RTCA, Inc.
1717 H Street, NW, Suite 655
Washington, DC 20006 USA

Airborne Electronics and Electrical Equipment Reliability

RTCA DO-167
September 16, 1977

Prepared by: SC-130
© RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

Please visit the RTCA Online Store for document pricing and ordering information.

F O R E W O R D

This Document was prepared by Special Committee 130 of the Radio Technical Commission for Aeronautics (RTCA). It was approved by RTCA on September 16, 1977.

RTCA is an association of aeronautical organizations of the United States from both government and industry. Dedicated to the advancement of aeronautics, RTCA seeks sound technical solutions to problems involving the application of electronics and telecommunications to aeronautical operations. Its objective is the resolution of such problems by mutual agreement of its member organizations.

The findings of RTCA are in the nature of recommendations to all organizations concerned. As RTCA is not an official agency of the Government of the United States, its recommendations may not be regarded as statements of official government policy unless so enunciated by the government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

TABLE OF CONTENTS

		Page
FOREWORD		i
1.0	INTRODUCTION	1
1.1	Terms of Reference	1
1.2	Recommendations	1
2.0	REPORT	3
2.1	Introduction	3
2.2	Techniques for Achieving Maximum Function Reliability	3
2.2.1	Accident Causes Related to Electronic Equipment Failures	3
2.2.2	Built-In Confidence Checks	4
2.2.3	Equipment Redundancy	4
2.2.4	Functional Redundancy	5
2.2.5	Alternative Operational Procedures	6
2.3	The Role of Equipment MTBF	6
2.4	Alternatives to MTBF	8
3.0	CONCLUSIONS	9
FIGURE 1		10
FIGURE 2		11
MEMBERSHIP		13
APPENDIX A	RELIABILITY ANALYSIS METHODS AND BIBLIOGRAPHY	1
BIBLIOGRAPHY		4

1.0 INTRODUCTION

This Document reports RTCA Special Committee 130's recommendations concerning the specification of electronics and electrical equipment reliability requirements in RTCA Minimum Performance Standards and FAA Technical Standard Orders.

1.1 Terms of Reference (TORs)

SC-130's Terms of Reference were:

a. Investigate the various means of determining and specifying reliability for electronic systems recommended by RTCA Minimum Performance Standards.

b. Assess the significance of specifying MTBR and MTBF for safety of flight electrical and electronic equipment.

c. Recommend which, if any, of these available techniques may be applicable for incorporation into Minimum Performance Standards.

As part of its work, the Special Committee was instructed to review the techniques employed by both civil and military agencies to improve reliability, and the results that these techniques have achieved.

1.2 Recommendations

SC-130's work in the areas defined by 1.1a and 1.1b above produced the conclusions that MTBF and MTBR are not appropriate reliability measures for use in RTCA MPS's and FAA TSO's. With respect to 1.1c, no other technique discussed was considered applicable for incorporation into Minimum Performance Standards.

2.0 REPORT

2.1 Introduction

According to National Transportation Safety Board data, the fatality rate due to air transportation accidents is lower than the equivalent rates in the surface transportation modes. Figure 1 depicts the last ten years' accident fatality rates for the primary means of transportation in the United States. At the same time, the industry is experiencing a tremendous growth in domestic and international travel. It is evident that suppliers, manufacturers, airlines, and regulatory agencies have been successful in producing reasonable and meaningful safety requirements and safer transportation for the air traveler. A comparison of accident fatalities for various modes of transportation during 1976 is shown in Figure 2.

The above facts notwithstanding, accidents do occur, and those people in industry and government responsible for safety must continue to seek ways of preventing them. Thus, the probability of a malfunction of an electronics system contributing to a future accident exercises their thoughts, as do the steps that should be taken in the regulatory processes associated with the systems to ensure that this number remains acceptably low. Lately, interest has been shown in specifying mean-time-between-failures (MTBF) as part of the regulatory criteria. RTCA formed Special Committee 130 to consider whether, and if so, how best to specify reliability requirements for electrical and electronic equipment certified under the FAA's TSO program, and to determine whether or not MTBF is a suitable measure for this purpose.

2.2 Techniques for Achieving Maximum Function Reliability

2.2.1 Accident Causes Related to Airborne Electronic Equipment Failures

An airborne electronic equipment which fails or provides erroneous information in a manner recognizable to the flight crew does not usually produce an unsafe situation if the crew has alternative means at its disposal to permit the execution of the task normally aided by the failed equipment. An equipment which fails in a manner which is not recognizable to the flight crew may, for reasons that are obvious, produce condi-