Kirkman

<u>COMPANY:</u>   TRW Space Technology Laboratories

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL X   MAGAZINE___

<u>NAME OR NUMBER:</u>   IRE Transactions on Military Electronics

<u>DATE:</u>   July 1962   <u>PAGES:</u>   240-250

<u>SCOPE:</u>   New test techniques and a better understanding of test objectives
          are needed to effectively utilize high-speed digital checkout
devices. Optimum selection of test points and operations can increase
reliability and availability, while lowering costs. Failures are classified
as a start toward selection of test definition. Results of testing two
electronic circuits are given.

<u>APPLICABILITY:</u>   Concepts and examples presented are basic to
                      development of an OBIFCO system, particularly
with respect to imposing design requirements on the systems to be tested.

NOTE: Similar material is contained in pages 337-347 of <u>Transactions,</u>
<u>winter convention, IRE Professional Group on Military Electronics,</u>
February 1962.

TITLE: The Case for Computers in Automatic Checkout

AUTHOR: R. E. Forbes

COMPANY: IBM, Endicott, New York

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Seminar on Automatic Checkout
Techniques, Battelle Memorial Institute

DATE: September 5-7, 1962   PAGES: 51-65

SCOPE: This paper surveys the use of computers in automatic checkout
equipment. Techniques for using computers are delineated for
test generation and test application. An example emphasizes the savings
in time and cost that can be effected.

APPLICABILITY: The approach is somewhat superficial, and therefore
is of value only in establishing the general need and approach for an
automated system such as OBIFCO. It is not applicable to configuring
or designing a system.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 213

TITLE: Message Compression

AUTHOR: H. Blasbalg and R. Van Blerkom

COMPANY: IBM, Federal Systems Division

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL X   MAGAZINE___

NAME OR NUMBER: IRE Transactions on Space Electronics and Telemetry

DATE: September 1962   PAGES: 228-238

SCOPE: Two general classes of compression are discussed, namely (1)
          entropy - reducing transformation and (2) information preserving
transformation (redundancy removal).   The concept of adaptive coding is
introduced and the buffer overflow problem is considered.

APPLICABILITY: This is a basic article on data compression providing
                  useful background information.   The suggestion is
made that the buffer overflow problem be solved, not by designing for
an acceptable probability of overflow, but by controlling the fidelity of the
source.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 214

TITLE: An automatic Self-Checking and Fault-Locating Method

AUTHOR: Fred Lee

COMPANY: Sylvania Electronic Systems

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IRE Transactions on Electronic Computers

DATE: October 1962   PAGES: 649-654

SCOPE: A technique is described for incorporating self-test features
        into a packaged electronic system by additional circuitry. A
timing capability and hardwire programming can give 100 percent
confidence that no fault exists, or define the fault down to one or two
circuit boards.

APPLICABILITY: Fault isolation to this level of component probability
                is not conducive to OBIFCO applications. However,
the basic concept should be examined for suitable modifications, such as
assistance from a central programming unit. It is possible that advantageous
tradeoffs exist with respect to such factors as number of wires between the
unit and a centralized OBIFCO processor.

TITLE: Pulse Analysis on High Speed Integrated Test System

AUTHOR: J. Bugler and D. Christiansen

COMPANY: IBM Federal Systems Division

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 63-816-3007

DATE: November 28, 1962   PAGES:

SCOPE: This program operates an experimental configuration for
         automatic test equipment which is computer controlled.   The
system measures characteristics such as amplitude, pulse width, rise
time, fall time and time delays and compares them with specified limits.

APPLICABILITY: The techniques described are typical of those which
                    might be employed by any high-speed integrated test
system such as OBIFCO.   The document would be useful in evaluating
whether IBM 1401 processes can be applied to an airborne computer.

TITLE: Gas Turbine Engine Condition Monitoring

AUTHOR: None indicated

COMPANY: Pratt & Whitney Aircraft

REPORT_X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Aircraft Gas Turbine Operation Information Letter,
Letter No. 15

DATE: Aug. 31, 61   PAGES: 19

SCOPE: This is an excellent report treating the Pratt and Whitney Aircraft
Co. philosophy on engine condition monitoring. The discussion covers
a description of the two categories of turbine engine parameters which can be
considered: those which must not exceed certain specified limits (called
"mechanical condition" parameters), and those which indicate engine "perform-
ance condition" as contrasted to its mechanical condition. Several examples
are given of malfunctions which can be indicated by parameter trend change.
Three methods of obtaining data are covered: (1) in-flight manual recording
by the flight crew; (2) ground recording; and (3) in-flight automatic
recording.

APPLICABILITY: The main contribution which this paper can make to the
OBIFCO Study is to provide a clear point of view of an
engine company regarding what we can expect a monitoring system to be able to
accomplish, and what mechanical and performance parameters should be monitored.
Some of the general discussion of the accuracy and frequency of measurement
of parameters for successful trend analysis should also be of value.

TITLE: Malfunction Detection with Vibration Instrumentation

AUTHOR: None indicated

COMPANY: Pratt & Whitney Aircraft

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Aircraft Cas Turbine Operation Information Letter, Letter No. 14

DATE: Sept. 14, 62   PAGES: 7

SCOPE: This report contains a general discussion of the usefulness of in-flight vibration monitoring to detect engine malfunctions. The discussion includes a description of a typical vibration monitoring system, monitoring procedure and conclusions regarding vibration monitoring.

APPLICABILITY: The report reaffirms the general conclusion that vibration amplitude of each engine is a necessary parameter for an OBIFCO system to monitor. Several of the conclusions are pertinent to the OBIFCO study. For example, it is stated that, although vibration during engine acceleration and deceleration should be monitored to determine if the vibration returns to normal after steady state operation is attained, the peak amplitude reached during transient engine operation is, in itself, not particularly important.

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<u>ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.</u> 218

<u>TITLE:</u>   ADEPT Computer Control

<u>AUTHOR:</u>   J. W. Gillings

<u>COMPANY:</u>   Nortronics Systems Support, under contract AF33(604)-29644

REPORT <u>X</u>   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

<u>NAME OR NUMBER:</u>   NSS 783

<u>DATE:</u>   December 6, 1960   <u>PAGES:</u>   65

<u>SCOPE:</u>   This report presents the findings of an investigation into the
feasibility of using a digital computer for control of an automatic
testing system such as ADEPT (Air Force Depot Performance Tester).
The purpose of the study is <u>not</u> to determine if such a concept is technically
possible; this has already been demonstrated.   The main intent of the
study is to describe the desired characteristics of a digital computer for
control of automatic testing systems and to consider the improvements
which may be achieved over conventional automatic testing systems.   The
scope of study includes analysis of test requirements for seven electronic
equipments at Dayton Air Force Depot (DAFD), synthesis of a hypothetical
computer-controlled testing system, and determination of the benefits
derived from application of computer control to automatic testing.

<u>APPLICABILITY:</u>   The concepts involved with defining test requirements
and developing a computer program to satisfy them are basic to
OBIFCO.   This document, even though dated and slanted toward depot
level testing, could prove useful in OBIFCO design.

TITLE: Development of a Traversing Rake System for Measuring In-Flight
Thrust of a Turbo-Jet Powered Aircraft --- Phase III Final Report

AUTHOR: R. L. Brovetto and D. W. Haines

COMPANY: Grumman Aircraft Engineering Corporation

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Report No. FA-B7-111-1-008

DATE: March 1962   PAGES: 154

SCOPE: Phase III, the flight test and final phase, of the Development of a
             Traversing Rake System for Measuring In-Flight Thrust of a Turbo-Jet
Powered Aircraft project has successfully accomplished its prescribed objectives
which may be summarized as follows. The installation and reliability of the
traversing rake system on the test aircraft was demonstrated.

        Gross thrust determined for complete traverse cycles under stabilized
flight conditions always repeated within 3%. The corresponding values of mass
flow and net thrust always repeated within 4% and $3\frac{1}{2}\%$ respectively.

        The correlation of the traversing rake with subsonic airplane measured
performance and wind tunnel drag showed that performance of the test aircraft
could be accounted for within +2% to -6% of the wind tunnel drag. The difference
in supersonic drag varied from 35 counts, or 7%. at M_T - 1.03 to 5 counts, or
1% at M_T - 1.07.

        The traversing rake flight test results have shown that propulsive
net thrust calculated using commonly accepted in-flight thrust calculation
procedures only partially accounted for the differences between the actual
measured airplane performance and that predicted by wind tunnel and engine
test cell results. In the past, these differences could not be accounted
for adequately because of the practical instrumentation difficulties assoc-
iated with determining secondary and leakage mass flows and their effect on
the installed engine-ejector nozzle.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 220

TITLE: Final Report on a Study of Parameters that Measure the Airworthiness of a Gas-Turbine-Powered Civil Aircraft to Research Division Aviation Research and Development Service Federal Aviation Agency

AUTHOR:

COMPANY: Battelle Memorial Institute
FAA/BRD-239

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: July 31, 1961   PAGES: 281

SCOPE: This report is the result of a research study which has been conducted to relate the measurable parameters to the airworthiness of gas-turbine-powered civil aircraft. The measurable parameters associated with the airframe, propulsion systems, mechanical system, and electrical and electronic systems were included.

       The report concludes that trend-analysis techniques can be used to indicate malperformance and predict some incipient mechanical failures for gas turbine power plants and for some mechanical systems. A limited knowledge of materials and their modes of failure impeded the identification of useful parameters for most mechanical and electromechanical systems and for airframe elements.

APPLICABILITY: This report contains an excellant, detailed treatment of the monitoring of aircraft system parameters, and is directly applicable to the OBIFCO study. The report is concerned with subsonic turbine-powered transport aircraft; however, most of the results are applicable to V/STOL and supersonic aircraft, as far as they go, since the basic aircraft systems are generally quite similar.

       The OBIFCO study can be considered an extension into the Supersonic and V/STOL regimes of this Battelle Memorial Institute Study, and therefore covers several new areas such as the supersonic variable spike inlet, afterburners and supersonic exhaust nozzles. The OBIFCO study also placed more emphasis on automatic data acquisition and analysis as apposed to manual techniques. The Battelle study may even be of help in these new areas, as a guide to a logical, organized approach to the problem.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 221

TITLE: Space Logistics: Technology versus Management

AUTHOR: Chauncey F. Bell

COMPANY: Rand Corp., Santa Monica, Calif.

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: IAS Large Booster Symposium, Sacramento, Calif.

DATE: Aug. 1962   PAGES: 10

SCOPE: The paper postulates that there are few new factors or elements in space logistics. Rather, the space environment places increased importance on improved management of these support elements, calling in some cases for use of automatic fault-isolation, test, checkout, and data-reduction techniques.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 222

TITLE: C-141 Propulsion Unit - Controls - Description and Fault Analysis

AUTHOR: J. E. Huie

COMPANY: Lockheed Aircraft Corporation
AF 33(600) - 42941

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Report No. ER-5158

DATE: Oct. 25, 1962   PAGES: 94

SCOPE: Presents a description and fault analysis of the engine and fire
emergency control systems.

APPLICABILITY: Has some applicability to OBIFCO in the sense that the
engine control system failure analysis provides a good
description of a typical control system and possible faults. Application of
this information to OBIFCO is limited since, in some cases, it is not feas-
ible or worthwhile to incorporate the detection of these malfunctions in a
monitoring system, and in other cases the detection of the malfunction is
subjective and only possible by the flight crew or maintenance crew.

TITLE: Integration and Automatic Fault Location Techniques in Large Digital Data Systems

AUTHOR: Donald W. Liddell

COMPANY: U. S. Navy Electronics Laboratory, San Diego, Calif.

REPORT___   SYMPOSIUM **X**   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of 1962 Spring Joint Computer Conference

DATE: 1962   PAGES: 213 through 224

SCOPE: A digital computer, if used with proper programming techniques, can be a powerful tool during the processes of physical integration of complex digital data processing systems. After system integration, as such, has been completed the same techniques may be used to provide performance monitoring and daily calibration status data for all or any part of a system.

        Investigation of such programming techniques during system integration of the Developmental Navy Tactical Data System (NTDS) at USNEL produced results which indicated the possibility of using the computer for automatic fault location in the system. Some progress has been made in this area, and a program which allows the NTDS computer to identify a failing logic card associated with its own memory logic and switching circuitry has been successfully demonstrated. The final objectives of this approach are to provide facilities to perform on line performance monitoring and automatic fault location, reduce to a minimum the external test equipment required for a system, and eliminate insofar as possible the high degree of training presently required in the system maintenance technician.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 224

TITLE: The Role of Checkout-Status Control of Weapon Systems

AUTHOR: R. D. Sherrill

COMPANY: Aeronautical Systems Division, Wright-Patterson AFB, Ohio

REPORT___ SYMPOSIUM X TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle Memorial Institute

DATE: September 5-7, 1962   PAGES: 11-20

SCOPE: In order to explore the role of "Checkout" in our modern weapon system complex, "Checkout" activity is defined and its purpose is identified. The concept of Status Control is introduced as a means for viewing the various factors related to system support. Planning for Status Control is discussed to indicate how the relationships between "Checkout" and other activities or consideration may be identified for the individual weapon system. By viewing "Checkout" through the eyes of the Status Control Planner, the broad scope of both techniques and equipment can be seen in relation to the goal of providing an adequate weapon system operational capability.

APPLICABILITY: This paper presents a perspective on scope of status control and its relationship with checkout, particularly automatic checkout. In this respect it can contribute to an OBIFCO design effort, even though no quantitative data is provided. A related paper is literature reference No. 225.

TITLE: A Generalized Model of Automatic Checkout Equipment and Its
Function in Status Control

AUTHOR: B. L. Fletcher, A. Alan B. Pritsker, and B. B. Gordon

COMPANY: Battelle Memorial Institute, Columbus, Ohio

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
Memorial Institute

DATE: September 5-7, 1962   **PAGES:**   33-50

SCOPE: How the required functions of automatic checkout equipment (ACE)
can be determined and implemented is discussed. The status
control concept provides a framework within which the required functions
can be determined for a specific weapon system. Techniques are required
for utilizing the capabilities of computer or other types of ACE to
accomplish these functions. A generalized model of ACE that is capable
of functions of present interest is described. The ACE implemented for
a specific system or group of systems may or may not be required to have
the capabilities of the generalized model.

APPLICABILITY: As indicated by the title, the approach is quite general.
A portion of it could be utilized in design of an in-flight
monitoring system. Greater detail is provided in literature reference 201,
while reference 224 contains related data.

TITLE: The Case for Checkout Without Computers

AUTHOR: J. Lawton

COMPANY: The Bendix Corporation

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
Memorial Institute

DATE: September 5-7, 1962   PAGES: 67-81

SCOPE: This paper considers four classes of automatic checkout equipment:
Computer controlled, computer augmented, symbiotic (where portions
of the tested equipment assist in the test), and Lethean. Emphasis is on the
last, with programmed commands and go/no go indications, but with no
memory or logic capability. Block diagrams are included.

APPLICABILITY: The concepts presented represent a spectrum of
capabilities which the OBIFCO designer would do
well to consider in gaining a perspective of the checkout problem. No
quantitative data is given.

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TITLE: The Diagnosis Process

AUTHOR: Erskine St. Clair

COMPANY: Vitro Laboratories

REPORT___   SYMPOSIUM x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
                  Memorial Institute

DATE: September 5-7, 1962   PAGES: 83-102

SCOPE: This paper is concerned with a particular mathematical approach
          to the problem of fault recognition and isolation by automatic
techniques, an approach which is closely related to the pattern recognition
method.   The underlying idea has been applied quite successfully in an air-
craft recognition study; an attempt is made to develop and extend its basic
notions in a more general mathematical framework, and to test both the
feasibility and practicability of applying it to the engineering design of
automatic checkout equipment.

APPLICABILITY: These techniques are applicable to OBIFCO.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 228

TITLE: Survey of Current Fault Isolation Techniques

AUTHOR: B. B. Gordon

COMPANY: Battelle Memorial Institute

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
                  Memorial Institute

DATE: September 5-7, 1962   **PAGES:**   103-111

SCOPE: The area of the fault isolation process under consideration is
         described. Four fault isolation techniques are described and
compared. These are (1) Simple Branching; (2) Information State
Techniques; (3) Pattern Identification; and (4) Solution of Simultaneous
Equations. Since the above techniques are primarily information handling
techniques, criteria for selection of tests are discussed.

APPLICABILITY: These techniques are applicable to OBIFCO.

TITLE: Performance Prediction Techniques

AUTHOR: William A. Rose

COMPANY: Radio Corporation of America, Camden, New Jersey

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle Memorial Institute

DATE: September 5-7, 1962   **PAGES:**   133-143

SCOPE: Performance prediction is a problem of fundamental importance both to reliability and maintainability. From the point of view of solid state physics, failures result from the formation of defect concentrations and their growth into larger localized defects. Evidence is presented showing that failure prediction is sometimes possible even for components which fail in an apparently random manner. The major problem of performance prediction is the identification of failure indicating parameters. Although a general theory has not been fully developed, it appears that failure precursors involve some form of localized energy dissipation and are therefore detectable from noise, temperature gradient, and resistance measurements.

APPLICABILITY: The trend analysis and failure prediction are areas requiring consideration in configuring an OBIFCO system.

TITLE: An Alternative Technique for Obtaining Performance Figures

AUTHOR: Magnus Moll

COMPANY: Battelle Memorial Institute, Columbus, Ohio

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
                  Memorial Institute

DATE: September 5-7, 1962   PAGES: 145-154

SCOPE: A performance figure indicating the current condition of a system
         in operational terms can be obtained by simulating all or part
of a mission. At present, performance figures are obtained by employing
the prime equipment directly in the simulation. An alternative, called
the measure-compute technique, has been developed. In the technique, the responses
of the system to a set of standard stimuli are obtained and employed in an off-
line digital simulation of the mission. When applied to linear systems, the
measure-compute technique offers potential advantages of reduction of
measurement equipment, and reduction of the time required to produce
statistical performance figures.

APPLICABILITY: The techniques described could be of value in defining
                        marginal and no-go limits in an OBIFCO system.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 231

TITLE: A survey of Failure Prediction Methods

AUTHOR: A. T. Kneale

COMPANY: Motorola Inc., Scottsdale, Arizona

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Seminar on Automatic Checkout Techniques, Battelle
Memorial Institute

DATE: September 5-7, 1962   PAGES: 155-163

SCOPE: This paper describes the mathematical and philosophical basis on
which failure prediction is based and reviews a typical imple-
mentation. Questions for future studies are raised.

APPLICABILITY: This paper raises questions which are applicable
to OBIFCO trend analysis, but does not provide
any real answers.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 301

TITLE: A controlled Study of Automated Testing Techniques

AUTHOR: P. R. Oyerly and D. C. King

COMPANY: ARINC Research Corporation, for Service Engineering Division
          of Dayton Air Force Depot

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Ninth National Symposium on Reliability
                  and Quality Control

DATE: January 22-24, 1963   PAGES: 401-414

SCOPE: Automatic and manual test techniques were applied to groups of
          airborne receiver/transmitter units at the depot and field shop
level. Costs of automatic testing were compared with benefits in increased
reliability and maintainability. It was concluded that cost effectiveness is
increased by use of automatic testing techniques.

APPLICABILITY: This thorough report points out the advantages of
                    automated testing, and could be used to justify
OBIFCO applications on complex electronic systems. Both passive and
dynamic testing were included.

RELATED DOCUMENTS: P. R. Oyerly, "Effects of Automated Testing
                        Techniques upon the Reliability of an Airborne
Communications Equipment," ARINC Report 134-2-282, February 9, 1962.

                        Oyerly and Morse, "Evaluation of Two
                        Maintenance Methods Using Automated Testing
Techniques and measurement of the Reliability and Maintainability of an
Automatic Testing Equipment," ARINC Report 182-1-287, March 1, 1962

TITLE: Computer-Controlled Automated Testing on the Polaris Program

AUTHOR: B. W. Furstenau

COMPANY: Lockheed Missiles and Space Company

REPORT___ SYMPOSIUM X TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER:

DATE: March 18-20, 1963   PAGES: 23

SCOPE: A description of test equipment used for checkout of Polaris missiles in the factory and static test stands and during prelaunch periods. Historical background as well as descriptions of components, software, and utilization are provided.

APPLICABILITY: Good background information for OBIFCO design, especially in relating in-flight checkout to lower test levels. The system utilizes a general-purpose computer capable of serving eight test consoles simultaneously.

TITLE: A Study of Time - Based Methods of Analysis in Cockpit Design

AUTHOR: L. F. Hanes, M. L. Ritchie, and J. H. Kearns

COMPANY: Ritchie & Associates and Aeronautical Systems Division, WPAFB;
          Contract No. AF33(616)-7759

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: ASD-TDR-63-289

DATE: May 1963   PAGES: 286

SCOPE: This report describes a study of the uses of time-related analyses to
         generate and define the design criteria necessary for control-display
development. The major methods of analysis which have been used in control-
display development work, as well as several approaches to the overall weapon
systems design, are reviewed. The control-display schedule is presented as a
sequence of design activities. Those requiring time-related analyses are indicated,
and descriptions of appropriate methods given.

APPLICABILITY: This study does not discuss display of systems status for
                   units monitored during flight. However, the criteria de-
fined in the document should be considered when defining the means of display-
ing OBIFCO results to the crew.

TITLE: In-Flight Vibration Monitoring

AUTHOR: None indicated

COMPANY: General Electric

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletion No. 19

DATE: Mar. 14, 62   PAGES: 7

SCOPE: This bulletin contains a brief description of the vibration char-
acteristics of the GE CJ805-3 (turbojet) and CJ805-23 (aft fan)
engines. The discussion includes: recommended pickup locations, normal
engine characteristics, and data recording forms.

APPLICABILITY: Several conclusions are made which may be applicable
to the OBIFCO study.

1.   Present day (1962) monitoring equipment may not
be sufficiently reliable to justify in-flight
shutdown due to high vibration indications alone.

2.   GE does not consider that vibration monitoring
equipment is required for flight safety.

3.   Each engine may have its own peculiar vibrational
characteristics, therefore a normal reference
pattern must be established for each engine, with
all vibration levels compared to the reference
values.

TITLE: Trouble-Shooting Guide

AUTHOR: None indicated

COMPANY: General Electric

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 32-3

DATE: May 6, 63   PAGES: 10

SCOPE: This bulletin for the CJ805-3 turbojet engines covers typical engine discrepancies likely to be indicated by deviations from the normal operative levels as determined on trend analysis plots during take-off, climb, cruise, etc. Charts are presented for a series of indicated malfunctions, the possible causes, and suggested actions. No required measurement accuracy levels are given.

APPLICABILITY: The report is applicable to OBIFCO since a number of engine malfunctions are given which can be picked up by trending of the following parameters: EGT, EPR, Rundown time, Vibration. Care must be taken in using this report, however, to isolate those malfunctions which are generally applicable to any type of engine and malfunctions which are peculiar to the CJ805-3 engines.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 306

TITLE: Operational Flight Control for Saturn Boost Vehicles

AUTHOR: C. W. Steeg, Jr., M. Pesando, and G. Filias

COMPANY: Radio Corporation of America, Burlington, Mass. Aerospace
            Communications and Controls Div.

REPORT_X_   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Institute of the Aerospace Sci. (1963) Presented at
                  the IAS 31st Annual Meeting, N. Y.

DATE: Jan. 21, 1963   PAGES: 24

SCOPE: The Operational Flight Control (OFC) is a real-time control system
        which is applicable to monitoring and assessing Saturn vehicle per-
formance and capability during powered flight, and for adjusting inflight
parameters to compensate for subsystem malfunctions or unforeseen circumstan-
ces is discussed. System concepts, system approach, concept feasibility, and
system design configuration are presented. Onboard and ground systems are
combined by the OFC concept for maximum overall effectiveness.

APPLICABILITY:

TITLE: Overhaul Life Development and Early Failure Detection of Gas Turbine Engines

AUTHOR: J. J. Eden

COMPANY: Trans Canada Airlines

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Society of Automotive Engineers
SAE Paper No. 639B

DATE: Jan. 14, 1963   PAGES: 20

SCOPE: The paper reviews programs applied in Trans-Canada Airlines to explore the existence of component total time limitations which will permit rapid utilization of the true overall life potential of jet engines. Development and application of early failure detection methods such as visual examination, x-ray of flame tubes, effective use of oil system to give warning of failure, engine vibration monitoring, and automotive flight performance recording are discussed.

APPLICABILITY: The report provides cost motivation for development of an OBIFCO system. Although most of the discussion is aimed primarily at manual check procedures, several areas such as discussion of the oil system, are of use to an OBIFCO study in establishing the value of monitoring several possible system parameters.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 308

TITLE: Flight and Ground Crew Operations: Preflight Crew Operations

AUTHOR: Donald M. Corcoran

COMPANY: NASA, Manned Spacecraft Center, Systems Integration Section, Houston, Texas

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE X

NAME OR NUMBER: Astronautics and Aerospace Engineering

DATE: Feb. 1963   .   PAGES: 68 through 70

SCOPE: Discussion of the requirements for present and future NASA manned spaceflight programs. The following topics are covered: spacecraft checkout and launch operations, crew preparation and preflight training, flight control and monitoring, and recovery for Projects Mercury, Gemini, and Apollo.

APPLICABILITY:

TITLE: Checking Out The Big Systems

AUTHOR: Lewin T. Baker

COMPANY: General Electric Co., Apollo Support Dept., Daytona Beach, Fla.

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE x

NAME OR NUMBER: Space/Aeronautics

DATE: July, 1963   PAGES: 85-87

SCOPE: Brief discussion of the future requirements for the checkout systems of spacecraft. Such systems will require a new means for monitoring circuits buried deep within a miniature assembly, and must handle decision theory in real time to reduce the problem to proportions that can be dealt with. Discussed is the necessity for the automation of data collection, transfer, and evaluation. Improving data collection will require more accurate, more reliable single-point sensors and the use of equipment the characteristics or responses of which are beyond the present scope of manual methods of evaluation. The increased application of computers for data evaluation is outlined.

APPLICABILITY:

TITLE: Diagnostic Maintenance: A Technique Using a Computer

AUTHOR: W. R. McCormack and C. Michel

COMPANY: Electronic Systems and Products Division, The Martin Company, Baltimore

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL X MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference Procedures, Vol. AS-1, No. 2

DATE: August 1963   PAGES: 931-941

SCOPE: Generalized techniques are presented for designing checkout equipment embodying the best features of computer-controlled and technician-controlled tests. Emphasis is placed on combining speed, work capacity, singlemindedness, and retentiveness with ability to recognize significant information, to alter method of attack, to learn from experience, and to abstract the system into subsystems and parts.

APPLICABILITY: The general approach is logical and useful, although it is designed more for flexibility and adaptability to any of several units than to repetitive monitoring in depth of a fixed group of units. It is intended to be self-programming; i.e., given a set of unit component parameters, the computer would define the test stimuli (levels, frequency, etc.) and allowable results. This feature would likely be prohibitive in an airborne checkout system.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 311

TITLE: Research Guidelines for Digital Computer-Controlled Systems for Checkout and Fault Isolation

AUTHOR: C. Beckman, S. D. Bedrosian, R. S. Berkowitz, and T. C. Chen

COMPANY: University of Pennsylvania, for Frankford Arsenal, U. S. Munitions Command, Contract DA 36-034-ORD-3347A.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference Procedures, Vol. AS-1, No. 2

DATE: August, 1963   PAGES: 1064-1073

SCOPE: This paper discusses the evolution of maintenance procedures through manual, semiautomatic, and automatic. General considerations are presented to make future electronic equipment better suited to automatic testing, such as optimum selection of accessible test points. A military specification for locating test points is recommended.

APPLICABILITY: The generalized approach of this paper makes it of little value to a specific program such as OBIFCO. However, the emphasis placed on need for efficiently placed test points is well taken.

TITLE: Computer Techniques for Solving Electronic Circuits for Fault Isolation

AUTHOR: R. S. Berkowitz and P. B. Krishnaswamy

COMPANY: University of Pennsylvania, Supported by Frankford Arsenal under Contract No. DA36-034-507-ORD-3347A

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference Procedures, Volume AS-1, No. 2

DATE: August, 1963   PAGES: 1090-1099

SCOPE: A general mathematical approach to fault isolation by matrices involving curcuit parameters. It is an interim report which stops short of defining a computer application.

APPLICABILITY: While the extended work in this area could be useful for OBIFCO, this document has limited application.

TITLE: Basic Capabilities of Man and Machine in Respect to Automated
         Checkout

AUTHOR: S. I. Firstman and N. Jordan

COMPANY: The Rand Corporation, for USAF

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL _X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference
                  Procedures, Vol. AS-1, No. 2

DATE: August 1963   PAGES: 1100-1106

SCOPE:
        The basic capabilities and limitations of men and machines are
discussed, as they relate to automated testing of aerospace vehicles.
Operators and technicians are discussed from psychological and
physiological viewpoints, and present automatic checkout equipment
is discussed in respect to in-system performance. Both general and
specific capabilities and limitations are discussed. The views
presented are based upon an extensive survey of field applications of
automatic checkout equipment.

APPLICABILITY:

        Although this analysis is slanted toward field checkout, many of
the factors discussed are pertinent to the problem of communication
between the OBIFCO system and the flight or ground crew.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 314

TITLE: The Relative Effectiveness of Internally - Programmed and Sequentially-Programmed Machines for Automatic Checkout

AUTHOR: R. A. Kirkman.

COMPANY: TRW Space Technology Laboratories

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference Procedures, Vol. AS-1, No. 2

DATE: August, 1963   PAGES: 1297-1307

SCOPE: Sequential automatic checkout equipment utilizes a stepping switch, punched cards, or a paper or mylar type. Internally programmed machines are high-speed data processors with measurement capabilities. Relative merits of these concepts are evaluated in terms of testability, efficiency, versatility, aging, fault isolation, and cost.

APPLICABILITY: This document provides insights into tailoring the design of an OBIFCO system, and can provide ground rules for defining design criteria. It suggests certain approaches and potential uses of an internally-programmed OBIFCO that should be taken into account in systems design.

TITLE: A Pattern Recognition Approach to Fault Isolation

AUTHOR: J. Kranton, A. Libenson

COMPANY: RCA, Burlington, Massachusetts

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference
                    Procedures, Vol. AS-1, No. 2

DATE: August, 1963   PAGES: 1320-1326

SCOPE: A means has been devised for isolating faults with limited test points
       available, using computerized monte carlo techniques. Known circuit
parameters and transfer functions are employed to analyze outputs of a complex
circuit as a function of input and define the most probable location of the failure.

APPLICABILITY: While this approach appears to be designed for use with a larger
               digital computer, certain aspects may apply to OBIFCO. For
example, detection of a failure within a system could be followed by analysis of
several auxiliary test point signals with varying combinations of inputs to either
isolate the fault or determine remaining system utility. While this report emphasizes
fault isolation to a circuit element, the technique may be useful on OBIFCO to
isolation to a replaceable unit. Such analysis may use ground processing of
data recorded during the mission.

TITLE: Test Procedure Language Development

AUTHOR: B. P. Gollomp and P. H. Gallo

COMPANY: Bendix Corporation and TRW Inc.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace-Support Conference
Procedures, Vol. AS-1, No. 2

DATE: August, 1963   PAGES: 1327-1334

SCOPE: This paper describes work on software to be used for automatic
testing. Two types of programs are needed: that which is
expected to remain relatively stable, and that which is modified by test
engineers for conducting special tests. To facilitate modification, a
computer is needed to permit writing of instructions in a restricted
English language. This work has resulted in the Computer Operated
Universal Test (COUNT) system, a description of which is given.

APPLICABILITY: Although the concepts discussed were not designed
for an airborne computer, they do apply to aircraft.
A list of basic requirements for an automated checkout system is interesting.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 317

TITLE: Pre-Launch Testing of High Frequency Digital Data

AUTHOR: Alan J. Kogan, Oscar M. Cromer, and William J. Wester

COMPANY: Westinghouse Electric Corp., Air Arm Division, Baltimore, Md.

REPORT___ SYMPOSIUM X_ TECHNICAL JOURNAL X_ MAGAZINE___

NAME OR NUMBER: Institute of Electrical and Electronics Engineers,
International Conference and Exhibit on Aerospace
Support, Washington, D. C.

DATE: Aug. 4, 1963 IEE Transactions on Aerospace PAGES: 195 through 201

SCOPE: Discussion of the techniques used in testing digital signals of a
sub-system interface at a distance of 1,200 ft. The development
of a hardline system which overcomes the problems of propagation delay and
poor cable response to pulse signals is described. The system evolves as a
three-piece unit including a cable driver located at the space vehicle, a
remote unit located at the gantry and a control and readout unit located at
the block-house.

APPLICABILITY:

TITLE: Remote and On-Board Checkout Concepts for the Manned Orbiting
          Research Laboratory

AUTHOR:

COMPANY: IBM Federal Systems Division

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 63-512-0035

DATE: August 7, 1963   PAGES: 6

SCOPE: A requirement of MORL missions is occasional orbital checkout
          of certain subsystems, with atomatic diagnosis and fault isolation
in the event of degraded performance.   This document presents concepts for
such checkout.

APPLICABILITY: The three concepts presented are similar to those
                 applicable to OBIFCO: On-board automatic checkout
and fault isolation; and on-board automatic detection with manual fault
isolation; and on-board detection with pertinent data transmitted to ground
complex for analysis.

TITLE: Sensing Side Effects for Supplementary Checkout Data

AUTHOR: D. A. Bernhart

COMPANY: Air Force Systems Command, Aeronautical Systems Division, WADC

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL x   MAGAZINE___

NAME OR NUMBER: IEEE-Trans. on Aerospace

DATE: Aug. 1963   PAGES: 208 through 212

SCOPE: Problems associated with checkout of modern weapon systems require acquisition of more information per measurement and increased accuracy of measurements; approach is advocated whereby new checkout parameters are established by sensing secondary effects, and by using these measurements in conjunction with other carefully chosen parameters such as current, voltage, frequency, and impedance measurements to produce desired results.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 320

TITLE: In-Flight Dynamic Checkout

AUTHOR: J. E. Valstar

COMPANY: North American Aviation, Inc., Autonetics Division, Downey, Calif.

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL X   MAGAZINE___

NAME OR NUMBER: Institute of Electrical and Electronics Engineers,
                 International Conference and Exhibit on Aerospace
                 Support, Washington, D. C.,
                 IEEE Transactions on Aerospace

DATE: Aug. 1963   PAGES: 213 through 221

SCOPE: Description of a new method for tracking transfer functions, based
        on a generalization of the transformation with exponential kernel;
a new variation of Laplace or Fourier type transformations is produced which
has a unique and simple way of instrumentation, making it very suitable for
in-operation transfer function tracking.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 321

TITLE: Checkout Methods for Space Vehicle Subsystems

AUTHOR: James P. Janis

COMPANY: Aerospace Corp., El Segundo, Calif.

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL _X_   MAGAZINE___

NAME OR NUMBER: Institute of Electrical and Electronics Engineers, International Conference and Exhibit on Aerospace Support, Washington, D. C.

DATE: Aug. 1963   IEE Transactions on Aerospace   PAGES: 547 through 549

SCOPE: Brief description of methods for checking the operation of space vehicle subsystems. The approaches considered include the use of wire connections at test points provided in a subsystem, telemetry, self-test, and the use of an airborne computer. Future approaches include continuous monitoring and self-repair.

APPLICABILITY:

TITLE: Interplanetary Logistics

AUTHOR: L. S. Mills

COMPANY: Honeywell, Inc., Minneapolis, Minn.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL X   MAGAZINE___

NAME OR NUMBER: IEEE-Trans. on Aerospace

DATE: Aug. 1963   PAGES: 706 through 713

SCOPE: Method for increasing reliability of space systems through on-board
          checkout equipment and selective automatic maintenance; features of
    concept called CEFOAM (Checkout Equipment for On-Board Automatic Maintenance).

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 323

TITLE: Failure Prediction Employing Continuous Monitoring Techniques

AUTHOR: Robert J. Allen

COMPANY: North American Aviation, Inc., Autonetics Division, Downey, Calif.

REPORT___ SYMPOSIUM X TECHNICAL JOURNAL X MAGAZINE___

NAME OR NUMBER: Institute of Electrical and Electronics Engineers, International Conference and Exhibit on Aerospace Support, Washington, D. C.

DATE: Aug. 1963 IEEE Transactions on Aerospace PAGES: 924-930

SCOPE: Discussion of the need of incorporating failure prediction in conjunction with the space program, in terms of the limitations of present go/no-go type testing. Discussed are the advantages of employing continuous minitoring methods which are particularly adaptable to lengthy, interplanetary flights and manned vehicles in parking orbits. Continuous monitoring types outlines include: (1) stimuli-signal monitoring above (or below) the operating range; (2) signals monitored within the operating band interspersed with normal functions; (3) subsystem-radiated-signal monitoring, full power and reduced power; and (4) component-radiated-signal monitoring simultaneous with operation.

APPLICABILITY:

TITLE: Planning Aspects of Automatic Test and Checkout in Missile and Space Systems

AUTHOR: L. T. Mast

COMPANY: Rand Corp., Santa Monica, Calif

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE__

NAME OR NUMBER: Institute of Electrical and Electronics Engineers, International Conference and Exhibit on Aerospace Support, Washington, D. C.,

DATE: Aug. 4-9, 63   IEEE Transactions on Aerospace   PAGES: 1056 through 1063

SCOPE: Examination of the feasibility of automating test, checkout, and servicing operations for missile and space systems. Guidelines for making decisions on when appropriate automation should be introduced into the development and operational cycle are established. A time-sequence procedure for automating these processes is described.

APPLICABILITY:

TITLE: Automatic Checkout: Significant Factor in Automation

AUTHOR: L. L. Fletcher and Roger C. Van Buskirk

COMPANY: Battelle Memorial Institute, Columbus, Ohio

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: Battelle Technical Review

DATE: May, 63   PAGES: 2 through 7

SCOPE: Discussion of the nature and function of automatic checkout equipment (ACE), emphasizing aerospace applications. ACE is designed to reduce the time required for checkout, monitor and control complex system operations, perform tasks beyond human capability, minimize human error, and make more efficient use of skilled manpower. The computer-type ACE is briefly described and schematically diagramed. Applications, listed tabularly, include use in the Atlas, Titan, and Polaris missiles. Possible configurations of ACE include centralized or decentralized, remote, on-board, and trailer-mounted. The problems in technical management and analysis presented by systems support are outlined, and effective planning for ACE application is discussed. Anticipated developments of ACE cited include use for space exploration, high-speed transport aircraft, failure prediction, and corrosion detection.

APPLICABILITY:

TITLE: NASA Plans for Future Hinge on Three Programs

AUTHOR:

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE X

NAME OR NUMBER: Missiles and Rockets Vol 12

DATE: May 20, 1963   PAGES: 43 through 46

SCOPE: Role and design of future test and checkout systems, on ground and on
        board, will depend on success and shortcomings of support systems for
Titan II/Gemini, Saturn/Apollo, and Atlas-Centaur/Surveyor; objectives of
checkout concepts for programs; 2-man Gemini will be first vehicle to have on-
board malfunction monitoring; first manufacturer's vertical checkout of major
launch vehicle will be performed on Gemini's Titan II booster prior to its
transport to launch facility; details of Malfunction Detection System (MDS),
built by Martin Co., and vertical test facility; block diagram showing Saturn-
Apollo checkout and assembly.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 327

TITLE: Introspective In-Flight Checkout Techniques for Manned Space Vehicle Electronics Systems

AUTHOR: E. R. Campbell, Jr., H. B. Goldman, and P. D. Stahl

COMPANY: Radio Corporation of America, Aerospace Communications and Controls Div. Camden, N. J.

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Annual East Coast Conference on Aerospace and Navigational Electronics, 10th, Baltimore, Maryland, Proceedings

DATE: Oct. 21-23, 63   PAGES: 3.6.3-1 to 3.6.3-12

SCOPE: Checkout methods for electronic equipment having built-in self-test circuitry. The following techniques are discussed: automatic computer controller checkout, semi-automatic checkout, and passive in-flight monitoring. It is stated that a combination of semi-automatic crew-controlled tests and introspective (self-contained) checkout circuitry offers a high degree of effectiveness. A checkout of typical radar and communications subsystems is described.

APPLICABILITY:

TITLE: Formulation of System Status Control Techniques

AUTHOR:

COMPANY: Battelle Memorial Institute, for AF Aero-Propulsion Laboratory,
WPAFB, under Contract AF33(616)-7761

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: ASD-TDR-63-792

DATE: September, 1963   PAGES: 191

SCOPE: This report describes techniques for measurement and prediction of
future system performance. Statistical methods are derived for
monitoring systems characterized by continuous or periodic checking as
well as feedback, adaptive, and redundant systems. The results are
designed to be programmed into automatic checkout equipment. Certain of
these results were previously published in reference 201.

APPLICABILITY: The results are quite general, and would be useful in
conceiving OBIFCO design criteria. However, certain
tests do not lend themselves to on-board monitoring during system opera-
tion; for example, driving an amplifier to its overload condition to determine
degradation.

TITLE: The Comparative Effectiveness of Several Telemetry Data Compression Techniques

AUTHOR: J. E. Medlin

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: International Telemetering Conference

DATE: September, 1963   PAGES: 328-340

SCOPE: This paper discusses part of an exploratory investigation into the comparative effectiveness of various data compression techniques. The comparisons were made by means of simulation with an IBM 7090 computer using 150,000 samplesof actual data and five techniques of compression.

APPLICABILITY: The techniques described are applicable to OBIFCO digital data. Results of the study showed that one of the simplest techniques to instrument (a zero order technique) was the most effective in removing redundancy from data.

TITLE: The System Approach to Automatic Checkout, Part I

AUTHOR: R. A. Kirkman

COMPANY: TRW Space Technology Laboratories

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and Techniques
                  Seminar, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 28

SCOPE: This paper discusses the general concept of Automatic Checkout, with
        emphasis on the increase in-flight reliability following a thorough pre-
flight test. Included is a discussion of failure modes, types of failures, and
their causes.

APPLICABILITY: Although the aspect of in-flight testing is not considered, this
                document contains good background information for OBIFCO.

TITLE: The System Approach to Automatic Checkout, Part II

AUTHOR: J. J. Coleman

COMPANY: TRW Space Technology Laboratories

REPORT__   SYMPOSIUM X   TECHNICAL JOURNAL__   MAGAZINE__

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and Techniques
                          Seminar, Battelle Memorial Institute

DATE: November 13-14, 1966   PAGES: 30

SCOPE: This paper discusses strategies in optimizing test point selection, fault
          isolation, and other quantitative concepts.

APPLICABILITY: The discussion is quite general and would serve only as an
                     overall guide in the conceptual stage of an OBIFCO System.

TITLE: The System Approach to Automatic Checkout, Part III

AUTHOR: M. C. Peterson

COMPANY: TRW Space Technology Laboratories

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and Techniques
                  Seminar, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 42

SCOPE: This paper discusses aspects of designing prime equipment to be com-
       patible with automatic checkout equipment, thus optimizing testability
and reliability Checkout equipment reliability and self test requirements are
discussed.

APPLICABILITY: This paper identifies specific areas to be considered in design
                 of automatic checkout equipment, with emphasis on design of
prime equipment.   Such factors as types of test or sequence of actions are presented
to provide a proper perspective to the OBIFCO System designer.   Some hardware
cost data presented may be useful.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 333

TITLE: Fault Isolation by Semi-Automatic Techniques

AUTHOR: Gustave Shapiro and Owen B. Laug

COMPANY: National Bureau of Standards

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE__

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and Techniques
                           Seminar, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 7

SCOPE: Project FIST (Fault Isolation by Semi-Automatic Techniques) was
             conducted by National Bureau of Standards for the Navy Department.
Objectives and techniques of the program are discussed.

APPLICABILITY: This was one of the early programs utilizing automated test
                          techniques. While of historical interest, the emphasis on
heavy shipboard equipment makes it generally inapplicable to OBIFCO.

TITLE: Precise Estimates of System Dynamics from Normal Operating Records

AUTHOR: Arthur E. Mace

COMPANY: Battelle Memorial Institute

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings on Second Seminar on Automatic Checkout
                  Equipment and $T_e$chniques, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 14

SCOPE: Techniques are described for statistical analysis of system performance
       by monitoring appropriate inputs and outputs. Technologies of transient
and power spectra analysis are applied to near-simultaneous measurements. While
application of this method to a specific system is believed to be quite time consuming,
the author feels that a direct unequivocal assessment of operating characteristics
could be provided, even during flight.

APPLICABILITY: With the large number of complex systems to be monitored
                 by OBIFCO, statistical techniques must certainly be considered.
Thus methods such as those described must be taken into account. Use of a digital
computer is required. One potential problem is lack of adaptability to account for
system modifications.

TITLE: A Computer - Controlled Integrated Checkout System

AUTHOR: Frank Medved

COMPANY: Minneapolis-Honeywell Aero Division

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and Techniques
                          Seminar, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 17

SCOPE: This paper discusses the problem of test equipment designed for only
one system, and then after-the-fact rather than concurrently with prime
equipment. A concept is given which would alleviate this problem by defining
automatic test techniques during design of avionics equipment.

APPLICABILITY: Most of the major points applicable to the area of automatic
checkout of avionics systems.

TITLE: VATE - Design and Operational Characteristics

AUTHOR: Victor Mayper, Jr.

COMPANY: Hughes Aircraft Company

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings, Automatic Checkout Equipment and
                Techniques Seminar, Battelle Memorial Institute

DATE: November 13-14, 1963   PAGES: 32

SCOPE: This paper discusses the background leading to development of
          versatile automatic checkout equipment (VATE) for checkout
and fault isolation of several inertial guidance systems. Types of tests,
accuracies, programming, adapters, and maintenance aspects are discussed.

APPLICABILITY: Except for being a depot system with consoles, this
                 system utilizes many features required of OBIFCO.
Much of the technical data could be useful, especially in defining guidance
system requirements.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 337

TITLE: Automatic Test Equipment for Systems Checkout

AUTHOR: D. J. Seaman

COMPANY: New York University

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: SETE 210/53.1

DATE: November 1963   PAGES: 75

SCOPE: This report is a tabulation of automatic test equipment that
       has been used for systems checkout, and test equipment then
in the prototype state that can be so used. Purpose, description, and
other ideas are given for each equipment, listed by manufacturer.

APPLICABILITY: Useful as a reference document to give a tie point
               for state of the art in automatic checkout.

TITLE: Failure Concepts in Reliability Theory.

AUTHOR: Robert A. Kirkman

COMPANY: TRW Space Technology Laboratories

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Reliability

DATE: December 1963   PAGES: 1-10

SCOPE: System reliability is a function of reducing parts failures not
            only by design controls, but by testing for detection.   Physics
and mechanisms of failures are discussed to show they are predictable.

APPLICABILITY: Except for pointing out the need to detect abnormalities
                in systems that are still operating within tolerance,
this document is of little value to OBIFCO.

TITLE: Parameter Selection for In-Flight Recording

AUTHOR: Robert D. Morris

COMPANY: Lockheed Aircraft Service Company

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Test Flight Symposium

DATE: December 1963   PAGES: 99-102

SCOPE: The steps involved in selection of parameters to be monitored
         in a maintenance recording system for jet aircraft are enumerated
    and discussed.

APPLICABILITY: This report is directly applicable to OBIFCO,
                 assuming that recording of some parameters for
    later processing is to be provided. The discussion of trade-offs between
    recording system capacity, recording time, and frequency response is
    useful, as is the description of a typical maintenance recorder.

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TITLE: Engine Operating Techniques

AUTHOR: None indicated

COMPANY: General Electric

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 34-3/25-23

DATE: Nov. 25, 63   PAGES: 5

SCOPE: This bulletin is a brief condensation of operating experience on the
         CJ805 engines, which contains operating hints concerning how to
achieve optimum economy and engine life. Hints are given for the following
points: starting, take-off, climb, cruise, landing and shutdown.

APPLICABILITY: This paper is of little direct use to the OBIFCO study
                  since it deals mainly with operational factors to be
considered by flight crews using a specific engine.

TITLE: A Preliminary Study of the Apollo In-flight Test System

AUTHOR: R. E. Johnson and C. T. Whitehead

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-3827

DATE: November 1963   PAGES:

SCOPE: A preliminary study of the general characteristics of the test
         equipment that should be placed on board the Apollo Command
Module for the purpose of in-flight checkout of the Command Module and
Service Module systems. The three alternative test techniques evaluated
are: a manual technique, using a multiple-range voltmeter; a voltage
comparator technique, using bi-level voltage comparators and out-of-
tolerance displays (when applicable); and a computer technique which
uses either the spacecraft telemetry system and guidance computer or
a special-purpose computer.

APPLICABILITY:

TITLE: Objectives, Measures of Effectiveness, and Criteria for
Apollo Prelaunch Operations as They Affect Checkout Activities

AUTHOR: J. R. Brom, J. J. Ferrante, S. I. Firstman, L. T. Mast
and D. S. Stoller

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-3888

DATE: October 1963   PAGES:

SCOPE: A compilation of objectives and measures for attaining those
objectives, for NASA's Apollo prelaunch operations. The
objectives and measures were synthesized by a working panel from
Bellcomm, Inc., The General Electric Company, and RAND. The
Memorandum documents the preparatory work and results of the panel's
meeting.

APPLICABILITY:

TITLE: Trend Analysis Troubleshooting Guide

AUTHOR: None indicated

COMPANY: General Electric

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 26-23

DATE: Dec. 4, 63   PAGES: 9

SCOPE: This bulletin for the CJ805-23 aft fan engines discrepancies likely
        to be indicated by deviations from the normal operative levels as
determined on trend analysis plots during take-off, climb, cruise, etc. Charts
are presented for a series of indicated malfunctions, the possible causes, and
suggested actions. No required measurement accuracy levels are given.

APPLICABILITY: The report is applicable to OBIFCO since a number of
               engine malfunctions are given which can be picked up
by trending of the following parameters: EGT, EPR, Rundown time, Vibration.
Care must be taken in using this report, however, to isolate those malfunc-
tions which are generally applicable to any type of engine and malfunctions
which are peculiar to the CJ805-23 engines.

TITLE: Programming Language for Automatic Checkout Equipment

AUTHOR: Burton H. Went

COMPANY: Battelle Memorial Institute

REPORT _X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RTD-TDR-4171 (2 vols.)

DATE: October 1963   PAGES: 180

SCOPE: This report contains a detailed description of the PLACE
          language and how it can be used to write programs for two
  specific automatic testers: RCA DEE and Bendix AN/GJQ-9.

APPLICABILITY: The scope of the report is general enough so that
                   it is not too machine dependent. It is useful for
   learning the PLACE language, which has potential application to an
   OBIFCO system.

TITLE: Aircraft Mounted GAM-87A Equipment Automatic Checkout Techniques Summary

AUTHOR: K. A. Francis and D. G. Henderson

COMPANY: Douglas Aircraft Co., Inc., Santa Monica, Calif.

REPORT_x_ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Report No. SM-43485

DATE: Mar. 1963   PAGES: 17

SCOPE: A technical discussion describes the development of automatic checkout equipment (Simulator, Missile Launch Control Subsystem) used to test aircraft mounted missile system monitoring and launch equipment. Emphasis is placed on design philosophy and the methods and reasoning used in choosing the types of tests to be performed.

APPLICABILITY:

TITLE: Tiros Pre-Flight Testing and Post-Launch Evaluation

AUTHOR: Edwin A. Goldberg

COMPANY: Radio Corporation of America, Astro-Electronics Div., Princeton, N. J.

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Space Flight Testing Conference, Cocoa Beach, Fla.

DATE: Mar. 18, 1963   PAGES: 21

SCOPE: Six TIROS satellites have been launched into orbit, and they performed
              their missions in one of the most successful unmanned space programs
to date.   The testing and evaluation of each satellite have contributed, in large
measure, to their continuing successful performance.   The test phases for flight
units include acceptance tests, hangar tests, on-stand precountdown and countdown
tests, and postlaunch evaluation tests.   This paper describes the various tests
and some of the special test fixtures developed by RCA.   As a result of the
evaluation of the performance of TIROS 1, a "magnetic-dipole" effect was discovered,
and this effect was used as the basis for development of an active attitude-control
device now used on both the TIROS and the Relay satellites.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 347

TITLE: Evolution of Automatic Check-Out Equipment

AUTHOR: B. Gollomp, John Lawton and A. B. Van Rennes

COMPANY: Bendix Corporation

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: British Interplanetary Society, Symposium on Ground
                                     Support Facilities in Astronautics, London, England

DATE: Mar. 6, 63   PAGES:

SCOPE: Review of the functional requirements, history, and advantages of auto-
                     matic check-out equipment for verifying the operational readiness and
calibration of a complex military-aircraft or missile system. Discussed are auto-
matic check-out systems of the Lethean, symbiotic, computer-controlled, and
computer-augmented types. Described, as an example of current practice, is the
Bendix AN/GJQ-9 tape controlled test set. The capabilities of the Bendix system
are outlined.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 348

TITLE: System Checkout and Flight Testing of Unmanned Lunar and
           Planetary Spacecraft

AUTHOR: James F. McGee

COMPANY: Jet Propulsion Lab. Calif. Inst. of Tech., Pasadena, Calif.

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Space Flight Testing Conference, Cocoa Beach, Fla.

DATE: Mar. 18, 1963   ·   PAGES: 23

SCOPE: This discussion of system checkout of unmanned lunar and planetary
           spacecraft is broad in scope and, basically, deals with the overall
philosophy and mechanization of testing, rather than the details of experiences
on specific spacecraft checkout. Test equipment, facilities, and types of tests
are discussed in chronological sequence, beginning with assembly of the space-
craft in Pasadena, and terminating with the launch at the Atlantic Missile Range.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 349

TITLE: Digital Data System for Automatic Checkout of Spacecraft

AUTHOR: Walter E. Parsons, Harold G. Johnson, and Gary J. Woods

COMPANY: NASA Manned Spacecraft Center, Cape Canaveral, Fla.

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Space Flight Testing Conference, Cocoa Beach, Fla.
                  AIAA

DATE: Mar. 1963   PAGES: 21

SCOPE: The PACE S/C digital data system for the automatic checkout of space-
         craft is described. It consists of five subsystems: the pulse-code
modulation ground-station subsystem, the computing subsystem, the display and
control subsystem, the data transmission subsystem, and the onboard associated
equipment (data acquisition and signal stimuli generator) subsystem. The
advantages of such a system will be the ability to: (1) process and present
large quantities of data in real time, (2) provide increased data accuracy,
(3) provide continuous data evaluation, (4) eliminate excess cabling, (5)
provide complete test documentation, (6) be program adaptive, (7) provide a
variety of stimuli generation, (8) possess diagnostic capability, (9) utilize
the same control room for all tests, (10) provide data familiarity during test
periods, (11) make checkout data available for other users, (12) utilize
available equipment, and (13) be operated with any degree of automation desired.

APPLICABILITY:

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TITLE: Computers and Programmers in Hybrid Checkout Systems

AUTHOR: Don L. Reed

COMPANY: Emerson Electric Manufacturing Co., St. Louis, Mo.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: Control Engineering

DATE: Apr. 63   PAGES: 79 through 82

SCOPE: Discussion of the value of using special-purpose automatic test equip-
ment (ATE) in hybrid systems with general-purpose computers. The
primary advantage of this is the directness of ATE in converting test instruc-
tions from engineering language to actual test sequences. The computer supple-
ments the tester, particularly when a need for additional logic or arithmetic
processing may be necessary.

APPLICABILITY:

TITLE: Turbojet Engine Analyzer System Study

AUTHOR: W. I. Rumer

COMPANY: Aeronautical Systems Div.

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Airesearch Report No. FC-4186-R

DATE: June 1963   PAGES: 721

SCOPE: This report describes a Turbojet Engine Analyzer System developed for J-57, J-60, J-79, J-85, and J-93 engines. The system combines airborne and ground equipment to automatically collect and process engine performance and stress data. System functions are: (1) verify that an engine is operational; (2) predict that the engine will accomplish the next mission with high confidence; (3) predict the expected time remaining before maintenance is required; (4) diagnose a faulty engine. The study encompassed data-collecting requirements, i.e., reference data (aircraft or elapsed time etc), performance data, compressor discharge pressure, turbine discharge temperature, etc), and mechanical parameters (oil temperature, breather pressure, etc.); a thermodynamic model; an analyzer system, its components and diagnostic function; data-collecting hardware; and analytical procedures. The report includes extensive tables, curves, and equations relating to diagnostic procedures, as well as recorder and converter techniques and airline and military failure data regarding present diagnostic and maintenance experience.

APPLICABILITY:

        The report is applicable directly to the bare engine portion of the OBIFCO Study since it is an identical type of analyses performed under a former government contract for this purpose.

TITLE: In-Flight Measurement of Ambient Temperature and Its Effect
Upon Aircraft Performance

AUTHOR: David W. Stratton

COMPANY:

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Aerospace Electrical Society, Annual Aerospace
Electrical/Electronics Conference, 21st, Los Angeles,
Calif.

DATE: Oct. 9, 1963   PAGES: 1 through 25

SCOPE: Clarification of various types of temperature measurements used
by jet aircraft pilots. The factors which influence the accuracy
of these measurements are enumerated, and an attempt is made to show the
relationship of temperature to engine performance. A detailed description
of thrust as applied to turbojet engines is given.

APPLICABILITY:

TITLE: Automatic Light Aircraft Readiness Monitor

AUTHOR: Richard G. Ballou, ed.

COMPANY: Bendix Corp., York, Penna. York Div.
           Contract DA-44-177-TC-641

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: Jan. 1963   PAGES: 60

SCOPE: This report details application of the developed ALARM system for
         implementation in various Army aircraft. The system will feasibly
reduce checkout downtime in most types of light aircraft.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 354

TITLE: Automatic Light Aircraft Readiness Monitor Project Alarm
Phase II Test Program Volume I

AUTHOR: Richard G. Ballou, ed.

COMPANY: Bendix Corp, York, Pa.
Contract DA-44-177-TC-641

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: Jan. 1963   PAGES: 140

SCOPE: The fundamental objective of the Phase II test and report has been
to establish and record the feasibility and utility of all concepts
of aircraft condition monitoring provided in the breadboard ALARM experimental
system. Based upon the results as given herein, conclusions and recommenda-
tions are provided as they relate to this objective.

APPLICABILITY:

TITLE: Automatic Light Aircraft Readiness Monitor Project Alarm
Phase II Test Program Volume II Appendices

AUTHOR: Richard G. Ballou, ed.

COMPANY: Bendix Corp., York, Pa., York Div.
Contract DA-44-177-TC-641

REPORT x SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER:

DATE: Jan. 1963   PAGES: 130

SCOPE: To develop engineering specifications for an automatic light aircraft
readiness monitor, project ALARM, operational and malfunction test
data on aircraft transmission, engine, and structural vibration are given.

APPLICABILITY:

TITLE: Automatic Light Aircraft Readiness Monitor-Project Alarm
Volume III: Addendum - Reinstallation

AUTHOR: Richard G. Ballou, ed.

COMPANY: Bendix Corp., York, Pa. York Div.
Contract DA-44-177-TC-641

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: Jan, 1963   PAGES: 94

SCOPE: Discussions include the installation procedures, calibration data,
and results of the modified ALARM System Installation. Data accumulated during this phase are included. The modified ALARM System virtually eliminates temperature drift, and the results of this phase compare favorably with the test-program results.

APPLICABILITY:

TITLE: Automatic Electronic Testing

AUTHOR: Ken Gilmore

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE__X

NAME OR NUMBER: Electronics World

DATE: January 1964   PAGES: 25ff

SCOPE: This article assesses the need for automated checkout in complex
          electronic systems. Specific test system capabilities are discussed,
with emphasis on Republic's RADFAC (Radiating Test Facility) and RCA's CAM
(Checkout and Automatic Monitoring).

APPLICABILITY: A general survey providing a perspective on automated
                            electronic testing.

TITLE: Analyzing Selected U. S. Air Force Data Systems and Determining
              Suitability of Data for Reliability Measurements of Aircraft Engines

AUTHOR: Thomas B. McHugh

COMPANY: George Washington University

REPORT _X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AD 608350, A Thesis for Master's Degree

DATE: February 1964   PAGES: 62

SCOPE: An evaluation of several Air Force Data reporting systems for suita-
          bility of data in determination of aircraft engine reliability. The
AFM 65-110, AFR 65-20, and AFM 66-1 systems were investigated. The
combined data from AFM 66-1 and AFR 65-20 provides a basis for determining
engine failure rates.

APPLICABILITY: This report is concerned with statistical reliability of
                      engines, while OBIFCO is primarily concerned with
"deterministic" reliability (failure signatures, wear out trends, etc.). Thus,
it would be useful only in evaluating OBIFCO benefits.

TITLE: Error Control Methods for an Automatic Checkout System

AUTHOR: T. S. Lewis and W. J. Huebner

COMPANY: IIT Research Institute and Aerospace Medical Research Laboratories, WPAFB; Contract AF 33(657)-10271

REPORT__X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AMRL-TDR-64-17

DATE: March 1964   PAGES: 152

SCOPE: Precedence and connection matrix techniques for use with total simulation methods were incorporated into a simulation computer program which comprised a total simulation of the computer which controls an operational automatic checkout system.

APPLICABILITY: This report, although lengthy, is quite general and appears to have no direct applicability to OBIFCO. Storage problems for the techniques discussed are of such magnitude that a large-scale computer is required, and therefore application to an on-board system would not be feasible.

TITLE: Engine Condition and Performance Trend Analysis

AUTHOR: None indicated

COMPANY: General Electric

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 36-3

DATE: Mar. 27, 64   PAGES: 3

SCOPE: This bulletin, which is intended primarily for the more recent operators of the CV990A Aircraft (uses CJ805-23B engines), contains some background information on jet engine trend analysis, nondimensionalized engine performance curves, and several sample trend indication curves. The discussion centers around the CJ805-23B engine and associated trend monitoring procedures, using the flight engineer or the third crew member to calculate and plot engine performance trends. The flight log information normally recorded by flight crews is separated into two categories:

> (1) Parameters related directly or indirectly to mechanical integrity (oil temperature and pressure, vibration, etc.).

> (2) Parameters related directly to engine performance (RPM, EGT, etc.).

APPLICABILITY: Some of the information contained in the bulletin is directly applicable to the OBIFCO Study and will be incorporated in the Boeing final report. Care must be taken in using the sample trend indication curves since some are general and therefore applicable to the OBIFCO Study, while others are likely to be more or less peculiar to the CJ805 engine family.

TITLE: CT58-110-1 Performance Trend Analysis

AUTHOR: None indicated

COMPANY: General Electric

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 3-110

DATE: Apr. 22, 64   PAGES: 14

SCOPE: This bulletin contains a brief discussion of trend analysis of the
CT58-110-1 turboshaft engine for helicopter operation. Included are
performance nomographs and tables applicable to the CT58-110-1 engine perform-
ance when installed in the Sikorsky S61 helicopter. The nomographs have been
constructed from a large sample of production engine performance data, and
provide a means to manually compare indicated to predicted performance levels.
Four typical helicopter flight altitudes have been selected, permitting a
comparison of indicated parameters, using engine torque as the independent
variable, at 100% rotor speed.

APPLICABILITY: Although neither the engine nor the mission considered
in this bulletin are directly applicable to the OBIFCO
study, it does contain some useful information, including a brief discussion
of some of the effects of variable stators on engine operation.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 406

TITLE: The Reliability and Maintainability Barrier

AUTHOR: J. M. Brearly

COMPANY: U. S. Navy, Bureau of Naval Weapons

REPORT___   SYMPOSIUM__X TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Air Transport and Space Meeting, SAE/ASME

DATE: April 27-30, 1964   PAGES: 5

SCOPE: The complexity of avionic equipment has continued to spiral and, by its very nature, requires ever-increasing numbers of maintenance personnel and higher skill levels to keep the systems operating at optimum reliability and with the versatility for which they have been designed. However, maintenance is handicapped by a decreasing number of skilled personnel, and this lack seriously affects the Navy mission capability. This paper reports on the measures taken to increase maintainability effectiveness by introducing new techniques and modular designs. Simplification of testing procedures is one phase of the program and is especially related to present and future suppliers.

APPLICABILITY: One approach to automated avionics checkout is discussed, although no emphasis is placed on in-flight monitoring.

RELATED ARTICLE: "Starve the Maintainability Wolf," same author, SAE Journal, March 1965, pp. 56-57.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 407

TITLE: Accuracy in Automatic Test Equipment

AUTHOR: Marshall C. Kidd

COMPANY: RCA, Burlington, Massachusetts

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace

DATE: April 1964   PAGES: 1073-1080

SCOPE: Basic blocks comprising an automatic test equipment system are
described, along with types of measurement associated standards.

APPLICABILITY: The article is a bit too superficial to be of much value
to OBIFCO. However, it does present a broad picture
of some problems along with approaches to their solution.

Numerical values of existing standards (1963 state-of-the-
art) could provide a perspective in system definition.

TITLE: Investigation of Fault Diagnosis by Computational Methods

AUTHOR:

COMPANY: Sperry Rand/UNIVAC, for AF Aero Propulsion Laboratory, under
Contract AF 33(657)-10113

REPORT __X__   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: APL TDR 64-62

DATE: May 1964   PAGES: 227

SCOPE: This study was directed toward isolation of electronic circuitry faults
by automatic techniques using known circuit parameters. Theoretical
analyses are made, recognizing that not all nodes are available as test points.
A sample FORTRAN program and flow charts are included. The report concludes
that such fault isolation techniques are feasible, and that prime systems can be
designed with test points located to permit fault isolation to any level of confidence.

APPLICABILITY: While this report assumes depot-level test designed to
locate faulty elements of a black box, the techniques can
probably be extrapolated to system monitoring for identification of a faulty
replaceable unit. The digital computer techniques used will probably be applicable
to OBIFCO.

TITLE: Measurement of Net Thrust in Flight

AUTHOR: Theron W. Davidson

COMPANY: Naval Air Test Center, Patuxent River, Md.

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE X

NAME OR NUMBER: Journal of Aircraft

DATE: May-June 1964   PAGES: 107 through 113

SCOPE: This paper compares the feasibility and accuracy of a traversing rake system of measuring net thrust to the General Electric gas-generator method for subsonic flight. The traversing rake samples pressures and temperatures through the engine exhaust. Results show agreement between the methods of within 1% in gross thrust and 5% in net thrust.

APPLICABILITY: This system promises developmental and research application bypassing extensive engine-test cell calibrations, however we see no application of this method to a production aircraft system for which OBIFCO is intended.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 410

TITLE: On-board Checkout and Remedial Activities for the Lunar
           Excursion Module (U)

AUTHOR: J. R. Brom, D. J. Dugas, E. M. Scheuer, and C. G. Vandervoort

COMPANY: RAND Corporation, for NASA

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4078 (Confidential)

DATE: May 1964   PAGES:

SCOPE: A discussion of the testing equipment aboard the Lunar Excursion
         Module for checkout during the lunar mission, and possible
      maintenance options for defective prime equipment in the LEM.

APPLICABILITY: Emphasis is heavily on LEM, and while the results
                     may be extended to other spacecraft, there is little
      applicability to aircraft.

TITLE: Growth of Automation in Apollo Prelaunch Checkout: Volume 1:
Go/No-Go Testing

AUTHOR: L. T. Mast, L. D. Amdahl, O. T. Gatto and A. A. B. Pritsker

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM__   TECHNICAL JOURNAL__   MAGAZINE__

NAME OR NUMBER: RM-4160

DATE: July 1964   PAGES:

SCOPE: A summary of Apollo go/no-go checkout requirements and their
implications for computer programming and equipment. The
study relates contributions from both the checkout and the computer
fields to the automation of Apollo checkout. This Memorandum is the
first of two volumes: the second (RM-4161-NASA) discusses further
automation with computers in time-phased growth of the Apollo checkout
system.

APPLICABILITY:

TITLE: Growth of Automation in Apollo Prelaunch Checkout: Volume II:
         Added Roles

AUTHOR: L. T. Mast, L. D. Amdahl, O. T. Gatto and A. A. B. Pritsker

COMPANY: RAND Corporation, for NASA

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4161

DATE: July 1964   PAGES:

SCOPE: A discussion of added tasks for computers in Apollo checkout--
        both near-term tasks and those that require additional research
or development. East task is described and the near-term tasks translated
into computer programming and equipment needs, singularly and as
composite systems for the launch vehicle, spacecraft, and lunar excursion
module. This Memorandum is the second of two volumes and builds upon
Volume I (RM-4160-NASA), which discussed Apollo go/no-go checkout
requirements.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 413

TITLE: Display Requirements for Prelaunch Checkout of Advanced
Space Vehicles

AUTHOR: R. D. Pepler and J. G. Wohl

COMPANY: Dunlap and Associates, for NASA

REPORT_X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4200

DATE: June 1964   PAGES:

SCOPE: A guide to the establishment of computer-driven display
requirements for earth prelaunch checkout of advanced space
vehicles. The report reviews existing uses of computer-driven displays,
identifies the information, display format, coding requirements for
prelaunch checkout systems, and develops a basis for determining
computer-driven display requirements of checkout systems with differing
levels of automation. A procedural guide is provided for developing the
requirements of a prelaunch checkout computer-driven display system.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 414

TITLE: In-flight LEM Checkout Prior to Lunar Operations (U)

AUTHOR: H. S. Dordick

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4214 (Confidential)

DATE: September 1964   PAGES:

SCOPE: Discusses requirements for in-flight Lunar Excursion Module
(LEM) checkout prior to lunar operations, various checkout
policies for the LEM, and the LEM Abort Sensing System (LASS), as
evolved from the analysis for use as one continuously operating monitor
of the LEM. Recommendations derived from this research are already
part of planning considerations for vehicle system design and operations.

APPLICABILITY:

TITLE: Scheduling of Apollo In-flight Checkout

AUTHOR: A. J. Truelove

COMPANY: RAND Corporation, for NASA

REPORT x SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: RM-4272

DATE: September 1964   PAGES:

SCOPE: Studies the critical checkout of any specified in-flight system
        of an Apollo spacecraft prior to final commitment to a programmed
mission event. It presents a theoretical method for defining the optimal
time to perform this checkout in order to maximize the probability of
successful operation.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 416

TITLE: Selecting Between Redundancy and Repair in Manned Spacecraft:
         A Designer's Tool

AUTHOR: C. G. Vandervoort and H. S. Dordick

COMPANY: RAND Corporation, for NASA

REPORT x SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4325

DATE: September 1964   PAGES:

SCOPE: Presents a method to assist the spacecraft equipment designer in determining
        the proper mix between two means of reliability augmentation:
the redundancy, or "self-repair," approach; and the spares approach,
utilizing man's maintenance skills. For the spares approach, this method,
or tool, allows the designer to specify his requirements for checkout
equipment, spares, and crew training in order to achieve the reliability
required of his equipment.

APPLICABILITY: This report deals more with the action taken in
                 event of a malfunction than with the means of
defining the malfunction. While both concepts must be considered in
system design, the report has little direct application to OBIFCO.

TITLE: On Avionics Systems Maintenance. I - Some General Considerations in Fault Isolation

AUTHOR: E. A. Flick

COMPANY: General Electric Co., Defense Electronics Div., Light Military Electronics Dept., Utica, N. Y.

REPORT x   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Aerospace Electronics Conference, Dayton, Ohio, Proceedings

DATE: May 11, 1964   PAGES: 220 through 223

SCOPE: Description of procedures for performing automatic confidence tests and fault-isolation tests on electronic systems. An in-flight performance-monitor system for confidence tests is reviewed which provides continuous monitoring, usually in the form of GO/NO-GO indicators to operational personnel. Considerations for the development of an in-flight creditability-monitoring system capable of fault isolation are discussed.

APPLICABILITY: Seven main points, listed for economy and performance trade-offs, are directly applicable to OBIFCO. Also the practical problems discussed are of value, e.g. a list of the operational environment problems that may defeat evaluation of test signals from a remote monitor, plus types of malfunctions which could be diagnosed by a skilled operator, but are extremely difficult or impossible with built-in sensory perception.

TITLE: On Avionics Systems Maintenance. II - Automated Checkout
of an ECM System

AUTHOR: Loren R. Seidl

COMPANY: General Electric Co., Defense Electronics Div., Light Military
Electronics Dept., Utica, N. Y.

REPORT X   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE__

NAME OR NUMBER: National Aerospace Electronics Conference, Dayton, Ohio,
Proceedings

DATE: May 11, 1964   PAGES: 224 and 225

SCOPE: Description of procedures for the automatic confidence testing of
ECM systems. An inflight performance-monitoring system is used
which monitors in GO/NO-GO fashion the important parameters of the ECM rf
antenna output, including the bandwidth, center frequency, and total rf
power.

APPLICABILITY: The techniques used here are applicable to rf systems in
OBIFCO and should definitely be given serious study and
consideration.

TITLE: Development and Use of Optimum Fault Isolation Routines

AUTHOR: J. Ver Hulst

COMPANY: Republic Aviation Corp., Farmingdale, N. Y.

REPORT x   SYMPOSIUM x   TECHNICAL JOURNAL __   MAGAZINE __

NAME OR NUMBER: National Aerospace Electronics Conference, Dayton, Ohio,
Proceedings

DATE: May 11, 1964   PAGES: 234 through 237

SCOPE: Description of techniques for developing optimum procedural fault-
isolation instructions for technicians testing complex systems.
Techniques developed in the Maintenance Engineering Management and Repair
Information (MEMRI) program are reviewed. The fault-isolation routines can
be (1) placed in a manual or book format, (2) placed on microfilm
operating in conjunction with a random-access microfilm presentation device,
or (3) used with a standard digital computer to conduct a continuous evalua-
tion of the engineering and maintenance environment in order to sequence the
fault isolation tests.

APPLICABILITY: The MEMRI approach is intended to utilize the technician
to his utmost and in that respect is contrary to the goals
of OBIFCO. The routines of MEMRI (not given in the report) may be adaptable
to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 420

TITLE: The Use of Automation in the Checkout of Aircraft, Spacecraft, and Missile Systems

AUTHOR: Robert A. Kirkman

COMPANY: TRW Space Technology Laboratories

REPORT _X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA 64-250

DATE: July 1964   PAGES: 23

SCOPE: This paper comprehensively documents the history of Automatic Checkout Equipment (ACOE) by describing many programs, past and present. It discusses current problems and postulates the future of ACOE by considering the effects of checkout trends and the expected increase in its application to new products and areas.

       Military, NASA, and Airline activities are described in detail in a discussion which estimates that over 100 different types of system and subsystem ACOE exist and points to the lack of standardization in equipment and programming as the greatest common problem. The paper also identifies current efforts to solve the problem, such as the Air Force's standard tape programmed AN/GJQ-9 and special studies such as PLACE (Programming Language for Automatic Checkout Equipment).

APPLICABILITY: This document is a valuable reference to any designer of automatic checkout equipment. Objectively written, it provides guidelines for determining the degree of influence that checkout should have on design of a prime system. While it identifies several potential OBIFCO problems, it offers no specific solutions.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 421

TITLE: A Survey of Programming Aspects of Computer Controlled
Automatic Test Equipment

AUTHOR:

COMPANY: New York University

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: June 1964   PAGES: 43 in Vol. I, 66 in Vol. II

SCOPE:

APPLICABILITY:

TITLE: Mission Reliability as a Function of Automatic Checkout

AUTHOR: R. A. Kirkman

COMPANY: TRW Space Technology Laboratories

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL X   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on aerospace, 1964

DATE: February 1964   PAGES: 22-29

SCOPE: Mission reliability can be increased by field tests which can
         detect incipient failures. Emphasis is on performing tests
prior to each mission, with automatic techniques mentioned only briefly.

APPLICABILITY: Since no specific on-board applications are included,
                 usefulness on OBIFCO is limited.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 423

TITLE: Saturn IB Instrument Unit Automatic Checkout Computer
Programming Plan

AUTHOR:

COMPANY: NASA, Marshall Space Flight Center

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: August 1964   PAGES: 44

SCOPE:

APPLICABILITY:

TITLE: Buffer Control in Data Compression Systems for Non-Stationary
           Data

AUTHOR: Dr. Richard S. Simpson

COMPANY: University of Alabama, Sponsored by Marshall Space Flight
          Center, Contract NAS8-5003

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference

DATE: June 1964   PAGES: 7

SCOPE: A buffer must be used to smooth the somewhat random output
         rate of a data compressor. Buffer overflow must be prevented
without degradation of accuracy, if practicable. A scheme for buffer
control is proposed which provides highest accuracy during periods of
peak activity.

APPLICABILITY: The techniques of buffer control described are applicable
                     to OBIFCO, assuming data compression is used.

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TITLE: The Use of Quantiles for Space Telemetry Data Compression

AUTHOR: Edward C. Posner

COMPANY: Jet Propulsion Laboratory, NASA   Contract No. NAS7-100

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference

DATE: June 1964   PAGES: 6

SCOPE: Sample quantiles for data compression are introduced in this
         report. After defining quantiles a method of recovering most
of the information present in an empirical distribution is shown using
only four quantiles. Design of a quantile data compression system is
presented. A compression ratio of 50 to 1 at 100 percent efficiency is shown
to be feasible.

APPLICABILITY: This technique should be investigated further since
                 it appears to be applicable to OBIFCO. An operational
quantile system is probably now in existence at JPL.

TITLE: Redundancy Reduction The Key To Adaptive Telemetry

AUTHOR: Lawrence W. Gardenhire

COMPANY: Radiation Inc.

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference

DATE: June 1964   PAGES: 16

SCOPE: Three different data compression (redundancy reduction)
           methods are explained and studied.   Theoretical and real
telemetry data are processed by each method using a digital computer to
perform the analysis.   The results of the study give advantages of each
method.

APPLICABILITY: The methods discussed are applicable to OBIFCO.

TITLE: Application of Data Compression To Flight Data Processing

AUTHOR: Wil. Morrison, W. P. Hogan, and R. M. Pentz

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 19.3, IEEE Wescon Convention Record

DATE: August 1964   PAGES: 11

SCOPE: Removal of data redundancy before computer entry can result
         in significant data processing cost savings. Compressed data
may be reconstructed within predictable error tolerances of the original
uncompressed data. Error analysis, hardware mechanization and cost
savings are discussed.

APPLICABILITY: The redundancy removal techniques of data compaction
                discussed here are applicable to OBIFCO. Although
primarily intended for telemetry data several of the techniques are
applicable to data acquired and processed while in flight.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 428

TITLE: Predicting System Checkout Error

AUTHOR: Warren D. Moon

COMPANY: Radio Corporation of America, Aerospace Systems Div., Burlington, Mass.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE X

NAME OR NUMBER: Electro-Technology

DATE: Jan. 64   PAGES: 46 through 50

SCOPE: Discussion of testing techniques and test equipment design criteria developed to reduce the number of both undetected defects and false alarms for present space vehicles. The methods given can be used to indicate the test-equipment accuracy required to keep the probabilities of false alarm and undetected defects below specified tolerable limits. For test equipment already designed, the methods may be used to determine probabilities of these checkout errors.

APPLICABILITY:

TITLE: Periodic Checkout and Associated Errors

AUTHOR: Warren D. Moon

COMPANY: Radio Corporation of America, Defense Electronic Products, Aerospace Systems Div., Burlington, Mass.)

REPORT___   SYMPOSIUM_X___   TECHNICAL JOURNAL___   MAGAZINE_X

NAME OR NUMBER: International Conference and Exhibit on Aerospace Electro-Technology, Phoenix, Arizona

IEEE Transactions on Aerospace, April, 1964

DATE: April 20, 1964   PAGES: 356 through 372

SCOPE: Periodic checkout of space or weapon systems is investigated to determine the probability of no undetected defects (or failures) as a mathematical function of various parameters related to checkout-equipment design criteria and checkout techniques. This probability is treated (1) when the checkout is complete and therefore tests for all possible failures and (2) when the checkout is not complete and does not test for all possible failures. One of the parameters affecting the probability of no undetected defects is the frequency of checkout. Special attention is paid to this parameter as it affects the system failure rate, as opposed to its effect on the probability of no undetected defects. The probability of a checkout erroneously determining that a failure exists (a false alarm) is treated as a matter of considerable importance because it results in unnecessary mission delays and money expenditures. This probability is also shown as a mathematical function of the various checkout equipment design and checkout techniques.

APPLICABILITY:

TITLE: Automatic Circuit Module Testing Technique and Philosophy

AUTHOR: G. Dailey

COMPANY: IBM Owego

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: East Coast Conference on Aerospace and Navigational Electronics, IEEE

DATE: October 21-23, 1964   PAGES: 2.3.3-1 through 7

SCOPE: This paper describes the semiautomatic circuit tester (SACT) system, used to test circuit modules in space guidance computers. Design factors are discussed.

APPLICABILITY: While the general aspects of this paper apply to any automatic checkout technique, it is basically limited to testing circuit modules. Within this limitation, it discusses such features as flexibility and printed results.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 431

TITLE: Apollo Preflight Automatic Checkout

AUTHOR: Ronald Murad and Jack Underwood

COMPANY: Apollo Program, NASA Headquarters

REPORT___   SYMPOSIUM_X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: East Coast Conference on Aerospace and Navigational
Electronics, IEEE

DATE: October 21-23, 1964   PAGES: 2

SCOPE: Applications of automatic checkout to Apollo are examined in
terms of cost, checkout time, errors, flexibility, and
maintenance problems. (abstract only)

APPLICABILITY: Since emphasis is on ground testing of a spacecraft,
the only application to OBIFCO might be relationships
of various test levels of avionics systems.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 432

TITLE: Automation of Dynamic Testing

AUTHOR: H. L. McCoy, W. C. Hutton

COMPANY: Douglas Aircraft Company, Aircraft Division

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: East Coast Conference on Aerospace and Navigational
Electronics, IEEE

DATE: October 21-23, 1964   PAGES: 7

SCOPE: This paper surveys the general area of testing electronic
systems, and concludes that an automatic analog comparator
is the best test equipment, whether for use on the ground or in flight.

APPLICABILITY: This paper is applicable to OBIFCO in that it
presents and supports one possible approach to
on-board testing.

TITLE: Design for In-Flight Maintenance for Manned Space Missions

AUTHOR: R. W. Tillotson

COMPANY: Honeywell Aero Division

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: SAE Aeronautic and Space Meeting

DATE: October 5-9, 1964   PAGES: 4

SCOPE: The reasons for and the design constraints associated with design for
        in-flight maintenance for manned space missions are discussed.
Analytical techniques used to define problem areas and design experience de-
rived from several current programs are presented. It is concluded that ad-
vantages of an in-flight maintainable system justifies the additional design effort
required to achieve such a system.

APPLICABILITY: More pertinent to spacecraft than to aircraft.

TITLE: Checkout and Test of Space Vehicles by Computer Simulation

AUTHOR: E. H. Kirsch

COMPANY: Brown Engineering

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL __   MAGAZINE X

NAME OR NUMBER: Ground Support Equipment

DATE: October 1964   PAGES: 20-23

SCOPE: A general-purpose computer is used to simulate vehicle component responses as an aid to checkout of related systems.

APPLICABILITY: A general description of techniques that could be used for on-board checkout.

TITLE: Pinpointing Systems Malfunctions

AUTHOR: H. Pallulat and R. F Klawa

COMPANY: General Dynamics Corp , General Dynamics/Astronautics, San Diego, Calif.

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif.

DATE: October, 1964   PAGES: 6

SCOPE: Description of the FASTI system (Fast Access to Systems Technical Information), a computer-oriented methodology of pinpointing system malfunctions. This technique is based on integrated system simulation and analysis, documentation of generated malfunction isolation data, rapid retrieval of these data for a specific problem, and solution at the point of use. The simulation technique also develops many types of data applicable to various engineering disciplines and critical technical management areas. It is stated that, although the peripheral benefits are significant, most important is that malfunction isolation data are rapidly available when needed to avoid catastrophic consequences and keep recovery time to a minimum.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 436

TITLE: Investigation of Secondary Phenomena for Use In Checkout

AUTHOR: Gilbert S. H. Hwang

COMPANY: Systems Research Labs., Inc., Dayton, Ohio

REPORT X SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER:

DATE: Jan, 64   PAGES: 136

SCOPE: This report discusses the experimental work, results, and conclusions of the investigation of secondary phenomena for use in checkout of electronic components and circuitry. It consists of a literature survey of the various secondary phenomena generated by operating electronic circuits and the methods of sensing them without direct electrical contact with these circuits. The investigation of physical laws and phenomena, from which suitable subjects for further consideration were selected, was also part of this program. Different detection techniques of various secondary phenomena were tested experimentally; these were X-ray absorption, infrared using a thermistor, infrared using fluorescence, radiofrequency emission, magnetic fields, and electric fields. At present the X-ray absorption, infrared, and radiofrequency emission show the most promise for future consideration, although these systems will require additional time and effort to develop the techniques and necessary instrumentation.

APPLICABILITY:

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TITLE: Titan III Integrated Electronic Aerospace Ground Equipment

AUTHOR: Leonard Chevlin

COMPANY: Aerospace Corp. El Segundo, Calif.   Manned Systems Division
Contract AF 04(695)-269

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: June 1, 64   PAGES: 43

SCOPE: The design philosophy that guided the development of an integrated checkout
and launch control system for the Titan III Standard Space Launch Vehicle
(SSLV) is presented along with the requirements and intended use of the operational
space system support equipment. Various concepts are presented to alert support
equipment designers to the various factors that require consideration to achieve the
optimum design solution. The Titan III operational ground-based system includes all
support equipment required within the operational logistic flow from factory through
launch. The specific areas involved in the logistic flow include factory operations,
storage and transportation, depot support center, and launch complexes. The primary
problems involved in integrating SSLV checkout and launch control equipment, and
solutions to these problems, are discussed. Cost criteria, risk factors, checkout
criteria, and the purpose and function of the major aerospace ground equipment (AGE)
items are presented.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 438

TITLE: In-Flight Checkout of the LEM Environmental Control System

AUTHOR: E. P. Cytryn

COMPANY: Grumman Aircraft Engineering Corp., Bethpage, N. Y.

REPORT_x_   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Society of Automotive Engineers, National Aeronautic
                  and Space Engineering and Manufacturing Meeting,
                  Los Angeles, Calif., Paper 914A

DATE: Oct. 5, 1964   PAGES: 3

SCOPE: Discussion of the LEM environmental control system consisting of the
        following five integrated sections: atmosphere revitalization,
oxygen supply and cabin pressure control, heat transport, water management,
and cold plates. Each of these sections is described, as are the check-out
phases before and during orbit, and the operational sequences with regard to
the in-flight mission. Limitations of the measuring instrumentation are
appraised, and are found not to affect the success of a lunar mission.

APPLICABILITY:

TITLE: Saturn Flight Instrumentation

AUTHOR: J. T. Powell, Jr.

COMPANY: NASA, Marshall Space Flight Center, Huntsville, Alabama

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL x   MAGAZINE___

NAME OR NUMBER: ISA Journal

DATE: Nov. 1964   PAGES: 51 through 63

SCOPE: Description of the flight monitoring and analysis instrumentation for
         the Saturn I, Saturn IB, and Saturn V. It is reported that the Saturn V
measuring and telemetry system measures physical quantities and signals on board
the vehicle and transmits the data to ground stations for (1) automatic preflight
checkout, (2) monitoring performance during powered flight, (3) monitoring and
checkout while in orbit, (4) verification of commands received by the vehicle
from ground stations, and (5) postflight analysis of performance. A total of
more than 2400 measurements of such parameters as pressure (473 measurements),
temperature (647 measurements), and electrical signals (363 measurements) will be
required. Block diagrams are presented for the measuring and telemetry system
of one stage for the Remote Automatic Checkout System (RACS), FM/FM system,
SSB/FM telemetry, and a PAM/DDAS (Digital Data Acquisition System). Also discussed
are RF systems and optical instrumentation.

APPLICABILITY:

TITLE: Reliability and Cost of Avionics

AUTHOR: E. J. Nalos and R. B. Schulz

COMPANY: The Boeing Company, Seattle

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE X

NAME OR NUMBER:

DATE: November 6, 1964   PAGES: 120-130

SCOPE: This study examines the relationship of avionics reliability to cost in a
        commercial airline with respect to the following areas: Cost history,
techology trends, basic reliability, redundancy, and cost of reliability. It is con-
cluded that utilization of microelectronics will produce a marked increase in
reliability in the 1968 to 1970 time period, with no real cost penalty.

APPLICABILITY: Good general extrapolations of avionics equipment trends in
                application and reliability into the 1970 time period.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 441

TITLE: Computer Algorithm for Fault Isolation and Test Point Selections

AUTHOR: S. M. Fisch and G. R. Brigida

COMPANY: Radio Corporation of America, for AF Aero Propulsion
Laboratory under Contract AF 33(615)-1347

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AFAPL-TR-65-12

DATE: December 1964   PAGES: 185

SCOPE: The document describes research to develop a programmed
algorithm for selection of preferred test point locations in
an analog electronic circuit. Testing would be done by a sequential
system of non-computing equipment, on a black box known to contain
one failure. Flow charts and a Fortran IV listing are included.

APPLICABILITY: The techniques used, while designed for detecting
faulty elements in a unit, may be applicable to a
programmable on-board computer to isolate faulty replaceable units.

TITLE: Turbine Blade Life

AUTHOR: E. B. Uhler

COMPANY: General Electric

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Operations Engineering Bulletin No. 46-3/38-23

DATE: Dec. 22, 64   PAGES: 10

SCOPE: This bulletin contains a discussion of the temperature and stress conditions which affect useable turbine blade life in jet engines. The three basic conditions which are discussed are: (1) thermal fatigue, (2) intergranular oxidation (IGO), (3) stress rupture. A list of recommendations is given which should be observed by flight and maintenance crews to increase turbine blade life.

APPLICABILITY: The report is applicable to OBIFCO since it points out several areas where engine monitoring may be used to keep track of turbine life. Several parameters which are emphasized are: time rate of change of temperature, severity of temperature, time of temperature and vibratory stresses. Measurements of EGT, time, and vibration could possibly provide adequate information in these areas.

TITLE: Current Concepts and Issues of In-Space Support

AUTHOR: Sidney I. Firstman

COMPANY: Rand, Corporation., Santa Monica, California

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: Aug. 1964   PAGES: 12

SCOPE: The focus of this paper is on maintenance and checkout system concepts
         for manned space vehicles. Currently, there are two primary mainten-
ance concepts: (1) modular design and inflight repair, and (2) redundancy and
switching. These are described, and the factors relating to their applicability
are discussed. Checkout system concepts compatible with both maintenance
approaches are similarly treated. The operational domains of interest are in
the in-flight and lunar mission phases of the next set of manned space missions,
typified by those of Gemini and Apollo.

APPLICABILITY:

TITLE: Preflight Acceptance Testing

AUTHOR: G. Merritt Preston

COMPANY: NASA, Manned Spacecraft Center, Houston, Texas

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___
Book, edited by P. E. Purser, M. A. Faget, and N. F. Smith

NAME OR NUMBER: Manned Spacecraft - Engineering Design and Operation

DATE: 1964   PAGES: 421-425

SCOPE: Review of procedures for assuring the flight-readiness status of
           manned spacecraft through rigorous preflight testing.   The basic
test philosophy and specific test concepts are presented.   The testing of a
typical manned spacecraft is described, including subsystems and simulated-
flight tests, and mating of spacecraft and launch vehicle.   Recent develop-
ments in checkout equipment are noted, and the acceptance checkout equipment
for spacecraft being developed for the Apollo program is described.

           This section is chapter 39 of the book.

APPLICABILITY: The entire book is devoted to manned spacecraft.   Thus
                 it applies to aircraft only insofar as the two vehicles
have common subsystems.   Within this limitation, the chapter lists overall
criteria for acceptance checkout.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 501

TITLE: Takeoff Power Trend Analysis

AUTHOR: None indicated

COMPANY: General Electric

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___
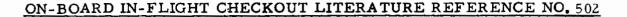

NAME OR NUMBER: Operations Engineering Bulletin No. 48-3/40-23

DATE: Jan. 18, 65   PAGES: 8

SCOPE: This bulletin contains a brief discussion of engine trend analysis
at take-off, including reasons for trending at take-off rather than
at cruise conditions when the trending is being done manually by the flight
crews. Included are some trend monitor tables for the CJ805-3 and CJ805-23
engines which provide a simplified method for monitoring take-off power trend
and permit a ready method of monitoring the most important parameters during
day to day power conditions.

APPLICABILITY: This report is applicable to OBIFCO since it covers in
reasonable detail the parameters to monitor for gross
engine health at take-off conditions. It is pointed out that EGT is by far
the most important parameter. Curves and tables for the CJ805 engines which
are provided give a feel for the values to be expected for this type of engine.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 502

TITLE: The Selection of Sampling Rate for Digital Scanning

AUTHOR: Judith M. S. Prewitt

COMPANY: University of Pennsylvania, contract with National Cancer
Institute, Bethesda, Maryland

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_x_   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Bio-Medical Engineering

DATE: January 1965   PAGES: 21

SCOPE: The problem of selecting and appraising a sampling interval
            for digital data systems is covered in general. Relative residual
is introduced as a figure of merit to measure error in the reconstructed
function. Specifically, CYDAC, a cytophotometric data acquisition
system is discussed.

APPLICABILITY: Selection of sampling rate for digital information is
                    definitely a problem for OBIFCO. The material in
this paper is applicable.

TITLE: Increasing Information Transfer

AUTHOR: Harold Gruen and Benjamin Olevsky

COMPANY: Philco Corporation

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: Space/Aeronautics

DATE: February 1965   PAGES: 40-47

SCOPE: To meet demands for more data from spacecraft, techniques are
         being developed to give up to 100:1 increase in information
transfer.   These techniques can provide faster transmission of TV data
and more channels for communication.   Some of the basic concepts of
communication theory are reviewed in this article.

APPLICABILITY: If the OBIFCO concept uses modulated signals for
                 data transfer within the aircraft, or includes a
data link to ground, the information in this article is applicable.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 504

TITLE: Infrared Techniques for Detecting Latent Failures on the
         Production Line

AUTHOR: G. W. Carter

COMPANY: IBM Federal Systems Division

REPORT $_x$ SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 65-825-1405

DATE: March 1965   PAGES: 15

SCOPE: This paper presents a brief introduction to the principles of
         infrared technology applicable to detection techniques, with
attention focused on the limiting parameters. It discusses use of
infrared techniques to locate shorts within multilayer circuit boards
undetectable by other means, as well as nicked wires in memory planes.
Applications to engineering and manufacturing process control are
mentioned.

APPLICABILITY: While these techniques are designed more for
                 manufacturing than for in-flight checkout, they
should be considered in an overall test philosophy.

TITLE: A Manual Device for Locating Electric Arc-Producing Faults

AUTHOR: Richard T. Stevens

COMPANY: Honeywell, Inc. , for AFAPL Research and Technology
Division, under contract AF33(615)-L031

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AFAPL-TR-65-25

DATE: March 1965   PAGES: 137

SCOPE: This program's purpose is to develop a noncontacting portable
instrument for locating defective components and circuits
which generate RF fields. These experiments show that circuit and
component defects resulting in an electric spark discharge can usually
be detected by the receiving equipment developed under this program,
while extremely low level RF disturbances, such as those generated by
noisy diodes, usually cannot be detected. When used with this limitation
in mind the equipment should provide a highly effective portable device
for locating a large number of electronic circuit and component defects.

APPLICABILITY: Although this program was limited to development
of a portable sensor for detection of RF disturbances,
many of the techniques described can be applied to in-flight monitoring.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 506

TITLE: Economic Impact of Aircraft Maintenance

AUTHOR: B. M. Meador

COMPANY: TWA

REPORT___ SYMPOSIUM_x_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Aviation and Space Conference, ASME 65-AV-14

DATE: March 14-18, 1965   **PAGES:** 5

SCOPE: A discussion of practices that affect the amount of time a commercial aircraft can be earning revenue. Emphasis is on maintenance techniques and means of reducing costs and down time.

APPLICABILITY: While the aspect of automatic checkout is not considered directly, the article presents a perspective on maintenance activities.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 507

TITLE: Maintenance of Aircraft Gas-Turbine Engines

AUTHOR: W. J. Cake

COMPANY: Pratt and Whitney Aircraft Division, United Aircraft Corporation

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Aviation and Space Conference, ASME 65-AV-14

DATE: March 14-18, 1965 PAGES: 5

SCOPE: This paper deals with current practices of aircraft gas-turbine engine maintenance. The author deals with overhaul, inspections and ground checks, and then describes the techniques of in-flight monitoring as a basis for determining malfunctions which require maintenance action. Case histories are cited which demonstrate the efficiency of this approach.

APPLICABILITY: This paper emphasizes the need for in-flight monitoring preferably by automatic techniques. However, it contains no quantitative data to aid the designer.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 508

TITLE: Programming for Automatic Checkout

AUTHOR: Victor Mayper

COMPANY: Mayper Associates

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE_x_

NAME OR NUMBER: Datamation

DATE: April 1965 PAGES: 28-32

SCOPE: A survey of automatic checkout philosophy dealing with problems involved in translating engineering statements of manual checkout procedures to those applicable to an automated procedure.

APPLICABILITY: Applicable as a generalized philosophy dealing with statements of test procedures and documentation for an automated checkout scheme.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.509

TITLE: The ATOLL Checkout Language

AUTHOR: B. L. Ryle

COMPANY: MESA Scientific Corporation

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X

NAME OR NUMBER: Datamation

DATE: April 1965   PAGES: 33-35

SCOPE: A very brief description of an automatic checkout language
        called ATOLL (Acceptance Test or Launch Language) and its
    history.

APPLICABILITY: Useful as background information on approaches
                  to automatic checkout languages.

TITLE: A Proposed Method for On-board Monitoring of Discrete Signals

AUTHOR:L. D. Amdahl and L. T. Mast

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4455

DATE: February 1965.   PAGES:

SCOPE: Suggestion for a method of incorporating the discrete monitoring
         function in a space vehicle and of telemetering the data to the
ground station. This method would meet prelaunch needs and would
provide data to the ground station after the launch vehicle has left the
pad--at a small decrease in vehicle weight.

APPLICABILITY: The concept of local scanners to replace a central
                   processor appears to be valid for OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 511

TITLE: Integration of Man and Computer in Prelaunch Checkout of
Advanced Space Vehicles

AUTHOR: R. D. Pepler and J. G. Wohl

COMPANY: Dunlap and Associates, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE__

NAME OR NUMBER: RM-4506

DATE: April 1965   PAGES:

SCOPE: An analysis of the roles, information, and interface display
and control requirements for different levels of checkout system
automation. The levels of automation considered are: (1) manual (the
computer is primarily used as a switching matrix); (2) minimal (some of
the more routine control and evaluation functions are delegated to the
computer); (3) moderate (the test engineer can learn more about his
system's performance through feedback reference information); and
(4) advanced (the checkout system can adapt to pretest modifications and
can preprogram test operations on line). The study distinguishes between
the hardware and software aspects of a man/computer interface and
stresses the importance of programming rather than panel and console
design.

APPLICABILITY:

TITLE: The Monitoring Task in Automated Checkout of Space Vehicles

AUTHOR: L. Chesler and R. Turn

COMPANY: RAND Corporation, for NASA

REPORT X_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4678

DATE: September 1965   PAGES:

SCOPE: A definition of the need for a human monitor in automated
              checkout operations. The Memorandum discusses the roles
he may need to assume, summarizes his information requirements
for performing selected monitoring tasks, and proposes a set of computer-
driven information displays designed to increase his effectiveness.
Experimental results from a pilot program for one of the displays are
used to indicate data processing support required for maintaining and
updating the display.

APPLICABILITY:

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 513

TITLE: A State-of-the-Art Evaluation of Infrared in Heat Transfer
Engineering

AUTHOR: G. W. Carter

COMPANY: IBM Federal Systems Division

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 65-825-1434

DATE: April 1965   PAGES: 27

SCOPE: An evaluation of state-of-the-art of infrared techniques is
made with respect to determining temperatures of microelectronics.
Advantages and disadvantages of two basic infrared systems are discussed.
Examples are given of IBM's use of infrared in thermal analysis of
electronic equipment.

APPLICABILITY: These techniques should be considered either as part
of an on-board checkout system or as a complement to it.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 514

TITLE: A Synopsis on Data Compression

AUTHOR: D. R. Weber

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 1965 National Telemetering Conference

DATE: April 13, 1965   PAGES: 9-16

SCOPE: Various types of data compression are defined and examples of
          compression ratios achieved are shown.   The necessary
compromise in data fidelity with higher compression ratios is explained
and illustrated.

APPLICABILITY: Many of the data compression techniques described
                    are applicable to OBIFCO.   The need for standardizing
terminology is recognized by the author and therefore the terms used
are well defined.   Examples of TIROS and Polaris data with and without
compression are shown.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.515

TITLE: Air Force Logistic Command's General Purpose Automatic Test
System (GPATS)

AUTHOR: W. D. Woodruff

COMPANY: Middletown Air Material Area, USAF

REPORT___ SYMPOSIUM x TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: AIAA Paper 65-270; AIAA/AFLC/ASD Support For
Manned Flight Conference

DATE: April 21-23, 1965   PAGES: 11

SCOPE: A general Description of GPATS, including history, concepts,
system description, and application.

APPLICABILITY: An interesting summary of an example of contemporary
Automatic checkout equipment. (Operational December 1965)

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 516

TITLE: PCM Telemetry and Data Compression Applied to Real Time
Flight Evaluation

AUTHOR: Burnell W. Furstenau

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Paper No. 65-272; Middletown Air Material
Area, USAF

DATE: April 21-23, 1965   PAGES: 9 plus figures

SCOPE: Basic data compression principles are reviewed. Application to
Spaceborne and ground-based. systems is presented. The ground-
based system can compress data at input rates up to 400,000 samples/
second. Compressed data is transmitted to a 7281/7094 complex for real
time processing and thence to a real time display. Three techniques are
discussed: zero order predictor, zero order interpolator, and first
order interpolator.

APPLICABILITY: The techniques discussed are adaptable to in-flight
or ground-based data processing for OBIFCO.

TITLE: Checkout Criteria and Requirements for Manned Spacecraft

AUTHOR: Rolf W. Lanzkron and William C. Fischer

COMPANY: NASA Manned Spacecraft Center

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA 65-284; AIAA/AFLC/ASD Support for Manned
                  Flight Conference

DATE: April 21-23, 1965   PAGES: 54

SCOPE: This is a general description of equipment and techniques to be
         used for prelaunch and in-flight checkout of the Apollo Spacecraft.
   In-flight repair is also discussed.

APPLICABILITY: The article is descriptive of contemporary automatic
                  checkout equipment.

See also "Apollo Checkout Equipment" by R. W. Lanzkron, Ground Support
Equipment, April 1965, pp. 16-17.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 518

TITLE: Data Compaction of Rocket Booster PCM Telemetry Data

AUTHOR: Lawrence W. Gardenhire

COMPANY: Radiation Inc.

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Second Space Congress

DATE: April 1965   PAGES: 10

SCOPE: Three channels of rocket booster data were studied to determine the amount of bandwidth reduction possible with an adaptive telemeter. A flow, temperature, and pressure measurement were evaluated, using zero order (step method) and first order (fan method) predictors.

APPLICABILITY: Assuming OBIFCO will process and record digital data, the methods analyzed in this report are applicable. The study shows that the answer to all the problems can be attained only by a detailed study of each measurement. Estimates of cost of implementation (computer size and cost per module) are included in the report.

TITLE: Techniques for the Diagnosis of Switching Circuit Failures

AUTHOR: J. M. Galey, R. E. Norby and J. P. Roth

COMPANY: IBM Corporation, Poughkeepsie, New York

REPORT___   SYMPOSIUM_X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Symposium on Combinatorial Problems

DATE: April 1960   PAGES: 152-160

SCOPE: In 2.12 minutes an IBM 7090 program found four input tests
         (for an 8-input parity check circuit) whose outcome determines
whether any one of 102 possible failures occurred.   For any single-output
combinational circuit, with no more than 35 input variables, the program
computes the set of all inputs detecting a given failure.   These sets, one
for each failure, are then processed to find a (small) subset of tests
which detect any failure.   The underlying method extends to the diagnosis
of circuits with feedback.

APPLICABILITY: Certain of these techniques could be applied to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 520

TITLE: Automatic Testing of Avionic Systems

AUTHOR: L. A. Spriggs

COMPANY: Advanced Aircraft Programs Group, IBM Federal Systems Division

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 65-829-4

DATE: May 7, 1965   **PAGES:**   48

SCOPE: IBM has conducted a study program to develop concepts and detail system requirements for built-in test stimuli, test procedures, test points, malfunction detection and isolation, and data recording for trend prediction. The APN-150 Radar Altimiter was selected as typical for this application. Criteria included continuous system operation and monitoring, minimum system modification, and interchangeability of like components.

APPLICABILITY: This document is an excellent example of applying certain OBIFCO techniques to avionics systems.

TITLE: Electro-Explosive Device Pulse Reflection Checkout Technique

AUTHOR: J. R. Petrick

COMPANY: General Electric Company

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Supplement to IEEE Transactions on Aerospace

DATE: June 1965   **PAGES:**   634-637

SCOPE: The pulse reflection test method permits a more comprehensive electrical check of all exploding bridewire ordnance device than can be obtained by continuity check methods. Pulse reflection testing is a specialized application of time domain reflectometry. Laboratory tests showed that waveforms under various test conditions are definite and repeatable, and can determine whether an EBW device is electrically operable or defective.

APPLICABILITY: The techniques described have a potential application to OBIFCO, although they may be more pertinent to spacecraft.

TITLE: Remote-Controlled "SPACE" for Confidence and Diagnostic Testing

AUTHOR: K. L. Skinner

COMPANY: The Boeing Company, Huntsville

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 7

SCOPE: Space-packaged automatic checkout equipment (SPACE) is described as proposed by Boeing for Saturn class vehicles and spacecraft. The system would utilize existing and additional built-in test features of the equipment, stimulated and monitored by ground equipment via radio link.

APPLICABILITY: The system described has many aspects common to OBIFCO. The radio link is only an incidental difference. The approach of built-in monitoring devices is especially applicable. General specifications for a digital processor are given, along with types of measurements, word structure, and packaging information.

TITLE: Progress Report on GPATS

AUTHOR: W. Metcalf

COMPANY: Emerson Electric Company

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 4

SCOPE: GPATS, general purpose automatic test system, is designed
for evaluation of systems, subsystems, and line replaceable
units, with capability of fault isolation. This paper discusses the
hardware concept, the software program, the evaluation program, and
future GPATS development

APPLICABILITY: An interesting summary of an example of contemporary
automatic checkout equipment.

TITLE: Malfunction Detection System for Advanced Spacecraft

AUTHOR: Kenneth McSweeney

COMPANY: Grumman Aircraft

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES:

SCOPE: A system for detecting malfunctions on board a manned space-
craft is described. Mathematical models, test limits, and
trade-offs in system selection are discussed. It is concluded that such
a system is feasible not only for spacecraft but also for other areas of
checkout and support.

APPLICABILITY: The preliminary design criteria presented should
be reviewed in configuring an OBIFCO system.
The mathematical analysis of selecting test points based on error
distributions and potential consequences is also useful.

NOTE: Similar information appears in IEEE transactions on aerospace
and electronic systems Vol. AES-2, No. 1, January 1966, pp. 27-35.

TITLE: Designing Equipment for Automatic Testability

AUTHOR: F. Liguori

COMPANY: RCA Burlington

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
                      for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   **PAGES:**   4

SCOPE: Features to be considered in design of prime systems to be
             tested automatically are discussed. Test point assignment,
packaging, and circuit design considerations are discussed in terms
of basic philosophy rather than rigid rules. The role of a design
specification for such equipment is considered.

APPLICABILITY: The article presents many guidelines that would
                         be helpful in integrating prime equipment and an
    OBIFCO system.

TITLE: Fault Detection and Diagnosis, an Energy Point of View

AUTHOR: J. L. Costanza and R. L. Osborne

COMPANY: University of California, Berkeley, sponsored by Lawrence Radiation Laboratory

REPORT___ SYMPOSIUM X TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 7

SCOPE: This paper treats a complex system as a group of energy manipulators. The form of this manipulation changes when a malfunction occurs. By placement of suitable transducers, energy characteristics can be analyzed to define the nature of a malfunction. Examples of such analyses on passive networks are given.

APPLICABILITY: The techniques described are designed for isolating faults to an element-resistor, capacitor, etc. While the concept of energy measurements might be extended to "black box" definition, it is suspected that no revolutionary techniques would result. Thus the report would be of little value to OBIFCO.

TITLE: In-flight Detection of Non-catastrophic Equipment Failures in
a Space Vehicle Guidance and Navigation System

AUTHOR: B. A. Kriegsman and D. S. Miller

COMPANY: Raytheon Company

REPORT___ SYMPOSIUM_x TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 8

SCOPE: The problem of detecting non-catastrophic failures is considered
for the case of two similar, independent guidance and navigation
systems on-board a space vehicle. Emphasis is on unpowered phases
of orbital-rendezvous and interplanetary missions. Simulation runs
were made to evaluate time required to detect the error and the probability
of identifying the faulty system.

APPLICABILITY: Although this analysis is limited to a specific
equipment configuration, it could apply to certain
types of systems on large aircraft.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 528

TITLE: Power Spectra Analysis as a Means of On-Line Checkout

AUTHOR: Paul B. Kraabel

COMPANY: The Boeing Company, Seattle

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 6

SCOPE: This report describes a means of evaluating a stimulus/response system while it continues to function as part of a larger system. Spectral analysis and statistical techniques are utilized.

APPLICABILITY: For many avionics systems, simpler techniques would be applicable. However, there is a large class of systems (e.g., flight control) which could benefit from the on-line checks described.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 529

TITLE: A Note on Man-Computer Adaptive Fault Isolation

AUTHOR: Sidney I. Firstman, Alan J. Truelove

COMPANY: The RAND Corporation

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 7

SCOPE: This paper outlines an adaptive computer-aided search
structure that should help technicians to shorten the fault
isolation search process. This man-computer interaction is structured
so that it (a) simulates an objective optimal process, (b) satisfies the
requirements imposed on the system by the presence of capable technicians,
and (c) allows technicians freedom of action consistent with the capabilities
of the automated system. The procedure requires no prior evaluation of
parameters or test effectiveness--this is left to the technician's judgment.

APPLICABILITY: This paper is only partially applicable to OBIFCO
since it emphasizes the role of a technician to
assist in testing. However, it may be possible to adopt some of the
manual actions into automated subroutines.

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TITLE: Feasibility of Instrumentation for Indirect Sensing of Secondary Effects for Checkout of Nonelectronic Systems

AUTHOR: H. R. Hegner, A. H. Hehn, M. J. Salkowski and H. S. Weber

COMPANY: IIT Research Institute of the Illinois Institute of Technology

REPORT___ SYMPOSIUM x TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 11

SCOPE: Both theoretical and experimental investigations were performed on secondary phenomena associated with the operation of nonelectronic systems and on the associated techniques for sensing these phenomena. The main objective of this investigation was to demonstrate the feasibility of sensing secondary phenomena of nonelectronic system operation and to obtain information concerning the status of the system or its components.

APPLICABILITY: Secondary sensing is directly applicable to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 531

TITLE: Indirectly Sensed Secondary Effects for Automatic Checkout

AUTHOR: D. A. Barnhart, J. E. Bridges, and A. Dravnieks

COMPANY: Aero Propulsion Laboratory, WPAFB, and IIT Research Institute

REPORT__ SYMPOSIUM x TECHNICAL JOURNAL__ MAGAZINE__

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 7

SCOPE: Secondary phenomena suitable for remote sensing may be considered on the basis of output energy, coupling mode, background noise, and detection techniques. Coupling modes may be electromagnetic, mechanical or chemical.

APPLICABILITY: Secondary sensing is directly applicable to OBIFCO.

TITLE: A Parametric Study of Airborne Fault Locators

AUTHOR: W. J. Chrupcala and L. M. Schmidt

COMPANY: Lockheed-California Company

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
                for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES:

SCOPE: A comparative study of airborne fault locator candidates has
         been completed. The study identifies the design criteria to
be considered as a maintenance aid in the aircraft. The benefits of
having a fault detection system must be weighed against system
reliability and costs. Comparison is made between automatic vs.
manual means. A substantial cost saving may be realized by replacing
the ground support equipment at the organizational level by an airborne
fault locator.

APPLICABILITY: This study contains a great deal of information
                    which directly influences OBIFCO design.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 533

TITLE: System Parameter Measurement Using Transient Response Sampling

AUTHOR: J. P. Chorzel, J. R. Thompson and R. G. Myers

COMPANY: Emerson Electric Company

REPORT___ SYMPOSIUM X_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 8

SCOPE: The response of a system to a pulse excitation contains the
information to assess the status of the system's parameters.
A method to extract and process the information is suggested. It
consists of first forming an error signal by comparing the response of
the system to that of a system model. An experimental device based
on the above principle has been built and applied to the study of an
instrument servo system.

APPLICABILITY: The techniques described could be used in an OBIFCO
application, but would be limited to systems
describable in terms of transfer functions.

TITLE: Essentials of Software

AUTHOR: Nuble S. Bishop

COMPANY: Northrop/Nortronics

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 7

SCOPE: In the first part of the paper, the scope of software as dictated by practical necessity and contractual convenience is explained and the processes involved in its creation are developed. In the latter part of the paper, the application of electronic data processing to the preparation of checkout system programs is amplified.

APPLICABILITY: This report is useful as a guide to what problems may be encountered in the development of a large software capability in terms of cost and testing.

TITLE: Simplifying the Use of Automatic Test Equipment with a Compiler

AUTHOR: Richard C. Miller

COMPANY: R.C.A. Aerospace Systems Division, Burlington, Mass.

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
                for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 4

SCOPE: This paper discusses some of the problems of using depot-
         installed maintenance automatic test equipment (DIMATE) and
   illustrates how a compiler has eliminated them.

APPLICABILITY: The description of their compiler is useful background
                    information to the development of future software for
       applications such as OBIFCO.

TITLE: PLACE Programming for the AN/GJQ-9

AUTHOR: Burton H. Went

COMPANY: Battelle Memorial Institute

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Proceedings of the Automatic Support System Symposium
                    for Advanced Maintainability, IEEE

DATE: June 7-9, 1965   PAGES: 12

SCOPE: This paper discusses some of the properties of the translation
         program and describes the three levels of programming in
PLACE for the AN/GJQ-9.

APPLICABILITY: PLACE is a three-level language with very special
                    applications towards automatic checkout. It
would be a useful tool in the implementation of OBIFCO.

TITLE: EMC in Apollo's ACE-S /C System

AUTHOR: H. Hoffart and N. Ball

COMPANY: General Electric and NASA

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE X_

NAME OR NUMBER: Frequency

DATE: January-February 1965   PAGES: 20-25

SCOPE: A general description of the ACE-S /C (acceptance checkout
        equipment-spacecraft) with emphasis on requirements and
 accomplishments with respect to electromagnetic compatibility, or
 EMC.

APPLICABILITY: Certain concepts could be useful in designing the
                 hardware for OBIFCO, particularly in the area
 of sensors and leads.

TITLE: Engine Air Inlet Compatibility for the Supersonic Transport

AUTHOR: F. W. Barry and C. Edward Kepler

COMPANY: United Aircraft

REPORT___ SYMPOSIUM X TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Society of Automotive Engineers
                      SAE Paper No. 650225

DATE: Apr. 12, 1965   PAGES: 35

SCOPE: This paper is a survey of the general requirements for the perform-
ance and control of supersonic inlets for turbojet or turbofan
propulsion systems for the supersonic transport. The first half of the paper
discusses the interaction between inlet and engine performance. The effects
of pressure recovery, bleed flows, and external drags on engine thrust and
Specific Fuel Consumption are shown for design and off-design operation.
The second half of the paper discusses the problem of controlling the inlet
to obtain safe and efficient operation. The effects of control tolerances
on the inlet geometry and terminal shock position on engine performance
are also shown. Possible approaches for simplifying or improving the inlet
control system are discussed.

APPLICABILITY: This paper is applicable in several areas to the OBIFCO
study. First, it given a complete functional descrip-
tion of a typical supersonic inlet system, which is useful in determining
the parameters which may be considered for monitoring.

        Secondly, the discussion of the control tolerances
necessary to safe and efficient operation may be helpful in determining
instrumentation accuracy requirements.

TITLE: Malfunction Analysis Through Gas Generator Comparisons and Mechanical Trends

AUTHOR: None indicated

COMPANY: Pratt & Whitney Aircraft

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Aircraft Gas Turbine Operation Information Letter, Letter No. 18

DATE: May 25, 65   PAGES: 46

SCOPE: This Pratt and Whitney Aircraft information letter contains one of the best discussions of gas turbine engine monitoring that has been found in the OBIFCO Literature Search. The paper treats two categories of trend parameters: (1) performance parameters, and (2) mechanical condition parameters. Several examples are given of trend monitoring using these parameters, where specific engine or installation malfunctions were observed. The process is described by which in-flight performance data may be obtained, corrected to standard atmospheric conditions, and compared to a basic set of gas generator curves.

APPLICABILITY: This paper is particularily applicable to the OBIFCO Study since it gives a good insight concerning the problem of gas generator comparisons. This material concerning the gas generator (or bare engine) is quite general and will be used appropriately in the OBIFCO Study.

TITLE: Computer-controlled Aerospace Ground Equipment for the AOSO
Communications and Data-Handling Subsystem

AUTHOR: A. E. Reeves and M. K. Meredith

COMPANY: Texas Instruments

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_x_   MAGAZINE___

NAME OR NUMBER: Supplement to IEEE Transactions on Aerospace

DATE: June 1965   PAGES: 429-435

SCOPE: The AOSO communication and data-handling subsystem (CDHS)
checkout is controlled by a general-purpose computer. Multi-
plexing, formats, and general techniques are described.

APPLICABILITY: The concepts described should be considered in
OBIFCO design.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 541

TITLE: An Experimental Telemetry Data Compressor

AUTHOR: H. N. Massey

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: National Telemetering Conference Proceedings

DATE: 1965   PAGES: 4

SCOPE: This document provides useful information on how to instrument
         a data compressor which uses a zero-order floating-aperture
    (tolerance) technique.

APPLICABILITY: This report is applicable to OBIFCO data compression.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 542

TITLE: A Plan For Analysis of Data Compression Techniques for the Apollo Extended System

AUTHOR: F. W. Olson

COMPANY: IBM, Federal Systems Division

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 65-511-0042

DATE: June 15, 1965   PAGES: 17

SCOPE: A general plan for analysis of data compression techniques is presented, and a few simple but effective techniques are reviewed. Various trade-offs are suggested as applicable to a study effort of this type. From a review of available literature, eighteen references were selected and listed.

APPLICABILITY: Although this report was prepared for a study on the Apollo extended system (AES), its contents are quite general and applicable to OBIFCO.

TITLE: Advanced Aircraft Computers

AUTHOR: William A. England and Thomas S. Stanton

COMPANY: Honeywell Aeronautical

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE x

NAME OR NUMBER: Space Aeronautics

DATE: July 1965   PAGES: 69-75

SCOPE: Microelectronics has given airborne computer designers more
            space to work in, but at a staggering cost in interconnection
complexity.   Physical redundancy is the current reliability approach,
but more capacious mini-memories and adaptive multi-processing
schemes show even greater promise.

APPLICABILITY: Emphasis is on use of computers for general air-
                craft functions with only brief mention of testing
and fault isolation.   Within this limitation it provides a perspective on
the role of an OBIFCO system.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.544

TITLE: Pre-indications of Failure in Electronic Components

AUTHOR: J. W. Klapheke, B. C. Spradlin, and J. L. Easterday

COMPANY: Battelle Memorial Institute for Redstone Scientific Information Center, U.S. Army Missile Command, Contract DA-01-021-AMC-11706(Z)

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RSIC-445

DATE: July 31, 1965   PAGES: 37

SCOPE: This report discusses state-of-the-art information and techniques concerned with indications of potential degradation and catastrophic failure in electronic components. This study is intended to provide basic information for future development in automatic checkout equipment. The following electronic parts were covered in the survey: semi-conductors, resistors, capacitors, inductors, computer cores, other items used in a computer, and vacuum tubes. Such items as wire, insulation, lamps, relays, and rotary devices were not considered.

APPLICABILITY: This work is largely theoretical, and no attempt is made to specify hardware applications. Failure modes, screening parameters, and precursors of failure are discussed for each electronic component. However, tests utilizing these data are the type that would be done at a receiving inspection or maintenance depot. There is little, if any, application to determining system readiness or isolating faults.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 545

TITLE: The Next Generation of Automated Checkout Equipment

AUTHOR: B. W. Furstenau

COMPANY: Lockheed Missiles and Space Company

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA-65-517

DATE: July 1965   PAGES: 10

SCOPE: This paper discusses general considerations affecting design
of automatic checkout equipment: complexity, reliability,
and cost. Factory testing, system testing, and in-flight testing are
discussed briefly.

APPLICABILITY: The superficial treatment of checkout considerations
presents an interesting overview of the situation,
but would be of little use in detailed design analysis.

TITLE: An Ideal Automatic Checkout Regime

AUTHOR: R. A. Kirkman

COMPANY: TRW, Space Technology Labs

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA-P-65-518

DATE: July 1965   PAGES: 20

SCOPE: Basic design considerations for automatic checkout equipment
        are presented, such as cost effectiveness, reliability, and
versatility. Comparisons are made of these features with potential
characteristics such as high speed and large capacity. Emphasis is
placed on ground systems.

APPLICABILITY: Many of the concepts discussed are at least partly
                   applicable to OBIFCO, in spite of the fact that the author
assumes airborne equipment must be minimized while no restrictions
(other than cost) apply to ground equipment. The conclusion is drawn that
field checkout of large (especially mass-produced) sophisticated electro-
mechanical systems is feasible, although checkout equipment and prime
system must be ideally matched.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 547

TITLE: Investigation of Secondary Effects for the Checkout of Nonelectronic Systems

AUTHOR: J. E. Bridges and Dr. A. Dravnieks,

COMPANY: IIT Research Institute, contract AF 33(615)-1488

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Technical Report AFAPL-TR-65-57

DATE: August 1965   PAGES: 377

SCOPE: A generally neglected area--checkout of nonelectronic systems
       --has been studied from the standpoint of secondary effects
monitoring. Electrical, electromechanical, electropneumatic, and
electrohydraulic systems exhibit side-effect phenomena which may change
shortly before a failure. The purpose of this report is to study the
normal and failure spectra of acoustic, electromagnetic, chemical, and
fine-particle side effects. Emphasis is on those effects which do not
require dismantling a system.

APPLICABILITY: This document could be very useful in designing an
                   OBIFCO system. Detailed descriptions of typical
systems and malfunctions are given along with applicable means of
secondary sensing. Results of IIT's research is given, along with present
state-of-the-art and additional required development.

NOTE: Material from the same study is presented in references 530
      and 531. In addition, it is discussed in Space/Aeronautics,
      March 1966, "Checkout by Secondary Sensing: no wiring, no
      test points," pp. 91-102

<u>ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.</u> 548

<u>TITLE:</u>   Automatic Test Equipment: A Million-Dollar "Screwdriver"

<u>AUTHOR:</u>   W. J. Evanzia

<u>COMPANY:</u>

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE x

<u>NAME OR NUMBER:</u> Electronics

<u>DATE:</u>   August 23, 1965   <u>PAGES:</u>   88-97

<u>SCOPE:</u>   The increasing role of automated testing is discussed, with
          descriptions of some current systems, their applications and
    evolution.

<u>APPLICABILITY:</u>   A good survey of the automatic test equipment field,
                     with no specific contribution to OBIFCO.

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TITLE: The Aquisition and Digestion of Aéro - Engine Test Data During Flight Development

AUTHOR: V. A. Fisher

COMPANY: Bristol Siddeley Engines Limited, Aero Division, Filton Bristol

REPORT___   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AGARD/NATO 10th Symposium on Flight Instrumentation - Aircraft Integrated Data System

DATE: July, 1965   PAGES: 23

SCOPE: The paper gives an outline of the instrumentation techniques being used in the initial flight testing of the Olympus 593B engine in a Vulcan flying test bed - including a description of the instrumentation requirements, transducers, digital data recorder and the control and form of the recorded data.

        The bulk of the test data is recorded on the digital data recorder onto magnetic tape. Improvement in accuracy and versatility is gained over conventional methods.

        Development of the present recording system to include on-line computing is proposed.

APPLICABILITY: Since the report covers an initial flight testing program where great care must be taken to obtain complete and accurate data at some expense in cost and weight, care must be taken in applying the information directly to an OBIFCO system, where cost and weight must necessarily be less. However, the report does contain information on engine parameters which was recorded, accuracies, and a rather complete discussion of the digital data recorder, which should be of help in looking at OBIFCO systems.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 550

TITLE: Signal Conditioning in Airborne Recording Systems

AUTHOR: A. Pool

COMPANY: National Aero - And Astronautical Research Institute - Amsterdam

REPORT _X_   SYMPOSIUM _X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AGARD-NATO-10th Symposium on Flight Instrumentation - Aircraft Integrated Data System, Paris; Report No. MP 235.

DATE: 8-24-65   PAGES: 24

SCOPE: The objective of this report is to review the functions performed by the signal conditioning elements of airborne recording and telemetry systems. These functions, described as signal transformation, conservation of static accuracy, and reduction of dynamic errors, are each analyzed and the significance of each part is discussed. The relation of these to the design of a signal conditioner is made clear.

The greatest emphasis was placed on the use of filtering to reduce dynamic errors; one is impressed with the fact that inadequate filtering can be the source of major system inaccuracies.

APPLICABILITY: The material contained in this report is of little use to the OBIFCO program except as an overall treatment of one phase of the system for background. It does, however, mention that aircraft flying at high mach numbers bring about temperature effects of undesirable magnitude which appear as an additional source of static error. The author also points to the usefulness of filters using active elements formed with microelectronics techniques.

TITLE: Monitoring Data From Jet Engines

AUTHOR: H. N. Taylor

COMPANY: United Air Lines

REPORT___ SYMPOSIUM X_ TECHNICAL JOURNAL__ MAGAZINE__

NAME OR NUMBER: AGARD/NATO-10th Symposium on Flight Instrumentation -
Aircraft Integrated Data System

DATE: 9-13-65   PAGES: 28

SCOPE: The paper reviews United Air Line's effort to determine the effectiveness
and usefulness of monitoring data from jet engines. It deals with the
existing monitoring program now in use, which uses in-flight cruise data that is
hand-recorded by flight crews. No attempt is made to explore the complete AIDS
concept in relation to this program.

        The paper covers the objectives of the "Flight Log Monitoring" program,
a description of the program and the principles involved, problems encountered,
program application and a review of the results.

APPLICABILITY: The paper is applicable to OBIFCO as a description of a crude,
hand-recorded system which has achieved some results. This description includes
such information relative to OBIFCO as: exponential smoothing; examples of error
introduction, examples of significant engineering and statistical thresholds, and
examples of variance of trend thresholds.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 552

TITLE: Airline Requirements Regarding Total System Flexibility of AIDS

AUTHOR: H. C. Vermeulen

COMPANY: KLM Royal Dutch Airlines

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AGARD/NATO-10th Symposium on Flight Instrumentation -
Aircraft Integrated Data System

DATE: 9-13-65   PAGES: 19

SCOPE: The paper contains a general discussion of the need for a flexible
AIDS system in airline usage. The need of freedom of selection of
the following items is discussed briefly: data source, sampling rate, samp-
ling program and integration of system with other aircraft systems.

APPLICABILITY: The paper is so broad so that its use to OBIFCO is limited
to a source of background information regarding, primarily,
the recording and electronic equipment of an OBIFCO system. There is no direct
coverage of the powerplant system variables which should be monitored.

TITLE: Engineering Report - Removal Rates for the Airesearch Model GTCP85-98 and its Components

AUTHOR: H. S. Fleck

COMPANY: Airesearch Manufacturing Co.

REPORT _x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Report No. GT-7098-R

DATE: May 23, 1965   PAGES: 7

SCOPE: This report presents data on the premature removal rate of AiResearch gas turbines and components in field operation.

APPLICABILITY: This report does not cover the main aircraft propulsion system, but deals with auxiliary power units (APU) and ground support equipment. It therefore is of only limited value to the OBIFCO study. It is possible that a CX-6 aircraft would use an aircraft mounted APU, and this report would have application in this case.

TITLE: Automatic Integrated Data Systems Developments and Objectives

AUTHOR: William I. Rumer

COMPANY: The Garrett Corporation

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AGARD/NATO - 10th Symposium on Flight Instrumentation -
Aircraft Integrated Data System

DATE: October 26, 1965   PAGES: 30

SCOPE: An excellent paper describing the objectives and benefits of automatic
data acquisition and processing systems for aircraft maintenance and
support.   Included is a review of current U.S. programs and developments in mili-
tary and commercial aviation.   The discussion considers advanced systems for
new aircraft and for purposes other than maintenance.   The evolution of AIDS
systems is described using the following three Air Force programs as illustra-
tions: The Turbojet Engine Analyzer System, The C-141 Integrated Aircraft
PCM Data Systems, and The C5A System.   A discussion of parameter selection
is given.

APPLICABILITY: The paper provides excellent background material in
addition to a good general discussion of the three phases
of system approach to design - problem definition, problem analysis and syn-
thesis of the system.   Although the paper provides little detailed information
applicable to the OBIFCO study, it contains some good ideas on approach to
the problem.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 555

TITLE: Turbine Engine Condition by Sonic Analyzer Method

AUTHOR: J. L. Frarey

COMPANY: Curtiss Division, Curtiss-Wright Corporation

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 1965 ATA Engineering and Maintenance Conference,
Miami Beach

DATE: 10-27-65   PAGES: 21

SCOPE: The paper discusses the basic concept of sonic analysis (different
than vibration analysis) as developed by Curtiss-Wright under con-
tracts from U.S. Navy Bu Weps. The system is based upon establishing a relation-
ship between acoustic spectral characteristics and component condition. Discusses
choice of microphones (sonic method) vs. vibration transducers. Brings out the
fact that the base line for comparison of vibration should not be the average
engine but the best one.

APPLICABILITY: The sonic analyzer has shown capability to diagnose mech-
anical conditions of turbine engines and transmission
systems. Spectral data is given to show capability of detection of compressor
imbalance, gearbox condition, bearing condition, accessory condition mechanical
alignment, using modulation and pulse shape analysis.

        To date, all the Curtiss-Wright effort has been directed
towards developing a useful piece of ground support equipment. Tests to date
have demonstrated a system capable of detecting incipient failures of engine
component or engine replacement or repair.

        While experimental investigation of this technique has
not been accomplished for airborne uses, it seems very likely that the system
would be useful to an OBIFCO system. However, a proper accounting of airborne
effects would first have to be made.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 556

TITLE: Malfunction Detection by Sound Analysis

AUTHOR: Robert A. Bailey

COMPANY: General Electric Company, Cincinnati, Ohio

REPORT___   SYMPOSIUM x   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 1965 ATA Engineering and Maintenance Conference

DATE: 10-26-65   PAGES: 13

SCOPE: A "broad brush" treatment of a sound analysis technique being developed
           by the General Electric Co. to be delivered to the Navy during 1966.
Lists engine components to be analyzed and the need for an extremely sensitive and
powerful data reduction and evaluation system to get a successful analysis.

APPLICABILITY: Since the paper is broad and general, its applicability to the
                 OBIFCO study is limited to providing background knowledge of
sound analysis. The system is described as a flight line diagnostic tool and no
mention is made of the possibility of in-flight use.

TITLE: Fault Location in a Modern Airborne Radar

AUTHOR: G. E. Crosby

COMPANY: Aerospace Division, Westinghouse Defense and Space Center

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: Ground Support Equipment

DATE: Fourth Quarter 1965   PAGES: 14-16

SCOPE: Self-test capability has been built into the Navy AN/AWG-10 Weapons
          Control System for the F4J aircraft. A sequence of tests is controlled
by data on 105-mm tape to determine the existence of a fault and then isolate
it to a replaceable assembly. The radar operator, considered part of the
system, is periodically commanded to perform functions necessary to the
checkout operation.

APPLICABILITY: The program discussed has goals similar to those of the
                  OBIFCO study. The approach of utilizing the radar
operator is one which might be considered for certain aircraft. However, a
means of communication between operator and computer must be kept simple.
The tape used in the technique described displays commands directly to the
man through a window; this would probably not be applicable to a multi-
system data monitoring device.

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TITLE: Investigation of Fault Diagnosis by Computational Methods for
             Microcircuits

AUTHOR: L. Mah, L. Buchsbaum, T. J. B. Hannom

COMPANY: Sperry Rand/UNIVAC, for AF Aero Propulsion Laboratory,
             under contract AF 33(615)-2094

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AFAPL-TR-65-111

DATE: November 1965   PAGES: 241

SCOPE: This study extends the results of APL TDR 64-62 (Literature
          Reference No. 408) to isolating faults within microcircuits.
     Mathematical analysis, programming data, and flow charts are included.

APPLICABILITY: Portions of this document could be useful if OBIFCO
                       applications were extended to include analysis of

     microcircuits.

TITLE: Investigation of Fault Diagnosis by Transfer Function Techniques

AUTHOR: Walter J. Stahl, Thomas K. McBride, John H. Maenpaa

COMPANY: ITT Kellogg Communications System

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AFAPL-TR-65-113

DATE: November 1965   PAGES: 108

SCOPE: This study was directed toward demonstrating the feasibility of
          fault diagnosis by transfer function techniques for linear electronic
circuits. The objective was to be able to diagnose faults to the component
level using only available input and output terminals and a minimum number
of internal test points. The technique investigated is that of observing changes
in the breakpoint frequencies and amplitudes of the normal frequency response
curves of the circuit under test and relating these changes to the faulty elements
so that they may be diagnosed. The validity of this technique is based upon the
fact that the breakpoint information together with the gain at any frequency
serves to uniquely identify the transfer function of the system.

APPLICABILITY: These techniques could be useful for OBIFCO, particu-
                      larly in the area of fault isolation.

TITLE: Spacecraft Support

AUTHOR: S. I. Firstman

COMPANY: Planning Research Corporation

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE X

NAME OR NUMBER: Space Aeronautics R&D Handbook, Vol. 44, No. 2

DATE: 1965   PAGES: 155-158

SCOPE: Spacecraft support for Apollo at NASA's Merritt Island Launch Complex
       (MILA) is examined in terms of automation, man-equipment interface,
logistics, and integral evaluation (on-board checkout).

APPLICABILITY: A general description, applicable primarily to spacecraft.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 561

TITLE: On-Line Command and Control Study

AUTHOR: W. D. Wilkinson and G. Martins

COMPANY: The Bunker-Ramo Corp.

REPORT__X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: D58-5U1

DATE: September 1965   PAGES: 78

SCOPE: A progress report on an automated command information system being developed for military application.

APPLICABILITY: Not applicable to OBIFCO, unless extensive communication is desired between the crew and the computer.

TITLE: Self-Instructional Text for PLACE Programming the AN/GJQ-9

AUTHOR: John R. Stock

COMPANY: Battelle Memorial Institute

REPORT_X_ SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AFAPL-IT-65-1

DATE: September 1965   PAGES:_ 370

SCOPE: A self-instructional text intended to instruct engineers in the use
           of PLACE (Programming Language for Automatic Checkout
   Equipment) to program the Bendix AN/GJQ-9.

APPLICABILITY: A useful manual to learn how to program in PLACE
                     using a fairly general automatic checkout machine such
   as the Bendix AN/GJQ-9. The abstract states that a test group of five
   engineers took about 30 hours to complete the text.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 563

TITLE: Application of AVM Equipment to Turbojet and Turbofan Engines

AUTHOR: Calvin O. Spear

COMPANY: Flight Operations Engineering, Pratt and Whitney Aircraft Div.

REPORT X SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Report No. 30

DATE: Jan. 1965   PAGES: 16

SCOPE: This report contains a description of a general Airborne Vibration
Monitoring System (AVM), followed by a discussion of engine vibra-
tion characteristics, vibration pick-up requirements, recording and moni-
toring methods and the significance of engine vibration characteristics.

APPLICABILITY: An OBIFCO system will contain AVM equipment. This report
is of value in determining the likely characteristics of
this equipment.

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TITLE: Evaluation of Engine Performance Analysis Equipment -
Fourth Report Final

AUTHOR: R. P. Lee

COMPANY: Naval Air Test Center

REPORT **x**   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER:

DATE: July 27, 1965   PAGES: 32

SCOPE: The purpose of the study described in this report was to determine
the capability of the Aero-Jetcol engine analyzer to provide a
means of correlating the effects of engine operating time and hot section
temperature with engine deterioration. Included is a description of the
equipment, the scope and method of the evaluation tests, and a discussion
of the results of these tests.

APPLICABILITY: The report suggests that a relationship exists between
the Hot Section Factor count (HSF) and remaining engine
life. This relationship is dependent on the engine hardware and must be
established by operational experience. Once determined, it could possibly
be used by an OBIFCO system as a technique for engine life prediction.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 565

TITLE: Choices in Preflight Checking of Gyros and Accelerometers

AUTHOR: Henry A. Dinter, Jr.

COMPANY: Honeywell, Inc., Military Products Group, Minneapolis, Minn.

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE X

NAME OR NUMBER: Control Engineering

DATE: Oct. 1965   PAGES: 75 through 77

SCOPE: Study of the operation of new sensors which have built-in self check features and methods of testing conventional sensors. Aspects of self-check gyros and accelerometers such as built-in spin detection and built-in torquing are discussed, and preflight checking with conventional gyros is considered, including spin checking and gimbal checking. A complete system for checking of conventional rate gyros including a hunting-frequency type of spin detector is shown schematically.

APPLICABILITY:

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 566

TITLE: Hardware and Techniques for Performance Analysis

AUTHOR: B. M. Meador

COMPANY: Trans World Airlines, Inc.

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 1965 ATA Engineering and Maintenance Conference, Miami Beach.

DATE: 10-26-65   PAGES: 9

SCOPE: The paper is a "broad brush" treatment of aircraft monitoring for fault prediction. It contains some background on aircraft maintenance, causes of failures, brief description of Lockheed maintenance recorder system used on TWA DC-9 aircraft and discussion of possible future systems.

APPLICABILITY: The paper is too general to be of much use to the OBIFCO study, proper; however it does give a good feel for how the airlines view monitoring as a maintenance tool.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 567

TITLE: Aircraft Integrated Data Systems

AUTHOR: Major General Earl C. Hedlund

COMPANY: Warner Robins Air Materiel Area, USAF

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: Air Force Review

DATE: July-August 1965 PAGES: 72-77

SCOPE: This is a comprehensive discussion of AIDS benefits to both commer-
cial airlines and military aircraft. Emphasis is on digital data
processing techniques and resulting impact on maintenance policies and crash
recording. AIDS is viewed as a necessary feature of the complex aircraft of
the near future.

APPLICABILITY: Since OBIFCO is really a specific form of AIDS, the
article is directly applicable and points up the advan-
tages of this concept.

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TITLE: Man-Computer Relationships in Fault Isolation

AUTHOR: Ugo O. Gagliardi

COMPANY: Dunlap and Associates, for NASA, contract NASA-954

REPORT_x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 510-TM-9; SSD-65-193

DATE: June 1965   PAGES: 33

SCOPE: An unsuccessful attempt was made to develop a truly optimal
            strategy for fault isolation. Heuristic aids apparently can be
developed, employing limited computer and display resources, which can
approach optimality   for any given set of test constraints.

APPLICABILITY: This report is of a theoretical nature and of
                       limited value to OBIFCO at this time. Appendix
A, on Mathematics of Fault Isolation based on a Boolean test matrix, may
have application.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 569

TITLE: Prelaunch Checkout Computers as Decision Aids

AUTHOR: Enrique Furth, George Grant

COMPANY: Dunlap and Associates, Inc.

REPORT_x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 510-TM-16; SSD-65-227

DATE: September 1965   PAGES: 37

SCOPE: The fault isolation task is analyzed and specific display format
techniques to assist in the diagnosis of NO-GO test results
during Apollo/Saturn prelaunch checkout are presented. The recommended
technique involves a test matrix which provides information on the failure
sources or modes tested in the checkout program.

APPLICABILITY: Definitely applicable to OBIFCO and should be
studied thoroughly.

<u>ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 601</u>

<u>TITLE:</u>   Survey of Saturn/Apollo Checkout Automation, Spring 1965

<u>AUTHOR:</u>   L. T. Mast, V. Mayper, and C. Pilnick

<u>COMPANY:</u>   Rand Corporation, for NASA, Contract NASr-21

REPORT__X__   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

<u>NAME OR NUMBER:</u>   RM-4784 and RM-4785

<u>DATE:</u>   January 1966   <u>PAGES:</u> 27, Vol. 1; 325, Vol. 2

<u>SCOPE:</u>   These two Memoranda review the status of automation in the Saturn/
Apollo checkout program. A general summary of the findings is
given in RM-4784, with details in the companion piece, RM-4785. This survey
reviews the degree of automation currently achieved and projected, and
examines problems involved in integrating automation techniques into the
total checkout spectrum. The slice through the various checkout systems
represents the status of checkout as of Spring, 1965.

<u>APPLICABILITY:</u>   Although this study was limited to spacecraft, much of
the data has a direct bearing on aircraft systems. Various
portions of the Saturn/Apollo have varying degrees of automation in checkout,
and thus yield a nearly controlled analysis of its benefits. Fault isolation and
adaptive testing are considered.

TITLE: Advanced Sensing Techniques for Automatic Checkout: A Comparative Discussion

AUTHOR: H. S. Dordick and J. W. Ranftl

COMPANY: RAND Corporation, for NASA

REPORT__X__ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: RM-4937-NASA

DATE: March 1966 **PAGES:**

SCOPE: An evaluative discussion of current trends in advanced sensor research, with emphasis on directing this research toward useful applications in the Apollo and post-Apollo automatic checkout programs. Infrared, acoustic, magnetic, electromagnetic, and chemical sensing methods are evaluated. Integral sensor technology and the use of single parameter testing are also discussed. Guidelines set up for the comparison of advanced sensing methods are the state of development, cost, and each method's range of application to various test or checkout stages. Suggestions for future work are included, and a selected bibliography is appended.

APPLICABILITY: This document provides an excellent discussion of various sensing techniques, along with aspects of their use, that would apply to OBIFCO. While the authors are primarily concerned with spacecraft, the document is equally pertinent to aircraft. The attached bibliography would be especially useful to an OBIFCO designer.

TITLE: Development of Guidelines for Equipment Design and Test
Point Selection to Facilitate Automated Checkout

AUTHOR: B. B. Gordon

COMPANY: RAND Corporation, for NASA

REPORT x   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: RM-4987

DATE: March 1966   PAGES:

SCOPE: Examines techniques for achieving an objective rationale
in the selection of test points, and analyzes one such technique.
It develops a mathematical model for obtaining optimal solutions to
test-point selection problems, and an optimization algorithm that
permits a test-point selection problem to be expressed as an integer
linear programming problem.   The model is applied to a system that
approximates the engine hydraulic system of the S-1 stage of the Saturn
vehicle, and several guidelines are advanced.   The study was performed
by the Battelle Memorial Institute under subcontract to The RAND
Corporation.

APPLICABILITY: The highly mathematical nature of this report makes
it of little value during conceptual stages of OBIFCO.
It may be of some value after all systems have been fully defined.

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 604

TITLE: Applying a General Purpose Digital Computer to Aircraft Shop
           Maintenance

AUTHOR: S. M. Koenig

COMPANY: Grumman Aircraft

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: Ground Support Equipment

DATE: January 1966   PAGES: 10-13

SCOPE: Trends in size and complexity of modern aircraft are noted, resulting
         in greater reliance on automation for systems checkout. Various
    approaches are discussed, with emphasis on Grumman techniques for shop
    checkout.

APPLICABILITY: This article is more pertinent to depot testing than to
                      in-flight testing.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 605

TITLE: Operational and Technical Guidelines on Failure Warning and Functional
         Test

AUTHOR: Aeronautical Radio (ARINC) and the Air Transport Association
         of America

COMPANY:

REPORT__X__ SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: ARINC No. 415 and ATA No. 112

DATE: 15 February 1966   PAGES: 29

SCOPE: Guidelines are provided for detecting failures of electronic airborne
         systems. General criteria are presented along with specific measure-
      ments of certain systems (radio altimeter, air data computer, attitude instru-
      mentation, and servo loops).

APPLICABILITY: Much information presented is useful in defining an
                      OBIFCO system. Two major drawbacks would be the
      following:

         1.   The study is oriented mainly toward commercial aircraft,
              and hence does not consider military systems nor the fact
              that crew attention may be unavailable for manual
              monitoring of instruments that would indicate failure.

         2.   No consideration is given to either failure prediction or
              fault isolation.

TITLE: Microcircuits Aid Onboard Test Concept

AUTHOR: R. G. O'Lone

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X

NAME OR NUMBER: Aviation Week and Space Technology

DATE: 18 April 1966   PAGES: 100-102

SCOPE: The Boeing Company, Seattle, has developed Microelectronic Inte-
           grated Test Equipment (MITE) for on-board system monitoring.
     Circuits are built into modules, and are capable of switching circuits.

APPLICABILITY: This concept is directly applicable to OBIFCO, and
                        could be included in specifications about 1971.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 607

TITLE: Data Compression

AUTHOR: Ware Myers, Michael Townsend, and Timothy Townsend

COMPANY: SDS Data Systems

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE_X

NAME OR NUMBER: Datamation

DATE: April, 1966 PAGES: 39-43

SCOPE: Types of data compression are discussed along with implementation by means of hardware or software (computer program). "When to use a computer" and "when to use a special unit" are discussed. Factors to be considered are enumerated.

APPLICABILITY: The techniques of data compression discussed in this article are definitely applicable to OBIFCO. A simplified block diagram of principles of operation of Limits-Type data compression is shown. Also included is a computer program flow chart for data compression appropriate to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 608

TITLE: Automation (Preliminary Report)

AUTHOR: O. L. Walker

COMPANY: IBM Federal Systems Division, Cape Kennedy

REPORT__X__ SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 66-941-002

DATE: March 1966   PAGES: 12

SCOPE: This report states the results of a preliminary investigation by the
          IBM automation group into the areas of the Saturn Instrument Unit
     that may be brought into a vehicle-oriented automated checkout plan. In
     addition, ground rules for a complete analysis of each area are provided.

APPLICABILITY: The analyses of each system with respect to feasibility
                      of automatic pre-launch checkout could provide an insight
     into a similar analysis for OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 609

TITLE: Automatic Diagnosis of Engine Ailments

AUTHOR: Phil Hirsch

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE__X

NAME OR NUMBER: Electronics

DATE: May 2, 1966   PAGES: 70-74

SCOPE: Biomedical research techniques have been applied to automatic
           testing of internal combustion engines. The approach, developed
by Frankford Arsenal and Letterkenny Depot (Army), requires the engine
to be mounted in a test cell. A digital computer compares data with stored
quantities for checkout and fault isolation. A printout displays complete
data on each fault.

APPLICABILITY: Although these tests are far removed from OBIFCO
                   concepts, certain techniques developed under the program
could prove applicable.

TITLE: Airborne Performance Analysis by Multiparameter Sampling

AUTHOR: J. F. Nemecek & W. D. Green

COMPANY: Trans World Airlines, Inc.

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL_X   MAGAZINE___

NAME OR NUMBER: IEEE Transactions on Aerospace and Electronic Systems
                   Vol. AES-2, No. 3

DATE: May, 1966   PAGES: 7

SCOPE: TWA's Flight Log Analysis program, the DC-9 Airborne Data
          Collection System, and an advanced concept for a supersonic data
management system are discussed. In the advanced concept, an airborne
computer would recognize abnormal operation and display pertinent informa-
tion to the flight crew.

APPLICABILITY: The advanced system described is applicable to OBIFCO,
                  but only the broad concept is discussed.

NOTE: An identical paper exists with a somewhat different title, "Dy-
namic Analysis of Airborne System Performance by Multi-Parameter
Sampling," Proceedings of the Automatic Support Symposium for Advanced
Maintainability, IEEE, June 7-9, 1965.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 611

TITLE: Failure Prediction in Electronic Systems

AUTHOR: Robert A. Kirkman

COMPANY: TRW Systems Group

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Reliability & Maintainability Conference

DATE: July 18-20, 1966   PAGES: 16

SCOPE: Methods of predicting specific failures, especially adapted to
         electronic systems, are classified and discussed. Deterministic
   failure prediction is contrasted with statistical failure prediction.

APPLICABILITY: The author states that, if used selectively and collectively,
               the failure prediction methods presented can form an
   optimal failure prevention strategy for use in a system test or checkout
   program. However, the question of failure signatures for electronic equipment
   is a big problem and although the philosophy presented is good, practical
   implementation is not significantly aided by this paper.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 612

TITLE: Microelectronic Integrated Test Equipment

AUTHOR:

COMPANY: The Boeing Company

REPORT_x_   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Technical Proposal D2-84262-1

DATE: March 1966   PAGES: 49

SCOPE: This document presents a proposed program to develop and evaluate the
        microelectronic integrated test equipment (MITE) in a completely micro-
miniaturized form and to establish its functional and operational characteristics.
A review of past progress is presented and the approaches for designing the individual
building blocks for MITE are proposed. Forseeable problems in the development and
possible methods for their solution are included.

APPLICABILITY   The MITE concept, which is described in this document, could
                 play a useful role in future OBIFCO systems. It uses micro-
circuit checkout modules which are designed as integral elements of onboard sys-
tems and is therefore compatible with the trend toward the increasing use of integrated
circuits in these systems. MITE offers a potential for high measurement accuracies
and reliability, and its digital or discrete output is readily accepted by a digital
computer, serving as the central control for an OBIFCO system. Also, more decentra-
lization of the total checkout system is made possible because the MITE circuits are
located at the source of the test signals.

TITLE: A Decision Table for Determining A Base-Depot Maintenance Policy
For Aircraft Engines

AUTHOR: Harris E. Heggerston and Thomas E. Brazier

COMPANY: Wright-Patterson Air Force Base

REPORT___ SYMPOSIUM_x_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 84-91

SCOPE: A method is described which will assist management in making
maintenance policy decisions for the jet aircraft engine inventory
of the United States Air Force. Any policy is measured via three parameters;
the total system cost, the calendar time necessary to perform major overhaul
on all engines of a given type, and the variation in the number of engines entering
the overhaul facility per time period. All pertinent data concerning several
maintenance policies is then presented to management in the form of a decision
table and from this "menu" of policies the most desirable policy can be selected
for implementation.

APPLICABILITY: Maintenance policies, such as those derived in this
paper, would be directly affected by an OBIFCO system.
Thus the information presented is pertinent to full evaluation of an airborne monitoring
concept.

TITLE: Microelectronics Cost of Ownership

AUTHOR: Howard A. Kenyon and Thomas F. McJilton, Jr.

COMPANY: Autonetics

REPORT___   SYMPOSIUM X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 215-221

SCOPE: Avionics systems are becoming more and more independent of
          flight line ground equipment. These new requirements lead to
alternative mode or abort displays, maintenance data recording, on-board
spares; which all can be realities through microelectronics. The discussion
in this paper applies to tactical avionics systems, but care has been taken to
ensure that the models of Economics of Ownership can be readily adapted to
other requirements with minor modification.

APPLICABILITY: Since feasibility of an OBIFCO system is probably
                     dependent on use of microelectronic circuits, this
subject is of interest. While the comparisons tend to justify microelectronics
development, no design data is provided.

<u>ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO.</u> 615

<u>TITLE</u>:   VTOL Operational Availability Computer Simulation Model

<u>AUTHOR</u>: Robert W. Caseria

<u>COMPANY</u>:   Sikorsky Aircraft, Division of United Aircraft Corp.

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

<u>NAME OR NUMBER</u>:   AIAA Reliability and Maintainability Conference

<u>DATE</u>:   July 18-20, 1966   <u>PAGES</u>:   274-283

<u>SCOPE</u>:   A computer model has been designed to describe operational air-
craft availability effectively and efficiently.   This model runs on
the IBM 7090/7094 computer and uses the GPSS III language.   Major variable
inputs to the model are times to failure, times to repair, scheduled maintenance,
periodic inspection intervals, and scheduled overhaul times.   Other inputs are
maintenance resources, personnel complements, spares resources and logistics
strategies, and aircraft utilization, introduced via the specialized GPSS features
with the randomization consistent with real-life operation.   The model output
comprises manpower, spares, ground support equipment utilization, number of
missions flown and cancelled, effects of many aircraft competing for limited
resources, and the amounts of time each aircraft is in all operational and non-
operational states.

<u>APPLICABILITY</u>:   This simulation could be applied to evaluation of several
military equipments and/or policies.   One such application
might be comparison of aircraft performance and availability with and without
OBIFCO.   Although it is designed for helicopters, the same techniques might
apply to conventional take-off and land aircraft.

TITLE: A New Concept of Planned Inspections

AUTHOR: Irving Katz

COMPANY: Headquarters Air Force Logistics Command Wright-Patterson
           Air Force Base

REPORT___   SYMPOSIUM_X   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 416-420

SCOPE: The concept presented in this paper is that a key consideration in deciding
          what to inspect, and how often to inspect, is the nature and duration
of warnings which different kinds of hardware present before they actually fail. It
is suggested that inspection processes can be improved when recognized as
comprising a "Predict and Preclude" objective, based upon case-by-case warning
analysis.

APPLICABILITY: Frequency of inspection is one of the primary parameters
                     that must be adjusted in analyzing a maintenance concept
involving OBIFCO. This article provides a means of evaluating trade-offs for
various mechanical system inspection policies.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 617

TITLE: Frequency of Maintenance

AUTHOR: O. N. Gabrielson

COMPANY: The Boeing Company

REPORT___   SYMPOSIUM_X_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 428-431

SCOPE: Analysis is made of those factors influencing the operating times
          between corrective maintenance and preventive maintenance.
Discussion consists mainly of citations from related studies.

APPLICABILITY: While the subject is pertinent to analysis of OBIFCO
                    benefits, and the excerpts are interesting, little
quantitative data is provided.

TITLE: Mechanical Signature Analysis, A New Tool For Product Assurance and Early Fault Detection

AUTHOR: Bjorn Weichbrodt

COMPANY: General Electric Company, Schenectady, New York

REPORT___ SYMPOSIUM_x_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 569-581

SCOPE: Sound and vibration signals have been useful for many years in judging the internal condition of machinery and structures. At General Electric's Research and Development Center, the interpretation of sound and vibration signals is being developed from an art into a scientific technique. This technique, Mechanical Signature Analysis, uses external measurement of sound and vibration signals to diagnose internal condition or malfunctions and to detect incipient failure.

APPLICABILITY: Sonic vibrations are key parameters in analysis of mechanical systems, and must be considered in definition of OBIFCO. This article presents a picture of the types of signatures possible for several airborne systems.

TITLE: Reliability Prediction by Function for Avionic Equipment

AUTHOR: H. Balaban, R. Plotkin and G. Harrison

COMPANY: ARINC Research Corporation for Rome AFDC under contract
AF30(602)-3387

REPORT___ SYMPOSIUM x_ TECHNICAL JOURNAL___ MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 694-699

SCOPE: This paper describes a study currently being conducted to develop
a technique for the prediction of avionic equipment reliability in
the early design stage. The term "reliability prediction by function" is now
commonly used to refer to such prediction techniques since the information
available and used for predicting equipment reliability during early design
concerns equipment functions rather than part population and stress factors.

APPLICABILITY: While this article is concerned more with design criteria
than with data monitoring, it contains information that might
be used in evaluating the degree of system monitoring with OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 620

TITLE: Preliminary Report on the Relationship Between Predicted Failure
Rates and Observed Failure Rates

AUTHOR: Herbert Dagen

COMPANY: ARINC Research Corporation

REPORT___   SYMPOSIUM_x_   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: AIAA Reliability and Maintainability Conference

DATE: July 18-20, 1966   PAGES: 704-709

SCOPE: This paper concerns itself with the relationship between predicted
failure rates and observed failure rates of units when the parts
complement is known.   The predictions for the units used in this study were
made to provide information for system analysis in a reliability improvement
effort.   The availability of these predictions provided an opportunity to compare
failure rates of units observed in the field with predictions derived from some
common sources of failure data.

APPLICABILITY: The data presented is primarily applicable reliability
assessments of proposed OBIFCO concepts.

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TITLE: Hughes Offers Microminiature Computer

AUTHOR: B. Miller

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: Aviation Week and Space Technology

DATE: July 18, 1966   PAGES: 91-93

SCOPE: The article briefly describes a concept of computer packaging
         applying microcircuits to fire control and navigation functions.
The Hughes Aircraft Company HCM-205 has a 4,096 18-bit word memory
with a cycle time of 2 microseconds; weight is 13.1 pounds.

APPLICABILITY: This technology is indicative of current trends, and
                    should be assumed to represent the state of the art
for OBIFCO applications of the near future.

TITLE: Computers and Displays/Controls State-of-the-Art Technology
           Studies

AUTHOR: O. J. Pizzicara

COMPANY: Litton Systems, Inc., for joint Army/Navy Instrumentation
           Program, contract NONR-4951(00)

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 4902, AD631663

DATE: February 1966   PAGES: 390

SCOPE: Computers and display/controls for Avionics systems are
          discussed primarily from a technology standpoint. State of the
art is discussed for the 1967, 1969-1970, and 1973-1978 time frames.
The section on computers concerns logic, memory, organization, and
analog/digital conversion. The section on displays considers CRT's,
scan conversion, color, analog/digital techniques, and electroluminescence.

APPLICABILITY: This report presents an excellent projection of
                      computer and display/control evaluation, and is
          directly applicable to OBIFCO.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 623

TITLE: Proper Test Point Allocation

AUTHOR: H. J. Jelinek, H. T. Breen

COMPANY: Autonetics Division, North American Aviation

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: Electro-Technology

DATE: June 1966   PAGES: 50-53

SCOPE: A computer technique for determining the optimum number and
         location of test points is described. The optimum configuration
is defined as the one that yields the maximum amount of information that
will lead to replacement of the faulty component.

APPLICABILITY: This report is directly applicable to the OBIFCO
program. The technique discussed should be evaluated thoroughly for
practicability.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 624

TITLE: Electronics Will Soon Log In-Flight Squawks

AUTHOR: Vernon A. Taylor

COMPANY:

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_X_

NAME OR NUMBER: American Aviation

DATE: May 1966   **PAGES:**   215-223

SCOPE: Airborne maintenance recorders being evaluated by four U.S.
trunk airlines (TWA, Eastern, United and American) are discussed, with
a comparison of the techniques used. 'Presently, only engine parameters
are monitored but future expansion to airframe and subsystem parameters
is planned.

APPLICABILITY: Techniques, used by the commercial airlines,
should be helpful for comparing continuous monitoring (e.g. IBM/Eastern
Airlines) with intermittent recording (e.g. American Airlines/Air Research).

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ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 625

TITLE: Post Checkout Error Computation

AUTHOR: Warren D. Moon

COMPANY: RCA Defense Electronic Products

REPORT___   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE_x_

NAME OR NUMBER: Electro-Technology

DATE: June 1966   PAGES: 58-60

SCOPE: Discusses a method for calculating the probability of an error
during a checkout procedure. Information could be used
immediately after a test sequence has been completed to help make go/
no-go decisions.

APPLICABILITY: Not considered applicable to OBIFCO at this
time as individual-measurement error
probabilities must be known.

TITLE: Automatic Test, Acquisition, and Control System (ATACS)

AUTHOR:

COMPANY: IBM Electronic Systems Center

REPORT X   SYMPOSIUM___   TECHNICAL JOURNAL___   MAGAZINE___

NAME OR NUMBER: 66-928-36A

DATE: May 1966   PAGES: 32

SCOPE: This report establishes the feasibility and cost-effectiveness
          of installing an automated unit test system for the B-52 bombing-
navigation system. An IBM 1800 data acquisition and control system is
recommended for controlling, monitoring, recording, and analyzing tests
from seven integrated test stations.

APPLICABILITY: The proposed test equipment is a large ground
                       based installation, rather than on-board equipment.
The proposed techniques are applicable, but are covered in a very general
manner.

ON-BOARD IN-FLIGHT CHECKOUT LITERATURE REFERENCE NO. 627

TITLE: Test Language Forms Link to Checkout Computer

AUTHOR: B. L. Ryle

COMPANY: Planning Research Corporation

REPORT___ SYMPOSIUM___ TECHNICAL JOURNAL___ MAGAZINE_x_

NAME OR NUMBER: Space Aeronautics

DATE: May 1966   PAGES: 118-131

SCOPE: Discusses Atoll 2 (Acceptance Test or Launch Language), a programming language designed to overcome the barrier between the test engineer and the programmer. Atoll 2 was designed specifically for the Saturn launch computer complex.

APPLICABILITY: The programming language discussed could be adapted to other automatic checkout systems and should be investigated for possible OBIFCO application.

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13. ABSTRACT

A literature search was made and an annotated bibliography prepared during the course of a study of On-Board In-Flight Checkout (OBIFCO). The bibliography covers documents of interest to the areas of on-board computers, checkout techniques, automatic checkout equipment, and related subjects. Part I of this report includes KWIC and author indices; Part II, the literature citations with comments. The work covers the period from January 1962 to mid-1966 and references reports, journal articles, and symposia.

(This abstract is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of Support Technology Division (APF), Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio.)

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
AIDS (Aircraft Integrated Data Systems) OBIFCO (On-Board In-Flight Checkout) Automatic Checkout Equipment (ACE) Aerospace Ground Equipment (AGE)						

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