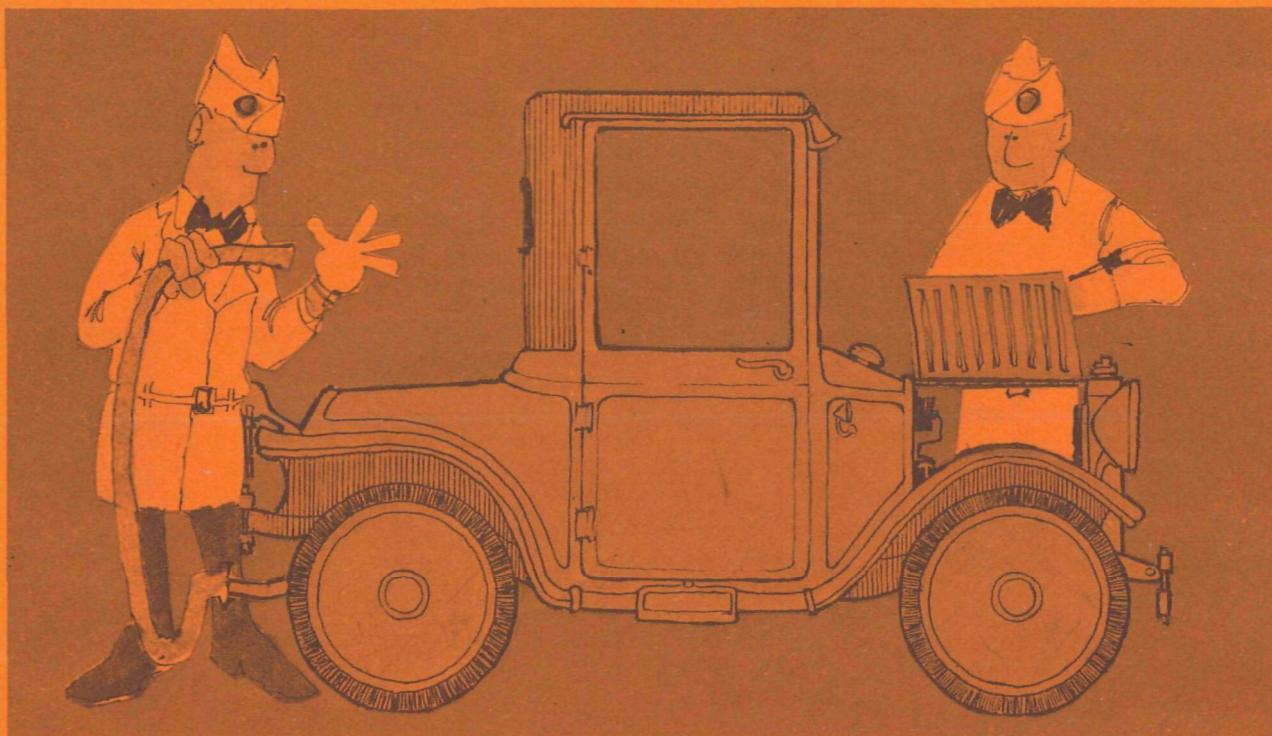


CPA 455/3-10-5108

A Study of Mandatory Engine Maintenance for Reducing Vehicle Exhaust Emissions

Volume VII. A User's Manual and Guide
to the Economic Effectiveness Computer Program



FINAL REPORT

July 1973

In Support of:

APRAC Project Number CAPE-13-68

for

Coordinating Research Council, Inc.
Thirty Rockefeller Plaza
New York, New York 10020

and

Environmental Protection Agency
Air Pollution Control Office
5600 Fishers Lane
Rockville, Maryland 20852

TRW / TRANSPORTATION &
ENVIRONMENTAL
OPERATIONS

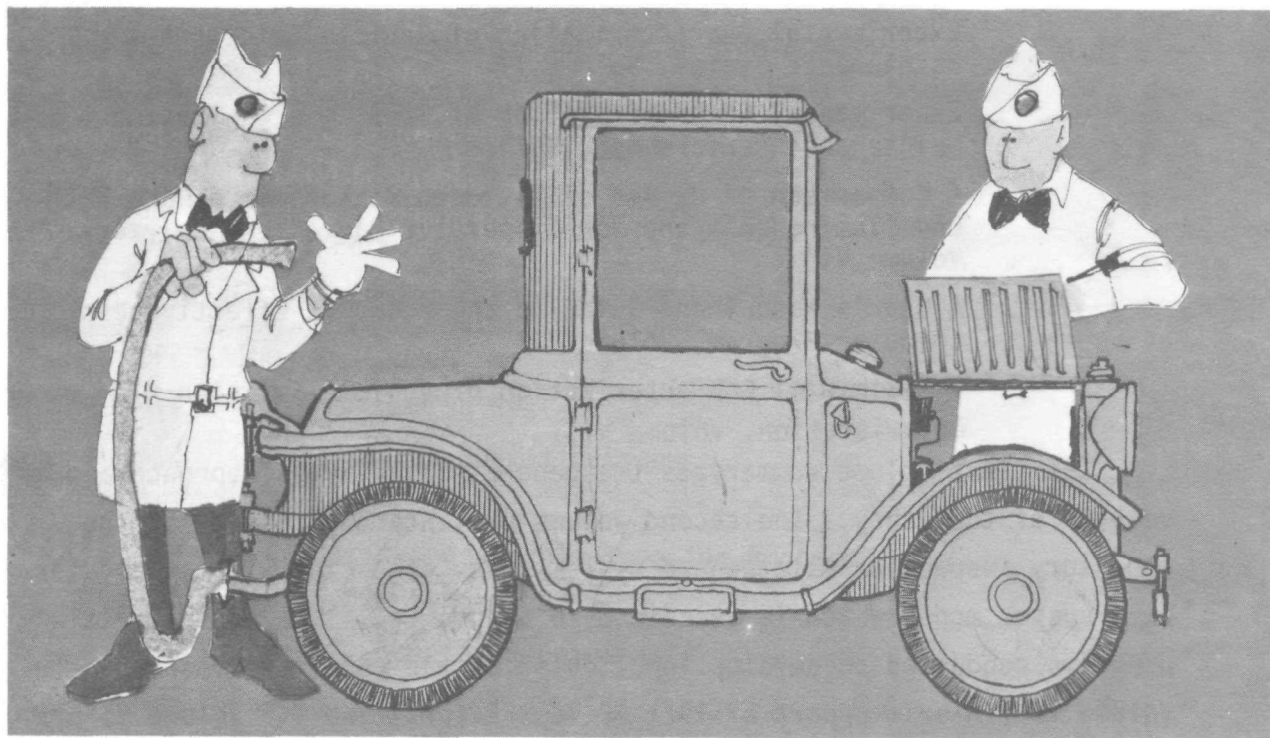
ONE SPACE PARK • REDONDO BEACH, CALIFORNIA 90278



SCOTT RESEARCH LABORATORIES, INC.
P. O. BOX 2416
SAN BERNARDINO, CALIFORNIA 92406

A Study of Mandatory Engine Maintenance for Reducing Vehicle Exhaust Emissions

Volume VII. A User's Manual and Guide
to the Economic Effectiveness Computer Program



FINAL REPORT

July 1973

In Support of:

APRAC Project Number CAPE-13-68

for

Coordinating Research Council, Inc.
Thirty Rockefeller Plaza
New York, New York 10020

and

Environmental Protection Agency
Air Pollution Control Office
5600 Fishers Lane
Rockville, Maryland 20852

PREFACE

This report, "A Study of Mandatory Engine Maintenance for Reducing Vehicle Exhaust Emissions," consists of eight volumes. The following are the subtitles given for each volume:

- . Executive Summary, Volume I
- . Mandatory Inspection/Maintenance Systems Study, Volume II
- . A Documentation Handbook for the Economic Effectiveness Model, Volume III
- . Experimental Characterization of Vehicle Emissions and Maintenance States, Volume IV
- . Experimental Characterization of Service Organization Maintenance Performance, Volume V
- . A Comparison of Oxides of Nitrogen Measurements Made With Chemiluminescent and Non-Dispersive Radiation Analyzers, Volume VI
- . A User's Manual and Guide to the Economic Effectiveness Computer Program, Volume VII
- . Experimental Characterization of Vehicle Emission Deterioration, Volume VIII

The first volume summarizes the general objectives, approach and results of the study. The second volume presents the results of the mandatory inspection/maintenance system study conducted with a computerized system model which is described in Volume III. The experimental programs conducted to develop input data for the model are described in Volume IV (Interim Report of 1971-72 Test Effort) and V. Volume VI presents comparative measurements of NO and NO_x using chemiluminescence and NDIR/NDUV instruments and differences in these measurements are examined. A detailed description of the Economic Effectiveness Computer Program along with a user's guide is presented in Volume VII. Volume VIII contains a characterization of vehicle emission and engine parameter deterioration rates.

The work presented herein is the product of a joint effort by TRW Transportation and Environmental Operations and its subcontractor, Scott Research Laboratories. TRW, as the prime contractor, was responsible for overall program management, experimental design, data management and analysis, and the economic effectiveness study. Scott acquired and tested all of the study vehicles. Scott also provided technical assistance in selecting emission test procedures and in evaluating the test results.

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1-1
2.0 MATHEMATICAL MODEL FRAMEWORK AND PROGRAM OVERVIEW . . .	2-1
2.1 Model Framework	2-1
2.2 Program Overview	2-3
3.0 BASIC INPUT REQUIREMENTS AND CALCULATED OUTPUT	3-1
3.1 Input Options	3-1
3.1.1 Keyword Data Input	3-2
3.1.2 Namelist Data Input	3-7
3.2 Input Format	3-7
3.3 Output Specification and Options	3-15
4.0 OPERATING PROCEDURES	4-1
4.1 The Programming System	4-1
4.2 Control Cards Specification	4-1
4.3 Deck Setup	4-1
4.4 Diagnostic and Trouble-Shooting Procedures	4-3
4.5 Library Routines Required	4-6
4.6 General Computer Requirements	4-6
4.7 Execution/Print Estimates	4-6
4.8 Program Limitations	4-9
5.0 DETAILED FLOW SCHEMATICS	5-1
5.1 Main Program	5-1
5.2 Subroutine INITIAL	5-1
5.3 Subroutine REGION - Demographic Data	5-19
5.3.1 Region 1 - L.A. Basin	5-31
5.3.2 Region 2 - New York/New Jersey	5-31
5.3.3 Region 3 - Washington D. C.	5-31
5.3.4 Region 4 - Denver	5-31
5.3.5 Region 5 - Detroit	5-31
5.4 Subroutine BLINE - Baseline Voluntary Program . . .	5-31
5.5 Subroutine MICRO - Mandatory Program	5-39

	<u>Page</u>
5.12.2 Subroutine PERCNT - Percent Distribution Manipulation Routine	5-215
5.12.3 Subroutine NOMAD - Distribution Normalizing Routine	5-222
5.12.4 Subroutine MILAGE - Mileage Distribution Routine	5-222
5.13 Linear Programming Model	5-222
5.13.1 Subroutine OPTMUM - Main Optimization Routine	5-229
5.13.2 Subroutine CUTPNT - Optimal Cutpoint Calculations	5-230
5.13.3 Subroutine LPAX - Linear Programming Algorithm	5-257
5.13.4 Subroutine PXCOEF - Engine Parameter Rejection Rate Union Routine	5-257
5.14 Output Routines	5-257
5.14.1 Subroutine DISTPR - Convoluted Distribution Printout	5-257
5.14.2 Subroutine OUT - Scalar Output Routine	5-260
5.14.3 Subroutine GEEPER - Header Routine	5-260
5.14.4 Plot Routines	5-260
5.14.5 EPLLOT - Emissions Distribution Plotting Routine	5-274
5.14.6 PLOTJK - Utility Discrete Plotter	5-274
5.14.7 PLOT - Emissions History Plotting Routine	5-274
5.14.8 PLOTXY - Utility Discrete Plotting Routine	5-282
5.14.9 Array Output Routines	5-282
5.14.10 PRINT1 - Prints Two 10x15x3 Arrays	5-282
5.14.11 PRINT2 - Prints Three 15x3 Arrays	5-282
5.14.12 PRINT3 - Prints Two 10x15 Arrays	5-282
5.14.13 PRINT4 - Prints Two 10x15x4 Arrays	5-282
5.14.14 PRINT5 - Prints Two 6x15 Arrays	5-290
5.14.15 PRINT6 - Attrition Data Output Routine	5-290
5.15 Block Data	5-290
APPENDIX A - NOMENCLATURE	A-1
APPENDIX B - SAMPLE PROBLEMS	B-1

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
2-1	Subroutine HIERARCHY	2-6
3-1	Available Keyword Input	3-3
3-2	Valid GEEP Namelist Variables	3-10
3-3	Engine Parameter Code Numbers	3-12
3-4	Mode Emission Code Numbers	3-12
3-5	Possible Namelist Variable Formats	3-14
3-6	Summary Output Options	3-17
3-7	Summary Output Results	3-18
4-1	Required Job Control Cards	4-2
4-2	Diagnostic Messages	4-5
4-3	System Library Function Called By GEEP	4-7
4-4	Execution/Print Estimates	4-8
5-0	Summary Level Subroutine Descriptions	5-2
5-1	Main Program Listing	5-12
5-2	Subroutine INITIAL Listing	5-23
5-3	Subroutine REGION Listing	5-30
5-4	Subroutine REGION1 Listing	5-33
5-5	Subroutine BLINE Listing	5-43
5-6	Subroutine MICRO Listing	5-55
5-7	Subroutine TEST Listing	5-71

LIST OF TABLES (cont.)

<u>Table</u>	<u>Title</u>	<u>Page</u>
5-8	Subroutine MAINT Listing	5-81
5-9	Subroutine PMAINT Listing	5-90
5-10	Subroutine EDECAY Listing	5-97
5-11	Subroutine MDECAY Listing	5-105
5-12	Subroutine PDECAY Listing	5-116
5-13	Subroutine COSTS Listing	5-131
5-14	Subroutine STATS Listing	5-146
5-15	Subroutine CONVOL Listing	5-159
5-16	Function AREA Listing	5-169
5-17	Subroutine INTEG Listing	5-174
5-18	Function FUN1 Listing	5-176
5-19	Function FUN2 Listing	5-179
5-20	Subroutine FIT Listing	5-181
5-21	Function UNION Listing	5-184
5-22	Subroutine QUEUE Listing	5-187
5-23	Function IFACT Listing	5-189
5-24	Subroutine STD Listing	5-191
5-25	Subroutine STD2 Listing	5-194
5-26	Subroutine NORM Listing	5-196
5-27	Subroutine RESIZE Listing	5-200
5-28	Function XPT Listing	5-202
5-29	Subroutine SWITCH Listing	5-205
5-30	Subroutine ADD Listing	5-207

LIST OF TABLES (cont.)

<u>Table</u>	<u>Title</u>	<u>Page</u>
5-31	Function EINT Listing	5-210
5-32	Subroutine PACKD Listing	5-213
5-33	Subroutine PERMIL Listing	5-217
5-34	Subroutine PERCNT Listing	5-220
5-35	Subroutine NOMAD Listing	5-224
5-36	Subroutine MILAGE Listing	5-227
5-37	Subroutine OPTMUM Listing	5-236
5-38	Subroutine CUTPNT Listing	5-250
5-39	Subroutine PXCOEF Listing	5-259
5-40	Subroutine DISTPR Listing	5-262
5-41	Subroutine OUT Listing	5-264
5-42	Subroutine GEEPER Listing	5-272
5-43	Subroutine EPLOT Listing	5-276
5-44	Subroutine PLOTJK Listing	5-278
5-45	Subroutine PLOT Listing	5-281
5-46	Subroutine PLOTXY Listing	5-284
5-47	Subroutine PRINT1 Listing	5-287
5-48	Subroutine PRINT6 Listing	5-293
5-49	Block Data Listing	5-295
A-1	Program Nomenclature	A-2
B-1	Sample Problem #1 (Engine Inspection Extensive B Program)	B-3

LIST OF TABLES (cont.)

<u>Table</u>	<u>Title</u>	<u>Page</u>
B-2	Input Data For First Case	B-4
B-3	Summary Results For Case 1	B-5
B-4	Vehicle Population Characteristics	B-6
B-5	Los Angeles Basin Data	B-7
B-6	Pass/Fail Analysis For Engine Inspection	B-8
B-7	Pass/Fail Inspection Criteria	B-9
B-8	Engine Parameter Rejection Rates For First Time Interval	B-10
B-9	Emission History Summary	B-14
B-10	Statistical Analysis of Predicted Emission Reductions .	B-16
B-11	Sample Problem #2 (Emission Inspection Extensive B Program)	B-17
B-12	Input Data For Second Case	B-18
B-13	Inspection Lane System	B-19
B-14	Summary Results For Case 2	B-20

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
2-1	Schematic Flowchart for the General Economic Effectiveness Program	2-5
2-2	Flowcharts for INITIAL and REGION	2-7
2-3	Flowcharts for the ATTRITION and BLINE	2-8
2-4	Flowchart for MICRO	2-9
2-5	Flowcharts for EDECAY, PDECAY and MDECAY	2-10
2-6	Flowcharts for TEST and MAINT	2-11
2-7	Flowchart for STATS	2-12
2-8	Flowchart for COSTS	2-13
3-1	Keyword Card Order	3-8
3-2	Namelist Input Card Order	3-9
4-1	Example Card Configuration For Object Deck Run	4-4
5-1	Main Program Flowchart	5-6
5-2	Subroutine INITIAL Flowchart	5-20
5-3	Subroutine REGION Flowchart	5-29
5-4	Subroutine REGION1 Flowchart	5-32
5-5	Subroutine BLINE Flowchart	5-40
5-6	Subroutine MICRO Flowchart	5-49
5-7	Subroutine TEST Flowchart	5-60
5-8	Subroutine MAINT Flowchart	5-78
5-9	Subroutine PMAINT Flowchart	5-85

LIST OF FIGURES (cont.)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
5-10	Subroutine EDECAY Flowchart	5-96
5-11	Subroutine MDECAY Flowchart	5-99
5-12	Subroutine PDECAY Flowchart	5-110
5-13	Subroutine COSTS Flowchart	5-120
5-14	Subroutine STATS Flowchart	5-140
5-15	Subroutine CONVOL Flowchart	5-153
5-16	Function AREA Flowchart	5-164
5-17	Subroutine INTEG Flowchart	5-173
5-18	Function FUN1 Flowchart	5-175
5-19	Function FUN2 Flowchart	5-178
5-20	Subroutine FIT Flowchart	5-180
5-21	Function UNION Flowchart	5-182
5-22	Subroutine QUEUE Flowchart	5-186
5-23	Function IFACT Flowchart	5-188
5-24	Subroutine STD Flowchart	5-190
5-25	Subroutine STD2 Flowchart	5-193
5-26	Subroutine NORM Flowchart	5-195
5-27	Subroutine RESIZE Flowchart	5-198
5-28	Function XPT Flowchart	5-201
5-29	Subroutine SWITCH Flowchart	5-204
5-30	Subroutine ADD Flowchart	5-206
5-31	Function EINT Flowchart	5-209
5-32	Subroutine PACKD Flowchart	5-212

LIST OF FIGURES (cont.)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
5-33	Subroutine PERMIL Flowchart	5-216
5-34	Subroutine PERCNT Flowchart	5-218
5-35	Subroutine NOMAD Flowchart	5-223
5-36	Subroutine MILAGE Flowchart	5-225
5-37	Subroutine OPTMUM Flowchart	5-231
5-38	Subroutine CUTPNT Flowchart	5-241
5-39	Subroutine PXCOEF Flowchart	5-258
5-40	Subroutine DISTPR Flowchart	5-261
5-41	Subroutine OUT Flowchart	5-263
5-42	Subroutine GEEPER Flowchart	5-271
5-43	Subroutine EPLLOT Flowchart	5-275
5-44	Subroutine PLOTJK Flowchart	5-277
5-45	Subroutine PLOT Flowchart	5-280
5-46	Subroutine PLOTXY Flowchart	5-283
5-47	Subroutine PRINT1 Flowchart	5-286
5-48	Subroutine PRINT6 Flowchart	5-291
B-1	HC Emission Time History Plot	B-11
B-2	CO Emission Time History Plot	B-12
B-3	NO _x Emission Time History Plot	B-13

1.0 INTRODUCTION

The General Economic Effectiveness Program (GEEP) is a computer model which simulates the dynamic behavior of alternative vehicle inspection/maintenance systems. It is completely general in design and can be used to assess a wide range of inspection/maintenance strategies. GEEP has been coded in Fortran IV and is presently operating on a CDC 6500 System.

The greatest potential uses of GEEP are: 1) Assessing the overall feasibility of vehicle inspection/maintenance, 2) measuring the impact of regional effects on program performance, 3) designing the optimal system configuration, and 4) contrasting the cost-effectiveness of a mandatory program with other control concepts.

GEEP was developed primarily for assessing the feasibility, both performance wise and economically, of a mandatory program of vehicle inspection/maintenance. Since its inception (circa 1969) it has been **expanded** to include other basic strategies; e.g. mandatory maintenance, voluntary maintenance, and to account for the influx of new vehicles with differing emission levels. These added features have greatly enhanced the program in terms of its effectiveness as a research tool.

The program has been constructed on a hierarchical input-output concept. Simplicity and flexibility are the salient characteristics of the input language. As such, the input system greatly reduces the time required to set up and execute a computer run. The program also provides several levels of output depending on user needs. For standard cases, it outputs computer generated plots of emission time histories, program figures of merit, estimated emission reductions and numerous cost accounting data. For more detailed information, a debug option is

available which prints the basic calculations from each of the major subroutines.

This manual describes for the programmer/user the operating instructions and input formats for the program. It is composed of five sections and two appendices. The present section summarizes the purpose and general uses of the program. Section 2.0 presents a brief discussion on the mathematical framework used in developing the basic model and provides a concise overview of the program's structure. Section 3.0 outlines the input requirements and formats for undertaking a computer simulation run. Included are tables of the available input and output options. Detailed information on the deck setup, computer resource requirements and program debugging options are given in Section 4.0. Finally, in Section 5.0 a complete set of flow schematics and listings is presented for each of the 55 subroutines contained in GEEP.

2.0 MATHEMATICAL MODEL FRAMEWORK AND PROGRAM OVERVIEW

2.1 MODEL FRAMEWORK

The primary purpose of the Economic Effectiveness Model is to serve as a research and design tool for assessing the various implications of a mandatory program of vehicle inspection/maintenance. As such, it has been constructed with the capability of investigating a wide range of possible procedure and design alternatives. The model has been constructed to analyze the regional feasibility of vehicle inspection/maintenance as well as specify an optimal system design. Input data for several regional areas have been incorporated directly into the model.

The model by its design is procedure oriented. That is, it is best used for evaluating the attractiveness of alternative procedures, e.g., engine inspection or emission inspection, which govern and control the operation of an inspection/maintenance system. Actually, there exists a hierarchy of decision variables within the structure of the model. The model analyzes these decision variables by simulating the behavior of the inspection/maintenance process over time. Here, the economic-effectiveness of various strategies can be measured in terms of emission reductions and program costs. A statistical analysis of these forecasted emission reductions is performed to determine their actual significance. This analysis includes an estimate of the overall variance for each emission species (i.e., HC, CO, NO_x).

In addition to these functions, the model can also be used to analyze the sensitivity of system performance to various assumptions and basic data inputs. Used in this way the model provides a mechanism for identifying areas requiring further analytical and empirical

definition. Finally, the model generates a description of the designed system including: total number of inspection lanes required, equipment specification and facilities configuration.

The methodological approach adopted for constructing the Economic Effectiveness Model involved a blending of theoretical and empirical relationships. The theory provided the conceptual framework for describing the inspection/maintenance process whereas the experimental data yielded the specific transformations needed to define and interconnect the various model elements.

The development of the model required a detailed specification of the various relationships characterizing the Inspection/Maintenance Process. Three main components -- engineering design, economic analysis and regional characterization -- form the core or nucleus of the model. Each of these components describes or delineates one fundamental aspect of the total process. How these interact must be clearly understood so that system design factors are selected in combinations to yield optimal cost and performance.

Attempting to describe a physical process with an abstract mathematical model raises a number of technical problems. One important issue involves the level of aggregation used in the model to characterize the actual process. Use of a simulation model yields an effective vehicle for coping with many of these questions. Here, basic study grounds and model assumptions, e.g., level of aggregation, can be isolated and examined in detail. As such, a simulation model strikes a good balance between a strictly theoretical model and an empirical model. The simulation model used in describing the inspection/maintenance process

provides a powerful tool not only for assessing the feasibility of this control approach but also in developing an optimal system design specification. One phase of such a feasibility assessment involves the evaluation of potential procedure strategies, e.g. engine inspection. Within this context, the simulation model can be used to measure the performance of these strategies over time and under varying system constraints. The resultant model design provides a great deal of flexibility yet contains sufficient depth to describe the process in intimate detail.

A detailed description of the basic model structure and flow processes is contained in Volume 3 of this series entitled, A Documentation Handbook for the Economic Effectiveness Model. Descriptions contained in this volume are designed for use by the user and/or the computer programmer engaged in exercising the GEEP computer program.

2.2 PROGRAM OVERVIEW

The General Economic Effectiveness Program embodies a set of mathematical algorithms and techniques which have been developed to simulate a mandatory program of vehicle inspection and maintenance (I/M). The program contains the necessary data and logic to evaluate a variety of inspection/maintenance alternatives. Figure 2-1 presents a schematic overview of the program's structure.

The program is nominally under the control of an executive system (GX) which checks for input errors and controls output. GX also initiates the computational process by calling subroutines INITIAL and REGION. INITIAL moves starting values into each storage array, expands, normalizes and determines mean values and variances for all engine parameters and mode emission distributions. Subroutine REGION calls one of five existing

regional sets which contain pass/fail criteria, regional emission weighting factors, initial emission levels, and vehicle population data (e.g., engine parameter distributions). Next, GX calls subroutine ATTRITION which estimates the change in the vehicle population due to the introduction of new cars on the attrition of older ones. This data is inputted directly into both MICRO and BLINE.

Subroutine MICRO embodies the actual Inspection/Maintenance Model. Here, the effects of deterioration, testing and maintenance are measured based on the specific procedure under investigation. Simultaneously, the same effects based on a voluntary program are computed in subroutine BLINE. The estimated emission reduced potential from the mandatory program is then contrasted with the results developed vis-a-vis the figure of merit.

Subroutine COSTS determines the costs of the mandatory program and develops the appropriate figures of merit. Cost of equipment, facilities and training are also estimated. Finally, subroutine OUT produces a concise summary of the calculated results.

Table 2-1 presents an overview of the subroutine hierarchy within GEEP. As can be seen, there exists six functional levels. The discussion thus far, has only covered the first two levels. A complete description of the remaining subroutines are found in Section 5.0.

The circled letters (A-G) shown in Figure 2-1 refer to access points associated with the second level hierarchy. A more detailed flow schematic for these subroutines is presented in Figures 2-2 through 2.8, respectively.

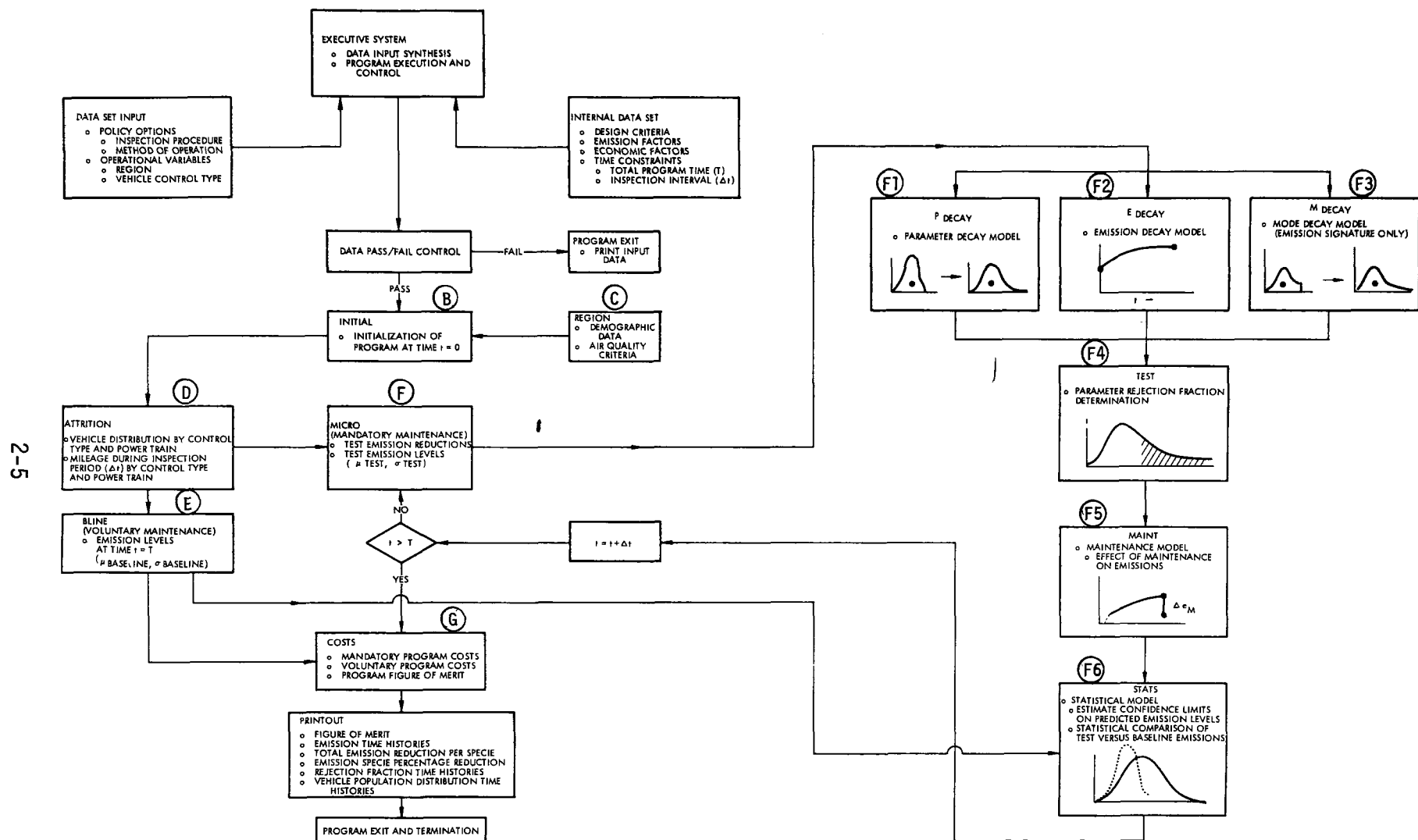


Figure 2-1 Schematic Flowchart for the General Economic Effectiveness Program

Table 2-1 SUBROUTINE HIERARCHY

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
	REGION	REGION 1 4 2 5 3 6			
	INITIAL	PRINT (1)(2)(3) PRINT (4)(5)(S)			
	BLINE	{ PRINT 2 FIT FUN 1			
GEEP		{ PDECAY MDECAY EDECAY	FUN 1 STD 2	NORM	
		TEST	AREA FUN 1 UNION	NORM FUN 1	
			TABLE	NORM	
	MICRO	{ STATS	DISTPR CONVOL	SWITCH RESIZE STD 2	NORM NORM
			NORM STD 2 FUN 1 XPT	NORM FUN 1 NORM	
		{ PLOT	PLOTXY		
	COSTS	{ QUEUE FIT	IFACT		
	OUT				

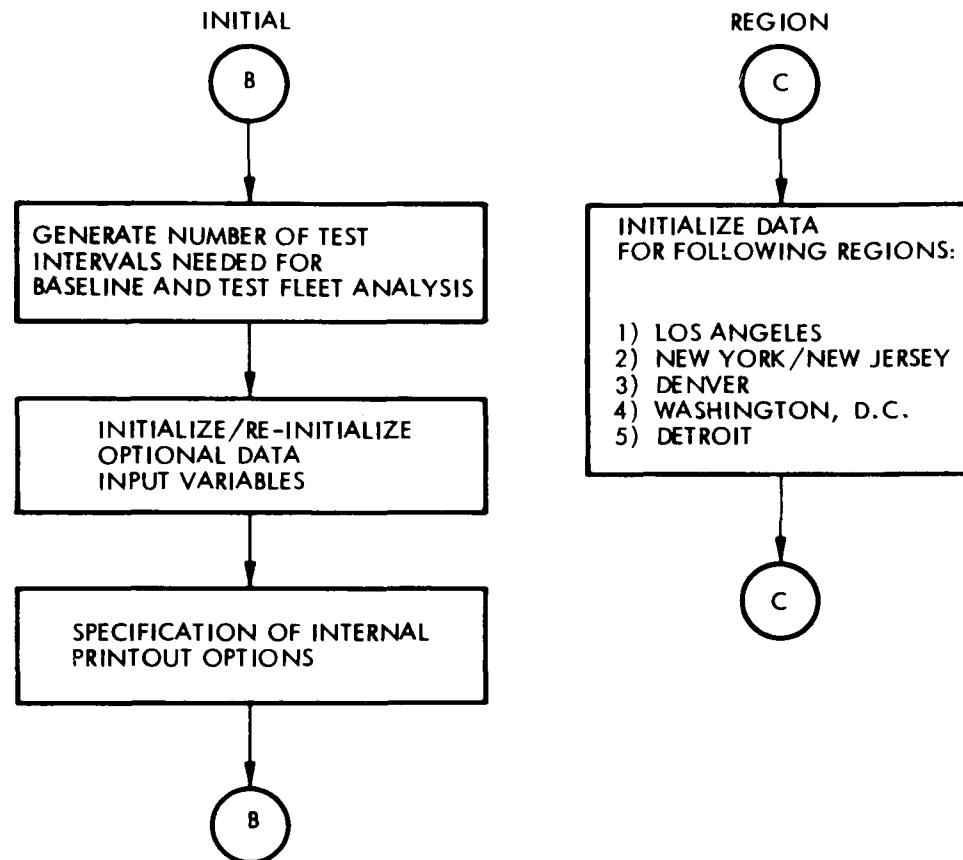


Figure 2-2 Flowcharts for Subroutines INITIAL and REGION

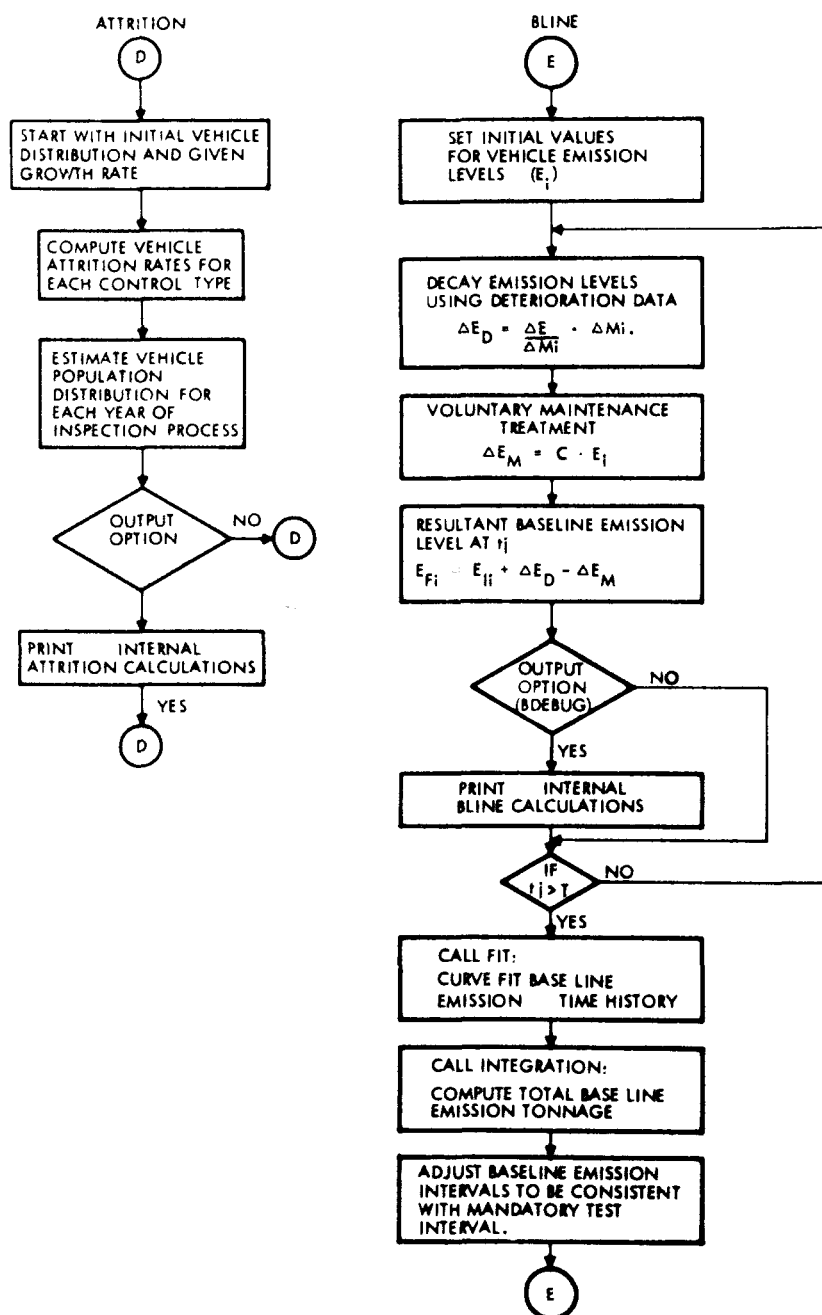


Figure 2-3 Flowcharts for Subroutines ATTRITION and BLINE

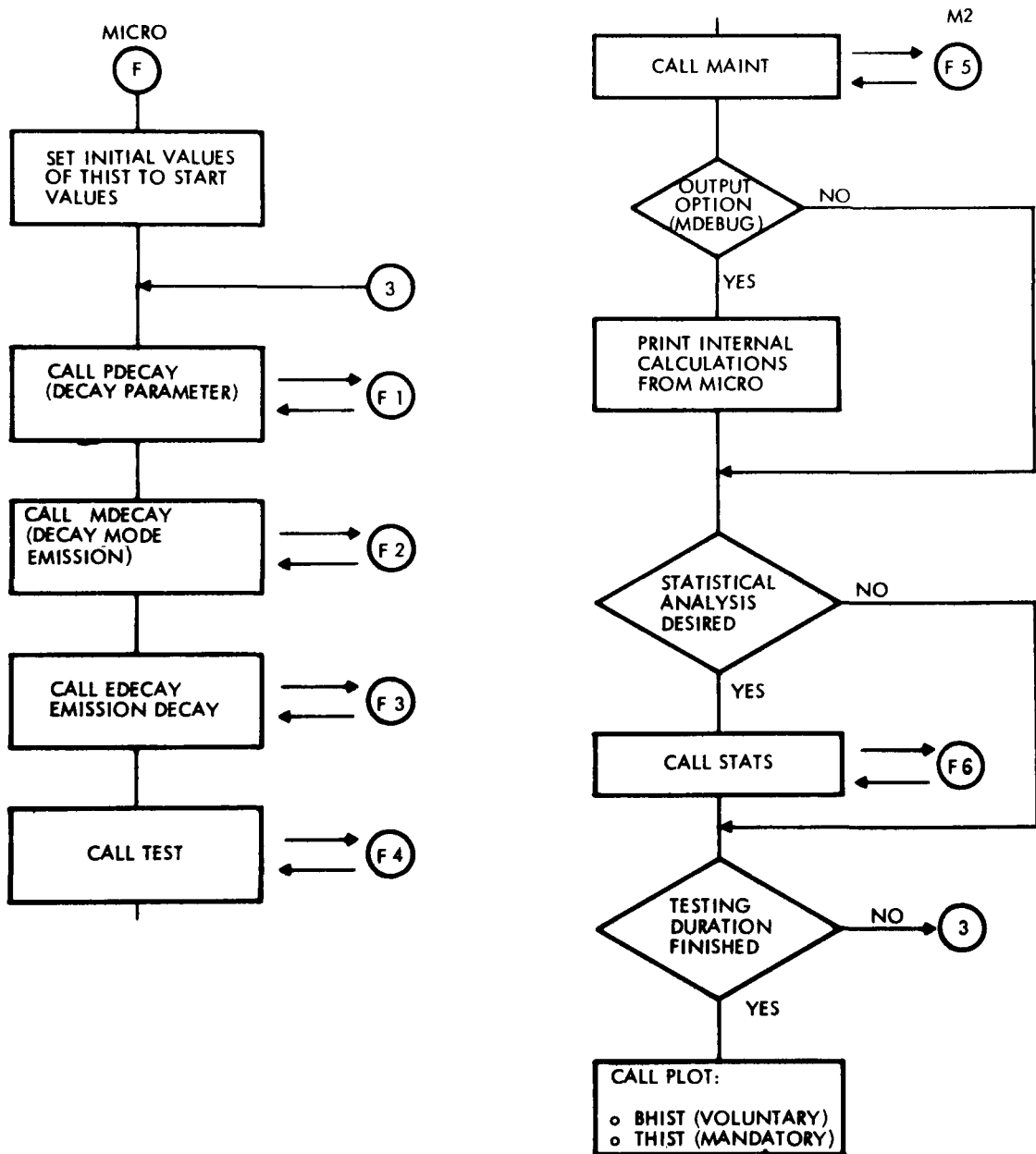


Figure 2-4 Flowchart, for Subroutine MICRO

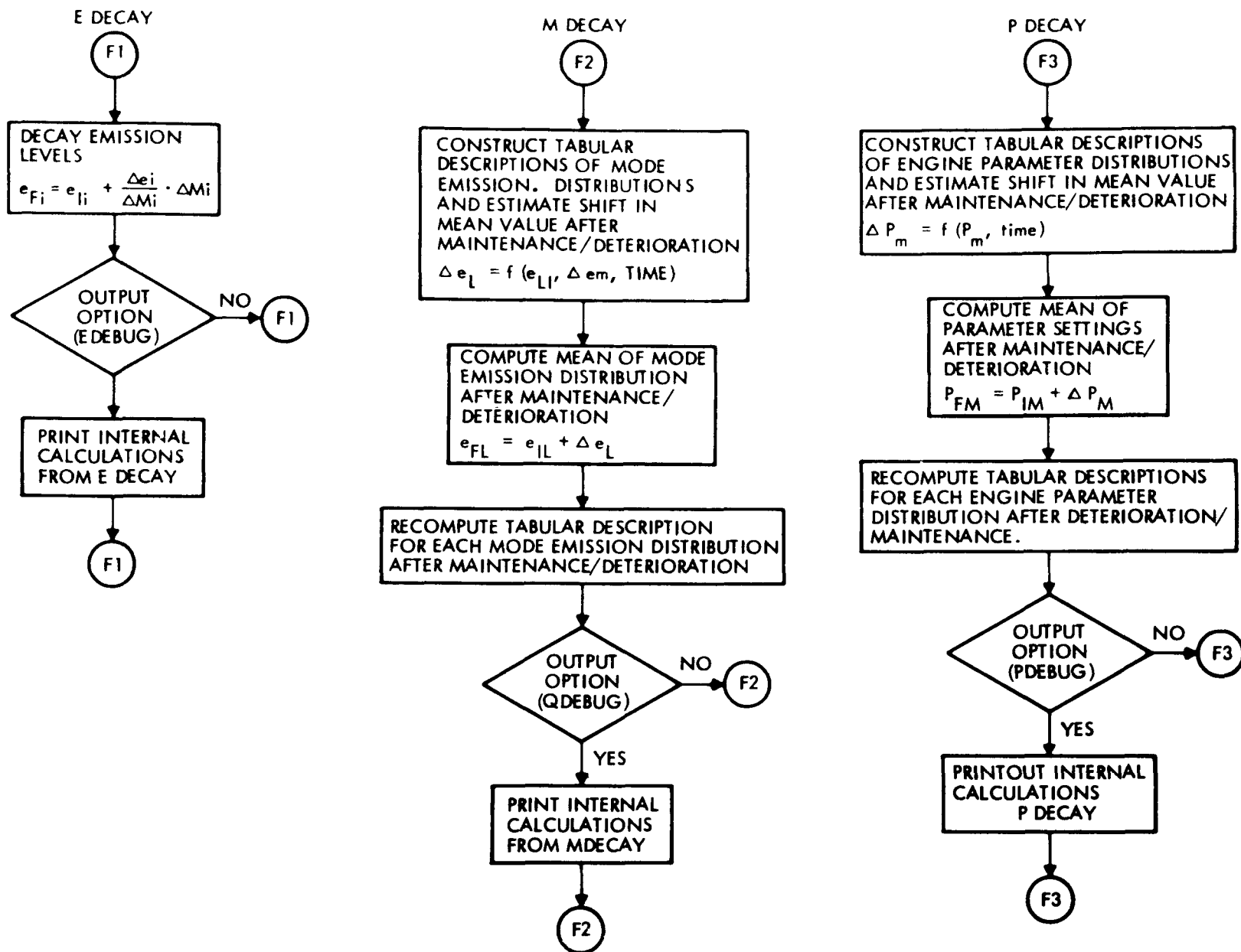
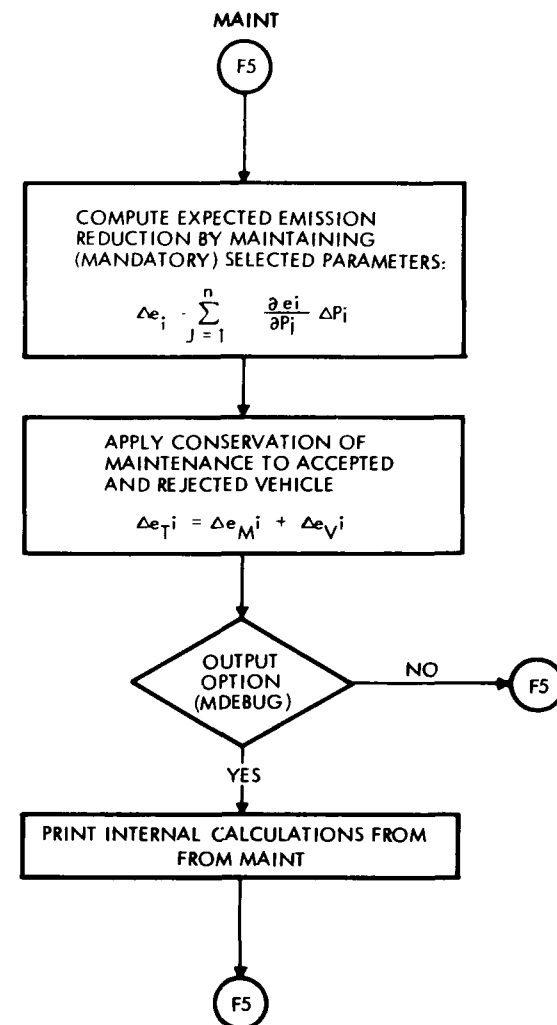
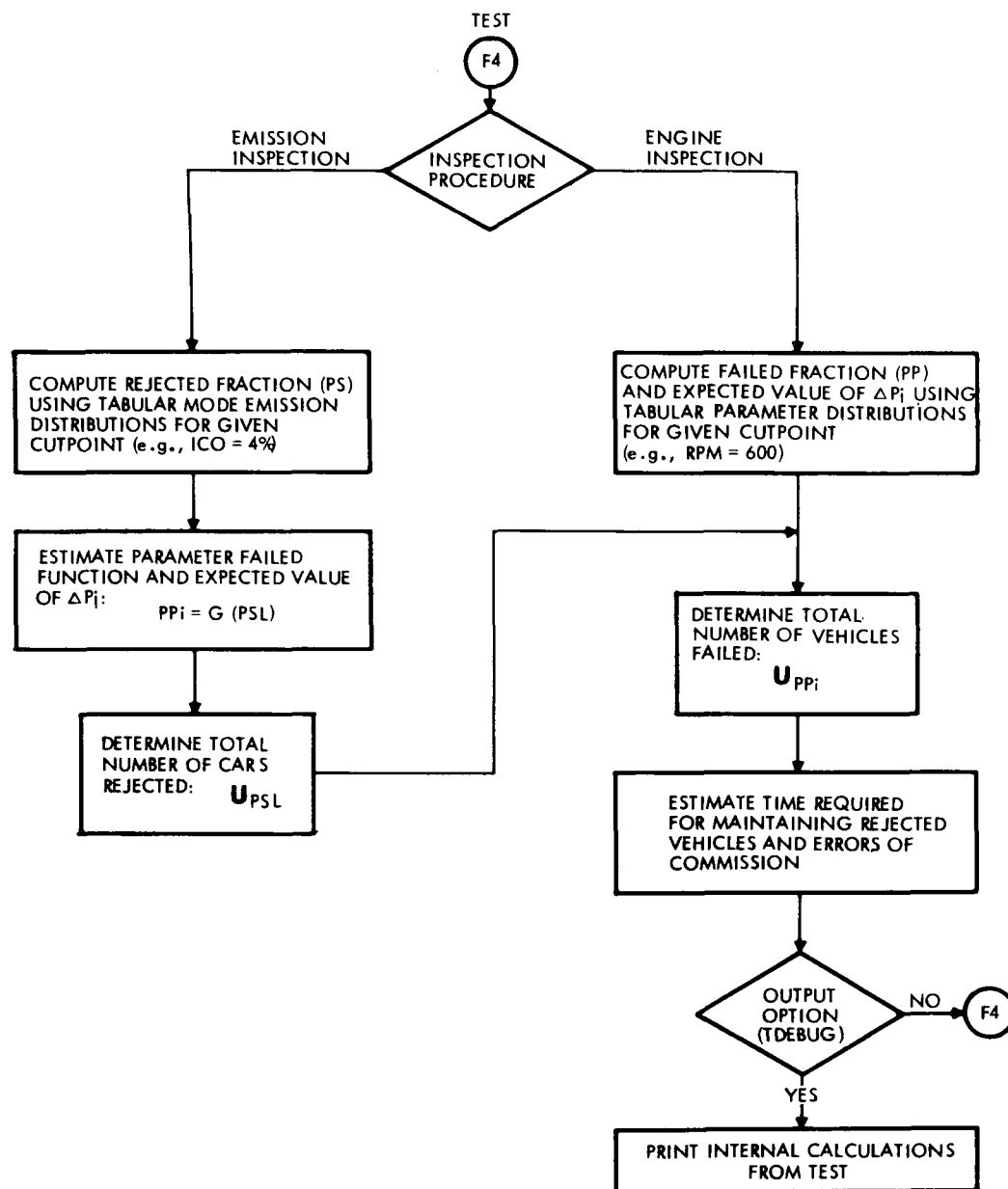


Figure 2-5 Flowcharts for Subroutines EDECAY, MDECAY and PDECAY



2-6 Flowcharts for Subroutines TEST and MAINT

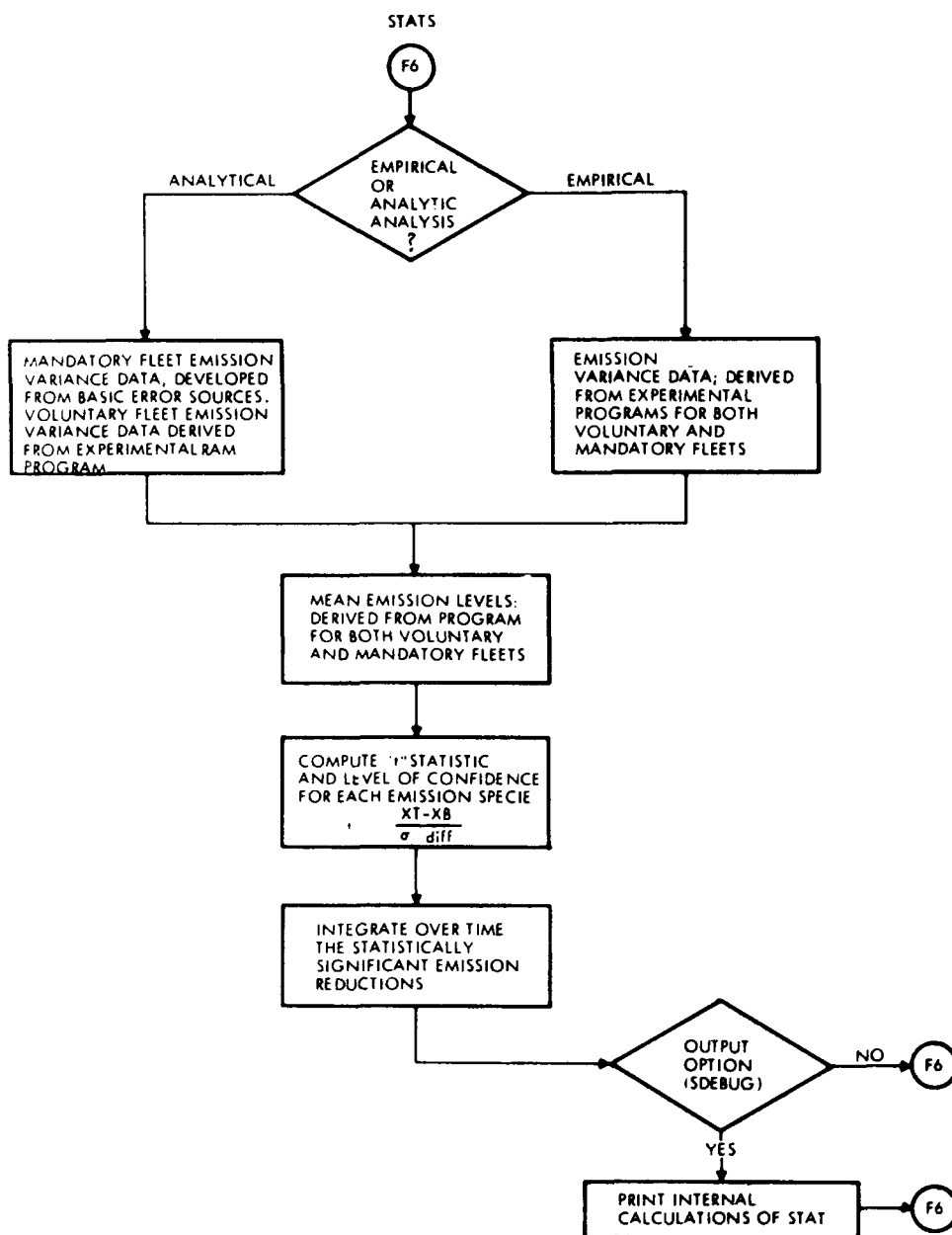


Figure 2-7 Flowchart for Subroutine STATS

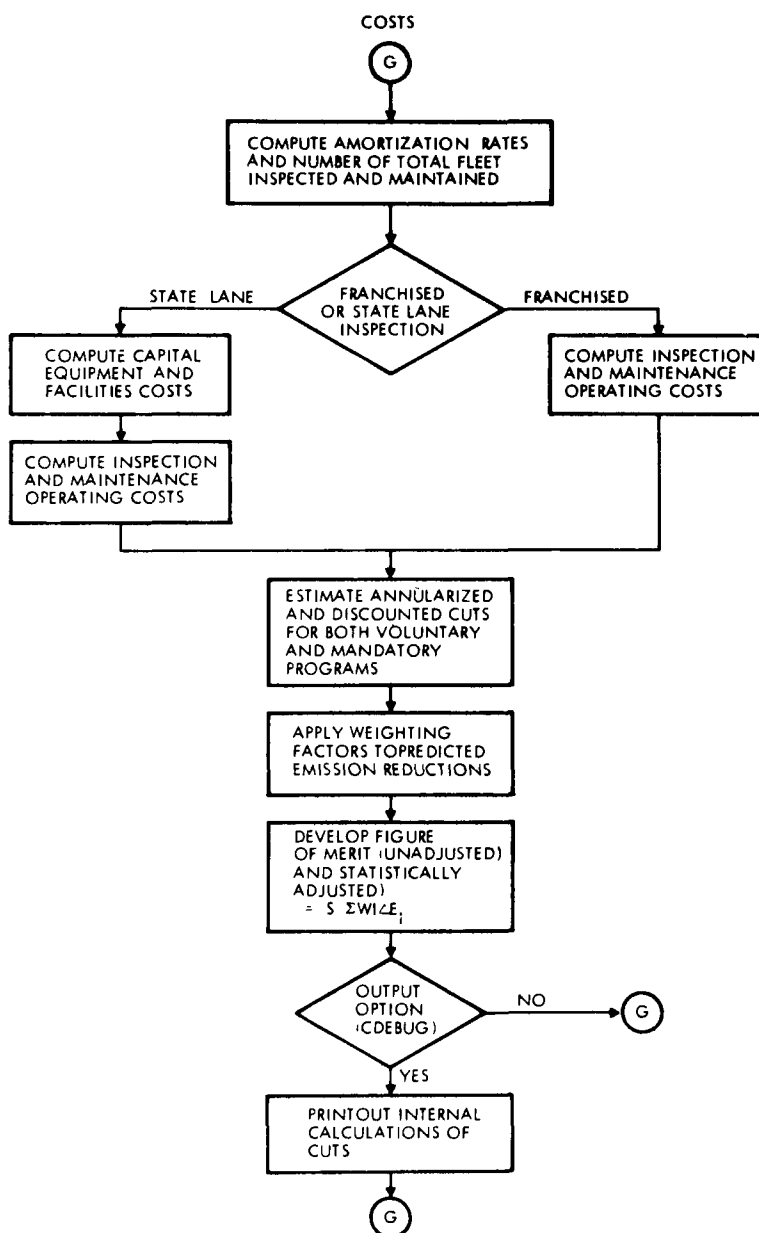


Figure 2-8 Flowchart for Subroutine COSTS

3.0 BASIC INPUT REQUIREMENTS AND CALCULATED OUTPUT

3.1 INPUT OPTIONS

Presented herein is a description of the salient input/output features of the program. The program's input/output system has been designed to accommodate a wide range of inspection/maintenance options. Basically, the input options can be separated as follows -- inspection procedure, maintenance treatment and regional area.

The inspection procedure refers to the type of diagnostic evaluation used in identifying engine maladjustments and malfunctions. There are two basic types of inspection strategies:

- (1) Engine Parameter Inspection
- (2) Exhaust Emission Inspection

Within each of these two approaches lies a number of different alternatives (e.g., idle). Based on a specific inspection strategy, the model determines the optimum pass/fail criteria for the various engine parameters and/or exhaust mode emissions.

The model partitions the engine block into three major subsystems -- idle, ignition and induction -- each of which can be maintained either singularly or in combination. The three maintenance treatments currently available are:

- (1) Idle Adjustment
- (2) Idle Adjustment with an Ignition Tuneup (Extensive A)
- (3) Idle Adjustment with an Ignition and Induction Tuneup (Extensive B)

Thus the model is capable of examining a total of six different and unique inspection/maintenance alternatives. Furthermore, the user can elect to

examine the impact of maintenance only strategies by merely rejecting the total vehicle population.

In addition to the various procedural options, the model requires descriptive information on the demographic and air quality characteristics of the candidate regional area. The essential regional data includes: (1) vehicle population distributions, (2) vehicle emission levels and engine state, and (3) a quantitative estimate of existing air quality. The last item is used in formulating an emission species weighting function. This function integrates the three exhaust emissions (HC, CO and NO_x) into a composite figure which can be used directly in contrasting various alternatives. To date, vehicular demographic and emissions data has been collected for the following regions:

- Los Angeles Basin
- Detroit Metropolitan Area
- Denver Metropolitan Area
- New York/New Jersey Metropolitan Area
- District of Columbia Metropolitan Area

Selection of one of these regions for analysis is made by merely specifying its key word name in the input file.

3.1.1 Keyword Data Input

The Keyword input consists of a series of input cards each containing a "keyword" from the list of valid entries (The ØPTS array). Each keyword activates an appropriate portion of GEEP code. Table 3-1 presents a list of all valid keywords with a description of the variables affected. For a detailed description of the consequences of a particular input, consult the flowcharts and listing in Section 5.1 (Main program).

Table 3-1 AVAILABLE KEYWORD INPUT

<u>KEYWORD</u>	<u>CODE NUMBER</u>	<u>DESCRIPTION</u>	<u>VARIABLES AFFECTED</u>
PARAMETER	2	Parameter inspection in franchised garages (unloaded)	RTYPE = PMØDEL, LIDLE=1, SLANE="GARAGE"
SIGNATURE	3	Mode emission signature inspection in state facilities (unloaded)	RTYPE = SMØDEL, LIDLE=1, SLANE="STATE"
UNCONTROL	5	Include uncontrolled vehicles (pre 1968) in fleet being modeled. (K=1)	KSTART=1, KSTØP=at least 1. Model uses control types KSTART through KSTØP
CONTROL	6	Include controlled vehicles (1968 - 1970) in fleet being modeled. (K=2)	KSTART=at most 2, KSTØP=at least 2
POST 70	7	Include post 70 vehicles (post 1970) in fleet being modeled. (K=3)	KSTART=at most 3, KSTØP=3
IDLE	8	Include Idle parameters in those being tested.	MSTART=1, MSTØP=at least 3. Model uses parameters MSTART through MSTØP. (See Table 4.1.1.2)
IGNITION	9	Include Ignition parameters in those being tested.	MSTART=at most 4, MSTØP=at least 5 OPTI=at least 2
INDUCTION	10	Include Induction parameters in those being tested	MSTART=at most 6, MSTØP=10 OPTI=at least 3
LOADED	25	Flag indicating test run in loaded condition.	LIDLE=2
HYBRID	27	Flag indicating hybrid test. Part run loaded, part unloaded.	LIDLE=3

Table 3-1 AVAILABLE KEYWORD INPUT (con't.)

<u>KEYWORD</u>	<u>CODE NUMBER</u>	<u>DESCRIPTION</u>	<u>VARIABLES AFFECTED</u>
DEBUG	1	OLD debug flag	None
BLINE	11	BLINE debug flag.	Turns on Bline debug output.BDEBUG=YES
MICRO	12	MICRO debug flag.	Turns on MICRO debug output.MDEBUG=YES
TEST	13	TEST debug flag.	Turns on TEST debug output.TDEBUG=YES
COSTS	14	COSTS debug flag.	Turns on COSTS debug output.CDEBUG=YES
AREA	15	AREA debug flag.	Turns on AREA debug output.ADEBUG=YES
CUTPTS	16	CUTPTS debug flag.	Turns on CUTPTS debug output.LDEBUG=YES
PDECAY	17	PDECAY debug flag.	Turns on PDECAY debug output.PDEBUG=YES
DATA	18	DATA debug flag.	Turns on DATA debug output.DDEBUG=YES
MDECAY	19	MDECAY debug flag.	Turns on MDECAY debug output.QDEBUG=YES
STATS	20	STATS debug flag.	Turns on STATS debug output.SDEBUG=YES
STOP	4	Indicates last case in a job.	RSTOP = YES

Table 3-1 AVAILABLE KEYWORD INPUT (con't)

<u>KEYWORD</u>	<u>CODE NUMBER</u>	<u>DESCRIPTION</u>	<u>VARIABLES AFFECTED</u>
LA	21	Los Angeles regional data flag.	RNAME=1
NY	22	New York regional data flag.	RNAME=2
WASH	23	Washington, D.C. regional data flag.	RNAME=3
DENVER	24	Denver regional data flag.	RNAME=4
DETROIT	35	Detroit regional data flag.	RNAME=5
IHC	31	Include IHC in mode emissions being tested.	LSTART=at most 1, LSTØP=at least 1. Model uses mode emission LSTART through LSTØP. See Table 4.1.1.3.
ICØ	30	Include ICØ in mode emissions being tested.	LSTART=at most 2, LSTØP=at least 2.
INØ	36	Include INØ in mode emissions being tested.	LSTART=at most 3, LSTØP=at least 3.
HC45	32	Include HC 45 in mode emissions being tested.	LSTART=at most 4, LSTØP=at least 4.
CØ45	33	Include CØ 45 in mode emissions being tested.	LSTART=at most 5, LSTØP=at least 5.
NØ45	37	Include NØ 45 in mode emissions being tested.	LSTART=at most 6, LSTØP=at least 6.

Table 3-1 AVAILABLE KEYWORD INPUT (con't.)

<u>KEYWORD</u>	<u>CODE NUMBER</u>	<u>DESCRIPTION</u>	<u>VARIABLES AFFECTED</u>
STATE	28	Flag indicating maintenance in State owned facilities.	SLANE="STATE"
GARAGE	29	Flag indicating franchised garage maintenance.	SLANE="GARAGE"
MISFIRE	34	Use misfire in simulation. (Misfire is normally not used.)	MISFIRE=YES

Figure 3-1 shows the sequential order for the Keyword card setup.

3.1.2 Namelist Data Input

Many inputs to the General Economic Effectiveness Program have numeric values and therefore do not lend themselves to a simple keyword input scheme. These parameters are specified in a namelist input data section. Table 3-2 contains a complete list of all valid namelist variables along with a description of their role in the Inspection/Maintenance model. Figure 3-2 illustrates the card order setup for the Namelist input. Section 3.2 describes the exact card formats and deck setup required for a namelist input record.

The bulk of the input data is normally invariant (e.g., influence coefficients) and accordingly resides within the program. This approach greatly simplifies the task of executing multiple computer runs and minimizes potential sources of error. A complete listing of all initial data is available through the use of the DATA option. Tables 3-3 and 3-4 have been prepared to assist the user in relating code internal numbers with input descriptions for engine parameters and mode emissions, respectively. These tables should be of specific value when attempting to introduce additional parameters and/or mode emissions.

3.2 INPUT FORMAT

Input to the General Economic Effectiveness Program is given by case. Each case, consisting of two sections, constitutes a complete inspection/maintenance program description. Keyword data input, the first section of each case, defines the inspection procedures, the inspection parameters or mode emissions, the region to be modeled and the debug options (See Table 3-1 for a complete list of keyword options). Namelist input data,

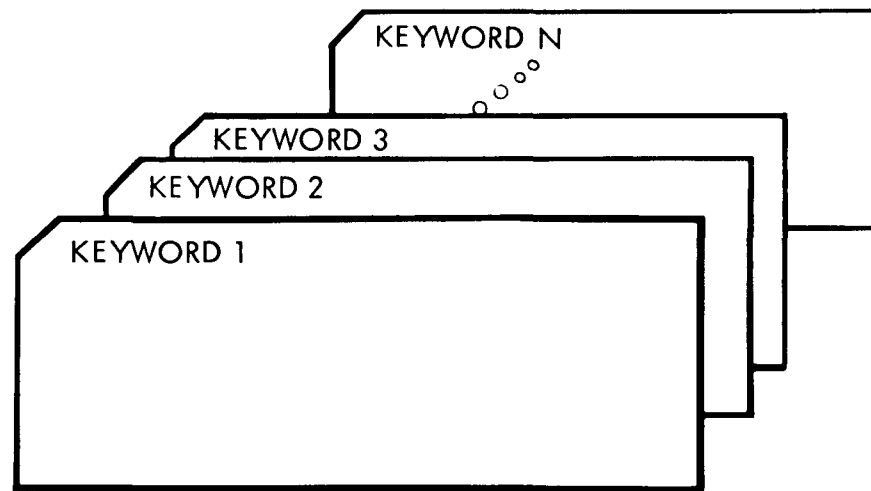


Figure 3-1 Keyword Card Order

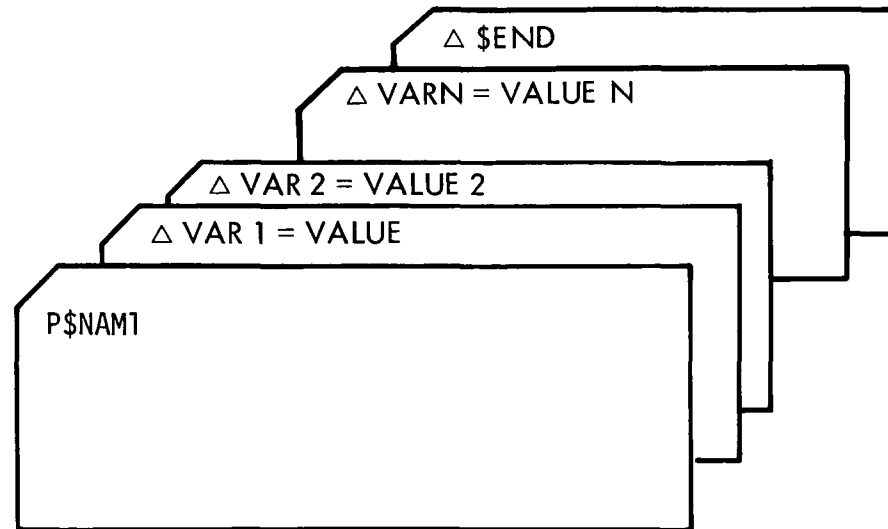


Figure 3-2 Namelist Input Card Order

Table 3-2 VALID GEEP NAMELIST VARIABLES

<u>VARIABLE</u>	<u>DIMENSION</u>	<u>DESCRIPTION</u>
COEFBP	10 × 15	Parameter decay rates. May be altered for sensitivity analysis.
EFF	10	Parameter maintenance efficiency for ΔE calculation.
EMW	3	Emission weighting function. Expresses relative importance of emission reductions by species.
FPERC	10 × 3	Voluntary maintenance by parameter and control type. May be altered for sensitivity analysis.
HORZN	scalar	Time horizon of I/M program in months.
LPICK	10	Array of time periods for linear programming cutpoint optimization
NPICK	10	Array of time periods for statistical analysis of results of the current time interval.
PARM	3 × 3	Emission decay rate not attributable to parameter deterioration.
PCONF	scalar	Confidence level for statistical analysis.
PI	15 × 10	Successful inspection percentage for each parameter and control-power train type.
PPICK	10	Array of time periods for plot generation under various debug options.
PSTAR	scalar	Constant rejection rate.
SCALEBM	3	Miscellaneous fudge factor input. Currently does nothing.
START	15 × 3	Initial emission rates for each species, control type and power train type. Initialized in REGION.

Table 3-2 VALID GEEP NAMELIST VARIABLES (Con't)

<u>VARIABLE</u>	<u>DIMENSION</u>	<u>DESCRIPTION</u>
STAT	scalar	Number of inspection stations.
SXCUT	6 × 3	Mode emission cutpoints.
TDIST	10 × 3	Parameter usage vector. Used for deleting certain parameters from consideration.
TINT	scalar	Time interval for mandatory inspection.
XCUT	10 × 3	Parameter cutpoints.
XLANE	scalar	Number of inspection lanes per station.
Z2	scalar	Mechanics hourly rate.
Z9	scalar	User inconvenience rate.
Z16	scalar	Attendant hourly rate.

Table 3-3. ENGINE PARAMETER CODE NUMBERS

<u>Parameter Number</u>	<u>Subsystem</u>	<u>Parameter</u>
1	Idle	Idle CØ
2	Idle	RPM
3	Idle	Timing
4	Ignition	Misfire
5	Ignition	NØ _x Control
6	Induction	Air Pump
7	Induction	PCV
8	Induction	Air Cleaner
9	Induction	Vacuum Choke Kick
10	Induction	Choke Heat Riser

Table 3-4 MODE EMISSION CODE NUMBERS

<u>MODE EMISSION NUMBER</u>	<u>MODE EMISSION</u>	<u>DESCRIPTION</u>
1	IHC	Idle HC
2	ICØ	Idle CØ
3	INØ	Idle NO _x
4	HC 45	Cruise 45 HC
5	CØ 45	Cruise 45 CØ
6	NØ 45	Cruise 45 NØ _x

the second section of each case, includes specification of all numeric data for a GEEP simulation. These data include the inspection time interval, emission weighting factors, cutpoints for parameter and mode emission inspections, and miscellaneous cost data.

Keyword data is specified by listing one keyword per card starting in card column 1. Only the first ten characters of the data card are read, and therefore columns 11 through 80 are available for comments or case descriptions. The order of the keyword cards is insignificant as the model treats each entry separately, setting the appropriate parameters depending on the keyword. An invalid entry, that is, one which does not appear in the OPTS array, is flagged and printed out along with a non-fatal error message. At the end of each case the keyword "THAT'S ALL" signals an end of section one data for the case being processed. A "STOP" keyword input, anywhere in a case, signals that the case being processed is the last one in the data deck.

Namelist input data, Section 2, is more strictly formatted than the keyword input. The card following the "THAT'S ALL" end of keyword data flag, must be a P\$NAM1 card starting in column 1. Following this card are the actual input data starting in card column 2. Possible variable input formats are described in Table 3-5. Each variable name must be a valid namelist NAM1 variable and must not start in column 1. The end of all namelist parameters is indicated by a \$END card in card column 2. Following the \$END card would be the first keyword input of the next case or a $\begin{pmatrix} 7 \\ 8 \\ 9 \end{pmatrix}$ EOR (END OF RECORD) card if this was the last case.

Table 3-5. POSSIBLE NAMELIST VARIABLE FORMATS

- SCALAR INPUT

$$\begin{pmatrix} c \\ c \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} c \\ c \\ 2 \end{pmatrix} = \text{card column 2}$$

VARNAME = value

- ARRAY INPUT - SINGLE CELL

$$\begin{pmatrix} c \\ c \\ 2 \end{pmatrix}$$

VARNAME (index) = value

- ARRAY INPUT - MULTICELL STARTING AT BEGINNING OF ARRAY

VARNAME = value, value, value, value, ..., value

- ARRAY INPUT - MULTICELL STARTING AT ARBITRARY CELL

VARNAME (index) = value, value, value, value, ..., value

NOTE

Matrix input is by columns.

Example:

If A is dimensioned 3×2 , then the order of input should be

$A = A_{11}, A_{21}, A_{31}, A_{12}, A_{22}, A_{32}$

Appendix B contains several complete sample cases, including listings of the input setup as well as produced output. Section 4.0 describes the operating procedures for running GEEP including all control cards required in the control card deck.

3.3 OUTPUT SPECIFICATIONS AND OPTIONS

GEEP has been designed to provide a wealth of information on the calculated emission reductions and associated costs of each inspection/maintenance program. Table 3-6 summarizes the basic output options.

The program also generates the following ancillary information:

- 1) Mass emission time histories.
 - Aggregated
 - Control type
 - Power train
- 2) Vehicle population distributions and attrition rates over time.
- 3) Summary of input data.
- 4) Engine parameter and mode emission distribution plots and statistics.
- 5) Pass/fail criteria and vehicle rejection probabilities by year.
- 6) Engine parameter rejection rates and average parameter adjustments.
- 7) Summary of regional and operational design results.
- 8) Statistical confidence limits on predicted emission reductions.

A debug option has been incorporated into each major system routine to assist in interpreting program output and in checking out new policy alternatives. This option yields a complete diagnostic analysis on all fundamental calculations within the model.

Printed and plotted output from GEEP are designed to display to the

user a maximum amount of information. Output from the program consists of three types: standard output, debug output and plots. The standard output includes emission rates, reduction percentages, figures of merit, and cost data. The debug printout is generally in the form of tables presenting the values of intermediate variables in the model's calculations. Plotted output consists of parameter frequency plots and emission time history plots.

Table 3-7 exhibits a printout summary of typical results. This printout features estimates for several figures of merit, computed emission reductions, and a variety of accounting costs. Additional examples of GEEP output are found in Appendix B.

Table 3-6 SUMMARY OUTPUT OPTIONS

<u>OPTION</u>	<u>INPUTS</u>	<u>RESULTING OUTPUT</u>
● BASIC	None	● Summary Results ● Emission Time History Plots ● Vehicle Population Characteristics ● Regional Data Summary ● STATS Results (if executed) ● CUTPOINT Data ● Emission Rate and Failure Rate Tables
● PPICK	PPICK	● Engine Parameter Distribution Plots
● DEBUG	BLINE MICRO TEST COSTS AREA CUTPTS PDECAY DATA STATS	● Debug information for Subroutine BLINE ● Debug information for Subroutine MICRO ● Debug information for Subroutine TEST ● Debug information for Subroutine COSTS ● Debug information for Function AREA ● Debug information for Subroutine CUTPTS ● Debug information for Subroutine PDECAY ● Debug information for DATA BLOCK ● Debug information for Subroutine STATS

Table 3-7 SUMMARY OUTPUT RESULTS

 * TRW INSPECTION/MAINTENANCE *
 * SYSTEM MODEL *

SUMMARY INFORMATION

ENGINE PARAMETER STRATEGY EXTENSIVE B
 INSPECTION PERIOD IS 12.0 MONTHS

PAYOFF FUNCTION UNADJUSTED (DOLLARS/WEIGHTED EMISSION)	5736.21
PAYOFF FUNCTION STATISTICALLY ADJUSTED (DOLLARS/WEIGHTED EMISSION)	4412.06
PAYOFF FUNCTION AT END OF LAST YEAR (DOLLARS/WEIGHTED EMISSION)	2736.02
HC EMISSION REDUCTION (PERCENT)	4.73
CO EMISSION REDUCTION (PERCENT)	4.08
NO EMISSION REDUCTION (PERCENT)	1.50
HC AVERAGE EMISSIONS (TONS/DAY)	1052.04
CO AVERAGE EMISSIONS (TONS/DAY)	13126.92
NO AVERAGE EMISSIONS (TONS/DAY)	728.26
TOTAL COSTS FOR MANDATORY PROGRAM (DOLLARS/YEAR)	187961701.45
TOTAL COSTS FOR VOLUNTARY PROGRAM (DOLLARS/YEAR)	237764666.67
RATIO OF MANDATORY TO VOLUNTARY COSTS (PERCENT)	79.05
INSPECTION CAPITAL COSTS (DOLLARS/STATION)	0.00
AVERAGE INSPECTION OPERATING COSTS (DOLLARS/YEAR)	76700284.45
MAINTENANCE CAPITAL COSTS (DOLLARS)	0.00
AVERAGE MAINTENANCE OPERATING COSTS (DOLLARS/YEAR)	111261417.00
USER COSTS (DOLLARS/CAR)	1.93
COST PER INSPECTION	31.46
COST PER VEHICLE MAINTAINED	34.25
AVERAGE NUMBER OF CARS INSPECTED/YEAR	5974450.00
AVERAGE NUMBER OF CARS REJECTED/YEAR	5196615.51
AVERAGE NUMBER OF CARS MAINTAINED/YEAR	5196615.51
AVERAGE FAILURE PERCENTAGE	.87
TOTAL PROGRAM DURATION (YEARS)	5.00

4.0 OPERATING PROCEDURES

4.1 THE PROGRAMMING SYSTEM

The General Economic Effectiveness Program is a Fortran IV program operational on the Control Data (CDC) 6000 series computers. The CDC machines are third generation multiprogrammable computers capable of processing approximately 1,000,000 instructions per second with up to 19 different jobs concurrently running in central memory. The TRW Time Sharing System (TRW/TSS) uses a CDC 6400-6500 combination with intercommunication between user disk files and the three CPU's with Batch and Remote Batch capabilities. The combined storage space on the two machines is in excess of 660,000₈ words (60 bit) central memory and 800 million words on disk.

The GEEP source and object decks reside on the permanent file storage disk of the TRW/TSS. As a file on this disk they are accessible in either Remote or Remote Batch mode. Since the control cards and deck setup are essentially identical, a Remote mode submission will be assumed in the following discussions.

4.2 CONTROL CARD SPECIFICATION

The TRW/TSS CDC machines run under the KRONOS operating system, the control cards of which are simple and self explanatory. Table 4-1 details the job control cards and contains a short explanation of each card. This control card setup assumes an object deck run.

4.3 DECK SETUP

The input deck setup required for the execution of the program consists of the job control cards (JCC), the program deck and the data

Table 4-1 REQUIRED JOB CONTROL CARDS

<u>CARD</u>	<u>DESCRIPTION</u>
\$ SEQUENCE, E284.	Operator supplied sequence card
\$ ACCOUNT, RB56415, ROBE564.	Program account and password
\$ NAME, 142001, 56415, BADDORF, R.	User Name card
\$ PROBLEM, 289010.	Charge number
\$ PRIORITY, N.	Nominal Priority
\$ FLENGTH, 150000.	150 ₈ K Field length request
\$ MAXTIM, 300.	5 minute max/time request
GET, GEEP.	Retrieve object deck
GEEP (TAPE 5=INPUT)	Execute Program (Data Follows)
(7) EØR (8) (9)	End of Record card.

cards set. Figure 4-1 illustrates the deck setup for a standard run. This example demonstrates the card setup for executing several cases during the same run.

4.4 DIAGNOSTIC AND TROUBLESHOOTING PROCEDURES

Basically, three types of errors can occur during a GEEP run: program detected errors, system detected error, and the elusive computer error. The last is a very rare, non-recoverable problem which can be solved by resubmitting either the entire run or just those cases not yet executed. Program detected errors are those inconsistencies which trigger an error branch in the GEEP code. These include input errors detected by the check routine in the main program. The diagnostics are self explanatory, and the problems are generally not fatal to the execution of a case. The linear programming package for cutpoint optimization is the second routine containing program data error flags. The diagnostic messages possible are listed in Table 4-2 with a description of the problem and the solution.

The other common diagnostic message results from a system detected error. These errors include dividing by zero, square roots of negative numbers, and raising negative numbers to non-integer powers. These occur most often in the routines which interpolate or manipulate distributions and are usually the result of bad input. A description of the various possible diagnostic messages can be found in Appendix K of the CDC Fortran Manual. The load map can be used with the help of a GEEP listing to pinpoint the location and exact nature of the data discrepancy. But probably the most likely system detected error will be associated with the NAMELIST input data.

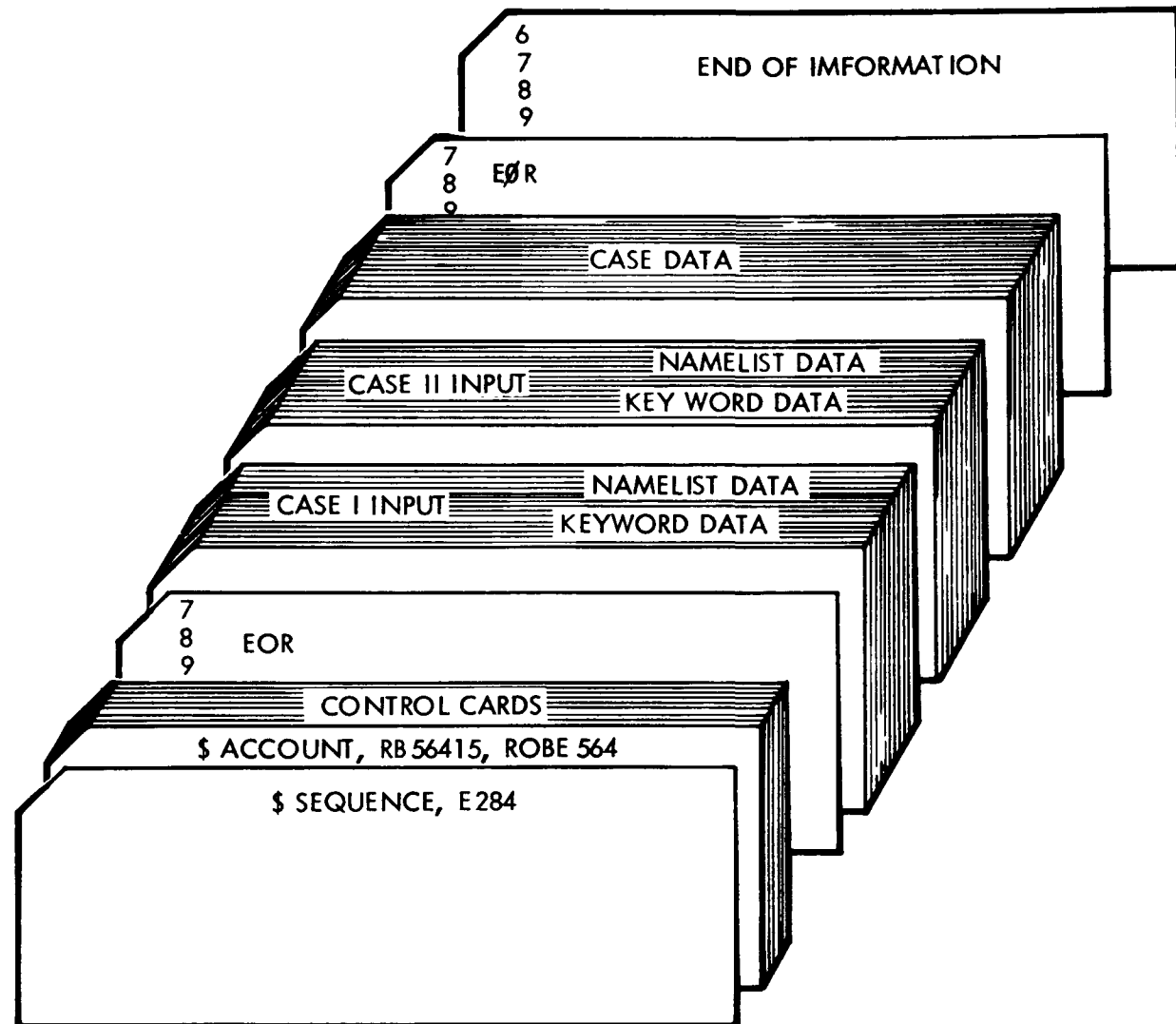


Figure 4-1 Example Card Configuration for Object Deck Run

Table 4-2 DIAGNOSTIC MESSAGES

<u>DIAGNOSTIC MESSAGE</u>	<u>MEANING AND SOLUTION</u>
A MATCH WAS NOT FOUND FOR XXXXXXXX	The key word input XXXXXXXX is either misspelled or not a valid GEEP option. The program ignores that card.
TOO MANY ITERATIONS IN LINPRO	The iteration loop to match cutpoints with rejected fractions is not converging. Change the emission reduction constraints a few percent to move the problem away from the unstable point. Fatal error.
NO FEASIBLE SOLUTION LOWERING CONSTRAINTS	The linear program has no feasible solution. The constraints are being lowered automatically by 10%. Program will continue until the constraints have been reduced by 70% at which point the case aborts.
SOLUTION UNBOUNDED - RUN TERMINATED	LPRO error message. Treated as no feasible solution.
TOO MANY ITERATIONS - RUN TERMINATED	LPRO error message. Treated as no feasible solution.
PROBLEM INFEASIBLE - RUN TERMINATED	LPRO error message. Treated as no feasible solution.
INSUFFICIENT DIMENSION IN XPT CALLED STATS	More than 50 points required to characterize a distribution. Contact programmer. Fatal error.
INSUFFICIENT DIMENSION SIZE IN RESIZE CALLED FROM CONVOL	More than 50 points required to characterize a distribution. Contact programmer. Fatal error.

In attempting to understand any problem with the processor, the debug flags for the affected routines should be activated (See Table 3-1).

4.5 LIBRARY ROUTINES REQUIRED

The GEEP computer program uses several standard Fortran functions from the CDC system library. These routines, with a brief description of each are tabulated in Table 4-3. If an error should occur within one of the library programs the system back-track printout will locate the calling subroutine for debugging purposes.

4.6 GENERAL COMPUTER REQUIREMENTS

Although GEEP was designed for the use on the CDC 6500 system it can be made to operate on other computing systems. Listed below are minimum requirements, both Hardware and Software, for possible conversion to an alternative system.

- Software support of Fortran IV (Fortran G).
- Computing Hardware equivalent to a CDC 6400 with at least 200,000 words of core storage (2 million bytes).
- A full operating system capable of supporting the above hardware system.
- A card reader/punch and high-speed line printer.

4.7 EXECUTION/PRINT ESTIMATES

The execution time, required field length, and number of pages printed by GEEP depend entirely on the number of cases and debug options chosen. Estimates for these figures appear in Table 4-4. It should be noted that, for a standard run, no compilation time or print-out is necessary. These values are all estimates and vary according to desired option.

Table 4-3 SYSTEM LIBRARY FUNCTIONS CALLED BY GEEP

FUNCTION	DESCRIPTION
SQRT (X)	Square root of X
MINO (I,J)	Minimum of I and J
MAXO (I,J)	Maximum of I and J
EXP (X)	e^x
ALOG (X)	$\ln x$
AMIN1 (X,Y)	Minimum of X and Y
AMAX1 (X,Y)	Maximum of X and Y
ABS (X)	Absolute value of X
IABS (I)	Absolute value of I
INT (X)	Largest integer less than X

Table 4-4 EXECUTION/PRINT ESTIMATES

Compilation of GEEP processor:	200 seconds CPU time
	110000 ₈ Words Storage
	250 Pages (10000 lines) output
One Case - No debug output:	30 seconds CPU time
	171000 ₈ Words Storage
	20 Pages (600 lines) output
One Case - PDECAY debug:	30 seconds CPU time
	171000 ₈ Words Storage
	150 Pages (5000 lines) output
One Case - Full debug:	35 seconds CPU time
	171000 ₈ Words Storage
	250 Pages (10000 lines) output

4.8 PROGRAM LIMITATIONS

The program is basically limited in terms of the programmed inspection/maintenance alternatives. The most important of these is the input inspection type and control fleet specification limitation. The GEEP computer program expects as input a series of inspection specifications such as idle, ignition and induction which are consecutive in the parameters affected. For instance, acceptable inspection type specifications include IDLE-IGNITION, IGNITION-INDUCTION, IDLE, IDLE-IGNITION-INDUCTION. The only non-permissible combination is IDLE-INDUCTION which would involve the inspection of parameters one through three and six through ten, a non-connected set. The same principle applies to the control subfleet specification limitation which states that any combination of control fleets except the UNCONTROLLED-POST 70 combination is acceptable.

The only other program limitations on the program are obvious constraints on the input data such as $0 \leq P^* \leq 1$. There are no limits on the number of cases. The amount of printed output is currently limited to 200,000 lines.

5.0 DETAILED FLOW SCHEMATICS

Presented in the following sections are descriptions, detailed flowcharts and computer listings of each of the fifty-five subroutines in GEEP. Each contains a description of the input variables and output results. Also included are brief summaries of the main equations and techniques for the routine.

This section has been prepared primarily for use by FORTRAN programmers in adopting or modifying the program's structure. Therefore, heavy emphasis is placed on the flowcharts and listings with only cursory descriptions of analytical techniques or data values, details of which are available in Volume III. The user is referred to Table 5.0 which provides a descriptive overview of the program's subroutines.

5.1 MAIN PROGRAM

The main routine of the General Economic Effectiveness Program contains the overall logic for evaluating a mandatory vehicle inspection/maintenance program. The basic input is read and decoded in the main routine, which then initiates the flow through the major routines of GEEP. The following sections contain complete descriptions of each GEEP routine which explain both the input and output as well as the execution flow paths.

Table 5-1 contains a listing of the main routine and Figure 5-1 a flowchart.

5.2 SUBROUTINE INITIAL

Subroutine INITIAL of the General Economic Effectiveness Program initializes various parameters and averages several large input matrices

Table 5-0 SUMMARY LEVEL SUBROUTINE DESCRIPTIONS

LEVEL 1

<u>Name</u>	<u>Description</u>
GEEP	The executive program; provides main linkage for major component subroutines.

LEVEL 2

<u>Subroutine Name</u>	<u>Description</u>
REGION	Supplies region data (location, size, population, emission levels, etc.) for a specific demographic region.
INITIAL	Initializes program variables. Certain variables change throughout the program execution but must be re-initialized at the start of each run. Also pertinent arrays are filled or "zeroed out."
BLINE	The emission study for the baseline fleet is performed at this time. Strictly voluntary maintenance.
MICRO	The emission study for the test fleet is controlled here. Mandatory inspections and maintenances.
COSTS	The program costs are calculated for parts, labor, land, etc.
OUT	The output of the entire program summaries (emission histories, rejection histories, percentage emission reductions, etc.).

Table 5-0 SUMMARY LEVEL SUBROUTINE DESCRIPTIONS (cont.)

LEVEL 3	
<u>Subroutine Name</u>	<u>Description</u>
PRINT 1	Output of the argument variable with the dimension size of (10, 15, 3).
PRINT 2	Output of the argument variable with the dimension size of (15, 3).
PRINT 3	Output of the argument variable with the dimension size of (10, 15).
PRINT 4	Output of the argument variable with the dimension size of (10, 15, 4).
PRINT 5	Output of the argument variable with the dimension size of (4, 15).
FIT	Each emission history must be represented in terms of a polynomial for integration purposes. This subroutine is a 2nd order curve fit.
FUN 1	A single table linear interpolation, with extrapolation beyond end points.
PDECAY	Particular parameter distributions must undergo specific decay processes between inspection periods.
MDECAY	Similar to PDECAY, particular mode distributions undergo decay.
EDECAY	Similar to PDECAY, emission levels are decayed.
TEST	This subroutine controls the estimations of that portion of a specific parameter or mode distribution that is rejected; i.e., that portion of the distribution which exceeds the allowable emission standards.
MAINT	Emission levels must be corrected for maintenance due to both the baseline and the test programs.
STATS	At the conclusion of any test interval, a statistical analysis may be performed on the baseline vs test program reductions.

Table 5-0 SUMMARY LEVEL SUBROUTINE DESCRIPTIONS (cont.)

<u>Subroutine Name</u>	<u>Description</u>
PLOT	Provides a graphical plot of the emission histories.
QUEUE	Provides a queue model for user inconvenience estimations.
LEVEL 4	
<u>Name</u>	<u>Description</u>
STD 2	Using a frequency distribution, calculates the corresponding mean and sigma.
AREA	(XOPT = 0) Estimates the normalized area of a parameter distribution, nominally from the end point to the cutpoint. (XOPT = 1) Returns the expected value of the rejected portion of the distribution. $\int xf(x)dx = \text{expected value}$
UNION	Provides the union of n number of probabilities; namely, the rejection fractions.
TABLE	Generates a frequency distribution (table) from a representative mean and sigma. Generates: (1) Normal (2) Lognormal (3) Hyperbolic
CONVOL	Generates the convolution of two distributions: $C = \int_{-\infty}^{\infty} f(t) g(x-t) dt$ e.g., for two standard normal distributions; $\mu_1 = \mu_2 = 0. \quad \sigma_1 = \sigma_2 = 1. \quad \mu_c = \mu_1 + \mu_2$ $\sigma_c = \sqrt{\sigma_1^2 + \sigma_2^2}$

Table 5-0 SUMMARY LEVEL SUBROUTINE DESCRIPTIONS (cont.)

<u>Subroutine Name</u>	<u>Description</u>
DISTPR	Used in conjunction with CONVOL. Outputs the two input distributions along with the resultant distribution with their respective means and sigmas.
NORM	Normalizes a distribution so that $\int f(x) dx = 1$
XPT	Given a distribution and an area, integrates until the input area is achieved and outputs the respective X-axis coordinate.
PLOTXY	Supports subroutine plot by outputting the actual grid pattern.
IFACT	Calculates N factorial for integer N.

LEVEL 5

<u>Name</u>	<u>Description</u>
SWITCH	For most purposes, a representative distribution's X-axis must be monotonically increasing. If not, the order of the X-axis values along with their respective Y values are reordered.
RESIZE	Given a distribution and a cell width, ΔX , a new array, is generated to represent the input distribution as a function of the new ΔX .

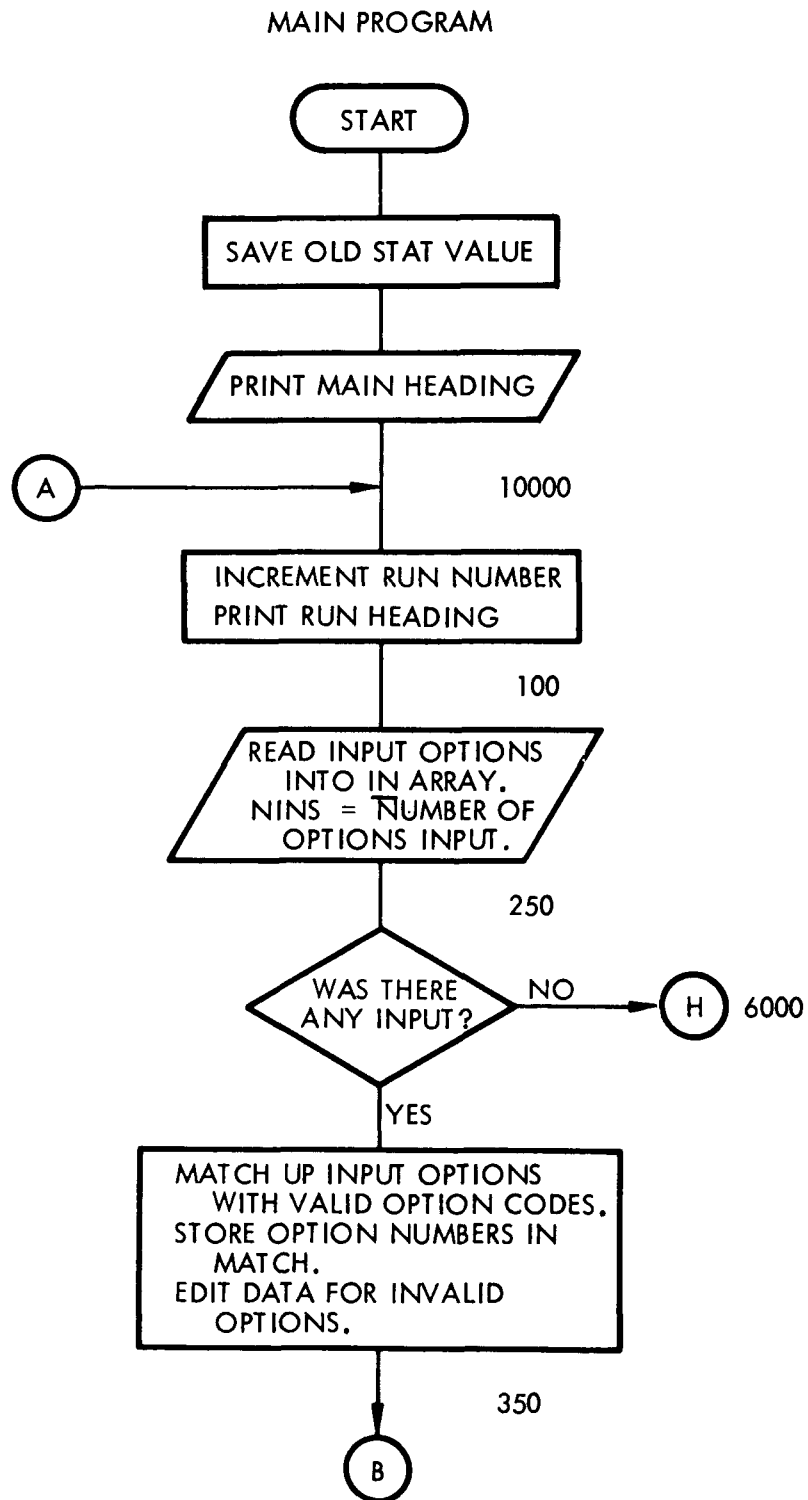


Figure 5-1 Main Program Flowchart

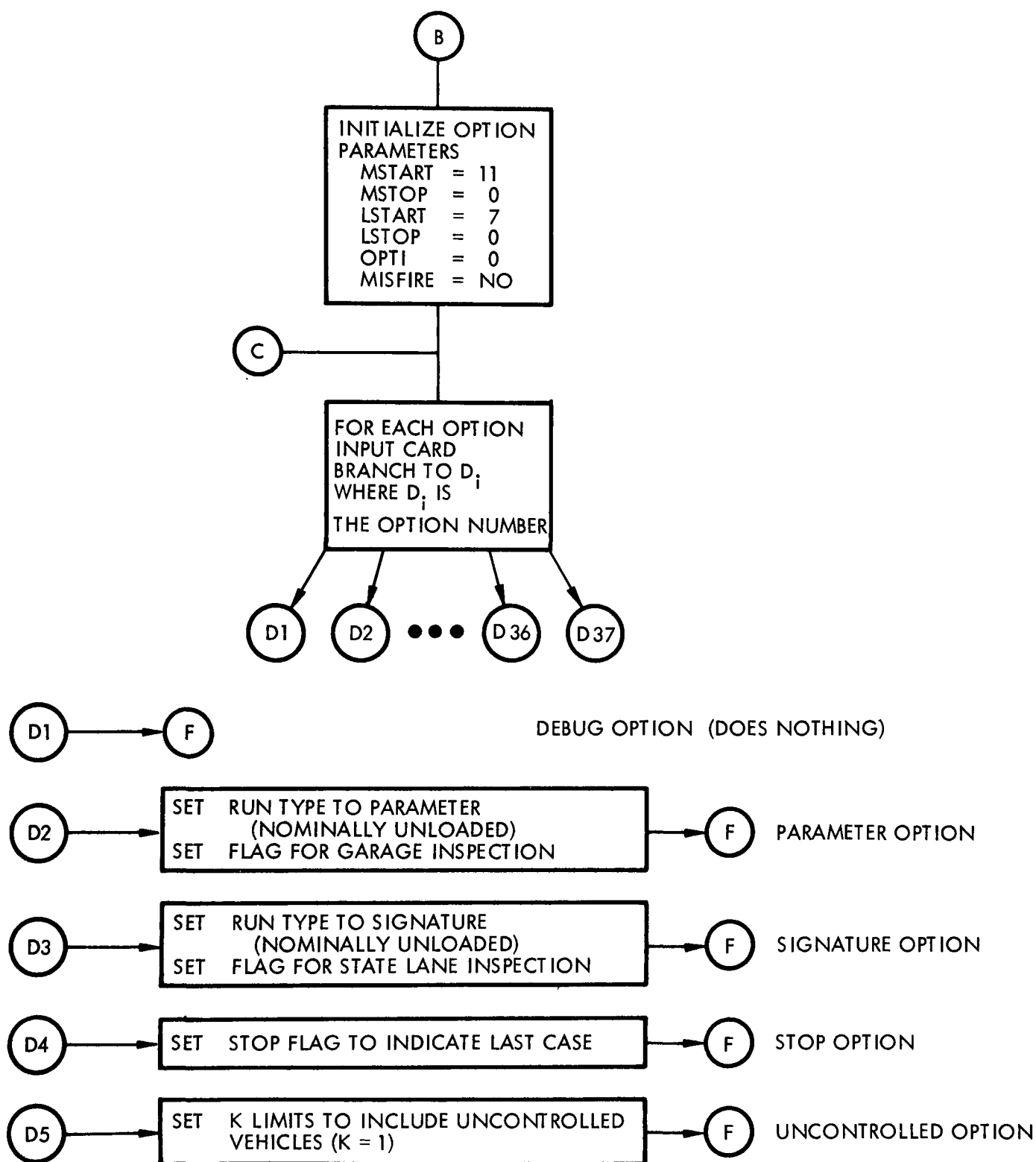


Figure 5-1 Main Program Flowchart (cont.)

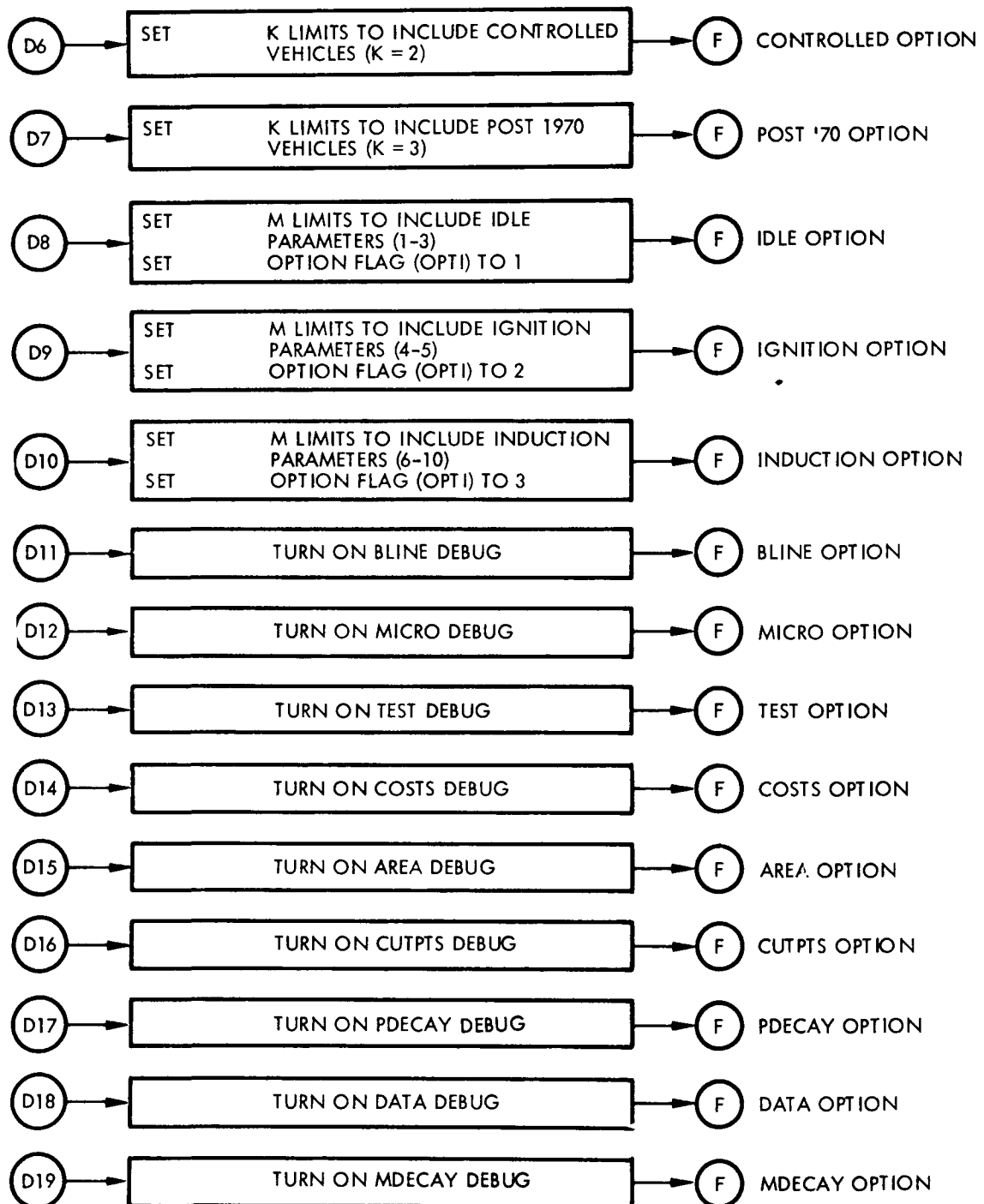


Figure 5-1 Main Program Flowchart (cont.)

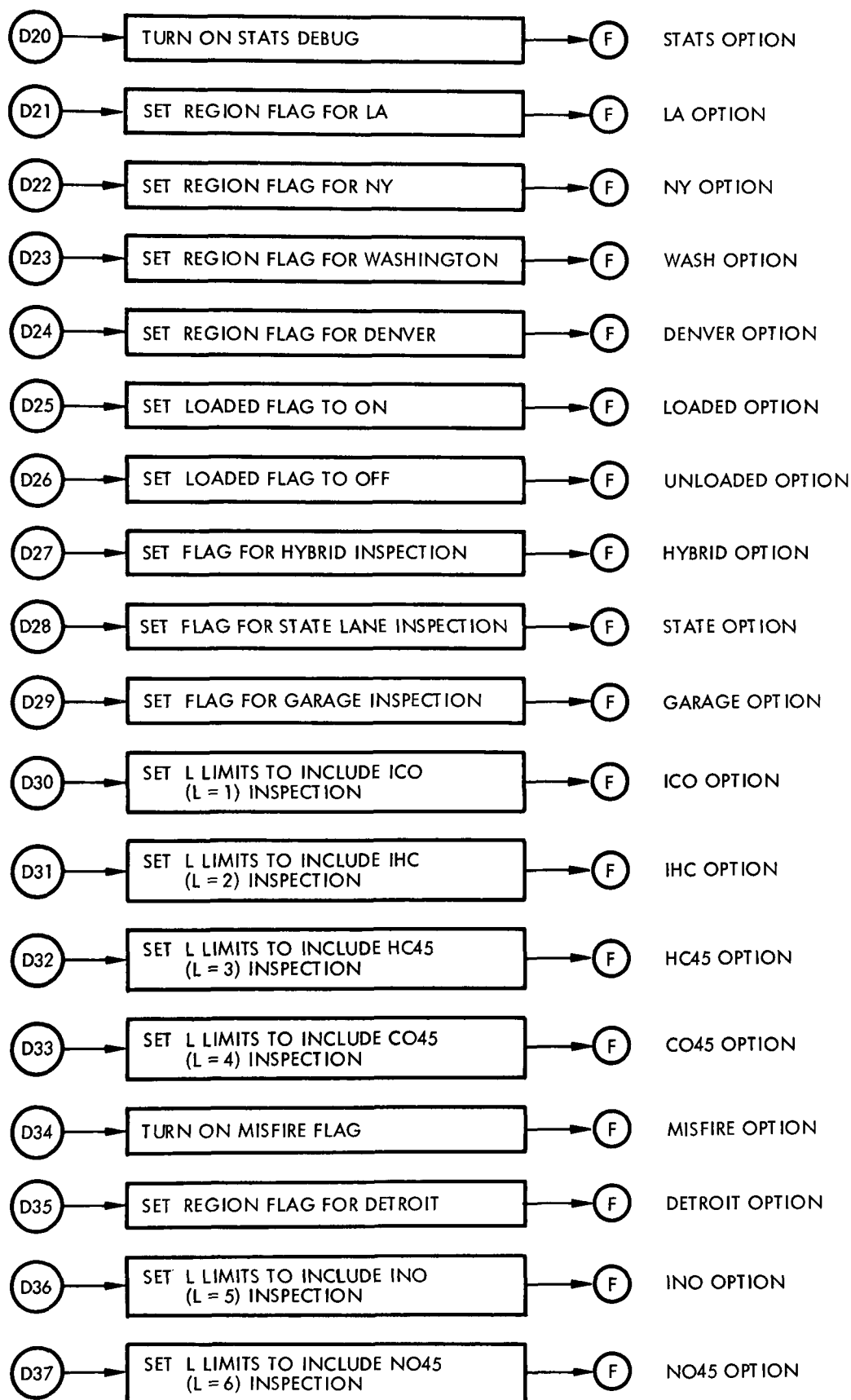


Figure 5-1 Main Program Flowchart (cont.)

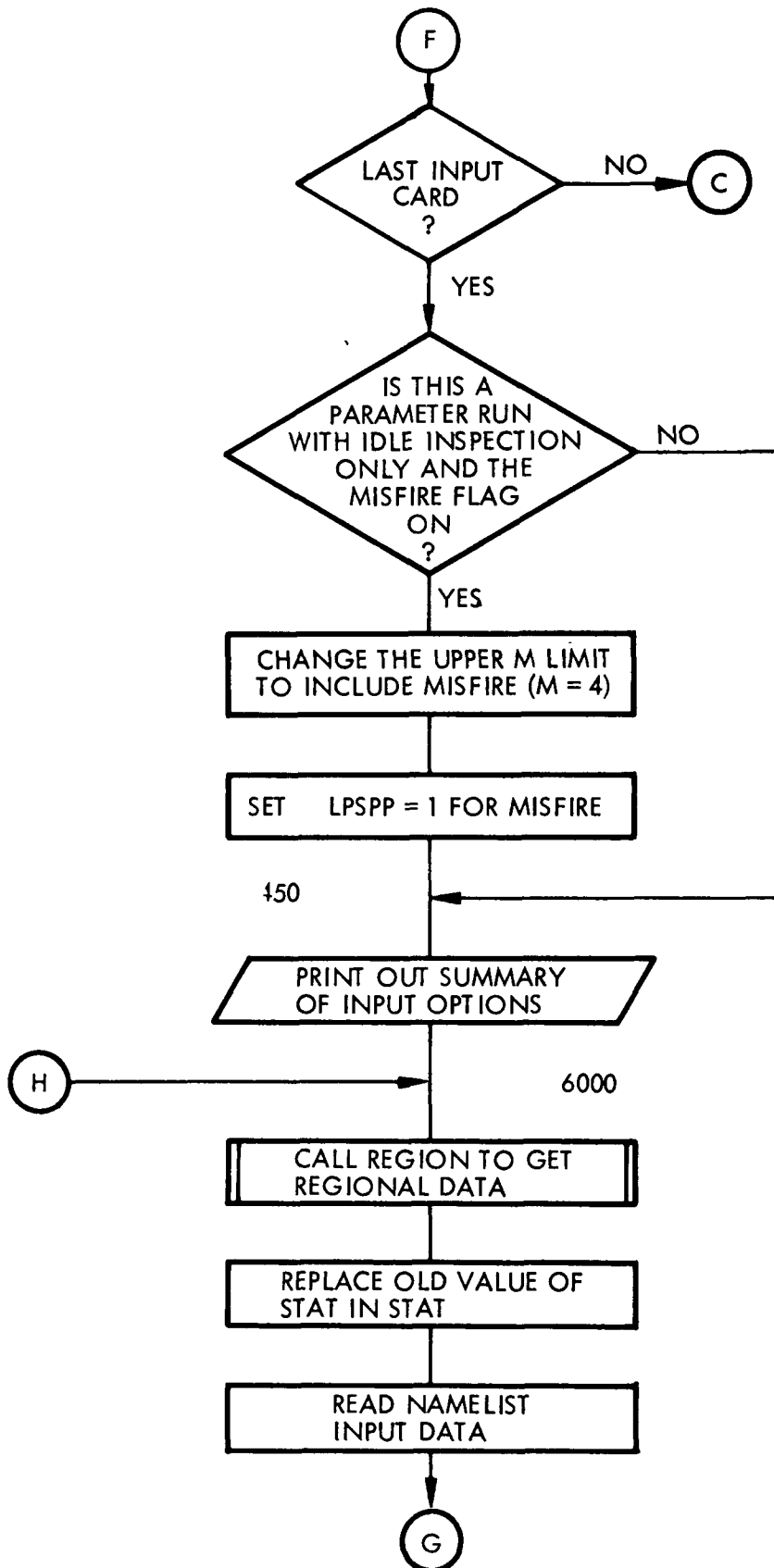


Figure 5-1 Main Program Flowchart (cont.)

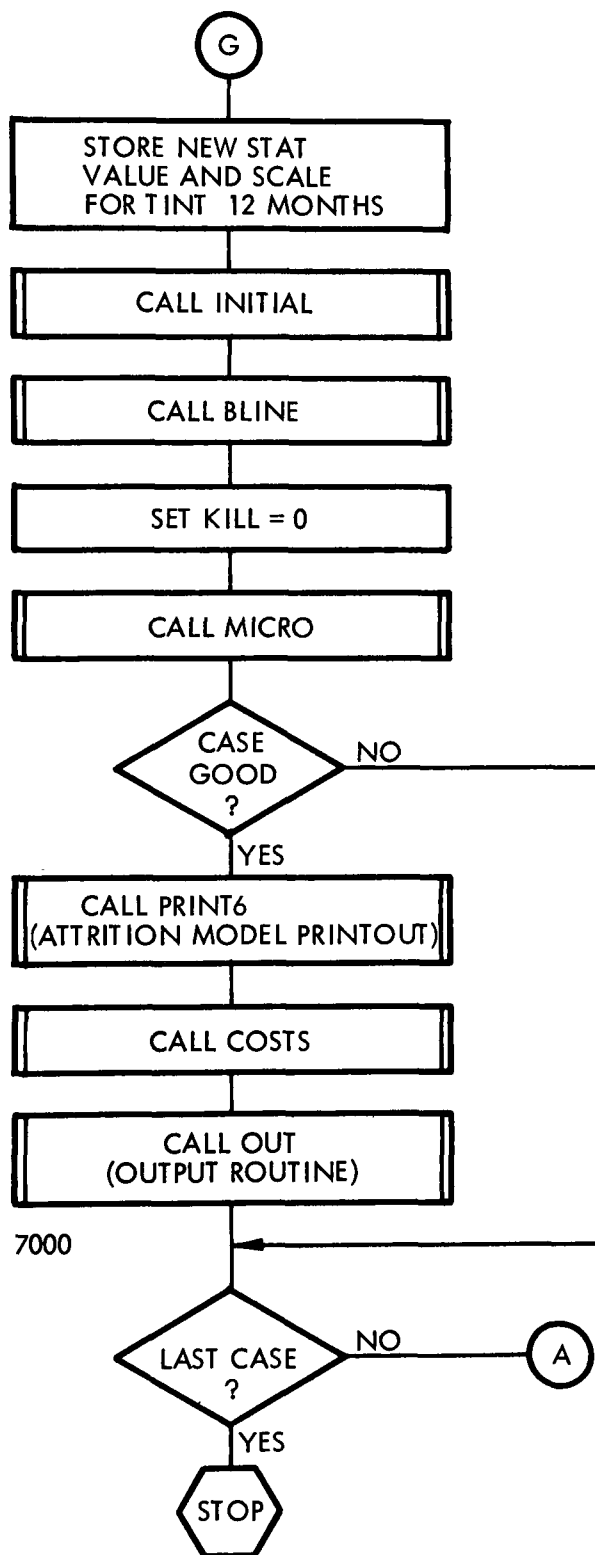


Figure 5-1 Main Program Flowchart (cont.)

Table 5-1 MAIN PROGRAM LISTING

```

00100      PROGRAM GX(INPUT,OUTPUT,TAPE5,TAPE6=OUTPUT)
00110      C      ECONOMIC/EFFECTIVENESS PROCESSOR
00120      DIMENSION IN(50),MATCH(50)

00130      COMMON /COM01/ AMB(3),ALAB,      AVV, BINT,
00140      +      BAREA(3), BLD1,      BLD2,      BSIG(3), BXTA,      BSIZE,
00150      +      BHIST(3,16),      BMMI(10,15,3),
00160      +      ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
00170      COMMON /COM02/
00180      +      CARA,      CARIY,      CARMY,      CARPOP(16),
00190      +      CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCOSTM,      CGTT,
00200      +      CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
00210      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
00220      +      CPART(10,15)
00220      CC ADD2
00230      COMMON /COM03/
00240      +      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
00250      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
00260      +      FREQA,      FREQB,      FPERC(10,3),
00270      +      HORZN,      HORZNY,
00280      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
00290      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
00300      +      HPTOTS(16)
00300      CC ADD3
00310      COMMON /COM04/
00320      +      ITE,      ITL,      ITP,      ITIME(16),
00330      +      KSTART,      KSTOP,      LOPT, LPICK(10),LLPICK,
00340      +      LIDLE,      LINT(16), LPSP(10),LSTART,      LSTOP,
00350      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
00360      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
00360      CC ADD4
00370      COMMON /COM05/
00380      +      NAME(50), NCNTR,      NEMIS,      NEMP,
00390      +      NINTR,      NINTRB,      NMODE,      NO,      NOPTS,      NPAR,
00400      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
00410      +      OCYIY,      OCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
00410      CC ADD5
00420      COMMON /COM06/
00430      +      PARM(3,3),PART,      PAYNEW,      PAYOFF(3),
00440      +      PC(15),      PCS(15),      PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
00450      +      PP(10,15),PS(6,15),      PT(5),      PTOT,      PTS(5),      PAYADJ,
00460      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
00470      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
00480      +      PSA(15),      PTA(5),      PCONF,      PARINT(10,10,9)
00490      +      ,PAYFIN
00490      COMMON /COM07/
00500      +      REINSP,      RNAME,      RSIZE,      RSTOP,
00500      +      RTYPE,

```

Table 5-1 MAIN PROGRAM LISTING (cont.)

```

00510      +   SALE,      SALL,      SALP,      SITEI,      SITEM,      SLANE,
00520      +   SMODEL,   START(15,3), STAT,      STIME(3), SUMBM(3),
00530      +   SCALEBM(3),      SM(6,15),      SPAR(10,15,6),
00540      +   SXCUT(6,3),      SIG(10,3),      SIGCE(3),
00550      +   SIGME(10),      SIGMNE(10),      SIGP(10,15),
00560      +   SIGRATE,   SIST,      SIGS(6,15),      SIGSDE(3),
00570      +   STABLEX(33,6,15),      STABLEY(33,6,15)
00580      COMMON /COM10/      TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),
00590      +   TINT,      TOBE(3),      TONX,      TOTE(3),      TPDB(3),      TPDT(3),
00600      +   TXTRA,      TSIZE,      TSIG(3),      TPER(16,15),      TMIL(16,15),
00610      +   THIST(5,3,16),      THISTT(3,16),      TIMEC(10,15),
00620      +   TIMEM(10,15),      TABLEX(33,10,15),      TABLEY(33,10,15)
00630      CC ADD10
00640      COMMON /COM11/      WF(10),
00650      +   X1BP(3,3,6), XINT,      XINTB,      XLANE,      XSUM,      XCUT(10,3),
00660      +   XTM(16),      XBASE(9,3), YBASE(9,3)
00670      CC ADD11
00680      COMMON /COM12/      Y1BP(3,3,10),      Y2BP(3,3,10),
00690      +   YES,      YSUM,      YTM(16),      Y1DBP(4,4,10), Y2DBP(4,4,10),
00700      +   Z1,      Z2,      Z3,      Z4,      Z5,      Z6,
00710      +   Z7,      Z8,      Z9,      Z10,      Z11,      Z12,
00720      +   Z13,      Z14,      Z15,      Z16,      Z17,
00730      +   ZCARI,      ZCARM,      ZIC,      ZSUM,
00740      +   ZZ(3,3)
00750      CC ADD12
00760      COMMON /DEBUG/      ADEBUG,      BDEBUG,      CDEBUG,      DDEBUG,
00770      +   LDEBUG,      MDEBUG,      PDEBUG,      QDEBUG,      SDEBUG,      TDEBUG
00780      CC ADDD
00790      REAL      ITE,      ITL,      ITP,      ITIME,
00800      +   MMS,      MPH,      MSPEC,      MU,      MVPR,
00810      +   NAME,      NO,      LDEBUG,      MDEBUG,
00820      +   IN,      MISFIRE
00830      INTEGER      RNAME,      SITEI,      SITEM,      STAT,
00840      +   TDIST,      XLANE,      OPTI,      PPICK,      PPPICK
00850      NAMEDLIST /NAM1/      XCUT, COEFBP, EMW, TINT, BMMI, START, HORZN,
00860      +   SCALEBM, MMS, SXCUT, Z2, Z9, Z16, STAT, XLANE, NPICK, PCONF, EFF, FPERC,
00870      +   PARM, TDIST, LPICK, PPICK, PI, PSTAR
00880      DATA KSTART, KSTOP/4,0/
00890      STATSV=STAT
00900      NRUN=0
00910      CALL GEEPER
00920      10000 CONTINUE

```


Table 5-1 MAIN PROGRAM LISTING (cont.)

```

00930      NRUN=NRUN+1
00940      WRITE (6,190) NRUN
00950      190  FORMAT(1H1,5(/),25X,*GENERALIZED ECONOMIC EFFECTIVENESS*,
00960      + * PROGRAM*,////)
00970      1 40X,*R U N  N O .*13/)
00980      CC  INPUT OF PROGRAM OPTIONS
00990      NINS=1
01000      100  READ (5,200) IN(NINS)
01010      200  FORMAT(A10)
01020      IF(IN(NINS).EQ.10HTHAT S ALL) GO TO 250
01030      NINS=NINS+1
01040      GO TO 100
01050      250  CONTINUE
01060      NINS=NINS-1
01070      IF(NINS.EQ.0) GO TO 6000
01080      DO 350 I=1,NINS
01090      MATCH(I)=1
01100      DO 300 J=1,NOPTS
01110      IF(IN(I).NE.OPTS(J)) GO TO 300
01120      MATCH(I)=J
01130      GO TO 350
01140      300  CONTINUE
01150      IF(I.EQ.NINS) GO TO 350
01160      WRITE (6,310) IN(I)
01170      310  FORMAT(5X,5(1H*),* A MATCH WAS NOT FOUND FOR*,
01180      + * THE INPUT *,A10/)
01190      350  CONTINUE
01200      MSTART=11
01210      MSTOP=0
01220      LSTART=7
01230      LSTOP=0
01240      OPTI=0
01250      MISFIRE=NO
01260      CC  DATA INITIALIZATION FOR PROGRAM OPTIONS
01270      DO 400 I=1,NINS
01280      IGO=MATCH(I)
01290      GO TO (400,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,
01300      + 20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37),IGO
01310      2  RTYPE=PMODEL
01320      LIDLE=1
01330      SLANE=10HGARAGE
01340      GO TO 400

```

Table 5-1 MAIN PROGRAM LISTING (cont.)

01350	3	RTYPE=SMODEL
01360		LIDLE=1
01370		SLANE=10HSTATE
01380		GO TO 400
01390	4	RSTOP=YES
01400		GO TO 400
01410	5	KSTART=1
01420		KSTOP=MAX0(KSTOP,1)
01430		GO TO 400
01440	6	KSTART=MIN0(KSTART,2)
01450		KSTOP=MAX0(KSTOP,2)
01460		GO TO 400
01470	7	KSTART=MIN0(KSTART,3)
01480		KSTOP=3
01490		GO TO 400
01500	8	MSTART=1
01510		MSTOP=MAX0(MSTOP,3)
01520		OPTI=MAX0(1,OPTI)
01530		GO TO 400
01540	9	MSTART=MIN0(MSTART,4)
01550		MSTOP=MAX0(MSTOP,5)
01560		OPTI=MAX0(2,OPTI)
01570		GO TO 400
01580	10	MSTART=MIN0(MSTART,6)
01590		MSTOP=10
01600		OPTI=MAX0(3,OPTI)
01610		GO TO 400
01620	11	BDEBUG=YES
01630		GO TO 400
01640	12	MDEBUG=YES
01650		GO TO 400
01660	13	TDEBUG=YES
01670		GO TO 400
01680	14	CDEBUG=YES
01690		GO TO 400
01700	15	ADEBUG=YES
01710		GO TO 400
01720	16	LDEBUG=YES
01730		GO TO 400
01740	17	PDEBUG=YES
01750		GO TO 400
01760	18	DDEBUG=YES

Table 5-1 MAIN PROGRAM LISTING (cont.)

01770		GO TO 400
01780	19	QDEBUG=YES
01790		GO TO 400
01800	20	SDEBUG=YES
01810		GO TO 400
01820	21	RNAME=1
01830		GO TO 400
01840	22	RNAME=2
01850		GO TO 400
01860	23	RNAME=3
01870		GO TO 400
01880	24	RNAME=4
01890		GO TO 400
01900	25	LIDLE=2
01910		GO TO 400
01920	26	LIDLE=1
01930		GO TO 400
01940	27	LIDLE=3
01950		GO TO 400
01960	28	SLANE=10HSTATE
01970		GO TO 400
01980	29	SLANE=10HGARAGE
01990		GO TO 400
02000	30	LSTART=1
02010		LSTOP=MAX0(1,LSTOP)
02020		GO TO 8
02030	31	LSTART=MIN0(2,LSTART)
02040		LSTOP=MAX0(2,LSTOP)
02050		GO TO 8
02060	32	LSTART=MIN0(3,LSTART)
02070		LSTOP=MAX0(3,LSTOP)
02080		GO TO 9
02090	33	LSTART=MIN0(LSTART,4)
02100		LSTOP=MAX0(LSTOP,4)
02110		GO TO 10
02120	34	MISFIRE=YES
02130		GO TO 400
02140	35	RNAME=5
02150		GO TO 400
02160	36	LSTART=MIN0(LSTART,5)
02170		LSTOP=MAX0(LSTOP,5)
02180		GOTO 400

Table 5-1 MAIN PROGRAM LISTING (cont.)

02190	37	LSTART=MINO(LSTART,6)
02200		LSTOP=6
02210		GOTO 400
02220	400	CONTINUE
02230		IF(RTYPE.EQ.PMODEL) GO TO 450
02240		IF(MSTOP.NE.3) GO TO 450
02250		IF(MISFIRE.EQ.NO) GO TO 450
02260		MSTOP=4
02270		LPSPP(4)=1
02280	450	CONTINUE
02290		WRITE (6,500) (IN(I),I=1,NINS)
02300	500	FORMAT(5(/),20X,*INPUTS ARE:*/30(21X,A10/))
02310		NN=2*RNAME-1
02320		WRITE (6,1000) RTYPE,NAME(NN+20),NAME(NN+21),
02330		+ (NAME(K+3),K=KSTART,KSTOP)
02340	1000	FORMAT(1H1,/,5X,*RUN TYPE -- *,T50,A10,* MODEL*,/
02350		+ 5X,*AREA CONSIDERED -- *,T50,2A10/
02360		+ 5X,*CAR POPULATION TYPE -- *,3(T49,A8/))
02370		WRITE (6,1100) (M,NAME(M+30),M=MSTART,MSTOP)
02380	1100	FORMAT(/5X,*PARAMETERS CONSIDERED -- *,10(T49,I2,5X,A10/))
02390		IF(RTYPE.EQ.SMODEL) WRITE (6,1150) (L,NAME(L+40),L=
02400		+ LSTART,LSTOP)
02410	1150	FORMAT(/,5X,*SIGNATURE MODES CONSIDERED -- *,
02420		+ 6(T49,I2,5X,A10/))
02430		IF(MISFIRE.EQ.YES)
02440		+WRITE (6,1200) OPTS(LIDLE+24),SLANE
02450	1200	FORMAT(/20X,*MISFIRE UNDER *A10,* CONDITIONS*/
02460		+ 20X,A10,* INSPECTION STATIONS*/)
02470		WRITE (6,1300) BDEBUG,MDEBUG,TDEBUG,CDEBUG,ADEBUG,
02480		+ LDEBUG,PDEBUG,DDEBUG,SDEBUG
02490	1300	FORMAT(/,20X,*DEBUG OPTIONS FOR THE FOLLOWING*,
02500		+ * SUBROUTINES:*/
02510		+ 10X,*BLINE*,T50,A10/10X,*MICRO*,T50,A10/
02520		+ 10X,*TEST*,T50,A10/10X,*COSTS*,T50,A10/
02530		+ 10X,*AREA*,T50,A10/10X,*LINPRO*,T50,A10/
02540		+ 10X,*PDECAY*,T50,A10/10X,*DATA*,T50,A10/,
02550		+ 10X,*STATS*,T50,A10/)
02560	6000	CONTINUE
02570		CALL REGION(RNAME)
02580		STAT=STATSV
02590		READ (5,NAM1)
02600		STATSV=STAT

Table 5-1 MAIN PROGRAM LISTING (cont.)

02610	STAT=STAT*12./TINT
02620	CALL INITIAL
02630	CALL BLINE
02640	KILL=0
02650	CALL MICRO(KILL)
02660	IF(KILL.EQ.1) GOTO 7000
02670	CALL PRINT6(CN,TPER,TMIL,NTR,CARPOP)
02680	CALL COSTS
02690	CALL OUT
02700	7000 IF(RSTOP.EQ.YES) STOP
02710	GO TO 10000
02720	999 FORMAT(1H1)
02730	END

for later use in the model. INITIAL computes the inspection time intervals for the test and base (mandatory and voluntary) cases and estimates the vehicle population size over the time horizon using an input linear regression. The Vehicle Population Model is called from INITIAL to evaluate the dynamic character of the age percentage and vehicle miles travelled distributions for the various subpopulations being modeled. Average partial derivatives and deterioration coefficients are computed along with certain average cost information. The parameter and mode emission distributions are expanded and their means and standard deviations computed. These means and sigmas are averaged and stored for later printout. Figure 5-2 contains a flowchart of INITIAL and Table 5-2 a computer listing

5.3 SUBROUTINE REGION - DEMOGRAPHIC DATA

Subroutine REGION contains the control logic for the regional data initialization routines. It shifts control to one of the regional data routines based on the value of RNAME.

<u>RNAME</u>	<u>SUBROUTINE CALLED</u>	<u>REGION</u>
1	REGION1	Los Angeles
2	REGION2	New York City
3	REGION3	Washington, D. C.
4	REGION4	Denver
5	REGION5	Detroit

Input to REGION consists solely of RNAME, the region flag. The output from REGION travels through the common blocks found in the REGION subroutines and the MAIN program from which REGION is called. Figure 5-3 presents a flowchart for subroutine REGION while Table 5-3 lists the code.

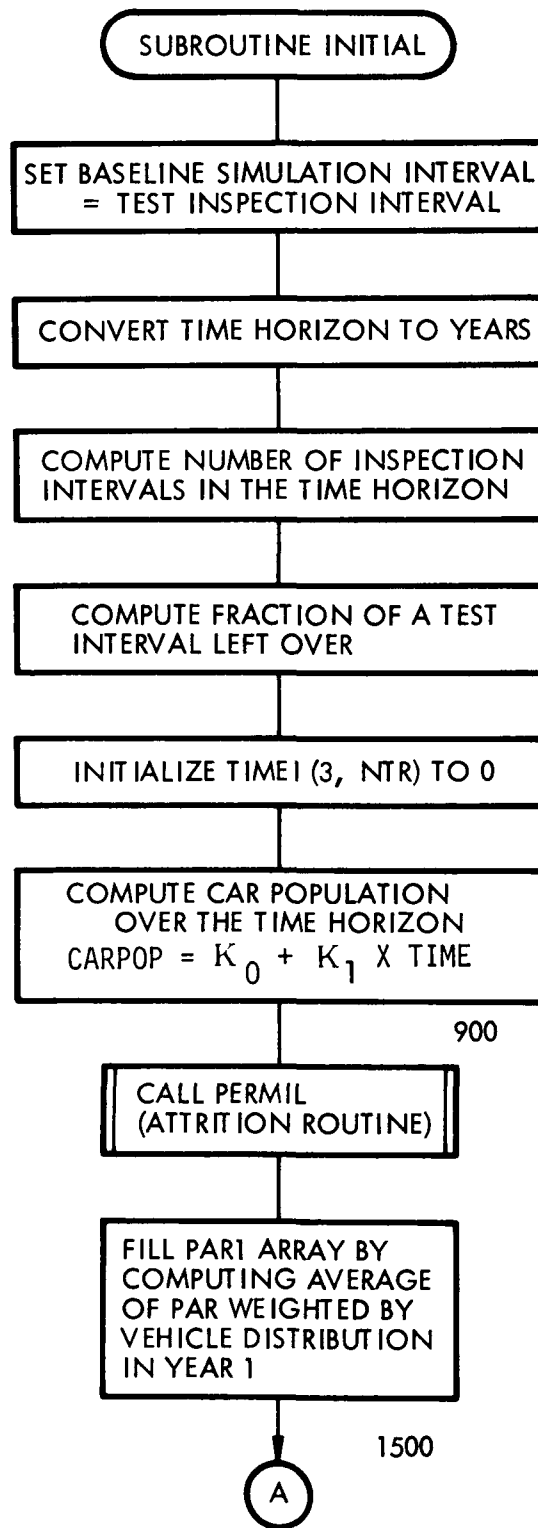


Figure 5-2 Subroutine INITIAL Flowchart

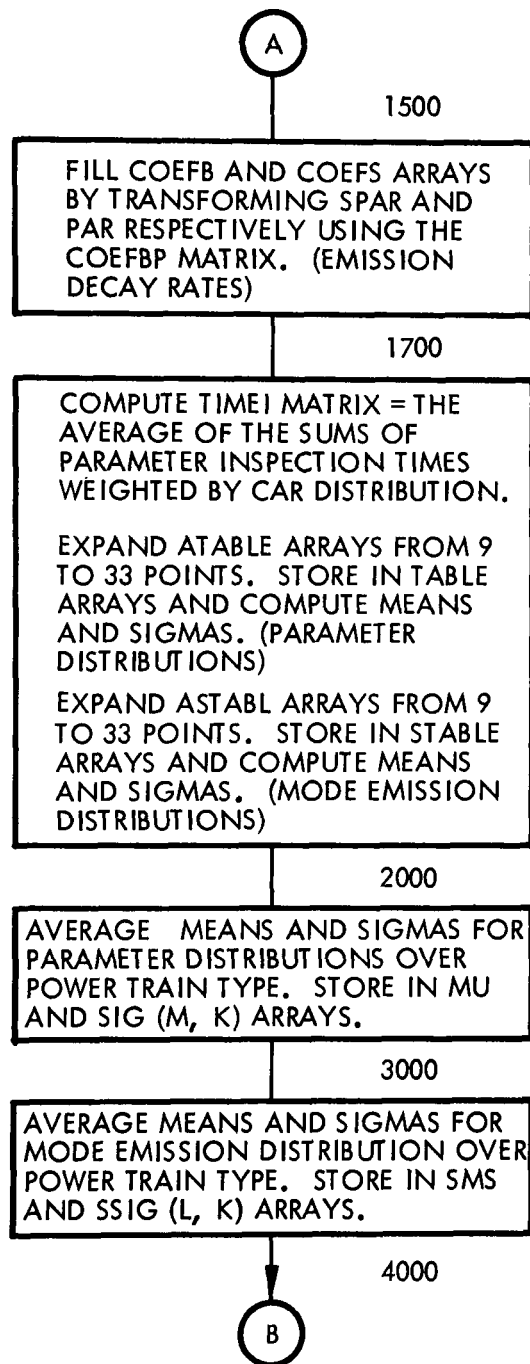


Figure 5-2 Subroutine INITIAL Flowchart (cont.)

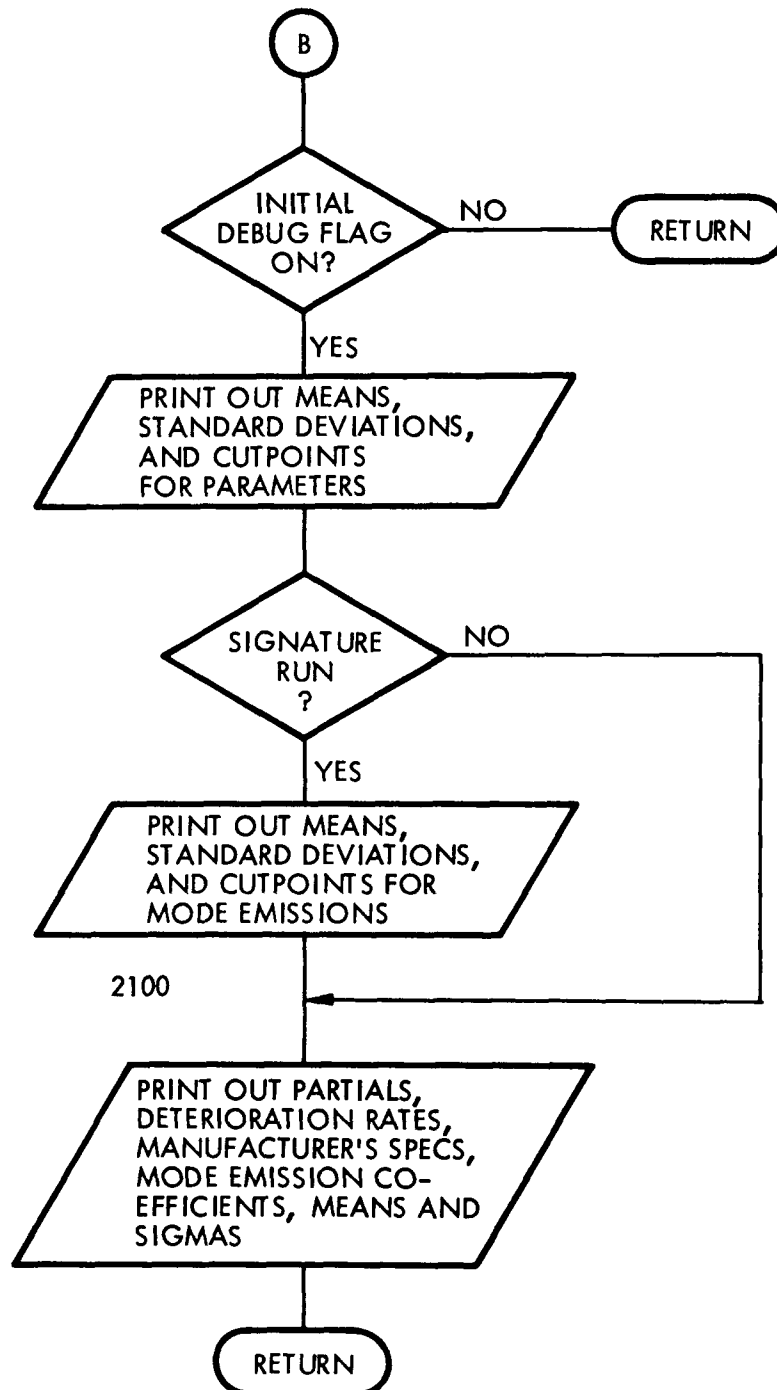


Figure 5-2 Subroutine INITIAL Flowchart (cont.)

Table 5-2 SUBROUTINE INITIAL LISTING

07770	SUBROUTINE INITIAL	
07780	DIMENSION SMS(6,3),SSIG(6,3)	
07790	DIMENSION XBP(9),YBP(9)	
07800	DIMENSION DUMX(33),DUMY(33)	
07810	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,	
07820	+	BAREA(3), BLD1, BLD2, BSIG(3), BXTRA, BSIZE,
07830	+	BHIST(3,16), BMMI(10,15,3),
07840	+	ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
07850	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),	
07860	+	CARSY, CBSUM, CCDEF(10),CCOSTI, CCOSTM, CGTT,
07870	+	CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
07880	+	CN(15,3,16), COEFB(15,3), COEFBP(10,15),
07890	+	CPART(10,15)
07900	CC ADD2	
07910	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),	
07920	+	EMW(3), EP(10,15),EFF(10), DELIT(3),
07930	+	FREQA, FREQB, FPERC(10,3),
07940	+	HORZN, HORZNY,
07950	+	HPC(15,16), HPCS(15,16), HPP(10,15,16),
07960	+	HPS(6,15,16), HPT(5,16), HPTOT(16),
07970	+	HPTOTS(16)
07980	CC ADD3	
07990	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),	
08000	+	KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
08010	+	LIDLE, LINT(16), LPSPP(10),LSTART, LSTOP,
08020	+	MBASE, MPH, MSPEC(10),MSTART, MSTOP,
08030	+	MU(10,3), MMS(10,15), MVPR(10,15)
08040	CC ADD4	
08050	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,	
08060	+	NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
08070	+	NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
08080	+	OCiy, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
08090	CC ADD5	
08100	COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),	
08110	+	PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
08120	+	PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
08130	+	PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
08140	+	PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
08150	+	PSA(15), PTA(5), PCONF, PARINT(10,10,9)
08160	+	,PAYFIN
08170	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,	

Table 5-2 SUBROUTINE INITIAL LISTING (cont.)

08180	+	RTYPE,						
08190	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,	
08200	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),		
08210	+	SCALEBM(3),	SM(6,15),		SPAR(10,15,6),			
08220	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),		
08230	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),		
08240	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),		
08250	+	STABLEX(33,6,15),		STABLEY(33,6,15)				
08260		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),	
08270	+	TINT,	TOBF(3),	TJNX,	TOTE(3),	TPDB(3),	TPDT(3),	
08280	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),		
08290	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),		
08300	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)		
08310		CC ADD10						
08320		COMMON /COM11/		WF(10),				
08330	+	X1BP(3,3,0),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),	
08340	+	XTM(16),	XBASE(9,3),	YBASE(9,3)				
08350		CC ADD11						
08360		COMMON /COM12/		Y1BP(3,3,10),		Y2BP(3,3,10),		
08370	+	YES,	YSUM,	YTM(16),		Y1DBP(4,4,10),	Y2DBP(4,4,10),	
08380	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,	
08390	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,	
08400	+	Z13,	Z14,	Z15,	Z16,	Z17,		
08410	+	ZCARI,	ZCARM,	ZIC,	ZSUM,			
08420	+	ZZ(3,3)						
08430		CC ADD12						
08440		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,	
08450	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG	
08460		CC ADD0						
08470		REAL	ITE,	ITL,	ITP,	ITIME,		
08480	+	MMS,	MPH,	MSPEC,	MU,	MVPR,		
08490	+	NAME,	NO,	LDEBUG,	MDEBUG,			
08500	+	IN,	MISFIRE					
08510		INTEGER	RNAME,	SITEI,	SITEM,	STAT,		
08520	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK		
08530	CC							
08540	CC	ANY DATA APPEARING IN THIS SUBROUTINE IS FOR						
08550	CC	RE-INITIALIZATION PURPOSES FOR MULTIPLE RUNS						
08560		BINT=TINT						
08570		HORZNY=HORZN/12						
08580		XINT=HORZN/TINT+1.E-10						
08590		INT=XINT						

Table 5-2 SUBROUTINE INITIAL LISTING (cont.)

08600		NINTR=XINT+.99
08610		NTR=NINTR+1
08620		MID=NTR
08630		TXTRA=XINT-INT
08640		XINTB=HORZN/BINT+1.E-10
08650		INTB=XINTB
08660		NINTRB=XINTB+.99
08670		NTRB=NINTRB+1
08680		BXTRA=XINTB-INTB
08690		SIGRATE=1.
08700		CARAV=CARPOP(1)
08710		TIMEI(1,1)=TIMEI(2,1)=TIMEI(3,1)=0.
08720		DO 900 N=2,NTR
08730		TIMEI(1,N)=TIMEI(2,N)=TIMEI(3,N)=0.
08740		N1=N-1
08750		CARPOP(N)=CARPOP(N1)*(1.00+0.03*TINT/12.)
08760	900	CARAV=CARAV+CARPOP(N)
08770		CARPOP(16)=CARAV/NTR
08780		CALL PERMIL(TPER, TMIL, TINT, KSTART, KSTOP, NPTRN)
08790		SUMBM(1)=SUMBM(2)=SUMBM(3)=0.
08800		DO 1500 M=1,NPAR
08810		DO 1500 K=1,NCNTR
08820		WW1=PAR1(M,K,1)=PAR1(M,K,2)=PAR1(M,K,3)=0.
08830		MU(M,K)=SIG(M,K)=0.
08840		DO 1400 JJ=1,NPTRN
08850		J=JJ+5*(K-1)
08860		PLUS(M,J)=0.
08870		WW1=WW1+TPER(1,J)
08880		DO 1400 I=1,NEMIS
08890		PAR1(M,K,I)=PAR1(M,K,I)+PAR(M,J,I)*TPER(1,J)
08900	1400	CONTINUE
08910		DO 1500 I=1,NEMIS
08920		IF(WW1.GT.1.E-10) PAR1(M,K,I)=PAR1(M,K,I)/WW1
08930		IF(WW1.LT.1.E-10) PAR1(M,K,I)=0.
08940	1500	CONTINUE
08950		DO 1700 I=1,NEMIS
08960		DO 1700 JJ=1,NPTRN
08970		DO 1700 K=1,NCNTR
08980		J=JJ+5*(K-1)
08990		DO 1650 L=1,NMODE
09000		SUM=0
09010		DO 1600 M=1,NPAR

Table 5-2 SUBROUTINE INITIAL LISTING (cont.)

```

09020      1600 SUM=SUM+PAR(M,J,I)*COEFBP(M,J)
09030      COEFB(J,I)=SUM+PARM(K,I)
09040      1650 CONTINUE
09050      1700 CONTINUE
09060      DO 2000 JJ=1,NPTRN
09070      DO 2000 K=KSTART,KSTOP
09080      J=JJ+5*(K-1)
09090      DO 1900 M=MSTART,MSTOP
09100      DO 1750 N=1,15
09110      1750 TIMEI(OPTI,N)=TIMEI(OPTI,N)+TIMEC(M,J)*TDIST(M,K)*TPER(N,J)
09120      IF(M.EQ.5.OR.M.EQ.6) GO TO 1900
09130      IF(M.EQ.4.OR.M.EQ.10) GO TO 1900
09140      DO 1850 L=1,NPTS
09150      XBP(L)=ATABLEX(L,M,K)
09160      YBP(L)=ATABLEY(L,M,K)
09170      1850 CONTINUE
09180      NN=NSTEPS+1
09190      DELX=(XBP(NPTS)-XBP(1))/NSTEPS
09200      DO 1875 L=1,NN
09210      DUMX(L)=XBP(1)+(L-1)*DELX
09220      DUMY(L)=FUN1(      DUMX(L),XBP,YBP,NPTS)
09230      1875 CONTINUE
09240      CALL PACKD(DUMX,DUMY,NN)
09250      CALL STD2(DUMX,DUMY,NN,PM(M,J),SIGP(M,J))
09260      DO 1880 L=1,NN
09270      TABLEX(L,M,J)=DUMX(L)
09280      TABLEY(L,M,J)=DUMY(L)
09290      1880 CONTINUE
09300      1900 CONTINUE
09310      DO 1975 LL=1,NMODE
09320      DO 1925 L=1,NPTS
09330      XBP(L)=ASTABLX(L,LL,K)
09340      YBP(L)=ASTABLY(L,LL,K)
09350      1925 CONTINUE
09360      DELX=(XBP(NPTS)-XBP(1))/NSTEPS
09370      DO 1950 L=1,NN
09380      DUMX(L)=XBP(1)+(L-1)*DELX
09390      DUMY(L)=FUN1(      DUMX(L),XBP,YBP,NPTS)
09400      1950 CONTINUE
09410      CALL PACKD(DUMX,DUMY,NN)
09420      CALL STD2(DUMX,DUMY,NN,SM(LL,J),SIGS(LL,J))
09430      DO 1960 L=1,NN

```

Table 5-2 SUBROUTINE INITIAL LISTING (cont.)

```

09440      STABLEX(L,LL,J)=DUMX(L)
09450      STABLEY(L,LL,J)=DUMY(L)
09460      1960  CONTINUE
09470      L=LL
09480      1975  CONTINUE
09490      2000  CONTINUE
09500      DO 3000 M=MSTART,MSTOP
09510      DO 3000 K=KSTART,KSTOP
09520      TT=0.
09530      DO 2500 JJ=1,NPTRN
09540      J=JJ+5*(K-1)
09550      MU(M,K)=MU(M,K)+PM(M,J)*TPER(N,J)
09560      SIG(M,K)=SIG(M,K)+SIGP(M,J)*TPER(N,J)
09570      TT=TT+TPER(N,J)
09580      2500  CONTINUE
09590      IF(TT.LT.1.E-10) GO TO 3000
09600      MU(M,K)=MU(M,K)/TT
09610      SIG(M,K)=SIG(M,K)/TT
09620      3000  CONTINUE
09630      DO 4000 L=LSTART,LSTOP
09640      DO 4000 K=KSTART,KSTOP
09650      TT=0.
09660      DO 3500 JJ=1,NPTRN
09670      J=JJ+5*(K-1)
09680      SMS(L,K)=SMS(L,K)+SM(L,J)*TPER(N,J)
09690      SSIG(L,K)=SSIG(L,K)+SIGS(L,J)*TPER(N,J)
09700      TT=TT+TPER(N,J)
09710      3500  CONTINUE
09720      IF(TT.LT.1.E-10) GO TO 4000
09730      SMS(L,K)=SMS(L,K)/TT
09740      SSIG(L,K)=SSIG(L,K)/TT
09750      4000  CONTINUE
09760      IF(DDEBUG.EQ.NO) RETURN
09770      DO 2100 K=KSTART,KSTOP
09780      WRITE (6,2005) K,NAME(K+3)
09790      2005  FORMAT(1H1,/,30X,*DISSCRIPTIVE DATA FOR E/E STUDIES*
09800      + ,* -- CONTROL TYPE *,I3,* -- *,A8//)
09810      WRITE (6,2010)
09820      2010  FORMAT(70X,*WEIGHTED PARTIALS*/,* PARAMETER*,5X,*TYPE*,
09830      + 4X,*XCUT*,6X,*MU*,8X,*SIG*,8X,5X,9X,*HC*,
09840      + 11X,*CO*,10X,*NO*//)
09850      DO 2025 M=MSTART,MSTOP

```

Table 5-2 SUBROUTINE INITIAL LISTING (cont.)

```

09860      WRITE (6,2020) NAME(M+30),          XCUT(M,K),MU(M,K),SIG(M,K),
09870      + (PAR1(M,K,I),I=1,NEMIS)
09880      2020 FORMAT(1X,A10,3X,3X,2X,3E10.2, 15X,3E13.4/)
09890      2025 CONTINUE
09900      IF(RTYPE.EQ.PMODEL) GO TO 2100
09910      WRITE (6,2030)
09920      2030 FORMAT(4(/),*  MODE */)
09930      J=1+5*(K-1)
09940      DO 2050 L=LSTART,LSTOP
09950      LL=L+10
09960      WRITE (6,2040) NAME(L+40),          ,SXCUT(L,K),SMS(L,K),SSIG(L,K)
09970      2040 FORMAT(1X,A10,3X,3X,2X,3E10.2/)
09980      2050 CONTINUE
09990      2100 CONTINUE
10000      WRITE (6,999)
10010      CALL PRINT1(
10020      + PAR,50HPAR - PARTIALS - DE/DP
10030      + ,PAR,50HPAR - PARTIALS - DE/DP
10040      + )
10050      IF(RTYPE.EQ.SMODEL) WRITE (6,999)
10060      IF (RTYPE.EQ.SMODEL) CALL PRINT4(
10070      + SPAR,50HSPAR - SIGNATURE PARTIALS
10080      + , SPAR,50H
10090      + )
10100      WRITE (6,999)
10110      CALL PRINT2(
10120      + COEFB,50HEMISSION DETERIORATION RATES
10130      + ,COEFB,50H
10140      + ,COEFB,50H
10150      + )
10160      CALL PRINT3(
10170      + COEFBP,50HCOEFBP -- PARAMETER DECAY COEFFICIENTS
10180      + ,NMS,50HMMS - MANUFACTURER SPECIFICATIONS
10190      + )
10200      IF (RTYPE.EQ.SMODEL) CALL PRINT5(
10210      + SM,50HSM -- INITIAL SIGNATURE MEAN VALUES
10220      + , SIGS,50HSIGS -- INITIAL SIGNATURE SIGMAS
10230      + )
10240      999  FORMAT(1H1)
10250      RETURN
10260      END

```

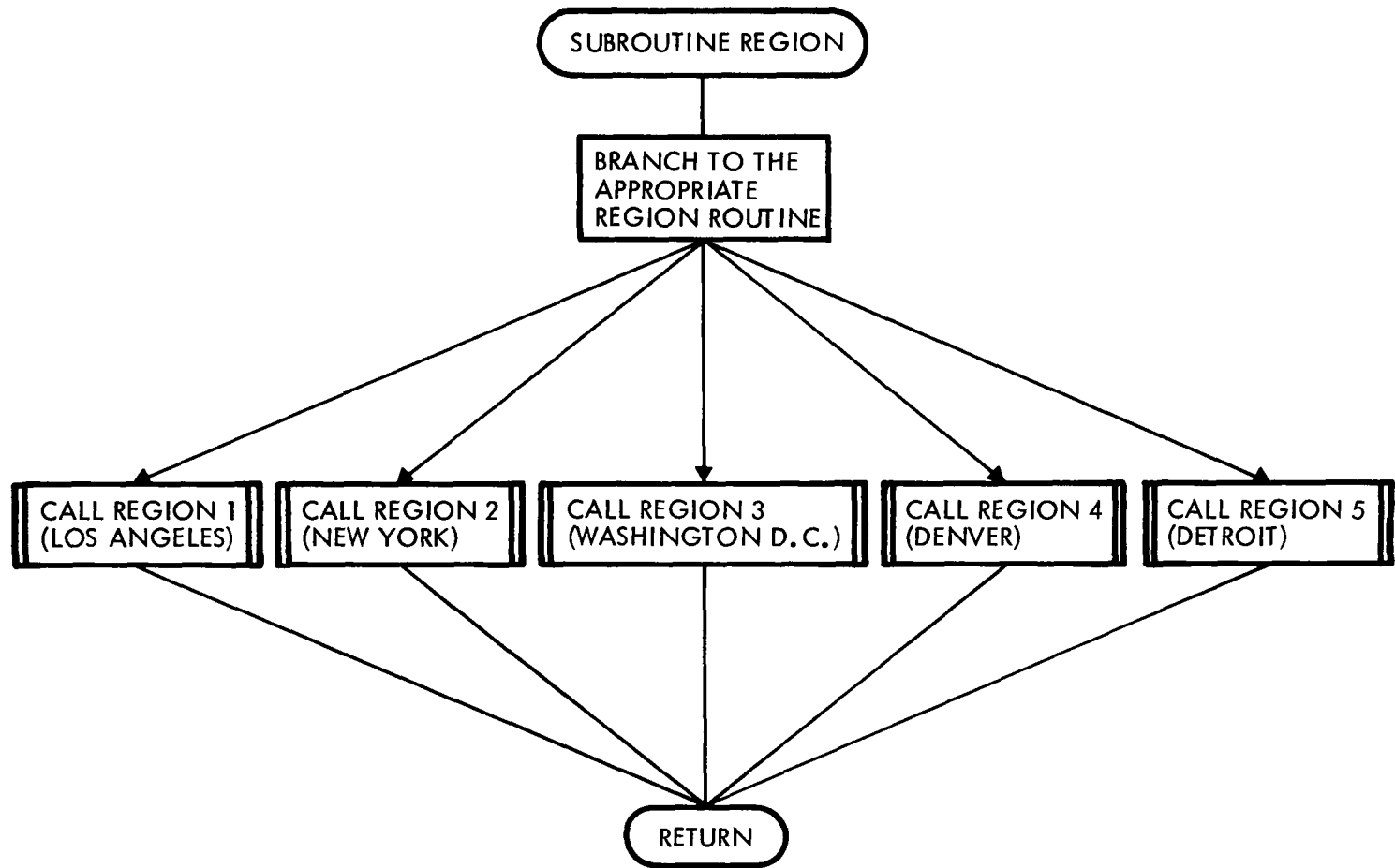


Figure 5-3 Subroutine REGION Flowchart

Table 5-3 SUBROUTINE REGION LISTING

10270		SUBROUTINE REGION(RNAME)
10280		INTEGER RNAME
10290		GOTO (10,20,30,40,50), RNAME
10300	10	CALL REGION1
10310		RETURN
10320	20	CALL REGION2
10330		RETURN
10340	30	CALL REGION3
10350		RETURN
10360	40	CALL REGION4
10370		RETURN
10380	50	CALL REGION5
10390		RETURN
10400		END

5.3.1 Subroutine REGION1

Subroutine REGION1 contains the data for the Los Angeles Basin. The data is stored in internal arrays and matrices and is moved into the main storage during the initialization phase.

There is no input to REGION1. It is called from REGION only when the LA data card has been included in the keyword input. Figure 5-4 shows the flowchart for this subroutine and Table 5-4 a listing. The data requirements for the other modeled regions is similar to that of REGION1.

5.3.2 Subroutine REGION2

(See 5.3.1)

5.3.3 Subroutine REGION3

(See 5.3.1)

5.3.4 Subroutine REGION4

(See 5.3.1)

5.3.5 Subroutine REGION5

(See 5.3.1)

5.4 SUBROUTINE BLINE

Subroutine BLINE contains the algorithms for simulating the impact of a voluntary maintenance program. The emission deterioration data, voluntary maintenance data and starting emission levels are all identical to those used in the mandatory model, and enter BLINE through the common blocks. Other than the common blocks there is no input to BLINE. Output consists of the baseline emission time history stored in BHIST and

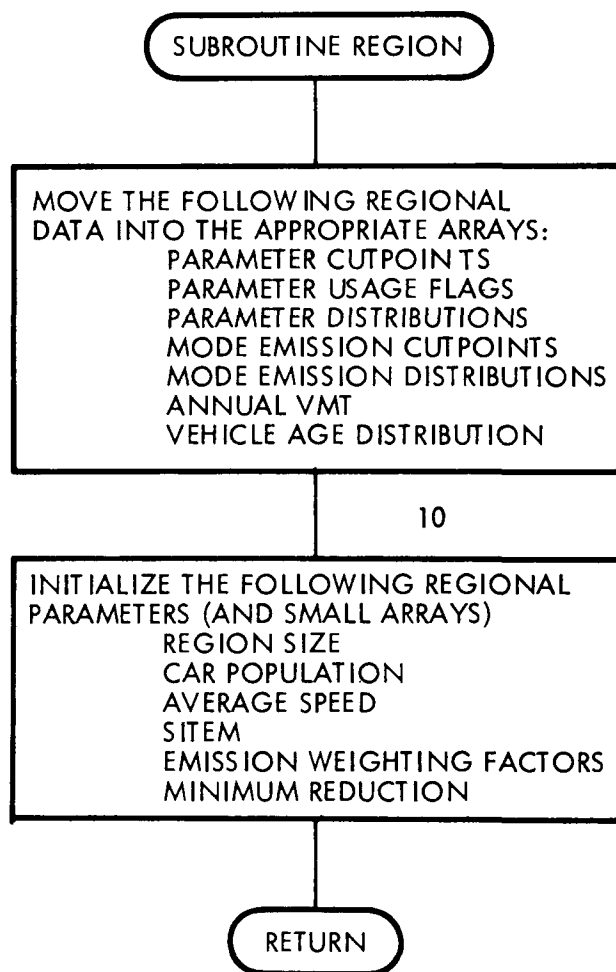


Figure 5-4 Subroutine REGION1 Flowchart

Table 5-4 SUBROUTINE REGION1 LISTING

10410		SUBROUTINE REGION1
10420		DIMENSION XCUT1(10,3),SXCUT1(6,3),ATABX(9,10,3),ATABY(9,10,3)
10430		DIMENSION ASTABX(9,6,3),ASTABY(9,6,3)
10440		DIMENSION TDST(10,3)
10450		INTEGER TDST
10460	CC	DISTRIBUTION CUTPOINTS
10470		DATA XCUT1/1.0,-50.,2.,0.,0.,0.,-1.0,30.,-0.05,0.,
10480		+ 1.0,-5.,1.0,0.,0.,0.,-1.0,25.,-0.05,0.,
10490		+ 1.0,-500.,2.,0.,0.,0.,-1.0,10.,-0.05,0./
10500		DATA SXCUT1/3000.,6.,4000.,450.,3.5,4000.,250.,4.0,5000.,250.,1.5,
10510		+ 5000.,2000.,3.0,4000.,200.,1.0,4000./
10520		DATA (ATABX (I),I=1,180)/
10530		+ -7.,-3.75,-2.25,-1.25,0.25,1.25,2.25,5.25,8.,
10540		+ -200.,-90.,-70.,-30.,10.,70.,110.,130.,380.,
10550		+ -10.,-3.75,-2.75,0.25,2.25,4.25,6.25,7.25,10.,
10560		+ 27*0.,
10570		+ -4.0,-2.75,-1.25,-0.75,0.25,0.75,1.25,2.25,6.,
10580		+ -70.,-55.,-25.,5.,25.,50.,75.,120.,180.,
10590		+ -0.22,-0.1,-0.03,-0.01,0.01,0.03,0.07,0.12,0.26,
10600		+ 9*0.,
10610		+ -8.,-4.75,-3.25,-1.25,.25,.75,2.25,4.75,8.,
10620		+ -250.,-190.,-130.,-50.,10.,30.,50.,110.,340.,
10630		+ -10.,-7.75,-4.75,-3.0,-1.75,0.25,2.25,4.25,10.,
10640		+ 27*0.,
10650		+ -2.75,-1.75,-1.25,-0.75,0.25,0.75,1.25,2.25,4.0,
10660		+ -70.,-55.,-25.,5.,25.,90.,115.,135.,170.,
10670		+ -0.14,-0.11,-0.07,-0.05,-0.01,0.01,0.03,0.05,0.21,
10680		+ 9*0./
10690		DATA (ATABX (I),I=181,270)/
10700		+ -8.,-4.5,-2.,-1.25,-.25,.75,1.75,5.25,7.5,
10710		+ -350.,-190.,-140.,-70.,-50.,30.,70.,150.,440.,
10720		+ -10.,-5.75,-1.75,0.25,2.25,4.25,5.25,8.25,10.,
10730		+ 27*0.,
10740		+ -2.75,-2.25,-1.25,-0.75,0.25,0.75,1.25,3.,3.5,
10750		+ -30.,-10.,5.,20.,35.,45.,105.,130.,170.,
10760		+ -0.21,-0.1,-0.07,-0.03,-0.01,0.01,0.03,0.1,0.28,
10770		+ 9*0./
10780		DATA (ATABY (I),I=1,180)/
10790		+ .0203,.0405,.0541,.0743,.0878,0.0743,.0405,.0270,.0067,
10800		+ 0.006,0.026,0.04,0.06,0.141,0.107,0.081,0.045,0.007,
10810		+ 0.02,0.034,0.06,0.228,0.087,0.08,0.02,0.013,0.007,

Table 5-4 SUBROUTINE REGION1 LISTING (cont.)

```

10820      + 27*0.,
10830      + 0.0079,0.0314,0.102,0.15,0.291,0.133,0.071,0.016,0.008,
10840      + .0075,.0149,.0299,.2+63,.0896,.0537,.0373,.0299,.0075,
10850      + 0.0175,0.035,0.088,0.298,0.175,0.105,0.07,0.018,0.0175,
10860      + 9*0.,
10870      + .0067,.0133,.0267,.0733,.0933,.1200,.0667,.0333,.0067,
10880      + 0.0133,0.0267,0.066,0.133,0.126,0.093,0.086,0.04,0.007,
10890      + 0.013,0.027,0.036,0.047,0.053,0.247,0.06,0.046,0.007,
10900      + 27*0.,
10910      + 0.014,0.043,0.065,0.158,.3450,.137,0.036,0.021,0.007,
10920      6 .0074,.0148,.0296,.3630,.0963,.0370,.0222,.0148,.0074,
10930      + 0.008,0.025,0.05,0.108,0.358,0.192,0.075,0.033,0.017,
10940      + 9*0./
10950      DATA (ATABY (I),I=181,270)/
10960      + .0067,.0134,.0336,.1007,.1409,.1208,.0872,.0268,.0067,
10970      + 0.007,0.02,0.04,0.093,0.153,0.12,0.067,0.033,0.006,
10980      + 0.0135,0.027,0.108,0.378,0.101,0.067,0.02,0.0135,0.013,
10990      + 27*0.,
11000      + 0.015,0.022,0.044,0.125,0.529,0.096,0.044,0.008,0.007,
11010      + .0155,.0233,.5659,.0698,.0465,.0310,.0155,.0078,.0077,
11020      + 0.008,0.016,0.032,0.142,0.44+,0.206,0.047,0.008,0.007,
11030      + 9*0./
11040      DATA (ASTABX (I),I=1,162)/
11050      *50.,150.,350.,450.,550.,750.,850.,1650.,1800.,
11060      * 1.,2.25,2.75,3.75,5.25,6.75,7.75,8.25,10.25,
11070      *10.,70.,90.,110.,130.,170.,190.,270.,400.,
11080      *50.,125.,175.,225.,275.,325.,375.,875.,1000.,
11090      * .5.,.75,1.25,1.75,2.75,3.75,4.25,8.25,9.25,
11100      *90.,700.,1100.,1500.,1900.,2100.,2300.,2800.,3000.,
11110      *50.,75.,125.,175.,275.,325.,375.,675.,775.,
11120      * .5,1.25,2.25,2.75,3.25,4.75,5.75,7.25,10.,
11130      *10.,30.,50.,70.,90.,110.,130.,150.,290.,
11140      *10.,75.,125.,175.,225.,275.,325.,425.,775.,
11150      * .5.,.75,1.25,1.75,2.25,3.25,3.75,4.25,6.75,
11160      * 400.,700.,1500.,2100.,2500.,2700.,2900.,3500.,4000.,
11170      *10.,50.,90.,110.,130.,170.,210.,330.,390.,
11180      * .5,1.5,3.5,5.5,6.5,8.5,9.5,10.5,12.,
11190      *10.,50.,70.,90.,150.,190.,210.,290.,390.,
11200      *10.,30.,50.,70.,90.,110.,130.,190.,300.,
11210      * .1,0.3,0.5,.7,.9,1.3,2.1,2.3,3.0,
11220      * 600.,1300.,1700.,2100.,2700.,2900.,3100.,3300.,3600./
11230      DATA ASTABY /

```

Table 5-4 SUBROUTINE REGION1 LISTING (cont.)

```

11240      * .0140,.0280,.1189,.1399,.1119,.0769,.0490,.0280,.0810,
11250      * .0208,.0347,.0486,.0556,.0625,.0833,.0625,.0486,.0347,
11260      * .0069,.2083,.2986,.1597,.0625,.0486,.0347,.0139,.0409,
11270      * .0000,.0417,.0903,.1806,.2083,.1736,.1042,.0139,.04,
11280      * .0278,.0764,.0833,.1319,.1111,.0903,.0486,.0108,.0469,
11290      * .0417,.0625,.0764,.1181,.0972,.0764,.0625,.0486,.0100,
11300      * .0000,.0270,.0946,.1959,.1622,.0946,.0608,.0275,.1000,
11310      * .0336,.0671,.0805,.1275,.0604,.0470,.0403,.0268,.0200,
11320      * .0000,.0067,.0940,.1544,.1946,.1678,.1409,.0805,.0400,
11330      * .0030,.0473,.2297,.3514,.2365,.0743,.0135,.0068,.0167,
11340      * .3557,.1879,.1800,.1745,.0470,.0268,.0267,.0070,.0160,
11350      * .0134,.0268,.0537,.0738,.0805,.1141,.1275,.0604,.1203,
11360      * .0000,.0144,.0288,.0647,.1079,.1151,.0719,.0504,.1088,
11370      * .2300,.2370,.1220,.0650,.0580,.0250,.0080,.0075,.0070,
11380      * .0000,.0144,.0935,.1799,.1511,.0719,.0432,.0216,.0272,
11390      * .0000,.0072,.0360,.1151,.1511,.1655,.1223,.0791,.0144,
11400      * .1799,.2158,.1439,.1079,.0863,.0360,.0216,.0144,.0302,
11410      * .0216,.0432,.0576,.0863,.1655,.1079,.0863,.0504,.0360/
11420      DATA TDST/1,1,1,1,0,0,1,1,1,1,1,1,1,1,0,1,1,1,1,1,0,1,1,1,0,1,
11430      + 1,1,0/
11440      COMMON /BADDOR/ X(15),ANNUAL(15)
11450      DIMENSION X1(15),ANNUAL(15),START1(15,3)
11460      DATA X1/10.8,10.5,10.2,9.8,9.3,8.8,8.1,7.2,6.2,5.1,
11470      + 4.1,3.0,2.0,0.9,4.0/
11480      DATA ANNUAL/15000.,13000.,11000.,9600.,8400.,7000.,5300.,
11490      + 5000.,4400.,4200.,4000.,3800.,3700.,3550.,3000./
11500      DATA START1/5*11.94,5*7.26,5*4.43,5*129.8,5*86.6,5*63.4,
11510      + 5*3.97,5*6.34,5*6.0/
11520      COMMON /COM01/ AMB(3),ALAB,      AVV,      BINT,
11530      + BAREA(3),BLD1,      BLD2,      BSIG(3), BXTA,      BSIZE,
11540      + BHIST(3,16),      BMMI(10,15,3),
11550      + ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
11560      COMMON /COM02/      CARA,      CARIY,      CARMY,      CARPOP(16),
11570      + CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCUSTM,      CGTI,
11580      + CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
11590      + CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
11600      + CPART(10,15)
11610      CC ADD2
11620      COMMON /COM03/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
11630      + EMW(3),      EP(10,15),EFF(10),      DELIT(3),
11640      + FREQA,      FREQB,      FPERC(10,3),
11650      + HORZN,      HORZNY,

```

Table 5-4 SUBROUTINE REGION1 LISTING (cont.)

```

11660      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
11670      +      HPS(5,15,16),      HPT(5,16),      HPTOT(16),
11680      +      HPTOTS(16)
11690      CC ADD3
11700      COMMON /COM04/      ITE,      ITL,      ITP,      ITIME(16),
11710      +      KSTART,      KSTOP,      LOPT, LPICK(10),LLPICK,
11720      +      LIDLE,      LINT(16), LPSP(10),LSTART,      LSTOP,
11730      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
11740      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
11750      CC ADD4
11760      COMMON /COM05/      NAME(50), NCNTR,      NEMIS,      NEMP,
11770      +      NINTR,      NINTRB, NMUDE,      NO,      NUPTS,      NPAR,
11780      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
11790      +      UCIY,      UCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
11800      CC ADD5
11810      COMMON /COM06/ PARM(3,3),      PART,      PAYNEW,      PAYOFF(3),
11820      +      PC(15),      PCS(15), PHI(14),      PLU(14),      PLTMAX(3),PMODEL,
11830      +      PP(10,15),PS(6,15), PT(5),      PTOT,      PTS(5),      PAYADJ,
11840      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
11850      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
11860      +      PSA(15),      PTA(5),      PCONE,      PARINT(10,10,9)
11870      +      ,PAYFIN
11880      COMMON /COM07/      REINSP,      RNAME,      RSIZE,      RSTOP,
11890      +      RTYPE,
11900      +      SALE,      SALL,      SALP,      SITEI,      SITEM,      SLANE,
11910      +      SMODEL,      START(15,3), STAT,      STIME(3), SUMBM(3),
11920      +      SCALEBM(3),      SM(6,15),      SPAR(10,15,6),
11930      +      SXCUT(6,3),      SIG(10,3),      SIGCE(3),
11940      +      SIGME(10),      SIGMNE(10),      SIGP(10,15),
11950      +      SIGRATE,      SIST,      SIGS(6,15),      SIGSDE(3),
11960      +      STABLEX(33,6,15),      STABLEY(33,6,15)
11970      COMMON /COM10/      TAREA(3), TDIST(10,3),TIDLE,TIMEI(3,16),
11980      +      TINT,      TOBE(3),      TONX,      TOTE(3),      TPDB(3),      TPDT(3),
11990      +      TXTRA,      TSIZE,      TSIG(3),      TPER(16,15),      TMIL(16,15),
12000      +      THIST(5,3,16),      THISTF(3,16),      TIMEC(10,15),
12010      +      TIMEM(10,15),      TABLEX(33,10,15),      TABLEY(33,10,15)
12020      CC ADD10
12030      COMMON /COM11/      WF(10),
12040      +      X1BP(3,3,6), XINT,      XINTB,      XLANE,      XSUM, XCUR(10,3),
12050      +      ATM(16),      XBASE(9,3),YBASE(9,3)
12060      CC ADD11

```

Table 5-4 SUBROUTINE REGION1 LISTING (cont.)

12070		COMMON /COM12/	Y1BP(3,3,10),	Y2BP(3,3,10),		
12080	+	YES,	YSUM,	YTM(15),	YIDBP(4,4,10),	Y2DBP(4,4,10),
12090	+	Z1,	Z2,	Z3,	Z4,	Z5,
12100	+	Z7,	Z8,	Z9,	Z10,	Z11,
12110	+	Z13,	Z14,	Z15,	Z16,	Z17,
12120	+	ZCARI,	ZCARM,	ZIC,	ZSUM,	
12130	+	ZZ(3,3)				
12140		CC ADD12				
12150		COMMON /DEBUG/	ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
12160	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,
12170		CC ADDD				
12180		REAL	ITE,	ITL,	ITP,	ITIME,
12190	+	MMS,	MPH,	MSPEC,	MU,	MVPR,
12200	+	NAME,	NO,	LDEBUG,	MDEBUG,	
12210	+	IN,	MISFIRE			
12220		INTEGER	RNAME,	SITEI,	SITEM,	STAT,
12230	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK
12240	CC	DATA INITIALIZATION FOR LOS ANGELES				
12250		DO 1 K=1,3				
12260		DO 1 M=1,10				
12270		XCUT(M,K)=XCUTI(M,K)				
12280		TDIST(M,K)=TDST(M,K)				
12290		DO 1 L=1,9				
12300		ATABLEX(L,M,K)=ATABX(L,M,K)				
12310	1	ATABLEY(L,M,K)=ATABY(L,M,K)				
12320		DO 2 M=1,6				
12330		DO 2 K=1,3				
12340		SXCUT(M,K)=SXCUTI(M,K)				
12350		DO 2 L=1,9				
12360		ASTABLX(L,M,K)=ASTABX(L,M,K)				
12370	2	ASTABLY(L,M,K)=ASTABY(L,M,K)				
12380		DO 3 I=1,15				
12390		X(I)=X1(I)				
12400		ANNUAL(I)=ANNUA1(I)				
12410		DO 3 J=1,3				
12420		START(I,J)=START1(I,J)				
12430	3	CONTINUE				
12440	CC	L. A. BASIN				
12450		RSIZE=1250.				
12460		MPH=30.				
12470		CARPOP(1)=4.E6				
12480		SITEM=1000				

Table 5-4 SUBROUTINE REGION1 LISTING (cont.)

12490	EMW(1)=.6
12500	EMW(2)=.1
12510	EMW(3)=.3
12520	AMB(1)=0.01
12530	AMB(2)=3.4
12540	AMB(3)=0.4
12550	RETURN
12560	END

the total integrated yearly emission located in BAREA and TOBE .

All emission rates are stored in A, B and C matrices as differences from the starting values, START. Therefore, the A matrix is initialized to zero, representing the emission delta at the start of the first simulation time period. Emission rates are weighted by the vehicle population percentages generated in the attrition routines to obtain the total emission rates by species.

The major equations of BLINE are:

$$(1) \quad B = A + \frac{dE}{dM} \times \frac{dM}{dt} \times \Delta t \quad \text{M is mileage, t is time.}$$

Where: Emission rate at the end of the simulation period (B) equals that at the beginning (A) plus the deterioration rates times Δt .

$$(2) \quad C = B - \Delta P_B \times \frac{\partial E}{\partial t} \times \Delta t$$

Where: The post maintenance emission rate (C) equals B minus the effects of voluntary maintenance ΔE . ΔE is computed by summarizing the change in the parameter setting (ΔP_B) due to voluntary maintenance times the appropriate influence coefficient. Figure 5-5 presents the flowchart for subroutine BLINE and Table 5-5 the listing.

5.5 SUBROUTINE MICRO

Subroutine MICRO contains the logic for the inspection/maintenance model. MICRO contains the calling sequence to the supporting subroutines and generates a set of time histories and integrated averages for each emission species. MICRO sets up in the CN array the starting emission values and initializes the THIST and the THISTT arrays in which the emission time histories are eventually stored. The A matrix is initialized

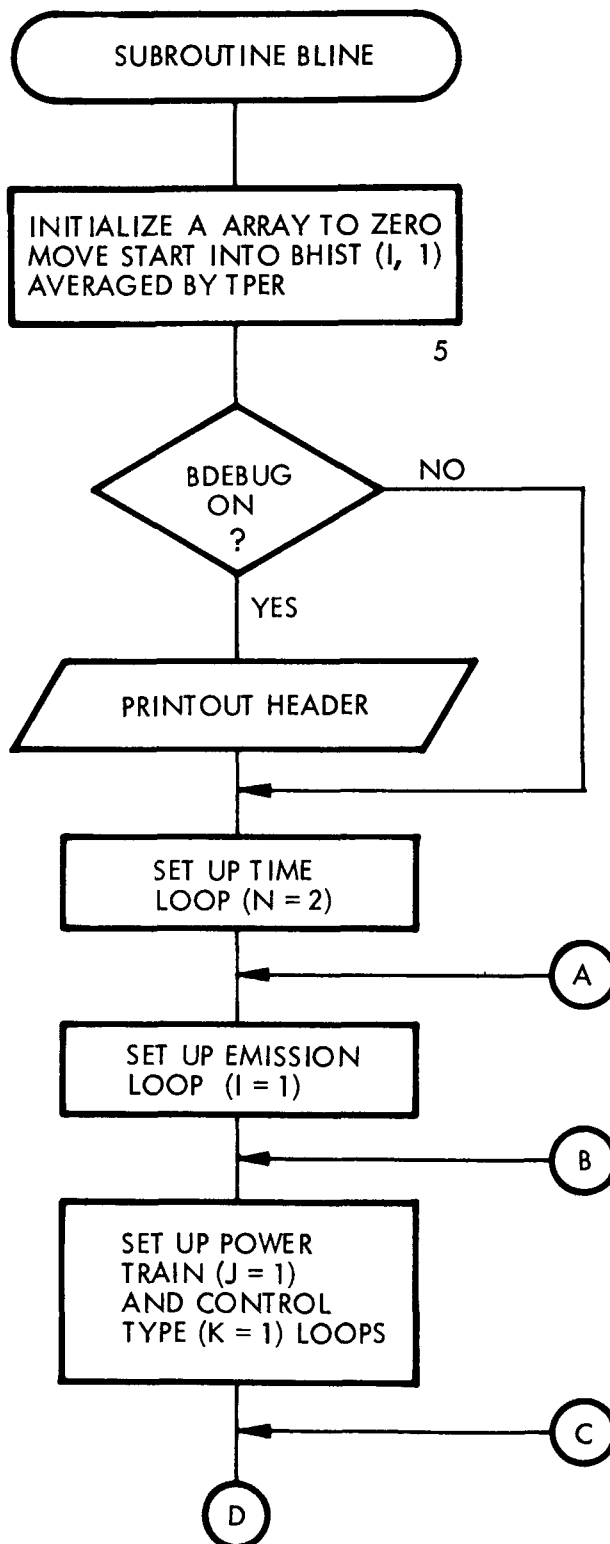


Figure 5-5 Subroutine BLINE Flowchart

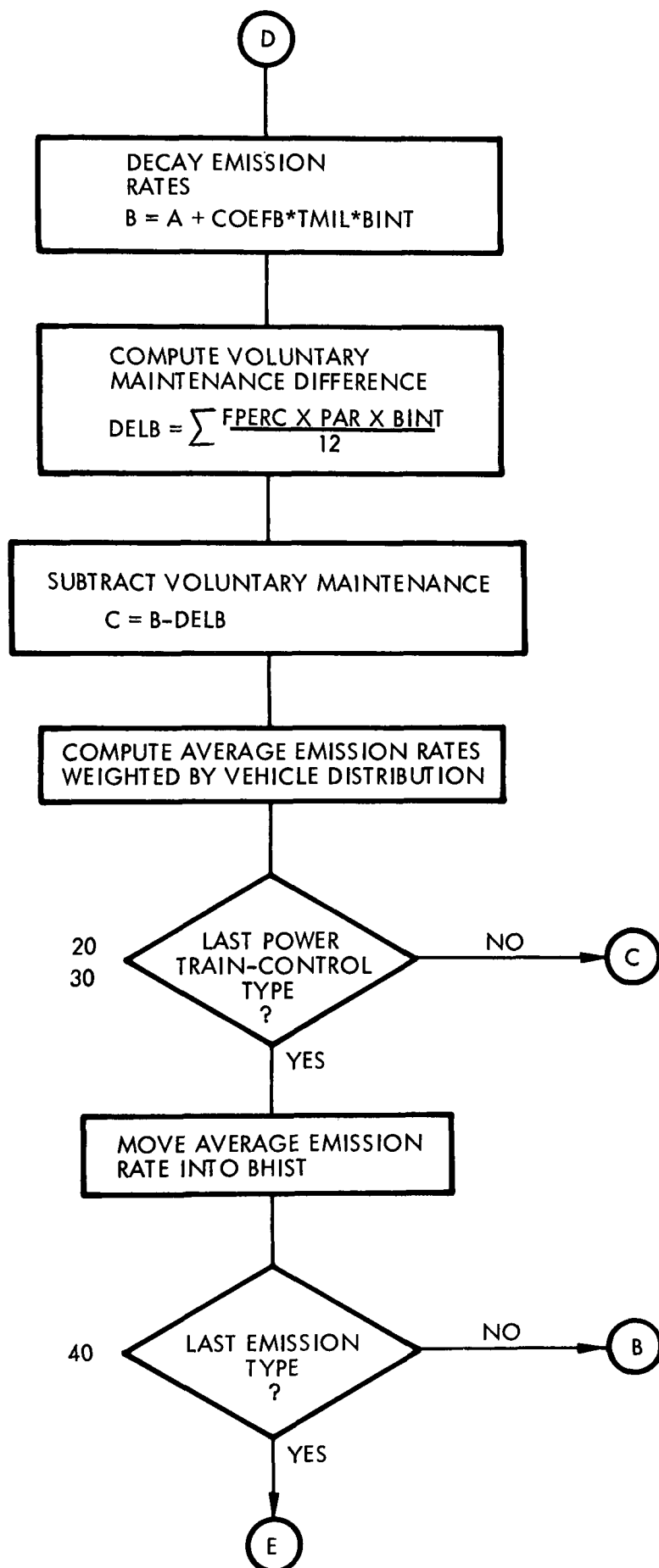


Figure 5-5 Subroutine BLINE Flowchart (cont.)

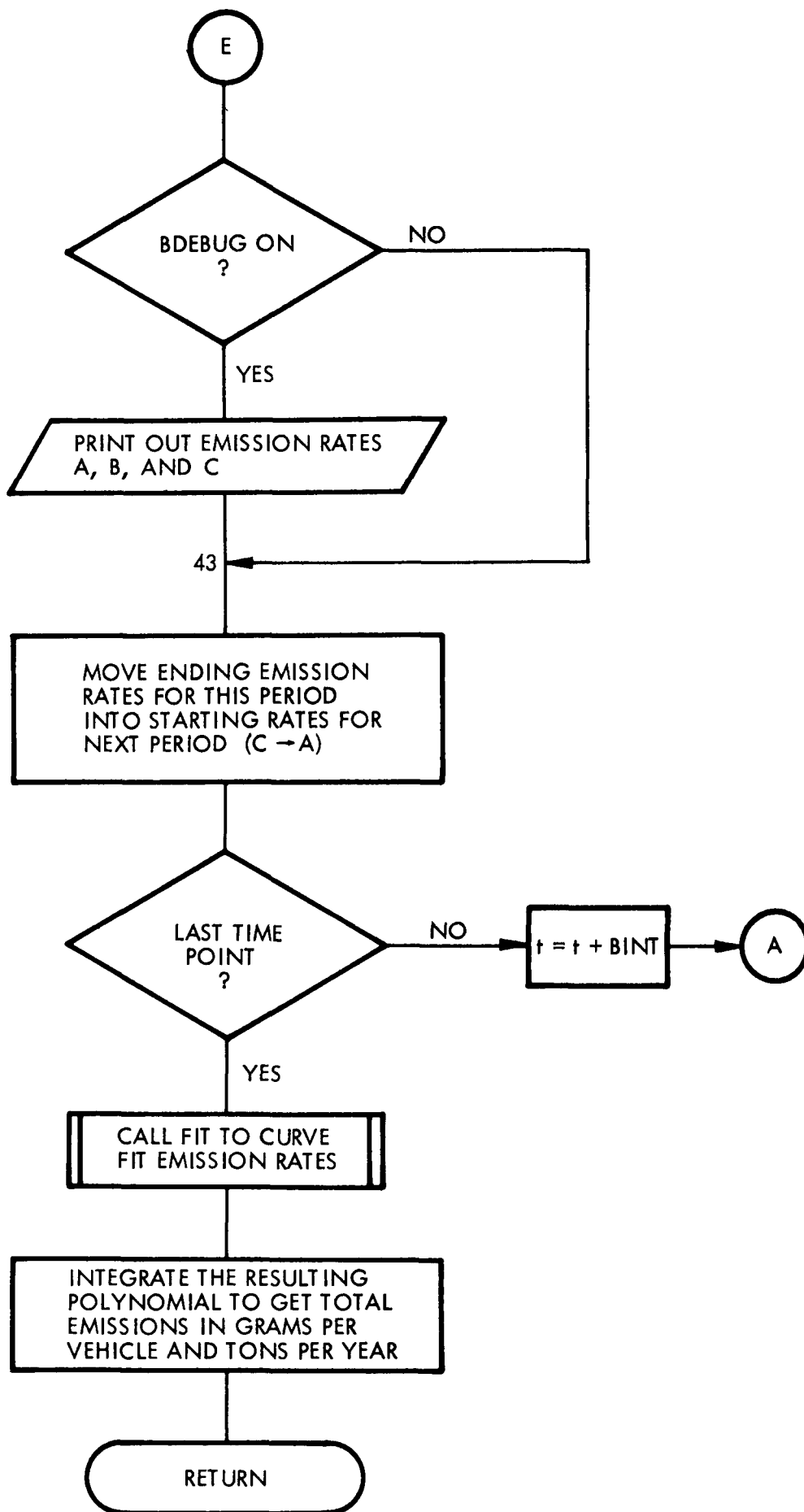


Figure 5-5 Subroutine BLINE Flowchart (cont.)

Table 5-5 SUBROUTINE BLINE LISTING

17080	SUBROUTINE BLINE				
17090	DIMENSION A(15,3),E(15,3),C(15,3)				
17100	COMMON /COM01/ AMB(3),ALAB, BINT,				
17110	+	EAREA(3), BLD1, BLD2, BSIG(3), BXTA, BSIZE,			
17120	+	BHIST(3,16),			
17130	+	ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)			
17140	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),				
17150	+	CARSY, CBSUM, CCCSTI, CCCSTM, CGTT,			
17160	+	CINCON, CPCE, CPI, CPVPY, CSLM, CARAY,			
17170	+	CN(15,3,16), CCEFB(15,3), CCEFBP(10,15),			
17180	+	CPART(10,15)			
17190	CC ACC2				
17200	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3T,				
17210	+	EMW(3), EP(10,15),EFF(10), DELIT(3),			
17220	+	FRECA, FREGE, FPERC(10,3),			
17230	+	FCRZN, HCRZNY,			
17240	+	FPC(15,16), FPCS(15,16), HPP(10,15,16),			
17250	+	HPS(6,15,16), HPT(5,16), HPTCT(16),			
17260	+	HPTCTS(16)			
17270	CC ACC3				
17280	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),				
17290	+	KSTART, KSTCF, LCPT, LPICK(10),LLPICK,			
17300	+	LIDLE, LINT(16), LPSP(10),LSTART, LSTCP,			
17310	+	MBASE, MPH, MSTART, MSTOP,			
17320	+	ML(10,3), MMS, MVPR(10,15)			
17330	CC ACC4				
17340	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,				
17350	+	NINTR, NINTRB, NMCDL, NC, NCPTS, NPAR,			
17360	+	NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(10),			
17370	+	CCYI, CCMY, OPTI, CPTM,CPTS(50),CVCHI(3),CVCHM(3)			
17380	CC ACC5				
17390	COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),				
17400	+	PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMCDL,			
17410	+	PP(10,15),PS(6,15), PI(5), PTOT, PTS(5), PAYADJ,			
17420	+	PAR(10,15,3), PARI(10,3,3), PLUS(10,15),			
17430	+	PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),			
17440	+	PSA(15), PTA(5), PCCNF, PARTINT(10,10,9)			
17450	+	,PAYFIN			
17460	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,				
17470	+	RTYPE,			
17480	+	SALE, SALL, SALP, SITEI, SITEM, SLANE,			

Table 5-5 SUBROUTINE BLINE LISTING (cont.)

```

1749C      +   SMODEL,   START(15,3), STAT,      STIME(3),
1750C      +   SCALEBM(3),      SM(6,15),      SPAR(10,15,6),
1751C      +   SXCLT(6,3),      SIG(10,3),      SIGCE(3),
1752C      +   SIGME(10),      SIGMNE(10),      SIGP(10,15),
1753C      +   SIGRATE,   SIST,      SIGS(6,15),      SIGSDE(3),
1754C      +   STABLEX(33,6,15),   STABLEY(33,6,15)
1755C      COMMON /CCM10/      TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),
1756C      +   TINT,      TCBE(3),   TCNX,      TOTTE(3),   TPCB(3),   TPDT(3),
1757C      +   TXTRA,      TSIZE,      TSIG(3),   TPER(16,15),   TMIL(16,15),
1758C      +   THIST(5,3,16),   THISTT(3,16),   TIMEC(10,15),
1759C      +   TIMEM(10,15),   TABLEX(33,10,15),   TABLEY(33,10,15)
1760C      CC ADD10
1761C      COMMON /CCM11/      WF(10),
1762C      +   XIBP(3,3,6), XINT,      XINTB,      XLANE,      XSUM, XCUT(10,3),
1763C      +   XTM(16),   XBASE(9,3), YBASE(9,3)
1764C      CC ADD11
1765C      COMMON /CCM12/      YIBP(3,3,10),      Y2BP(3,3,10),
1766C      +   YES,      YSUM,      YTM(16),      Y1DBP(4,4,10), Y2DBP(4,4,10),
1767C      +   Z1,      Z2,      Z3,      Z4,      Z5,      Z6,
1768C      +   Z7,      Z8,      Z9,      Z10,      Z11,      Z12,
1769C      +   Z13,      Z14,      Z15,      Z16,      Z17,
1770C      +   ZCARI,   ZCARM,      ZIC,      ZSUM,
1771C      +   ZZ(3,3)
1772C      CC ADD12
1773C      COMMON /DEBUG/      ADEBUG,   BDEBUG,   CDEBUG,   DDEBUG,
1774C      +   LDEBUG,   MDEBUG,   PDEBUG,   QDEBUG,   SDEBUG,   TDEBUG
1775C      CC ADDC
1776C      REAL      ITE,      ITL,      ITP,      ITIME,
1777C      +   FMS,      MPF,      MU,      MVPR,
1778C      +   NAME,   NC,      LDEBUG,   MDEBUG,
1779C      +   IN,      MISFIRE
1780C      INTEGER      RNAME,   SITEI,   SITEM,   STAT,
1781C      +   TCIST,   XLANE,   CPTI,   PPICK,   PPPICK
1782C      CC      *** BASELINE EMISSIONS
1783C      CC      EMISSION SPECIE --- FC,CC,NO --- NEMIS(I)
1784C      CC 5 I=1,NEMIS
1785C      BHIST(I,1)=0
1786C      CC 4 JJ=1,NPTRN
1787C      CC 4 K=1,NCNTR
1788C      J=JJ+5*(K-1)
1789C      A(J,I)=0.
1790C      BHIST(I,1)=BHIST(I,1)+START(J,I)*TPER(1,J)

```

Table 5-5 SUBROUTINE BLINE LISTING (cont.)

17910	4	CCNTINUE
17920	5	CCNTINUE
17930		IF(EEBUG.EQ.YES) WRITE (6,500)
17940	500	FORMAT(1H1,10(/),35X,50(1H*))//,45X,
17950		+ *START OF THE BASELINE*/50X,*FLEET ANALYSIS*//
17960		+ 35X,50(1H*))
17970		DC 50 N=2,NTRB
17980	C:	
17990	C:	ADJUST EMISSION MEANS FOR INCOMING NEW CARS.
18000	C:	10.8 PERCENT OF THE FLEET IS NEW EACH YEAR.
18010	C:	
18020		IF(N.EQ.2) GOTO 24
18030		DO 23 JJ=1,NPTRN
18040		J=JJ+10
18050		DO 23 I=1,3
18060		IF(TPER(N,J).LT.C.108/5.) GOTO 23
18070		IF(A(J,I).LE.0.) GOTO 23
18080	C:	
18090	C:	THE A ARRAY IS A DELTA E ARRAY. THEREFORE, THE
18100	C:	STARTING VALUE IS ZERO.
18110	C:	
18120		A(J,I)=A(J,I)*(TPER(N-1,J)-.108/5.)/TPER(N-1,J)
18130	23	CCNTINUE
18140	24	CCNTINUE
18150		DO 40 I=1,NEMIS
18160		SUMJ=C.
18170		DO 30 JJ=1,NPTRN
18180		DO 20 K=KSTART,KSTOP
18190		J=JJ+5*(K-1)
18200		E(J,I)=A(J,I)+CCEFE(J,I)*TML(N,J)*BINT
18210		DELB=C.
18220		DO 10 M=1,NPAR
18230		DELB=DELB+FPERC(M,K)*PAR(M,J,I)*BINT/12.
18240	10	CCNTINUE
18250		C(J,I)=B(J,I)-DELB
18260		SUMJ=SUMJ+(B(J,I)+C(J,I)+2.*START(J,I))/2.*TPER(N,J)
18270	20	CCNTINUE
18280	30	CCNTINUE
18290		BHIST(I,N)=SUMJ
18300	40	CCNTINUE
18310		IF(EEBUG.EQ.NO) GO TO 43
18320		WRITE (6,42) N

Table 5-5 SUBROUTINE BLINE LISTING (cont.)

18330		SYSTEMS	
18340	42	FORMAT(1H1,40X,*TIME HISTORY POINT *,13,* --- *,	
18350		+ 2X,*BASELINE*,/)	
18360		CALL PRINT2(A,	
18370		+ 50FEMISSION DELTA BEFORE DECAY	
18380		+ ,B,50FEMISSION DELTA AFTER DECAY	
18390		+ ,C,50FEMISSION DELTA AFTER MAINTENANCE	
18400	43	DO 45 I=1,NEMIS	
18410		DO 45 JJ=1,NPTRN	
18420		DO 45 K=1,ACNTR	
18430		J=JJ+5*(K-1)	
18440	45	A(J,I)=C(J,I)	
18450	50	CONTINUE	
18460		DO 100 I=1,NEMIS	
18470		CALL FIT(BHIST,NTRB,AA1,AA2,AA3,I)	
18480		BAREA(I)=(AA1*XINTB+AA2*XINTB**2/2.+AA3*XINTB**3/3.)*	
18490		+ MEASE*BINT	
18500		TCBE(I)=BAREA(I)*CARPOP(16)/CGTT	
18510	100	CONTINUE	
18520		RETURN	
18530		END	

to zero then represents the starting emission values (emission values in the A, B and C arrays are stored as differences from the starting value). Next, MICRO initializes the N loop, from 2 to NTR, where NTR is the number of inspection intervals. If the LPICK flag A is "turned on", MICRO calls OPTMUM to compute the optimal parameter cutpoints for an inspection/maintenance program. MICRO then adjusts the average emission rates to reflect new cars entering the population and starts the actual inspection/maintenance simulation.

Simulation of the inspection/maintenance process begins with the parameter deterioration routine which adjusts the engine parameters distributions based on parameter deterioration over time. MICRO then calls EDECAY to similarly deteriorate the vehicle emission levels. Subroutine TEST, which simulates the actual inspection process, is called next. TEST computes rejection rates and mean value of rejected parameters for each subfleet in the population. Subroutine TEST also calls the PMAINT routine which adjusts parameter distributions to account for mandatory maintenance. MICRO next calls MAINT which computes the actual emission reduction achieved due to the maintenance treatment.

MICRO then outputs these calculations, based on appropriate flags and updates the emission arrays. This is done by moving the BM array which represents the post maintenance emission rates back into the A array. The time value is incremented and, if the NPICT flag is set, the statistical routines are executed and MICRO proceeds to the next inspection interval.

After simulating the inspection/maintenance process over its entire time horizon, MICRO calls FIT to curve fit the emission time histories

using a second degree polynomial. This polynomial is integrated to obtain total yearly emissions for the program. The mandatory and voluntary emission time histories are plotted by calling subroutine PLOT. Figure 5-6 contains a flowchart of MICRO and Table 5-6 a listing.

5.6 SUBROUTINE TEST

Subroutine TEST contains the logic and algorithms for performing a mandatory inspection on a vehicle population. Input to TEST are indices JJ and N, where JJ is the parameter power train type and N is the inspection interval number. TEST initializes the appropriate variables to zero and branches on inspection type. For a parameter inspection, TEST computes the expected value of rejected parameters by calling AREA with the first argument equal to one and the expected rejection rates by calling AREA with the first argument equal to zero. TEST also calls PMAINT which updates the parameter distributions. For an Emission Inspection, TEST computes the rejection rate based on the mode emission distributions and specified cutpoints. These values are then used to adjust the parameter distributions. Subroutine TEST then computes, for both parameter and emission cases, the total overall rejection rate for the vehicle population (i.e., number of cars that failed). Subroutine TEST also computes various cost information and prints out all computations when the TDEBUG flag is set to YES. TEST returns control to subroutine MICRO.

Output from subroutine TEST consists of the average rejection rates, mean value of the rejected parameters, and new post maintenance parameter distributions for each of the six distributed parameters. Figure 5-7 contains a flowchart of TEST and Table 5-7 a Listing.

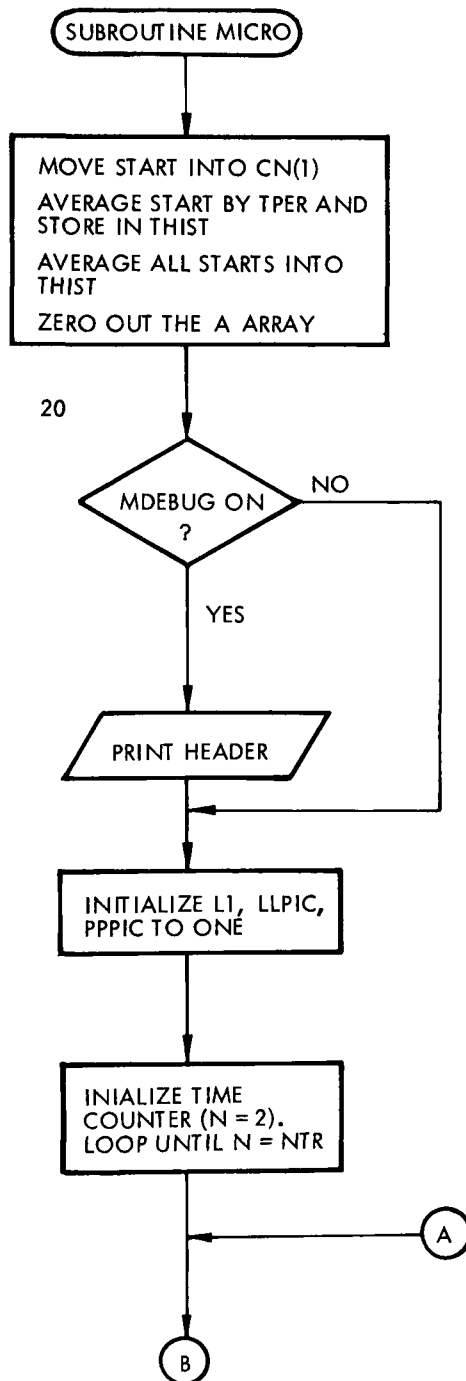


Figure 5-6 Subroutine MICRO Flowchart

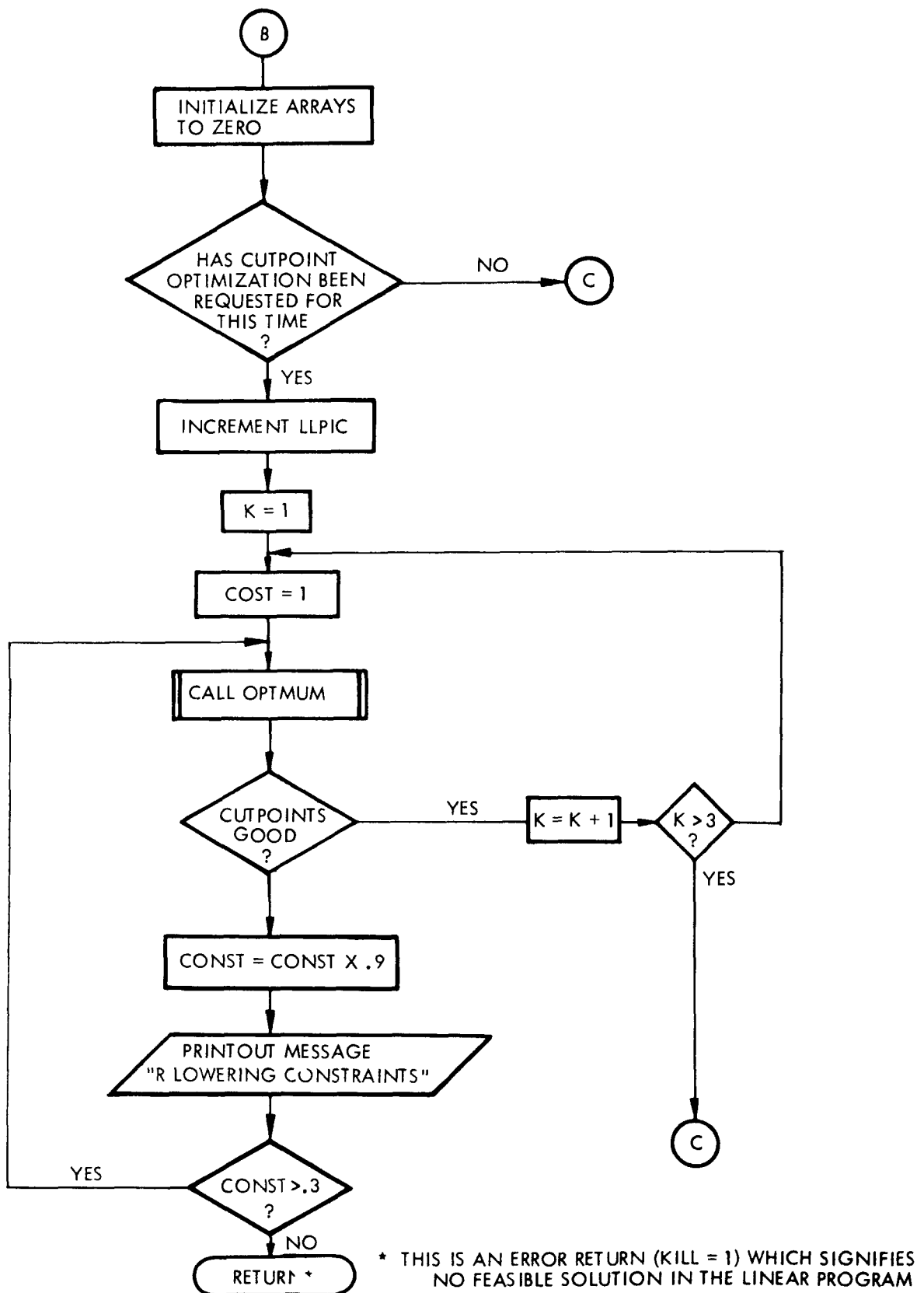


Figure 5-6 Subroutine MICRO Flowchart (cont.)

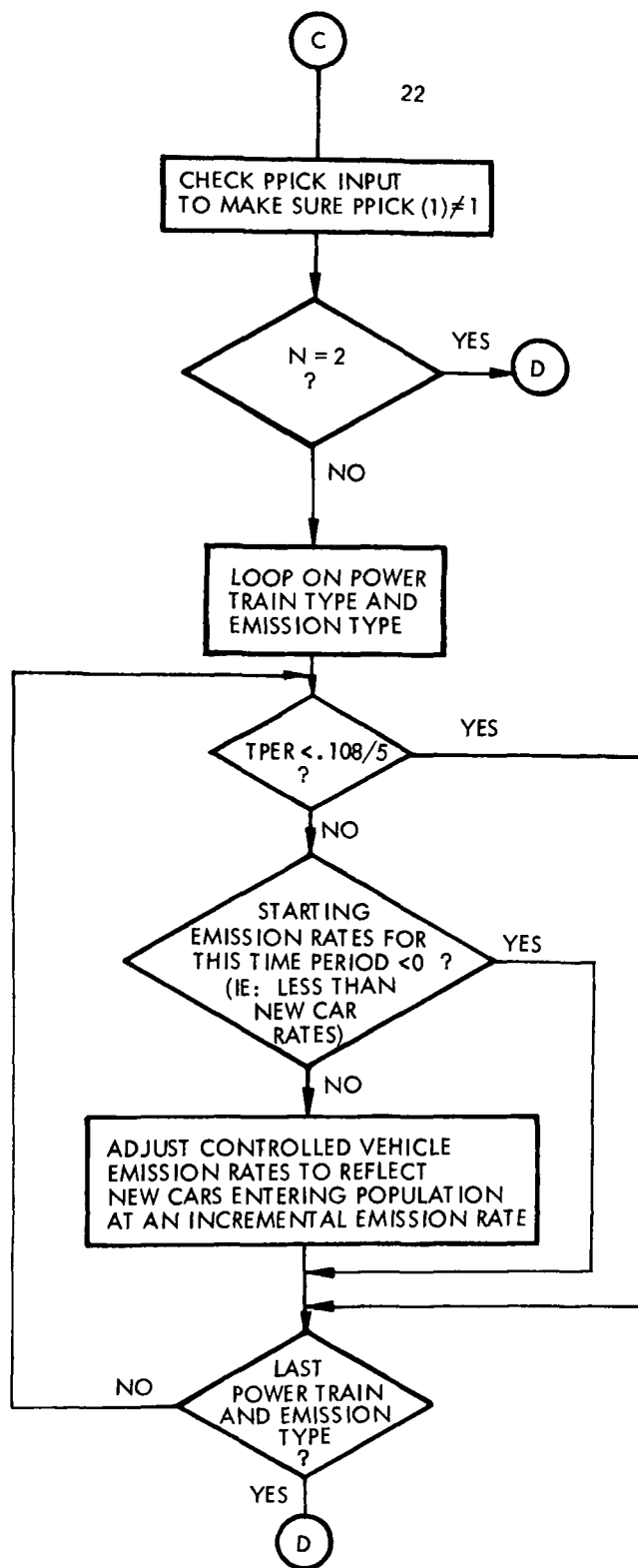


Figure 5-6 Subroutine MICRO Flowchart (cont.)

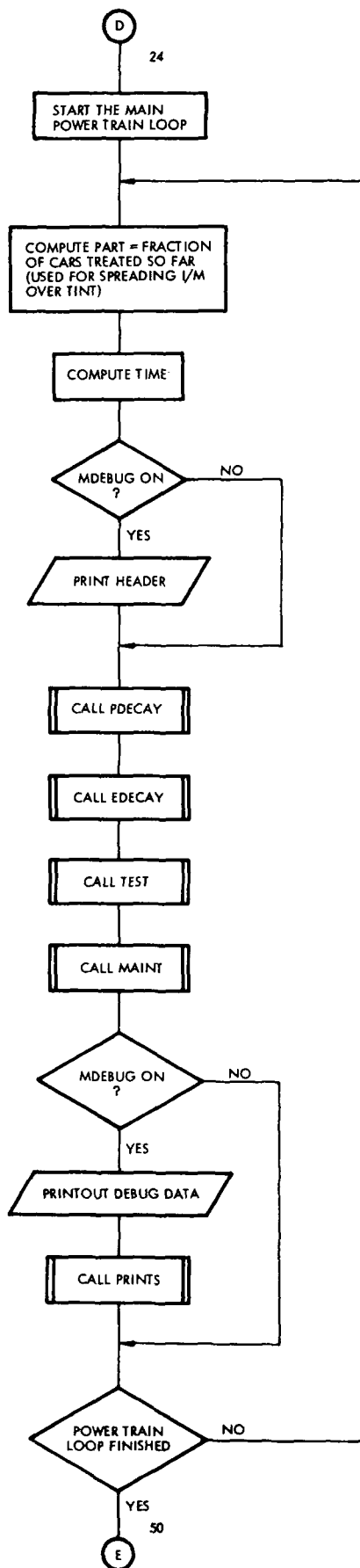


Figure 5-6 Subroutine MICRO Flowchart (cont.)

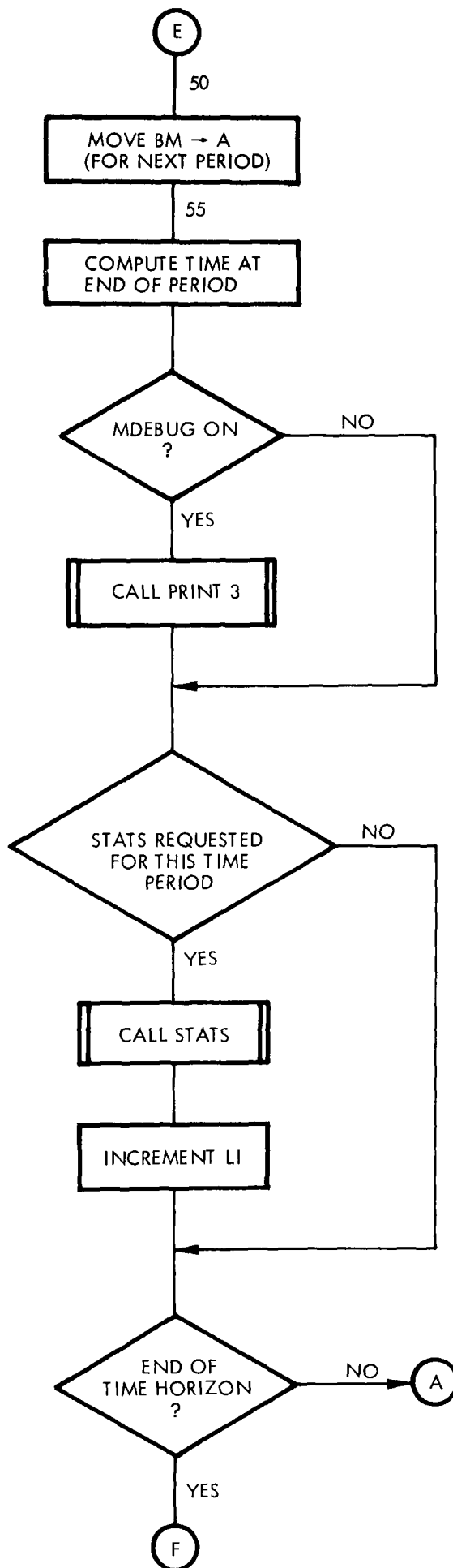


Figure 5-6 Subroutine MICRO Flowchart (cont.)

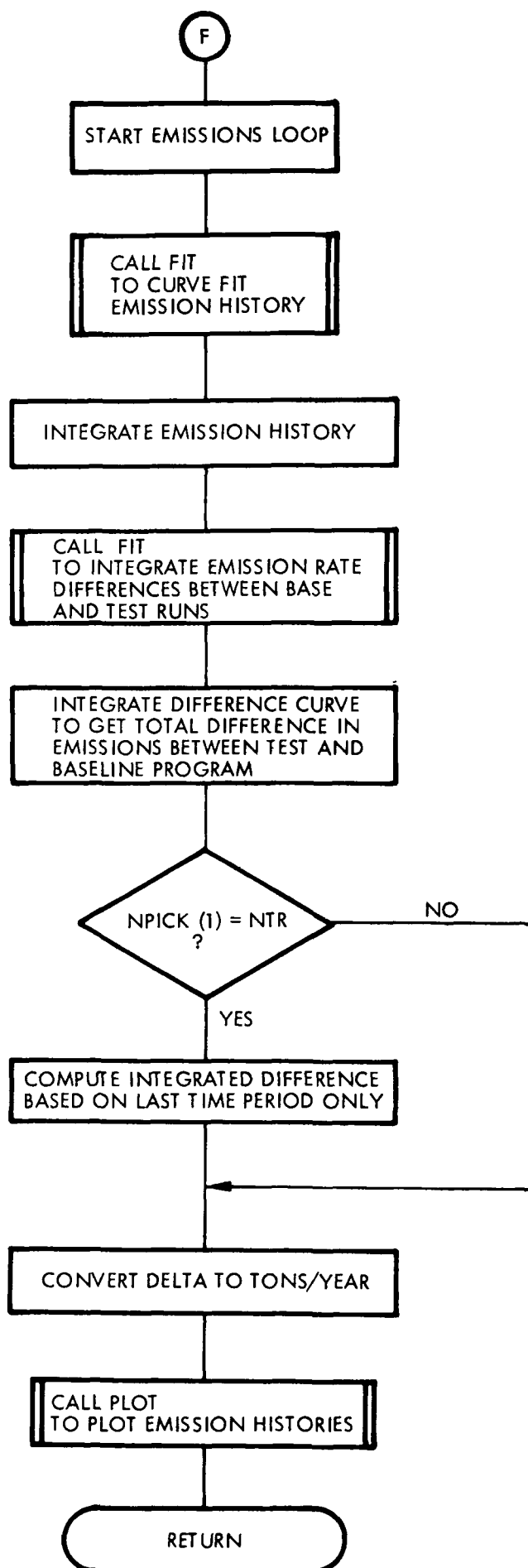


Figure 5-6 Subroutine MICRO Flowchart (cont.)

Table 5-6 SUBROUTINE MICRO LISTING

18420	SUBROUTINE MICRO (KILL)	
18430	DIMENSION A(15,3),B(15,3),BM(15,3)	
18440	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,	
18450	+	BAREA(3), BLD1, BLD2, BSIG(3), BXTA, BSIZE,
18460	+	BHIST(3,16), BMMI(10,15,3),
18470	+	ATABLEX(9,10,3), ATABLEY(9,10,3), ASTABLX(9,6,3), ASTABLY(9,6,3)
18480	COMMON /COM02/ CARA, CARIY, CAFMY, CARPOP(16),	
18490	+	CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
18500	+	CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
18510	+	CN(15,3,16), COEFB(15,3), COEFBP(10,15),
18520	+	CPART(10,15)
18530	CC ADD2	
18540	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),	
18550	+	EMW(3), EP(10,15),EFF(10), DELIT(3),
18560	+	FREQA, FREQB, FPERC(10,3),
18570	+	HORZN, HORZNY,
18580	+	HPC(15,16), HPCS(15,16), HPP(10,15,16),
18590	+	HPS(6,15,16), HPT(5,16), HPTDT(16),
18600	+	HPTCTS(16)
18610	CC ADD3	
18620	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),	
18630	+	KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
18640	+	LIDLE, LINT(16), LPSPP(10),LSTART, LSTOP,
18650	+	MBASE, MPH, MSPEC(10),MSTART, MSTOP,
18660	+	MU(10,3), MMS(10,15), MVPR(10,15)
18670	CC ADD4	
18680	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,	
18690	+	NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
18700	+	NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
18710	+	DCIY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
18720	CC ADD5	
18730	COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),	
18740	+	PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
18750	+	PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
18760	+	PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
18770	+	PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
18780	+	PSA(15), PTA(5), PCONF, PARINT(10,10,9)
18790	+	,PAYFIN
18800	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,	
18810	+	RTYPE,
18820	+	SALE, SALL, SALP, SITEI, SITEM, SLANE,

Table 5-6 SUBROUTINE MICRO LISTING (cont.)

```

18830      +   SMODEL,   START(15,3), STAT,      STIME(3), SUMRM(3),
18840      +   SCALEM(3),      SM(6,15),      SPAR(10,15,6),
18850      +   SXOUT(6,3),      SIG(10,3),      SIGCE(3),
18860      +   SIGME(10),      SIGMNE(10),      SIGP(10,15),
18870      +   SIGRATE, SIST,      SIGS(6,15),      SIGSDE(3),
18880      +   STABLEX(33,6,15), STABLEY(33,6,15)
18890      COMMON /COM10/
18900      +   TINT,      TOBF(3), TONX,      TOTE(3), TPDB(3), TPOT(3),
18910      +   TXTRA,      TSIZE,      TSIG(3), TPER(16,15), TMIL(16,15),
18920      +   THIST(5,3,16), THISTT(3,16),      TIMEC(10,15),
18930      +   TIMEM(10,15), TABLEX(33,10,15), TABLEY(33,10,15)
18940      CC ADD10
18950      COMMON /COM11/      VF(10),
18960      +   XIBP(3,3,6), XINT,      XINTB,      XLANE,      XSUM, XCUT(10,3),
18970      +   XTM(16), XBASE(9,3), YBASE(9,3)
18980      CC ADD11
18990      COMMON /COM12/      YIBP(3,3,10),      Y2BP(3,3,10),
19000      +   YES,      YSUM,      YTM(16),      Y1DBP(4,4,10), Y2DBP(4,4,10),
19010      +   Z1,      Z2,      Z3,      Z4,      Z5,      Z6,
19020      +   Z7,      Z8,      Z9,      Z10,      Z11,      Z12,
19030      +   Z13,      Z14,      Z15,      Z16,      Z17,
19040      +   ZCARI,      ZCARM,      ZIC,      ZSUM,
19050      +   ZZ(3,3)
19060      CC ADD12
19070      COMMON /DEBUG/      ADEBUG,      BDEBUG,      CDEBUG,      DDEBUG,
19080      +   LDEBUG,      MDEBUG,      PDEBUG,      QDEBUG,      SDEBUG,      TDEBUG
19090      CC ADD0
19100      REAL      ITE,      ITL,      ITP,      ITIME,
19110      +   MMS,      MPH,      MSPEC,      MU,      MVPR,
19120      +   NAME,      NO,      LDEBUG,      MDEBUG,
19130      +   IN,      MISFIRE
19140      INTEGER      RNAME,      SITEI,      SITEM,      STAT,
19150      +   TDIST,      XLANE,      OPTI,      PPICK,      PPPICK
19160      THISTT(1,1)=THISTT(2,1)=THISTT(3,1)=0.
19170      DO 20 I=1,NEMIS
19180      DO 20 JJ=1,NPTRN
19190      TH=0
19200      T=0
19210      DO 10 K=1,NCNTR
19220      J=JJ+5*(K-1)
19230      CN(J,I,1)=START(J,I)
19240      TH=TH+START(J,I)*TPER(1,J)

```

Table 5-6 SUBROUTINE MICRO LISTING (cont.)

```

19250      T=T+TPER(1,J)
19260      10  CONTINUE
19270      THIST(JJ,1,1)=TH/T
19280      THISTT(1,1)=THISTT(1,1)+THIST(JJ,1,1)*(TPER(1,JJ)
19290      + +TPER(1,JJ+5)+TPER(1,JJ+10))
19300      DO 20 K=1,NCNTR
19310      J=JJ+5*(K-1)
19320      A(J,1)=0.
19330      20  CONTINUE
19340      IF(MDEBUG.FQ.YES) WRITE (6,505)
19350      505  FORMAT(1H1,10(/),35X,50(1H*)//,45X,*START OF THE*,
19360      + * TESTING CYCLES*,/45X,*DECAY - TEST - MAINT*//
19370      + 35X,50(1H*))
19380      L1=1
19390      LLPICK=1
19400      PPPICK=1
19410      DO 100 N=2,NTR
19420      XTM(N)=YTM(N)=PART=THISTT(1,N)=THISTT(2,N)=THISTT(3,N)=0.
19430      HPTOT(N)=HPTOTS(N)=0.
19440      C:
19450      C:      CUTPOINT OPTIMIZATION WITH LINPRO.
19460      C:
19470      IF(N.NE.LPICK(LLPICK)) GOTO 22
19480      LLPICK=LLPICK+1
19490      DO 21 K=1,3
19500      CONST=1.0
19510      15  CALL OPTMUM (K,KILL,N,CONST)
19520      IF(KILL.NE.1) GOTO 21
19530      CONST=CONST*0.9
19540      WRITE(6,998)
19550      998  FORMAT(/* NO FEASIBLE SOL. LOWERING CONSTRAINTS.*/)
19560      IF(CONST.GE.0.3) GOTO 15
19570      RETURN
19580      21  CONTINUE
19590      22  CONTINUE
19600      IF(N.GT.PPICK(PPPICK)) PPPICK=PPPICK+1
19610      C:
19620      C:      ADJUST EMISSION MEANS FOR INCOMING NEW CARS.
19630      C:      10.8 PERCENT OF THE FLEET IS NEW EACH YEAR.
19640      C:
19650      IF(N.EQ.2) GOTO 24
19660      DO 23 JJ=1,NPTRN

```

Table 5-6 SUBROUTINE MICRO LISTING (cont.)

```

19670      J=JJ+10
19680      DO 23 I=1,3
19690      IF(TPER(N,J).LT.0.108/5.) GOTO 23
19700      IF(A(J,I).LE.0.) GOTO 23
19710      C:
19720      C:      THE A ARRAY IS A DELTA E ARRAY.  THERFORE, THE
19730      C:      STARTING VALUE IS ZERO.
19740      C:
19750      A(J,I)=A(J,I)*(TPER(N-1,J)-.108/5.)/TPER(N-1,J)
19760      23  CONTINUE
19770      24  CONTINUE
19780      DO 50 JJ=1,NPTRN
19790      C:
19800      C:      START THE POWER TRAIN LOOP.
19810      C:
19820      PART=PART+TPER(1,JJ)+TPER(1,JJ+5)+TPER(1,JJ+10)
19830      TIME=TINT*(N-2+PART)
19840      IF(MDEBUG.EQ.YES) WRITE (6,25) TIME
19850      CALL PDECAY(JJ,N)
19860      CALL EDECAY(A,B,JJ,N)
19870      CALL TEST(JJ,N)
19880      CALL MAINT(B,BM,JJ,N)
19890      25  FORMAT(1H1,40X,*DEBUG -- MICRO*//38X,*TIME DURATION IS *,
19900      + F5.1* MONTHS*)
19910      IF(MDEBUG.EQ.NO) GO TO 50
19920      WRITE (6,30) NAME(JJ+10)
19930      30  FORMAT(1H1,40X,A3//,
19940      +/,35X,*A -- EMISSION DELTA BEFORE DECAY*/
19950      + 35X,*B -- EMISSION DELTA AFTER DECAY*/,35X,
19960      + *C -- EMISSION DELTA AFTER DECAY AND MAINTENANCE*/)
19970      DO 40 I=1,NEMIS
19980      WRITE (6,35) NAME(1),NAME(4),NAME(5),NAME(6),
19990      + A(JJ,I),A(JJ+5,I),A(JJ+10,I),B(JJ,I),B(JJ+5,I),
20000      + B(JJ+10,I),BM(JJ,I),BM(JJ+5,I),BM(JJ+10,I)
20010      35  FORMAT(/,40X,A2,* EMISSION DELTA*,/,
20020      + /,26X,A8,12X,A8,12X,A8,/,18X,*A *,3(5X,E15.4),
20030      + /,18X,*B *,3(5X,E15.4)/,18X,*C *,3(5X,E15.4)/)
20040      40  CONTINUE
20050      IF (RTYPE.EQ.SMODEL) CALL PRINT5(
20060      + SM,50HMEAN VALUE OF THE MODE EMISSIONS
20070      + ,SIGS,50HSIGMA VALUES OF THE MODE EMISSIONS
20080      + )

```

Table 5-6 SUBROUTINE MICRO LISTING (cont.)

```

20090          50  CONTINUE
20100          NN=3*NPTRN
20110          DO 55 J=1,NN
20120          DO 55 I=1,NEMIS
20130          55  A(J,I)=BM(J,I)
20140          TIME=TINT*(N-1)
20150          N1=N-1
20160          IF(MDEBUG.EQ.YES) CALL PRINT3(
20170          + PM,50HPM - PARAMTER MEAN VALUES AFTER PDECAY
20180          + ,PLUS,50HPLUS -- PARAMETER CHANGE -- DECAY AND MAINT
20190          + )
20200          IF(N.NE.NPICK(L1)) GO TO 100
20210          L1=L1+1
20220          CALL STATS(N,1)
20230          100  CONTINUE
20240          DO 150 I=1,NEMIS
20250          CALL FIT(THISTT,NTR,CC1,CC2,CC3,I)
20260          TAREA(I)=(CC1*XINT+CC2*XINT**2/2.+CC3*XINT**3/3.)*
20270          *TINT*MBASE
20280          CALL FIT(DELEM,NTR,DD1,DD2,DD3,I)
20290          DELI(I)=(DD1*XINT+DD2*XINT**2/2.+
20300          + DD3*XINT**3/3.)*TINT*MBASE*CARPOP(16)
20310          IF(NPICK(1).EQ.NTR) DELI(I)=DELEM(I,NTR)*MBASE*TINT*CARPOP(NTR)
20320          DELIT(I)=DELI(I)/CGTT
20330          CALL PLOT(THISTT,BHIST,NTR,TXTRA,7,0,TINT,0.,PLTMAX(I),I)
20340          150  CONTINUE
20350          999  FORMAT(1H1)
20360          RETURN
20370          END

```

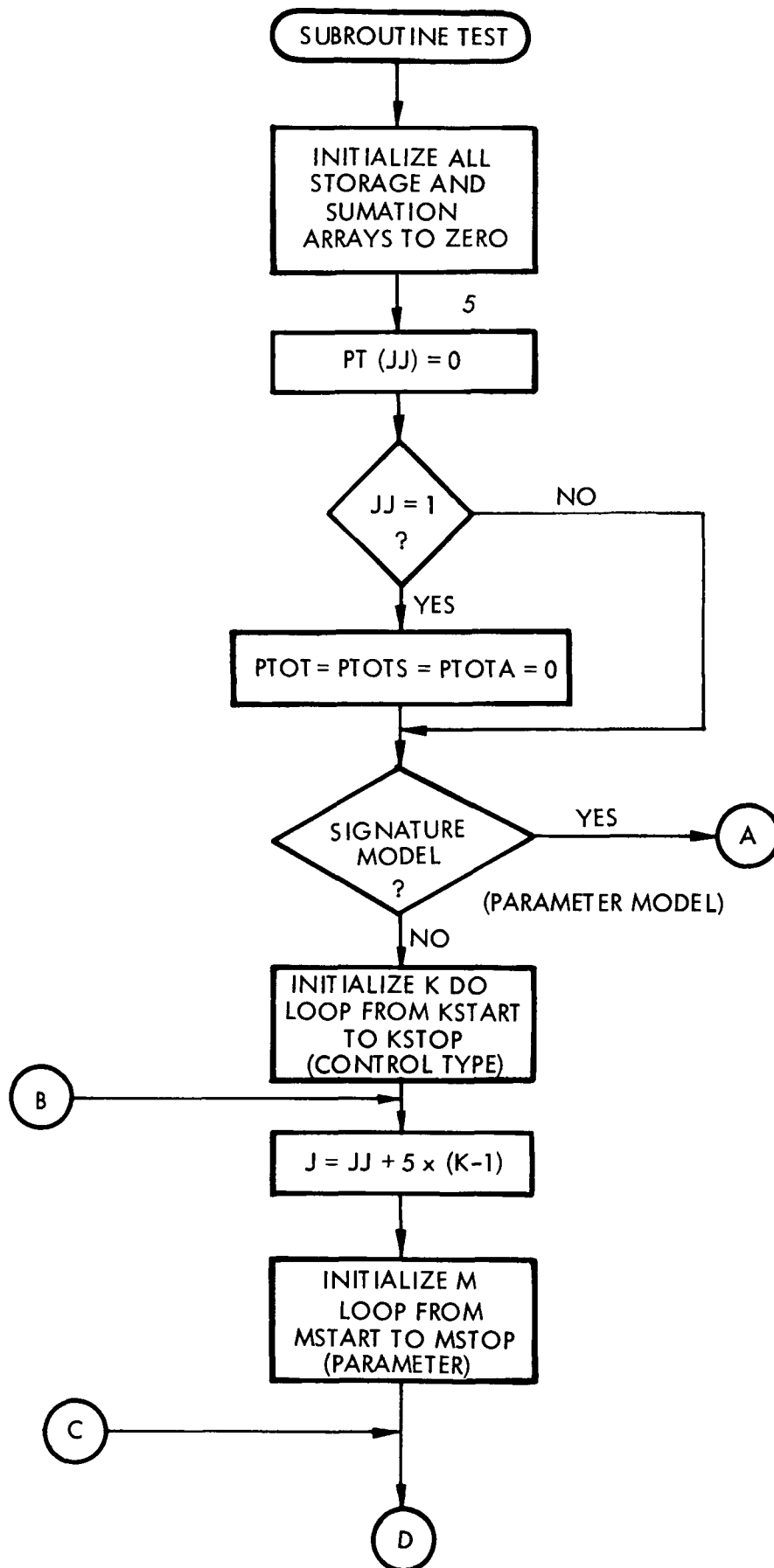


Figure 5-7 Subroutine TEST Flowchart

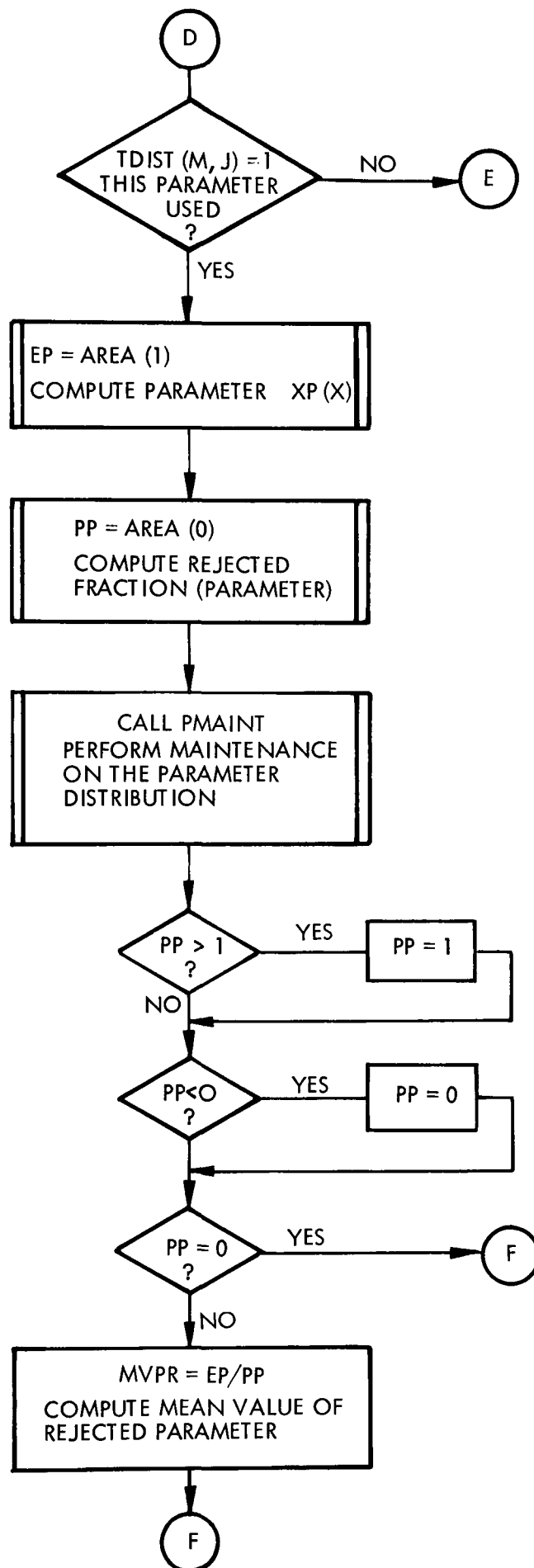


Figure 5-7 Subroutine TEST Flowchart (cont.)

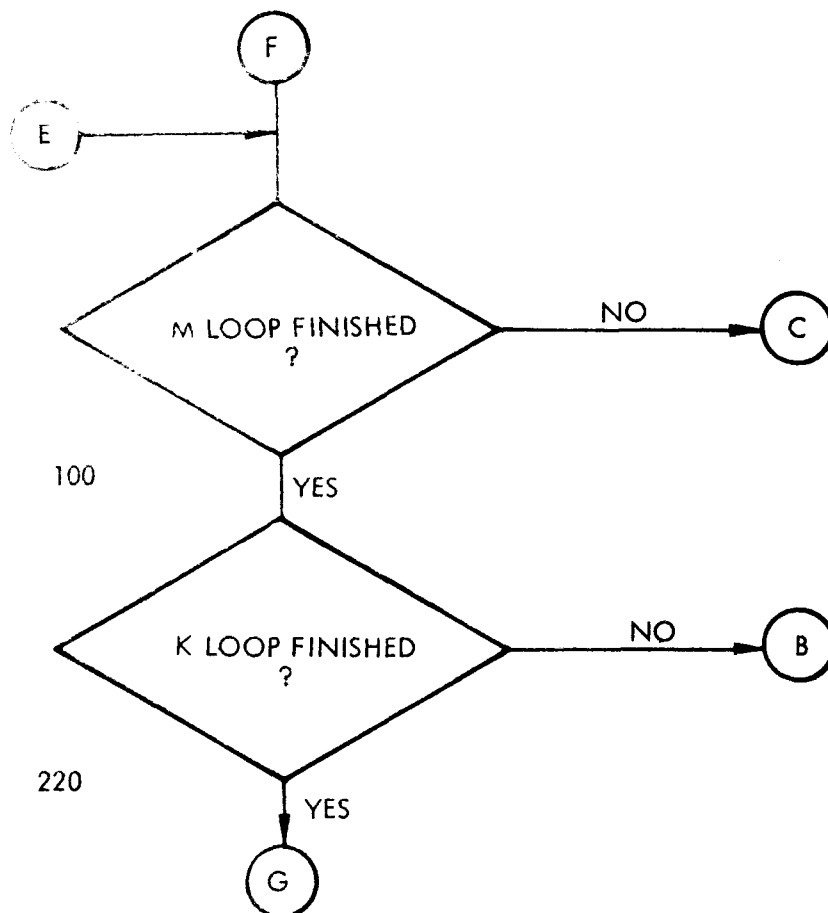


Figure 5-7 Subroutine TEST Flowchart (cont.)

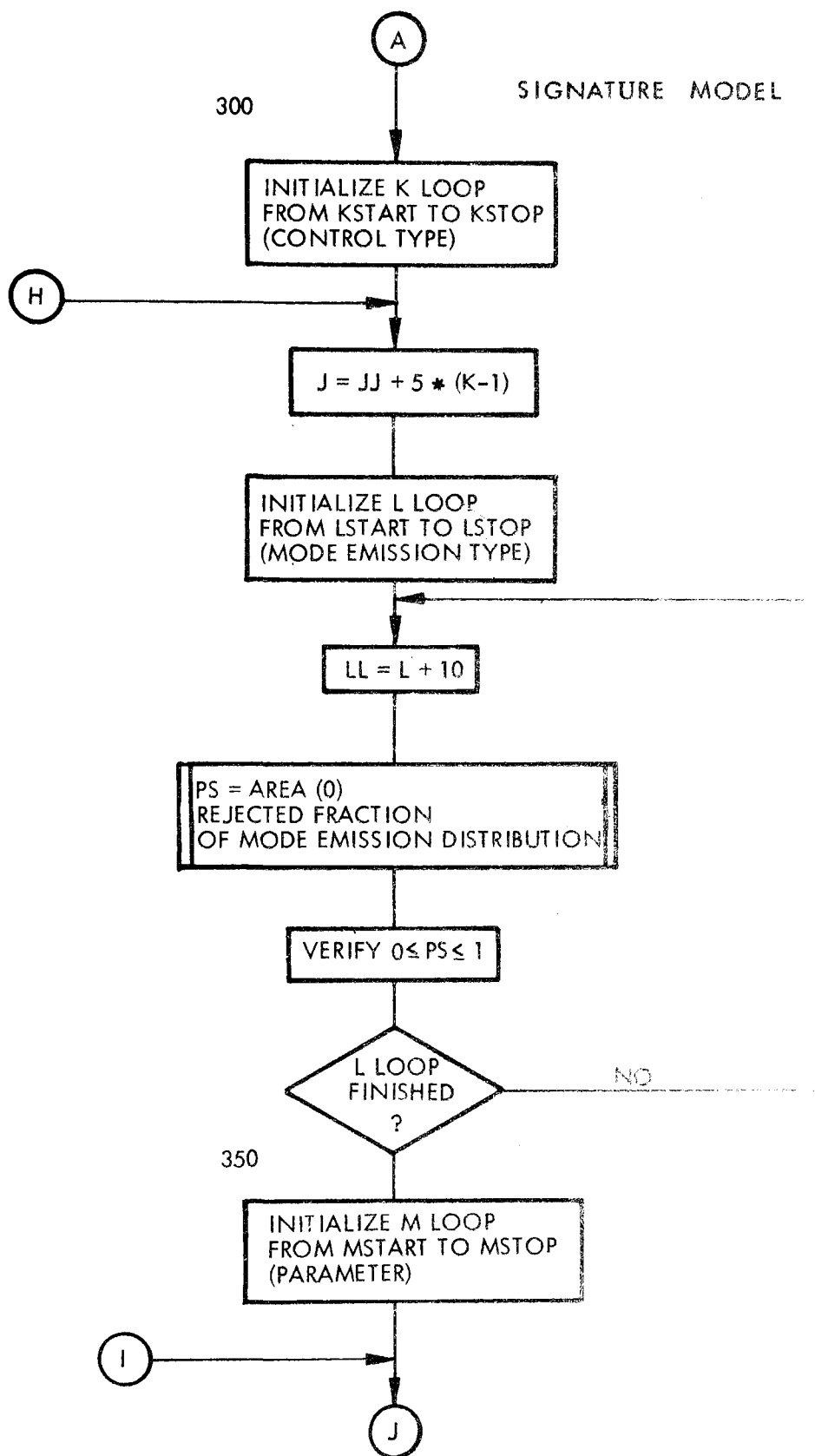


Figure 5-7 Subroutine TEST Flowchart (cont.)

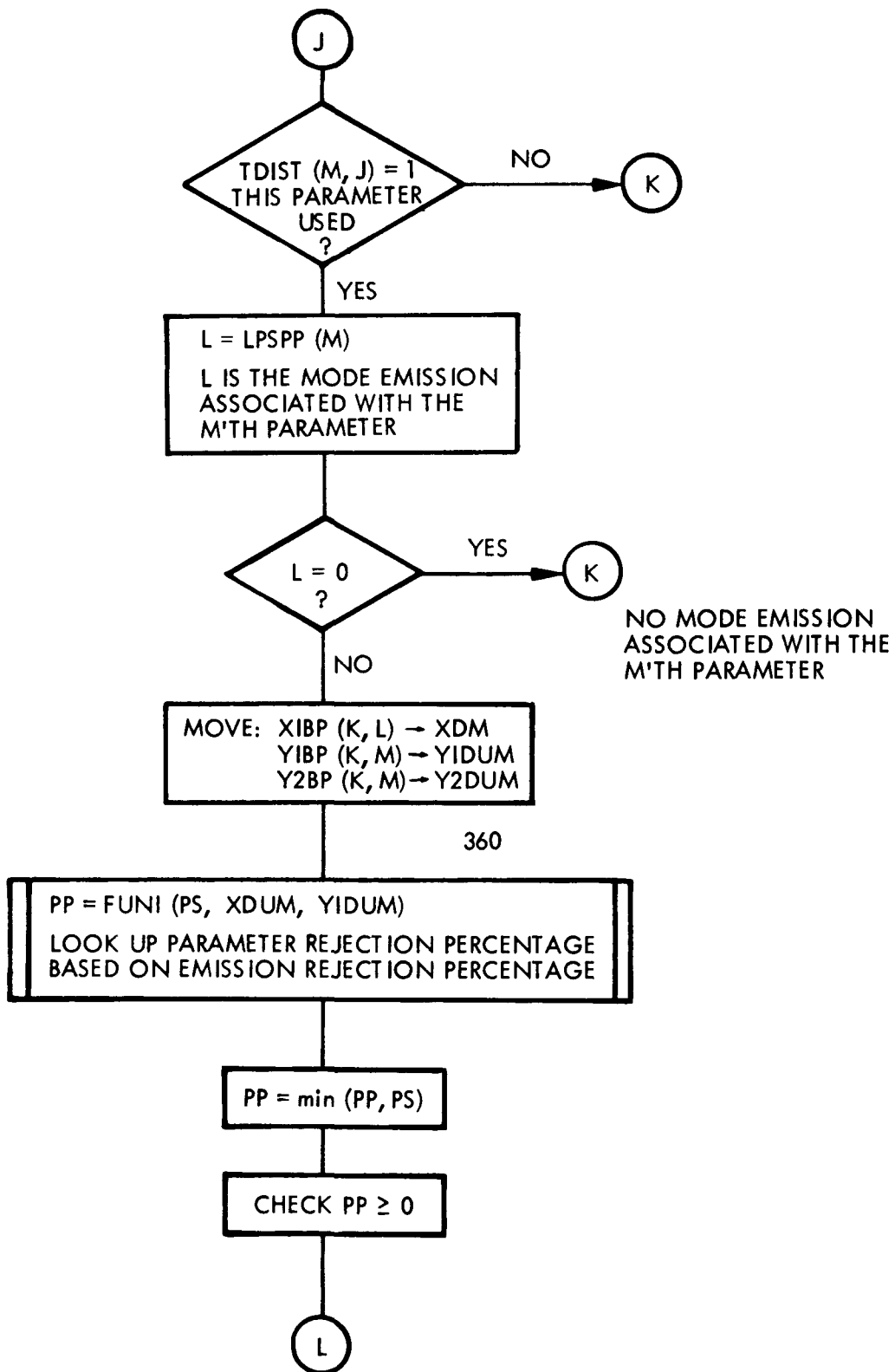


Figure 5-7 Subroutine TEST Flowchart (cont.)

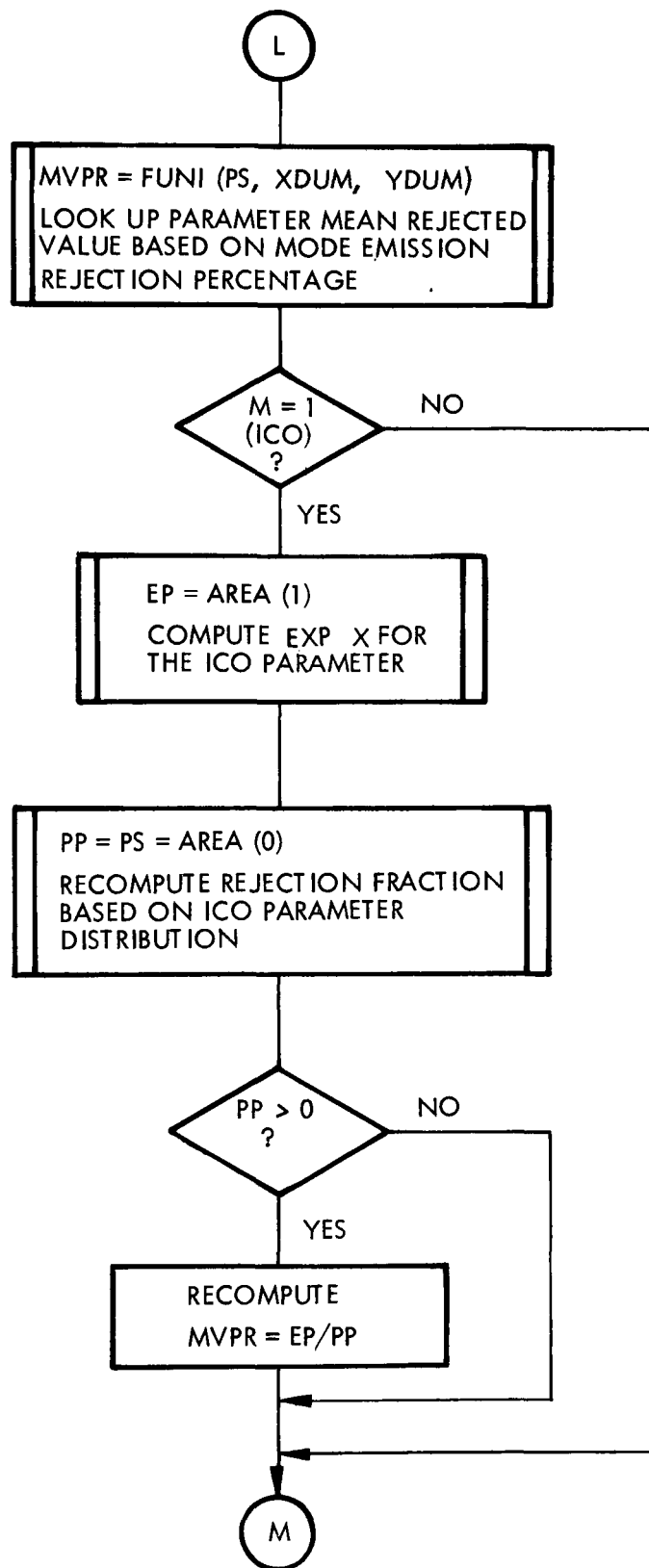


Figure 5-7 Subroutine TEST Flowchart (cont.)

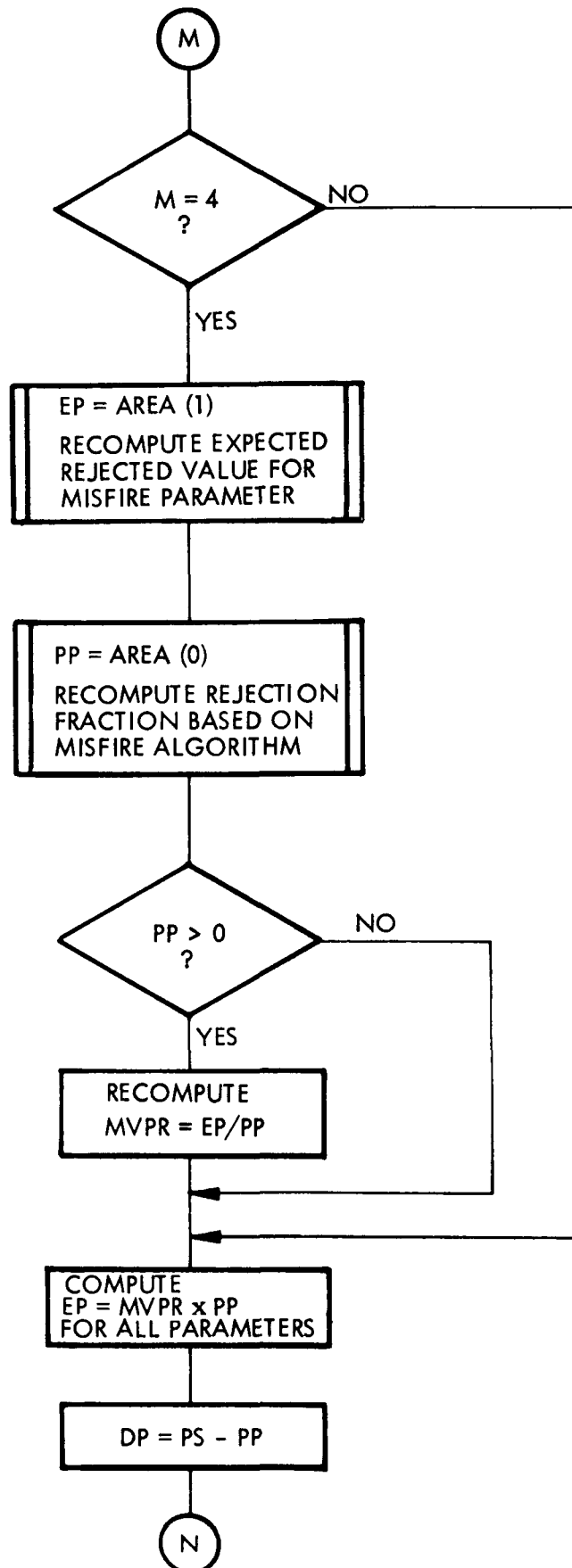


Figure 5-7 Subroutine TEST Flowchart (cont.)

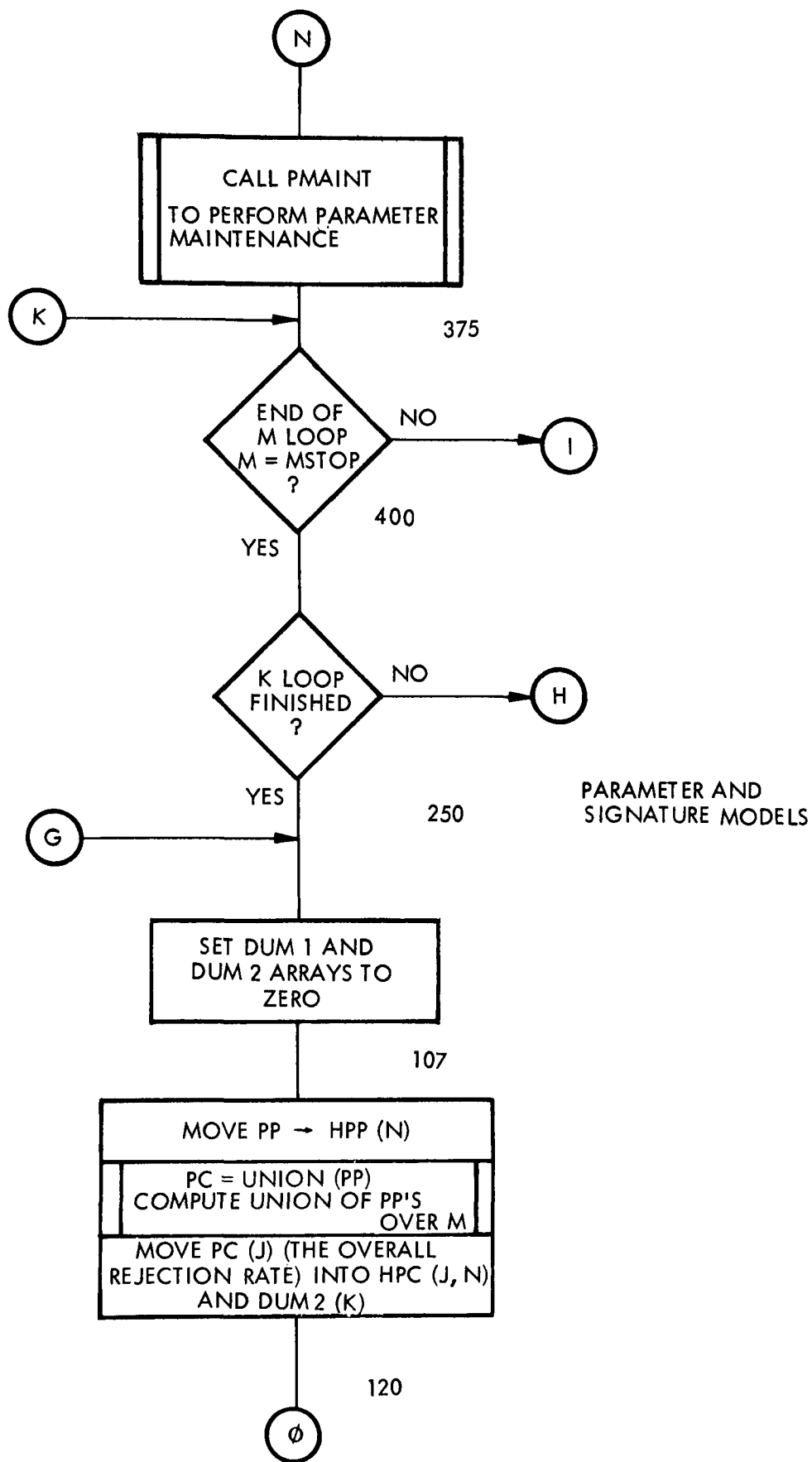


Figure 5-7 Subroutine TEST Flowchart (cont.)

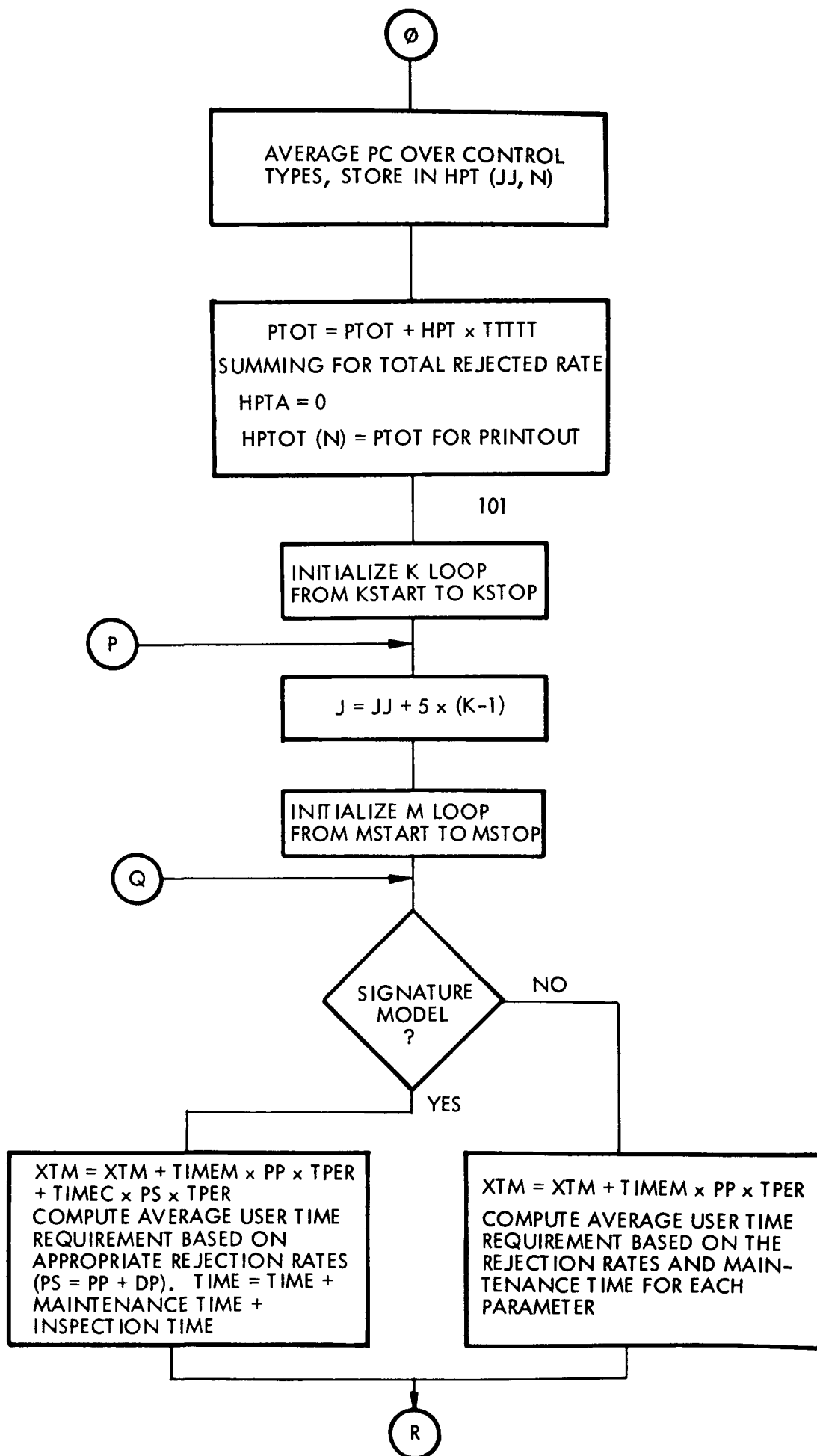


Figure 5-7 Subroutine TEST Flowchart (cont.)

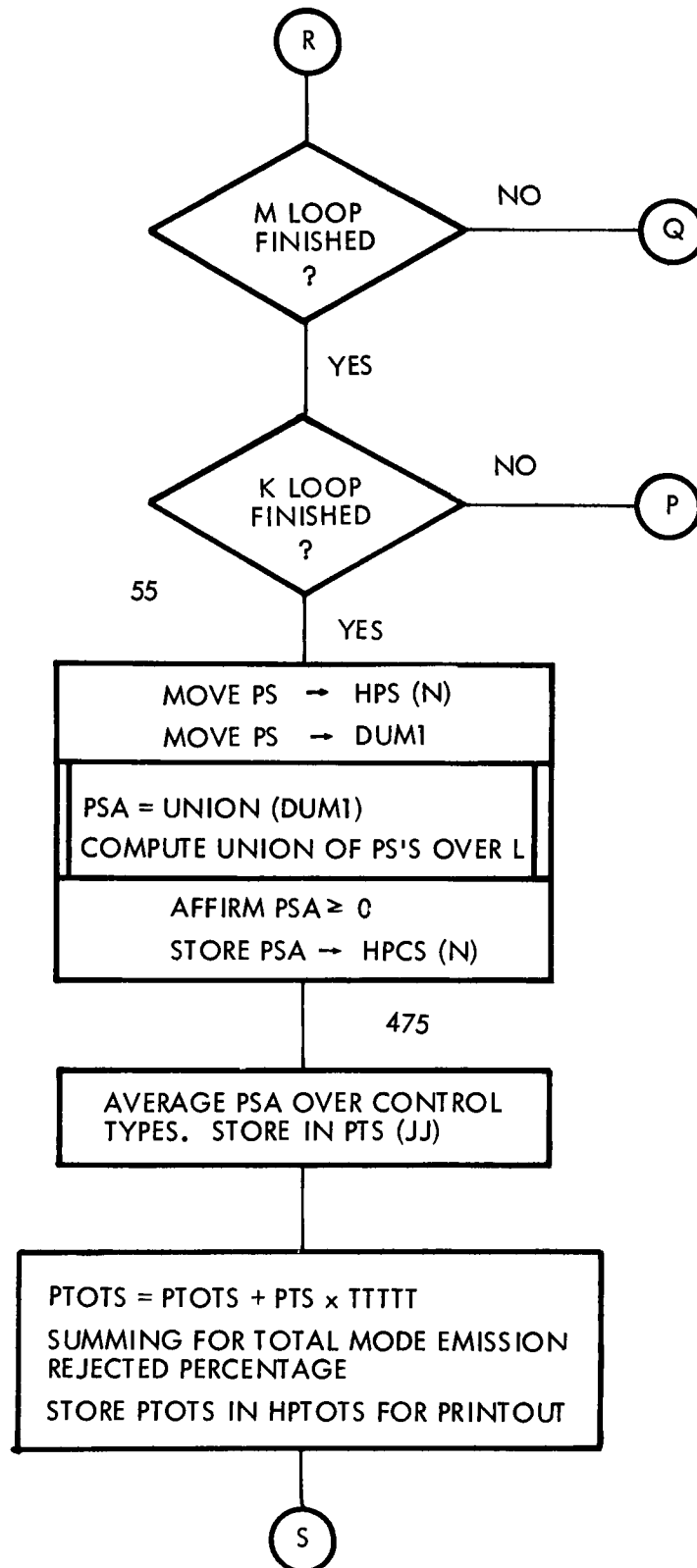


Figure 5-7 Subroutine TEST Flowchart (cont.)

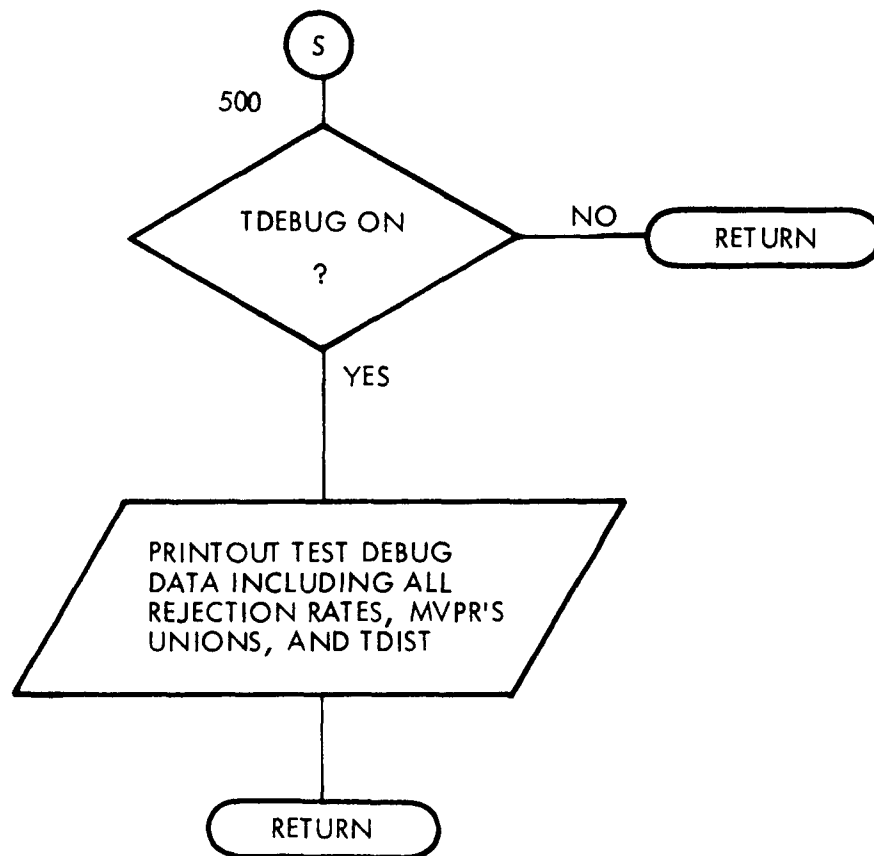


Figure 5-7 Subroutine TEST Flowchart (cont.)

Table 5-7 SUBROUTINE TEST LISTING

20380	SUBROUTINE TEST(JJ,N)
20390	DIMENSION DUM1(10),DUM2(3),DUM3(3)
20400	DIMENSION XDUM(3),Y1DUM(3),Y2DUM(3),Y1DDUM(3,3),Y2DDUM(3,3)
20410	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,
20420	+ BAREA(3), BLD1, BLD2, BSIG(3), BxTRA, BSIZE,
20430	+ BHIST(3,16), BMMI(10,15,3),
20440	+ ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
20450	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),
20460	+ CARSY, CBSUM, CCDEF(10),CCOSTI, CCOSTM, CGTT,
20470	+ CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
20480	+ CN(15,3,16), COEFB(15,3), COEFBP(10,15),
20490	+ CPART(10,15)
20500	CC ADD2
20510	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
20520	+ EMW(3), EP(10,15),EFF(10), DELIT(3),
20530	+ FREQA, FREQB, FPERC(10,3),
20540	+ HORZN, HORZNY,
20550	+ HPC(15,16), HPCS(15,16), HPP(10,15,16),
20560	+ HPS(6,15,16), HPT(5,16), HPTOT(16),
20570	+ HPTOTS(16)
20580	CC ADD3
20590	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
20600	+ KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
20610	+ LIDLE, LINT(16), LPSPP(10),LSTART, LSTOP,
20620	+ MBASE, MPH, MSPEC(10),MSTART, MSTOP,
20630	+ MU(10,3), MMS(10,15), MVPR(10,15)
20640	CC ADD4
20650	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,
20660	+ NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
20670	+ NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
20680	+ OCIY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
20690	CC ADD5
20700	COMMON /COM06/PARM(3,3), PART, PAYNEW, PAYOFF(3),
20710	+ PC(15), PCS(15), PHI(14), PLU(14), PLTMAX(3),PMODEL,
20720	+ PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
20730	+ PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
20740	+ PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
20750	+ PSA(15), PTA(5), PCONF, PARINT(10,10,9)
20760	+ ,PAYFIN
20770	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,
20780	+ RTYPE,

Table 5-7 SUBROUTINE TEST LISTING (cont.)

20790	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,
20800	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
20810	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
20820	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
20830	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
20840	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),	
20850	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
20860		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
20870	+	TINT,	TQBE(3),	TONX,	TOTE(3),	TPDB(3),	TPDT(3),
20880	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
20890	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),	
20900	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
20910	CC ADD10						
20920		COMMON /COM11/		WF(10),			
20930	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
20940	+	XIM(16),	XBASE(9,3),	YBASE(9,3)			
20950	CC ADD11						
20960		COMMON /COM12/		Y1BP(3,3,10),		Y2BP(3,3,10),	
20970	+	YES,	YSUM,	YIM(16),		Y1DBP(4,4,10),	Y2DBP(4,4,10),
20980	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
20990	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
21000	+	Z13,	Z14,	Z15,	Z16,	Z17,	
21010	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
21020	+	ZZ(3,3)					
21030	CC ADD12						
21040		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
21050	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
21060	CC ADDD						
21070		REAL	ITE,	ITL,	ITP,	ITIME,	
21080	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
21090	+	NAME,	NO,	LDEBUG,	MDEBUG,		
21100	+	IN,	MISFIRE				
21110		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
21120	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
21130	C	PARAMETER MODEL					
21140		DO 5 I=1,NEMIS					
21150		DO 5 K=1,NCNTR					
21160		DUM2(K)=DUM3(K)=0.					
21170		J=JJ+5*(K-1)					
21180		DO 5 P=1,NPAR					
21190		DUM1(M)=0.					
21200		DP(M,J)=0.					

Table 5-7 SUBROUTINE TEST LISTING (cont.)

21210		EP(M,J)=0.
21220		PP(M,J)=0.
21230		PC(J)=0.
21240		MVPR(M,J)=0.
21250		DO 5 L=1,NMODE
21260		PS(L,J)=0.
21270	5	CONTINUE
21280		PT(JJ)=C.
21290		IF(JJ.EQ.1) PTOT=PTOTS=PTOTA=0.
21300		IF(RTYPE.EQ.SMODEL) GO TO 300
21310	CC	ENGINE PARAMETERS
21320	CC	M=1 DELTA CO
21330	CC	M=2 DELTA RPM
21340	CC	M=3 DELTA TIMING
21350	CC	M=4 MISFIRE
21360	CC	M=5 NOX CONTROL
21370	CC	M=6 AIRPUMP
21380	CC	M=7 PCV
21390	CC	M=8 AIR CLEANER
21400	CC	M=9 VACCUUM CHOKE KICK
21410	CC	M=10 CHOKE BLADE SETTING
21420	CC	L = 1 HC - IDLE
21430	CC	L = 2 CO - IDLE
21440	CC	L = 3 NO - IDLE
21450	CC	L = 4 HC CRUISE (45)
21460	CC	L = 5 CO CRUISE (45)
21470	CC	L = 6 NO CRUISE (45)
21480	CC	OPT1 - 1 -- INSPECT PARAMETERS 1 2 3
21490	CC	- 2 -- INSPECT PARAMETERS 1 2 3 4 5
21500	CC	- 3 -- INSPECT PARAMETERS 1 2 3 4 5 6 7 8 9 10
21510		DO 220 K=KSTART,KSTOP
21520		J=JJ+5*(K-1)
21530		DO 100 M=MSTART,MSTOP
21540		IF(TDIST(M,K).NE.1) GOTO 100
21550		EP(M,J)=AREA(1,M,J,K,N)*PI(J,M)
21560		PP(M,J)=AREA(0,M,J,K,N)*PI(J,M)
21570		CALL PMAINT(0,M,J,K,N)
21580		PP(M,J)=AMIN1(PP(M,J),1.0)
21590		PP(M,J)=AMAX1(PP(M,J),0.0)
21600		IF(PP(M,J).NE.0.) MVPR(M,J)=EP(M,J)/PP(M,J)
21610	100	CONTINUE
21620	220	CONTINUE

Table 5-7 SUBROUTINE TEST LISTING (cont.)

21630		GO TO 250
21640	300	CONTINUE
21650		DO 400 K=KSTART,KSTOP
21660		J=JJ+5*(K-1)
21670		DO 350 L=LSTART,LSTOP
21680		LL=L+10
21690		PS(L,J)=AREA(0,LL,J,K,N)
21700		PS(L,J)=AMAX1(PS(L,J),0.)
21710		PS(L,J)=AMIN1(PS(L,J),1.)
21720	350	CONTINUE
21730		DO 375 M=MSTART,MSTOP
21740		IF(TDIST(M,K).NE.1) GOTU 375
21750		L=LPSP(M)
21760		IF(L.EQ.0) GO TO 375
21770		DO 360 I1=1,3
21780		XDUM(I1)=X1BP(I1,K,L)
21790		Y1DUM(I1)=Y1BP(I1,K,M)
21800		Y2DUM(I1)=Y2BP(I1,K,M)
21810	360	CONTINUE
21820		PP(M,J)=FUN1(PS(L,J),XDUM,Y1DUM,3)
21830		PP(M,J)=AMIN1(PP(M,J),PS(L,J))
21840		IF(PP(M,J).LT.0.) PP(M,J)=0.
21850		MVPR(M,J)=FUN1(PS(L,J),XDUM,Y2DUM,3)
21860		IF(M.EQ.1) EP(M,J)=AREA(1,M,J,K,N)*PI(J,M)
21870		IF(M.EQ.1) PP(M,J)=PS(2,J)=AREA(0,1,J,K,N)*PI(J,M)
21880		IF(M.EQ.1.AND.PP(M,J).GT.1.E-5) MVPR(M,J)=EP(M,J)/PP(M,J)
21890		IF(M.EQ.4) EP(M,J)=AREA(1,M,J,K,N)*PI(J,M)
21900		IF(M.EQ.4) PP(M,J)=AREA(0,M,J,K,N)*PI(J,M)
21910		IF(M.EQ.4.AND.PP(M,J).GT.1.E-5) MVPR(M,J)=EP(M,J)/PP(M,J)
21920		EP(M,J)=PP(M,J)*MVPR(M,J)
21930		DP(M,J)=PS(L,J)-PP(M,J)
21940		CALL PMAINT(0,M,J,K,N)
21950	375	CONTINUE
21960	400	CONTINUE
21970	250	CONTINUE
21980	C	PP - PROBABILITIES PER PARAMETER
21990	C	PC - PROBABILITIES PER CONTROL CRITERIA
22000	C	PT - PROBABILITIES PER POWERTRAINS
22010	C	PTOT - TOTAL PROBABILITY
22020		DO 107 K=1,NCNTR
22030		DUM2(K)=0.
22040		DO 107 M=1,NPAR

Table 5-7 SUBROUTINE TEST LISTING (cont.)

22050		DUM1(M)=0.
22060	107	CONTINUE
22070		DO 120 K=KSTART,KSTOP
22080		J=JJ+5*(K-1)
22090		DO 110 M=1,NPAR
22100		HPP(M,J,N)=PP(M,J)
22110	110	DUM1(M)=PP(M,J)
22120		PC(J)=UNION(DUM1,NPAR,1)
22130		HPC(J,N)=PC(J)
22140	120	DUM2(K)=PC(J)
22150		HPT(JJ,N)=PC(JJ)*TPER(N,JJ)+PC(JJ+5)*TPER(N,JJ+5)+PC(JJ+10)*TPER(N
22160		*,JJ+10)
22170		TTTTT=TPER(N,JJ)+TPER(N,JJ+5)+TPER(N,JJ+10)
22180		IF(TTTTT.GT.10.E-10) HPT(JJ,N)=HPT(JJ,N)/TTTTT
22190		PTOT=PTOT+HPT(JJ,N)*TTTTT
22200		HPTOT(N)=PTOT
22210		DO 55 K=KSTART,KSTOP
22220		J=JJ+5*(K-1)
22230		DO 55 M=MSTART,MSTOP
22240		IF(RTYPE.EQ.SMODEL)
22250		+ XTM(N)=XTM(N)+TIMEM(M,J)*PP(M,J)*TPER(N,J)+
22260		+ TIMEC(M,J)*(PP(M,J)+DP(M,J))*TPER(N,J)
22270		IF(RTYPE.NE.SMODEL)
22280		+ XTM(N)=XTM(N)+TIMEM(M,J)*PP(M,J)*TPER(N,J)
22290		YTM(N)=YTM(N)+CPART(M,J)*PP(M,J)*TPER(N,J)
22300	55	CONTINUE
22310		DO 475 K=KSTART,KSTOP
22320		J=JJ+5*(K-1)
22330		DO 450 L=1,NMODE
22340	450	HPS(L,J,N)=PS(L,J)
22350		DO 115 L=1,NMODE
22360	115	DUM1(L)=PS(L,J)
22370		PSA(J)=UNION(DUM1,NMODE,2)
22380		IF(PSA(J).LT.0.) PSA(J)=0.
22390	475	HPCS(J,N)=PSA(J)
22400		PTS(JJ)=PSA(JJ)*TPER(N,JJ)+PSA(JJ+5)*TPER(N,JJ+5)+PSA(JJ+10)*TPER
22410		+(N,JJ+10)
22420		IF(TTTTT.GT.1.E-10) PTS(JJ)=PTS(JJ)/TTTTT
22430		PTOTS=PTOTS+PTS(JJ)*TTTTT
22440		HPTOTS(N)=PTOTS
22450	500	IF(TDEBUG.EQ.NO) RETURN
22460		WRITE (6,999)

Table 5-7 SUBROUTINE TEST LISTING (cont.)

```

22470      WRITE (6,510)
22480      510 FORMAT(40X,*DEBUG -- TEST*)
22490      WRITE (6,520)
22500      520 FORMAT(/,40X,*VARIABLE - A - PROBABILITY *
22510      + *PER PARAMETER -- PP*/40X,*VARIABLE - B - EXPECTED *
22520      + *,*VALUE PER PARAMETER -- EP*/40X,*VARIABLE - C - *
22530      + *,*MEAN VALUE OF THE REJECTED PARAMETER -- MVPR*,/
22540      + 40X,*VARIABLE - D - PS - PP (SIGNATURE ONLY)*)
22550      WRITE (6,530) JJ,NAME(JJ+10),(J,J=1,10)
22560      530 FORMAT(/,40X,*POWERTRAIN*,13,* -- *,A10//
22570      + * PARAMETER*,10(3X,12,5X))
22580      DO 550 K=KSTART,KSTOP
22590      J=JJ+5*(K-1)
22600      WRITE (6,540) NAME(K+3),(PP(M,J),M=1,10),
22610      + (EP(M,J),M=1,10),(MVPR(M,J),M=1,10),(DP(M,J),M=1,10)
22620      540 FORMAT(/,A3,* A*,10E10.2/8X,* B*,10E10.2/8X,* C*,10E10.2
22630      + /8X,* D*,10E10.2/)
22640      550 CONTINUE
22650      IF(JJ.EQ.5) WRITE (6,570) (PC(J),J=1,15),(PT(JJ),JJ=1,5),PTOT
22660      + ,XTM(N),YTM(N),PTOTS
22670      570 FORMAT(/,* PC = */10X,5E12.5/10X,5E12.5/10X,5E12.5//
22680      + * PT = */10X,5E12.5/* PTOT = *E12.5/* XTM = *,
22690      + E15.5,5X,*YTM = *E15.5/* PTOTS = *E15.5)
22700      WRITE(6,580) TDIST
22710      580 FORMAT(/,30X,*TDIST*,/3(5X,10I5//),/)
22720      999 FORMAT(1H1)
22730      RETURN
22740      END

```

5.7 MAINTENANCE ROUTINES

The maintenance routines estimate the effects of a specific maintenance treatment on the emission and parameter distributions. Estimates of the emission reduction achieved from maintenance are based on the influence coefficients and garage efficiency factors. Subroutine MAINT computes the adjustment in average emission rates based on maintenance, while subroutine PMAINT updates the parameter distributions.

5.7.1 Subroutine MAINT

Subroutine MAINT computes the reduction in the average vehicle emission rate based on the maintenance of parameters which were rejected by inspection. MAINT computes, for each control type, DELB, the effect of voluntary maintenance on emission rates and DELT the effect of mandatory maintenance. DDI, developed in Function EINT computes the impact of engine parameter on emission rates. MAINT subtracts DELB, DELT and DDI from the average emission rate A to compute AM, the post maintenance emission rate. MAINT then averages and summarizes the emission rates in the CN array for later use in MICRO. The THIST and THISTT matrices are updated and averaged for printout, curve fitting and plotting in MICRO.

Table 5-8 contains a complete listing of subroutine MAINT while Figure 5-8 documents its techniques and variables in an extensive flow-chart.

5.7.2 Subroutine PMAINT

Subroutine PMAINT updates the parameter distributions based on maintenance treatment. Input to subroutine PMAINT are XOPT, M, the parameter number, J the control-power train type, K the control type

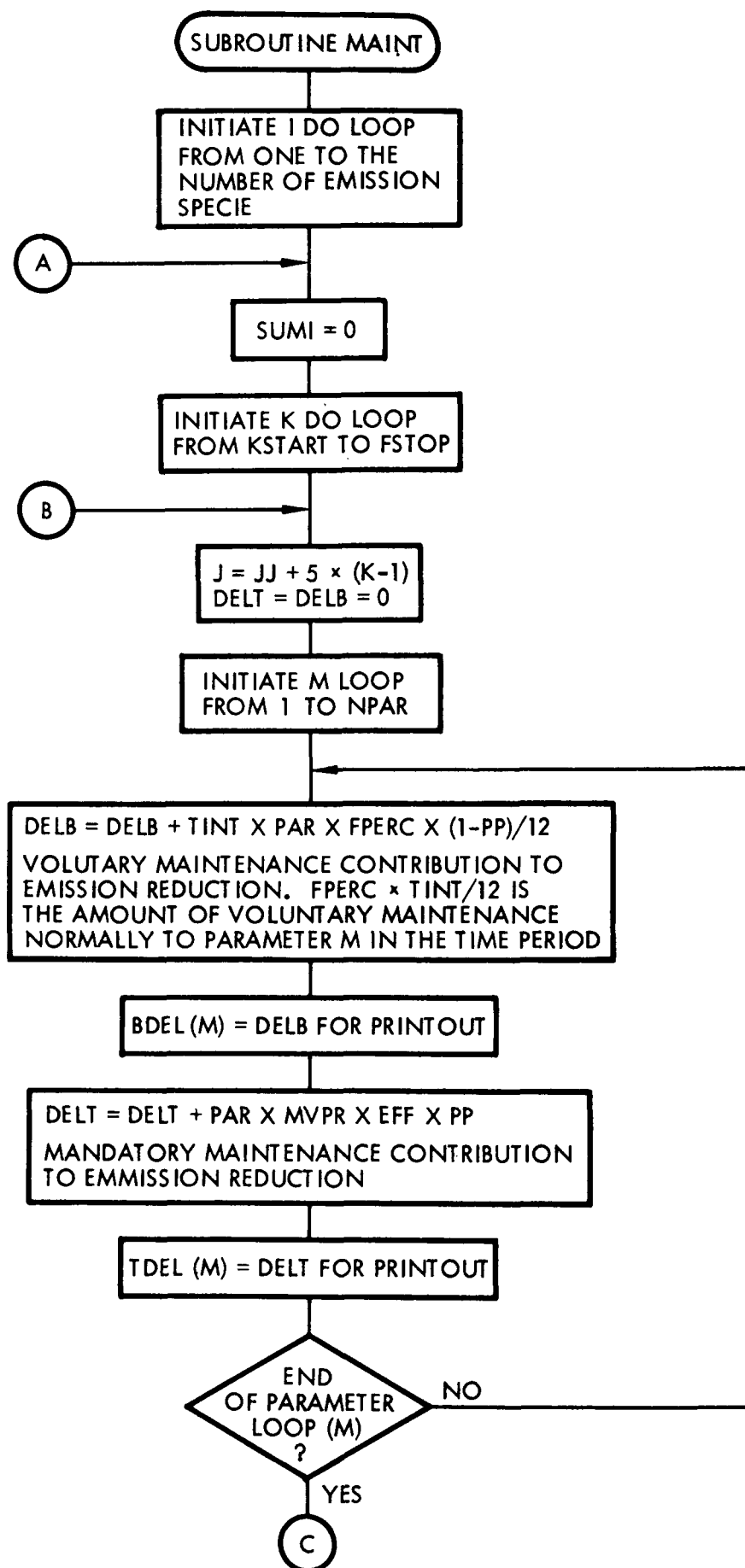


Figure 5-8 Subroutine MAINT Flowchart

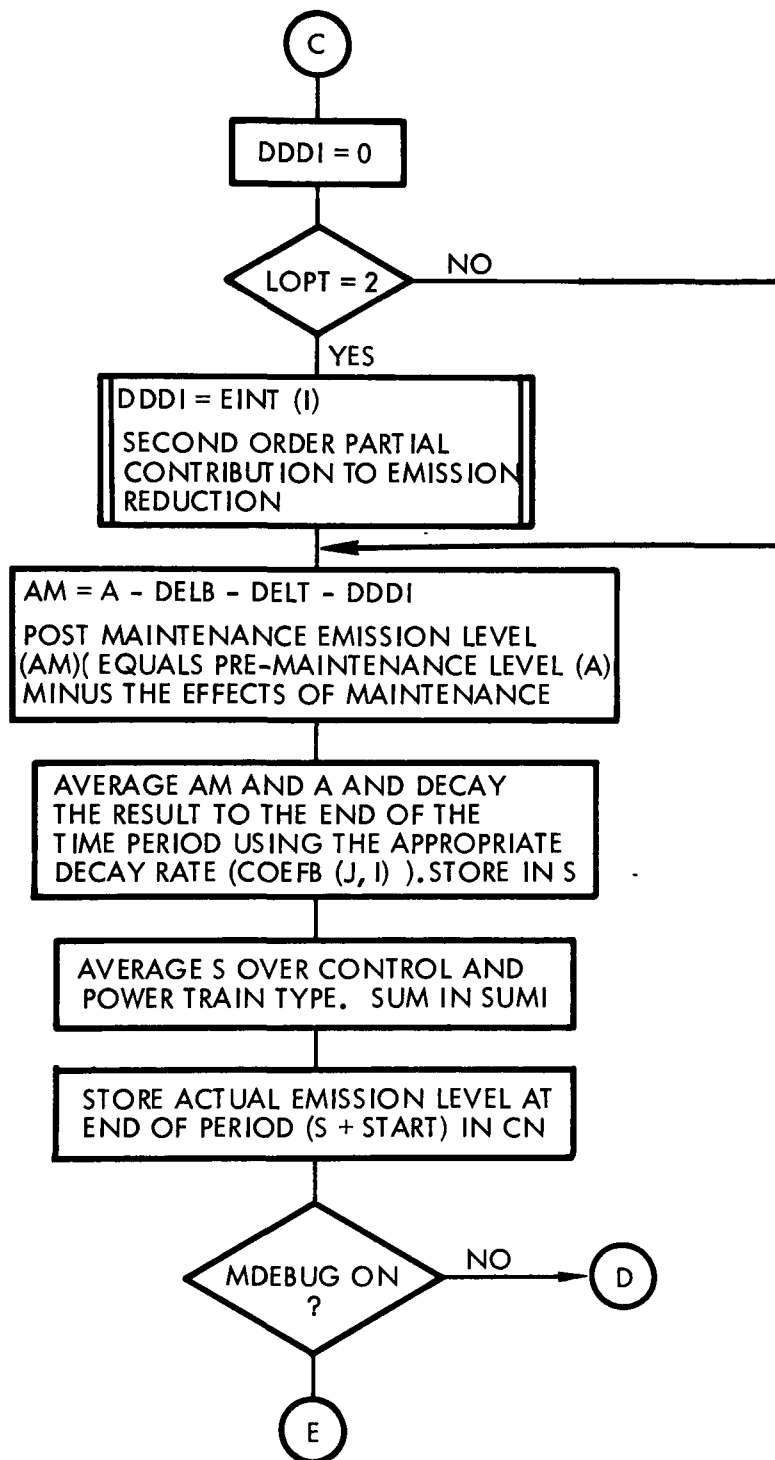


Figure 5-8 Subroutine MAINT Flowchart (cont.)

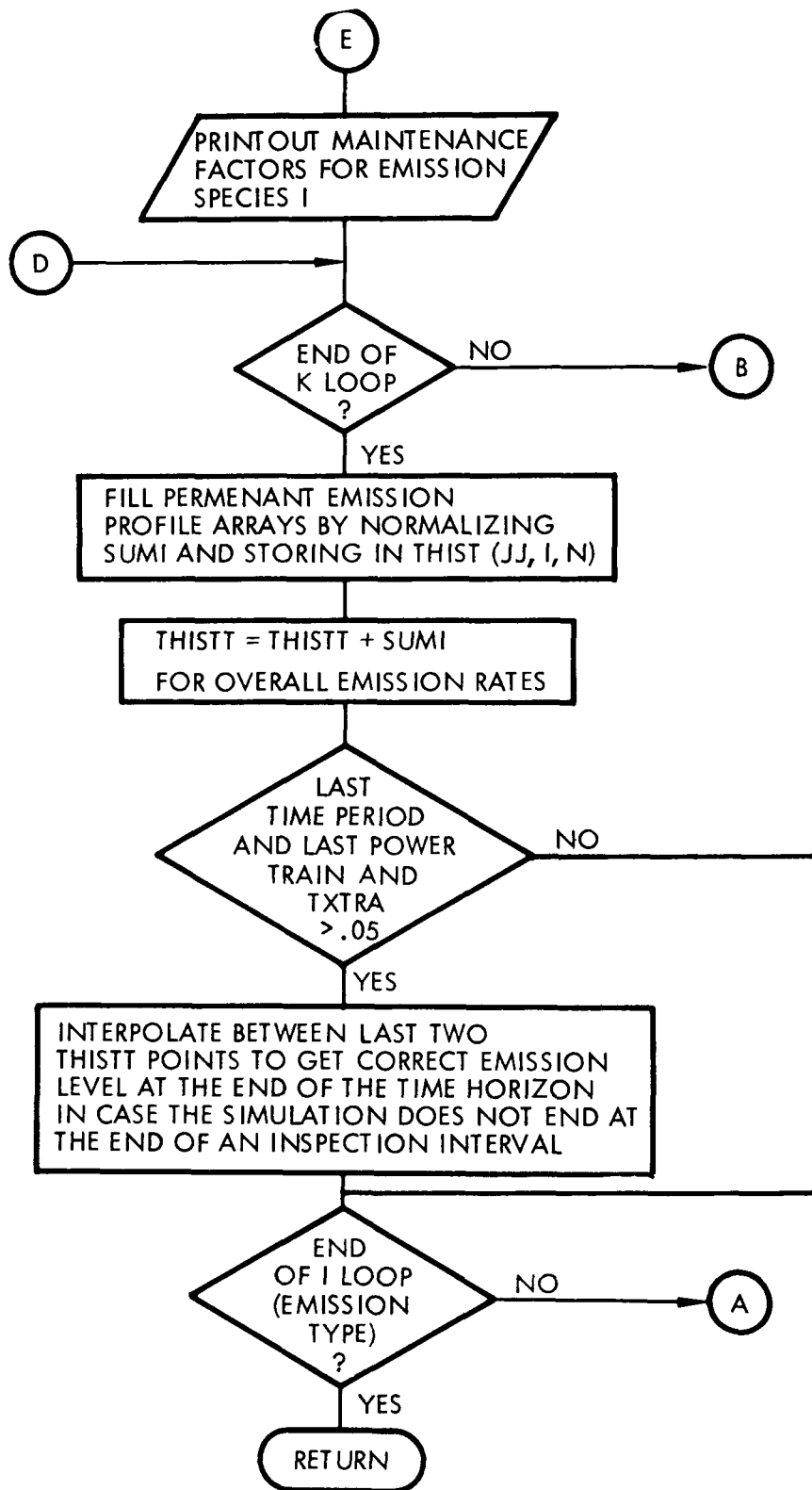


Figure 5-8 Subroutine MAINT Flowchart (cont.)

Table 5-8 SUBROUTINE MAINT LISTING

```

22750      SUBROUTINE MAINT(A,AM,JJ,N)
22760      DIMENSION A(15,3),AM(15,3),BDEL(10),TDEL(10)
22770      COMMON /COM01/      AMB(3),ALAB,      AVV,      BINT,
22780      +      BAREA(3),BLD1,      BLD2,      BSIG(3),      EXTRA,      BSIZE,
22790      +      BHIST(3,16),      BMMI(10,15,3),
22800      +      ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
22810      COMMON /COM02/      CARA,      CARIY,      CARMY,      CARPOP(16),
22820      +      CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCOSTM,      CGIT,
22830      +      CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
22840      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
22850      +      CPART(10,15)
22860      CC ADD2
22870      COMMON /COM03/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
22880      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
22890      +      FREQA,      FREQB,      FPERC(10,3),
22900      +      HORZN,      HORZNY,
22910      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
22920      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
22930      +      HPTOTS(16)
22940      CC ADD3
22950      COMMON /COM04/      ITE,      ITL,      ITP,      ITIME(16),
22960      +      KSTART,      KSTOP,      LOPT,      LPICK(10),LLPICK,
22970      +      LIDLE,      LINT(16),      LPSP(10),LSTART,      LSTOP,
22980      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
22990      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
23000      CC ADD4
23010      COMMON /COM05/      NAME(50),      NCNTR,      NEMIS,      NEMP,
23020      +      NINTR,      NINTRB,      NMODE,      NO,      NOPTS,      NPAR,
23030      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
23040      +      OCY,      OCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
23050      CC ADD5
23060      COMMON /COM06/      PARM(3,3),      PART,      PAYNEW,      PAYOFF(3),
23070      +      PC(15),      PCS(15),      PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
23080      +      PP(10,15),PS(6,15),      PT(5),      PTOT,      PTS(5),      PAYADJ,
23090      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
23100      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
23110      +      PSA(15),      PTA(5),      PCONE,      PARINT(10,10,9)
23120      +      ,PAYFIN
23130      COMMON /COM07/      REINSP,      RNAME,      RSIZE,      RSTOP,
23140      +      RTYPE,
23150      +      SALE,      SALL,      SALP,      SITEI,      SITEM,      SLANE,

```

Table 5-8 SUBROUTINE MAINT LISTING (cont.)

```

23160      +   SMODEL,   START(15,3), STAT,   STIME(3), SUMBM(3),
23170      +   SCALEBM(3),   SM(6,15),   SPAR(10,15,6),
23180      +   SXCUT(6,3),   SIG(10,3),   SIGCE(3),
23190      +   SIGMF(10),   SIGMNE(10),   SIGP(10,15),
23200      +   SIGRATE,   SIST,   SIGS(6,15),   SIGSOE(3),
23210      +   STARLEX(33,6,15),   STABLEY(33,6,15)
23220      COMMON /COM10/   TAREA(3), TOIST(10,3), TIDLE, TIMEI(3,16),
23230      +   TINT,   TOBE(3), TONX,   TOTE(3), TPDB(3), TPDT(3),
23240      +   TXTRA,   TSIZE,   TSIG(3), TPER(16,15), TMIL(16,15),
23250      +   THIST(5,3,16),   THISTT(3,16),   TIMEC(10,15),
23260      +   TIMEM(10,15),   TABLEX(33,10,15),   TARLEY(33,10,15)
23270      CC ADD10
23280      COMMON /COM11/   WF(10),
23290      +   XIBP(3,3,6), XINT,   XINTB,   XLANE,   XSUM, XCUT(10,3),
23300      +   XTM(16),   XBASE(9,3), YBASE(9,3)
23310      CC ADD11
23320      COMMON /COM12/   YIBP(3,3,10),   Y2BP(3,3,10),
23330      +   YES,   YSUM,   YTM(16),   YIDBP(4,4,10), Y2DBP(4,4,10),
23340      +   Z1,   Z2,   Z3,   Z4,   Z5,   Z6,
23350      +   Z7,   Z8,   Z9,   Z10,   Z11,   Z12,
23360      +   Z13,   Z14,   Z15,   Z16,   Z17,
23370      +   ZCARI,   ZCARM,   ZIC,   ZSUM,
23380      +   ZZ(3,3)
23390      CC ADD12
23400      COMMON /DEBUG/   ADEBUG,   BDEBUG,   CDEBUG,   DDEBUG,
23410      +   LDERUG,   MDEBUG,   PDEBUG,   QDEBUG,   SDEBUG,   TDEBUG
23420      CC ADD3
23430      REAL   ITE,   ITL,   ITP,   ITIME,
23440      +   MMS,   MPH,   MSPEC,   MU,   MVPR,
23450      +   NAME,   NO,   LDEBUG,   MDEBUG,
23460      +   IN,   MISFIRE
23470      INTEGER   RNAME,   SITEI,   SITEM,   STAT,
23480      +   TDIST,   XLANE,   OPTI,   PPICK,   PPPICK
23490      DO 50 I=1,NEMIS
23500      SUMI=0.
23510      DO 40 K=KSTART,KSTOP
23520      J=JJ+5*(K-1)
23530      DELT=DELB=0.
23540      DO 30 M=1,NPAR
23550      DELB=DELB+TINT/12.*PAR(M,J,I)*FPERC(M,K)*(1.-PP(M,J))
23560      BDEL(M)=DELB
23570      DELT=DELT+PAR(M,J,I)*MVPR(M,J)*EFF(M)*PP(M,J)

```

Table 5-8 SUBROUTINE MAINT LISTING (cont.)

23580		TDEL(M)=DELT
23590	30	CONTINUE
23600		DDDI=0.
23610		IF(LOPT.EQ.2) DDDI=EINT(I,K,J)
23620		AM(J,I)=A(J,I)-DELB-DELT-DDDI
23630	91	FORMAT(1X,F10.6)
23640		S=(AM(J,I)+A(J,I))/2.+COEFB(J,I)*TMIL(N,J)*TINT*(1.-PART)
23650		SUMI=SUMI+(S+START(J,I))*TPER(N,J)
23660		CN(J,I,N)=S+START(J,I)
23670		IF(MDEBUG.EQ.NU) GO TO 40
23680		WRITE(6,1234) DDDI
23690	1234	FORMAT(1X,E20.10)
23700		WRITE(6,90)
23710	90	FORMAT(/,50X,*DEBUG - MAINT EFFECTS SUMMED*)
23720		WRITE(6,100) NAME(I),NAME(K+3),(BDEL(M),M=1,NPAR),
23730		+ (TDEL(M),M=1,NPAR)
23740	100	FORMAT(2X,A2,2X,A8,* BASE*,10E9.2/,14X,* TEST*,10E9.2)
23750	40	CONTINUE
23760	C:	
23770	C:	FILL PERMANENT EMISSION PROFILE ARRAYS.
23780	C:	(INSIDE I LOOP)
23790	C:	
23800		THIST(JJ,I,N)=SUMI/(TPER(N,JJ)+TPER(N,JJ+5)+TPER(N,JJ+10))
23810		THISTT(I,N)=THISTT(I,N)+SUMI
23820		IF(N.EQ.NTR.AND.TXTRA.GT..05.AND.J.EQ.NPTRN)
23830	+	THISTT(I,N)=THISTT(I,N)-
23840	+	(1.-TXTRA)*(THISTT(I,N)-THISTT(I,N-1))
23850	50	CONTINUE
23860		RETURN
23870		END

and N the inspection interval. Also input to PMAINT (via the common block) are the parameter or mode emission distributions stored in TABLEX, TABLEY, or STABLEX or STABLEY, respectively. Output from PMAINT is returned through the TABLEX, TABLEY and STABLEX, STABLEY matrices. Subroutine PMAINT first branches on parameter or emission inspection type. For parameter inspection the limits of the rejected population are computed by reference to the LINT array which specifies upper and or lower end rejection. The TABLEX and TABLEY arrays are moved into the XBP and YBP working storage. For the emission case, since, for mode emissions, the upper end is always rejected, the rejection limits are set at the cutpoint and highest value in the STABLEX array, and the STABLEX and the STABLEY data is moved into XBP and YBP.

For both the emission and the parameter case subroutine PMAINT normalizes the parameter or mode emission distribution and calls AREA to compute the rejected fraction. The portion of the distribution which was rejected is then reduced by a factor of PI, the inspection efficiency parameter. The vehicles that were rejected and, therefore, maintained are then added back into the population at the manufacturer's specification point. The distribution is then packed to discard long tail ends and moved back into STABLEX or STABLEY or TABLEX, TABLEY.

Subroutine PMAINT provides debug output when the ADEBUG flag is turned on.

Table 5-9 contains a complete listing of subroutine PMAINT while Figure 5-9 displays graphically the PMAINT coding technique in a descriptive flowchart.

5.8 DETERIORATION SUBROUTINES

The Decay subroutines model the deterioration of emission rates,

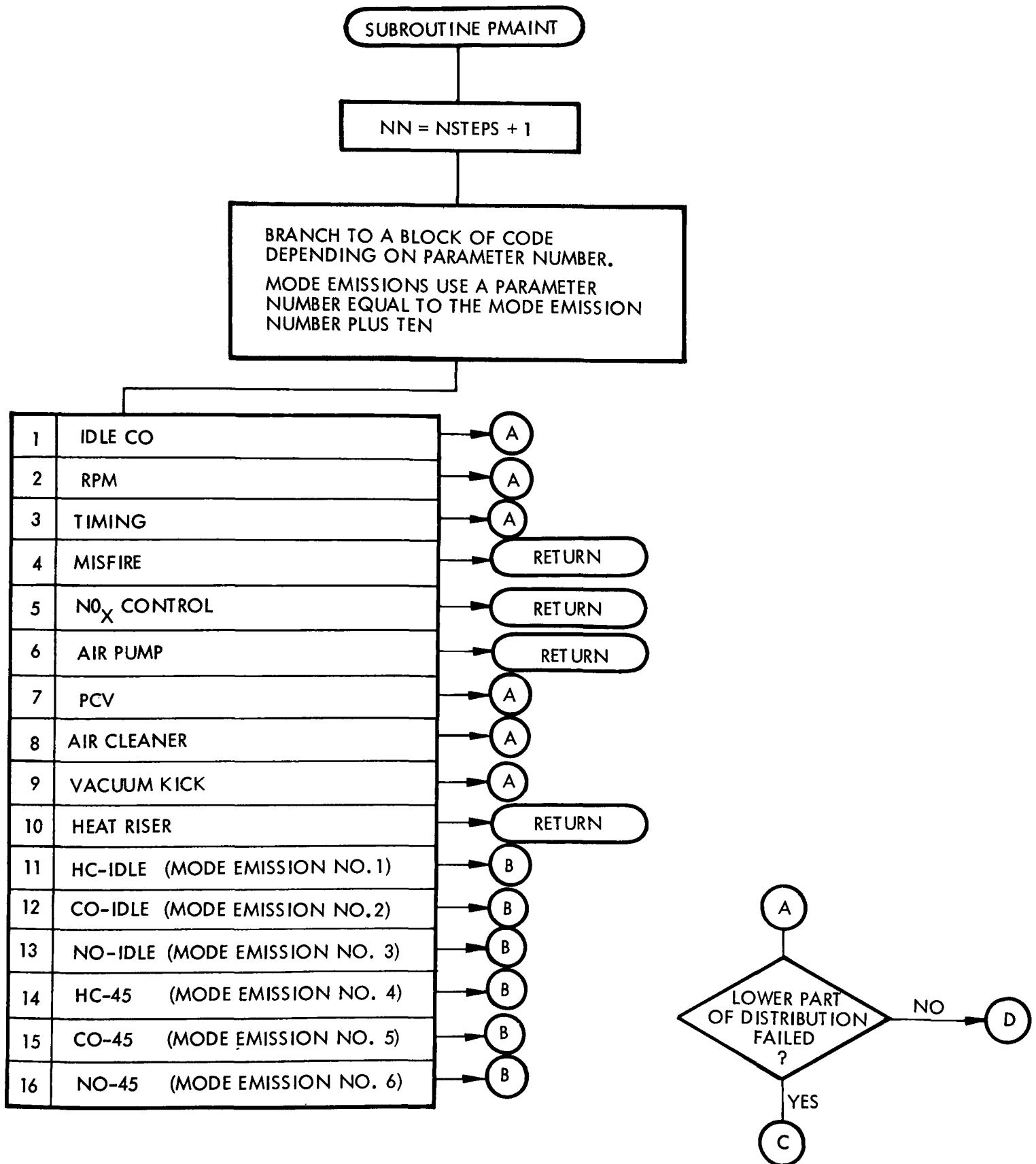


Figure 5-9 Subroutine PMAINT Flowchart

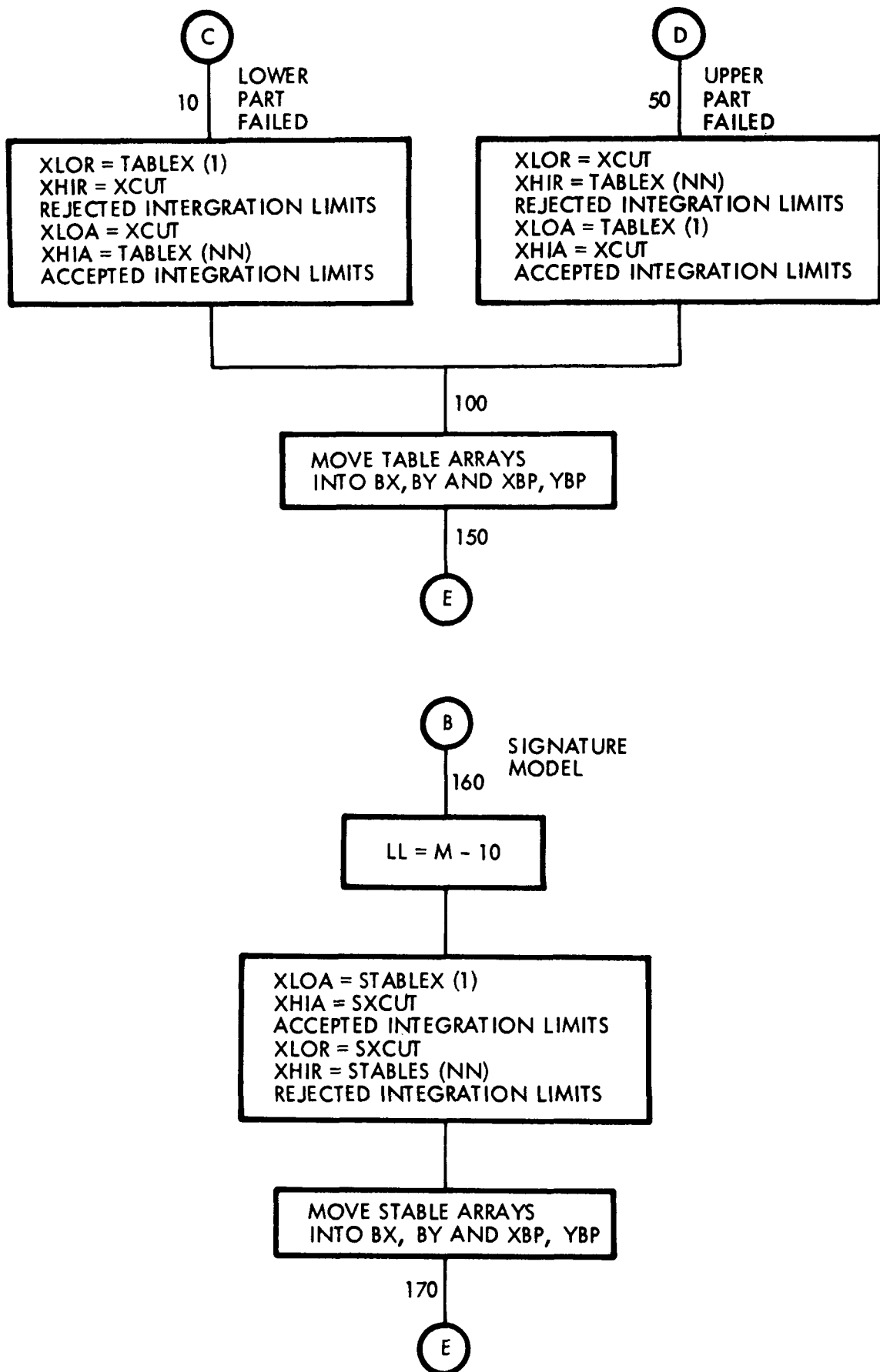


Figure 5-9 Subroutine PMAINT Flowchart (cont.)

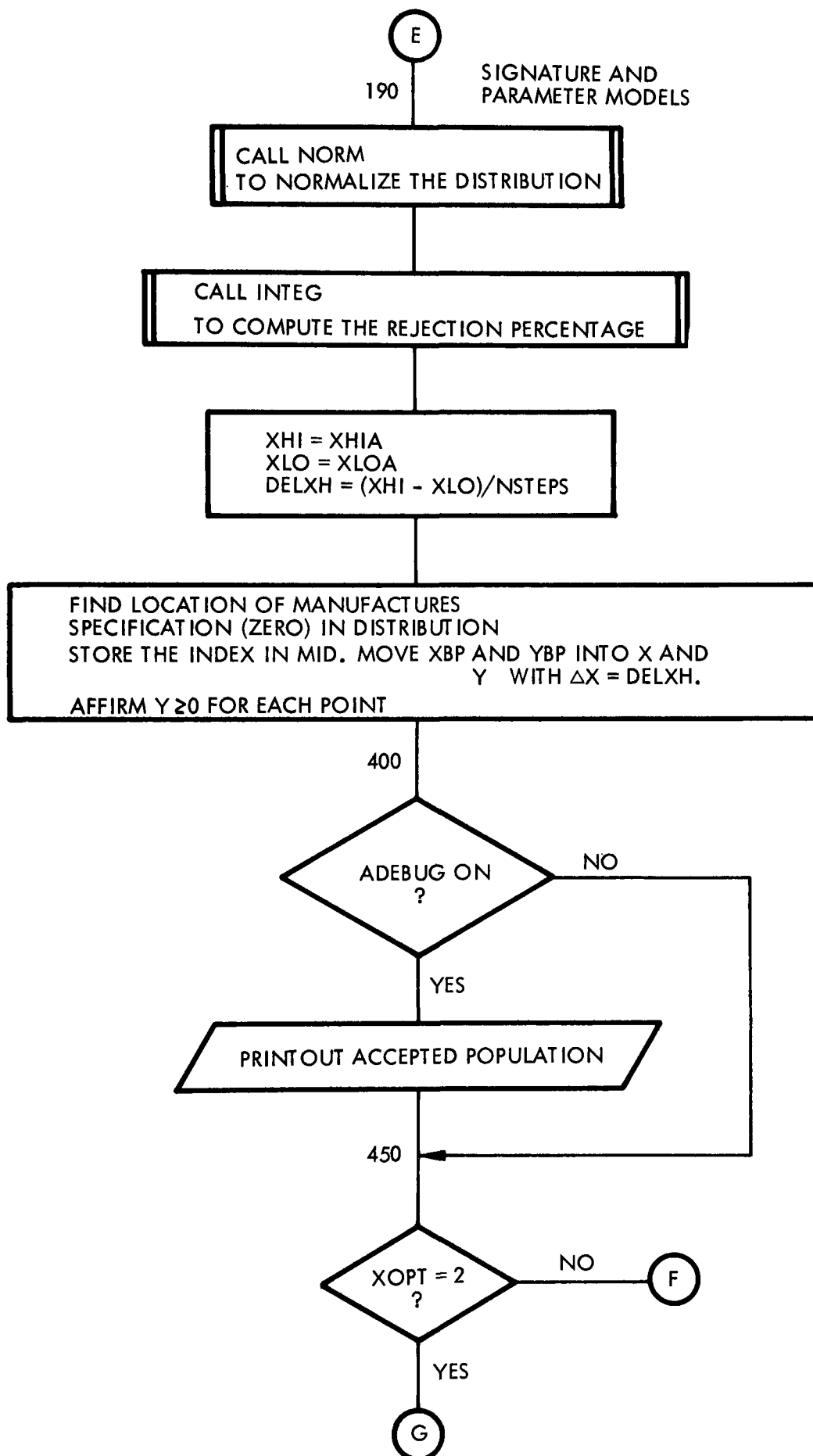


Figure 5-9 Subroutine PMAINT Flowchart (cont.)

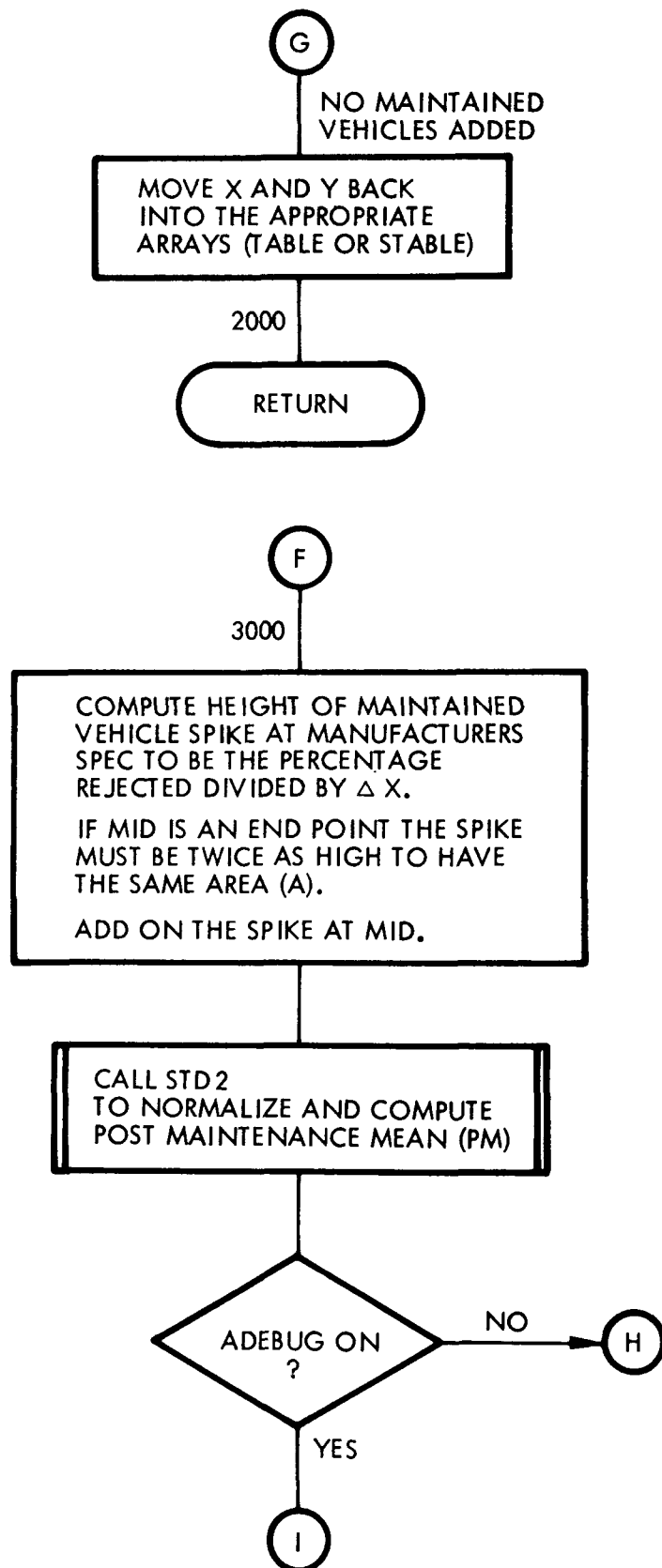


Figure 5-9 Subroutine PMAINT Flowchart (cont.)

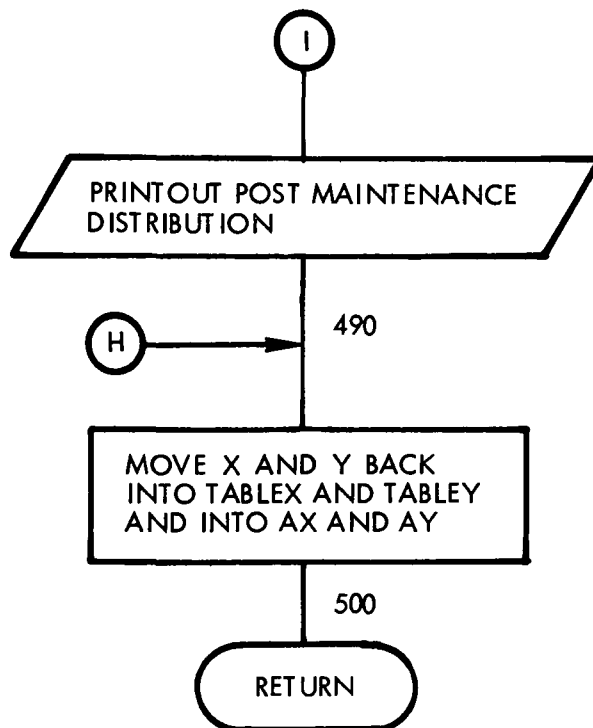


Figure 5-9 Subroutine PMAINT Flowchart (cont.)

Table 5-9 SUBROUTINE PMAINT LISTING

```

36080 SUBROUTINE PMAINT(XOPT,M,J,K,N)
36070 DIMENSION X(35),Y(35),XBP(35),YBP(35)
36080 COMMON /COM01/ AM3(3),ALAB, AVV, BINT,
36090 + BAREA(3),BLD1, BLD2, BSIG(3), BXTA, BSIZE,
36100 + BHIST(3,16), BMMI(10,15,3),
36110 + ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
36120 COMMON /COM02/ CARA, CARIY, CARMY, CAPPOP(16),
36130 + CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
36140 + CINCCN, CPCB, CPI, CPVPY, CSUM, CARAY,
36150 + CN(15,3,16), CDEFB(15,3), CDEFBP(10,15),
36160 + CPART(10,15)
36170 CC ADD2
36180 COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
36190 + EMW(3), EP(10,15),EFF(10), DELIT(3),
36200 + FREQA, FREQB, FPERC(10,3),
36210 + HORZN, HOKZNY,
36220 + HPC(15,16), HPCS(15,16), HPP(10,15,16),
36230 + HPS(6,15,16), HPT(5,16), HPTOT(16),
36240 + HPTQTS(16)
36250 CC ADD3
36260 COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
36270 + KSTART, KSTOP, LUPT, LPICK(10),LLPICK,
36280 + LIDLE, LINT(16), LPSPP(10),LSTART, LSTOP,
36290 + MBASE, MPH, MSPEC(10),MSTART, MSTOP,
36300 + MU(10,3), MMS(10,15), MVPR(10,15)
36310 CC ADD4
36320 COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,
36330 + NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
36340 + NPTRN, NPTS, NSTEPS, NTR, NTHB, NPICK(16),
36350 + OCIY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
36360 CC ADD5
36370 COMMON /COM06/PARM(3,3), PART, PAYNEW, PAYOFF(3),
36380 + PC(15), PCS(15), PHI(14), PLC(14), PLTMAX(3),PMODEL,
36390 + PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
36400 + PAR(10,15,3), PARI(10,3,3), PLUS(10,15),
36410 + PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
36420 + PSA(15), PTA(5), PCOFF, PARINT(10,10,9)
36430 + ,PAYFIN
36440 COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,
36450 + RTYPE,
36460 + SALE, SALL, SALP, SITEI, SITEM, SLANE,

```

Table 5-9 SUBROUTINE PMAINT LISTING (cont.)

36470	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),
36480	+	SCALEBM(3),	SM(6,15),	SPAR(10,15,6),		
36490	+	SXCUT(6,3),	SIG(10,3),	SIGCE(3),		
36500	+	SIGME(10),	SIGMNE(10),	SIGP(10,15),		
36510	+	SIGRATE, SIST,	SIGS(6,15),	SIGSDE(3),		
36520	+	STABLEX(33,6,15),	STABLEY(33,6,15)			
36530		COMMON /COM10/	TAREA(3),	TDIST(10,3),	TIDLE,TIMEI(3,16),	
36540	+	TINT,	TOBE(3),	TONX,	TOTE(3),	TPDB(3), TPDT(3),
36550	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),
36560	+	THIST(5,3,16),	THISTT(3,16),	TIMEC(10,15),		
36570	+	TIMEM(10,15),	TABLEX(33,10,15),	TABLEY(33,10,15)		
36580	CC ADD10					
36590		COMMON /COM11/	WF(10),			
36600	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM, XCUT(10,3),
36610	+	XTM(10),	XBASE(9,3),	YBASE(9,3)		
36620	CC ADD11					
36630		COMMON /COM12/	Y1BP(3,3,10),	Y2BP(3,3,10),		
36640	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),	Y2DBP(4,4,10),
36650	+	Z1,	Z2,	Z3,	Z4,	Z5, Z6,
36660	+	Z7,	Z8,	Z9,	Z10,	Z11, Z12,
36670	+	Z13,	Z14,	Z15,	Z16,	Z17,
36680	+	ZCARI,	ZCARM,	ZIC,	ZSUM,	
36690	+	ZZ(3,3)				
36700	CC ADD12					
36710		COMMON /DEBUG/	ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
36720	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG, TDEBUG
36730	CC ADD0					
36740		REAL	ITE,	ITL,	ITP,	ITIME,
36750	+	MMS,	MPH,	MSPEC,	MU,	MVPR,
36760	+	NAME,	NO,	LDEBUG,	MDEBUG,	
36770	+	IN,	MISFIRE			
36780		INTEGER	RNAME,	SITEI,	SITEM,	STAT,
36790	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK
36800		INTEGER XOPT				
36810	CC	LINT -	LIMITS OF INTEGRATION CRITERIA	(REJECTED)		
36820	CC	- 1 --	XLO TO XCUT			
36830	CC	- 2 --	XCUT TO XHI			
36840		NN=NSTEPS+1				
36850		GO TO (1,1,1,2,2,2,1,1,1,2,160,160,160,160,160,160),M				
36860	2	RETURN				
36870	1	IGO=LINT(M)				
36880		GO TO (10,50),IGO				

Table 5-9 SUBROUTINE PMAINT LISTING (cont.)

36890	10	CONTINUE
36900	CC	CUT LOWER PORTION OF DISTRIBUTION
36910		XLOR=TABLEX(1,M,J)
36920		XHIR=XCUT(M,K)
36930		XLOA=XCUT(M,K)
36940		XHIA=TABLEX(NN,M,J)
36950		GO TO 100
36960	50	CONTINUE
36970	CC	CUT UPPER PORTION OF DISTRIBUTION
36980		XLOR=XCUT(M,K)
36990		XHIR=TABLEX(NN,M,J)
37000		XLOA=TABLEX(1,M,J)
37010		XHIA=XCUT(M,K)
37020	100	CONTINUE
37030		DO 150 L=1,NN
37040		XBP(L)=TABLEX(L,M,J)
37050		YBP(L)=TABLEY(L,M,J)
37060	150	CONTINUE
37070		GO TO 190
37080	CC	SIGNATURE MODEL
37090	160	CONTINUE
37100		LL=M-10
37110		XLOA=STABLEX(1,LL,J)
37120		XHIA=SXCUT(LL,K)
37130		XLOR=SXCUT(LL,K)
37140		XHIR=STABLEX(NN,LL,J)
37150		DO 170 L=1,NN
37160		XBP(L)=STABLEX(L,LL,J)
37170		YBP(L)=STABLEY(L,LL,J)
37180	170	CONTINUE
37190	190	CALL NORM(XBP,YBP,NN)
37200	CC	REJECTED PORTION
37210		CALL INTEG(XOPT,XHIR,XLOR,XBP,YBP,NSTEPS,A)
37220	CC	ACCEPT PORTION
37230	CC	SHRINK REJECTED PORTION
37240		XLO=XBP(1)
37250		XHI=XBP(NN)
37260		DELXH=(XHI-XLO)/NSTEPS
37270	CC	LOCATION OF MANUFACTURERS SPEC. IN DIST*N
37280		MID=2
37290		DO 400 I=1,NN
37300		X(I)=XLO+(I-1)*DELXH

Table 5-9 SUBROUTINE PMAINT LISTING (cont.)

37310		Y(I)=FUN1(X(I),XBP,YBP,NN)
37320		IF(ABS(X(I)-MMS(M,J)).LE.DELXH/2.) MID=I
37330		IF(Y(I).LT.0.) Y(I)=0.
37340	CC	MAINTENANCE REMOVAL OF BAD CARS
37350		IF(X(I).GE.XLOR.AND.X(I).LE.XHIR) Y(I)=Y(I)*(1.-PI(J,M)
37360	400	CONTINUE
37370		IF(ADBUG.EQ.NO) GO TO 450
37380		WRITE (6,410) (I,X(I),Y(I),I=1,NN)
37390	410	FORMAT(//,5X,* POPULATION BEFORE ADDING MAINTENANCE*
37400		+ //,3(3X,*N*,8X,*X*,15X,*Y*,5X)//
37410		+ 13(14,2E15.4,14,2E15.4,14,2E15.4//)
37420	450	CONTINUE
37430		IF(XOPT.NE.2) GO TO 3000
37440	CC	STORAGE OF ACCEPTED PORTION
37450		CALL PACKD(X,Y,NN)
37460		DO 2000 L=1,NN
37470		IF(M-10) 1400,1600,1600
37480	1400	CONTINUE
37490	CC	PARAMTER MODEL
37500		TABLEX(L,M,J)=X(L)
37510		TABLEY(L,M,J)=Y(L)
37520		GO TO 2000
37530	1600	CONTINUE
37540	CC	SIGNATURE MODEL
37550		STABLEX(L,LL,J)=X(L)
37560		STABLEY(L,LL,J)=Y(L)
37570	2000	CONTINUE
37580		RETURN
37590	3000	CONTINUE
37600		BUP=A/DELXH*PI(J,M)
37610		Y(MID)=Y(MID)+BUP
37620		IF(MID.EQ.1.OR.MID.EQ.NN) Y(MID)=Y(MID)+BUP
37630		CALL PACKD(X,Y,NN)
37640		CALL STD2(X,Y,NN,PM(M,J),SD)
37650		IF(ADBUG.EQ.NO) GO TO 490
37660		WRITE (6,465) (I,X(I),Y(I),I=1,NN)
37670	465	FORMAT(/,10X,*NEW PTS AFTER MAINTENANCE*//
37680		+ 3(3X,*N*,8X,*X*,15X,*Y*,5X,)//,
37690		+ 13(14,2E15.4,14,2E15.4,14,2E15.4//)
37700	490	DO 500 L=1,NN
37710		TABLEX(L,M,J)=X(L)
37720		TABLEY(L,M,J)=Y(L)

Table 5-9 SUBROUTINE PMAINT LISTING (cont.)

TRW SYSTEMS	
37730	500 CONTINUE
37740	999 FORMAT(1H1)
37750	RETURN
37760	END

mode emissions, and parameters over time. The deterioration rates for each of these three dimensions of the vehicle have been developed empirically and are used to update emission levels between maintenance treatments. The three decay routines are called EDECAY, MDECAY and PDECAY.

5.8.1 Subroutine EDECAY

Subroutine EDECAY computes the deterioration in average vehicle emission rates over the inspection interval TINT. Input to EDECAY are A, the pre-decay emission rates, JJ the power train type and N the inspection interval number. Output from EDECAY consists of the array B representing the average emission rates of the vehicle population after deterioration. The emission rate of decay, COEFB, which was computed in subroutine INITIAL, is multiplied by the appropriate time interval and added to the emission level for determining the post deterioration value.

Figure 5-10 presents a flow chart and Table 5-10 contains a listing of subroutine EDECAY.

5.8.2 Subroutine MDECAY

Subroutine MDECAY deteriorates the mode emission levels based on estimated changes in the engine parameters. MDECAY uses a technique similar to that used in PDECAY in adjusting the mode emission distributions.

Table 5-11 contains a listing of MDECAY and Figure 5-11 a flow chart.

5.8.3 Subroutine PDECAY

Subroutine PDECAY is used to estimate the rate of parameter deterioration between inspection intervals. Figure 5-12 contains a complete

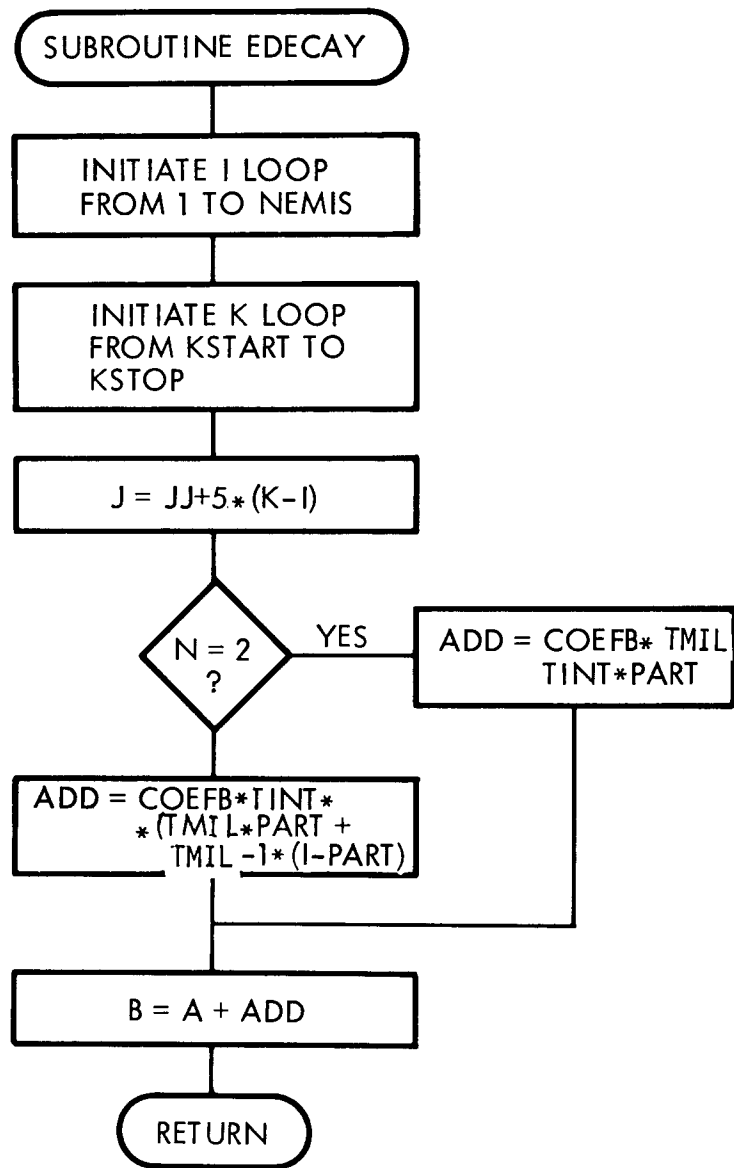


Figure 5-10 Subroutine EDECAY Flowchart

Table 5-10 SUBROUTINE EDECAY LISTING

23880	SUBROUTINE EDECAY(A,B,JJ,N)						
23890	DIMENSION A(15,3),B(15,3)						
23900	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,						
23910	+	BAREA(3),	BLD1,	BLD2,	BSIG(3),	BXTRA,	BSIZE,
23920	+	BHIST(3,16),		BMMI(10,15,3),			
23930	+	ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)					
23940	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),						
23950	+	CARSY,	CBSUM,	CCOEF(10),	CCOSTI,	CCOSTM,	CGTT,
23960	+	CINCON,	CPCB,	CPI,	CPVPY,	CSUM,	CARAY,
23970	+	CN(15,3,16),		COEFB(15,3),		COEFBP(10,15),	
23980	+	CPART(10,15)					
23990	CC ADD2						
24000	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),						
24010	+	EMW(3),	EP(10,15),	EFF(10),	DELIT(3),		
24020	+	FREQA,	FREQB,	FPERC(10,3),			
24030	+	HORZN,	HORZNY,				
24040	+	HPC(15,16),		HPCS(15,16),		HPP(10,15,16),	
24050	+	HPS(6,15,16),		HPT(5,16),		HPTOT(16),	
24060	+	HPTOTS(16)					
24070	CC ADD3						
24080	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),						
24090	+	KSTART,	KSTOP,	LOPT,	LPICK(10),	LLPICK,	
24100	+	LIDLE,	LINT(16),	LPSP(10),	LSTART,	LSTOP,	
24110	+	MBASE,	MPH,	MSPEC(10),	MSTART,	MSTOP,	
24120	+	MU(10,3),	MMS(10,15),			MVPR(10,15)	
24130	CC ADD4						
24140	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,						
24150	+	NINTR,	NINTRB,	NMODE,	NO,	NOPTS,	NPAR,
24160	+	NPTRN,	NPJS,	NSTEPS,	NTR,	NTRB,	NPICK(16),
24170	+	UCIY,	UCMY,	OPTI,	OPTM,OPTS(50),	OVCHI(3),	OVCHM(3)
24180	CC ADD5						
24190	COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),						
24200	+	PC(15),	PCS(15),	PHI(14),	PLO(14),	PLTMAX(3),	PMODEL,
24210	+	PP(10,15),	PS(6,15),	PT(5),	PTOT,	PTS(5),	PAYADJ,
24220	+	PAR(10,15,3),		PAR1(10,3,3),		PLUS(10,15),	
24230	+	PM(10,15),		PPICK(10),	PPPICK,	PSTAR,PI(15,10),	
24240	+	PSA(15),	PTA(5),	PCONF,	PARINT(10,10,9)		
24250	+	,PAYFIN					
24260	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,						
24270	+	RTYPE,					
24280	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,

Table 5-10 SUBROUTINE EDECAY LISTING (cont.)

```

24290      + SMODEL, START(15,3), STAT, STIME(3), SUM3M(3),
24300      + SCALEM(3), SM(6,15), SPAR(10,15,6),
24310      + SXCUT(6,3), SIG(10,3), SIGC(3),
24320      + SIGME(10), SIGMNE(10), SIGP(10,15),
24330      + SIGRATE, SIST, SIGS(6,15), SIGSDE(3),
24340      + STABLEX(33,6,15), STABLEY(33,6,15)
24350      COMMON /COM10/ TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),
24360      + TINT, TOBE(3), TONX, TOTE(3), TPDB(3), TPDT(3),
24370      + TXTPA, TSIZE, TSIG(3), TPER(16,15), TMIL(16,15),
24380      + THIST(5,3,16), THISTT(3,16), TIMEC(10,15),
24390      + TIMEM(10,15), TABLEX(33,10,15), TABLEY(33,10,15)
24400      CC ADD10
24410      COMMON /COM11/ WF(10),
24420      + X1BP(3,3,6), XINT, XINTB, XLANE, XSUM, XCUT(10,3),
24430      + XTM(16), XBASE(9,3), YBASE(9,3)
24440      CC ADD11
24450      COMMON /COM12/ Y1BP(3,3,10), Y2BP(3,3,10),
24460      + YES, YSUM, YTM(15), Y1DBP(4,4,10), Y2DBP(4,4,10),
24470      + Z1, Z2, Z3, Z4, Z5, Z6,
24480      + Z7, Z8, Z9, Z10, Z11, Z12,
24490      + Z13, Z14, Z15, Z16, Z17,
24500      + ZCARI, ZCARM, ZIC, ZSUM,
24510      + ZZ(3,3)
24520      CC ADD12
24530      COMMON /DEBUG/ ADEBUG, BDEBUG, CDEBUG, DDEBUG,
24540      + LDEBUG, MDEBUG, PDEBUG, QDEBUG, SDEBUG, TDEBUG
24550      CC ADDD
24560      REAL ITE, ITL, ITP, ITIME,
24570      + MMS, MPH, MSPEC, MU, MVPR,
24580      + NAME, ND, LDEBUG, MDEBUG,
24590      + IN, MISFIRE
24600      INTEGER RNAME, SITEI, SITEM, STAT,
24610      + TDIST, XLANE, OPTI, PPICK, PPPICK
24620      DO 50 I=1,NEMIS
24630      DO 40 K=KSTART,KSTOP
24640      J=JJ+5*(K-1)
24650      ADD=COEFB(J,I)*TINT*(TMIL(N,J)*PART+TMIL(N-1,J)*(1.-PART))
24660      IF(N.EQ.2) ADD=COEFB(J,I)*TMIL(N,J)*TINT*PART
24670      b(J,I)=A(J,I)+ADD
24680      40 CONTINUE
24690      50 CONTINUE
24700      RETURN
24710      END

```

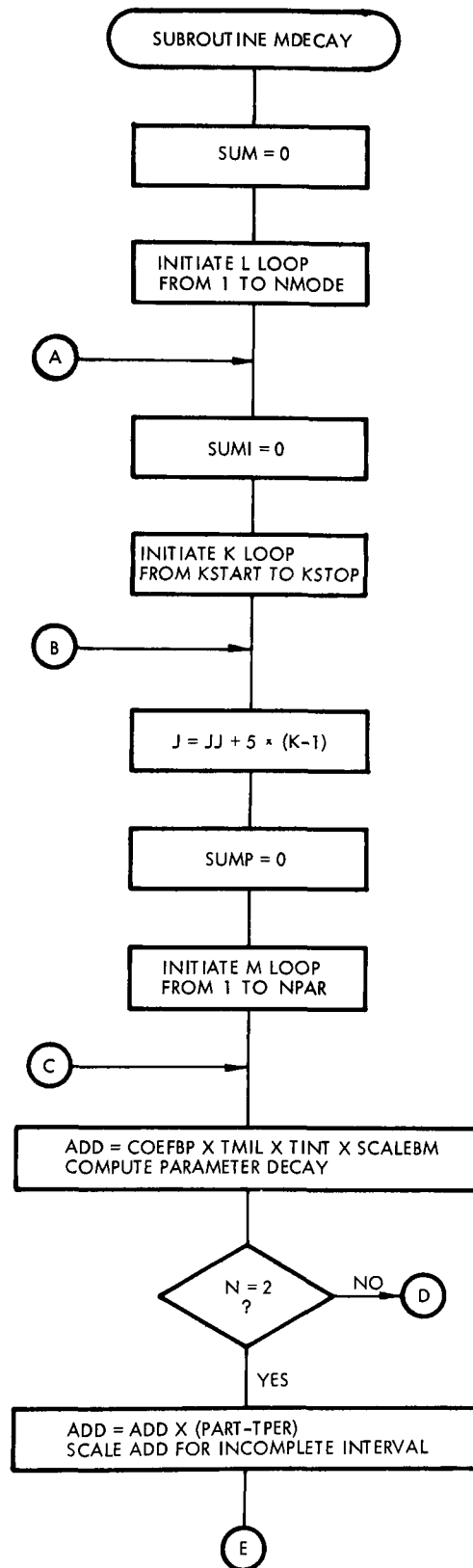


Figure 5-11 Subroutine MDECAY Flowchart

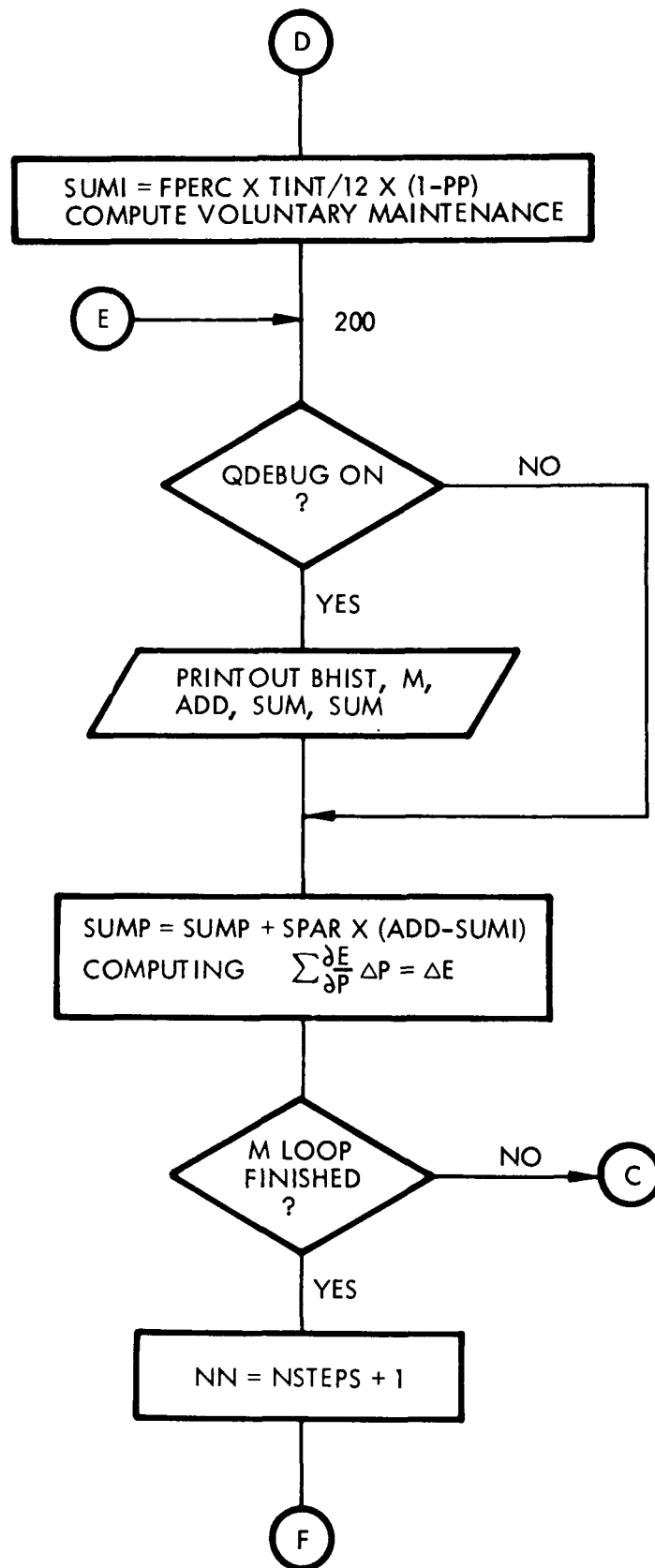


Figure 5-11 Subroutine MDECAY Flowchart (cont.)

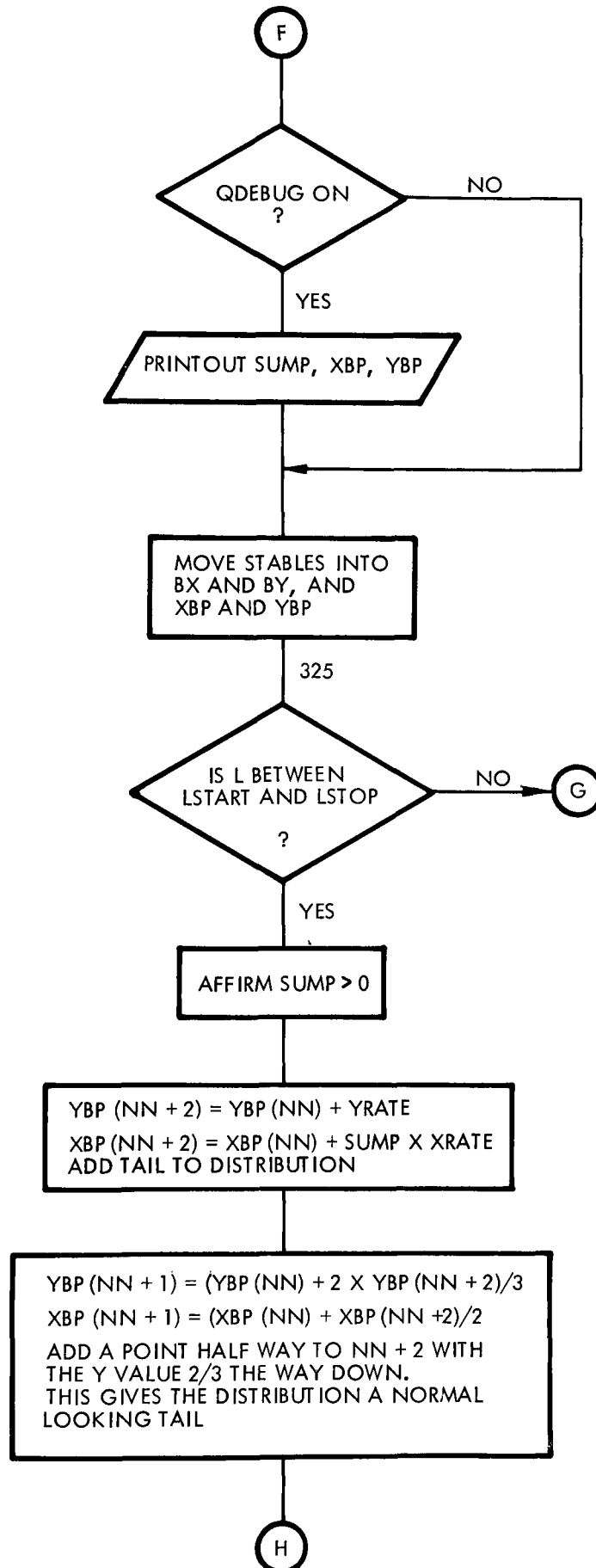


Figure 5-11 Subroutine MDECAY Flowchart (cont.)

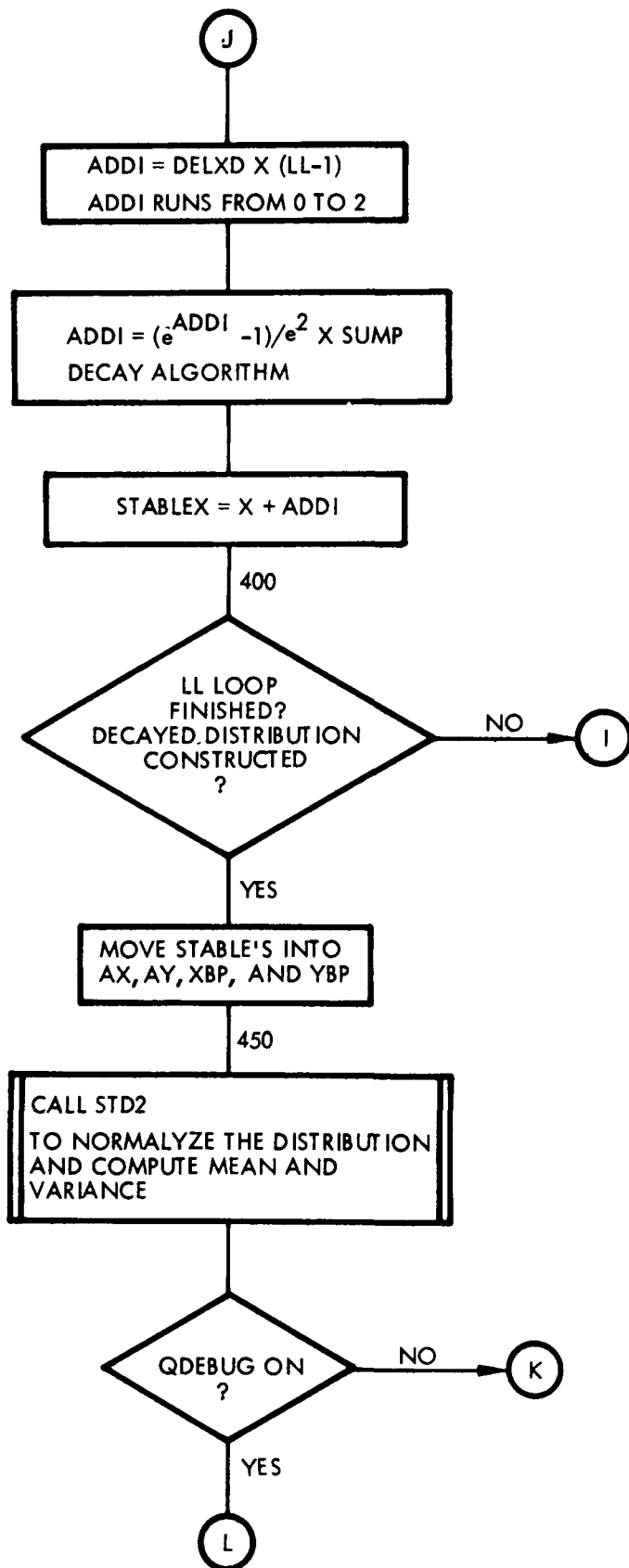


Figure 5-11 Subroutine MDECAY Flowchart (cont.)

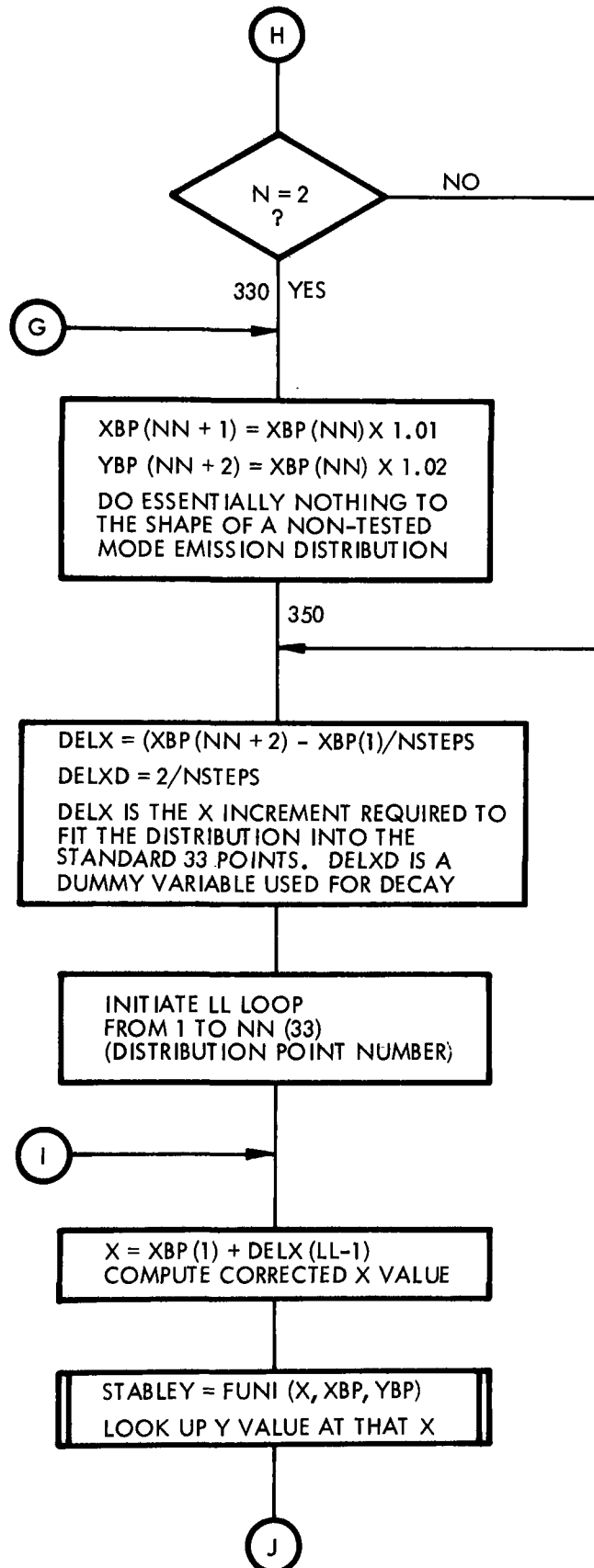


Figure 5-11 Subroutine MDECAY Flowchart (cont.)

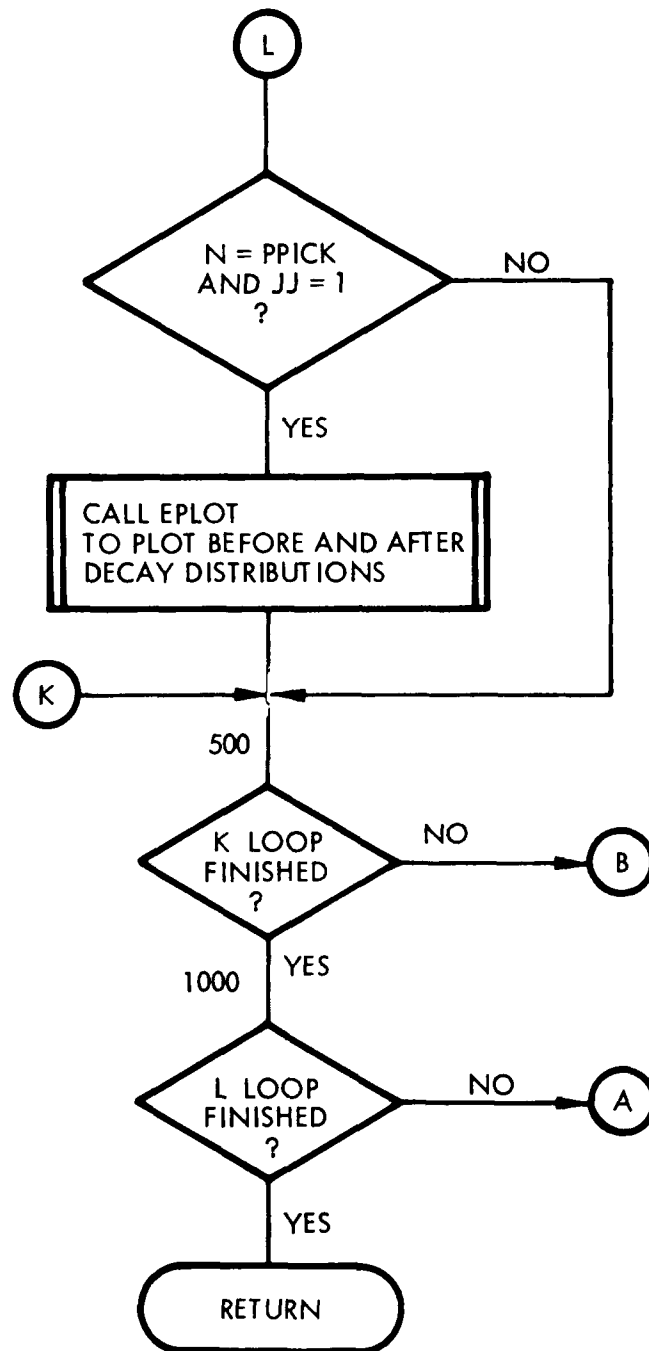


Figure 5-11 Subroutine MDECAY Flowchart (cont.)

Table 5-11 SUBROUTINE MDECAY LISTING

```

24720      SUBROUTINE MDECAY(JJ,N)
24730      DIMENSION YRATE(6)
24740      DIMENSION XRATE(6)
24750      DIMENSION XBP(35),YBP(35)
24760      COMMON /COM01/      AMB(3),ALAB,      AVV, BINT,
24770      +      BAREA(3), BLD1,      BLD2,      BSIG(3), BXTRA,      BSIZE,
24780      +      BHIST(3,16),      BMMI(10,15,3),
24790      +      ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
24800      COMMON /COM02/      CARA,      CARIY,      CARMY,      CARPOP(16),
24810      +      CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCOSTM,      CGTT,
24820      +      CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
24830      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
24840      +      CPART(10,15)
24850      CC ADD2
24860      COMMON /COM03/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
24870      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
24880      +      FREQA,      FREQB,      FPERC(10,3),
24890      +      HORZN,      HORZNY,
24900      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
24910      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
24920      +      HPTOTS(16)
24930      CC ADD3
24940      COMMON /COM04/      ITE,      ITL,      ITP,      ITIME(16),
24950      +      KSTART,      KSTOP,      LOPT,      LPICK(10),LLPICK,
24960      +      LIDLE,      LINT(16), LPSPP(10),LSTART,      LSTOP,
24970      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
24980      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
24990      CC ADD4
25000      COMMON /COM05/      NAME(50), NCNTR,      NEMIS,      NEMP,
25010      +      NINTR,      NINTRB,      NMODE,      NO,      NOPTS,      NPAR,
25020      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
25030      +      OCIY,      OCMY,      OPT1,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
25040      CC ADD5
25050      COMMON /COM06/ PARM(3,3), PART,      PAYNEW,      PAYOFF(3),
25060      +      PC(15),      PCS(15), PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
25070      +      PP(10,15),PS(6,15), PT(5),      PTOT,      PTS(5),      PAYADJ,
25080      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
25090      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
25100      +      PSA(15),      PTA(5),      PCONF,      PARINT(10,10,9)
25110      + ,PAYFIN
25120      COMMON /COM07/      REINSP,      RNAME,      RSIZE,      RSTOP,

```

Table 5-11 SUBROUTINE MDECAY LISTING (cont.)

25130	+	RTYPE,					
25140	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,
25150	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
25160	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
25170	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
25180	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
25190	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),	
25200	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
25210		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
25220	+	TINT,	TOBE(3),	TONX,	TOTE(3),	TPUB(3),	TPDT(3),
25230	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
25240	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),	
25250	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
25260		CC ADD10					
25270		COMMON /COM11/		WF(10),			
25280	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
25290	+	XTM(16),	XBASE(9,3),	YBASE(9,3)			
25300		CC ADD11					
25310		COMMON /COM12/		Y1BP(3,3,10),		Y2BP(3,3,10),	
25320	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),	Y2DBP(4,4,10),	
25330	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
25340	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
25350	+	Z13,	Z14,	Z15,	Z16,	Z17,	
25360	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
25370	+	ZZ(3,3)					
25380		CC ADD12					
25390		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
25400	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
25410		CC ADD0					
25420		REAL	ITE,	ITL,	ITP,	ITIME,	
25430	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
25440	+	NAME,	NO,	LDEBUG,	MDEBUG,		
25450	+	IN,	MISFIRE				
25460		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
25470	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
25480		DATA XRATE/3.,3.,3.,3.,8.,3./					
25490		DATA YRATE/6*0.15/					
25500		SUM=0.					
25510		DO 1000 L=1,NMODE					
25520		SUM1=0.					
25530		DO 500 K=KSTART,KSTOP					
25540		J=JJ+5*(K-1)					

Table 5-11 SUBROUTINE MDECAY LISTING (cont.)

```

25550      SUMP=0.
25560      DO 300 M=1,NPAR
25570      ADD=COEFBP(M,J)*TINT*(PART*TMIL(N,J)+(1.-PART)*TMIL(N-1,J))
25580      IF(N.EQ.2) ADD=CDEFBP(M,J)*TINT*TMIL(N,J)*PART
25590      SUM1=FPERC(M,K)*TINT/12.*(1.-PP(M,J))
25600      IF(N.EQ.2) SUM1=SUM1*PART
25610      200 CONTINUE
25620      IF(QDEBUG.EQ.YES) WRITE (6,205) (BHIST(I,N-1),I=1,NEMIS)
25630      205 FORMAT(* BHIST = *,E15.5)
25640      IF(QDEBUG.EQ.YES) WRITE (6,250) M,ADD,SUM,SUM1
25650      250 FORMAT(* M = *I2,5X,*ADD = *E15.5,5X,* SUM = *E15.5,
25660      + 5X,*SUM1 = *E15.5)
25670      SUMP=SUMP+SPAR(M,J,L)*(ADD -SUM1)
25680      300 CONTINUE
25690      NN=NSTEPS+1
25700      IF(QDEBUG.EQ.YES) WRITE (6,305) SUMP,XBP(NN),YBP(NN)
25710      305 FORMAT(* SUMP = *E15.4,5X,*X = *E15.4,5X,*Y = *E15.4/)
25720      DO 325 LL=1,NN
25730      XBP(LL)=STABLEX(LL,L,J)
25740      YBP(LL)=STABLEY(LL,L,J)
25750      325 CONTINUE
25760      IF(L.LT.LSTART.OR.L.GT.LSTOP) GO TO 330
25770      IF(SUMP.LT.0.) SUMP=0.01
25780      YBP(NN+2)=YBP(NN)*YRATE(L)
25790      XBP(NN+2)=XBP(NN)+SUMP*XRATE(L)
25800      XBP(NN+1)=(XBP(NN)+XBP(NN+2))/2.
25810      YBP(NN+1)=(YBP(NN)+2*YBP(NN+2))/3
25820      IF(N.NE.2) GO TO 350
25830      330 XBP(NN+1)=XBP(NN)*1.01
25840      XBP(NN+2)=XBP(NN)*1.02
25850      350 CONTINUE
25860      DELX=(XBP(NN+2)-XBP(1))/NSTEPS
25870      DELXD=2./NSTEPS
25880      DO 400 LL=1,NN
25890      X=XBP(1)+DELX*(LL-1)
25900      STABLEY(LL,L,J)=FUN1(X,XBP,YBP,NN+2)
25910      ADD1=DELXD*(LL-1)
25920      ADD1=(EXP(ADD1)-1.)/EXP(2.)*SUMP
25930      STABLEX(LL,L,J)=X+ADD1
25940      400 CONTINUE
25950      DO 450 LL=1,NN
25960      XBP(LL)=STABLEX(LL,L,J)

```

Table 5-11 SUBROUTINE MDECAY LISTING (cont.)

25970	YBP(LL)=STABLEY(LL,L,J)
25980	400 CONTINUE
25990	CALL STD2(XBP,YBP,NN,S4(L,J),SIGS(L,J))
26000	C*****IF(QDEBUG.EQ.YES.AND.N.EQ.PPICK(PPPICK).AND.JJ.EQ.1)
26010	C***** CALL EPLOT(BX,BY,AX,AY,NN,LINT(M))
26020	500 CONTINUE
26030	1000 CONTINUE
26040	RETURN
26050	END

flowchart of PDECAY which documents the programming techniques used. Table 5-12 gives the program listings.

5.9 SUBROUTINE COSTS

The General Economic Effectiveness Program contains data and algorithms for estimating the economic impact of a mandatory vehicle inspection and maintenance program. Subroutine COSTS contains the equations for estimating user inconvenience costs, inspection station land, building, and management costs and labor training costs. COSTS also computes the various figures-of-merit and average emission reductions. The listing and flowcharts contained in Table 5-13 and Figure 5-13 respectively describe in detail the techniques and data assumptions used.

5.10 SUBROUTINE STATS

Subroutine STATS contains the algorithms for conducting a statistical analysis of the predicted emission reduction results. The model makes two basic assumptions: 1) all distribution functions can be adequately described by tables regardless of their shape, and 2) these distribution functions are independent of each other.

The model begins with a set of engine parameter distributions that characterize the state of vehicles as they now exist in the population. These distributions are modified to reflect the maintenance treatment and various system errors. There are basically three classes of errors -- inspection, maintenance, and model generated. The resulting distribution yields an estimate of the emission variance for a fleet of vehicles that has passed through the inspection/maintenance process. The final distribution

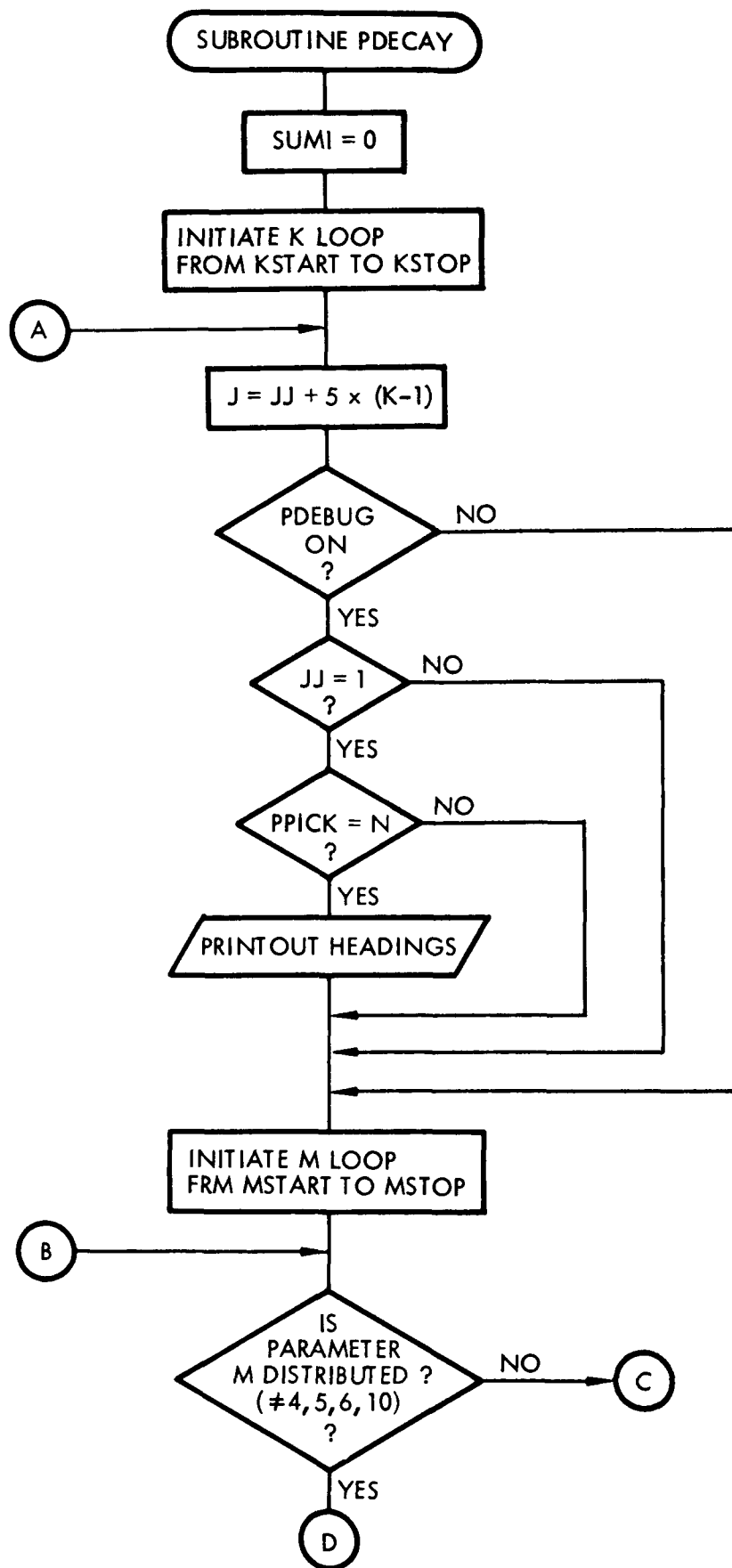


Figure 5-12 Subroutine PDECAY Flowchart

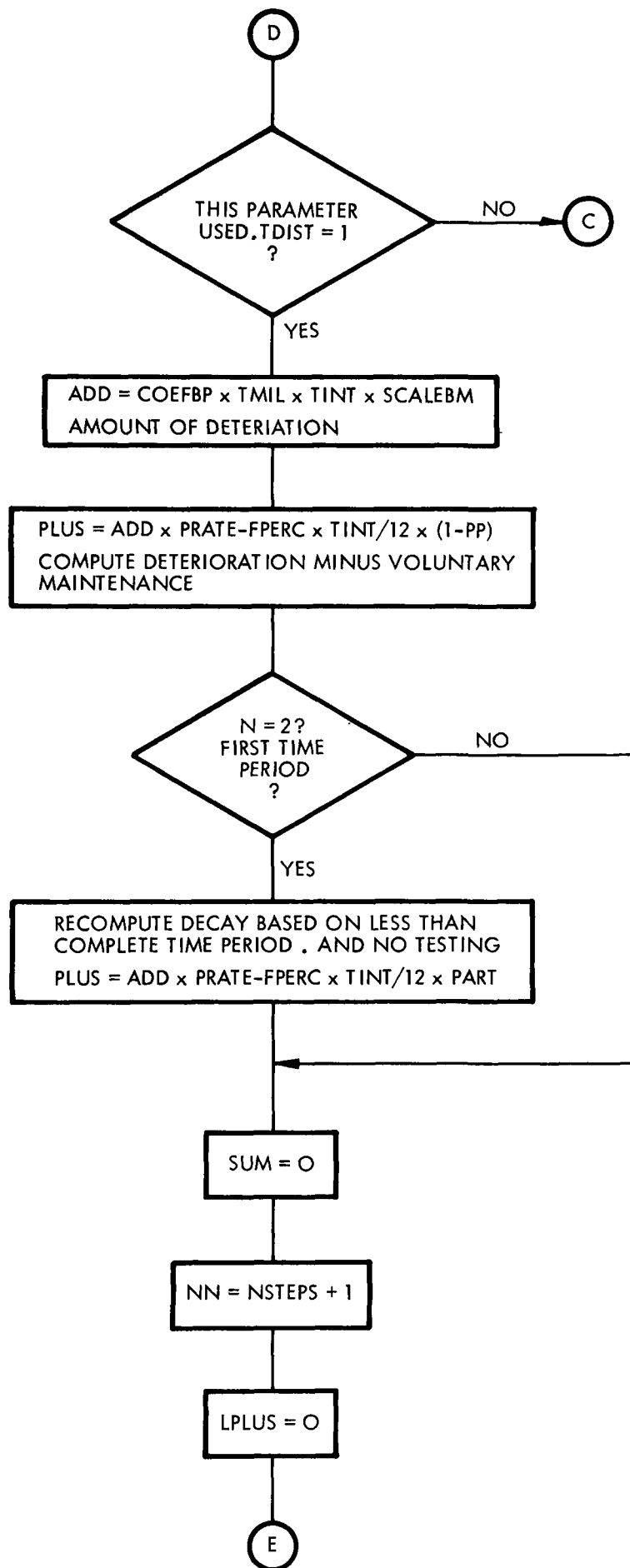


Figure 5-12 Subroutine PDECAY Flowchart (cont.)

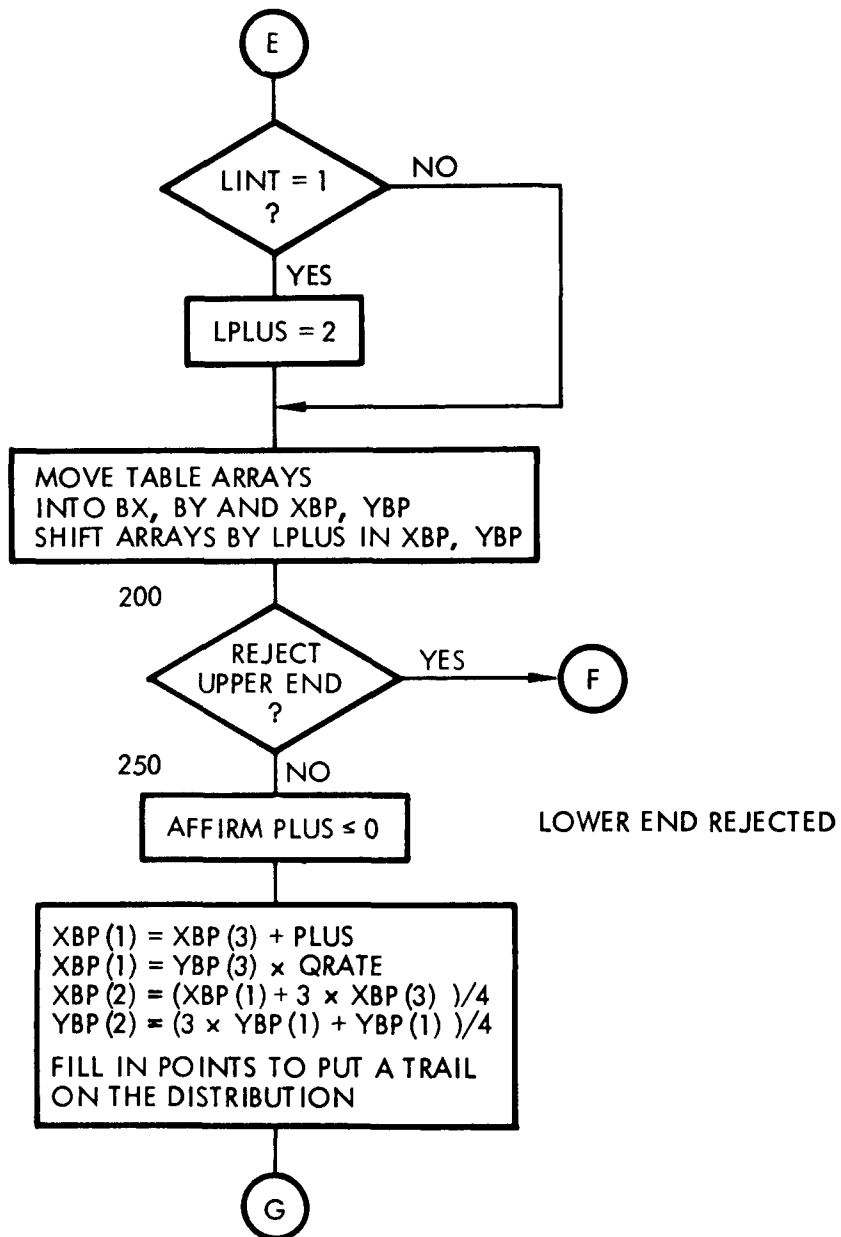


Figure 5-12 Subroutine PDECAY Flowchart (cont.)

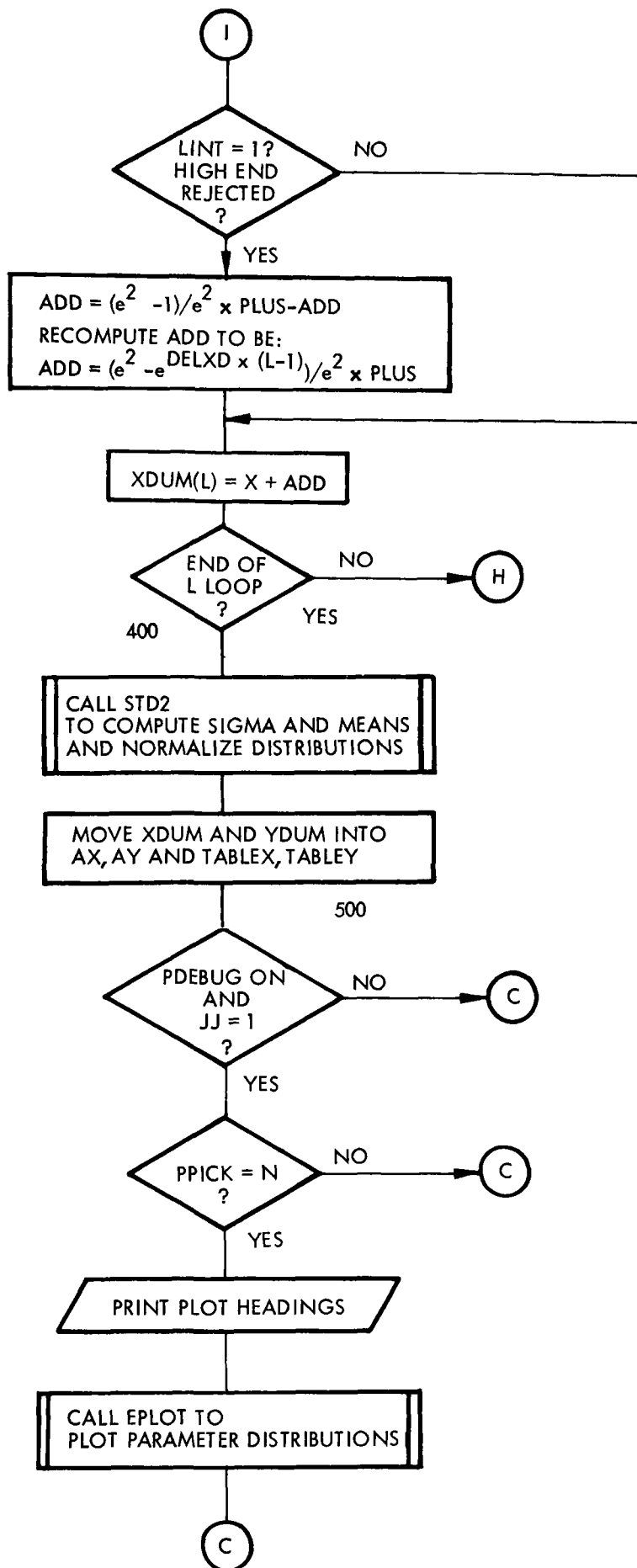


Figure 5-12 Subroutine PDECAY Flowchart (cont.)

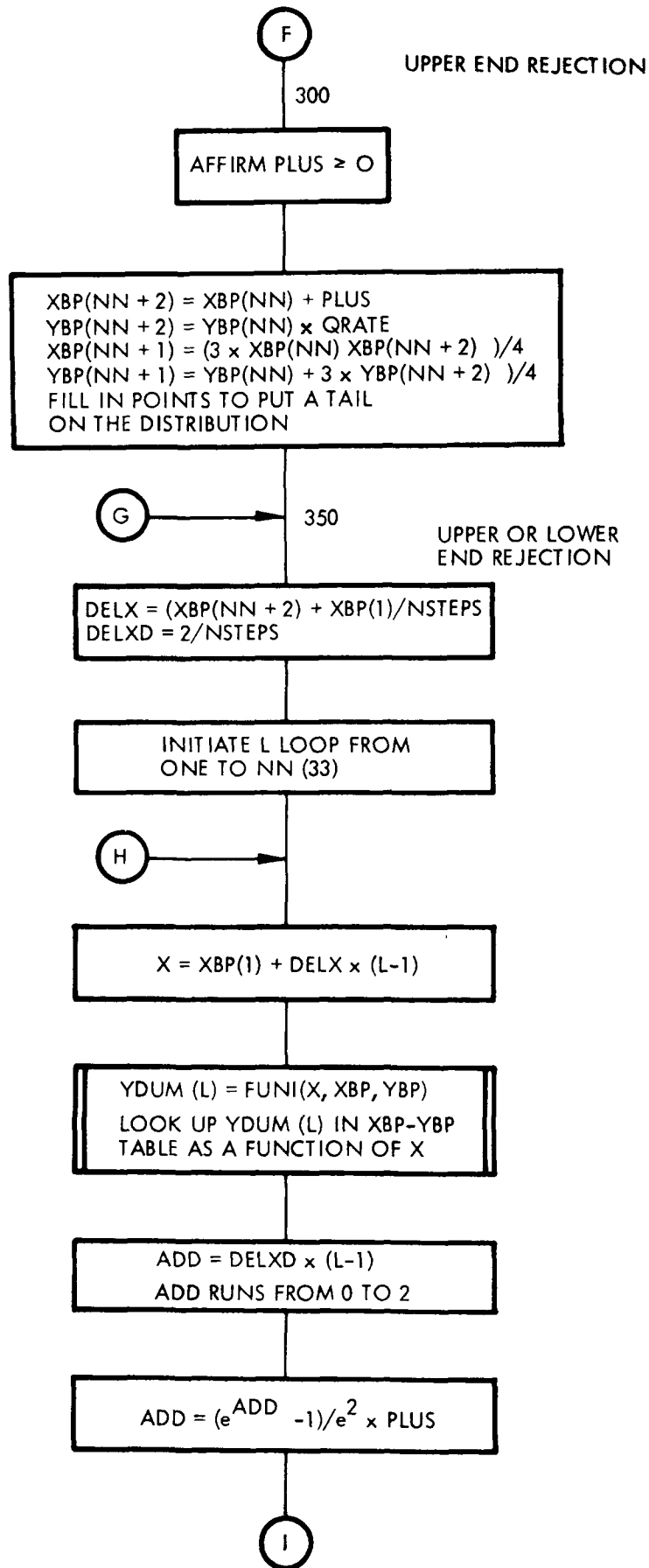


Figure 5-12 Subroutine PDECAY Flowchart (cont.)

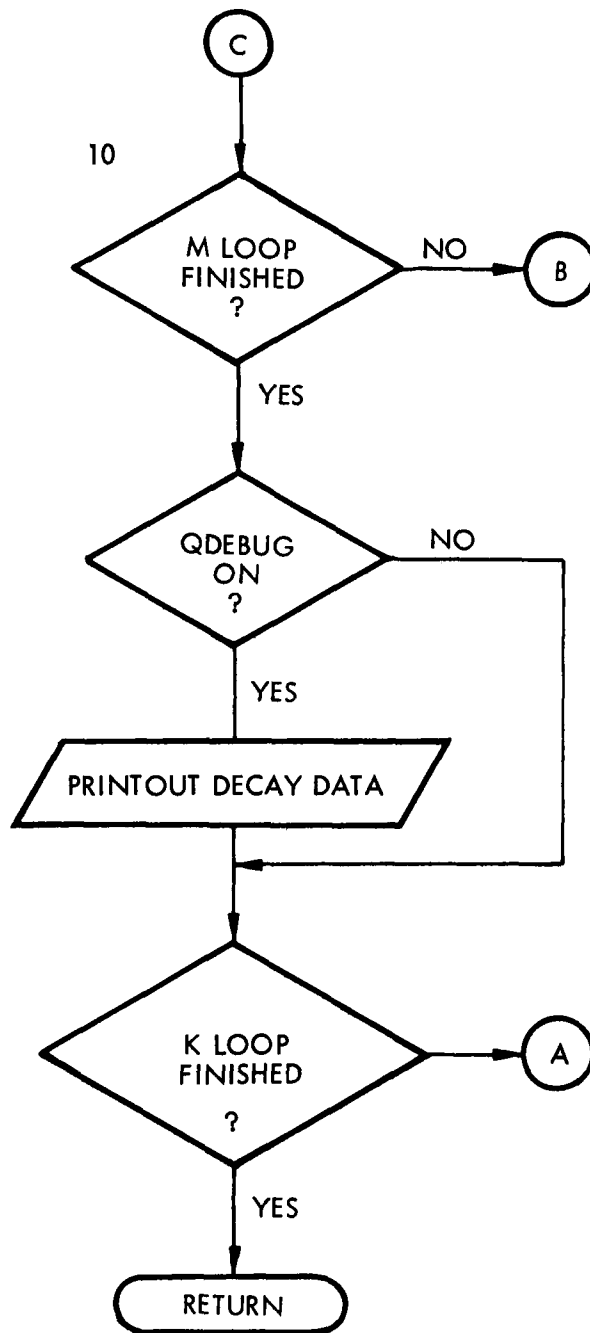


Figure 5-12 Subroutine PDECAY Flowchart (cont.)

Table 5-12 SUBROUTINE PDECAY LISTING

```

26060      SUBROUTINE PDECAY(JJ,N)
26070      DIMENSION XBP(50),YBP(50)
26080      DIMENSION DATE(10,3),PRATE(10,3)
26090      DIMENSION BX(35),BY(35),AX(35),AY(35)
26100      COMMON /COM01/      AM3(3),ALAB,      AVV,      BINT,
26110      +      BAREA(3),BLD1,      BLD2,      BSIG(3),      BXTA,      BSIZE,
26120      +      BHIST(3,16),      BMMI(10,15,3),
26130      +      ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
26140      COMMON /COM02/      CARA,      CARIY,      CARMY,      CARPOP(16),
26150      +      CARSY,      CBSUM,      CCDEF(10),CCOSTI,      CCOSTM,      CGTT,
26160      +      CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
26170      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
26180      +      CPART(10,15)
26190      CC ADD2
26200      COMMON /COM03/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
26210      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
26220      +      FRECA,      FREQB,      FPRFC(10,3),
26230      +      HORZN,      HORZNY,
26240      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
26250      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
26260      +      HPTOTS(16)
26270      CC ADD3
26280      COMMON /COM04/      ITE,      ITL,      ITP,      ITIME(16),
26290      +      KSTART,      KSTOP,      LUPT,      LPICK(10),LLPICK,
26300      +      LIDLF,      LINT(16),      LPSP(10),LSTART,      LSTOP,
26310      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
26320      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
26330      CC ADD4
26340      COMMON /COM05/      NAME(50),      NCNTR,      NEMIS,      NEMP,
26350      +      NINTR,      NINTRB,      NMODE,      NU,      NOPTS,      NPAR,
26360      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTFB,      NPICK(16),
26370      +      CCIY,      OCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
26380      CC ADD5
26390      COMMON /COM06/      PARM(3,3),      PART,      PAYNEW,      PAYOFF(3),
26400      +      PC(15),      PCS(15),      PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
26410      +      PP(10,15),PS(6,15),      PT(5),      PTOT,      PTS(5),      PAYADJ,
26420      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
26430      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
26440      +      PSA(15),      PTA(5),      PCDEF,      PARINT(10,10,9)
26450      +      ,PAYFIN
26460      COMMON /COM07/      REINSP,      RNAME,      RSIZE,      RSTOP,

```

Table 5-12 SUBROUTINE PDECAY LISTING (cont.)

26470	+	RTYPE,					
26480	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,
26490	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
26500	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
26510	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
26520	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
26530	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),	
26540	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
26550		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
26560	+	TINT,	TOBE(3),	TONX,	TOTE(3),	TPDB(3),	TPDT(3),
26570	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
26580	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),	
26590	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
26600		CC ADD10					
26610		COMMON /COM11/		WF(10),			
26620	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
26630	+	XTM(16),	XBASE(9,3),	YBASE(9,3)			
26640		CC ADD11					
26650		COMMON /COM12/		Y1BP(3,3,10),		Y2BP(3,3,10),	
26660	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),	Y2DBP(4,4,10),	
26670	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
26680	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
26690	+	Z13,	Z14,	Z15,	Z16,	Z17,	
26700	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
26710	+	ZZ(3,3)					
26720		CC ADD12					
26730		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
26740	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
26750		CC ADDD					
26760		REAL	ITE,	ITL,	ITP,	ITIME,	
26770	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
26780	+	NAME,	NO,	LDEBUG,	MDEBUG,		
26790	+	IN,	MISFIRE				
26800		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
26810	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
26820		DATA ORATE/.33,9*.16,.33,9*.16,.33,9*.16/					
26830		DATA PRATE/2.,1.,9.,0.,0.,0.,1.,2.,1.,0.,2.,1.,12.,0.,0.,0.,1.,					
26840	+	2.,1.,0.,2.,1.,9.,0.,0.,0.,1.,2.,1.,0./					
26850		SUM1=0.					
26860		DO 20 K=KSTART,KSTOP					
26870		J=JJ+5*(K-1)					
26880		IF(PDEBUG.EQ.NO) GO TO 5					

Table 5-12 SUBROUTINE PDECAY LISTING (cont.)

```

26890      IF(JJ.NE.1) GOTO 5
26900      IF(PPICK(PPPICK).NE.N) GOTO 5
26910      WRITE (6,30)
26920      WRITE (6,55) NAME(JJ+10),NAME(K+3),(L,L=1,10),
26930      + (PM (M,J),M=1,10),(SIGP(M,J),M=1,NPAR)
26940      5 DO 10 M=MSTART,MSTOP
26950      IF(M.EQ.5.OR.M.EQ.6) GO TO 10
26960      IF(M.EQ.4.OR.M.EQ.10) GO TO 10
26970      IF(TDIST(M,K).NE.1) GOTO 10
26980      ADD=COEFBP(M,J)*TINT*(PART*TMIL(N,J)+(1.-PART)*TMIL(N-1,J))
26990      IF(N.EQ.2) ADD=COEFBP(M,J)*TINT*TMIL(N,J)
27000      PLUS(M,J)=ADD*PRATE(M,K) -FPERC(M,K)*TINT/12.*(1.-PP(M,J))
27010      IF(N.EQ.2) PLUS(M,J)=(ADD*PRATE(M,K)-FPERC(M,K)*TINT/12.)*PART
27020      SUM=0.
27030      NN=NSTEPS+1
27040      LPLUS=0
27050      IF(LINT(M).EQ.1) LPLUS=2
27060      DO 200 L=1,NN
27070      BX(L)=XBP(L+LPLUS)=TABLEX(L,M,J)
27080      BY(L)=YBP(L+LPLUS)=TABLEY(L,M,J)
27090      200 CONTINUE
27100      IGO=LINT(M)
27110      GO TO (250,300), IGO
27120      250 CONTINUE
27130      CC REJECT LOWER PORTION
27140      IF(PLUS(M,J).GT.0.) PLUS(M,J)=-0.01
27150      XBP(1)=XBP(3)+ PLUS(M,J)
27160      YBP(1)=YBP(3)*QRATE(M,K)
27170      XBP(2)=(XBP(1)+3.*XBP(3))/4.
27180      YBP(2)=(YBP(3)+3.*YBP(1))/4.
27190      GO TO 350
27200      300 CONTINUE
27210      IF(PLUS(M,J).LT.0.) PLUS(M,J)=0.01
27220      CC REJECT UPPER PORTION
27230      XBP(NN+2)=XBP(NN)+ PLUS(M,J)
27240      YBP(NN+2)=YBP(NN)*QRATE(M,K)
27250      XBP(NN+1)=(3.*XBP(NN)+XBP(NN+2))/4.
27260      YBP(NN+1)=(YBP(NN)+3.*YBP(NN+2))/4.
27270      350 CONTINUE
27280      DELX=(XBP(NN+2)-XBP(1))/NSTEPS
27290      DELXD=2./NSTEPS
27300      CC DECAY OF ENTIRE DISTRIBUTION

```

Table 5-12 SUBROUTINE PDECAY LISTING (cont.)

27310		DO 400 L=1,NN
27320		X=XBP(1)+DELX*(L-1)
27330		AY(L)=FUN1(X,XBP,YBP,NN+2)
27340		ADD=DELXD*(L-1)
27350		ADD=(EXP(ADD)-1.)/EXP(2.)*PLUS(M,J)
27360		IF(LINT(M).EQ.1) ADD=(EXP(2.)-1.)/EXP(2.)*PLUS(M,J) -ADD
27370		AX(L) = X+ADD
27380	400	CONTINUE
27390		CALL PACKD(AX,AY,NN)
27400		CALL STD2(AX,AY,NN,PM(M,J),SIGP(M,J))
27410		DO 500 L=1,NN
27420		TABLEX(L,M,J)=AX(L)
27430		TABLEY(L,M,J)=AY(L)
27440	500	CONTINUE
27450	11	FORMAT(1H1,/40X,A10,/))
27460		IF(PDEBUG.NE.YES) GOTO 10
27470		IF(JJ.NE.1) GOTO 10
27480		IF(PPICK(PPPICK).NE.N) GOTO 10
27490		MM=30+M
27500		WRITE(6,11) NAME(MM)
27510		CALL EPLD(BX,BY,AX,AY,NN,LINT(M))
27520	10	CONTINUE
27530		IF(PDEBUG.NE.YES) GOTO 20
27540	30	FORMAT(1H1,25X,*PARAMETER SETTINGS BEFORE DECAY AND MAINT*)
27550		WRITE (6,40)
27560	40	FORMAT(/,25X,*PARAMETER SETTINGS AFTER DECAY AND MAINT*)
27570		WRITE (6,55) NAME(JJ+10),NAME(K+3),(L,L=1,10),(PM (M,J),
27580		+ M=1,10),(SIGP(M,J),M=1,NPAR)
27590	55	FORMAT(/,25X,A8,* -- *,A8//,* PARAMETER *,
27600		+ 10(3X,12,5X),//,3X,*PM*,5X,10E10.2/2X,*SIGP*,4X,10E10.2)
27610	20	CONTINUE
27620		RETURN
27630		END

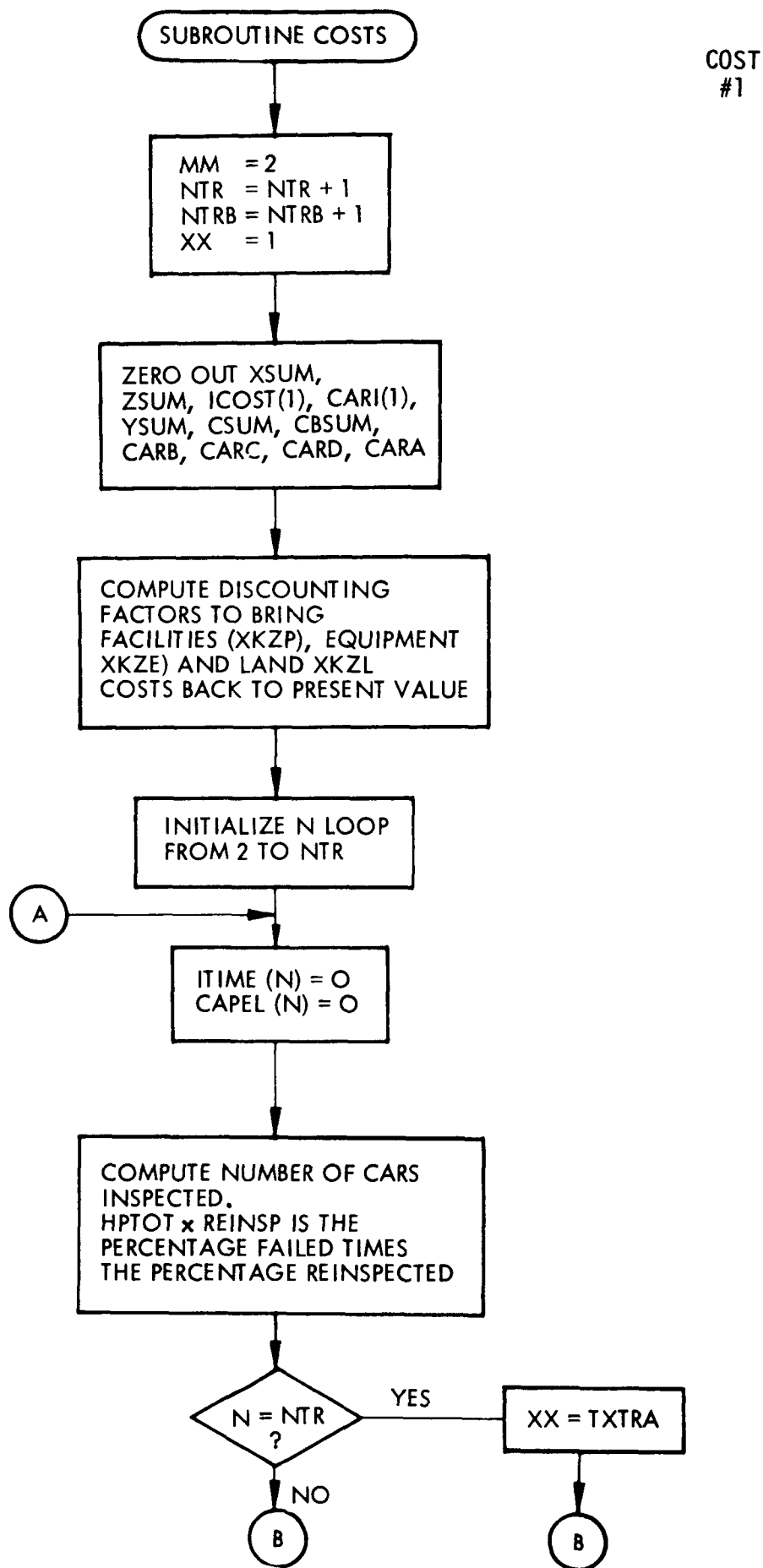


Figure 5-13 Subroutine COSTS Flowchart

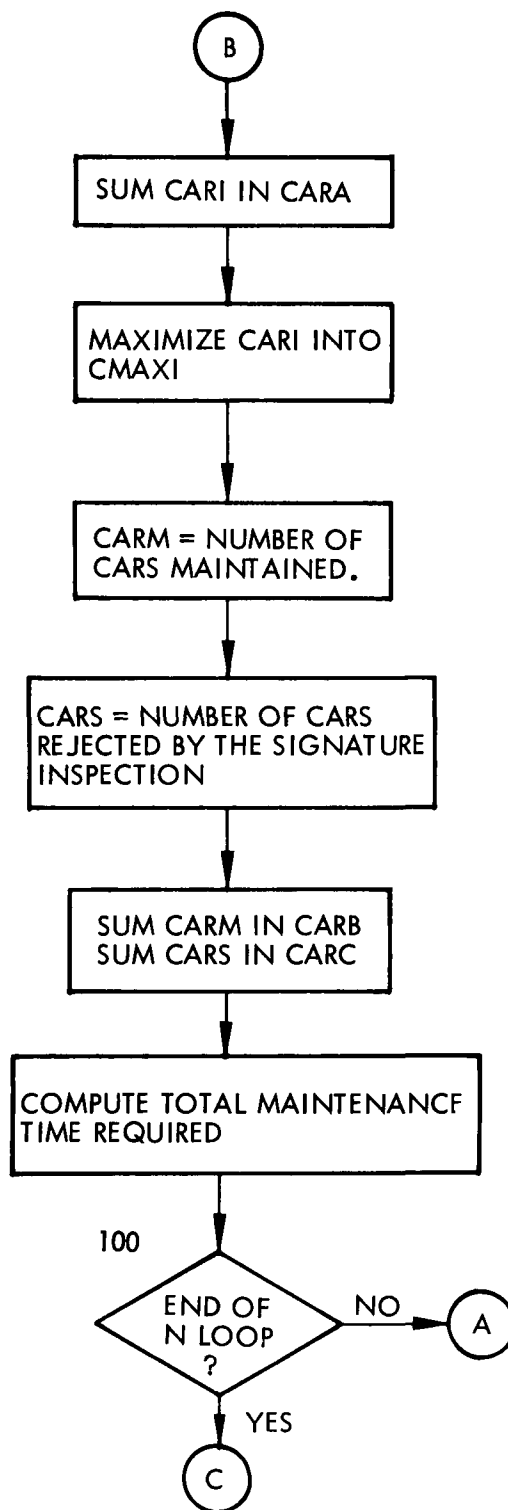


Figure 5-13 Subroutine COSTS Flowchart (cont.)

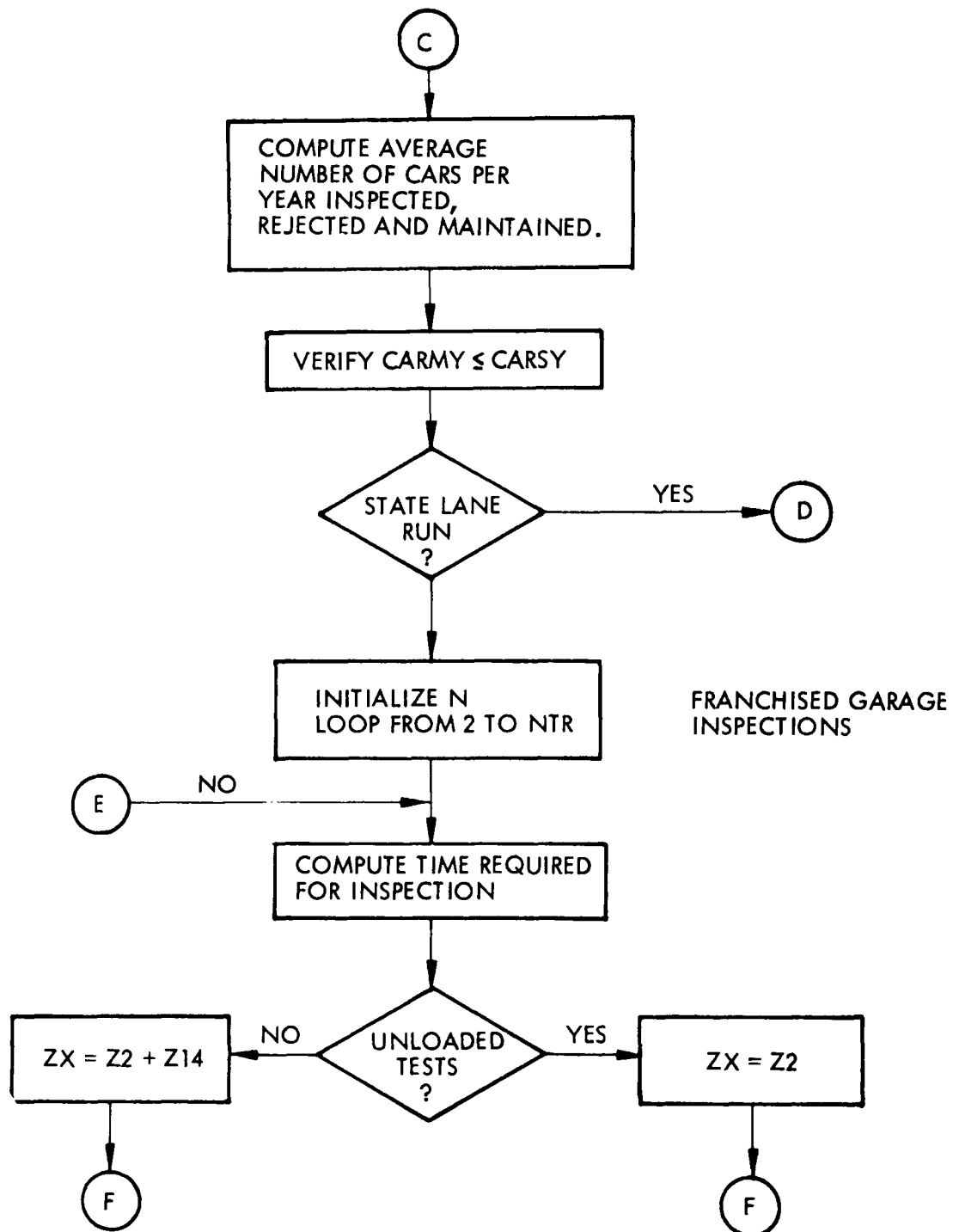


Figure 5-13 Subroutine COSTS Flowchart (cont.)

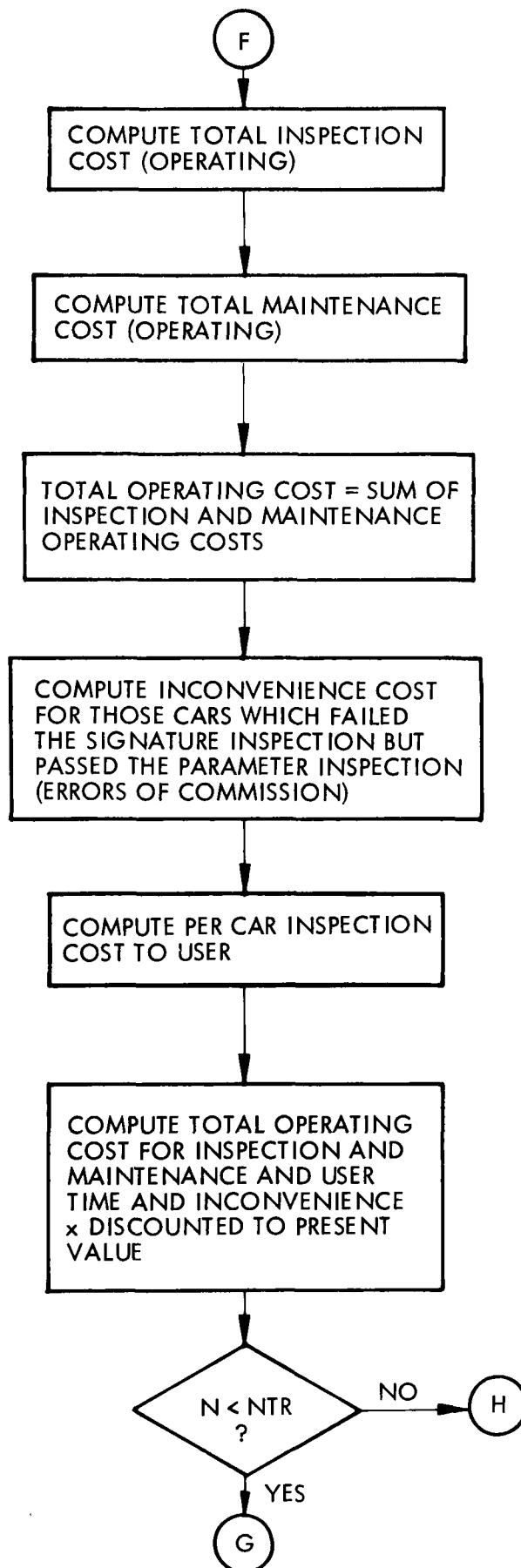


Figure 5-13 Subroutine COSTS Flowchart (cont.)

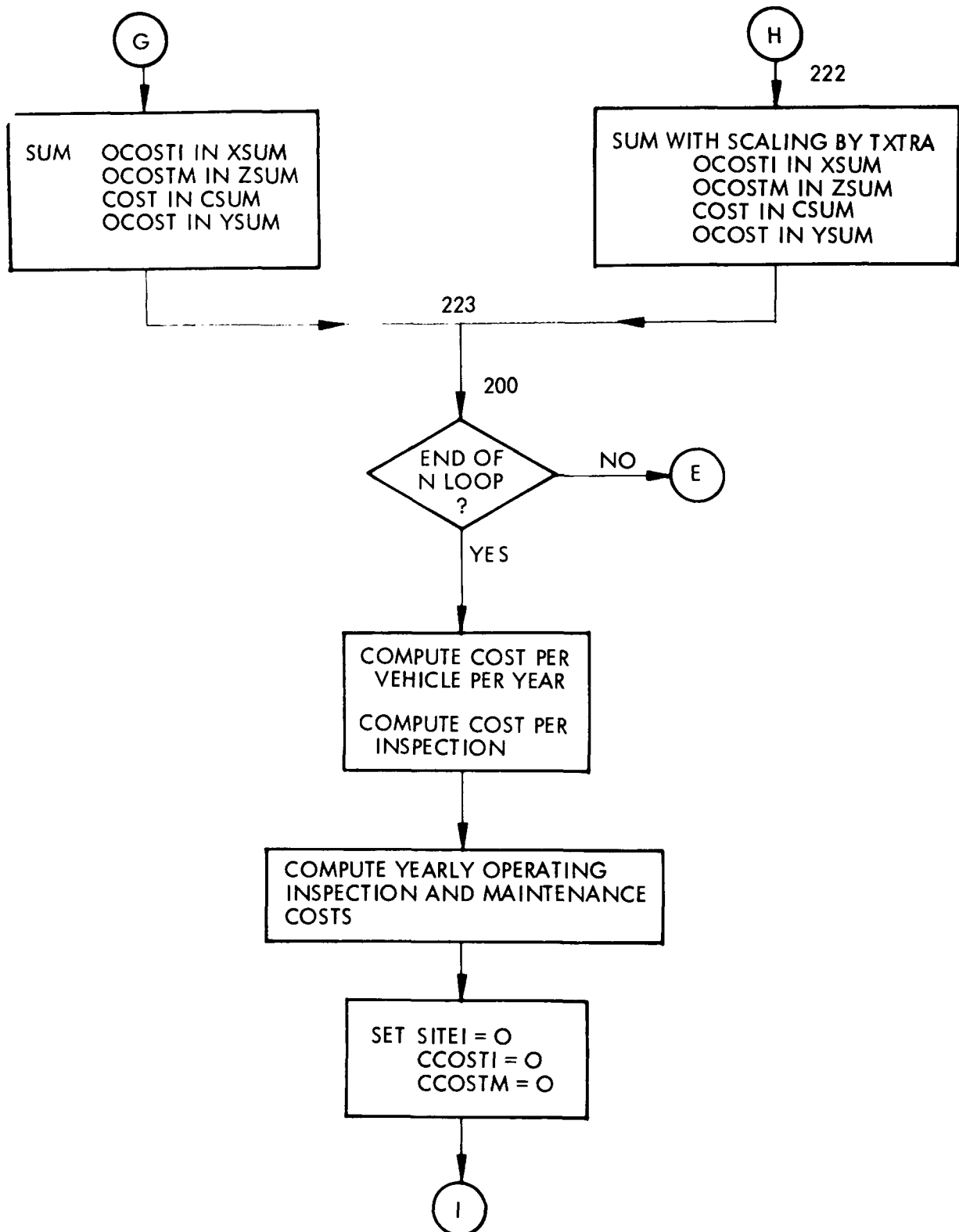


Figure 5-13 Subroutine COSTS Flowchart (cont.)

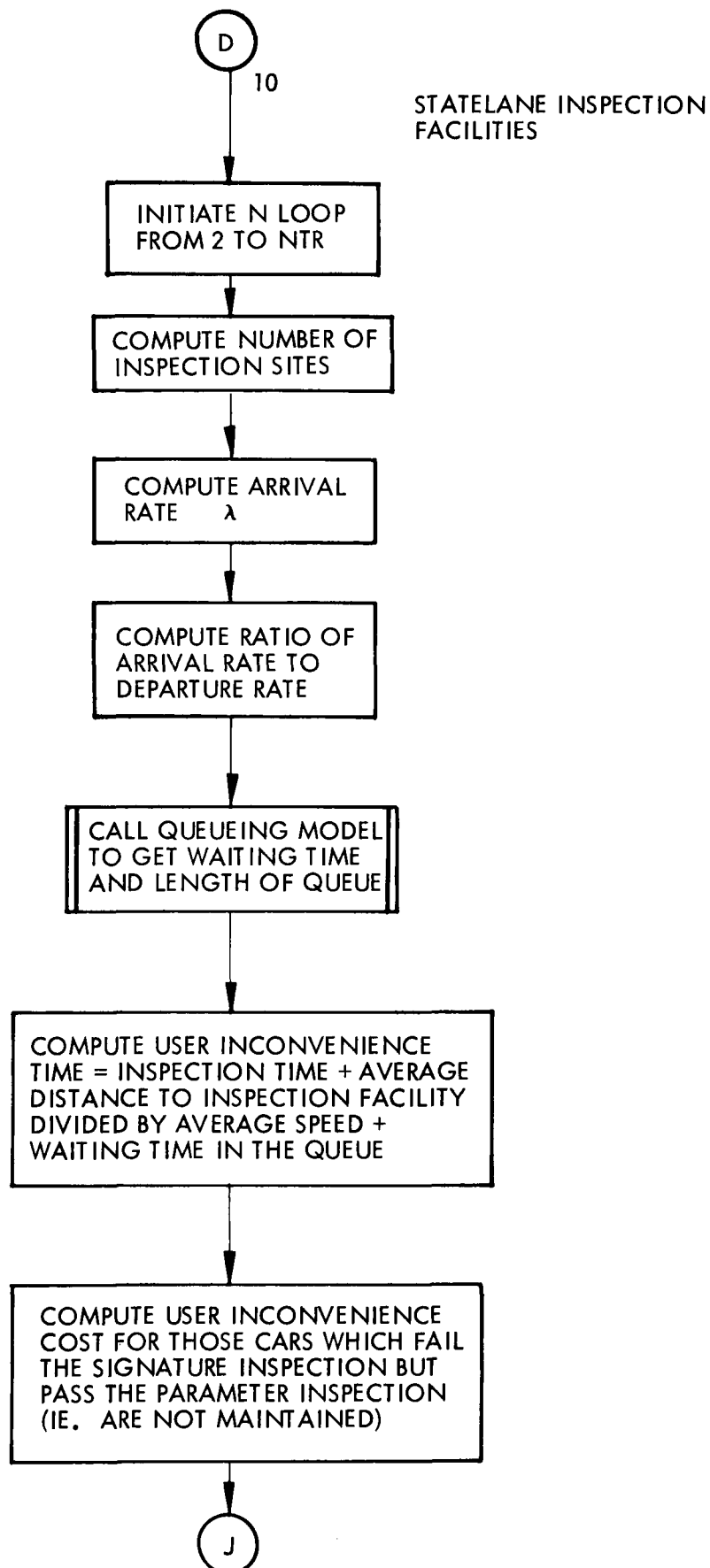


Figure 5-13 Subroutine COSTS Flowchart (cont.)

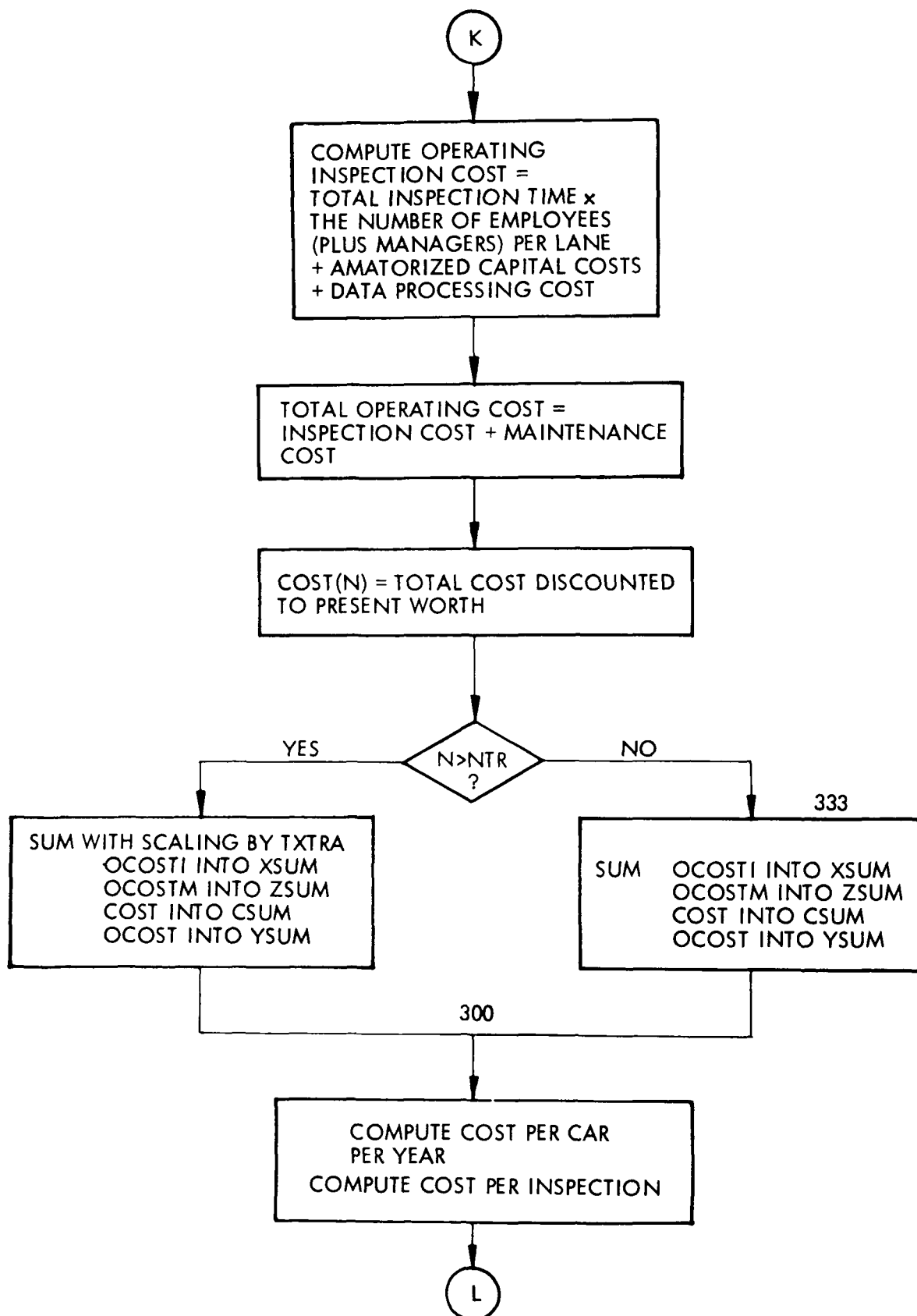


Figure 5-13 Subroutine COSTS Flowchart (cont.)

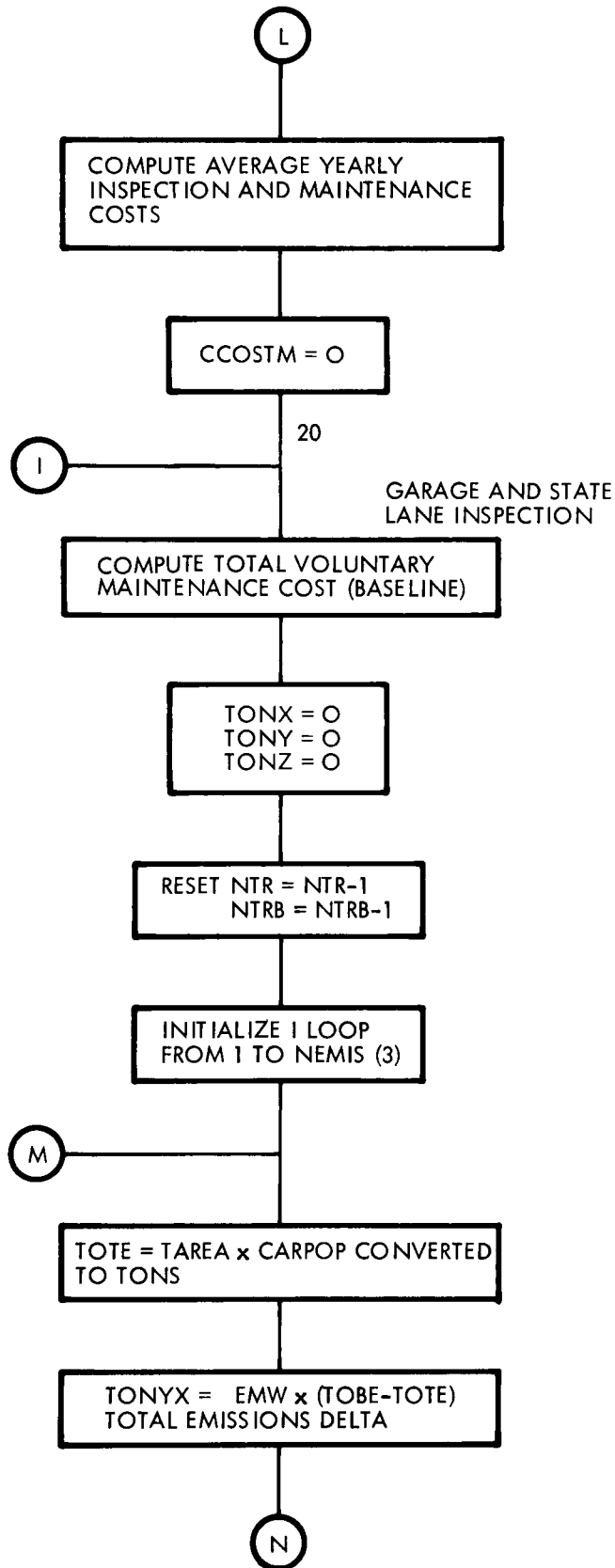


Figure 5-13 Subroutine COSTS Flowchart (cont.)

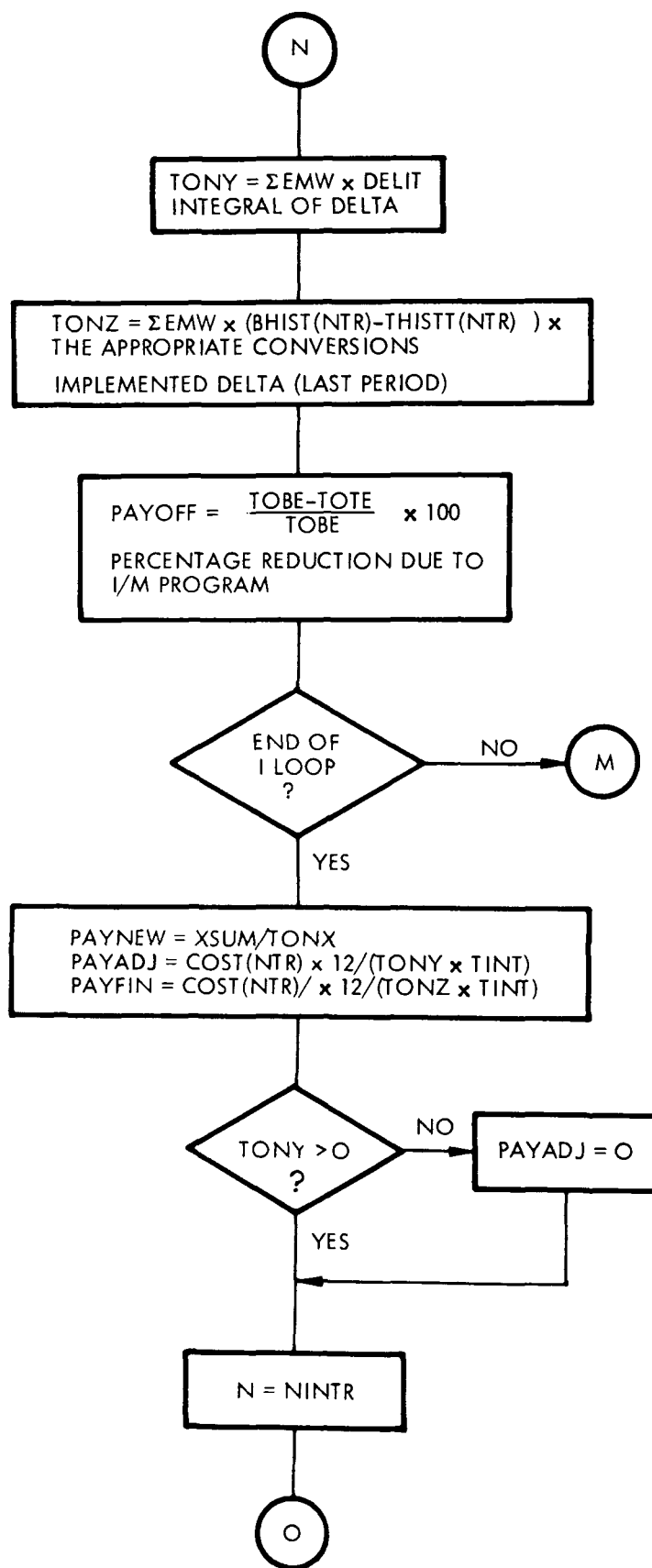


Figure 5-13 Subroutine COSTS Flowchart (cont.)

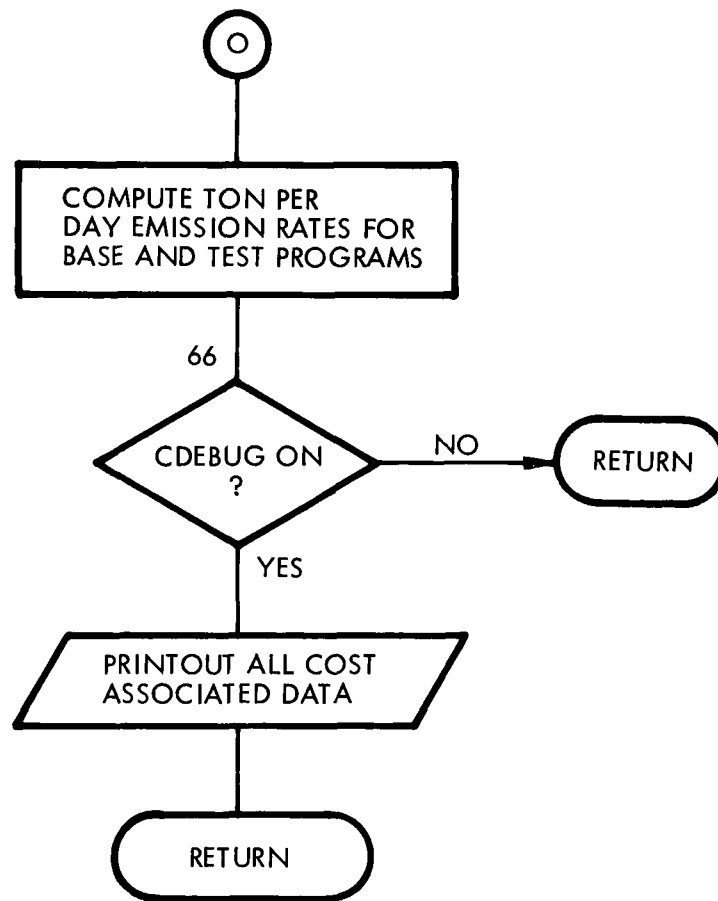


Figure 5-13 Subroutine COSTS Flowchart (cont.)

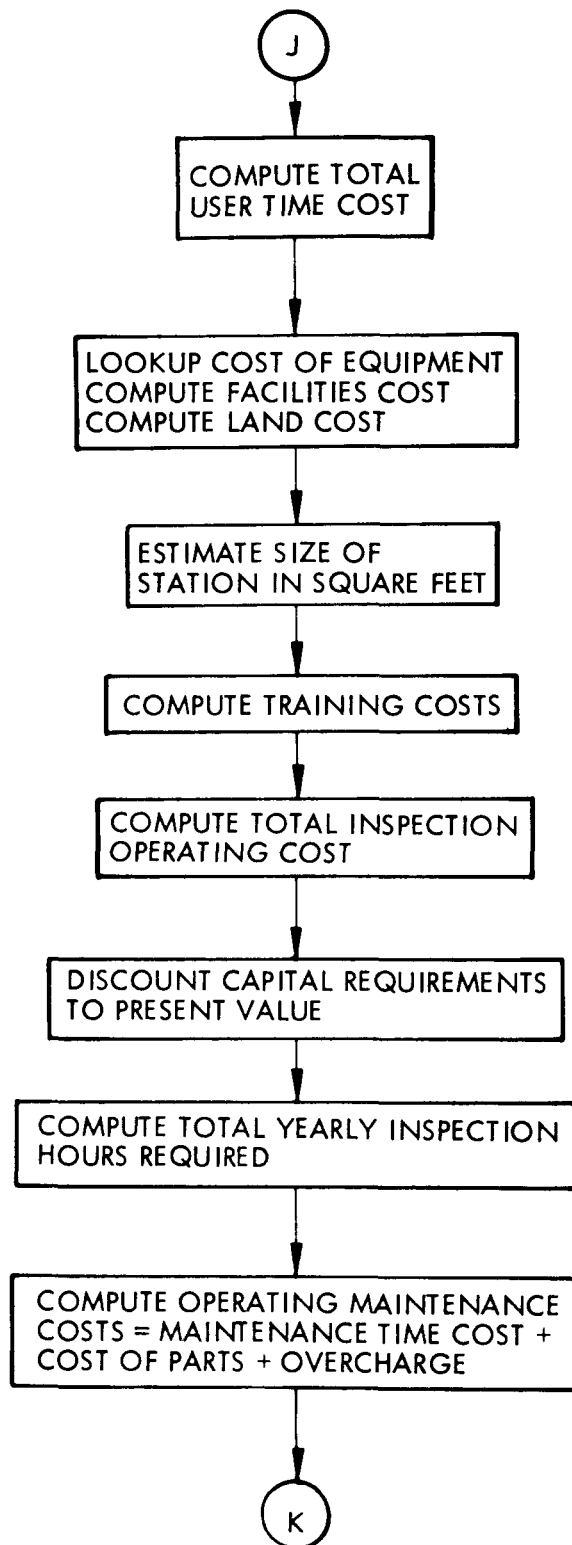


Figure 5-13 Subroutine COSTS Flowchart (cont.)

Table 5-13 SUBROUTINE COSTS LISTING

27640	SUBROUTINE COSTS
27650	DIMENSION CARI(16),CARM(16),TIM(16),TEIMEM(16),
27660	+ TCP(16),TTI(16),OCOST(16),CUST(16),
27670	2 ICOST(16),CAPEL(16),ACAPC(16),COSTB(16),TTM(16),
27680	+ OCOSTI(16),OCOSTM(16),WTIME(16)
27690	DIMENSION CARS(16),CARSA(16)
27700	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,
27710	+ BAREA(3),BLD1, BLD2, BSIG(3), BXTA, BSIZE,
27720	+ BHIST(3,16), BMMI(10,15,3),
27730	+ ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
27740	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),
27750	+ CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
27760	+ CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
27770	+ CN(15,3,16), COEFB(15,3), COEFBP(10,15),
27780	+ CPART(10,15)
27790	CC ADD2
27800	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
27810	+ EMW(3), EP(10,15),EFF(10), DELIT(3),
27820	+ FREQA, FREQB, FPERC(10,3),
27830	+ HORZN, HORZNY,
27840	+ HPC(15,16), HPCS(15,16), HPP(10,15,16),
27850	+ HPS(6,15,16), HPT(5,16), HPTOT(16),
27860	+ HPTOTS(16)
27870	CC ADD3
27880	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
27890	+ KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
27900	+ LIDLE, LINT(16), LPSP(10),LSTART, LSTOP,
27910	+ MBASE, MPH, MSPEC(10),MSTART, MSTOP,
27920	+ MU(10,3), MMS(10,15), MVPR(10,15)
27930	CC ADD4
27940	COMMON /COM05/ NAME(50),NCNTR, NEMIS, NEMP,
27950	+ NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
27960	+ NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
27970	+ OCY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
27980	CC ADD5
27990	COMMON /COM06/PARM(3,3), PART, PAYNEW, PAYOFF(3),
28000	+ PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
28010	+ PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
28020	+ PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
28030	+ PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
28040	+ PSA(15), PTA(5), PCONF, PARINT(10,10,9)

Table 5-13 SUBROUTINE COSTS LISTING (cont.)

28050	+	,PAYFIN					
28060		COMMON /COM07/		REINSP,	RNAME,	RSIZE,	RSTOP,
28070	+	RTYPE,					
28080	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,
28090	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
28100	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
28110	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
28120	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
28130	+	SIGRATE,	SIST,	SIGS(5,15),		SIGSDE(3),	
28140	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
28150		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
28160	+	TINT,	TONE(3),	TGNX,	TOTE(3),	TPDB(3),	TPDT(3),
28170	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
28180	:	THIST(5,2,15),		THISTT(3,15),		TIMEC(10,15),	
28190	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
28200	CC ADD10						
28210		COMMON /COM11/		WF(10),			
28220	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
28230	+	XTM(16),		XBASE(9,3),		YBASE(9,3)	
28240	CC ADD11						
28250		COMMON /COM12/		Y1BP(3,3,10),	Y2BP(3,3,10),		
28260	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),Y2DBP(4,4,10),		
28270	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
28280	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
28290	+	Z13,	Z14,	Z15,	Z16,	Z17,	
28300	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
28310	+	ZZ(3,3)					
28320	CC ADD12						
28330		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
28340	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
28350	CC ADDD						
28360		REAL	ITE,	ITL,	ITP,	ITIME,	
28370	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
28380	+	NAME,	NO,	LDEBUG,	MDEBUG,		
28390	+	IN,	MISFIRE				
28400		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
28410	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
28420		REAL ICOST,LO					
28430	CC	*** COST MODEL					
28440		NM=2					
28450		NTR=NTP+1					
28460		NTRB=NTPB+1					

Table 5-13 SUBROUTINE COSTS LISTING (cont.)

```

28470      XSUM=ZSUM=0.
28480      ICOST(1)=0.
28490      CARI(1)=0.
28500      YSUM=CSUM=CBSUM=0.
28510      XX=1.
28520      CARB=CARC=0.
28530      CARA=0.
28540      XKZP=(1.-SALP)*ZIC*(1.+ZIC)**ITP/((1.+ZIC)**ITP-1.)+ZIC*SALP
28550      XKZE=(1.-SALE)*ZIC*(1.+ZIC)**ITE/((1.+ZIC)**ITE-1.)+ZIC*SALE
28560      XKZL=(1.-SALL)*ZIC*(1.+ZIC)**ITL/((1.+ZIC)**ITL-1.)+ZIC*SALL
28570      DO 100 N=2,NTR
28580          ITIME(N)=CAPEL(N)=0.
28590          CARI(N)=CARPOP(N)*(1.+HPTOT(N)*REINSP)
28600          IF(N.GE.NTR) XX=TXTRA
28610          CAFA=CARA+CARI(N)*XX
28620          CMAXI=AMAX1(CARI(N-1),CARI(N))
28630          CARM(N)=HPTOT(N)*CARI(N)/(1.+HPTOT(N)*REINSP)
28640          CARS(N)=HPTOTS(N)*CARI(N)/(1.+HPTOTS(N)*REINSP)
28650          CARB=CARB+CARM(N)*XX
28660          CARC=CAPC+CARS(N)*XX
28670          TTM(N)=XTM(N)*CARI(N)
28680          TCP(N)=YTM(N)*CARI(N)
28690      100 CONTINUE
28700          CARIY=CARA/HORZNY
28710          CARMY=CARB/HORZNY
28720          CARSY=CARC/HORZNY
28730          CARSY=CARMY
28740          IF(SLANE.EQ.10HSTATE) GO TO 10
28750      DO 200 N=2,NTR
28760      CC      FRANCHISED GARAGE INSPECTION/MAINTENANCE
28770      CC      NO FACILITIES SIZING
28780          TTI(N)=CARI(N)*TIMEI(OPTI,N)
28790          ZX=Z2
28800          IF(LIDLE.GT.1) ZX=Z2+Z14
28810          OCOSTI(N)=ZX*TTI(N)+Z15*CARI(N)+OVCHI(OPTI)*CARI(N)
28820          OCOSTM(N)=ZX*TTM(N)+TCP(N)+OVCHM(OPTI)*CARM(N)
28830          OCOST(N)=OCOSTI(N)+OCOSTM(N)
28840          ICOST(N)=Z9*(TIMEI(OPTI)+Z7)*(CARI(N)-CARM(N))
28850          CINCON=Z9*(TIMEI(OPTI)+Z7)
28860          COST(N)=(ICOST(N)+OCOST(N))*((1.+Z4)/(1.+Z5))*YR
28870          IF(N.GE.NTR) GOTO 222
28880          XSUM=XSUM+OCOSTI(N)

```


Table 5-13 SUBROUTINE COSTS LISTING (cont.)

28890		ZSUM=ZSUM+OCOSTM(N)
28900		CSUM=CSUM+COST(N)
28910		YSUM=YSUM+OCOST(N)
28920		GOTO 223
28930	222	CONTINUE
28940		XSUM=XSUM+OCOSTI(N)*TXTRA
28950		ZSUM=ZSUM+OCOSTM(N)*TXTRA
28960		CSUM=CSUM+COST(N)*TXTRA
28970		YSUM=YSUM+OCOST(N)*TXTRA
28980	223	CONTINUE
28990	200	CONTINUE
29000		IF(CARB.GT.1.E-20)
29010	*	CPVPY=ZSUM/CARB+XSUM/CARA
29020		CPI=YSUM/CARA
29030		DCIY=XSUM/HORZNY
29040		UCMY=ZSUM/HORZNY
29050		CCOSTM=0.
29060		SITEI=0
29070		CCOSTI=0.
29080		GO TO 20
29090	CC	STATELANE INSPECTION
29100	CC	FACILITIES SIZING USING INCONVIENCE COSTS
29110	10	DO 300 N=2,NTR
29120		SITEI=STAT/XLANE+.99
29130		XLAM=CMAI/(STAT*250.*8.*60.*TINT/12.)
29140		RHO=XLAM*STIME(OPTI)/XLANE
29150		CALL QUEUE(RHO,LQ,WTIME(N),XLANE)
29160		ITIME(N)=STIME(OPTI)+2.*SORT((ALAB/SITEI)/3.1+15)*2./
29170	+	AVV*60.+WTIME(N)
29180		ICOST(N)=Z9*ITIME(N)/60.*(CARI(N)-CARM(N))
29190		CINCON=Z9*ITIME(N)/60.
29200	CC	COSTS OF FACILITIES, EQUIPMENT, LAND
29210		CAE=ZZ(XLANE,LIDLE)
29220		CAP=Z10*(BLD1+BLD2*XLANE)
29230		CAL=Z13*((BLD1+BLD2)*10.+BLD2*XLANE*(1.+LQ))
29240		SIST=CAL/Z13
29250		CAT=Z6*(NEMP+Z1)*STAT
29260		CCOSTI=CAE+CAL+CAP+CAT
29270		CAPEL(N)=(XKZP*CAP+XKZE*CAE+XKZL*CAL+XKZE*CAT)*SITEI
29280		TTI(N)=CARI(N)*STIME(OPTI)/60.
29290		UCCSTM(N)=Z2*TTM(N)+TCP(N)+OVCHM(OPTI)*CARM(N)
29300		OCOSTI(N)=(Z1+NEMP)*Z16*TTI(N)+

Table 5-13 SUBROUTINE COSTS LISTING (cont.)

29310		+ CAPEL(N)+Z15*CARI(N)
29320		OCOST(N)=OCOSTI(N)+OCOSTM(N)
29330		COST(N)=(OCOST(N)+ICOST(N))*((1.+Z4)/(1.+Z5))*YR
29340		IF(N.GE.NTR) GOTO 333
29350		XSUM=XSUM+OCOSTI(N)
29360		ZSUM=ZSUM+OCOSTM(N)
29370		CSUM=CSUM+COST(N)
29380		YSUM=YSUM+OCOST(N)
29390		GOTO 300
29400	333	CONTINUE
29410		XSUM=XSUM+OCOSTI(N)*TXTRA
29420		ZSUM=ZSUM+OCOSTM(N)*TXTRA
29430		CSUM=CSUM+COST(N)*TXTRA
29440		YSUM=YSUM+OCOST(N)*TXTRA
29450	300	CONTINUE
29460		IF(CARB.GT.1.E-20)
29470		*CPVPY=ZSUM/CARB+XSUM/CARA
29480		CPI=YSUM/CARA
29490		OCMY=ZSUM/HORZNY
29500		OCY=XSUM/HORZNY
29510		CCOSTM=0.
29520	20	CBSUM=(NTRB-2+BXTRA)*CPCB*CARPOP(15)
29530		TONX=TONY=0.
29540		TONZ=0.
29550		NTR=NTR-1
29560		NTRB=NTRB-1
29570		DO 33 I=1,NEMIS
29580		TOTE(I)=TAREA(I)*CARPOP(16)/CGTT
29590		TONX=TONX+EMW(I)*(TOBE(I)-TOTE(I))
29600		TONY=TONY+EMW(I)*DELIT(I)
29610		TONZ=TONZ+EMW(I)*(BHIST(I,NTR)-THIST(I,NTR))*CARPOP(NTR)/CGTT*
29620		+ MBASE*TINT
29630		PAYOFF(I)=(TOBE(I)-TOTE(I))/TOBE(I)*100.
29640	33	CONTINUE
29650		PAYNEW=CSUM/TONX
29660		PAYADJ=COST(NTR)*12./TINT
29670		PAYADJ=PAYADJ/TONY
29680		PAYFIN=COST(NTR)/TONZ*12./TINT
29690		IF(TONY.LT..001) PAYADJ=0.
29700		N=NINTR
29710		DO 66 I=1,NEMIS
29720		TPDT(I)=TOTE(I)/(HORZNY*365.)

Table 5-13 SUBROUTINE COSTS LISTING (cont.)

29730		TPDB(I)=TOTE(I)/(HORZNY*365.)
29740	66	CONTINUE
29750		IF(CDEBUG.EQ.NO) RETURN
29760		WRITE (6,504)
29770	504	FORMAT(1H1,* FROM SUBROUTINE COST*//3X,*CARI*,6X,*CARM*,
29780		1 7X,*TTM*,6X,*TCP*,6X,*TTI*,5X*DCOST*,5X,*COST*,4X,*ITIME*,4X,
29790		2 *CAPEL*,4X,*DCOSTI*,3X,*DCOSTM*,3X,*COSTB*//)
29800		DO 505 N=1,NINTR
29810		WRITE (6,502) CARI(N),CARM(N),TTM(N),TCP(N),TTI(N),DCOST(N),
29820		1 COST(N),ITIME(N),CAPEL(N),DCOSTI(N),DCOSTM(N),COSTB(N)
29830	502	FORMAT(2X,12E9.2)
29840	505	CONTINUE
29850		WRITE(6,501) CARIY,CARMY ,XSUM,YSUM,ZSUM,CARA,CCOSTI,CPVPY,
29860		1 CPI,STAT,SITEI
29870	501	FORMAT(/* CARIY = *E12.5,10X,*CARMY = *E12.5,
29880		1 /* XSUM= *E12.5,13X,*YSUM= *E12.5,13X,*ZSUM= *E12.5,/
29890		2 * CARA = *E12.5/* CCOSTI = *E12.5/* CPVPY = *E12.5/* CPI = *
29900		3 E12.5/* STAT = *I5/* SITEI = *I4//)
29910		DO 530 I=1,NEMIS
29920		WRITE (6,510) NAME(I),TONX,PAYNEW,PAYOFF(I),TOTE(I),
29930		+ TAREA(I),TPDT(I),TPDB(I)
29940	510	FORMAT(/,30X,A2,* EMISSION DELTA*//,5X,* TON = *E15.5,5X,
29950		+ * PAYNEW = *E15.5,5X,* PAYOFF = *E15.5//5X,* TOTE = *
29960		+ E15.5,5X,* TAREA = *E15.5//,5X,* TPDT = *E15.5,5X,
29970		+ * TPDB = *E15.5//)
29980	530	CONTINUE
29990		RETURN
30000		END

is compared with the distribution from a base fleet that has not been subjected to a mandatory maintenance program. This comparison determines if the program has produced a statistically significant reduction in emissions for the species of interest.

The primary unit function of the statistical model is the integration of two distributions. This is accomplished mathematically by convoluting two distributions. The convolution procedure combines two independent distributions of a given population into a third distribution that represents the sum of the first two. Convolution is linear in the sense that the mean and variance of the new distribution are, respectively, the sums of the means and variances of the two input distributions. Similarly, the number of degrees of freedom of the output distribution is the sum of the degrees of freedom of the two input distributions i.e., $(n_1 - 1) + (n_2 - 1) = N_3$. Mathematically, the degrees of freedom represent the number of independent observations. If two independent distributions are added together, the number of independent variables would also be added to give the number of independent variables in the output distribution. If many distributions are added via convolution, the degrees of freedom of the resulting distribution would be expected to be large.

Also built into the convolution procedure is a test that determines whether or not a change in any one parameter distribution will have any significant effect on the total distribution. If one of the input ranges is sufficiently smaller than the other, then the smaller input will be ignored, and the convolution step will be by-passed. This check was built into the model to reduce the number of calculations during the

convolution process. While the error introduced by ingoring distribution with relatively small standard deviations is at most 2.5%, the accumulative effect of this could bias the final distribution.

Those cars that fail the inspection test undergo a maintenance treatment. This treatment modifies the initial distribution according to the extent of maintenance and rejection rates. Next these engine component distributions are converted, using the influence coefficients to vehicle emission distributions. Lastly, the model errors (deterioration, influence coefficient) are convoluted to give a final distribution. This last step yields a distribution which corresponds to the mean emission levels forecasted with the E/E model.

Finally, the adjusted emission distribution (without model errors) is compared with the emission distribution of a base fleet. To do this, convolution is used to subtract the former distribution from the latter. This gives a distribution that represents the reduction in emission that is obtained from the specific program. By numerical integration, i.e. approximating the area under the "left hand side" of the distribution curve, the 10% level of this distribution is calculated, and this is used to test the statistical-significance of the emission reduction and determine confidence limits for emission reduction. This is the only valid method to obtain the confidence limits from this distribution. In particular, the standard normal test, also known as the z-score test, cannot be used since it assumes a normal distribution with mean equal to zero. However, the model contains an alternative test which compares the test fleet and base fleet distributions without first combining them into a single distribution.

An alternate method of testing the significance of the emission reduction is to compare the mean of the test fleet distribution and the mean of the base fleet distribution by using a t-test. First, the model uses an F-test to insure that the standard deviations are nearly equal. This test gives confidence limits similar to the ones found by using the numerical method. The t-test compares the two means with each other, and the model test works with the difference of the two means. The combination of the F-test followed by the t-test eliminates one convolution and the numerical integration approximation and is thus, computationally more efficient. However, these tests assume normal distributions, and if the emission rate distributions are skewed, they may yield misleading results.

Figure 5-14 presents a detailed flowchart for subroutine STATS. A computer listing of STATS is given in Table 5-14.

5.11 UTILITY ROUTINES

GEEP employs several functions and subroutines which perform such standard mathematical operations as computing means and standard deviations, curve fitting, linear interpolation and integration. These routines are further described in detail, with flowcharts and listings, in the following sections.

5.11.1 Subroutine CONVOL

Subroutine CONVOL is a generalized routine which convolutes two input distributions to generate a third. The input distributions are stored in P1 and Y1, P2 and Y2, with output in P3 and Y3. The sizes of the two input distributions are L1 and L2, while that of the output distributions is N3. All input to CONVOL comes through an argument list.

Subroutine CONVOL first checks if either distribution is an approximate

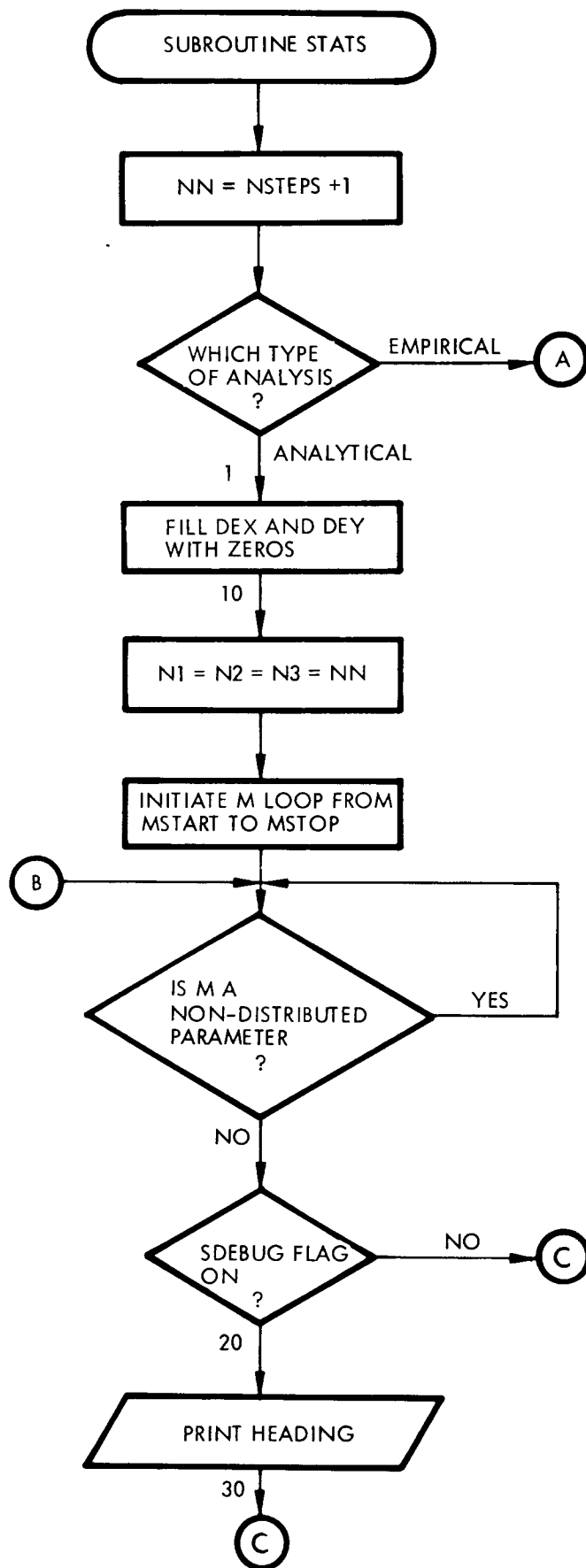


Figure 5-14 Subroutine STATS Flowchart

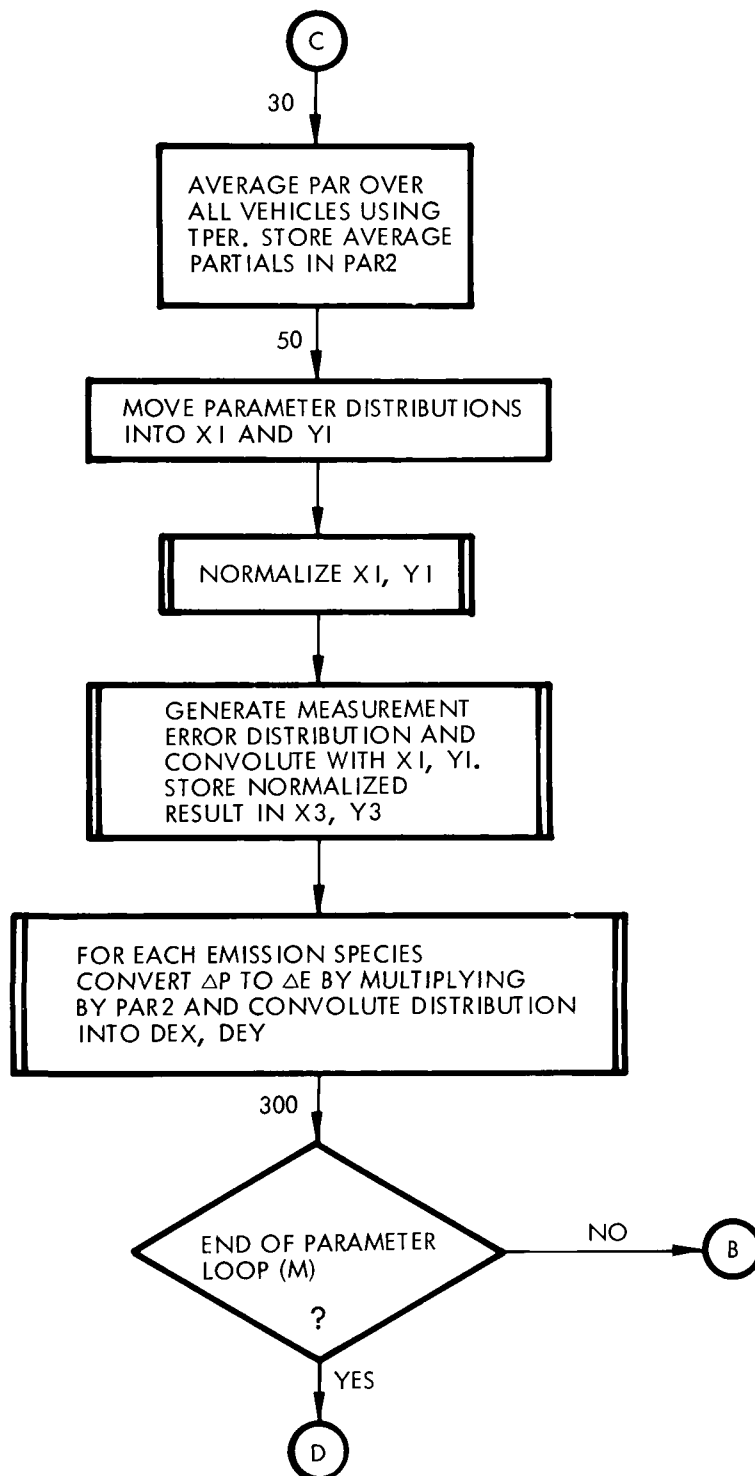


Figure 5-14 Subroutine STATS Flowchart (cont.)

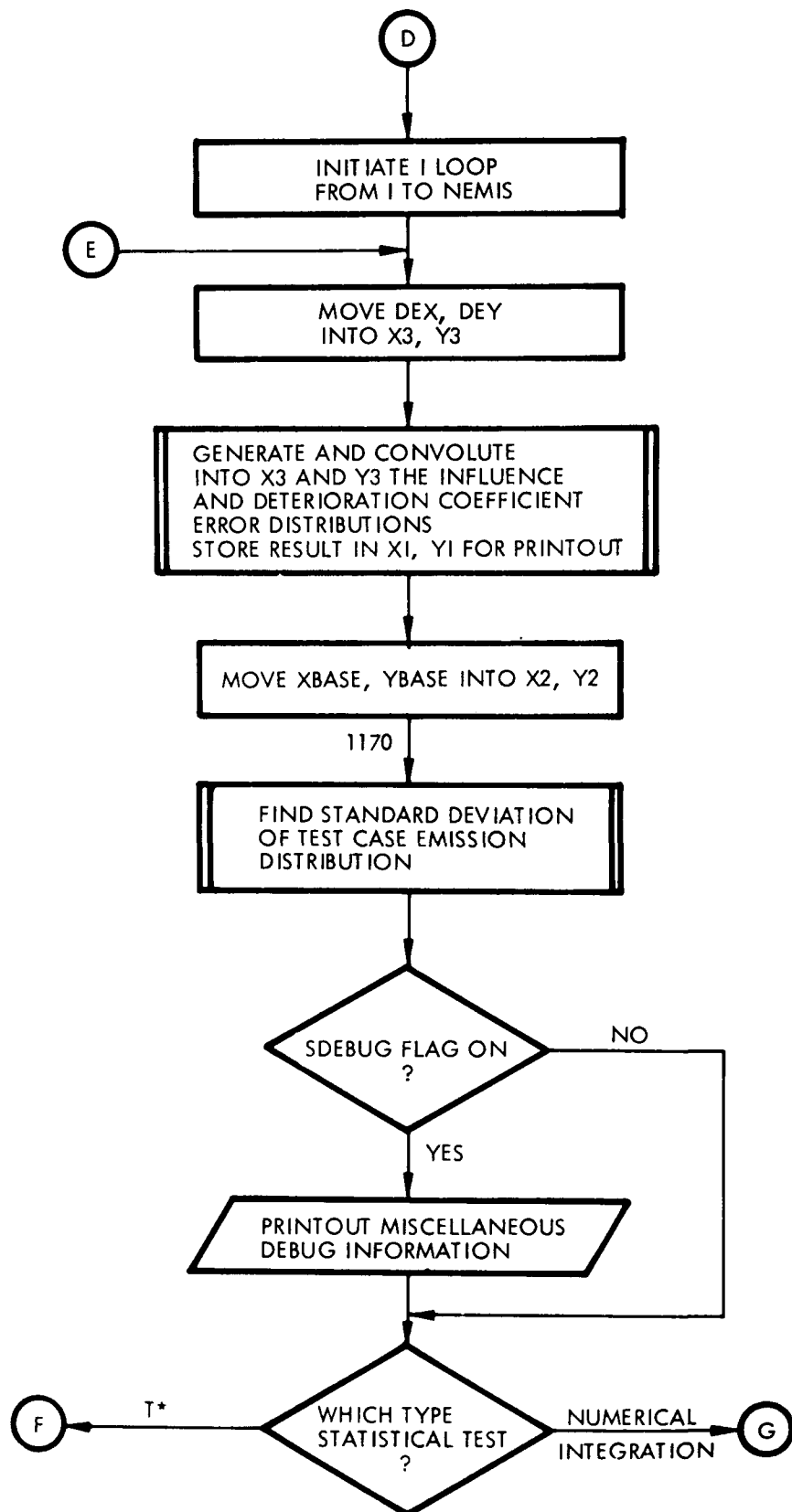


Figure 5-14 Subroutine STATS Flowchart (cont.)

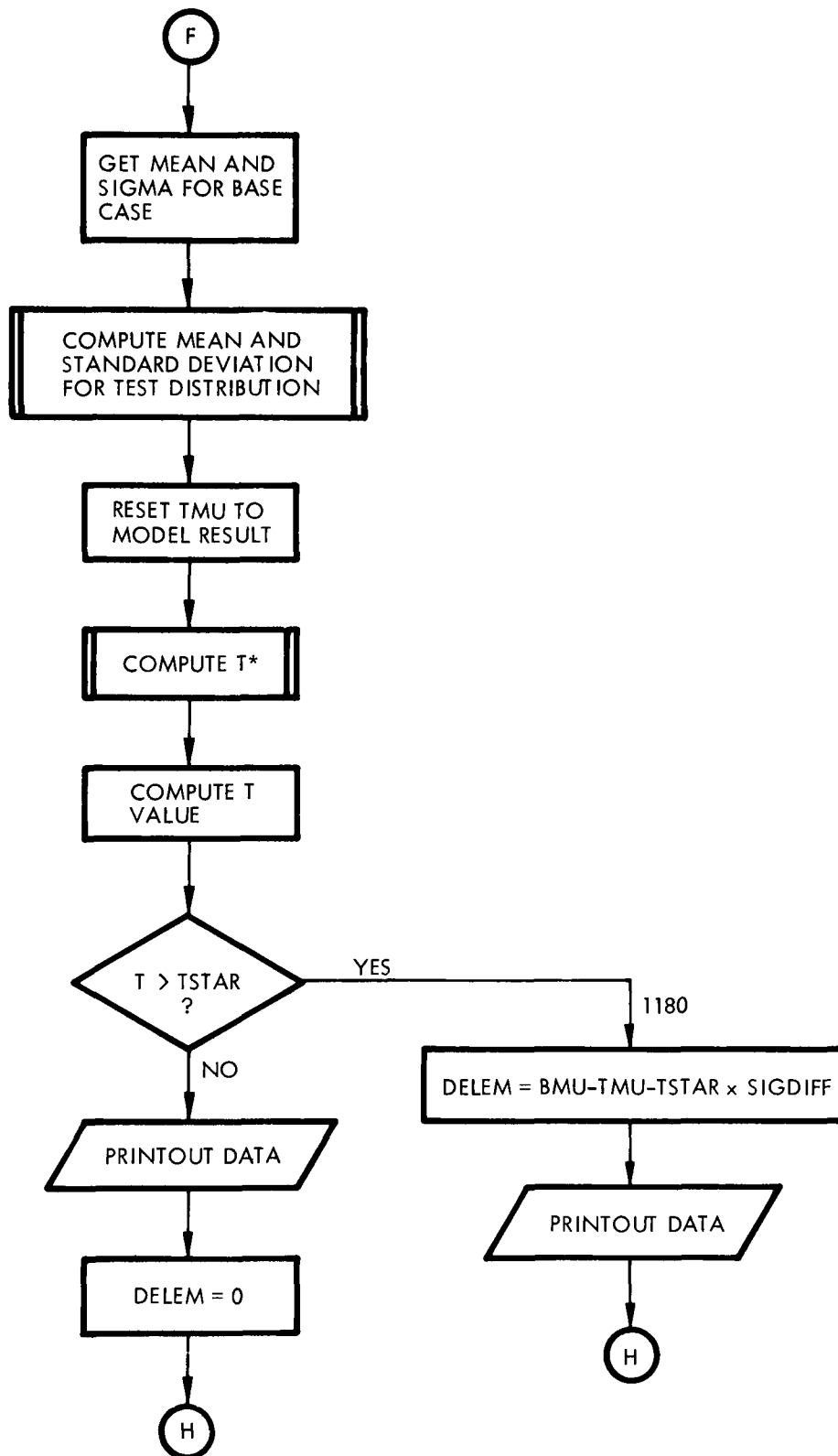


Figure 5-14 Subroutine STATS Flowchart (cont.)

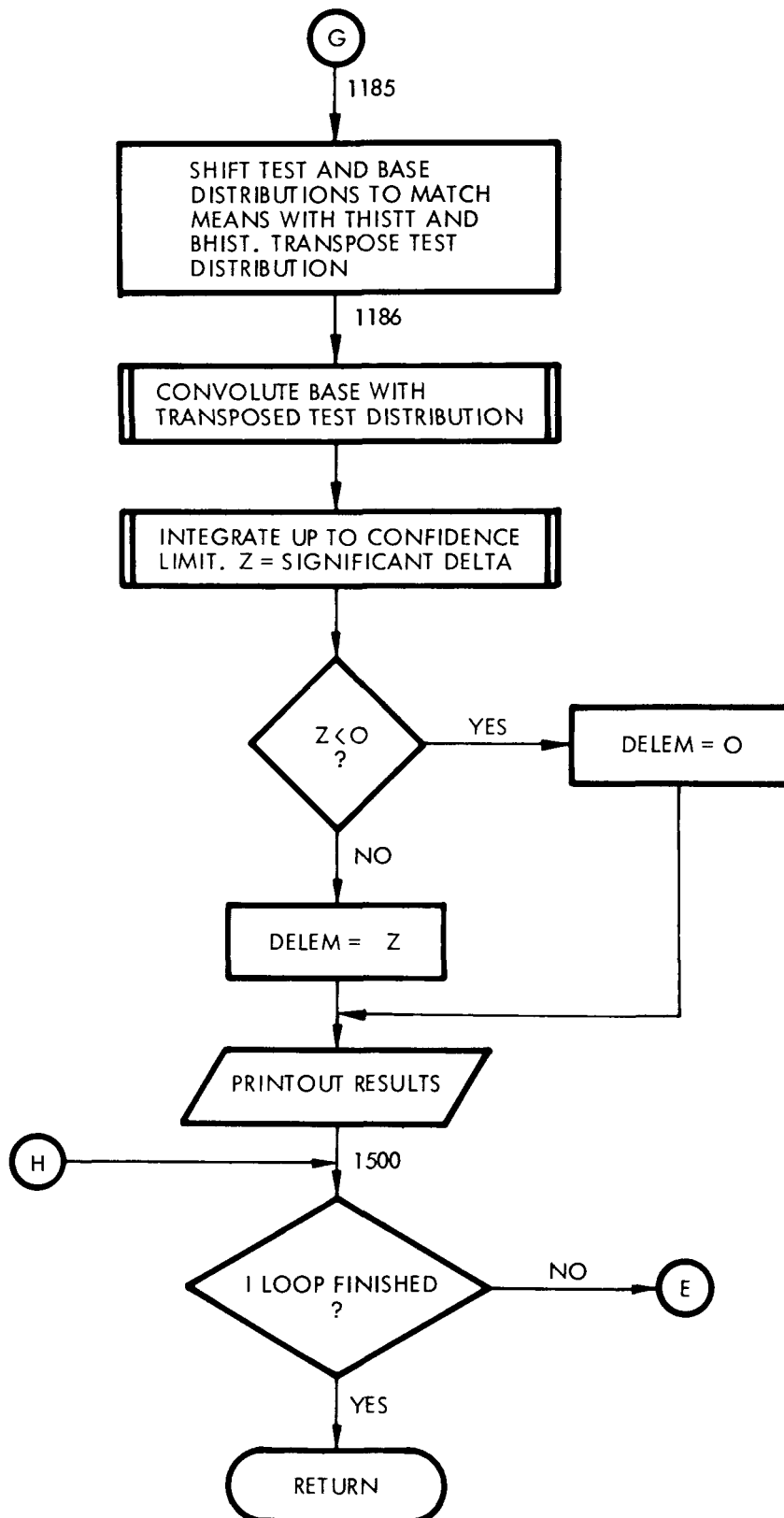


Figure 5-14 Subroutine STATS Flowchart (cont.)

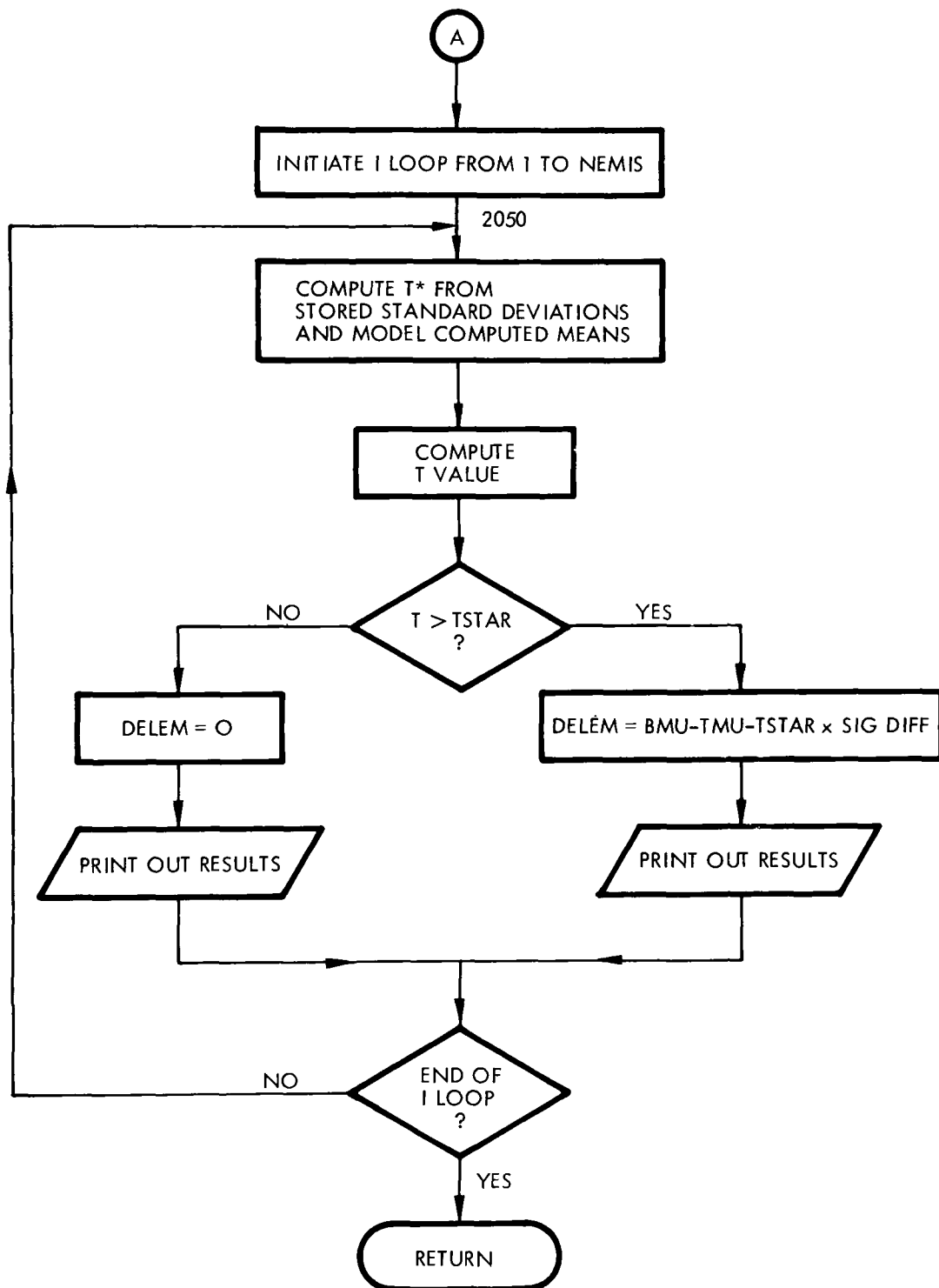


Figure 5-14 Subroutine STATS Flowchart (cont.)

Table 5-14 SUBROUTINE STATS LISTING

RUN2,3L 03/21/73. 17.56.03.

	SUBROUTINE STATS(N,IOPT)	
000005	DIMENSION DEX(33,3),DEY(33,3),X1(33),X2(33),X3(33),Y1(33),	
	* Y2(33),Y3(33),PCXBP(5),PCYBP(5),PAR2(3)	
000005	COMMON /COM01/ AMB(3),ALAB, BINT,	
	+ BAREA(3), BLD1, BLD2, BSIG(3), BXTRA, BSIZE,	
	+ BHIST(3,16),	
	+ ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)	
000005	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),	
	+ CARSY, CBSUM, CCOSTI, CCOSTM, CGTT,	
	+ CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,	
	+ CN(15,3,16), COEFB(15,3), COEFBP(10,15),	
	+ CPART(10,15)	
	CC ADD2	
000005	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),	
	+ EMW(3), EP(10,15),EFF(10), DELIT(3),	
	+ FREQA, FREQB, FPERC(10,3),	
	+ HORZN, HORZNY,	
	+ HPC(15,16), HPCS(15,16), HPP(10,15,16),	
	+ HPS(6,15,16), HPT(5,16), HPTOT(16),	
	+ HPTOTS(16)	
	CC ADD3	
000005	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),	
	+ KSTART, KSTOP, LOPT, LPICK(10),LLPICK,	
	+ LIDLE, LINT(16), LPSP(10),LSTART, LSTOP,	
	+ MBASE, MPH, MSTART, MSTOP,	
	+ MU(10,3), MMS, MVPR(10,15)	
	CC ADD4	
000005	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,	
	+ NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,	
	+ NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(10),	
	+ OCIY, OCMY, OPTI, CPTM,OPTS(50),OVCHI(3),OVCHM(3)	
	CC ADD5	
000005	COMMON /COM06/PARM(3,3), PART, PAYNEW, PAYOFF(3),	
	+ PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,	
	+ PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,	
	+ PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),	
	+ PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),	

Table 5-14 SUBROUTINE STATS LISTING (cont.)

TRW SYSTEMS		SUBROUTINE STATS LISTING (CONT.)				
RUN2.31 03/21/73 17.56.03.		STATS				
	+ PSA(15), PTA(5), PCONF, PARINT(10,10,9)					
	+ ,PAYFIN					
000005	COMMON /CCM07/	REINSP,	RNAME,	RSIZE,	RSTOP,	
	+ RTYPE,					
	+ SALE, SALL, SALP, SITEI, SITEM, SLANE,					
	+ SMODEL, START(15,3), STAT, STIME(3),					
	+ SCALEBM(3), SM(6,15), SPAR(10,15,6),					
	+ SXCUT(6,3), SIG(10,3), SIGCE(3),					
	+ SIGME(10), SIGMNE(10), SIGP(10,15),					
	+ SIGRATE, SIST, SIGS(6,15), SIGSDE(3),					
	+ STABLEX(33,6,15), STABLEY(33,6,15)					
000005	COMMON /COM10/	TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),				
	+ TINT, TOBE(3), TONX, TOTE(3), TPDB(3), TPDT(3),					
	+ TXTRA, TSIZE, TSIG(3), TPER(16,15), TMIL(16,15),					
	+ THIST(5,3,16), THISTT(3,16), TIMEC(10,15),					
	+ TIMEM(10,15), TABLEX(33,10,15), TABLEY(33,10,15)					
	CC ADD10					
000005	COMMON /COM11/	WF(10),				
	+ X1BP(3,3,6), XINT, XINTB, XLANE, XSUM, XCUT(10,3),					
	+ XTM(16), XBASE(9,3), YBASE(9,3)					
	CC ADD11					
000005	COMMON /COM12/	Y1BP(3,3,10), Y2BP(3,3,10),				
	+ YES, YSUM, YTM(16), Y1DBP(4,4,10), Y2DBP(4,4,10),					
	+ Z1, Z2, Z3, Z4, Z5, Z6,					
	+ Z7, Z8, Z9, Z10, Z11, Z12,					
	+ Z13, Z14, Z15, Z16, Z17,					
	+ ZCARI, ZCARM, ZIC, ZSUM,					
	+ ZZ(3,3)					
	CC ADD12					
000005	COMMON /DEBUG/	ADEBUG, BDEBUG, CDEBUG, DDEBUG,				
	+ LDEBUG, MDEBUG, PDEBUG, QDEBUG, SDEBUG, TDEBUG					
	CC ADDD					
000005	REAL	ITE, ITL, ITP, ITIME,				
	+ MMS, MPH, MU, MVPR,					
	+ NAME, NO, LDEBUG, MDEBUG,					
	+ IN, MISFIRE					
000005	INTEGER	RNAME, SITEI, SITEM, STAT,				
	+ TDIST, XLANE, OPTI, PPICK, PPPICK					

Table 5-14 SUBROUTINE STATS LISTING (cont.)

```

RUN2.31 03/21/73. 17.56.03.          STATS

000005      DATA PCXBP/80.,90.,95.,99.,99.9/
000005      DATA PCYBP/.84,1.28,1.645,2.33,3.08/

      CC      IOPT = 1 -- FOR GIVEN MEANS AND SIGMAS FROM GEEP
      CC      IOPT = 2 -- FOR STATS GENERATION OF MEANS AND SIGMAS
000005      NN=NSTEPS+1
000007      IF(IOPT.EQ.1) GO TO 2050
000011      1   DO 10 I=1,NEMIS
000013      DO 10 L=1,NN
000014      DEX(L,I)=DEY(L,I)=0.
000022      10  CONTINUE
000026      N1=N2=N3=NN
000032      DO 1000 M=1,10
000033      IF(M.EQ.4.OR.M.EQ.5.OR.M.EQ.6.OR.M.EQ.10) GO TO 1000
000053      IF(SDEBUG.EQ.2HNO) GO TO 30
000055      WRITE (6,20) M
000063      20  FORMAT(1H1,/5X,*PARAMETER NO. *,I2/)
000063      30  CONTINUE
000063      PAR2(1)=PAR2(2)=PAR2(3)=0.
000067      DO 100 JJ=1,NPTRN
000072      DO 100 K=1,NCNTR
000073      J = JJ+5*(K-1)
000077      DO 50 I=1,NEMIS
000100      50  PAR2(I) = PAR2(I) + PAR(M,J,I)*TPER(N,J)
000117      100 CONTINUE
000124      DO 101 L=1,NN
000126      X1(L)=TABLEX(L,M,J)
000135      Y1(L)=TABLEY(L,M,J)
000143      101 CONTINUE
000145      CALL NORM(X1,Y1,NN)
      CC      MEASUREMENT ERROR DIST.
      CC
000150      CALL TABLE (M,1,SIGME(M),0.0,X2,Y2,N2)
000160      CALL CONVOL (X1,Y1,X2,Y2,X3,Y3,N1,N2,N3)
000171      CALL DISTPR(X1,Y1,X2,Y2,X3,Y3,N1,N2,N3,
+ 50HENG. PARAMETER DIST. + MEASUREMENT ERRORS      )
000203      CALL NORM(X3,Y3,N3)
000206      DO 300 I=1,NEMIS
000211      IF(SDEBUG.EQ.3HYES) WRITE (6,190) I

```

Table 5-14 SUBROUTINE STATS LISTING (cont.)

TRW SYSTEMS
RUN2.31 03/21/73. 17.56.03.

STATS

```

000222      190 FORMAT(1H1,/5X,*EMISSION NO. *,I2/)
000222      DO 200 L=1,NN
000224      X3(L)=PAR2(I)*X3(L)
000230      X1(L)=DEX(L,I)
000235      200 Y1(L)=DEY(L,I)
000244      CALL NORM(X1,Y1,N1)
000246      CALL CONVOL(X1,Y1,X3,Y3,X2,Y2,N1,N3,N2)
000257      CALL DISTPR(X1,Y1,X3,Y3,X2,Y2,N1,N3,N2,
+ 50HCONVOL OF EMISSION DIST FOR PARAMETERS )
000271      DO 210 L=1,NN
000274      DEX(L,I)=X2(L)
000301      210 DEY(L,I)=Y2(L)
000310      300 CONTINUE
000312      1000 CONTINUE
C
C      DEX,DEY ARE THE TEST FLEET EMISSION SPECIE DECREMENT
C      ERROR DIST.
C
000314      DO 1500 I = 1,NEMIS
000316      IF(SDEBUG.EQ.3HYES) WRITE (6,190) I
000327      DO 1100 L=1,NN
000331      X3(L)=DEX(L,I)
000336      1100 Y3(L)=DEY(L,I)
000345      CALL TABLE(M,1,SIGCE(I),0.,X1,Y1,N1)
000355      CALL CONVOL(X3,Y3,X1,Y1,X2,Y2,N3,N1,N2)
000366      CALL DISTPR(X3,Y3,X1,Y1,X2,Y2,N3,N1,N2,
+ 50HSPECIE DIST + RESPONSE SURFACE ERRORS )
000400      CALL TABLE(M,1,SIGSDE(I),0.,X1,Y1,N1)
000410      CALL DISTPR(X2,Y2,X1,Y1,X1,Y1,N2,NN,N1)
000421      CALL DISTPR(X2,Y2,X1,Y1,X1,Y1,N2,N1,N1,
+ 50HEMIS. AND RESP. DIST. + EMISSION DECAY ERROR
000433      DO 1170 L=1,NPTS
000436      X2(L)=XBASE(L,I)
000443      Y2(L)=YBASE(L,I)
000447      1170 CONTINUE
000452      CALL STD2(X1,Y1,N1,TMU,TSD)
000455      IF(SDEBUG.EQ.YES) WRITE(6,606) NAME(I),THISTT(I,N),TSD
000501      606 FORMAT(* EMISSION - *,A2,*      MEAN AND SD (COSMETICIZED) *,

```


Table 5-14 SUBROUTINE STATS LISTING (cont.)

TRW

RUN2.3L 03/21/73 17.56.03.

STATS

```

      + 2E15.8)
000501      IF(NTEST.GT.1) GOTO 1185
000505      BMU=BHIST(I,N)
000510      BSD=BSIG(I)
000513      CALL STD2(X3,Y3,N3,TMU,TSD)
000516      TMU=THISTT(I,N)
000523      TSTAR=FUN1(PCONF,PCXBP,PCYBP,5)
000527      SIGDIFF=SQRT(TSD*TSD/TSIZE+BSD*BSD/BSIZE)
000536      T=(BMU-TMU)/SIGDIFF
000541      IF(I.EQ.1) WRITE (6,505) N
000554      505  FORMAT(1H1,20X,*STATISICAL ANALYSIS OF EMISSION REDUCTIONS*,
      + //,30X,*YEAR *,I2//)
000554      WRITE (6,1190) NAME(I)
000563      IF(T.GT.TSTAR) GO TO 1180
000570      WRITE (6,600) PCONF,T,TSTAR,TMU,BMU
000605      600  FORMAT(/,5X,*ACCEPT THE NULL HYPOTHESIS.*/
      + 5X,*THERE IS NOT A SIGNIFICANT DIFFERENCE IN THE MEANS*,/
      + 5X,*AT A CONFIDENCE LEVEL OF *,F10.2/
      + 5X,* T = *E15.4,5X,*TSTAR = *E15.4/
      + 5X,*TEST MU = *E15.4,5X,*BASE MU = *E15.4//)
000605      DELEM(I,N)=0.
000612      GOTO 1500
000612      1180 CONTINUE
000612      A=BMU-TMU-TSTAR*SIGDIFF
000616      DELEM(I,N)=A
000622      WRITE (6,700) PCONF,A,T,TSTAR,TMU,BMU
000641      GOTO 1500
000643      700  FORMAT(/,5X,*REJECT NULL HYPOTHESIS.*/,
      + 5X,*THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS*,/
      + 5X,*AT A CONFIDENCE LEVEL OF *,F10.2/
      + 5X,*THE LOWER CONFIDENCE LIMIT IS *,E15.4/
      + 5X,*T = *E15.4,5X,*TSTAR = *E15.4/
      + 5X,*TEST MU = *E15.4,5X,*BASE MU = *E15.4//)
000643      1185 CONTINUE
000643      CALL STD2(X2,Y2,NPTS,BMU,BSD)
000647      CALL STD2(X3,Y3,N3,TMU,TSD)
000653      DO 1187 L=1,NPTS
000656      1187  X2(L)=X2(L)+BHIST(I,N)-BMU

```

Table 5-14 SUBROUTINE STATS LISTING (cont.)

TRW SYSTEMS
 RUN2.31 03/21/73. 17.56.03. STATS

```

000670      DO 1186 L=1,NN
000671      1186 X3(L)=-X3(L)-THISTT(I,N)+TMU
000703      CALL CONVOL(X3,Y3,X2,Y2,X1,Y1,N3,NPTS,N1)
000713      1190 FORMAT(/,5X,A2,* EMISSION*)
000713      Z=XPT(X1,Y1,N1,PCONF)
000717      IF(Z.LT.0) Z=0
000723      DELEM(I,N)=Z
000727      WRITE(6,1400) PCONF,Z
000736      1400 FORMAT(/,5X,*THERE EXISTS A*,
+ F6.0,* PERCENT CONFIDENCE LEVEL THAT EMISSIONS*,
+ * ARE REDUCED BY*,E14.3/)
000736      CALL DISTPR(X3,Y3,X2,Y2,X1,Y1,N3,NPTS,N1,
+ 50H -TEST DIST + BASE DIST = CONVOL B-T
000750      1500 CONTINUE
000754      RETURN
000755      2050 CONTINUE
000755      DO 2500 I=1,NEMIS
000757      TMU=THISTT(I,N)
000763      BMU=BHIST(I,N)
000766      TSD=TSIG(I)
000771      TSTAR=FUN1(PCONF,PCXBP,PCYBP,5)
000775      SIGDIFF=SQRT(TSD*TSD/TSIZE+BSD*BSD/BSIZE)
001004      T=(BMU-TMU)/SIGDIFF
001007      IF(I.EQ.1) WRITE (6,505) N
001022      WRITE (6,1190) NAME(I)
001031      IF(T.GT.TSTAR) GO TO 2100
001036      WRITE (6,600) PCONF,T,TSTAR,TMU,BMU
001053      DELEM(I,N)=0.
001060      GO TO 2500
001060      2100 CONTINUE
001060      A=BMU-TMU-TSTAR*SIGDIFF
001064      DELEM(I,N)=A
001070      WRITE (6,700) PCONF,A,T,TSTAR,TMU,BMU
001107      2500 CONTINUE
001113      RETURN
001114      END

```

identity with respect to the other. In this case, a convolution is not performed, but the mean of the non-identity distribution is shifted by the mean of the approximate identity and the new distribution is output in P3 and Y3.

If neither distribution is an approximate identity with respect to the other, CONVOL performs a standard numeric convolution of the two distributions. A flowchart of CONVOL is found in Figure 5-15 and a listing in Table 5-15.

5.11.2 Function AREA

The AREA routine integrates a parameter or mode emission distribution based on cutpoints stored in XCUT or SXCUT. The limits of the rejected portion of the distribution are determined by the LINT array and the upper and lower values stored in the distribution. If LINT for a parameter is one, indicating the lower portion of the distribution is rejected, the limits are set at the first entry and the cutpoint respectively. If LINT is two for a parameter, indicating the upper portion of the distribution is rejected, the limits are set at the cutpoint and the upper value of the distribution respectively. All mode emission distributions are rejected at the upper end, and therefore have no associated LINT value. After establishing the rejected fraction integration limits the AREA routine calls subroutine INTEG which performs a standard numerical (trapezoidal) integration of the distribution between the limits specified. The area under the rejected portion of the distribution is returned in AREA.

For non-distributive parameters such as NO_x control, air pump, choke blade, and misfire, algorithms have been incorporated into the

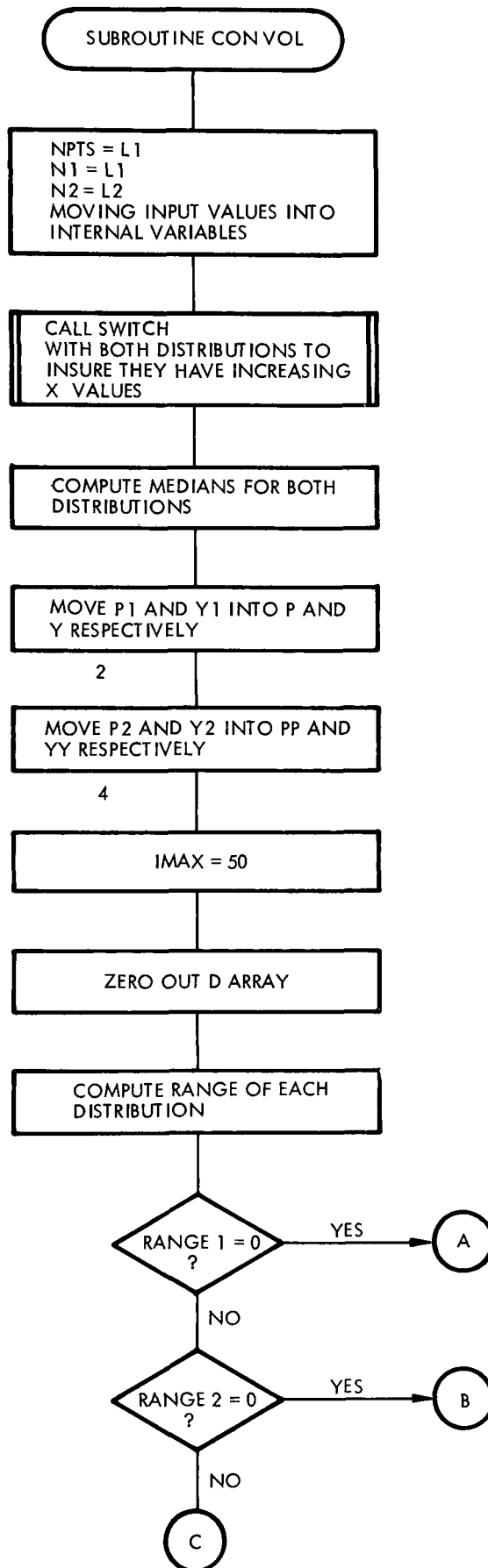


Figure 5-15 Subroutine CONVOL Flowchart

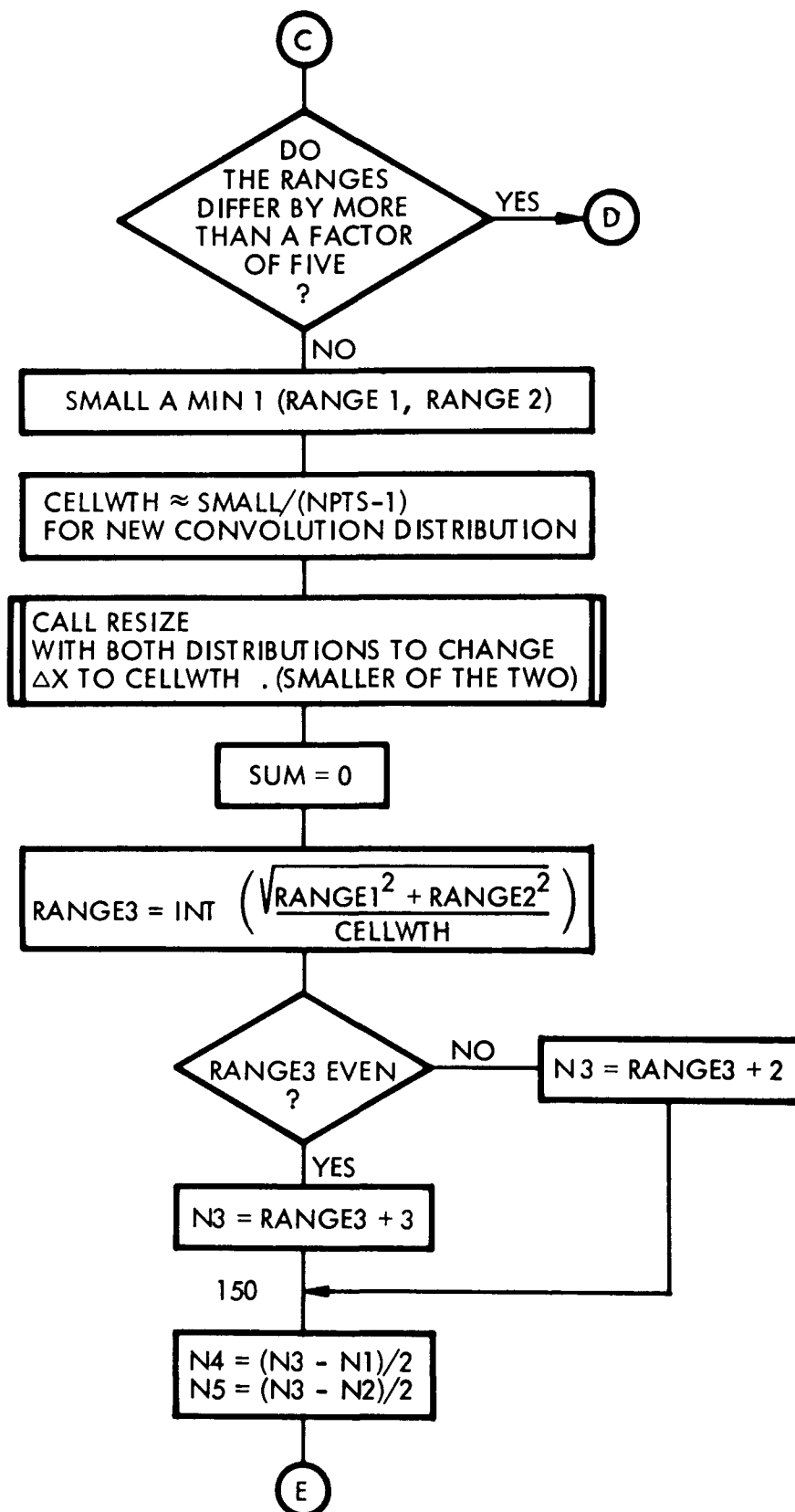


Figure 5-15 Subroutine CONVOL Flowchart (cont.)

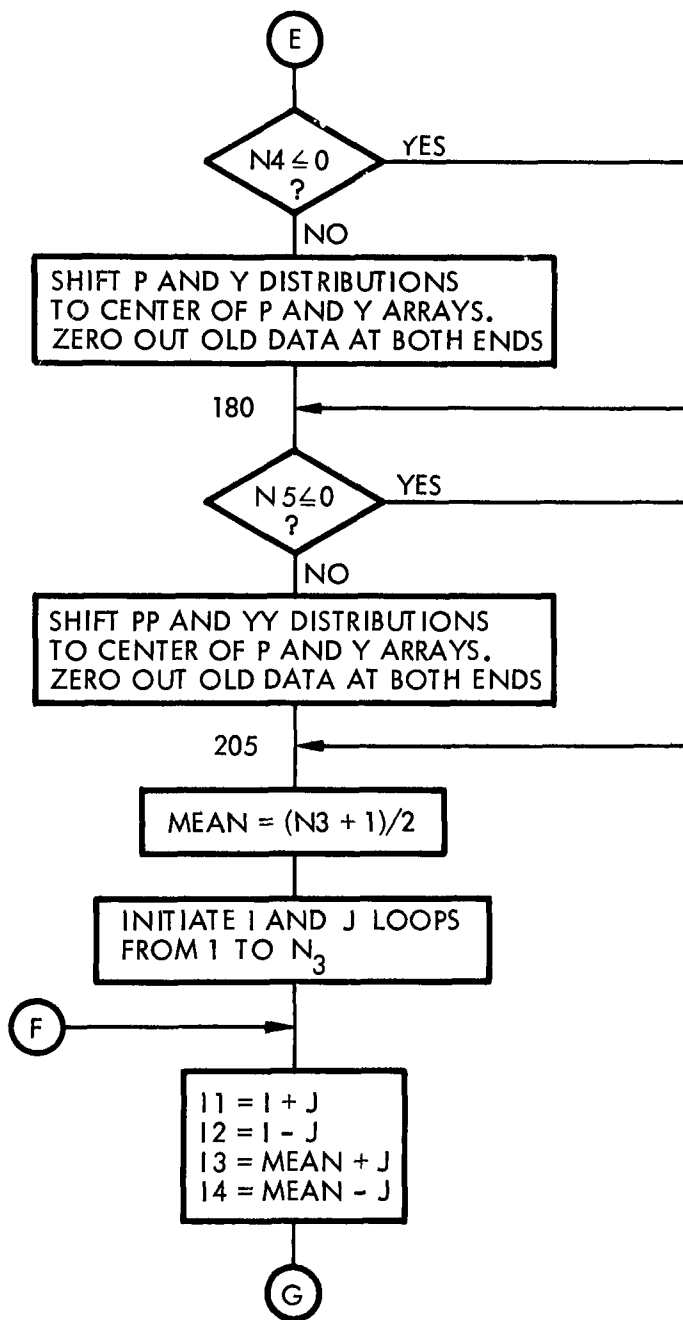


Figure 5-15 Subroutine CONVOL Flowchart (cont.)

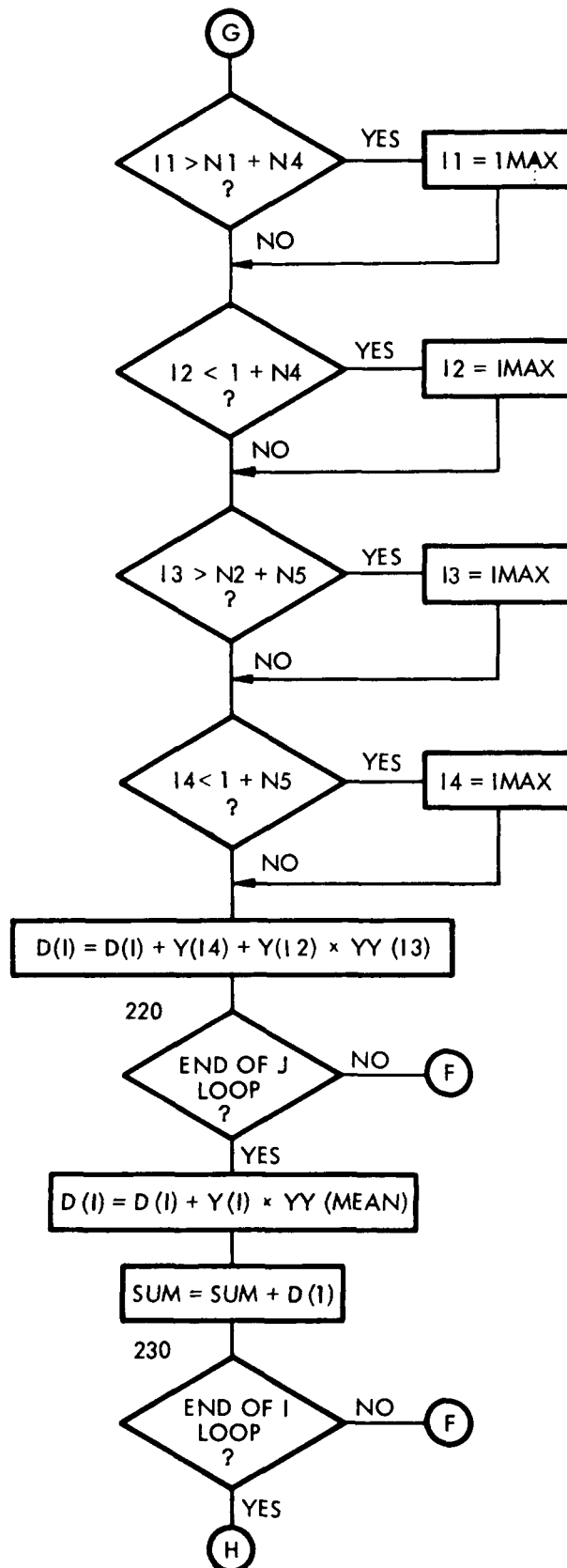


Figure 5-15 Subroutine CONVOL Flowchart (cont.)

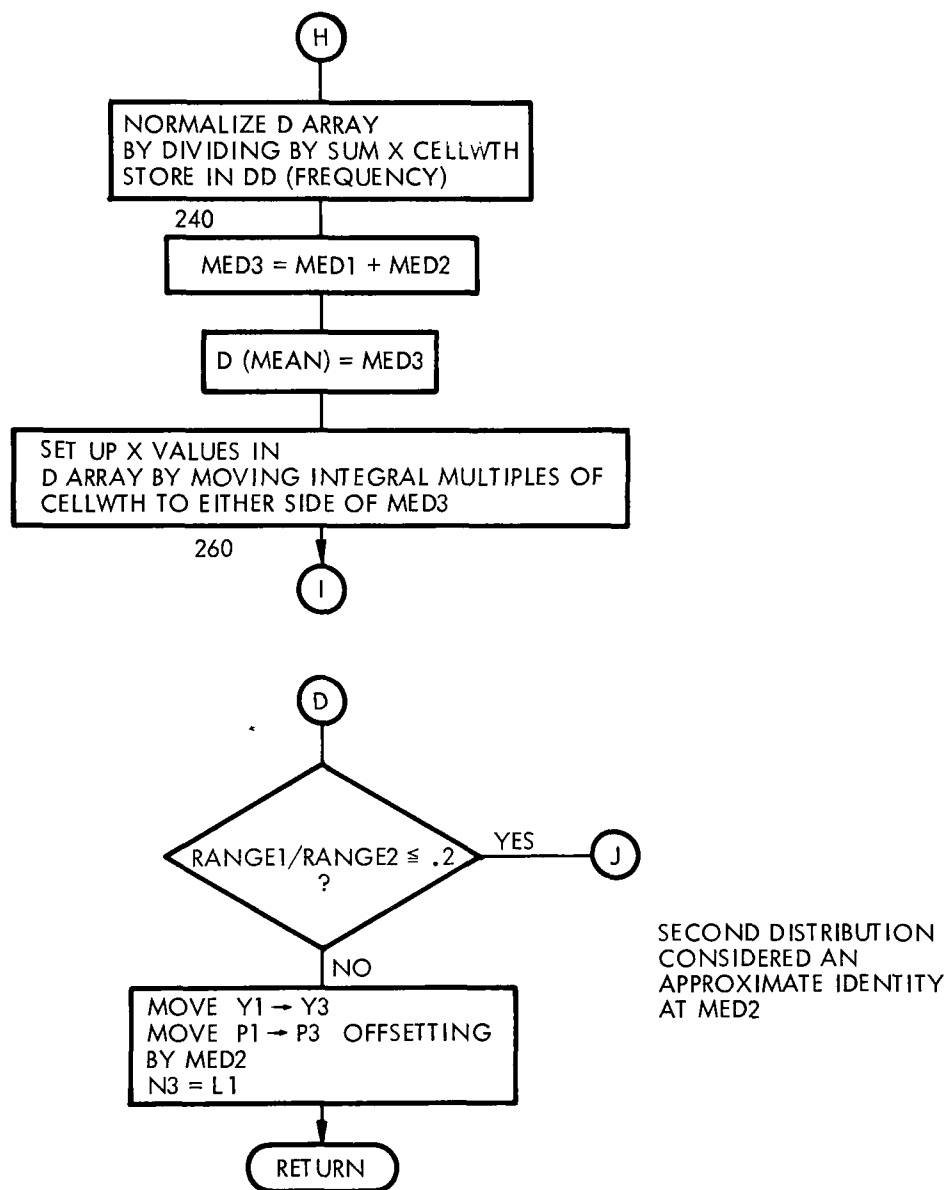
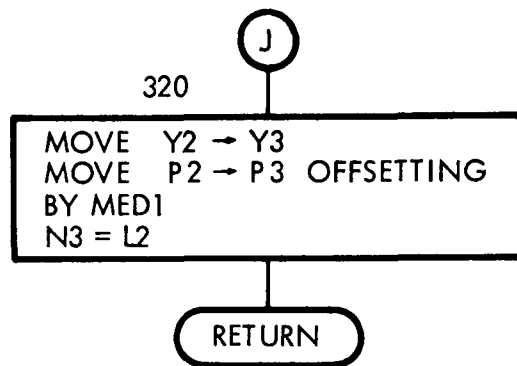


Figure 5-15 Subroutine CONVOL Flowchart (cont.)



FIRST DISTRIBUTION
CONSIDERED AN
APPROXIMATE
IDENTITY AT
MED1

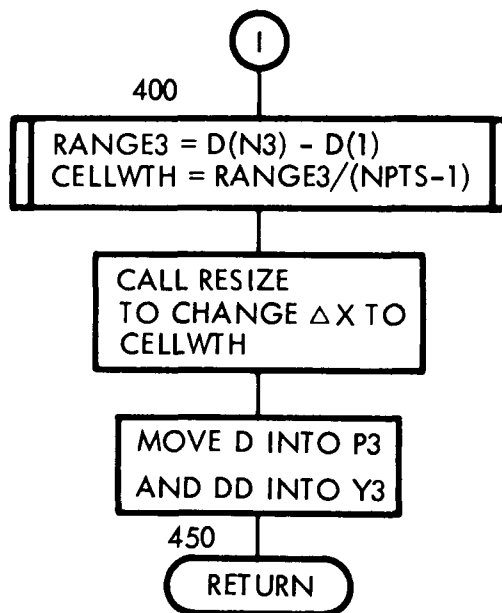


Figure 5-15 Subroutine CONVOL Flowchart (cont.)

Table 5-15 SUBROUTINE CONVOL LISTING

IRV SYSTEMS		
33220		SUBROUTINE CONVOL(P1,Y1,P2,Y2,P3,Y3,L1,L2,N3)
33230		DIMENSION P(50),Y(50),PP(50),YY(50),D(50),DD(50),
33240		+ P1(1),Y1(1),P2(1),Y2(1),P3(1),Y3(1)
33250		REAL MED1,MED2,MED3
33260		NPTS=L1
33270		N1 = L1
33280		N2 = L2
33290		CALL SWITCH(P1,Y1,N1)
33300		CALL SWITCH(P2,Y2,N2)
33310		MED1=P1((N1+1)/2)
33320		MED2=P2((N2+1)/2)
33330		DO 2 I = 1,N1
33340		P(I) = P1(I)
33350	2	Y(I) = Y1(I)
33360		DO 4 I= 1,N2
33370		PP(I) = P2(I)
33380	4	YY(I) = Y2(I)
33390		IMAX = 50
33400		DO 10 I = 1 ,IMAX
33410	10	D(I) = 0.0
33420	C	
33430	C	CALC. RANGE1 AND RANGE2
33440	C	
33450		RANGE1 = ABS(P(N1)-P(1))
33460		RANGE2 = ABS(PP(N2)-PP(1))
33470		IF(RANGE1.EQ.0.) GO TO 320
33480		IF(RANGE2.EQ.0.) GO TO 305
33490	C	
33500	C	CHECK FOR 5/1 RANGE RATIO
33510	C	
33520		IF(RANGE1/RANGE2 .GE. 5.0 .OR. RANGE1/RANGE2
33530		+ .LE. 0.20) GO TO 300
33540		SMALL = AMIN1(RANGE1,RANGE2)
33550		CELLWTH = SMALL/(NPTS-1)
33560		CALL RESIZE(CELLWTH,RANGE1,P,Y,N1)
33570		CALL RESIZE(CELLWTH,RANGE2,PP,YY,N2)
33580	C	
33590		SUM = 0.0
33600	C	
33610	C	CALC. RANGE3 (ODD NUMBER)
33620	C	

Table 5-15 SUBROUTINE CONVOL LISTING (cont.)

33630		RANGE3=INT(SQRT(RANGE1*RANGE1+RANGE2*RANGE2)/CELLWTH)
33640		RTEST = RANGE3/2.0
33650		IF(RTEST-INT(RTEST) .LE. 0.0) GO TO 140
33660		N3 = RANGE3 + 2
33670		GO TO 150
33680	140	N3 = RANGE3 + 3
33690	150	N4 = (N3-N1)/2
33700		N5 = (N3-N2)/2
33710	C	
33720	C	SHIFT BOTH PRIMARY AND SECCNDARY TO FIT RESULTANT
33730	C	
33740		IF(N4 .LE. 0) GO TO 180
33750		DO 160 I = 1,N1,1
33760		II = N1+N4-I+1
33770		IJ = N1-I+1
33780		P(II) = P(IJ)
33790	160	Y(II) = Y(IJ)
33800		DO 170 I = 1,N4,1
33810		P(I) = 0.0
33820	170	Y(I) = 0.0
33830		II = N3-N4 +1
33840		DO 175 I = II,N3
33850		P(I) = 0.0
33860	175	Y(I) = 0.0
33870	180	IF(N5 .LE. 0) GO TO 210
33880		DO 190 I = 1,N2,1
33890		II = N2+N5-I+1
33900		IJ = N2-I+1
33910		PP(II) = PP(IJ)
33920	190	YY(II) = YY(IJ)
33930		DO 200 I = 1,N5,1
33940		PP(I) = 0.0
33950	200	YY(I) = 0.0
33960		II = N3-N5 +1
33970		DO 205 I = II,N3
33980		PP(I) = 0.0
33990	205	YY(I) = 0.0
34000	210	MEAN = (N3+1)/2
34010	C	
34020	C	CONVOLUTION
34030	C	
34040		DO 230 I = 1,N3,1

Table 5-15 SUBROUTINE CONVOL LISTING (cont.)

34050		DO 220 J = 1,N3,1
34060		I1 = I+J
34070		I2 = I-J
34080		I3 = MEAN + J
34090		I4 = MEAN - J
34100		IF(I1 .GT. N1+N4) I1 = IMAX
34110		IF(I2 .LT. 1 +N4) I2 = IMAX
34120		IF(I3 .GT. N2+N5) I3 = IMAX
34130		IF(I4 .LT. 1 +N5) I4 = IMAX
34140	220	D(I) = D(I) + Y(I1)*YY(I4) + Y(I2)*YY(I3)
34150		D(I) = D(I) + Y(I)*YY(MEAN)
34160	230	SUM = SUM + D(I)
34170		DO 240 I = 1,N3,1
34180	240	DD(I) = D(I)/(SUM*CELLWTH)
34190		MED3=MED1+MED2
34200		D(MEAN)=MED3
34210		DO 250 I=2,MEAN
34220		II = MEAN-I+1
34230	250	D(II) = D(II+1) - CELLWTH
34240		JJ = MEAN + 1
34250		DO 260 I = JJ,N3
34260	260	D(I) = D(I-1) + CELLWTH
34270		GO TO 400
34280	C	
34290	C	CHECK IF RANGE2 GREATER THAN RANGE1
34300	C	
34310	300	IF(RANGE1/RANGE2 .LE. 0.20) GO TO 320
34320	C	
34330	C	RANGE1 GREATER THAN RANGE2
34340	C	
34350	305	DO 310 I = 1,L1
34360		Y3(I) = Y1(I)
34370	310	P3(I)= P1(I) + MED2
34380		N3 = L1
34390		RETURN
34400	C	
34410	C	RANGE2 GREATER THAN RANGE1
34420	C	
34430	320	DO 330 I = 1,L2
34440		Y3(I) = Y2(I)
34450	330	P3(I)= P2(I) + MED1
34460		N3 = L2

Table 5-15 SUBROUTINE CONVOL LISTING (cont.)

34470		RETURN
34480	C	
34490	C	RESIZE THE RESULTANT
34500	C	
34510	400	RANGE3=D(N3)-D(1)
34520		CELLWTH = RANGE3/(NPTS-1)
34530		CALL RESIZE(CELLWTH,RANGE3,D,DD,N3)
34540		DO 450 I = 1,N3
34550		P3(I) = D(I)
34560	450	CONTINUE
34570		RETURN
34580		END

AREA function for estimating rejection rates. These algorithms utilize a rejected mean value of one (i.e., failed mode).

Figure 5-16 contains a detailed flowchart of the AREA function.

Table 5-16 lists the corresponding computer code.

5.11.3 Subroutine INTEG

Subroutine INTEG integrates an unspecified function over some given bounds using a trapezoidal technique. The data is manipulated in tabular form as a set of x's and corresponding y's at N points. The trapezoidal technique utilizes the following equation:

$$\text{Area} = \sum_{i=1}^{N-1} \left\{ 1/2 (Y_{i+1} + Y_i) \Delta X \right\}$$

Subroutine INTEG is listed in Table 5-17 and flowcharted in Figure 5-17.

5.11.4 Function FUN1

Many mathematical functions in GEEP are represented in tabular form. Function FUN1 returns an interpolated value for y given an arbitrary x and a table of values for x and y.

Function FUN1 is flowcharted and listed in Figure 5-18 and Table 5-18 respectively.

5.11.5 Function FUN2

Function FUN2 contains a double table look-up with linear interpolation routine. Input to FUN2 is a matrix containing values of the dependent variable and two coordinate vectors. FUN2 is called with X and Y values which are referenced against the coordinate vectors to

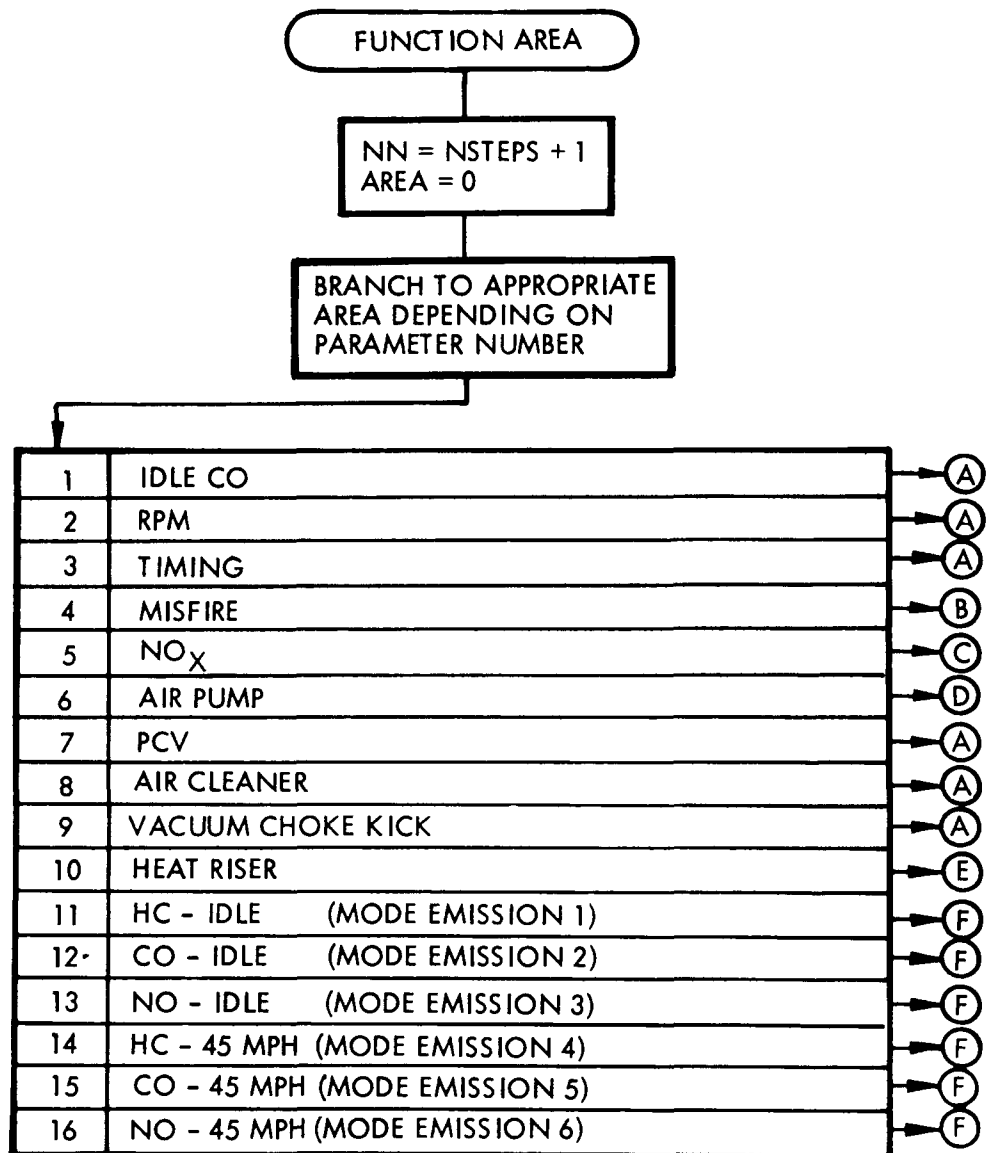


Figure 5-16 Function AREA Flowchart

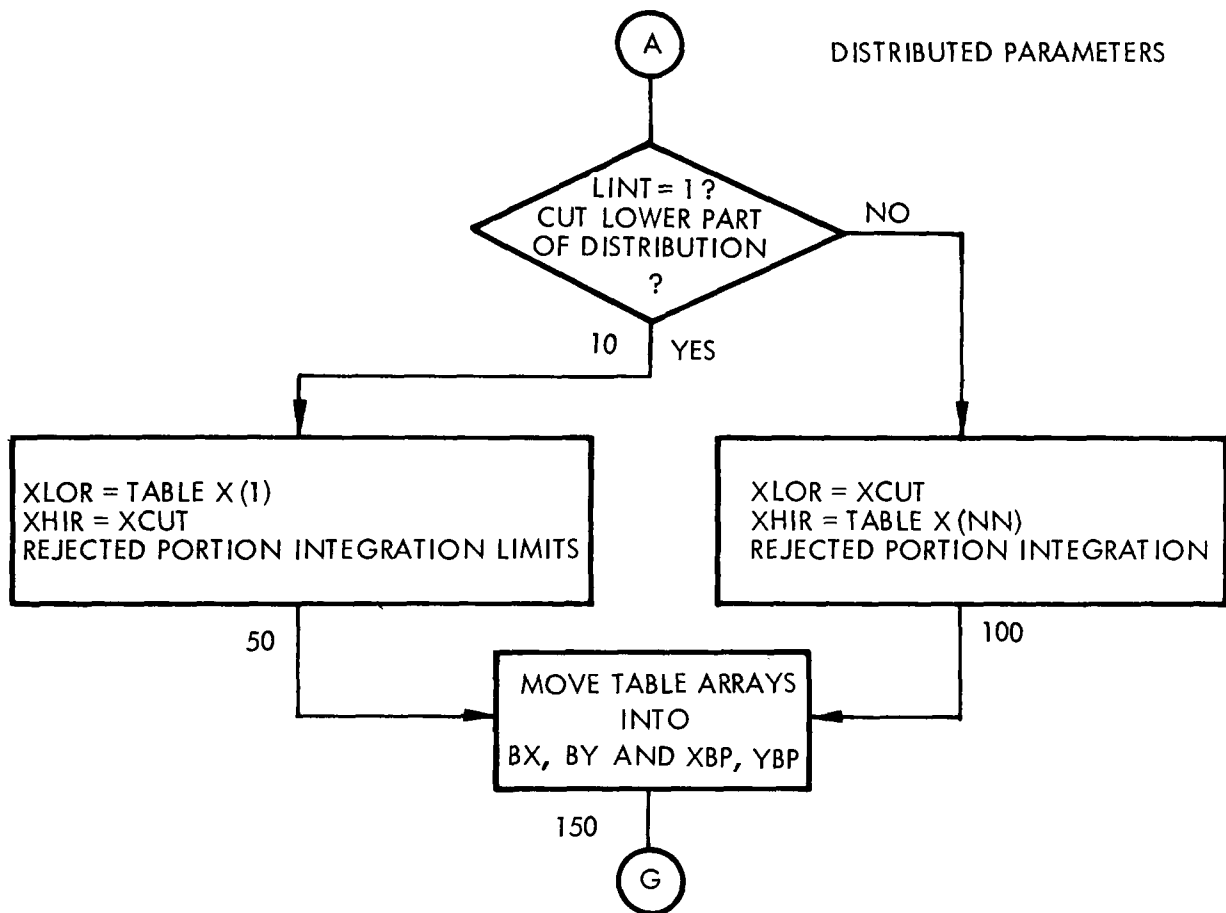


Figure 5-16 Function AREA Flowchart (cont.)

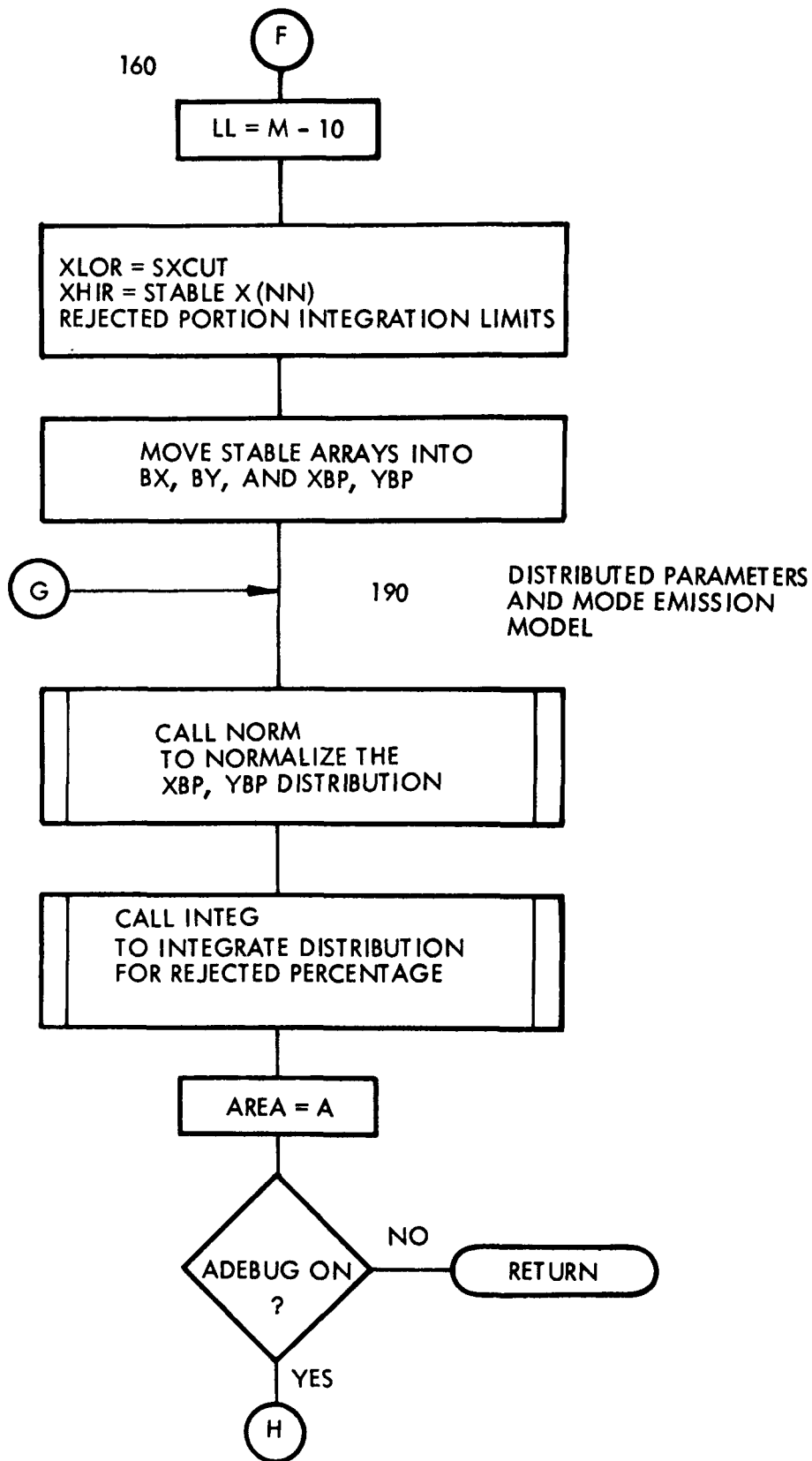


Figure 5-16 Function AREA Flowchart (cont.)

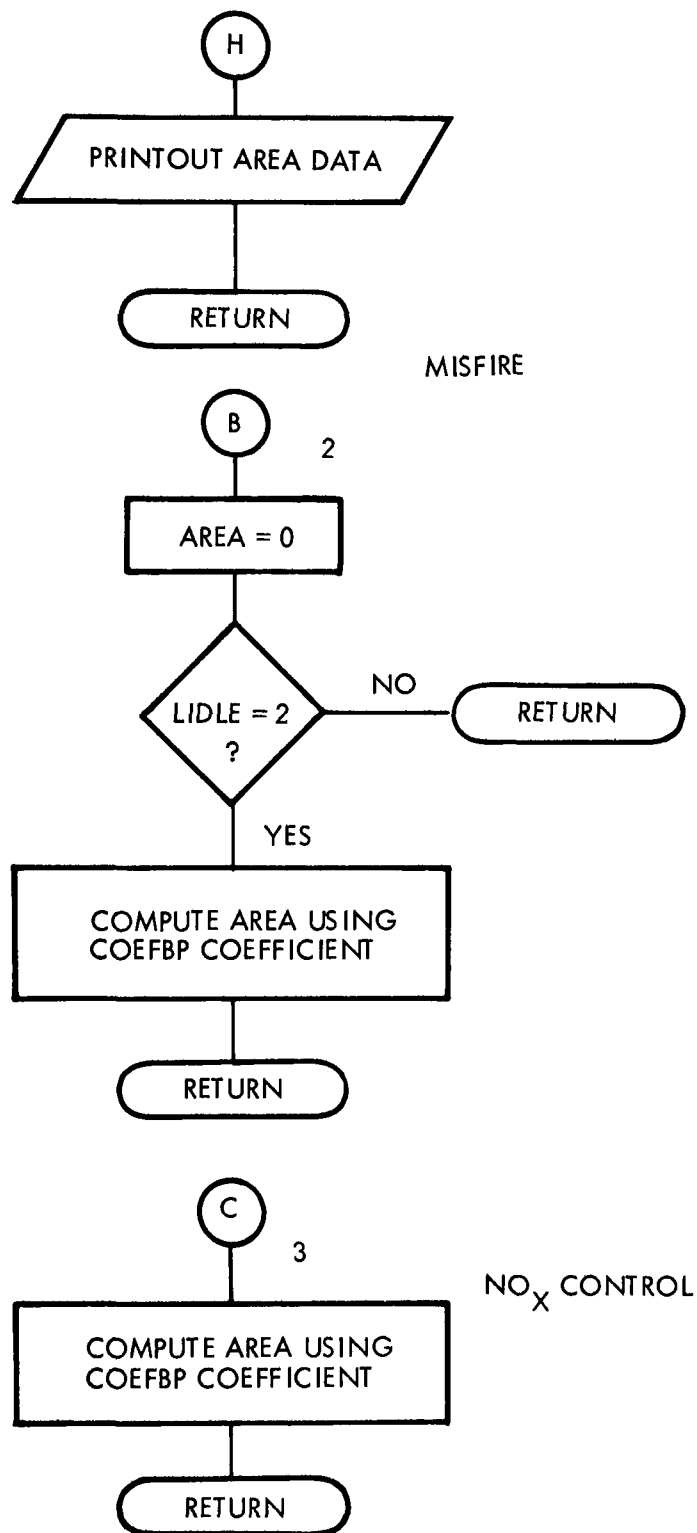


Figure 5-16 Function AREA Flowchart (cont.)

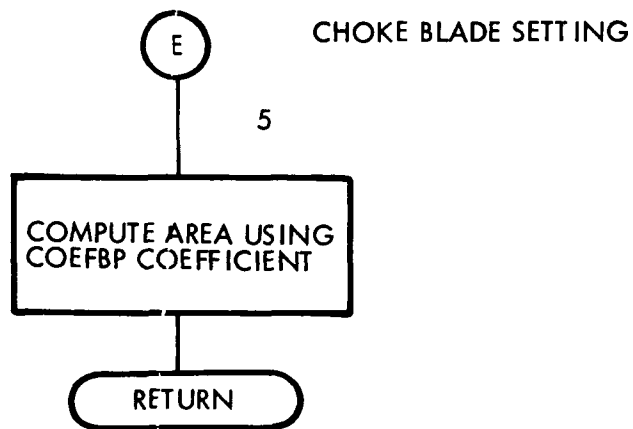
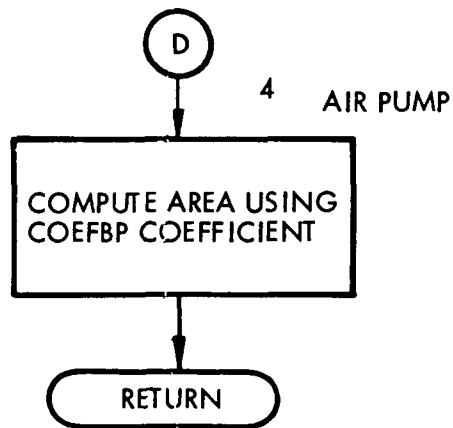


Figure 5-16 Function AREA Flowchart (cont.)

Table 5-16 FUNCTION AREA LISTING

34590	FUNCTION AREA(XOPT,M,J,K,N)
34600	DIMENSION XBP(35),YBP(35)
34610	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,
34620	+ BAREA(3), BLD1, BLD2, BSIG(3), BXTA, BSIZE,
34630	+ BHIST(3,16), BMMI(10,15,3),
34640	+ ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
34650	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),
34660	+ CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
34670	+ CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
34680	+ CN(15,3,16), CDEFB(15,3), CDEFBP(10,15),
34690	+ CPART(10,15)
34700	CC ADD2
34710	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
34720	+ EMW(3), EP(10,15),EFF(10), DELIT(3),
34730	+ FREQA, FREQB, FPERC(10,3),
34740	+ HORZN, HORZNY,
34750	+ HPC(15,16), HPCS(15,16), HPP(10,15,16),
34760	+ HPS(6,15,16), HPT(5,16), HPTOT(16),
34770	+ HPTOTS(16)
34780	CC ADD3
34790	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
34800	+ KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
34810	+ LIDLE, LINT(16), LPSP(10),LSTART, LSTOP,
34820	+ MBASE, MPH, MSPEC(10),MSTART, MSTOP,
34830	+ MU(10,3), MMS(10,15), MVPR(10,15)
34840	CC ADD4
34850	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,
34860	+ NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
34870	+ NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
34880	+ OCY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
34890	CC ADD5
34900	COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),
34910	+ PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
34920	+ PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
34930	+ PAK(10,15,3), PAR1(10,3,3), PLUS(10,15),
34940	+ PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
34950	+ PSA(15), PTA(5), PCONE, PARINT(10,10,9)
34960	+ ,PAYFIN
34970	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,
34980	+ RTYPE,
34990	+ SALE, SALL, SALP, SITEI, SITEM, SLANE,

Table 5-16 FUNCTION AREA LISTING (cont.)

35000	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),
35010	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),
35020	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),
35030	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),
35040	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),
35050	+	STABLEX(33,6,15),		STABLEY(33,6,15)		
35060		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,TIMEI(3,16),
35070	+	TINT,	TOBE(3),	TONX,	TOTE(3),	TPDB(3), TPDT(3),
35080	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),
35090	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),
35100	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)
35110	CC	ADD10				
35120		COMMON /COM11/		WF(10),		
35130	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM, XCUT(10,3),
35140	+	XTM(16),	XBASE(9,3),	YBASE(9,3)		
35150	CC	ADD11				
35160		COMMON /COM12/		Y1GP(3,3,10),		Y2BP(3,3,10),
35170	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),	Y2DBP(4,4,10),
35180	+	Z1,	Z2,	Z3,	Z4,	Z5, Z6,
35190	+	Z7,	Z8,	Z9,	Z10,	Z11, Z12,
35200	+	Z13,	Z14,	Z15,	Z16,	Z17,
35210	+	ZCARI,	ZCARM,	ZIC,	ZSUM,	
35220	+	ZZ(3,3)				
35230	CC	ADD12				
35240		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG, DDEBUG,
35250	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG, TDEBUG
35260	CC	ADD0				
35270		REAL	ITE,	ITL,	ITP,	ITIME,
35280	+	MMS,	MPH,	MSPEC,	4U,	MVPR,
35290	+	NAME,	NO,	LDEBUG,	MDEBUG,	
35300	+	IN,	MISFIRE			
35310		INTEGER	RNAME,	SITEI,	SITEM,	STAT,
35320	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK
35330		INTEGER XOPT				
35340	CC	XOPT - FUNCTION OPTION				
35350	CC	0 - F(X) -- FUNCTION				
35360	CC	1 - X*F(X) -- EXPECTATION VALUE				
35370	CC	2 - F(X) -- ONLY (NO MAINTENANCE)				
35380	CC	3 - F(X) -- AREA ONLY (NO MAINTAINANCE AT ALL)				
35390	CC	4 - F(X)*X -- EXPECTED VALUE (NO MAINT.)				
35400	CC	LINT - LIMITS OF INTEGRATION CRITERIA				
35410	CC	- 1 -- XLO TO XCUT				

Table 5-16 FUNCTION AREA LISTING (cont.)

35420	CC	- 2 -- XCUT TO XHI
35430		NN=NSTEPS+1
35440		AREA=0.
35450		GO TO (1,1,1,2,3,4,1,1,1,5,160,160,160,160,160,160),M
35460	1	IGO=LINT(M)
35470		GO TO (10,50),IGO
35480	10	CONTINUE
35490	CC	CUT LOWER PORTION OF DISTRIBUTION
35500		XLOR=TABLEX(1,M,J)
35510		XHIR=XCUT(M,K)
35520		GO TO 100
35530	50	CONTINUE
35540	CC	CUT UPPER PORTION OF DISTRIBUTION
35550		XLOR=XCUT(M,K)
35560		XHIR=TABLEX(NN,M,J)
35570	100	CONTINUE
35580		DO 150 L=1,NN
35590		XBP(L)=TABLEX(L,M,J)
35600		YBP(L)=TABLEY(L,M,J)
35610	150	CONTINUE
35620		GO TO 190
35630	CC	SIGNATURE MODEL
35640	160	CONTINUE
35650		LL=M-10
35660		XLOR=SXCUT(LL,K)
35670		XHIR=STABLEX(NN,LL,J)
35680		DO 170 L=1,NN
35690		XBP(L)=STABLEX(L,LL,J)
35700		YBP(L)=STABLEY(L,LL,J)
35710	170	CONTINUE
35720	190	CALL NORM(XBP,YBP,NN)
35730	CC	REJECTED PORTION
35740		CALL INTEG(XOPT,XHIR,XLOR,XBP,YBP,NSTEPS,A)
35750		AREA=A
35760		IF(ADEBUG.EQ.NO) RETURN
35770		WRITE (6,225) M,J,K,XOPT,AREA,DELXL,XLOR,XHIR
35780	225	FORMAT(1H1,5X,*PARAMETER NO. *,12,5X,*POWERTRAIN NO.*,
35790		+ 12,5X,*CONTROL TYPE *,12//5X,*XOPT = *,12,
35800		+ 5X,*AREA = *E15.4,5X,*DELX = *E15.4/
35810		+ 5X,*XLO REJ = *E15.4,5X,*XHI REJ = *E15.4/)
35820		RETURN
35830	2	CONTINUE

Table 5-16 FUNCTION AREA LISTING (cont.)

35840	C	MISFIRE DISTRIBUTION
35850	CC	REJECTED PERCENTAGE
35860		AREA=0.
35870		IF(LIDLE.EQ.2) AREA=COEFBP(4,J)*TMIL(N,J)*TINT
35880		+ *SCALEBM(1)
35890		RETURN
35900	3	CONTINUE
35910	C	NOX DISTRIBUTION
35920		AREA=COEFBP(5,J)*TMIL(N,J)*TINT
35930		+ *SCALEBM(1)
35940		RETURN
35950	4	CONTINUE
35960	C	AIR PUMP DISTRIBUTION
35970		AREA=COEFBP(6,J)*TMIL(N,J)*TINT
35980		+ *SCALEBM(1)
35990		RETURN
36000	5	CONTINUE
36010	C	CHOKE BLADE SETTING
36020		AREA=COEFBP(10,J)*TMIL(N,J)*TINT
36030		+ *SCALEBM(1)
36040		RETURN
36050		END

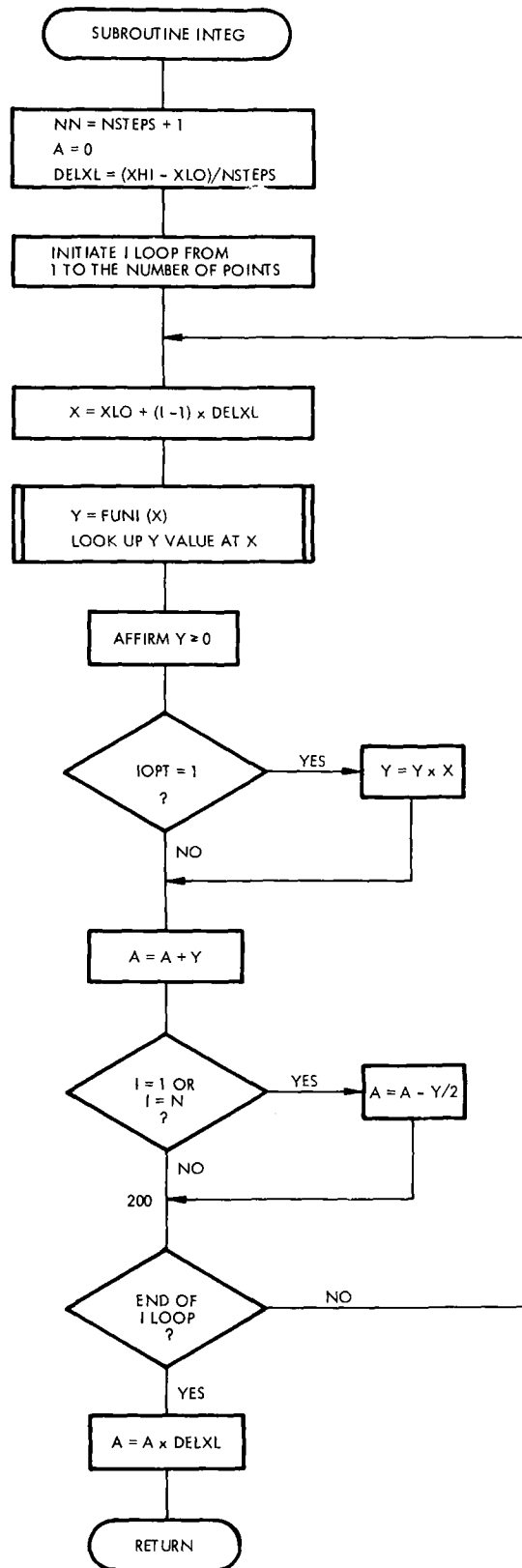


Figure 5-17 Subroutine INTEG Flowchart

Table 5-17 SUBROUTINE INTEG LISTING

37770		SUBROUTINE INTEG(IOPT,XHI,XLO,XBP,YBP,NSTEPS,A)
37780		DIMENSION XBP(1),YBP(1)
37790		NN=NSTEPS+1
37800		A=0.
37810		DELXL=(XHI-XLO)/NSTEPS
37820		DO 200 I=1,NN
37830		X=XLO+(I-1)*DELXL
37840		Y=FUN1(X,XBP,YBP,NN)
37850		IF(Y.LT.0.) Y=0.
37860		IF(IOPT.EQ.1) Y=Y*X
37870		A=A+Y
37880		IF(I.EQ.1) A=A-Y/2.
37890		IF(I.EQ.NN) A=A-Y/2.
37900	200	CONTINUE
37910		A=A*DELXL
37920		RETURN
37930		END

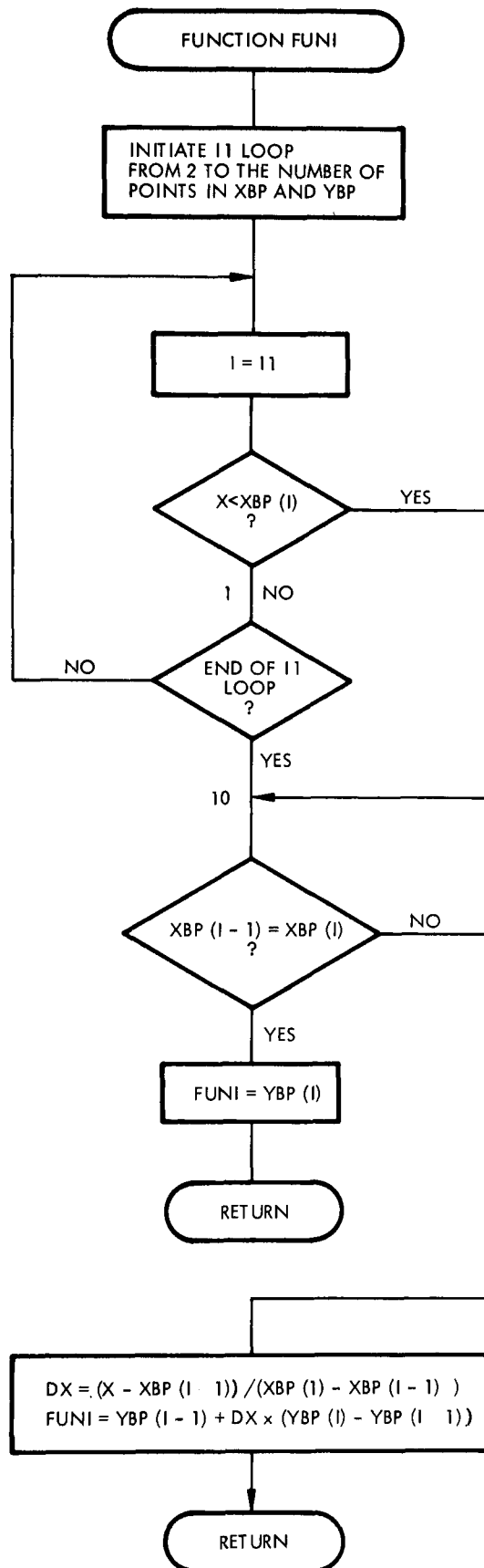


Figure 5-18 Function FUN1 Flowchart

Table 5-18 FUNCTION FUN1 LISTING

37940		FUNCTION FUN1(X,XBP,YBP,N)
37950	CC	
37960	CC	LINEAR INTERPOLATION
37970	CC	
37980		DIMENSION XBP(N),YBP(N)
37990		DO 1 II=2,N
38000		I = II
38010	1	IF(X .LT. XBP(I)) GO TO 10
38020	10	IF(XBP(I-1).NE.XBP(I)) GOTO 20
38030		FUN1=YBP(I)
38040		RETURN
38050	20	DX=(X-XBP(I-1))/(XBP(I)-XBP(I-1))
38060		FUN1 = YBP(I-1)+DX*(YBP(I)-YBP(I-1))
38070		RETURN
38080		END

get the appropriate entries in the storage matrix. A linear interpolation is performed (in two dimensions) to obtain the required value.

Figure 5-19 presents a flowchart and Table 5-19 contains a listing of FUN2.

5.11.6 Subroutine FIT

Subroutine FIT performs a least square binomial curve fit using orthonormal polynomials and inner products. The Chebyshev technique is used to generate an approximation from tabular data.

Figure 5-20 exhibits a flowchart and Table 5-20 provides a listing of subroutine FIT.

5.11.7 Function UNION

The function UNION computes the total rejection rate for N individual rejection fractions. Input to UNION are the individual probabilities, the number of values and a flag indicating whether these are parameter or mode emission rejection rates. For parameter rejection rates, function UNION simply computes the set theoretical union of probabilities and returns that value in functional variable UNION. For mode emission rejection rates the function computes the set theoretical union corrected for non-independence. This correction is necessary because of the statistically significant dependence observed between several of the mode emissions. Output from function UNION is the function itself. A flowchart of UNION is given in Figure 5-21 while Table 5-21 presents a computer listing.

5.11.8 Subroutine QUEUE

Subroutine QUEUE contains a standard queuing model for a multiple server Poission input queuing problem. Input to QUEUE is RHO, the ratio of arrival time to serving time and J, the number of lanes in the

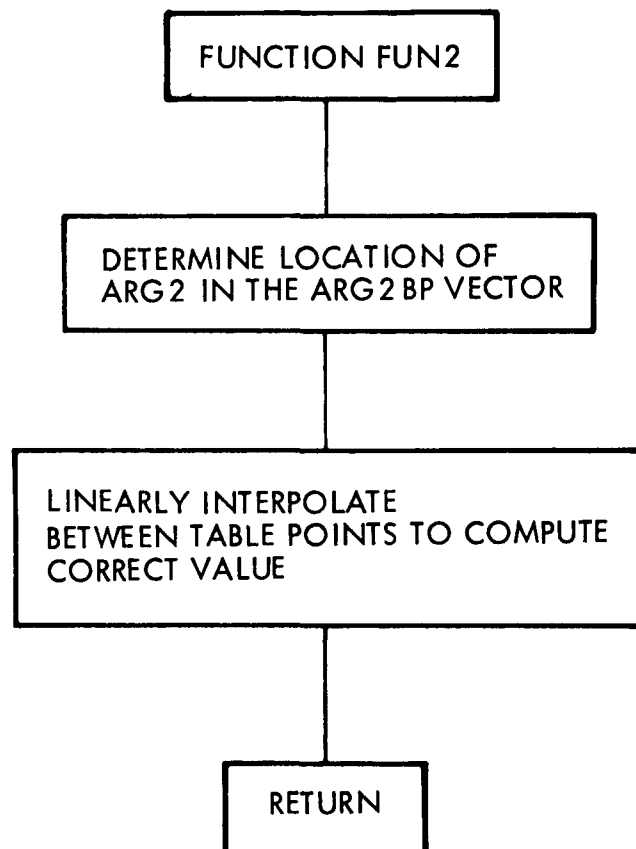


Figure 5-19 Function FUN2 Flowchart

Table 5-19 FUNCTION FUN2 LISTING

62790	FUNCTION FUN2(ARG1,ARG1BP,ARG2,ARG2BP,FUN2BP,I1,I2)
62800	DIMENSION ARG1BP(I1),ARG2BP(I2),FUN2BP(I1,I2)
62810	DO 10 JJ1=2,I1
62820	J1=JJ1
62830	10 IF(ARG1.LE.ARG1BP(J1)) GO TO 20
62840	20 DO 30 JJ2=2,I2
62850	J2=JJ2
62860	30 IF(ARG2.LE.ARG2BP(J2)) GO TO 40
62870	40 ARG=ARG1BP(J1-1)
62880	FUN=FUN2BP(J1-1,J2-1)
62890	DX=(ARG1-ARG)/(ARG1BP(J1)-ARG)
62900	DY=(ARG2-ARG2BP(J2-1))/(ARG2BP(J2)-ARG2BP(J2-1))
62910	FUNX=FUN+DX*(FUN2BP(J1,J2-1)-FUN)
62920	FUNY=FUN2BP(J1-1,J2)+DX*(FUN2BP(J1,J2)-FUN2BP(J1-1,J2))
62930	FUN2=FUNX+DY*(FUNY-FUNX)
62940	RETURN
62950	END

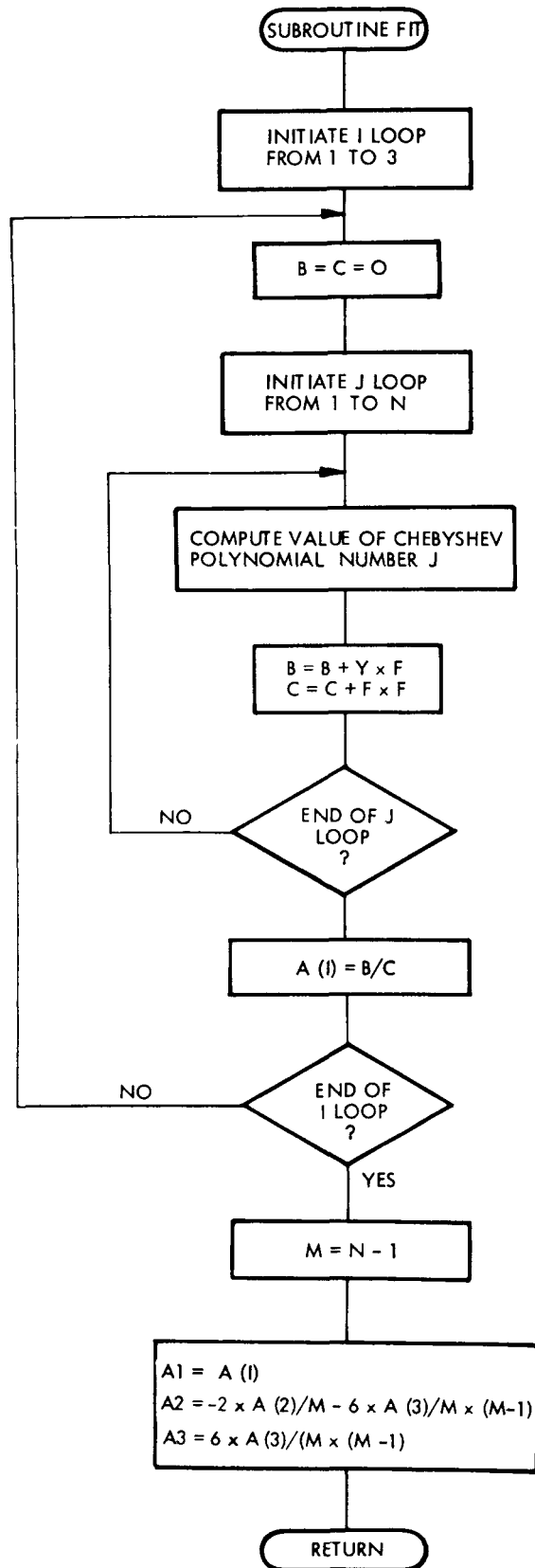


Figure 5-20 Subroutine FIT Flowchart

Table 5-20 SUBROUTINE FIT LISTING

38090		SUBROUTINE FIT(Y,N,A1,A2,A3,II)
38100		DIMENSION A(3),D(3,2)
38110		DIMENSION Y(3,16)
38120		COMMON /COM99/ OPTI,OPTM,XLANE,SLANE,RTYPE,YES,NO,RSTOP,
38130		+ SMODEL,PMODEL,NAME(50),OPTS(50),NOPTS,SITEI,SITEM,RNAME,LIDLE
38140		COMMON /DEBUG/ BDEBUG,MDEBUG,TDEBUG,CDEBUG,ADEBUG,LDEBUG,PDEBUG,
38150		+ DDEBUG,QDEBUG,SDEBUG
38160		DATA D/0.,2.,2*0.,2*6./
38170		DO 30 I=1,3
38180		B=C=0.
38190		DO 20 J=1,N
38200		F=1.-D(I,1)*(J-1)/(N-1)+D(I,2)*(J-1)*(J-2)/((N-2)*(N-1))
38210		B=B+Y(II,J)*F
38220	20	C=C+F*F
38230	30	A(I)=B/C
38240		M=N-1
38250		A1=A(1)+A(2)+A(3)
38260		A2=-A(2)*2./M-A(3)*6./M-6.*A(3)/(M*(M-1))
38270		A3=A(3)*6./M*(M-1)
38280	40	FORMAT(* A1 = *,E12.5,5X,*A2 = *,E12.5,5X,*A3 = *,E12.5/)
38290		RETURN
38300		END

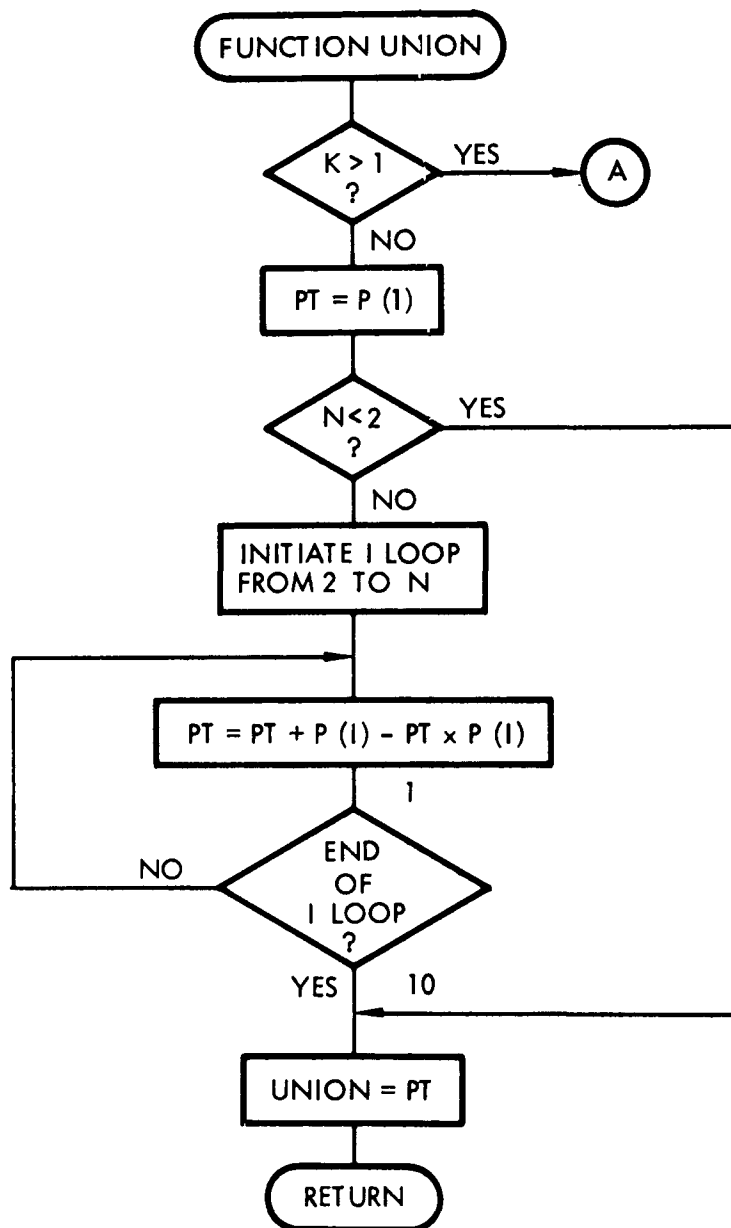


Figure 5-21 Function UNION Flowchart

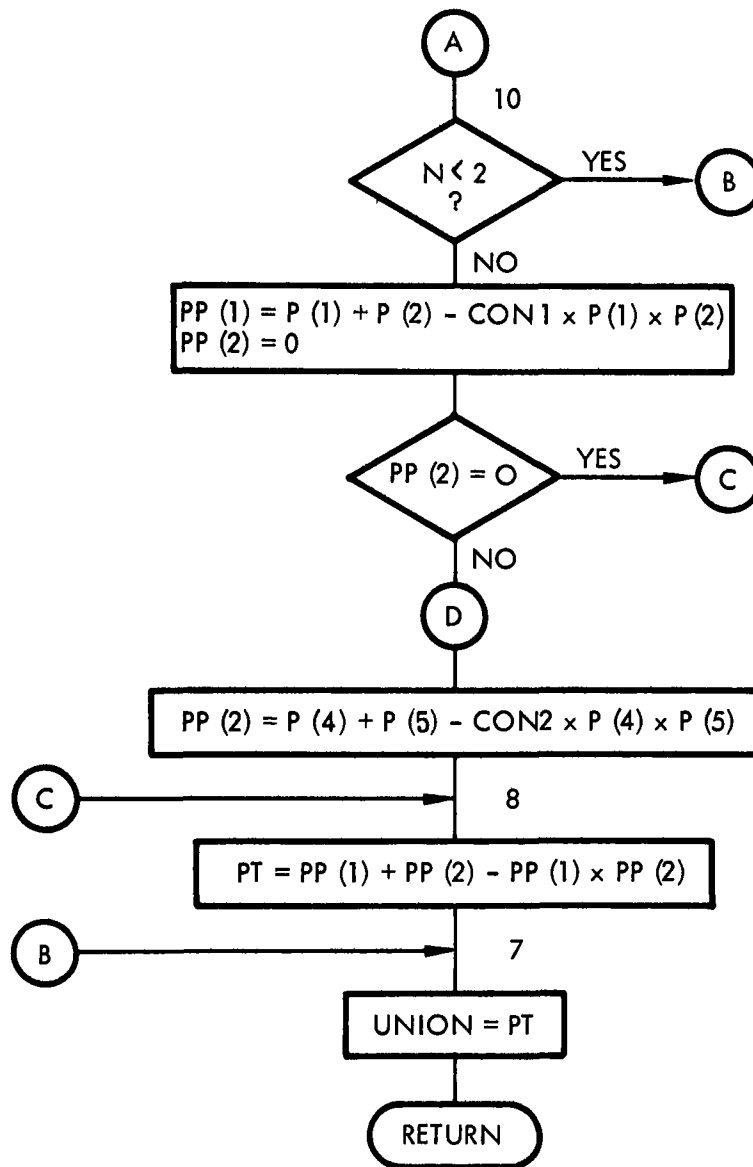


Figure 5-21 Function UNION Flowchart (cont.)

Table 5-21 FUNCTION UNION LISTING

FUNCTION UNION		
38310		FUNCTION UNION(P,N,K)
38320		DIMENSION P(N)
38330		DIMENSION PP(4)
38340		DATA CON1,CON2/1.2,1.05/
38350		IF(K.GT.1) GOTO 10
38360		PT= P(1)
38370		IF(N.LT.2) GO TO 5
38380		DO 1 I=2,N
38390	1	PT=PT+P(I)-PT*P(I)
38400	5	UNION=PT
38410		RETURN
38420	10	PT=P(1)
38430		IF(N.LT.2) GOTO 7
38440		PP(1)=P(1)+P(2)-CON1*P(1)*P(2)
38450		PP(2)=0.
38460		IF(P(4).LE.0.) GOTO 8
38470		PP(2)=P(4)+P(5)-CON2*P(4)*P(5)
38480	8	CONTINUE
38490		PT=PP(1)+PP(2)-PP(1)*PP(2)
38500	7	UNION=PT
38510		RETURN
38520		END

inspection station. Output from QUEUE are ZQUEI, the expected size of the queue and WTQI the expected waiting time in the queue. The equations for ZQUEI and WTQI are fully documented in Volume III. Figure 5-22 gives a flowchart for subroutine QUEUE. A detailed listing of QUEUE is present in Table 5-22.

5.11.9 Function IFACT

Function IFACT is a GEEP utility routine which computes the factorial of an input J. Output from IFACT is simply J factorial stored in the functional variable IFACT.

$$IFACT(J) = J! = \sum_{I=1}^J I$$

A flowchart of IFACT is given in Figure 5-23. Table 5-23 presents the actual computer code.

5.11.10 Subroutine STD

Subroutine STD, a GEEP utility routine, computes the mean and standard deviation of an input vector of N real numbers, X. The computations in STD are simply:

$$AVE = \frac{1}{N} \sum X$$

$$SD = \sqrt{\frac{(X-AVE.)^2}{N-1}}$$

These are simply the standard equations for average and standard deviation. STD outputs AVE and STD. Figure 5-24 contains a flowchart and Table 5-24 a listing of STD.

5.11.11 Subroutine STD2

GEEP subroutine STD2 computes the mean and standard deviation of an input distribution. The input distribution is specified by two vectors, X and Y, and N the length of each vector. Output from STD2 is

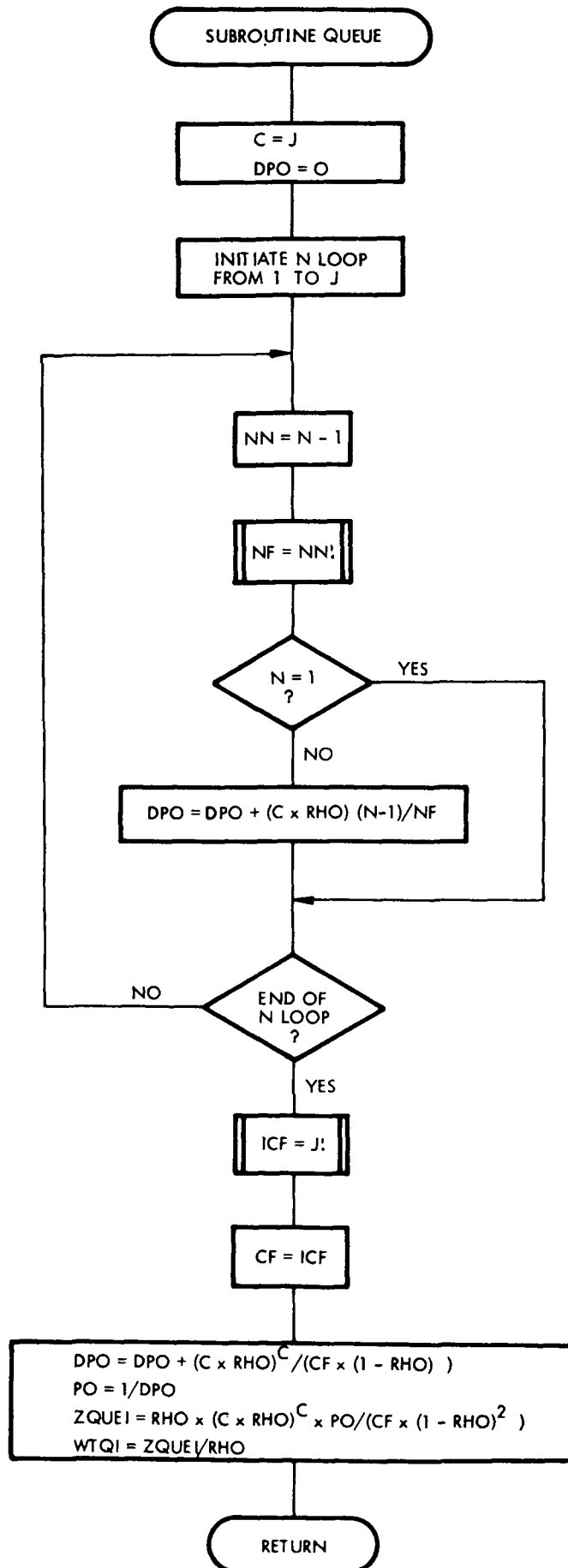


Figure 5-22 Subroutine QUEUE Flowchart

Table 5-22 SUBROUTINE QUEUE LISTING

NEW SYSTEM	
38530	SUBROUTINE QUEUE(RHO,ZQUEI,WTQI,J)
38540	INTEGER C
38550	C=J
38560	DPO=0
38570	DO 10 N=1,J
38580	NN=N-1
38590	NF=IFACT(NN)
38600	IF(N.EQ.1) GO TO 10
38610	DPO=DPO+(C*RHO)**(N-1)/NF
38620	10 CONTINUE
38630	ICF=IFACT(J)
38640	CF=ICF
38650	DPO=DPO+(C*RHO)**C/(CF*(1.-RHO))
38660	PO=1/DPO
38670	ZQUEI=RHO*(C*RHO)**C*PO/(CF*(1.-RHO)**2)
38680	WTQI=ZQUEI/RHO
38690	RETURN
38700	END

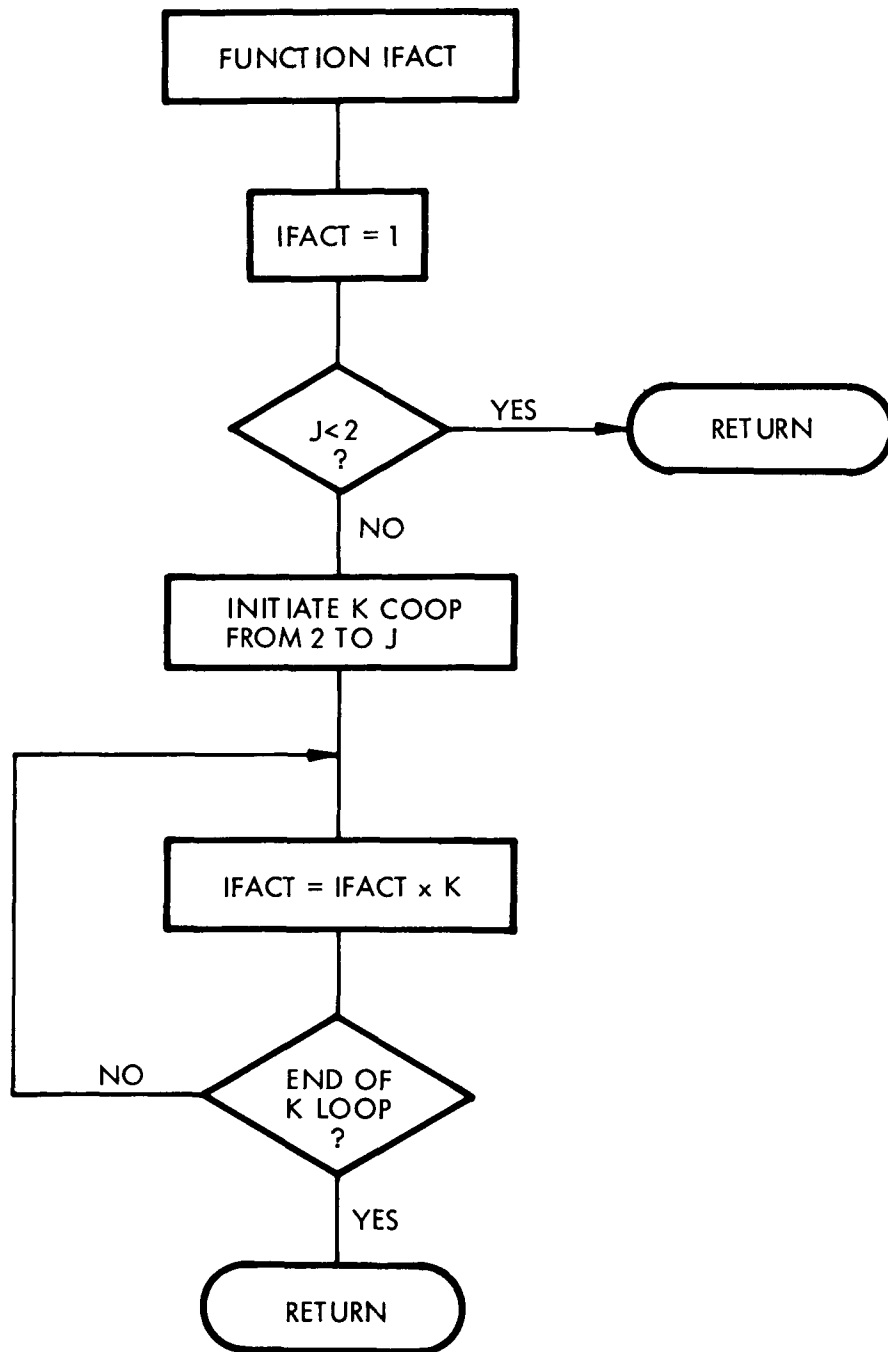


Figure 5-23 Function IFACT Flowchart

Table 5-23 FUNCTION IFACT LISTING

38710		FUNCTION IFACT(J)
38720		IFACT=1
38730		IF(J.LT.2) RETURN
38740		DO 10 K=2,J
38750	10	IFACT=IFACT*K
38760		RETURN
38770		END

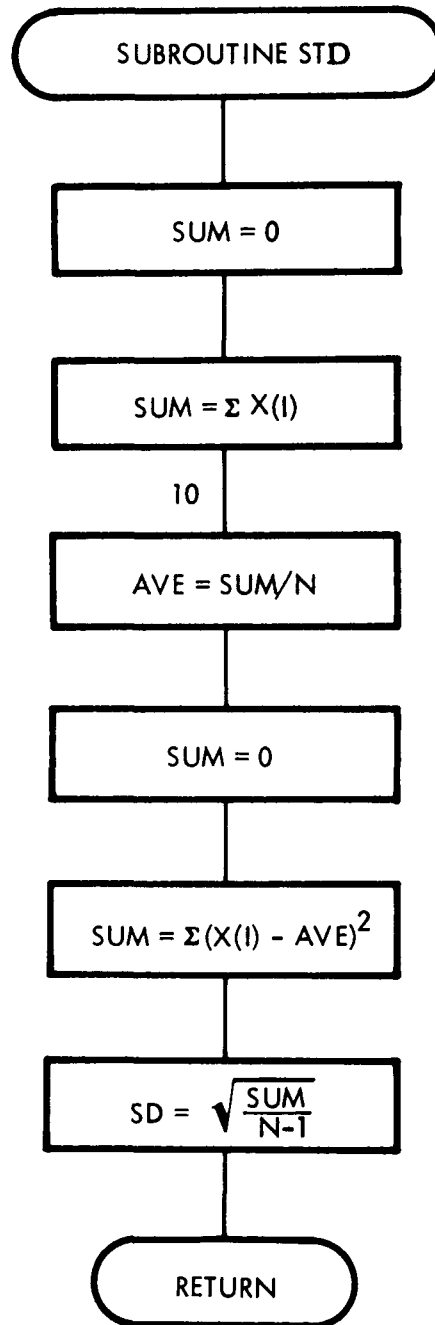


Figure 5-24 Subroutine STD Flowchart

Table 5-24 SUBROUTINE STD LISTING

38780		SUBROUTINE STD(X,N,AVE,SD)
38790		DIMENSION X(N)
38800	C	UNIFORM DISTRIBUTION
38810		SUM = 0.0
38820		DO 10 I=1,N
38830	10	SUM = SUM+X(I)
38840		AVE = SUM/N
38850		SUM = 0.0
38860		DO 20 I=1,N
38870	20	SUM=SUM+(X(I)-AVE)**2
38880		SD=SQRT(SUM/(N-1))
38890		RETURN
38900		END

AVE the mean and SD the standard deviation. AVE and SD are computed from standard moment equations using an arbitrary distribution.

The equations in STD2 are:

$$v_1 = \sum X_i Y_i \Delta X \quad (\text{first moment about origin})$$

$$v_2 = \sum X_i^2 Y_i \Delta X \quad (\text{second moment about origin})$$

$$\text{AVE} = v_1 \quad (\text{Mean})$$

$$\text{SD} = \sqrt{v_2 - v_1^2} \quad (\text{Square root of variance})$$

Figure 5-25 gives a flowchart for STD2 and Table 5-25 presents a listing of the code.

5.11.12 Subroutine NORM

Subroutine NORM normalizes an input distribution X, Y of size N. NORM simply integrates the entire X, Y distribution and divides each Y value by that integral. The integral of the resultant distribution is unity, i.e. normalized.

This technique can be specified mathematically as:

$$C = \int_{-\infty}^{\infty} Y \, dx$$

$$\frac{Y_i}{C} \rightarrow Y_i \quad \text{for } i = 1 \text{ to } N$$

A flowchart of this routine is given in Figure 5-26. Table 5-26 presents a computer listing of subroutine NORM.

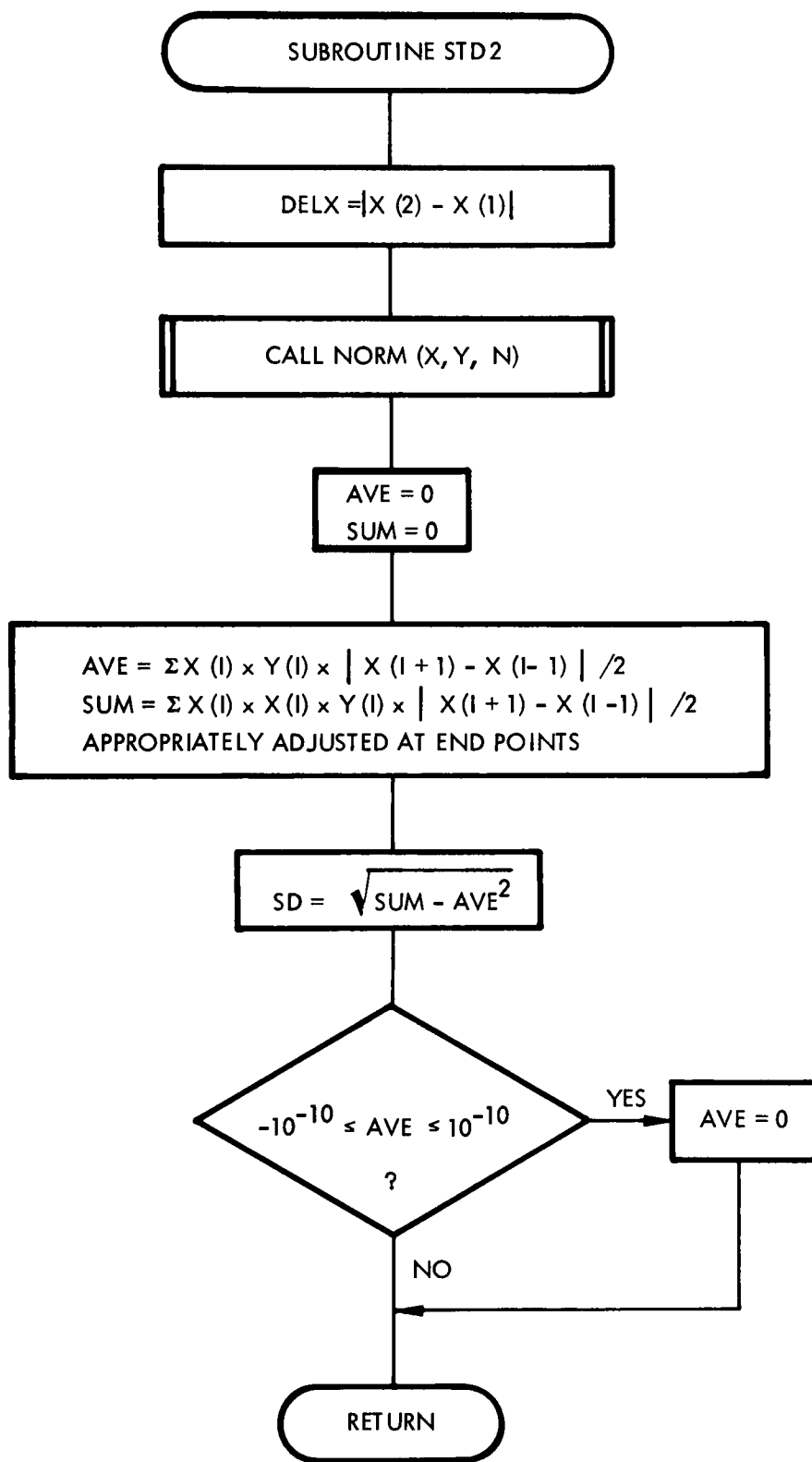


Figure 5-25 Subroutine STD2 Flowchart

Table 5-25 SUBROUTINE STD2 LISTING

38910		SUBROUTINE STD2(X,Y,N,AVE,SD)
38920	C	PROBABILITY DISTRIBUTION (NORMAL,ETC)
38930		DIMENSION X(1),Y(1)
38940	C	
38950	C	NORMALIZE INPUT
38960	C	
38970		DELX = ABS(X(2)-X(1))
38980		CALL NORM(X,Y,N)
38990		AVE = SUM = 0.0
39000		DO 10 I = 1,N
39010		IF(I.GT.1.AND.I.LT.N) DELX=ABS((X(I+1)-X(I-1))/2.)
39020		IF(I.EQ.N) DELX=ABS(X(N)-X(N-1))
39030		AVE = AVE+X(I)*Y(I)*DELX
39040	10	SUM = SUM+X(I)*X(I)*Y(I)*DELX
39050		SD = SORT(SUM-AVE*AVE)
39060		IF(ABS(AVE) .LT. 1.E-10) AVE = 0.0
39070		RETURN
39080		END

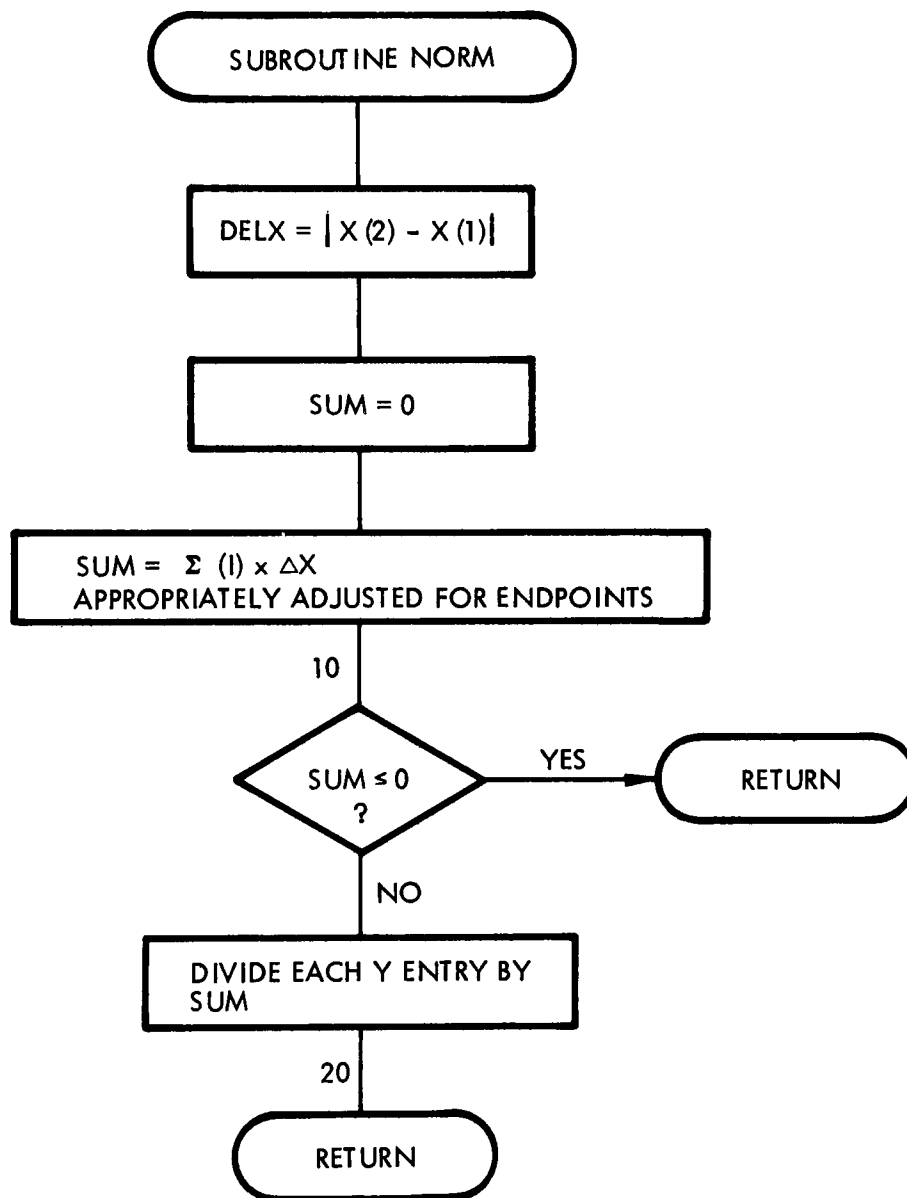


Figure 5-26 Subroutine NORM Flowchart

Table 5-26 SUBROUTINE NORM LISTING

39090		SUBROUTINE NORM(X,Y,N)
39100		DIMENSION X(1),Y(1)
39110	CC	NORMALIZE INPUT
39120		SUM=0.
39130		DO 10 I=1,N
39140		DELX=ABS(X(I+1)-X(I))
39150		IF(I.EQ.1) DELX=DELX/2.
39160		IF(I.EQ.N) DELX=ABS(X(N)-X(N-1))/2.
39170	10	SUM=SUM+Y(I)*DELX
39180		IF(SUM.LE.0.) RETURN
39190		DO 20 I=1,N
39200		Y(I)=Y(I)/SUM
39210	20	CONTINUE
39220		RETURN
39230		END

5.11.13 Subroutine RESIZE

Subroutine RESIZE resizes an arbitrary distribution based on an input range and cell width. Input to RESIZE consists of the old distribution X,Y with N1 equalling the number of points and the required width and range for the new distribution: WIDTH and R1. The distribution is resized to have range R1 with cell width WIDTH. The variable N1 is reset to the number of points in the new distribution.

The fundamental equations for RESIZE are:

$$N2^1 = R1 / (WIDTH \times 2) \quad \text{rounded up to an integer}$$

$$N2 = N2^1 \times 2 + 1 \quad \text{total number of points in new distribution}$$

After resizing the resultant distribution is normalized and returned in X and Y. Figure 5-27 presents a flowchart of RESIZE while Table 5-27 gives a listing of the code.

5.11.14 Function XPT

The function XPT computes the cutpoint required to yield a given rejection fraction. Input to XPT are the distribution X, Y and the number of points N, and the required rejection rate, A. Output is the computed cutpoint in the functional value XPT. Function XPT integrates the input distribution until the accepted area exceeds 1 minus the input rejection fraction. At that point a linear interpolation is performed between the boundary points on the distribution to estimate the exact cutpoint at which the input rejection fraction would be realized.

Figure 5-28 contains a detailed flowchart for XPT while Table 5-28 presents a computer listing.

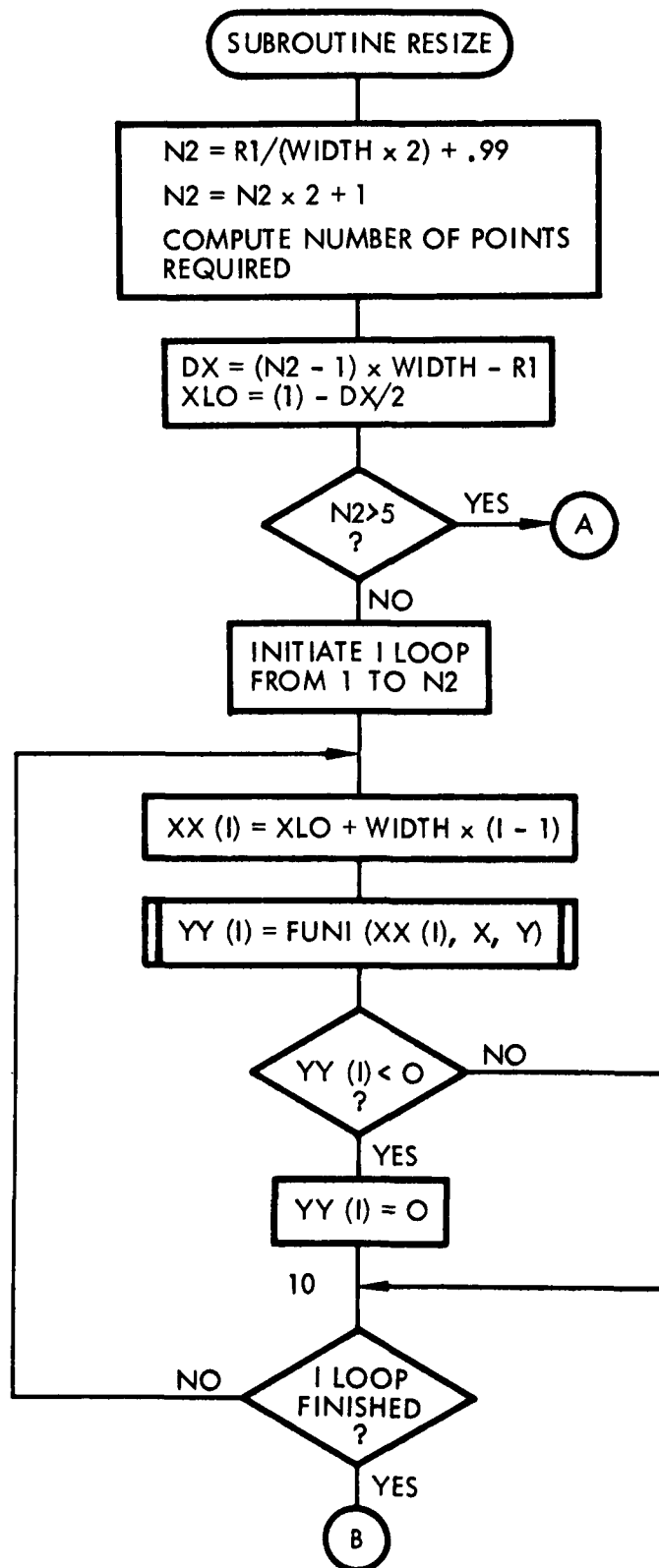


Figure 5-27 Subroutine RESIZE Flowchart

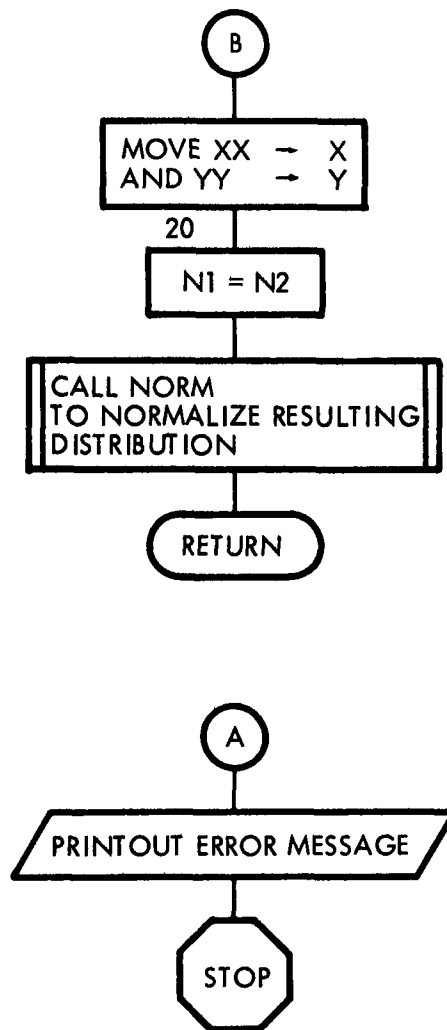


Figure 5-27 Subroutine RESIZE Flowchart (cont.)

Table 5-27 SUBROUTINE RESIZE LISTING

39240		SUBROUTINE RESIZE(WIDTH,R1,X,Y,N1)
39250		DIMENSION X(1),Y(1),XX(50),YY(50)
39260		N2 = R1/(WIDTH*2.0) + .99
39270	C	
39280	C	GET AVE FROM STD2
39290	C	
39300		N2=N2*2+1
39310		DX=(N2-1)*WIDTH-R1
39320		XLO=X(1)-DX/2.
39330		IF(N2.GT.50) GO TO 40
39340		DO 10 I = 1,N2
39350		XX(I) = XLO + WIDTH*(I-1)
39360		YY(I) = FUN1(XX(I),X,Y,N1)
39370	10	IF(YY(I) .LT. 0.) YY(I) = 0.0
39380		DO 20 I = 1,N2
39390		X(I) = XX(I)
39400	20	Y(I) = YY(I)
39410		N1 = N2
39420	C	
39430	C	RE-NORMALIZE THE RE-SIZED CURVE
39440	C	
39450		CALL NORM(X,Y,N1)
39460		RETURN
39470	40	WRITE (6,50) N2
39480	50	FORMAT(//,* INSUFFICIENT DIMENSION SIZE IN RESIZE --*
39490		+ *CALLED FROM CONVOL -- *,15//)
39500		STOP
39510		END

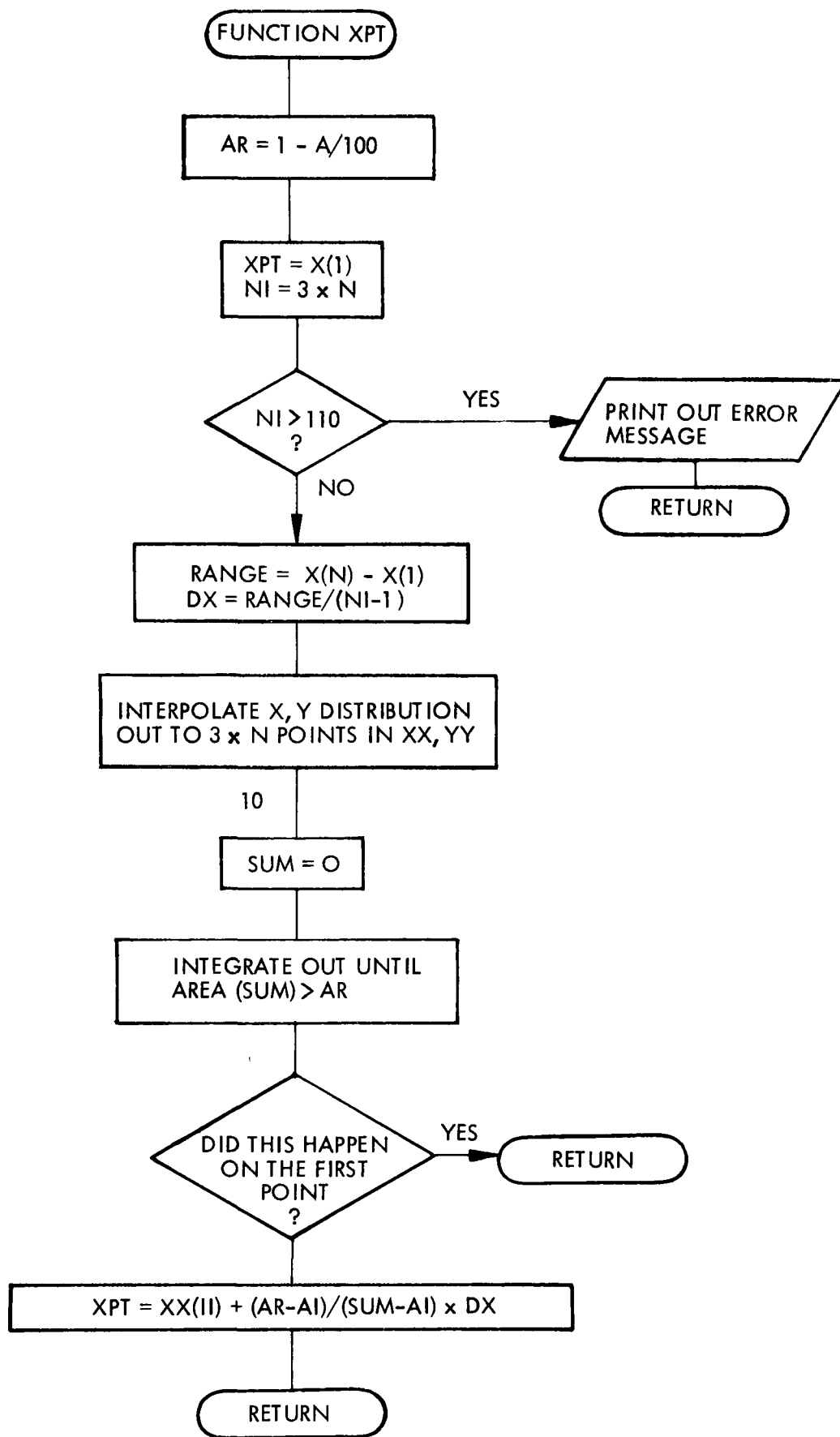


Figure 5-28 Function XPT Flowchart

Table 5-28 FUNCTION XPT LISTING

39790		FUNCTION XPT(X,Y,N,A)
39800	CC	THIS SUBROUTINE SUPPORTS STATS BY INTEGRATING THE INPUT
39810	CC	CURVE UNTIL AN AREA IS ACHIEVED AND RETURNING THE
39820	CC	X-AXIS VALUE
39830		DIMENSION X(1),Y(1),XX(110),YY(110)
39840		AREA=1.-A/100.
39850		XPT=X(1)
39860		N1=3*N
39870		IF(N1.GT.110) GO TO 40
39880		RANGE=ABS(X(N)-X(1))
39890		DX=RANGE/(N1-1)
39900		DO 10 I=1,N1
39910		XX(I)=X(1)+DX*(I-1)
39920	10	YY(I)=FUN1(XX(I),X,Y,N)
39930		CALL NORM(XX,YY,N1)
39940		SUM=0.
39950		DO 20 I=1,N1
39960		I1=I-1
39970		I2=I
39980		A1=SUM
39990		SUM=SUM+YY(I)*DX
40000		IF(SUM.GT.AREA) GO TO 30
40010	20	CONTINUE
40020	30	IF(I1.EQ.0) RETURN
40030		XPT=XX(I1)+(AREA-A1)/(SUM-A1)*DX
40040		RETURN
40050	40	WRITE (6,50) N1
40060	50	FORMAT(/,*, INSUFFICIENT DIMENSION IN XPT CALLED FROM *
40070		+ , *STATS -- *,15/)
40080		STOP
40090		END

5.11.15 Subroutine SWITCH

Subroutine SWITCH reorders a distribution for increasing values on the X axis. Input to subroutine SWITCH is a distribution X, Y and its size N. SWITCH assumes an odd number of points in the distribution and transposes the distribution around its central point - if and only if the distribution has decreasing X's - and therefore outputs a distribution identical to the input but reordered such that the last X value exceeds the first one. Figure 5-29 contains a detailed flowchart for subroutine SWITCH and Table 5-29 a listing of the code.

5.11.16 Subroutine ADD

Subroutine ADD mathematically adds two distributions X1, Y1 and X2, Y2, with sizes N1 and N2 respectively. Output consists of the sum distribution X3, Y3 with size N3. Subroutine ADD, expecting each vector to have nine points, checks to see if either distribution is empty and, if so, moves the non-empty distribution into the resultant and returns. If neither distribution is empty ADD creates a new distribution with domain equal to the union of the domains of the input vectors. Figure 5-30 contains a detailed flowchart of subroutine ADD and Table 5-30 a listing of the code.

5.11.17 Function EINT

Function EINT contains the algorithms for assessing the second order parameter interactions. While MICRO assumes a linear relationship between parameter adjustments and emission reductions, function EINT assesses the nonlinear second order parameter interactions which contribute to emission reductions. EINT outputs a value, DELI, for each

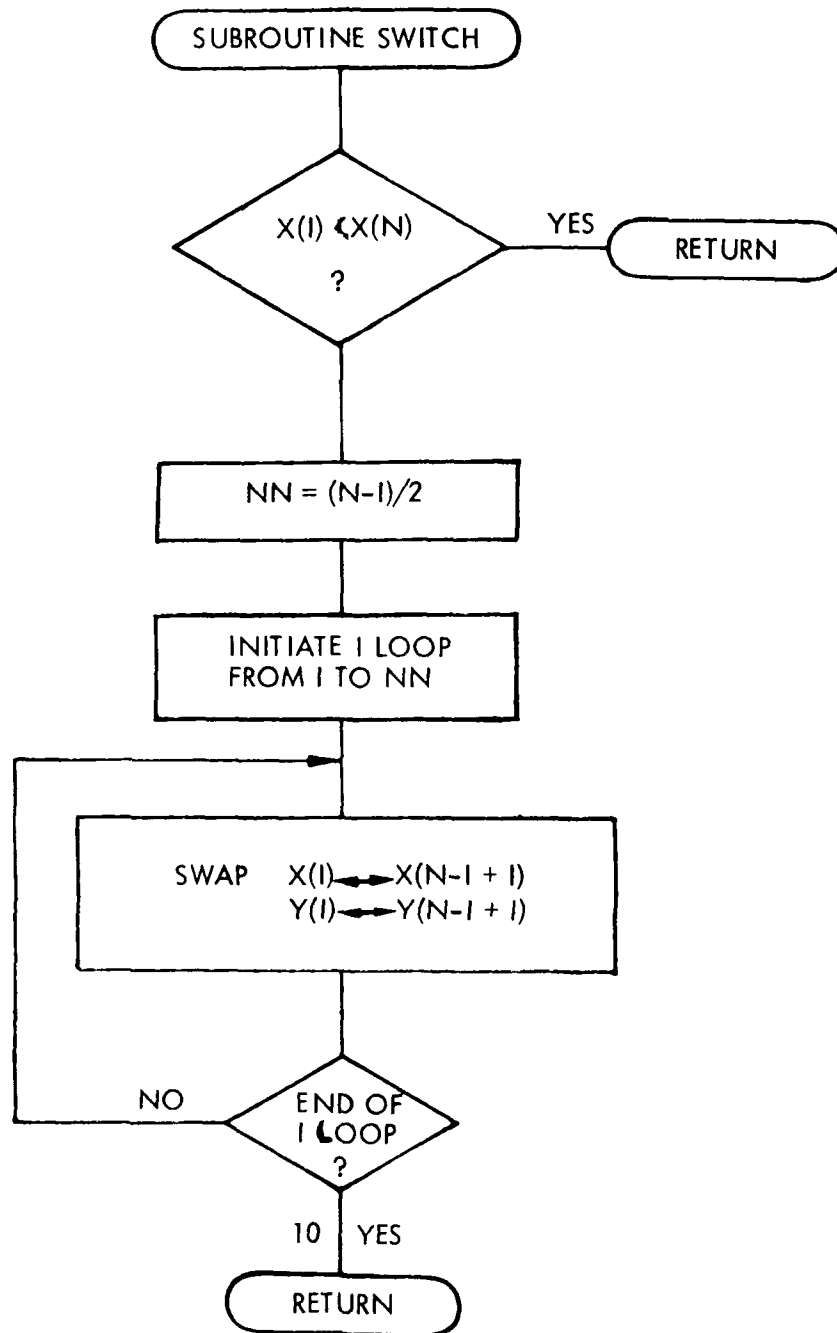


Figure 5-29 Subroutine SWITCH Flowchart

Table 5-29 SUBROUTINE SWITCH LISTING

40100		SUBROUTINE SWITCH(X,Y,N)
40110		DIMENSION X(1),Y(1)
40120	CC	REORDER DIST FOR ODD NO OF PTS
40130		IF(X(1).LT.X(N)) RETURN
40140		NN=(N-1)/2
40150		DO 10 I=1,NN
40160		DUM=X(I)
40170		X(I)=X(N-I+1)
40180		X(N-I+1)=DUM
40190		DUM=Y(I)
40200		Y(I)=Y(N-I+1)
40210		Y(N-I+1)=DUM
40220	10	CONTINUE
40230		RETURN
40240		END

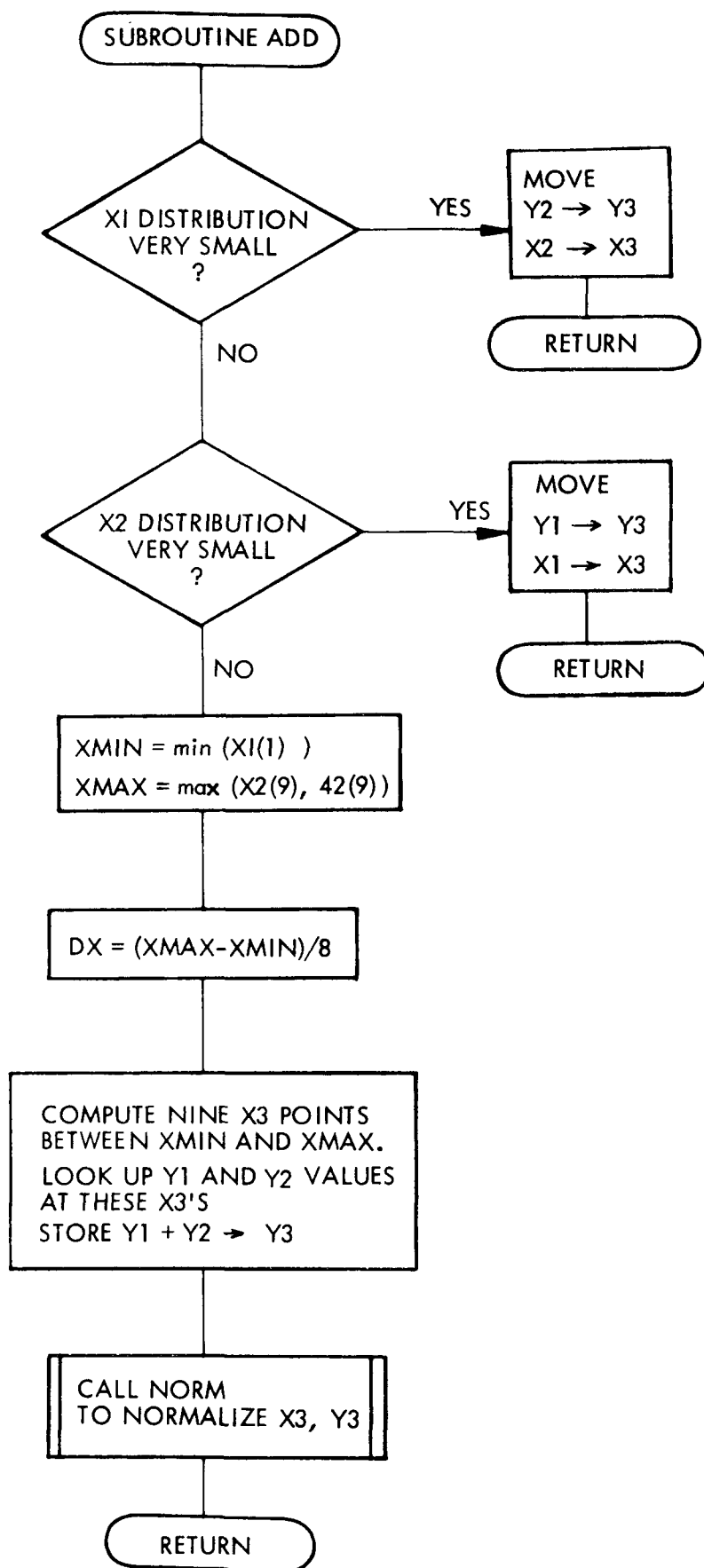


Figure 5-30 Subroutine ADD Flowchart

Table 5-30 SUBROUTINE ADD LISTING

40250		SUBROUTINE ADD(X1,Y1,X2,Y2,X3,Y3,N1,N2,N3)
40260		DIMENSION X1(9),Y1(9),X2(9),Y2(9),X3(9),Y3(9)
40270		IF (ABS(X1(1)-X1(9)).LT..01) GOTO 20
40280		IF (ABS(X2(1)-X2(9)).LT..01) GOTO 30
40290		XMIN=AMIN1(X1(1),X2(1))
40300		XMAX=AMAX1(X1(9),X2(9))
40310		DX=(XMAX-XMIN)/8
40320		DO 10 I=1,9
40330		X3(I)=XMIN+DX*(I-1)
40340		A1=FUN1(X3(I),X1,Y1,N1)
40350		IF(A1.LT.0.) A1=0.
40360		A2=FUN1(X3(I),X2,Y2,N2)
40370		IF(A2.LT.0.) A2=0.
40380		Y3(I)=A1+A2
40390	10	CONTINUE
40400		CALL NORM(X3,Y3,N3)
40410		RETURN
40420	20	DO 25 I=1,9
40430		X3(I)=X2(I)
40440	25	Y3(I)=Y2(I)
40450		N3=N2
40460		RETURN
40470	30	DO 35 I=1,9
40480		X3(I)=X1(I)
40490	35	Y3(I)=Y1(I)
40500		N3=N1
40510		RETURN
40520		END

emission species which is used in computing the total emission reduction achieved from the maintenance treatment. Figure 5-31 presents a flow-chart of EINT and Table 5-31 gives a computer listing.

5.11.18 Subroutine PACKD

Subroutine PACKD eliminates the tail ends of parameter and mode emission distributions. It computes the 1 and 99 percent points of the distribution and resizes it to these endpoints. Input to PACKD is the distribution X, Y with size N. The packed and resized distribution is returned to the same vectors, X and Y. Figure 5-32 presents a flowchart of PACKD and Table 5-32 a listing.

5.12 VEHICLE POPULATION MODEL

The Vehicle Population Model (VPM) is a general methodology for projecting future distributions of vehicle population versus vintage year. Used in conjunction with GEEP, VPM can provide estimates of the vehicle population makeup for the period 1970 – 1980 under a variety of growth/attrition rate combinations.

The basic model methodology involves analytically describing the "birth and death" process taking place within the vehicle population itself. Older vehicles are continually aging, with the oldest leaving the population entirely after many years of service. Simultaneously, new vehicles are being added to the population at some forecasted rate. Because of this process, the relative weights of various vehicle age groups in determining the net emissions change with time. Any accurate emissions projection must account for this phenomenon.

VPM computes the vehicle age distribution over time, adjusting for both new cars and vehicle attrition. This distribution provides a set of weighting factors for each age class and for each year analyzed.

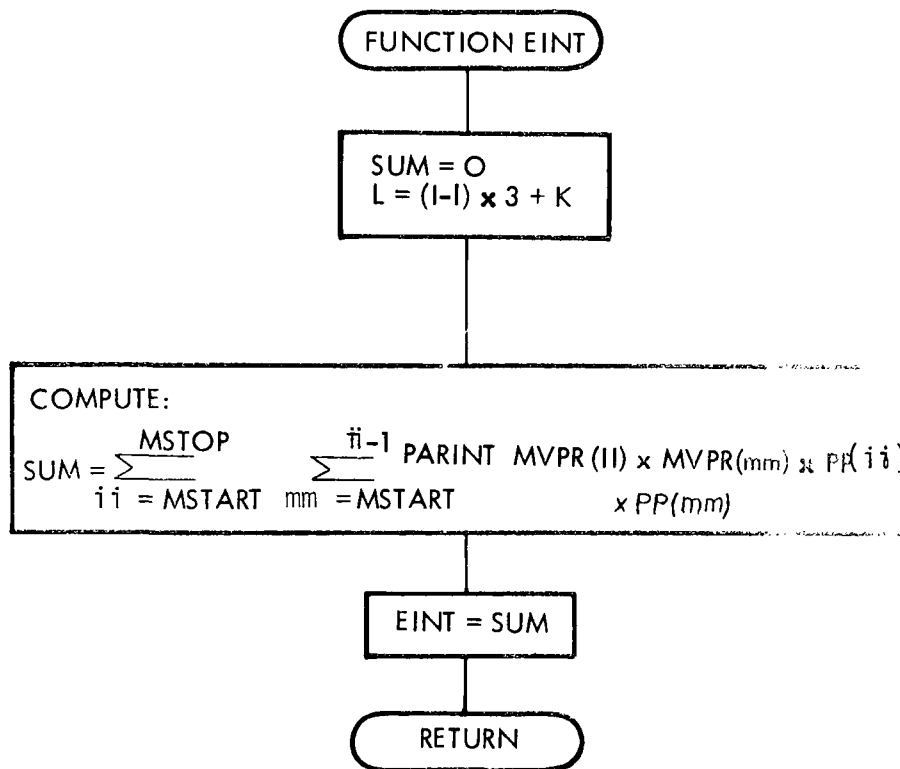


Figure 5-31 Function EINT Flowchart

Table 5-31 FUNCTION EINT LISTING

52380	FUNCTION EINT(I,K,J)
52390	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,
52400	+ PAREA(3), BLD1, BLD2, BSIG(3), BXTA, bSIZE,
52410	+ BHIST(3,16), BMMI(10,15,3),
52420	+ ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
52430	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),
52440	+ CARSY, CHSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
52450	+ CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
52460	+ CN(15,3,16), COEFB(15,3), COEFRP(10,15),
52470	+ CPART(10,15)
52480	CC ADD2
52490	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
52500	+ EMW(3), EP(10,15),LFF(10), DELIT(3),
52510	+ FREQA, FREQB, FPEPL(10,3),
52520	+ HORIZN, HORIZY,
52530	+ HPC(15,16), HPCS(15,16), HPP(10,15,16),
52540	+ HPS(5,15,16), HPT(5,16), HPTOT(16),
52550	+ HPTOTS(16)
52560	CC ADD3
52570	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
52580	+ KSTART, KSTOP, LGPT, LPICK(10),LLPICK,
52590	+ LIDLE, LINT(16), LPSPP(10),LSTART, LSTOP,
52600	+ MBASE, MPH, MSPEC(10),MSTART, MSTOP,
52610	+ MU(10,3), MMS(10,15), MVPR(10,15)
52620	CC ADD4
52630	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,
52640	+ NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
52650	+ NPTRN, NPTS, NSTEPS, NTR, NTKB, NPICK(16),
52660	+ OCIY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
52670	CC ADD5
52680	COMMON /COM06/ PARM(3,3), PAKT, PAYNEW, PAYOFF(3),
52690	+ PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
52700	+ PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
52710	+ PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
52720	+ PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
52730	+ PSA(15), PTA(5), PCONE, PARINT(10,10,9)
52740	+ ,PAYFIN
52750	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,
52760	+ RTYPE,
52770	+ SALE, SALL, SALP, SITEI, SITEM, SLANE,
52780	+ SMODEL, START(15,3), STAT, STIME(3), SUM3M(3),

Table 5-31 FUNCTION EINT LISTING (cont.)

52790	+	SCALEBM(3),	SM(6,15),	SPAR(10,15,6),
52800	+	SXCUT(6,3),	SIG(10,3),	SIGCE(3),
52810	+	SIGME(10),	SIGMNE(10),	SIGP(10,15),
52820	+	SIGRATE, SIST,	SIGS(6,15),	SIGSDE(3),
52830	+	STABLEX(33,6,15),	STABLEY(33,6,15)	
52840		COMMON /COM10/	TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),	
52850	+	TINT, TOBE(3),	TONX, TOTE(3), TPDB(3), TPDT(3),	
52860	+	TXTRA, TSIZE,	TSIG(3), TPER(16,15), TMIL(16,15),	
52870	+	THIST(5,3,16),	THISTT(3,16), TIMEC(10,15),	
52880	+	TIMEM(10,15),	TABLEX(33,10,15), TABLEY(33,10,15)	
52890	CC ADD10			
52900		COMMON /COM11/	WF(10),	
52910	+	X1BP(3,3,6), XINT,	XINTB, XLANE, XSUM, XCUT(10,3),	
52920	+	XTM(16), XBASE(9,3), YBASE(9,3)		
52930	CC ADD11			
52940		COMMON /COM12/	Y1BP(3,3,10), Y2BP(3,3,10),	
52950	+	YES, YSUM,	YTM(16), Y1DBP(4,4,10), Y2DBP(4,4,10),	
52960	+	Z1, Z2,	Z3, Z4, Z5, Z6,	
52970	+	Z7, Z8,	Z9, Z10, Z11, Z12,	
52980	+	Z13, Z14,	Z15, Z16, Z17,	
52990	+	ZCARI, ZCARM,	ZIC, ZSUM,	
53000	+	ZZ(3,3)		
53010	CC ADD12			
53020		COMMON /DEBUG/	ADEBUG, BDEBUG, CDEBUG, DDEBUG,	
53030	+	LDEBUG, MDEBUG,	PDEBUG, QDEBUG, SDEBUG, TDEBUG	
53040	CC ADDD			
53050		REAL	ITE, ITL, ITP, ITIME,	
53060	+	MMS, MPH,	MSPEC, MU, MVPR,	
53070	+	NAME, NO,	LDEBUG, MDEBUG,	
53080	+	IN, MISFIRE		
53090		INTEGER	RNAME, SITEI, SITEM, STAT,	
53100	+	TDIST, XLANE,	OPTI, PPICK, PPPICK	
53110		SUM=0.		
53120		L=(I-1)*3+K		
53130		DO 100 II=MSTART,MSTOP		
53140		DO 100 MM=MSTART,II		
53150		IF(MM.GE.II) GO TO 100		
53160		SUM=SUM + PARINT(II,MM,L)*		
53170	+	MVPR(II,J)*MVPR(MM,J)*PP(II,J)*PP(MM,J)*EFF(II)*EFF(MM)		
53180	100 CONTINUE			
53190		EINT=SUM		
53200		RETURN		
		END		

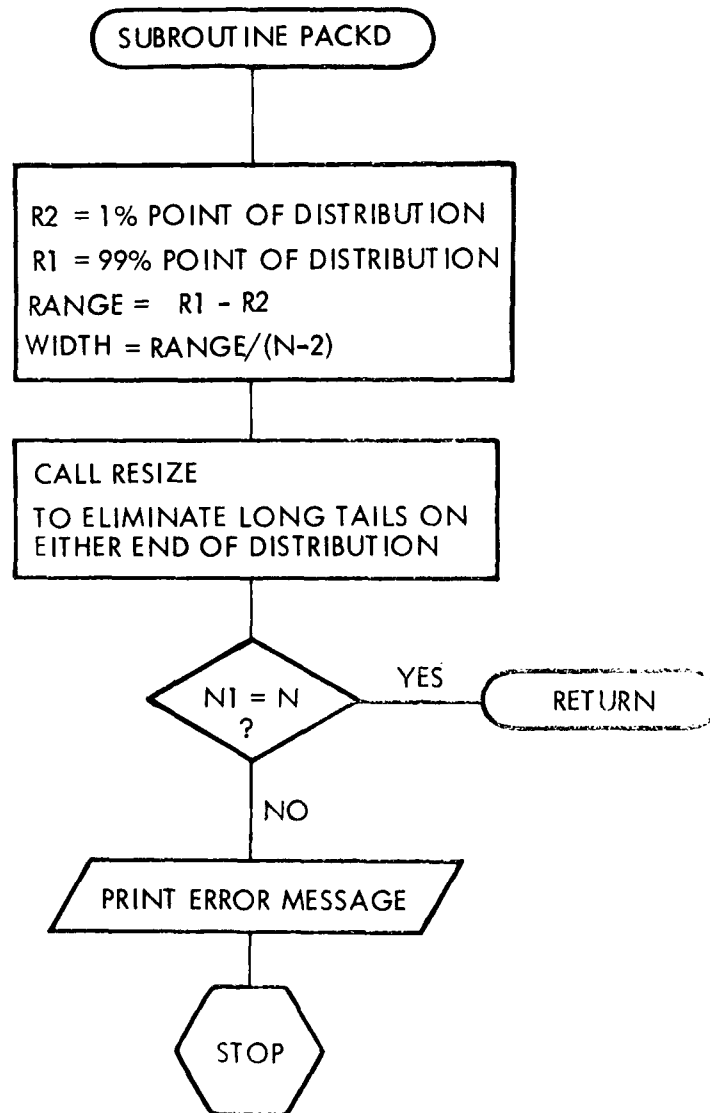


Figure 5-32 Subroutine PACKD Flowchart

Table 5-32 SUBROUTINE PACKD LISTING

64330		SUBROUTINE PACKD(X,Y,N)
64340		DIMENSION X(1),Y(1)
64350		R2=XPT(X,Y,N,1.0)
64360		R1=XPT(X,Y,N,99.0)
64370		RANGE=ABS(R1-R2)
64380		WIDTH=RANGE/(N-2)
64390		N1=N
64400		CALL RESIZE(WIDTH,RANGE,X,Y,N1)
64410		IF(N1.EQ.N) RETURN
64420		WRITE(6,100)
64430	100	FORMAT(//* NUMBER OF ENTRIES PROBLEM IN PACKD *,//////)
64440		STOP
64450		END

Combined with independently estimated vehicle emission rates, this distribution data can lead to emission projections weighted for changes in vehicle population characteristics.

This weighting process is crucial in making accurate projections. Under the current vehicle breakdown, three separate classes of light duty vehicles are considered: uncontrolled (pre-1968), controlled (1968 - 1970) and post 1970. Emission levels of the first two groups rise substantially over time due to vehicle deterioration. Yet, due to natural attrition processes, their numbers decline. The net contribution of these groups depends upon the interaction of both vehicle attrition and deterioration. Similarly, post-1970 vehicles have substantially reduced emission levels. (The emission levels for new cars are assumed to be in compliance with promulgated standards). As they enter the population and represent an increasingly large fraction, the aggregate emissions characteristics of the population will approach those of the post-1970 cars. It is this complex interaction between vehicle attrition, entrance of new cars and resultant population emission levels which is described quantitatively by VPM and which can provide a straightforward mechanism for projecting emission levels over future periods.

The following sections present detailed descriptions of the sub-routines comprising VPM.

5.12.1 Subroutine PERMIL

Subroutine PERMIL is the attrition routine for VPM. PERMIL accepts as input TINT, the inspection interval, KSTART and KSTOP, the control type limits for the simulation, and NPTRN the number of power train types.

PERMIL calls the PERCNT and MILAGE subroutines which fill the PPER and PMILES arrays with the percentages and annual vehicle miles travelled of each control and power train type. PERMIL then interpolates these data to the TINT inspection interval and returns the percentage distribution of power trains and control type in TPER and annual vehicle miles travelled in TMIL. Both TPER and TMIL are referenced by inspection interval number, N. Present in Figure 5-33 is a flowchart for subroutine PERMIL. A listing of PERMIL is given in Table 5-33.

5.12.2 Subroutine PERCNT

Subroutine PERCNT simulates the vehicle age distribution over time to account for vehicle attrition and population growth. Input to PERCNT is N, the number of years since the start of the simulation. Output is PPER the vehicle age distribution by control and power train type, the J index. The main equation of PERCNT is:

$$X_{n+1}(L) = X_n(L-1) \times \frac{\text{DIFF}(L)}{\text{DIFF}(L-1)}$$

where the DIFF vector represents vehicle attrition rates and X is the vehicle age vector. For each year, PERCNT sums the appropriate entries in the X array to fill the PPER array with the percentages for uncontrolled, controlled and POST 70 vehicles.

Figure 5-34 is a complete flowchart of the PERCNT routine which pictorially describes the techniques used. Table 5-34 contains a listing.

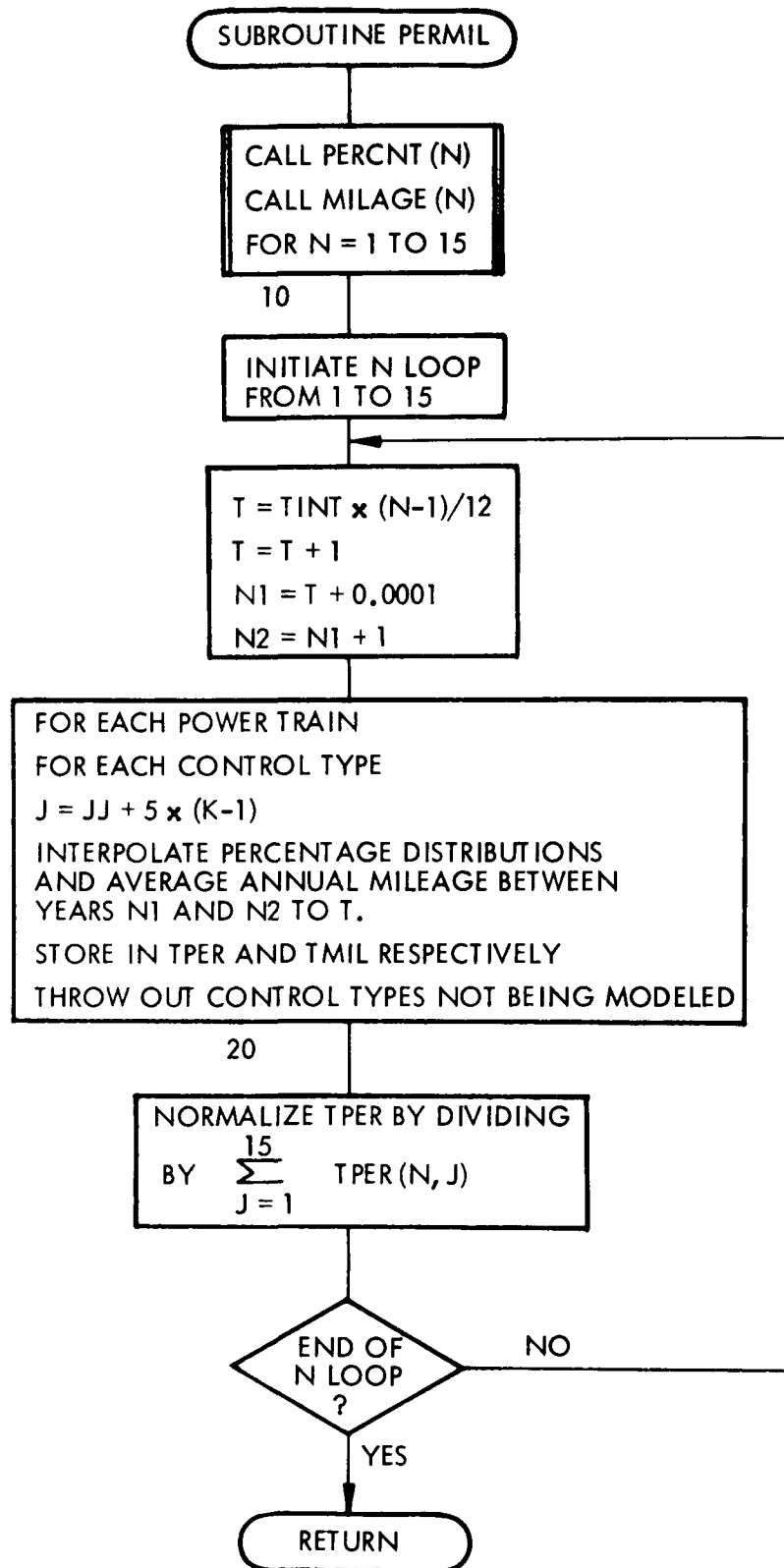


Figure 5-33 Subroutine PERMIL Flowchart

Table 5-33 SUBROUTINE PERMIL LISTING

50440		SUBROUTINE PERMIL(TPER, TMIL, TINT, KSTART, KSTOP, NPTRN)
50450		DIMENSION TPER(16,15), TMIL(16,15)
50460		COMMON /SAVE/ PPER(16,15), PMILES(16,15)
50470		DO 10 N=1,15
50480		CALL PERCNT(N)
50490	10	CALL MILAGE(N)
50500		DO 40 N=1,15
50510		T=TINT*(N-1)/12.
50520		T=T+1.
50530		N1=T+0.0001
50540		N2=N1+1
50550		DO 20 JJ=1, NPTRN
50560		DO 20 K=1,3
50570		J=JJ+5*(K-1)
50580		P=PPER(N1,J)+(PPER(N2,J)-PPER(N1,J))*(T-N1)
50590		TPER(N,J)=P
50600		IF(K.LT.KSTART.OR.K.GT.KSTOP) TPER(N,J)=0.
50610		XM=PMILES(N1,J)+(PMILES(N2,J)-PMILES(N1,J))*(T-N1)
50620		TMIL(N,J)=XM
50630	20	CONTINUE
50640		TT=0
50650		DO 30 K=KSTART,KSTOP
50660		DO 30 JJ=1, NPTRN
50670		J=JJ+5*(K-1)
50680	30	TT=TT+TPER(N,J)
50690		IF(TT.LT.0.0000001) TT=10.E30
50700		DO 40 J=1,15
50710		TPER(N,J)=TPER(N,J)/TT
50720	40	CONTINUE
50730		RETURN
50740		END

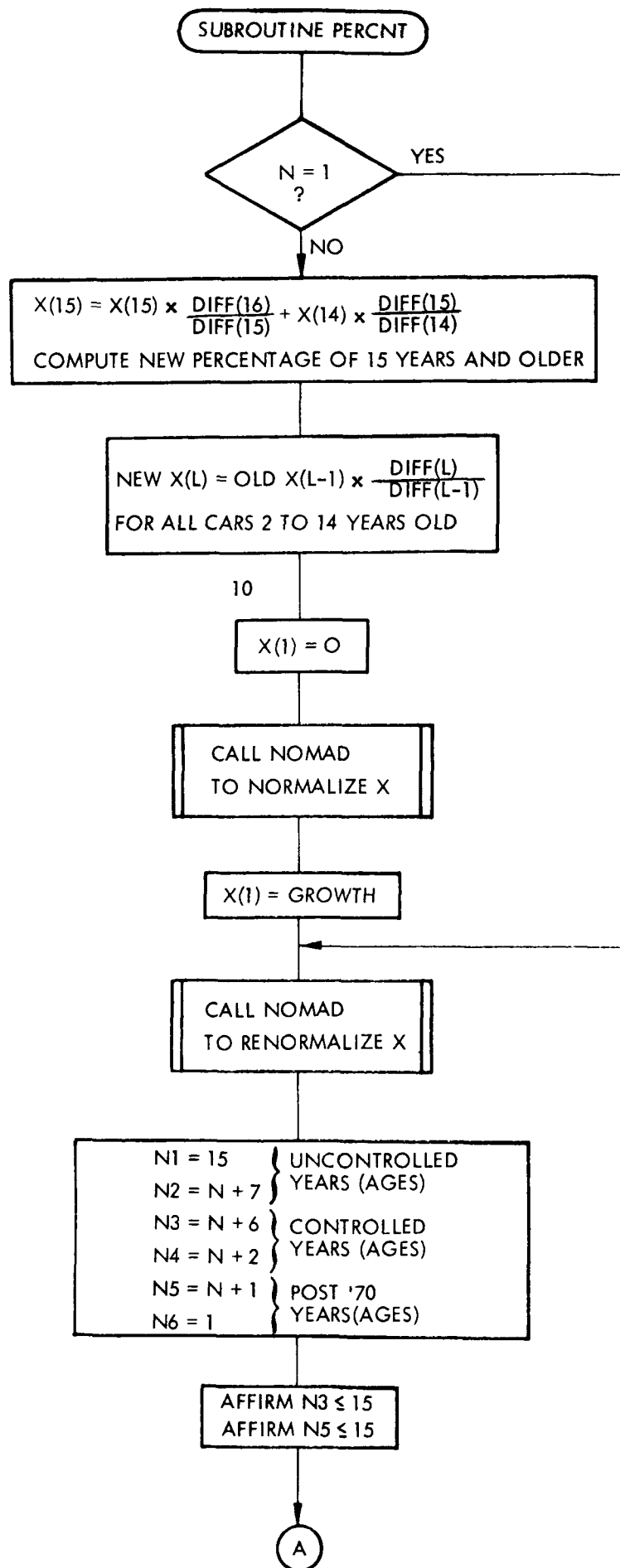


Figure 5-34 Subroutine PERCNT Flowchart

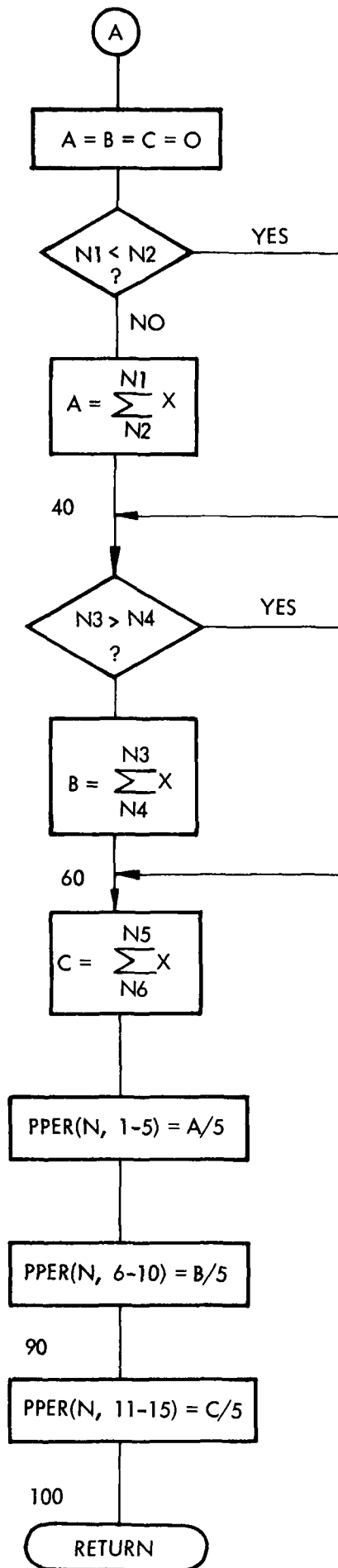


Figure 5-34 Subroutine PERCNT Flowchart (cont.)

Table 5-34 SUBROUTINE PERCNT LISTING

50750		SUBROUTINE PERCNT(N)
50760		COMMON /BADDOR/ X(15),ANNUAL(15)
50770		COMMON /SAVE/ PPER(16,15),PMILES(16,15)
50780		DIMENSION DIFF(16)
50790		DATA X/10.8,10.5,10.2,9.8,9.3,8.8,8.1,7.2,6.2,5.1,
50800		* 4.1,3.0,2.0,0.9,4.0/
50810		DATA DIFF/1.,1.,1.,.98,.96,.93,.86,.75,.61,.47,.34,
50820		* .25,.19,.13,.11,.08/
50830		DATA GROWTH/.121/
50840		IF(N.EQ.1) GOTO 15
50850		X(15)=X(15)*DIFF(16)/DIFF(15)+X(14)*DIFF(15)/DIFF(14)
50860		DO 10 J=2,14
50870		L=16-J
50880		M=L-1
50890	10	X(L)=X(M)*(DIFF(L)/DIFF(M))
50900		X(1)=0
50910		CALL NOMAD(X)
50920		X(1)=GROWTH
50930	15	CONTINUE
50940		CALL NOMAD(X)
50950		N1=15
50960		N2=N+7
50970		N3=N+6
50980		N4=N+2
50990		N5=N+1
51000		IF(N3.GT.15) N3=15
51010		IF(N5.GT.15) N5=15
51020		N6=1
51030		A=0
51040		B=0
51050		C=0
51060		IF(N1.LT.N2) GOTO 40
51070		DO 30 J=N2,N1
51080	30	A=A+X(J)
51090	40	IF(N3.LT.N4) GOTO 60
51100		DO 50 J=N4,N3
51110	50	B=B+X(J)
51120	60	DO 70 J=N6,N5
51130	70	C=C+X(J)
51140		DO 80 J=1,5
51150	80	PPER(N,J)=A/5.

Table 5-34 SUBROUTINE PERCNT LISTING (cont.)

51160		DO 90 J=6,10
51170	90	PPER(N,J)=B/5.
51180		DO 100 J=11,15
51190	100	PPER(N,J)=C/5.
51200		RETURN
51210		END

5.12.3 Subroutine NOMAD

Subroutine NOMAD is a GEEP utility routine which normalizes a population age distribution X . The fundamental equation for NOMAD is:

$$\frac{X_i}{\sum X} \rightarrow X_i \quad \text{for each } i$$

which simply sums the X vector and divides each component by that sum.

Figure 5-35 contains a flowchart of NOMAD. Table 5-35 presents a computer listing.

5.12.4 Subroutine MILAGE

Subroutine MILAGE computes the vehicle miles travelled distribution for a population at each time point in the simulation. MILAGE sums the annual vehicle miles travelled for each control and power train type (the J index) and stores the average mileage for each subfleet in the PMILES array. Input to subroutine MILAGE is the time period N . Output is the PMILES matrix which is returned through common block SAVE.

Figure 5-36 contains a complete flowchart of the MILAGE routine and Table 5-36 a listing.

5.13 LINEAR PROGRAMMING MODEL

The Linear Programming Model is used for optimizing the parameter cutpoints based on input influence coefficients and cost constraints. The model is contained in a series of four routines which solve for a set of optimal cutpoints. Basically, the process starts with a set of cutpoints and uses them to estimate the corresponding rejection fractions.

The final results of the analysis are a set of "optimal" cutpoints for the distributed parameters along with that combination of non-distributed parameters which yields the largest weighted emission reduction within the given cost constraints.

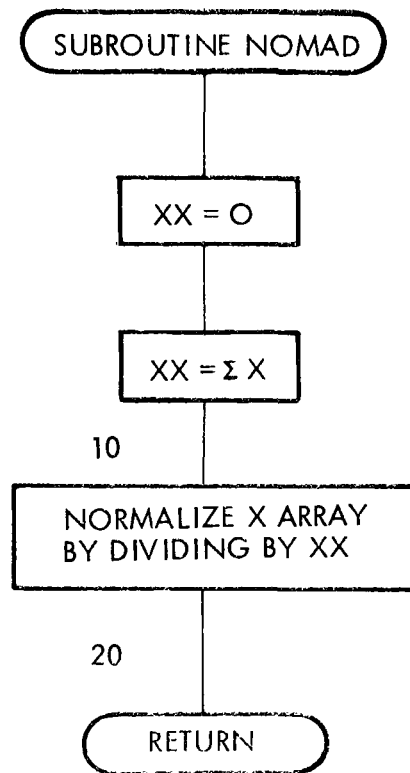


Figure 5-35 Subroutine NOMAD Flowchart

Table 5-35 SUBROUTINE NOMAD LISTING

51220		SUBROUTINE NOMAD(X)
51230		DIMENSION X(1)
51240		XX=0
51250		DO 10 J=1,15
51260	10	XX=XX+X(J)
51270		DO 20 J=1,15
51280	20	X(J)=X(J)/XX
51290		RETURN
51300		END

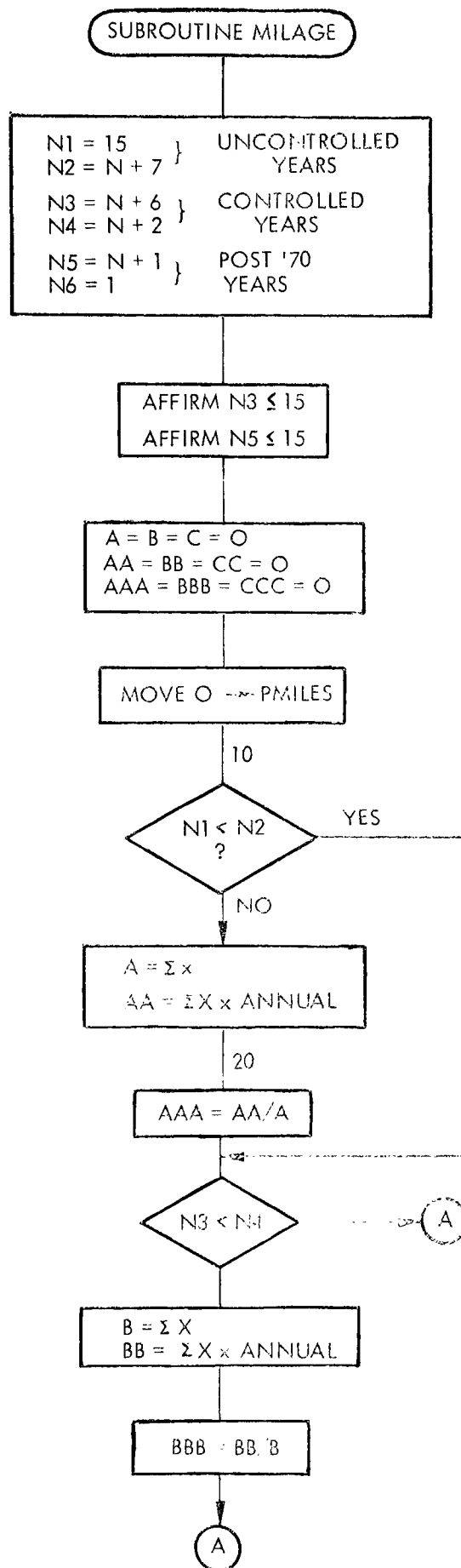


Figure 5-36 Subroutine MILAGE Flowchart

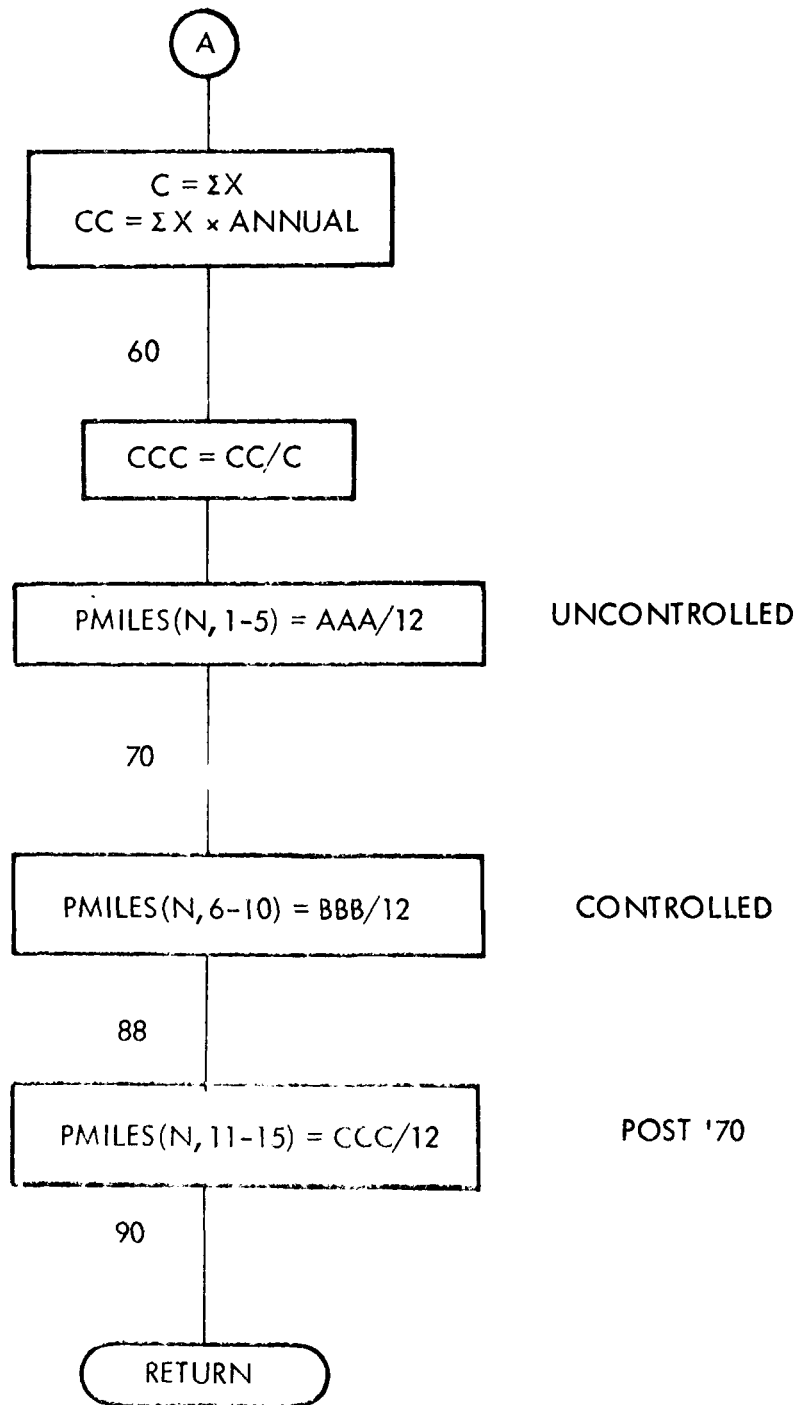


Figure 5-36 . Subroutine MILAGE Flowchart (cont.)

Table 5-36 SUBROUTINE MILAGE LISTING

51310		SUBROUTINE MILAGE(N)
51320		COMMON /BADDOR/ X(15),ANNUAL(15)
51330		COMMON /SAVE/ PPER(16,15),PMILES(16,15)
51340		N1=15
51350		N2=N+7
51360		N3=N+6
51370		N4=N+2
51380		N5=N+1
51390		N6=1
51400		IF(N3.GT.15) N3=15
51410		IF(N5.GT.15) N5=15
51420		A=0
51430		B=0
51440		C=0
51450		AA=0
51460		BB=0
51470		CC=0
51480		AAA=0
51490		BBB=0
51500		CCC=0
51510		DO 10 J=1,15
51520	10	PMILES(N,J)=0
51530		IF(N1.LT.N2) GOTO 30
51540		DO 20 J=N2,N1
51550		A=A+X(J)
51560	20	AA=AA+X(J)*ANNUAL(J)
51570		AAA=AA/A
51580	30	IF(N3.LT.N4) GOTO 50
51590		DO 40 J=N4,N3
51600		B=B+X(J)
51610	40	BB=BB+X(J)*ANNUAL(J)
51620		BBB=BB/B
51630	50	DO 60 J=N6,N5
51640		C=C+X(J)
51650	60	CC=CC+X(J)*ANNUAL(J)
51660		CCC=CC/C
51670		DO 70 J=1,5
51680	70	PMILES(N,J)=AAA/12.
51690		DO 80 J=6,10
51700	80	PMILES(N,J)=BBB/12.
51710		DO 90 J=11,15

Table 5-36 SUBROUTINE MILAGE LISTING (cont.)

51720	90	PMILES(N,J)=CCC/12.
51730		RETURN
51740		END

This iterative scheme then computes for the rejected vehicle population a set of mean value engine parameter settings. Using the basic engine parameter distributions, a systematic search is made to find the pass/fail criteria which will yield the optimal rejection fraction. In this manner, then, a linear programming algorithm can provide an approximate mechanism for determining pass/fail criteria for multi-parameter inspections.

5.13.1 Subroutine OPTMUM

Subroutine OPTMUM contains the logic for computing the optimal cut-points for a set of engine parameters. OPTMUM sets up and solves the following linear program:

$$\text{Maximize: } \sum C_i X_i$$

where X_i are the distributed parameter rejection rates.

$$\text{and } C_i \text{ are } \sum EMW_j \times \frac{\partial E_j}{\partial P_i}$$

Subject to:

$$X_i \geq 0 \quad \text{for } i = 1 \text{ to } 6$$

$$X_i \leq b_i \quad \text{for } i = 1 \text{ to } 6$$

where b_i is the rejection fraction based on a minimum deviation cutpoint.

$$\sum A_{7i} X_i \leq \text{COST}$$

where A_{7i} is the cost of parameter maintenance and COST is the input cost constraint (adjusted for non-distributed parameter cost).

$$\sum A_{ji} X_i \geq \text{GOALS } (j)$$

for $j=1$ to 3 (emission species)
GOALS are the minimum percentage reductions and A_{ji} are $\frac{\partial E_j}{\partial P_i}$ in percent.

$$\sum PS_i X_i \leq 1.05 \times P^*$$

$$\sum PS_i X_i \geq 0.95 \times P^*$$

where P^* is the input constant rejection rate and PS are the "union of X_i " coefficients from subroutine PXCOEF.

The linear program is solved sixteen times, once for each possible combination of non-distributed parameters. An array of possible combinations of the four non-distributed parameters is stored in the vector ITRY5 and for each of the sixteen entries the linear programming loop is executed. OPTMUM then finds that combination of non-distributed parameters which yields the maximum emission reduction within the given cost constraints. That optimal solution along with the resulting cutpoints is returned in the TDIST and XCUT arrays, both of which are contained in the common blocks. OPTMUM outputs miscellaneous debugging information when the LDEBUG flag is set to YES. Figure 5-37 contains a flowchart of OPTMUM and Table 5-37 a listing.

5.13.2 Subroutine CUTPNT

Subroutine CUTPNT performs the final setup operations prior to optimizing the parameter cutpoints. Subroutine CUTPNT, which is called from OPTMUM, initializes the various arrays containing constraints coefficients, constraints and utility functions for use by LPAX, the linear programming algorithm. CUTPNT determines an optimal set of cutpoints by iterating on the rejection fractions for each parameter. Final output from CUTPNT consists of the converged cutpoints in the XCUT matrix and the optimal value of the corresponding utility function. Figure 5-38 details exactly the techniques and algorithms used for setting up the linear optimization program. Table 5-38 contains a complete listing.

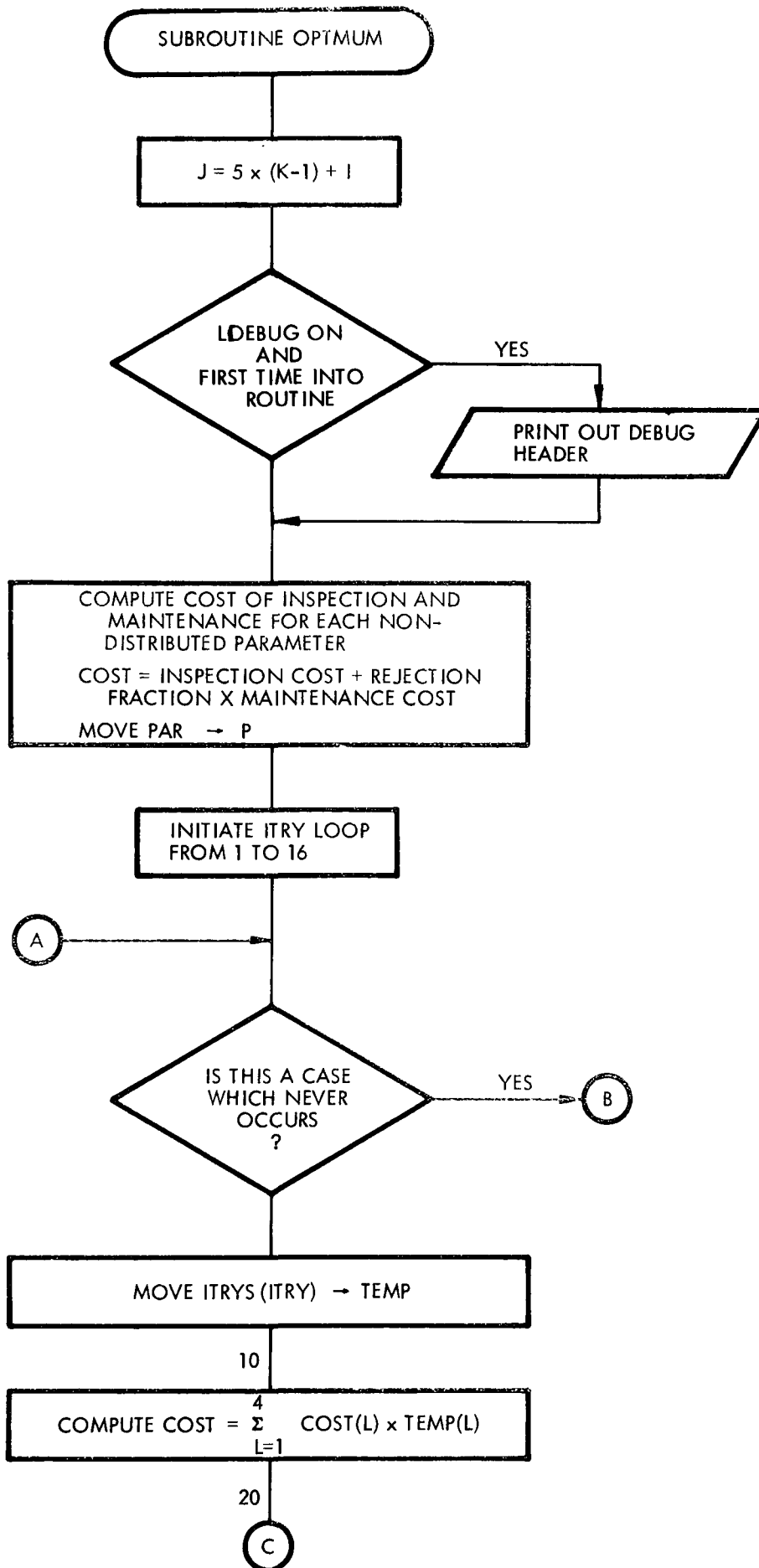


Figure 5-37 Subroutine OPTMUM Flowchart

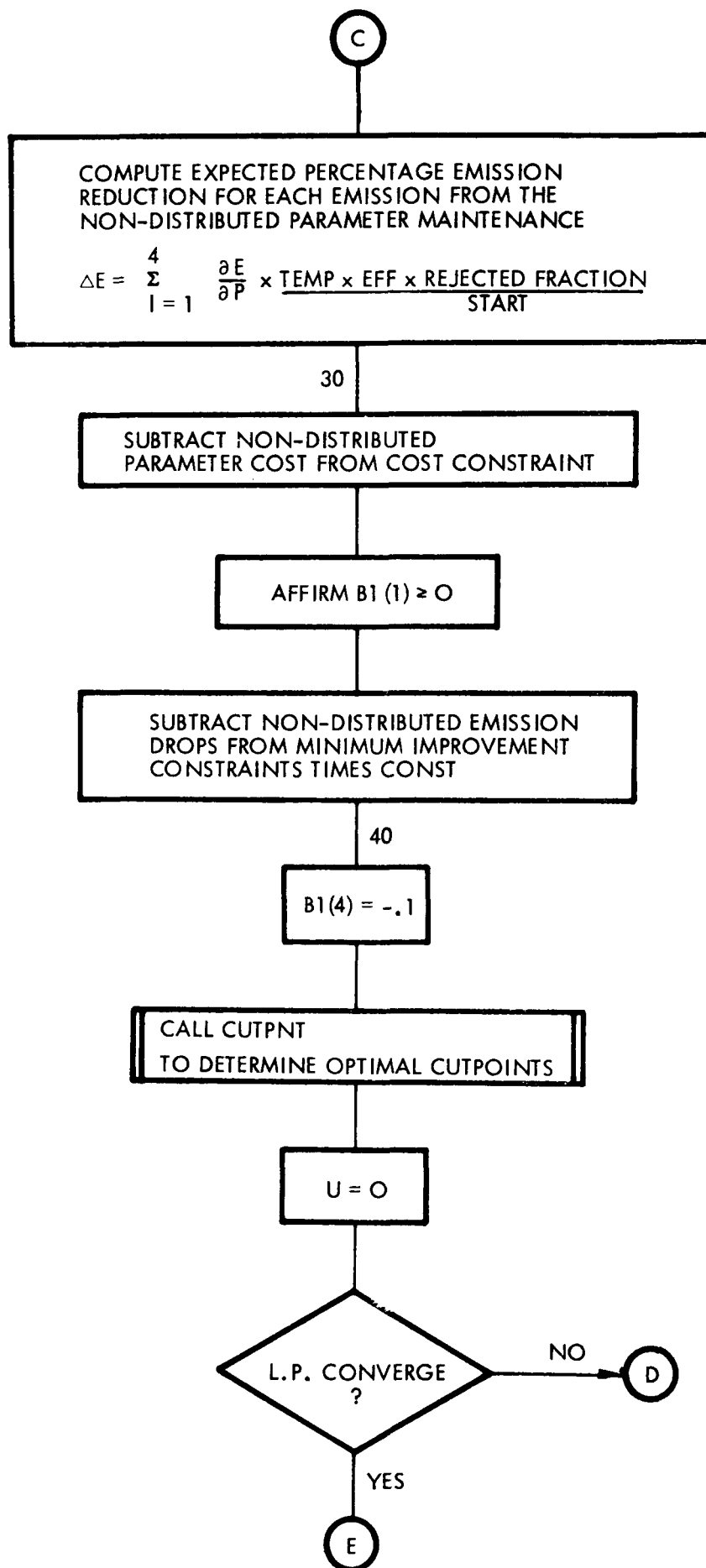


Figure 5-37 Subroutine OPTMUM Flowchart (cont.)

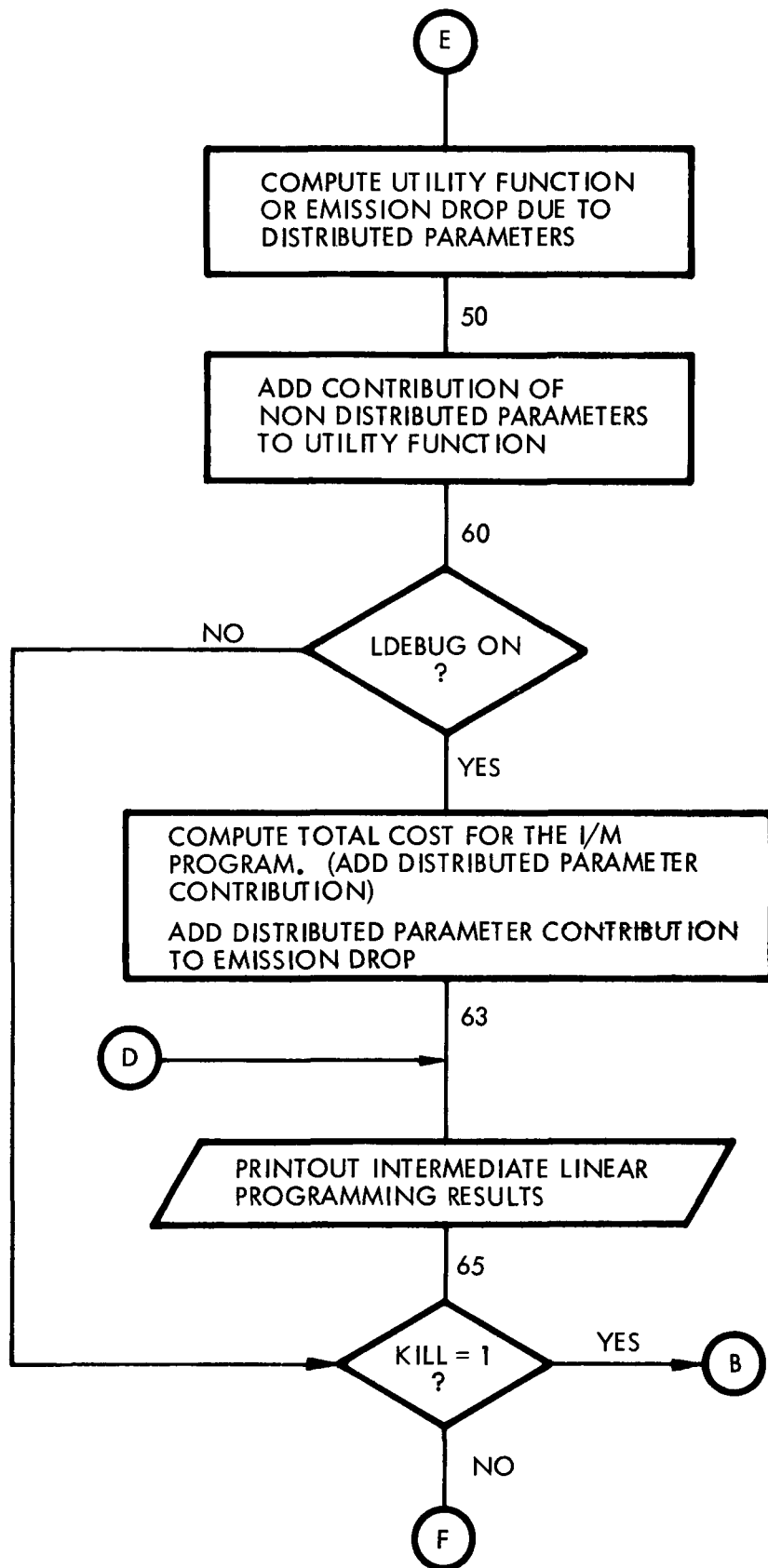


Figure 5-37 Subroutine OPTMUM Flowchart (cont.)

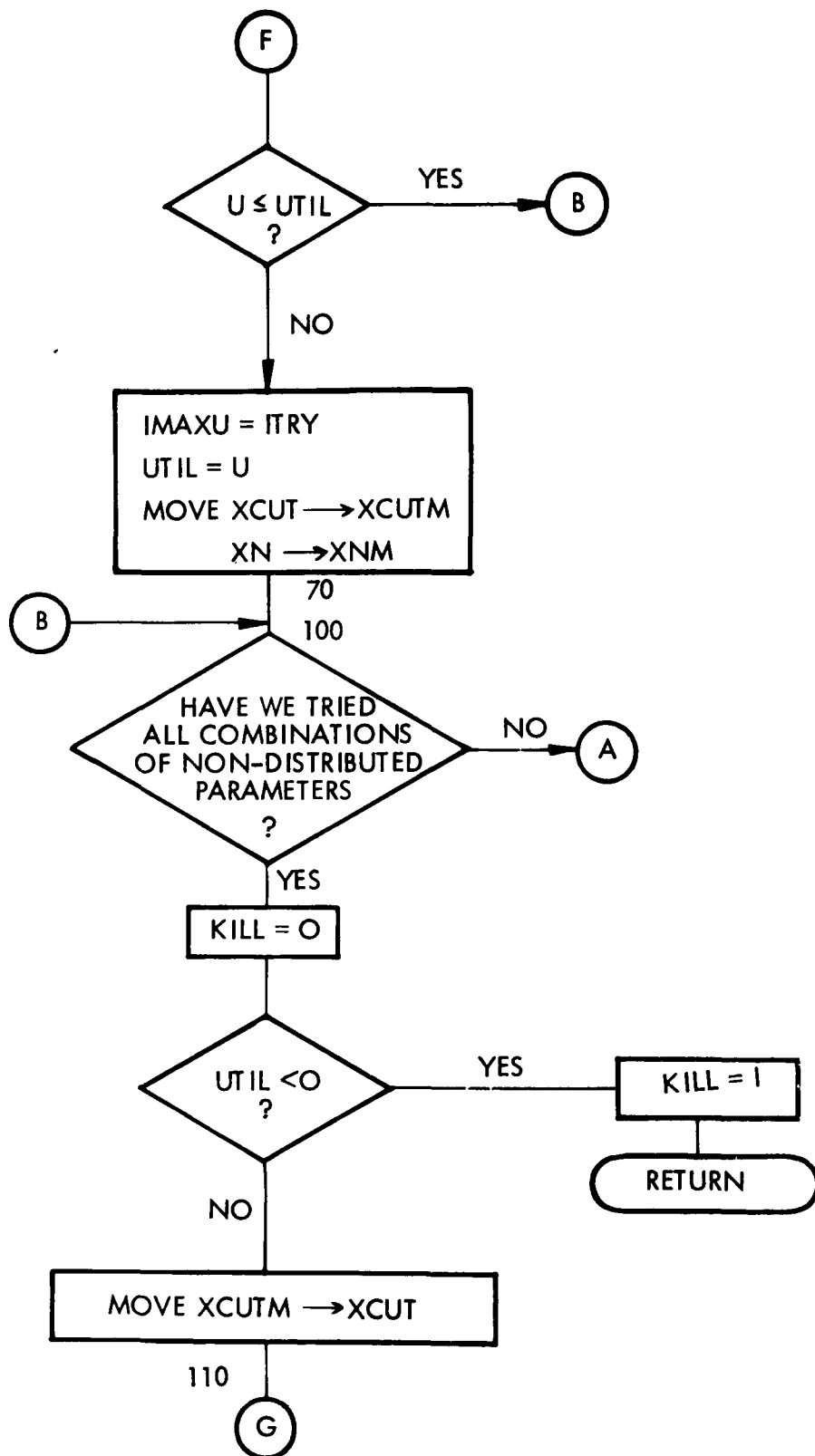


Figure 5-37 Subroutine OPTMUM Flowchart (cont.)

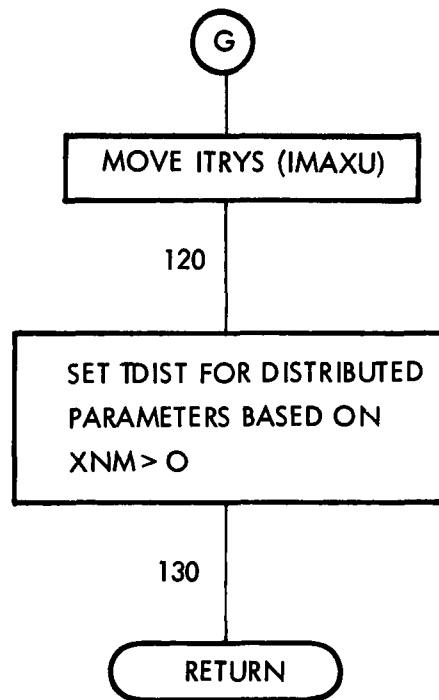


Figure 5-37 Subroutine OPTMUM Flowchart (cont.)

Table 5-37 SUBROUTINE OPTMUM LISTING

62360		SUBROUTINE OPTMUM(K,KILL,N,CONST)
62370		DIMENSION BSAVE(4,3),B1(4),COST(4),LCODE(4),ITRYS(16,4)
62380		DIMENSION DROP(3),P(4,3),TEMP(4)
62390		DIMENSION XCUTM(10),XNM(10)
62400		DIMENSION XN(6),C(6),NCODE(6),A(15,15)
62410		COMMON /COM01/ AMB(3),ALAB, AVV, BINT,
62420	+	BAREA(3), BLD1, BLD2, BSIG(3), BXTA, BSIZE,
62430	+	BHIST(3,16), BMMI(10,15,3),
62440	+	ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
62450		COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),
62460	+	CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
62470	+	CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
62480	+	CN(15,3,16), COEF3(15,3), COEFBP(10,15),
62490	+	CPART(10,15)
62500	CC ADD2	
62510		COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),
62520	+	EMW(3), EP(10,15),EFF(10), DELIT(3),
62530	+	FREQA, FREQB, FPERC(10,3),
62540	+	HURZN, HORZNY,
62550	+	HPC(15,16), HPCS(15,16), HPP(10,15,16),
62560	+	HPS(6,15,16), HPT(5,16), HPTOT(16),
62570	+	HPTOTS(16)
62580	CC ADD3	
62590		COMMON /COM04/ ITE, ITL, ITP, ITIME(16),
62600	+	KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
62610	+	LIDLE, LINT(16), LPSP(10),LSTART, LSTOP,
62620	+	MBASE, MPH, MSPEC(10),MSTART, MSTOP,
62630	+	MU(10,3), MMS(10,15), MVPR(10,15)
62640	CC ADD4	
62650		COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,
62660	+	NINTR, NINTRB, NMUDE, NO, NOPTS, NPAR,
62670	+	NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
62680	+	OCYI, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
62690	CC ADD5	
62700		COMMON /COM06/ PARM(3,3), PART, PAYNEW, PAYOFF(3),
62710	+	PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
62720	+	PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
62730	+	PAR(10,15,3), PAR1(10,3,3), PLUS(10,15),
62740	+	PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
62750	+	PSA(15), PTA(5), PCNF, PARINT(10,10,9)
62760	+	.PAYFIN

Table 5-37 SUBROUTINE OPTMUM LISTING (cont.)

62770		COMMON /COM07/	REINSP,	RNAME,	RSIZE,	RSTOP,	
62780	+	RTYPE,					
62790	+	SALE,	SALL,	SALP,	SITE1,	SITEM,	SLANE,
62800	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
62810	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
62820	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
62830	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
62840	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),	
62850	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
62860		COMMON /COM10/	TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),	
62870	+	TINT,	TOBE(3),	TUNX,	TOTE(3),	TPDB(3),	TPDT(3),
62880	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
62890	+	THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),	
62900	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
62910	CC ADD10						
62920		COMMON /COM11/	WF(10),				
62930	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
62940	+	XTM(16),	XBASE(9,3),	YBASE(9,3)			
62950	CC ADD11						
62960		COMMON /COM12/	Y1BP(3,3,10),		Y2BP(3,3,10),		
62970	+	YES,	YSUM,	YTM(16),	Y1DBP(4,4,10),	Y2DBP(4,4,10),	
62980	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
62990	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
63000	+	Z13,	Z14,	Z15,	Z16,	Z17,	
63010	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
63020	+	ZZ(3,3)					
63030	CC ADD12						
63040		COMMON /DEBUG/	ADERBUG,	BDEBUG,	CDEBUG,	DDEBUG,	
63050	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
63060	CC ADDD						
63070		REAL	ITE,	ITL,	ITP,	ITIME,	
63080	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
63090	+	NAME,	NO,	LDEBUG,	MDEBUG,		
63100	+	IN,	MISFIRE				
63110		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
63120	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
63130		DATA	ITRYS/8*0,8*1,4*0,4*1,4*0,4*1,2*0,2*1,2*0,2*1,				
63140	+		2*0,2*1,2*0,2*1,0,1,0,1,0,1,0,1,0,1,0,1,0,1/				
63150		DATA	LCODE/4,5,6,10/				
63160		DATA	BSAVE/10...03,.03,0..15...10..03,0..20...10..05,0./				
63170		DATA	NCODE/1,2,3,7,8,9/				
63180			J=5*(K-1)+1				

Table 5-37 SUBROUTINE OPTMUM LISTING (cont.)

63190		IF(LDEBUG.EQ.YES.AND.CONST.GT.J.99) WRITE(6,1000) K
63200		DO 5 L=1,4
63210		LL=LCODE(L)
63220		COST(L)=Z2*TIMEC(LL,J)+AREA(0,LL,J,K,N)*(Z2*TIMEM(LL,J)+
63230		* CPART(LL))
63240		DO 5 I=1,3
63250	5	P(L,I)=PAR(LL,J,I)
63260		UTIL=-100.
63270		IMAXU=0
63280		DO 100 ITRY=1,16
63290	C:	
63300	C:	SET UP FOR THIS TRY AT AN OPTIMUM PARAMETERS 4,5,6
63310	C:	AND 10 COMBINATION.
63320		IF(K.EQ.1.AND.ITRYS(ITRY,2)+ITRYS(ITRY,3).GE.1)GO TO 100
63330		IF(K.EQ.2.AND.ITRYS(ITRY,2).EQ.1) GO TO 100
63340		IF(K.EQ.3.AND.ITRYS(ITRY,3).EQ.1) GO TO 100
63350		DO 10 L=1,4
63360	10	TEMP(L)=ITRYS(ITRY,L)
63370	C:	
63380	C:	COMPUTE COSTS
63390	C:	
63400		CC=0.
63410		DO 20 L=1,4
63420	20	CC=CC+COST(L)*TEMP(L)
63430	C:	
63440	C:	COMPUTE EMISSION REDUCTION PERCENTAGES.
63450	C:	
63460		DO 30 I=1,3
63470		DROP(I)=0.
63480		DO 30 L=1,4
63490		LL=LCODE(L)
63500	30	DROP(I)=DROP(I)+P(L,I)*TEMP(L)*EFF(LL)/START(J,I)
63510		+ *AREA(0,LL,J,K,N)
63520	C:	
63530	C:	SUBTRACT C FROM COST CONSTRAINT.
63540	C:	
63550		B1(1)=BSAVE(1,OPTI)-CC
63560		IF(B1(1).LT.0.) B1(1)=0.
63570	C:	
63580	C:	SUBTRACT DELTA EMISSIONS FROM CUNSTRAINT
63590	C:	
63600		DO 40 I=1,3

Table 5-37 SUBROUTINE OPTMUM LISTING (cont.)

63610		M=I+1
63620		B1(M)=BSAVE(M,OPTI)*CONST-DROP(I)
63630	40	CONTINUE
63640		B1(4)=-.1
63650	C:	
63660	C:	CALL LINPRO
63670	C:	
63680		CALL CUTPNT(K,KILL,B1,C,XN,NCODE,N,A)
63690	C:	
63700	C:	COMPUTE UTILITY FUNCTION
63710	C:	
63720		U=0.
63730		IF(KILL.EQ.1) GOTO 63
63740		DO 50 M=1,6
63750	50	U=U-XN(M)*C(M)
63760		DO 60 I=1,3
63770	60	U=U+EMW(I)*DROP(I)*START(J,I)
63780	C:	
63790	C:	MAXIMIZE THE UTILITY FUNCTION
63800	C:	
63810		IF(LDEBUG.NE.YES) GOTO 65
63820		DO 62 M=1,6
63830		CC=CC+A(7,M)*XN(M)
63840		DO 62 I=1,3
63850		II=I+7
63860	62	DROP(I)=DROP(I)-A(II,M)*XN(M)
63870	63	WRITE(6,1010) (ITRYS(ITRY,L),L=1,4),
63880		+ XN,CC,
63890		+ (DROP(I),I=1,3),U
63900	65	IF(KILL.EQ.1) GOTO 100
63910		IF(U.LE.UTIL) GOTO 100
63920		IMAXU=ITRY
63930		UTIL=U
63940	C:	
63950	C:	SAVE CUTPOINTS
63960	C:	
63970		DO 70 M=1,10
63980		XCUTM(M)=XCUT(M,K)
63990	70	XNM(M)=XN(M)
64000	C:	
64010	C:	SET UP OPTIMAL CASE AND RETURN.

Table 5-37 SUBROUTINE OPTMUM LISTING (cont)

64020	C:	SET KILL=1 IF NO CASES WORKES
64030	C:	
64040	100	CONTINUE
64050		KILL=0
64060		IF(UTIL.LT.-5.) KILL=1
64070		IF(UTIL.LT.-5.) RETURN
64080	C:	
64090	C:	MOVE BACK OPTIMAL CUTPOINTS
64100	C:	
64110		DO 110 M=1,10
64120	110	XCUT(M,K)=XCUTM(M)
64130	C:	
64140	C:	FILL TDIST ARRAY
64150	C:	
64160		DO 120 L=1,4
64170		LL=LCODE(L)
64180	120	TDIST(LL,K)=ITRYS(IMAXU,L)
64190		DO 130 M=1,6
64200		MM=NCODE(M)
64210		TDIST(MM,K)=0
64220		IF(XNM(M).GT.1.E-5) TDIST(MM,K)=1
64230	130	CONTINUE
64240		RETURN
64250	1000	FORMAT(1H1,/40X,*CUTPOINT ANALYSIS (K=*,I2,*)*,//,
64260		+ 62X,*DISCRETE PARAMETER*,/,
64270		+ 20X,*PARAMETER REJECTION RATES*,13X,*I/M EMISSION DELTA*,
64280		+ * WEIGHTED*,/,* 4 5 6 10 1*,7X,*2*,7X,*3*,7X,
64290		+ *7*,7X,*8*,7X,*9 COSTS PERCENT EMISSION*
64300		+, /,69X,*HC CO NO DROP*//)
64310	1010	FORMAT(1X,4I2,6F8.2,F6.2,1X,3F7.4,F7.4,/,)
64320		END

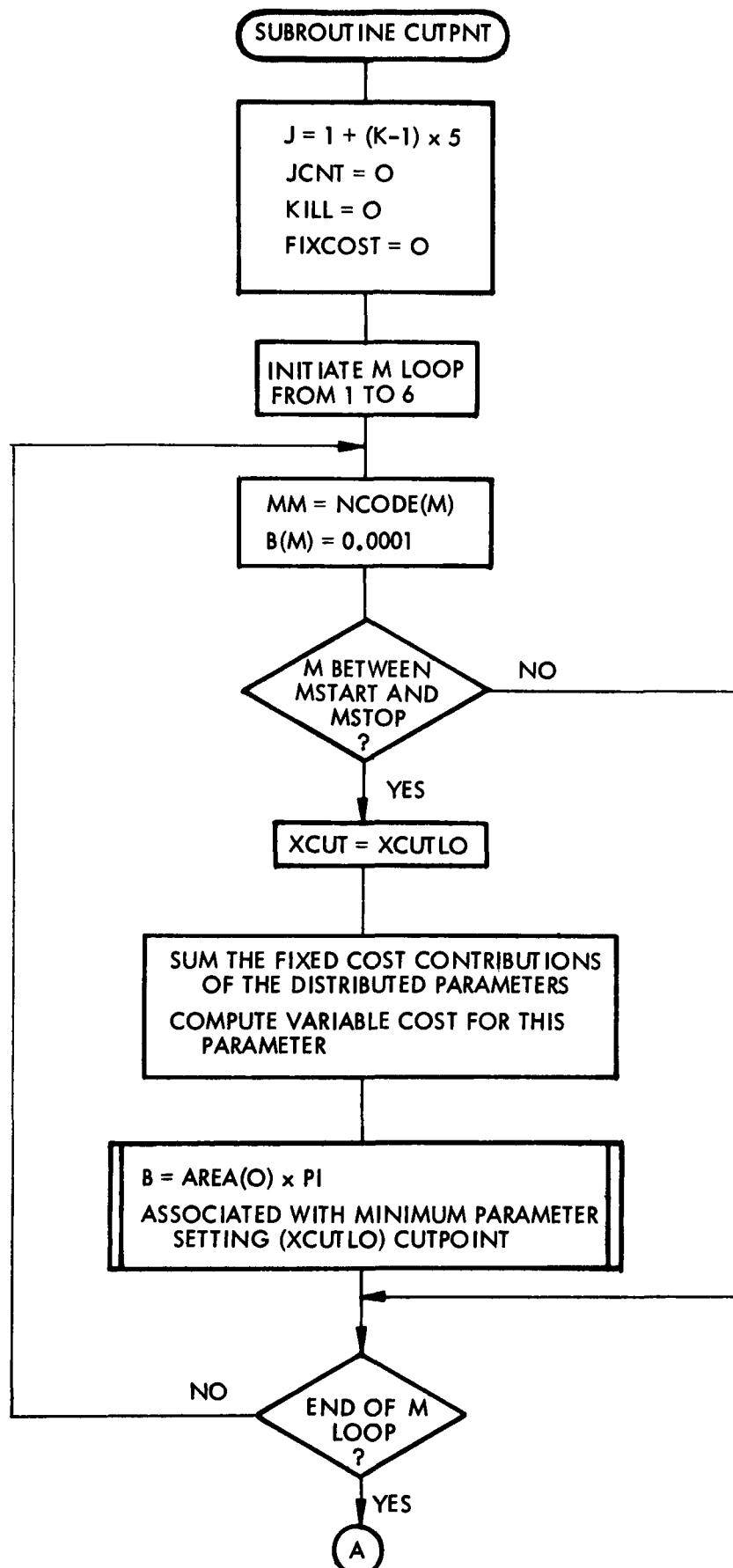


Figure 5-38 Subroutine CUTPNT Flowchart

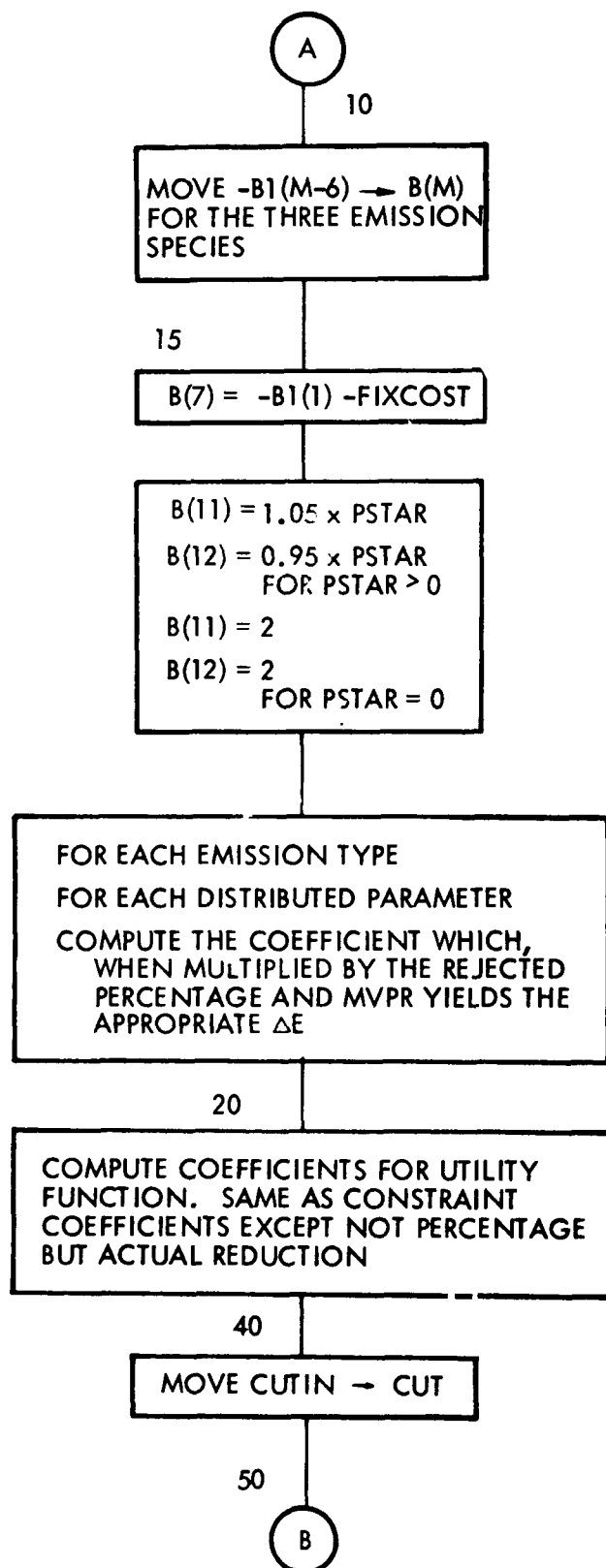


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

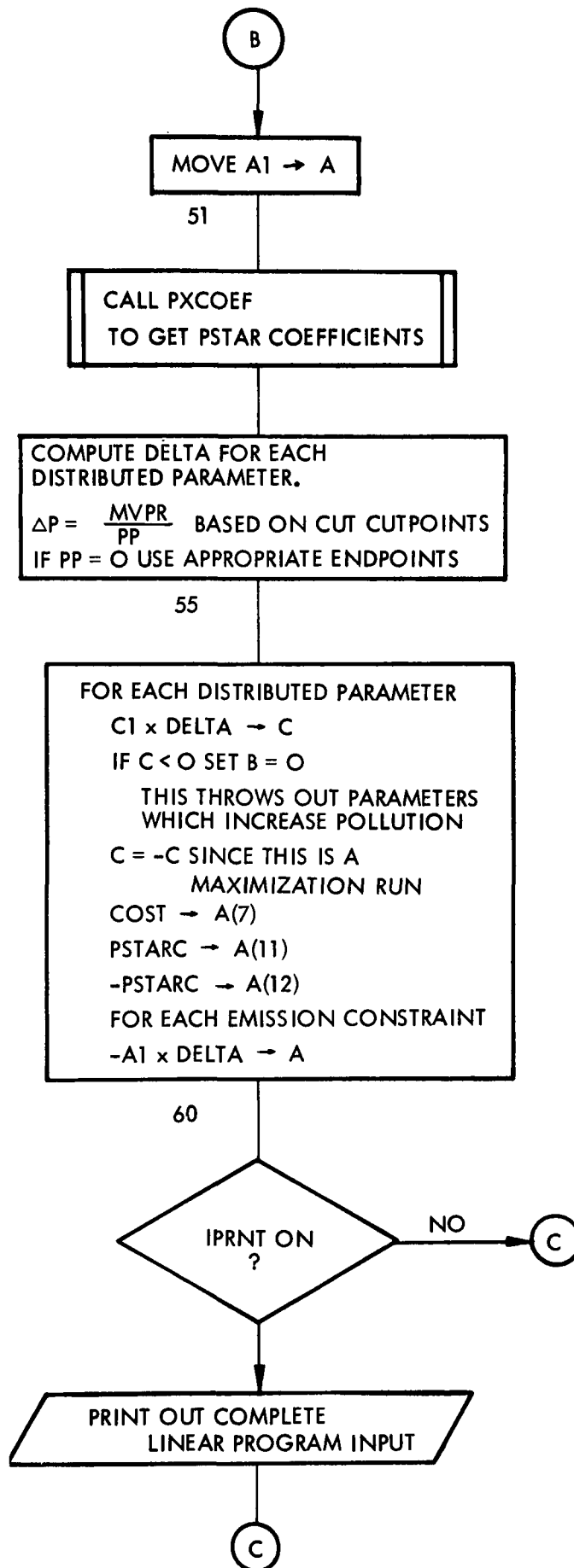


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

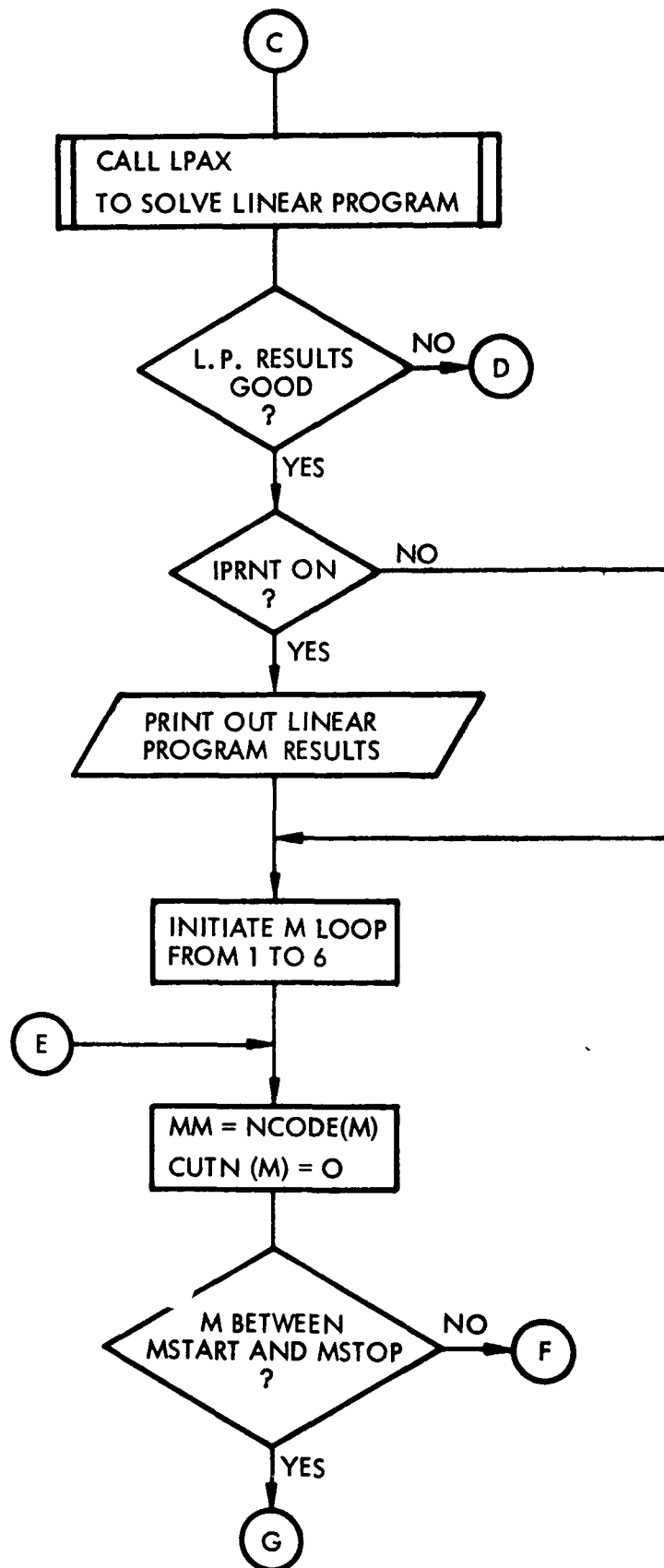


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

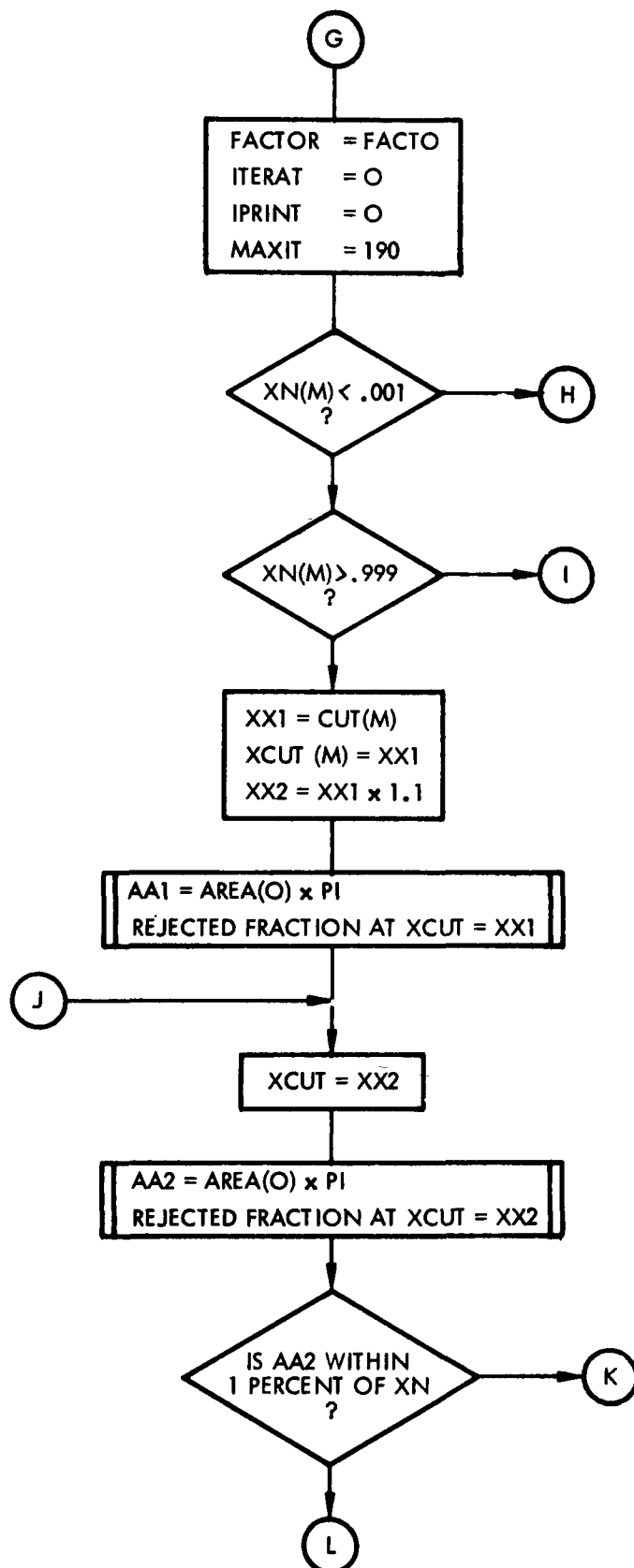


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

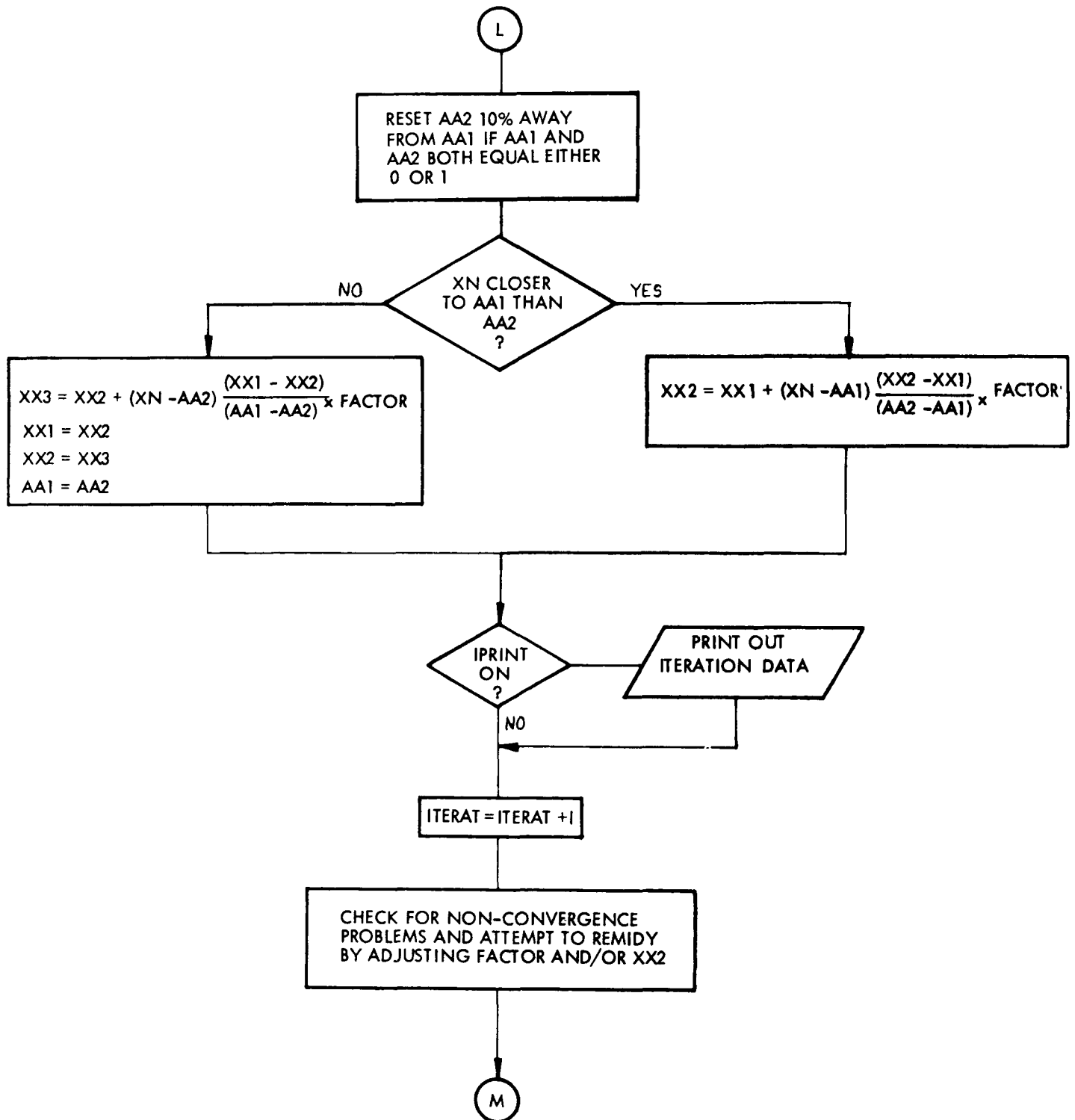


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

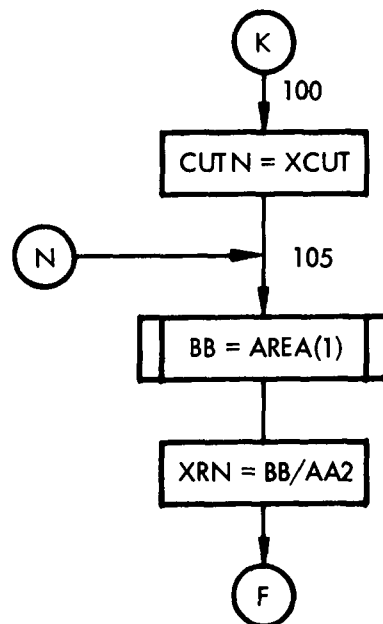
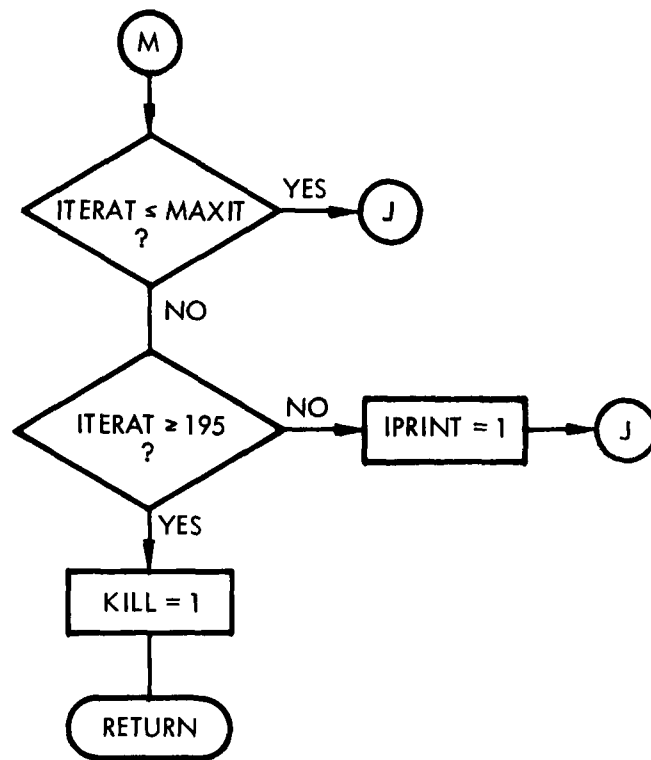


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

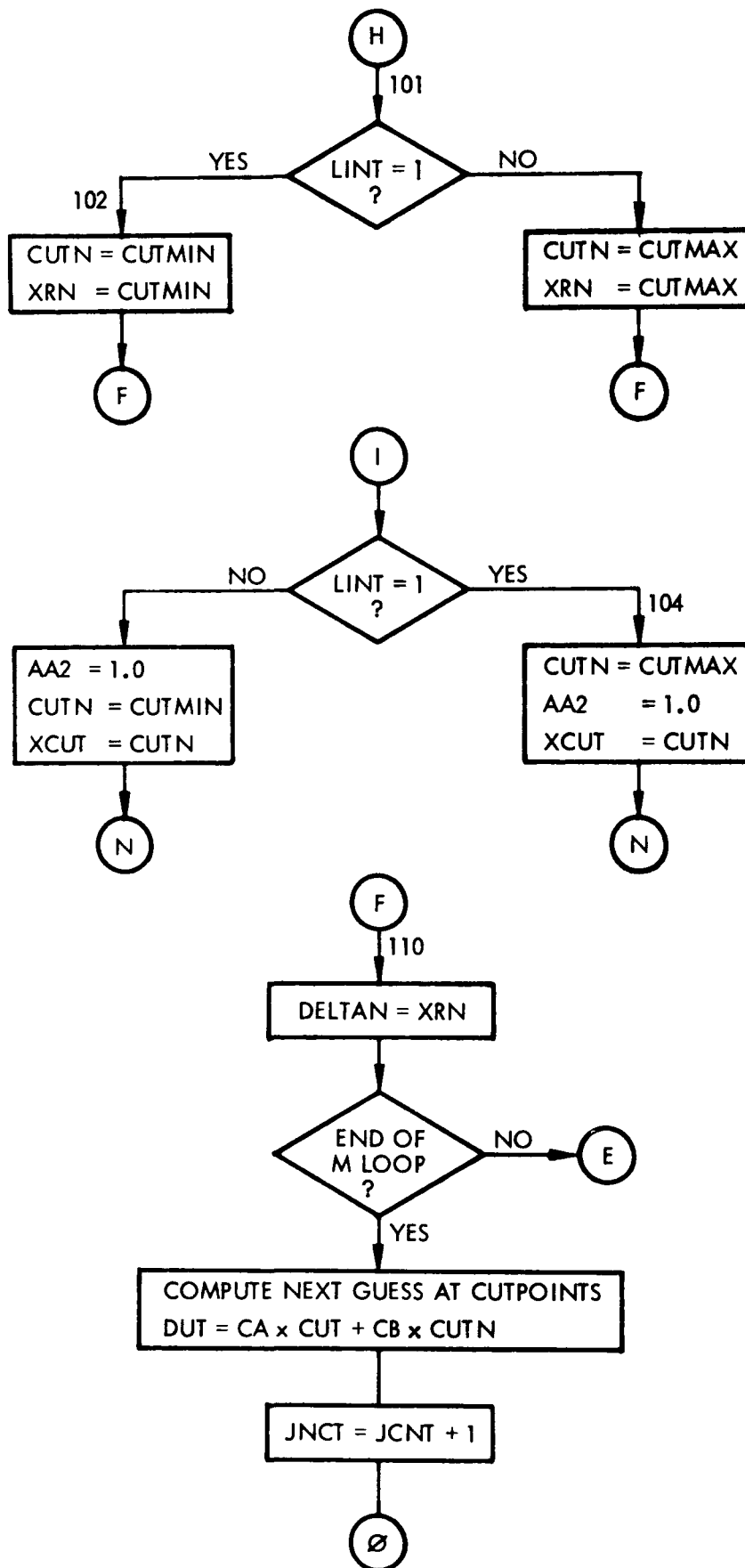


Figure 5-38 Subroutine CUTPNT Flowchart (cont.)

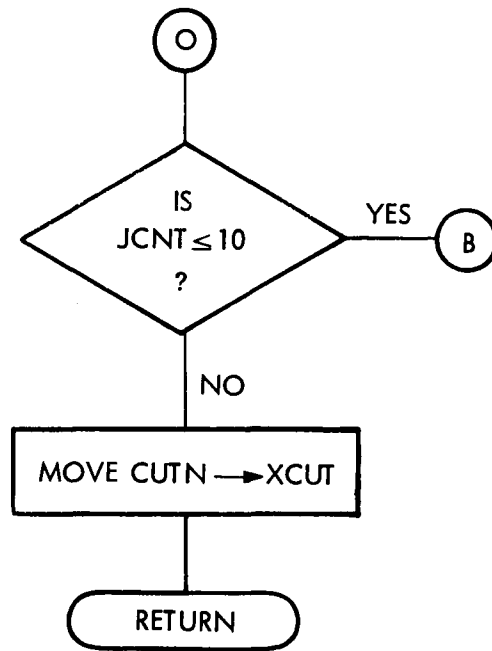


Figure 5-38 Subroutine COTPNT Flowchart (cont.)

Table 5-38 SUBROUTINE CUTPNT LISTING

```

53220      SUBROUTINE CUTPNT(K,KILL,B1,C,XN,NCODE,N,A)
53230      C:
53240      C:      THIS ROUTINE USES A LINEAR PROGRAMMING PACKAGE
53250      C:      (LINPRO) TO PRODUCE THE OPTIMAL PARAMETER
53260      C:      CUTPOINTS.
53270      C:
53280      COMMON /COMO1/ AMB(3),ALAB,      AVV, BINT,
53290      +      BAREA(3), BLD1,      BLD2,      BSIG(3), BXTA,      BSIZE,
53300      +      BHIST(3,16),      BMMI(10,15,3),
53310      +      ATARLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
53320      COMMON /COMO2/      CARA,      CARIY,      CARMY,      CARPOP(16),
53330      +      CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCOSTM,      CGIT,
53340      +      CINCON,      CPCR,      CPI,      CPVPY,      CSUM,      CARAY,
53350      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
53360      +      CPART(10,15)
53370      CC ADD2
53380      COMMON /COMO3/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
53390      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
53400      +      FRECA,      FREQB,      FPERC(10,3),
53410      +      HORZN,      HORZNY,
53420      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
53430      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
53440      +      HPTOTS(16)
53450      CC ADD3
53460      COMMON /COMO4/      ITE,      ITL,      ITP,      ITIME(16),
53470      +      KSTART,      KSTOP,      LOPT, LPICK(10),LLPICK,
53480      +      LIDLE,      LINT(16), LPSP(10),LSTART,      LSTOP,
53490      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
53500      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
53510      CC ADD4
53520      COMMON /COMO5/      NAME(50), NCNTR,      NEMIS,      NEMP,
53530      +      NINTR,      NINTRB,      NMDE,      NO,      NOPTS,      NPAR,
53540      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
53550      +      OCYI,      OCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
53560      CC ADD5
53570      COMMON /COMO6/ PARM(3,3), PART,      PAYNEW,      PAYOFF(3),
53580      +      PC(15),      PCS(15), PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
53590      +      PP(10,15),PS(6,15), PT(5),      PTOT,      PTS(5),      PAYADJ,
53600      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
53610      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
53620      +      PSA(15),      PTA(5),      PCNF,      PARINT(10,10,9)

```

Table 5-38 SUBROUTINE CUTPNT LISTING (cont.)

5269C	+ ,PAYFIN					
5270C	CCMMCN /CCMC7/		REINSP,	RNAME,	RSIZE,	RSTOP,
5271C	+ RTYPE,					
5272C	+ SALE,		SALL,	SALP,	SITEI,	SITEM,
5273C	+ SMODEL,		START(15,3),	STAT,	STIME(3),	
5274C	+ SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
5275C	+ SXCLT(6,3),		SIG(10,3),		SIGCE(3),	
5276C	+ SIGME(10),		SIGMNE(10),		SIGP(10,15),	
5277C	+ SIGRATE, SIST,		SIGS(6,15),		SIGSDE(3),	
5278C	+ STABLEX(33,6,15),		STABLEY(33,6,15)			
5279C	CCMMCN /CCM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
5280C	+ TINT,		TCBE(3),	TCNX,	TOTE(3),	TPDB(3),
5281C	+ TXTRA,		TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),
5282C	+ THIST(5,3,16),		THISTT(3,16),		TIMEC(10,15),	
5283C	+ TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
5284C	CC ADD10					
5285C	CCMMCN /CCM11/		WF(10),			
5286C	+ XIBP(3,3,6),		XINT,	XINTB,	XLANE,	XSUM,
5287C	+ XTM(16),		XBASE(9,3),	YEASE(9,3)		
5288C	CC ADD11					
5289C	CCMMCN /CCM12/		YIBP(3,3,10),		Y2BP(3,3,10),	
5290C	+ YES,		YSLM,	YTM(16),	YIDBP(4,4,10),	Y2CBP(4,4,10),
5291C	+ Z1,		Z2,	Z3,	Z4,	Z5,
5292C	+ Z7,		Z8,	Z9,	Z10,	Z11,
5293C	+ Z13,		Z14,	Z15,	Z16,	Z17,
5294C	+ ZCARI,		ZCARM,	ZIC,	ZSUM,	
5295C	+ ZZ(3,3)					
5296C	CC ADD12					
5297C	CCMMCN /CDEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
5298C	+ LDEBUG,		MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,
5299C	CC ADDC					
5300C	REAL		ITE,	ITL,	ITP,	ITIME,
5301C	+ MMS,		MPH,	MU,	MVPR,	
5302C	+ NAME,		NC,	LDEBUG,	MDEBUG,	
5303C	+ IN,		MISFIRE			
5304C	INTEGER		RNAME,	SITEI,	SITEM,	STAT,
5305C	+ TDIST,		XLANE,	CPTI,	PPICK,	PPPICK
5306C	DIMENSION CLT(6),X(6),XR(6),A(15,15),XRN(6),B(12),C(6),					
5307C	* C1(6),A1(10,6),DELTA(6),CLTN(6),DELTAN(6),XN(6),					
5308C	* DUP(60),NCCDE(6),B1(4),XCUTLC(6),PSTARC(6)					
5309C	DIMENSION CUTMAX(6),CUTMIN(6)					
5310C	DIMENSION CUTIN(10),COST(6)					

Table 5-38 SUBROUTINE CUTPNT LISTING (cont.)

```

53110 DATA CLTMIN/-E.,-555.,-10.,-10.,-10.,-1./
53120 DATA CLTMAX/10.,555.,10.,5.,180.,1./
53130 DATA CA,CB/.7,.3/
53140 DATA A1/1.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
53150 * 0.,1.,0.,0.,0.,0.,0.,0.,0.,0.,
53160 * 0.,0.,1.,0.,0.,0.,0.,0.,0.,0.,
53170 * 0.,0.,0.,1.,0.,0.,0.,0.,0.,0.,
53180 * 0.,0.,0.,0.,1.,0.,0.,0.,0.,0.,
53190 * 0.,0.,0.,0.,0.,1.,0.,0.,0.,0./
53200 DATA CLTIN/1.,-100.,2.,-1.,100.,-.1/
53210 DATA IPRNT/1/
53220 DATA XCUTLC/1.,-10.,1.,-.1,10.,-.05/
53230 C:
53240 C: SET LP CONSTRAINT AND UTILITY FUNCTION MATRICES
53250 C:
53260 NN=NSTEPS+1
53270 J=1+(N-1)*5
53280 JCNT=C
53290 KILL=0
53300 FIXCCST=0.
53310 DO 10 M=1,6
53320 MM=NCCDE(M)
53330 E(M)=C.CCC1
53340 IF(MM.LT.MSTART.OR.MM.GT.MSTOP) GOTO 10
53350 XCUT(MM,K)=XCUTLC(M)
53360 C:
53370 C: COMPLETE CCST FOR THE DISTRIBUTED PARAMETERS
53380 C:
53390 FIXCCST=FIXCCST+Z2*TIMEC(MM,J)
53400 COST(M)=Z2*TIME(MM,J)+CPART(MM)
53410 10 E(M)=AREA(C,MM,J,K,N)
53420 C:
53430 C: MOVE THE EMISSION DELTA AND CCST CONSTRAINTS INTO
53440 C: THE E ARRAY. E(M)
53450 C:
53460 DO 15 M=8,10
53470 15 E(M)=-B1(M-6)
53480 E(7)=E1(1)-FIXCCST
53490 E(11)=1.05*PSTAR
53500 E(12)=C.95*PSTAR
53510 IF(PSTAR.LT.1.E-5) E(11)=20.
53520 IF(PSTAR.LT.1.E-5) E(12)=-20.

```

Table 5-38 SUBROUTINE CUPNT LISTING (cont.)

```

5353C      C:
5354C      C:      COMPUTE EMISSION CONSTRAINT CCEF.
5355C      C:
5356C      DO 20 I=1,3
5357C      II=I+7
5358C      DO 20 M=1,6
5359C      MM=NCCDE(M)
5360C      20  A1(II,M)=EFF(M)*PAR(MM,J,I)/START(J,I)
5361C      C:
5362C      C:      MOVE TEMPORARY CCEFFICIENTS INTO THE A ARRAY  -A(10,6)-
5363C      C:
5364C      DO 40 M=1,6
5365C      C1(M)=0.
5366C      MM=NCCDE(M)
5367C      DO 40 I=1,3
5368C      40  C1(M)=C1(M)+EMW(I)*PAR(MM,J,I)*EFF(MM)
5369C      DO 50 I=1,6
5370C      50  CLT(I)=CUTIN(I)
5371C      54  DO 51 I=1,10
5372C      DO 51 M=1,6
5373C      51  A(I,M)=A1(I,M)
5374C      C:
5375C      C:      COMPUTE EXPECTED EMISSION DROP (DELTA)
5376C      C:
5377C      DO 55 M=1,6
5378C      MM=NCCDE(M)
5379C      XCLT(MM,K)=CLT(M)
5380C      AA=AREA(0,MM,J,K,N)
5381C      BB=AREA(1,MM,J,K,N)
5382C      IF(LINT(MM).EQ.1) XR(M)=CLTMIN(M)
5383C      IF(LINT(MM).EQ.2) XR(M)=CLTMAX(M)
5384C      IF(AA.GT.C.CCCC1) XR(M)=BB/AA
5385C      X(M)=AA
5386C      DELTA(M)=XR(M)
5387C      55  CCNTINCE
5388C      CALL FXCCEF(X,PSTARC)
5389C      DO 60 M=1,6
5390C      C(M)=C1(M)*DELTA(M)
5391C      C*****IF(C(M).LT.0.) WRITE(6,56) M
5392C      56  FORMAT(/11F SETTING B( ,I2,10H) TO ZERO  //)
5393C      C:
5394C      C:      THROW OUT NON POSITIVE CONTRIBUTING DISTRIBUTIVE PARAMETERS

```


Table 5-38 SUBROUTINE CUTPNT LISTING (cont.)

```

5395C      C:
5396C      IF(C(M).LT.0.) B(M)=C.CCC1
5397C      C(M)=-C(M)
5398C      A (7,M)=CCST(M)
5399C      A(11,M)=PSTARC(M)
5400C      A(12,M)=-PSTARC(M)
5401C      DO 6C L=8,10
5402C      60  A(L,M)=-A1(L,M)*DELTA(M)
5403C      IF(IPRNT.EQ.C) GOTO 7C
5404C      IF(JCNT.NE.0.AND.JCNT.NE.5.AND.JCNT.NE.10) GO TO 70
5405C      WRITE(6,1010) C
5406C      DO 65 L=1,12
5407C      65  WRITE(6,1020) (A(L,M),M=1,6),E(L)
5408C      1010 FORMAT(/6F10.4/)
5409C      1020 FORMAT(7F10.4)
5410C      C:
5411C      C:      CALL LINEAR PROGRAMMING ROUTINE.
5412C      C:
5413C      70  CALL LPAX(A,B,C,XN,CUM,15,12,6,IERR,C,2.)
5414C      C:
5415C      C:      COMPUTE OPTIMAL CUTPOINTS BASED ON THE OPTIMAL
5416C      C:      REJECTION FRACTION FROM LINPRC.
5417C      C:
5418C      IF(IERR.NE.C) GOTO 55
5419C      IF(IPRNT.EQ.1) WRITE(6,150) XN
5420C      DO 11C M=1,6
5421C      MM=NCCDE(M)
5422C      CLTN(M)=C.
5423C      IF(MM.LT.MSTART.OR.MM.GT.MSTOP) GOTO 110
5424C      IF(XN(M).LT.0.001) GOTO 101
5425C      IF(XN(M).GT.0.999) GOTO 103
5426C      XCLT(MM,K)=XFT(TAELEX(1,MM,J),TABLEY(1,MM,J),NN,XN(M))
5427C      AA2=AREA(C,MM,J,K,N)
5428C      C:
5429C      C:      COMPUTE REJECTED POPULATION MEAN.
5430C      C:
5431C      CLTN(M)=XCUT(MM,K)
5432C      105  BB=AREA(1,MM,J,K,N)
5433C      XRN(M)=BB/AA2
5434C      GOTO 11C
5435C      101  IF(LINT(MM).EQ.1) GOTO 102
5436C      C:

```

Table 5-38 SUBROUTINE CUTPNT LISTING (cont.)

5437C	C:	REJECT THE HIGH END. REJECT FRACTION=0.
5438C	C:	
5439C		CUTN(M)=CUTMAX(M)
5440C		XRN(M)=CUTMAX(M)
5441C		GOTO 11C
5442C	C:	
5443C	C:	REJECT THE LOWER END. REJECT FRACTION=0.
5444C	C:	
5445C	102	CUTN(M)=CUTMIN(M)
5446C		XRN(M)=CUTMIN(M)
5447C		GOTO 11C
5448C	103	IF(LINT(MM).EQ.1) GOTO 104
5449C	C:	
5450C	C:	REJECT THE HIGH END. REJECT FRACTION = 1.
5451C	C:	
5452C		AA2=1.C
5453C		CUTN(M)=CUTMIN(M)
5454C		XCUT(MM,K)=CUTN(M)
5455C		GOTO 105
5456C	C:	
5457C	C:	REJECT THE LOWER END. REJECT FRACTION = 1.
5458C	C:	
5459C	104	CUTN(M)=CUTMAX(M)
5460C		AA2=1.C
5461C		XCUT(MM,K)=CUTN(M)
5462C		GOTO 105
5463C	110	DELTA(M)=XRN(M)
5464C		DO 13C M=1,6
5465C	C:	
5466C	C:	COMPUTE NEXT CUTPOINT GUESSES AND GO TO
5467C	C:	THE TOP OF THE LOOP.
5468C	C:	
5469C	130	CUT(M)=CA*CUT(M)+CB*CUTN(M)
5470C	150	FORMAT(* X*,F8.4,5F10.4)
5471C		JCNT=JCNT+1
5472C		IF(JCNT.LE.10) GOTO 54
5473C	C:	
5474C	C:	MOVE OPTIMAL CUTPOINTS INTO XCUT
5475C	C:	
5476C		DO 16C M=1,6
5477C		MM=NCCDE(M)
5478C	160	XCUT(MM,K)=CUTN(M)

Table 5-38 SUBROUTINE CUTPNT LISTING (cont.)

5479C		RETURN
5480C	95	KILL=1
5481C		RETURN
5482C		END

5.13.3 Subroutine LPAX

Subroutine LPAX is the actual linear programming algorithm used in the model. LPAX is a TRW proprietary programming package and consequently has not been included in this writeup.

5.13.4 Subroutine PXCOEF

Subroutine PXCOEF computes the coefficients necessary for estimating the union of a set of parameter rejection rates. The coefficients are used in the linear programming model for the P* option in which a constant rejection rate is required. The fundamental equation of PXCOEF computes the union of probabilities for independent occurrences. The coefficients are computed for each of the distributed parameters and multiplied by the rejection rate X in the OPTMUM optimization loop. Figure 5-39 contains a complete flowchart of the subroutine while Table 5-39 includes a listing.

5.14 OUTPUT ROUTINES

Since GEEP is a user oriented program, an effort has been made to make the output as clear and self-explanatory as possible. This requirement has, of course, lead to a large number of specialized output routines with a variety of output options including plots, tables, debug information, and summary level results. The following routine descriptions provide an overview of the various output options. The reader is referred to Section 3.0 for more details on program output.

5.14.1 Subroutine DISTPR

Subroutine DISTPR is an output subroutine used in the convolution routine of GEEP. DISTPR prints out three distributions along with their respective means and standard deviations. Usually these distributions

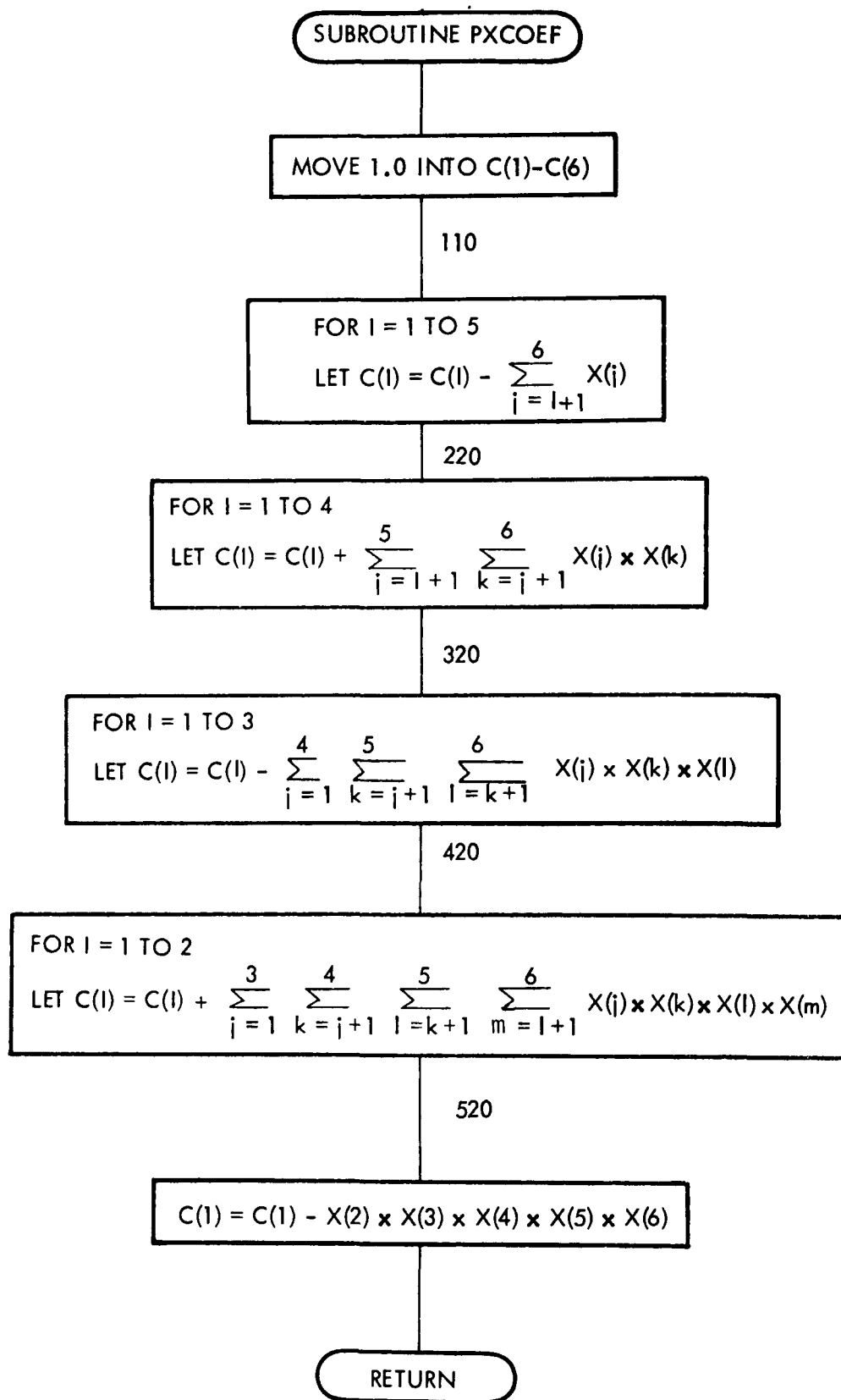


Figure 5-39 Subroutine PXCOEF Flowchart

Table 5-39 SUBROUTINE PXCOEF LISTING

64460		SUBROUTINE PXCOEF(X,C)
64470		DIMENSION X(1),C(1)
64480		DO 110 I=1,6
64490	110	C(I)=1.0
64500		DO 220 I=1,5
64510		J1=I+1
64520		A=0
64530		DO 210 J=J1,6
64540	210	A=A+X(J)
64550	220	C(I)=C(I)-A
64560		DO 320 I=1,4
64570		J1=I+1
64580		A=0
64590		DO 310 J=J1,5
64600		K1=J+1
64610		DO 310 K=K1,6
64620	310	A=A+X(J)*X(K)
64630	320	C(I)=C(I)+A
64640		DO 420 I=1,3
64650		J1=I+1
64660		A=0.
64670		DO 410 J=J1,4
64680		K1=J+1
64690		DO 410 K=K1,5
64700		L1=K+1
64710		DO 410 L=L1,6
64720	410	A=A+X(J)*X(K)*X(L)
64730	420	C(I)=C(I)-A
64740		DO 520 I=1,2
64750		J1=I+1
64760		A=0
64770		DO 510 J=J1,3
64780		K1=J+1
64790		DO 510 K=K1,4
64800		L1=K+1
64810		DO 510 L=L1,5
64820		M1=L+1
64830		DO 510 M=M1,6
64840	510	A=A+X(J)*X(K)*X(L)*X(M)
64850	520	C(I)=C(I)+A
64860		C(1)=C(1)-X(2)*X(3)*X(4)*X(5)*X(6)
64870		RETURN
64880		END

will be two arbitrary distributions and their convolution. A flowchart of DISTPR is found in Figure 5-40. Table 5-40 presents a listing of the code.

5.14.2 Subroutine OUT

Subroutine OUT is the main output routine for the General Economic Effectiveness Program. All computed cost values, payoff functions, Inspection/Maintenance descriptors, and emission time histories are printed by subroutine OUT. Several unit conversion and index calculations appear for referencing name arrays and outputting data in meaningful units. Figure 5-41 contains a summary level flowchart for subroutine OUT. Table 5-41 provides a complete listing of output variables and formats.

5.14.3 Subroutine GEEPER

Subroutine GEEPER is a header routine which prints a GEEP/CRC Logo on the first page of each run. GEEPER is called only once for each run. Figure 5-42 contains a flowchart for GEEPER while Table 5-42 contains a listing.

5.14.4 Plot Routines

Output from GEEP is provided in easy-to-read tables and plots. The following plot routines perform specialized functions involved in generating the summary and debug plotted output for a GEEP execution. The basic plot routine, PLOTJK, is a well known standard output routine for displaying data on a digital line printer. It works with an alphanumeric array initialized blank and fills it with characters for the functions being plotted. There is theoretically no limit to the number of functions which can be plotted on one graph, but for GEEP, in the interest of clarity, that number has been limited to two. Off-scale flags at both ends of the plot indicate out-of-bounds data, but since GEEP automatically adjusts the scales to the data, this data range error should never occur.

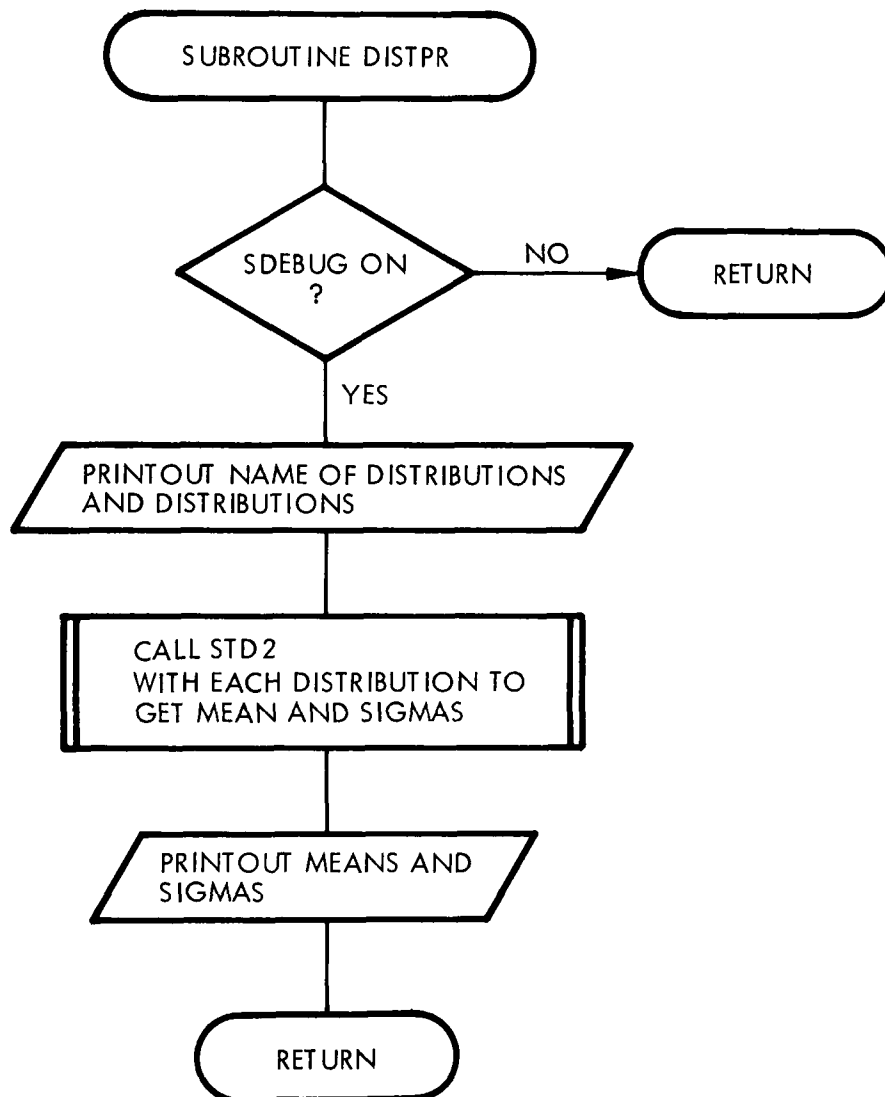


Figure 5-40 Subroutine DISTPR Flowchart

Table 5-40 SUBROUTINE DISTPR LISTING

39520		SUBROUTINE DISTPR(P,Y,PP,YY,D,DD,N1,N2,N3,NAME)
39530		DIMENSION P(1),Y(1),PP(1),YY(1),D(1),DD(1)
39540		REAL MU1,MU2,MU3,NAME(5)
39550		COMMON /DEBUG/ ADEBUG, BDEBUG, CDEBUG, DDEBUG,
39560		+ LDEBUG, MDEBUG, PDEBUG, QDEBUG, SDEBUG, TDEBUG
39570		REAL LDEBUG,MDEBUG
39580	CC	
39590	CC	CONVOLUTION DISTRIBUTION PRINT
39600	CC	
39610		IF(SDEBUG.EQ.2HNO) RETURN
39620		WRITE (6,800) NAME
39630	800	FORMAT(/,20X,5A10/)
39640		WRITE (6,900)
39650		WRITE (6,910) (I,P(I),Y(I),PP(I),YY(I),D(I),DD(I),I=1,N3)
39660		CALL STD2(P,Y,N1,MU1,SD1)
39670		CALL STD2(PP,YY,N2,MU2,SD2)
39680		CALL STD2(D,DD,N3,MU3,SD3)
39690		WRITE (6,920)
39700		WRITE (6,930) MU1,SD1,MU2,SD2,MU3,SD3
39710	900	FORMAT (/,11X,1HI,5X,2HAX,9X,2HAY,9X,2HBX,9X,2HBY,
39720		+ 9X,2HCX,9X,2HCY,/)
39730	910	FORMAT (10X,12,6E11.3)
39740	920	FORMAT (/,17X,3HMU1,8X,3HSD1,8X,3HMU2,8X,3HSD2,
39750		+ 8X,3HMU3,8X,3HSD3,/)
39760	930	FORMAT (13X,6E11.3)
39770		RETURN
39780		END

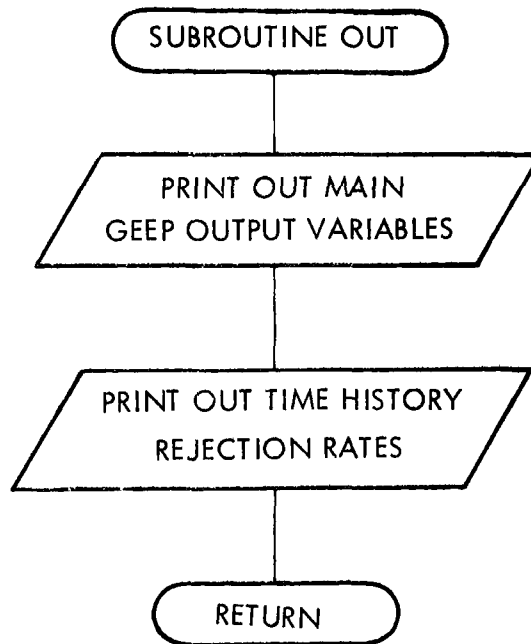


Figure 5-41 Subroutine OUT Flowchart

Table 5-41 SUBROUTINE OUT LISTING

40530	SUBROUTINE OUT	
40540	COMMON /COM01/ AMB(3),ALAB, AVV, BINT,	
40550	+	BAREA(3), BLD1, BLD2, BSIG(3), BXTKA, BSIZE,
40560	+	BHIST(3,16), BMMI(10,15,3),
40570	+	ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
40580	COMMON /COM02/ CARA, CARIY, CARMY, CARPOP(16),	
40590	+	CARSY, CBSUM, CCOEF(10),CCOSTI, CCOSTM, CGTT,
40600	+	CINCON, CPCB, CPI, CPVPY, CSUM, CARAY,
40610	+	CN(15,3,16), COEFB(15,3), COEFBP(10,15),
40620	+	CPART(10,15)
40630	CC ADD2	
40640	COMMON /COM03/ DELPCV, DP(10,15),DELEM(3,16),DELI(3),	
40650	+	EMW(3), EP(10,15),EFF(10), DELIT(3),
40660	+	FREQA, FREQB, FPERC(10,3),
40670	+	HOR7N, HORZNY,
40680	+	HPC(15,16), HPCS(15,16), HPP(10,15,16),
40690	+	HPS(6,15,16), HPT(5,16), HPTOT(16),
40700	+	HPTGTS(16)
40710	CC ADD3	
40720	COMMON /COM04/ ITE, ITL, ITP, ITIME(16),	
40730	+	KSTART, KSTOP, LOPT, LPICK(10),LLPICK,
40740	+	LIDLE, LINT(16), LPSP(10),LSTART, LSTOP,
40750	+	MBASE, MPH, MSPEC(10),MSTART, MSTOP,
40760	+	MU(10,3), MMS(10,15), MVPR(10,15)
40770	CC ADD4	
40780	COMMON /COM05/ NAME(50), NCNTR, NEMIS, NEMP,	
40790	+	NINTR, NINTRB, NMODE, NO, NOPTS, NPAR,
40800	+	NPTRN, NPTS, NSTEPS, NTR, NTRB, NPICK(16),
40810	+	GCIY, OCMY, OPTI, OPTM,OPTS(50),OVCHI(3),OVCHM(3)
40820	CC ADD5	
40830	COMMON /COM06/PARM(3,3), PART, PAYNEW, PAYOFF(3),	
40840	+	PC(15), PCS(15), PHI(14), PLO(14), PLTMAX(3),PMODEL,
40850	+	PP(10,15),PS(6,15), PT(5), PTOT, PTS(5), PAYADJ,
40860	+	PAR(10,15,3), PARI(10,3,3), PLUS(10,15),
40870	+	PM(10,15), PPICK(10),PPPICK,PSTAR,PI(15,10),
40880	+	PSA(15), PTA(5), PCONF, PARINT(10,10,9)
40890	+	,PAYFIN
40900	COMMON /COM07/ REINSP, RNAME, RSIZE, RSTOP,	
40910	+	RTYPE,
40920	+	SALE, SALL, SALP, SITEI, SITEM, SLANE,
40930	+	SMODEL, START(15,3), STAT, STIME(3), SUMBM(3),

Table 5-41 SUBROUTINE OUT LISTING (cont.)

40940	+	SCALEBM(3),	SM(6,15),	SPAR(10,15,6),
40950	+	SXCUT(6,3),	SIG(10,3),	SIGCE(3),
40960	+	SIGME(10),	SIGMNE(10),	SIGP(10,15),
40970	+	SIGRATE, SIST,	SIGS(6,15),	SIGSDE(3),
40980	+	STABLEX(33,6,15),	STABLEY(33,6,15)	
40990		COMMON /COM10/	TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),	
41000	+	TINT, TOBE(3),	TONX, TOTE(3), TPDB(3), TPDT(3),	
41010	+	TXTRA, TSIZE,	TSIG(3), TPER(16,15), TMIL(16,15),	
41020	+	THIST(5,3,16),	THISTT(3,16), TIMEC(10,15),	
41030	+	TIMEM(10,15),	TABLEX(33,10,15), TABLEY(33,10,15)	
41040		CC ADD10		
41050		COMMON /COM11/	WF(10),	
41060	+	X1BP(3,3,6), XINT,	XINTB, XLANE, XSUM, XCUT(10,3),	
41070	+	XTM(16), XBASE(9,3), YBASE(9,3)		
41080		CC ADD11		
41090		COMMON /COM12/	Y1BP(3,3,10), Y2BP(3,3,10),	
41100	+	YES, YSUM,	YTM(16), Y1DBP(4,4,10), Y2DBP(4,4,10),	
41110	+	Z1, Z2,	Z3, Z4, Z5, Z6,	
41120	+	Z7, Z8,	Z9, Z10, Z11, Z12,	
41130	+	Z13, Z14,	Z15, Z16, Z17,	
41140	+	ZCARI, ZCARM,	ZIC, ZSUM,	
41150	+	ZZ(3,3)		
41160		CC ADD12		
41170		COMMON /DEBUG/	ADEBUG, BDEBUG, CDEBUG, DDEBUG,	
41180	+	LDEBUG, MDEBUG,	PDEBUG, QDEBUG, SDEBUG, TDEBUG	
41190		CC ADDD		
41200		REAL	ITE, ITL, ITP, ITIME,	
41210	+	MMS, MPH,	MSPEC, MU, MVPR,	
41220	+	NAME, NO,	LDEBUG, MDEBUG,	
41230	+	IN, MISFIRE		
41240		INTEGER	RNAME, SITEI, SITEM, STAT,	
41250	+	TDIST, XLANE,	OPTI, PPICK, PPPICK, XNAME(6)	
41260		DATA XNAME/4HIDLE,1H,10HEXTENSIVE,1HA,10HEXTENSIVE,		
41270		+1HB/		
41280		I=OPTI		
41290		VEHPOP=CARPOP(1)/1.E6		
41300		NN=2*RNAME-1		
41310		WRITE (6,1) NAME(20+NN), NAME(20+NN+1)		
41320	1	FORMAT(1H1,/30X,2A10,* REGIONAL DATA*)		
41330		WRITE (6,2)		
41340	2	FORMAT(/20X,*EMISSION SURVEILLANCE DATA SOURCE*,T73,		
41350	+	*TRW/ARB*)		

Table 5-41 SUBROUTINE OUT LISTING (cont.)

```

41360      WRITE (6,3) (AMB(I),I=1,NEMIS)
41370      3  FORMAT(/,20X,*FEDERAL 1975 MOTOR VEHICLE STANDARDS *,/,
41380      + 40X,*HC*,T71,F6.2,* G/MI*/40X,*CO*,T71,F6.2,* G/MI*,/
41390      + 40X,*NO*,T71,F6.2,* G/MI*)
41400      WRITE (6,4) (EMW(I),I=1,NEMIS)
41410      4  FORMAT(/,20X,*EMISSION SPECIE WEIGHTING FUNCTION*,/
41420      + /,40X,*HC*,T71,F6.2,/40X,*CO*,T71,F6.2,/
41430      + 40X,*NO*,T71,F6.2)
41440      C*****WRITE (6,5) (GOALS(I),I=1,NEMIS)
41450      5  FORMAT(/,20X,*MINIMUM EMISSION REDUCTION GOALS*/
41460      + 40X,*HC*,T71,F6.2* PERCENT*/40X,*CO*,T71,F6.2,* PERCENT*/
41470      + 40X,*NO*,T71,F6.2,* PERCENT*)
41480      WRITE (6,6) RSIZE
41490      6  FORMAT(/,20X,*REGIONAL AREA*,T69,F8.2,* SQ MI*)
41500      WRITE (6,7) MPH
41510      7  FORMAT(/,20X,*AVERAGE VEHICLE SPEED*,T71,F6.2,* MPH*)
41520      WRITE (6,8) VEHPOP
41530      8  FORMAT(/,20X,*VEHICLE POPULATION*,T72,F5.2,* MILLION*,/)
41540      WRITE (6,9) SITEM
41550      9  FORMAT(20X,*NUMBER OF CLASS #A# FRANCHISED GARAGES*,
41560      + T71,I4)
41570      WRITE (6,10)
41580      10  FORMAT(1H1,/,36X,34(1H*)/36X,1H*,4X,
41590      + *TRW INSPECTION/MAINTENANCE*,2X,1H*,/36X,1H*,10X,
41600      + *SYSTEM MODEL*,10X,1H*,/36X,34(1H*),/)
41610      WRITE (6,25)
41620      25  FORMAT(43X,*SUMMARY INFORMATION*,/)
41630      WRITE (6,50) RTYPE,XNAME(2*I-1),XNAME(2*I)
41640      50  FORMAT(37X,*ENGINE *,A9,* STRATEGY *,A10,A1)
41650      WRITE (6,20) TINT
41660      20  FORMAT(38X,*INSPECTION PERIOD IS*,F5.1,* MONTHS*)
41670      WRITE (6,60) PAYNEW
41680      60  FORMAT(//,T20,*PAYOFF FUNCTION UNADJUSTED (DOLLARS/*,
41690      + *WEIGHTED EMISSION) *,T90,F15.2)
41700      WRITE (6,65) PAYADJ
41710      65  FORMAT(T20,*PAYOFF FUNCTION STATISTICALLY ADJUSTED*,
41720      + * (DOLLARS/WEIGHTED EMISSION) *,T90,F15.2)
41730      WRITE (6,66) PAYFIN
41740      66  FORMAT(T20,*PAYOFF FUNCTION AT END OF LAST YEAR*,
41750      + * (DOLLARS/WEIGHTED EMISSION)*,T90,F15.2)
41760      WRITE (6,70) (NAME(I),PAYOFF(I),I=1,NEMIS)
41770      70  FORMAT(T20,A3,*EMISSION REDUCTION (PERCENT)*,T90,F15.2)

```

Table 5-41 SUBROUTINE OUT LISTING (cont.)

41780		WRITE (6,80) (NAME(I),TPDT(I),I=1,NEMIS)
41790	80	FORMAT(T20,A2,* AVERAGE EMISSIONS (TONS/DAY)*,T90,F15.2)
41800		YSUM=YSUM/HORZNY
41810		WRITE (6,90) YSUM
41820	90	FORMAT(T20,*TOTAL COSTS FOR MANDATORY PROGRAM*,
41830		+* (DOLLARS/YEAR)*,T90,F15.2)
41840		CBSUM=CBSUM/XINTB
41850		WRITE (6,100) CBSUM
41860	100	FORMAT(T20,*TOTAL COSTS FOR VOLUNTARY PROGRAM (DOLLARS/*,
41870		+*YEAR)*,T90,F15.2)
41880		RCS=(YSUM/CBSUM)*100.
41890		WRITE (6,215) RCS
41900		WRITE (6,110) CCOSTI
41910	110	FORMAT(T20,*INSPECTION CAPITAL COSTS (DOLLARS/STATION)*
41920		+ ,T90,F15.2)
41930		WRITE (6,120) OCIY
41940	120	FORMAT(T20,*AVERAGE INSPECTION OPERATING COSTS (DOLLARS*,
41950		+*/YEAR)*,T90,F15.2)
41960		WRITE (6,130) CCOSTM
41970	130	FORMAT(T20,*MAINTENANCE CAPITAL COSTS (DOLLARS)*,T90,
41980		+ F15.2)
41990		WRITE (6,140) OCMY
42000	140	FORMAT(T20,*AVERAGE MAINTENANCE OPERATING COSTS (DOLLARS*,
42010		+*/YEAR)*,
42020		+ T90,F15.2)
42030		WRITE (6,150) CINCON
42040	150	FORMAT(T20,*USER COSTS (DOLLARS/CAR) *,T90,F15.2)
42050		WRITE (6,160) CPI
42060	160	FORMAT(T20,*COST PER INSPECTION*,T90,F15.2)
42070		WRITE (6,170) CPVPY
42080	170	FORMAT(T20,*COST PER VEHICLE MAINTAINED*,
42090		+ T90,F15.2)
42100		WRITE (6,180) CARIY
42110	180	FORMAT(T20,*AVERAGE NUMBER OF CARS INSPECTED/YEAR*,
42120		+ T90,F15.2)
42130		WRITE (6,185) CARSY
42140	185	FORMAT(T20,*AVERAGE NUMBER OF CARS REJECTED/YEAR*,
42150		+ T90,F15.2)
42160		WRITE (6,190) CARMY
42170	190	FORMAT(T20,*AVERAGE NUMBER OF CARS MAINTAINED/YEAR*,
42180		+ T90,F15.2)
42190		AVEFAIL=CARMY/CARIY

Table 5-41 SUBROUTINE OUT LISTING (cont.)

```

42200      WRITE (6,210) AVEFAIL
42210      210  FORMAT(T20,*AVERAGE FAILURE PERCENTAGE*,T90,F15.2)
42220      215  FORMAT(T20,*RATIO OF MANDATORY TO VOLUNTARY COSTS (PERCENT)*
42230      + ,T90,F15.2)
42240      WRITE (6,220) HORZNY
42250      220  FORMAT(T20,*TOTAL PROGRAM DURATION (YEARS)*,T90,F15.2)
42260      WRITE (6,230) (I,I=1,10)
42270      230  FORMAT(1H1,/,40X,*PASS/FAIL INSPECTION CRITERIA*,///,
42280      * 12X,*PARAMETER *,3X,10I8,/)
42290      WRITE (6,240) (NAME(K+3),(XCUT(M,K),M=1,3),(TDIST(M,K),M=
42300      + 4,6),(XCUT(M,K),M=7,9),TDIST(10,K),K=1,3)
42310      240  FORMAT(17X,A10,F8.2,F8.0,F8.2,3(10,2X),F8.4,F8.2,F8.4,16)
42320      WRITE (6,250) (I,I=1,6)
42330      250  FORMAT(///,12X,*MODE EMISSIONS *,10,5I8,/)
42340      WRITE (6,260) (NAME(K+3),(SX CUT(M,K),M=1,6),K=1,3)
42350      260  FORMAT(17X,A10,F8.0,F8.2,F8.0,F8.0,F8.0,F8.2,F8.0)
42360      WRITE (6,420) (NAME(I),I=1,NEMIS),(TPDB(I),I=1,NEMIS),
42370      + (TPDT(I),I=1,NEMIS)
42380      420  FORMAT(////////,35X,* TOTAL EMISSION LEVELS (TONS/DAY)*,
42390      + /,T30,A2,T50,A2,T70,A2/20X,*BASE*,
42400      + T25,F10.2,T45,F10.2,T65,F10.2/,20X,*TEST*,
42410      + T25,F10.2,T45,F10.2,T65,F10.2/)
42420      310  FORMAT(//,20X,5(1H*),A4,*LEVEL -- END OF *,
42430      + *INSPECTION INTERVAL (GR/VEHICLE-MILE) *,5(1H*))
42440      330  CONTINUE
42450      IF(RTYPE.EQ.PMODEL) GO TO 335
42460      WRITE (6,600)
42470      600  FORMAT(1H1,/,40X,*STATELANE INSPECTION CONFIGURATION*)
42480      WRITE (6,610) STAT
42490      610  FORMAT(///,20X,*TOTAL NUMBER OF STATE OPERATED INSPECTION*
42500      + ,* LANES*,T84,I3)
42510      WRITE (6,620) XLANE
42520      620  FORMAT(/,20X,*NUMBER OF LANES PER SITE*,T86,I1)
42530      NS=STAT/XLANE+.5
42540      WRITE (6,630) NS
42550      630  FORMAT(/,20X,*TOTAL NUMBER OF SITES*,T85,I3)
42560      WRITE (6,640) STIME
42570      640  FORMAT(/,20X,*VEHICLE INSPECTION TIMES*/
42580      + 25X,*IDLE*,T75,F15.2,* MIN*/25X,*LOADED*,T75,F15.2,* MIN*
42590      + /25X,*HYBRID*,T75,F15.2,* MIN*)
42600      WRITE (6,650)
42610      650  FORMAT(/,20X,*EQUIPMENT REQUIREMENTS AND COSTS*/

```

Table 5-41 SUBROUTINE OUT LISTING (cont.)

```

42620      + 25X,*NDIR*,T83,*2000 DOLLARS/LANE*/
42630      + 25X,*COMPUTER*,T82,*15000 DOLLARS/LANE*/
42640      + 25X,*MISC.*,T83,*3000 DOLLARS/LANE*/
42650      + 25X,*DYNO*,T83,*7000 DOLLARS/LANE*)
42660      WRITE (6,660) Z15
42670      660 FORMAT(/,20X,*INFORMATION PROCESSING COSTS*,T75,F15.2
42680      + * DOLLARS/CAR*)
42690      WRITE (6,670) Z9
42700      670 FORMAT(/,20X,*USER TIME COSTS*,T75,F15.2,* DOLLARS/HR.*)
42710      WRITE (6,680) ITIME(2)
42720      680 FORMAT(/,20X,*TOTAL USER TIME PER PERSON*,T75,F15.2,* MIN*)
42730      WRITE (6,690) NEMP
42740      690 FORMAT(/,20X,*NUMBER OF STATE EMPLOYEES PER LANE*,
42750      + T84,I3)
42760      SSIZE=BLD1+BLD2*XLANE
42770      WRITE (6,700) SSIZE
42780      WRITE (6,707) SIST
42790      700 FORMAT(/,20X,*STATION SIZE (FACILITIES ONLY)*
42800      +,T75,F15.2,* SQ. FT.*)
42810      707 FORMAT(/,20X,*STATION LAND SIZE*,T75,F15.2,* SQ. FT.*)
42820      335 WRITE (6,340)
42830      340 FORMAT(1H1,/,30X,*TEST CASE EMISSION HISTORIES*)
42840      DO 380 I=1,NEMIS
42850      IF(I.EQ.3) WRITE (6,999)
42860      WRITE (6,310) NAME(I)
42870      WRITE (6,350) (NAME(II),II=11,15)
42880      350 FORMAT(//,T40,*POWERTRAIN TYPE*//,5X,*TEST NO.*,
42890      + 4X,5(5X,A10)/)
42900      DO 370 N=1,NTR
42910      WRITE (6,360) N,(THIST(JJ,I,N),JJ=1,NPTRN)
42920      360 FORMAT(8X,I2,5X,5F15.4)
42930      370 CONTINUE
42940      380 CONTINUE
42950      WRITE (6,390) (NAME(I),I=1,NEMIS)
42960      390 FORMAT(1H0,5(/),40X,*SUMMARY EMISSION HISTORIES*
42970      + //,3X,*TEST*,3X,*TIME*,T32,A2,T55,A2,T80,A2,/
42980      + 4X,*NO*,5X,*MO*,T26,3(*BASE*,8X,*TEST*,8X)/)
42990      DO 410 N=1,NTR
43000      TIME=TINT*(N-1)
43010      IF(N.EQ.NTR) TIME=HORZN
43020      WRITE (6,400) N,TIME,(BHIST(I,N),THIST(I,N),I=1,NEMIS)
43030      400 FORMAT(4X,I2,3X,F4.1,5X,6F12.3)

```


Table 5-41 SUBROUTINE OUT LISTING (cont.)

43040	410	CONTINUE
43050		DO 560 N=2,NTR
43060		TIME=(N-1)*TINT
43070		WRITE (6,500)
43080	500	FORMAT(1H1,45X,*FAILURE PROBABILITIES*)
43090		WRITE (6,510) N,TIME,HPTOT(N)
43100	510	FORMAT(/,28X,*TIME HISTORY POINT*,I3,F6.1,* MONTHS*,5X,
43110		+ *TOTAL FAILURE IS *,F9.3,*≤*,/)
43120		DO 550 JJ=1,NPTRN
43130		WRITE (6,520) JJ,NAME(JJ+10),HPT(JJ,N),(II,II=1,10)
43140	520	FORMAT(/,35X,*POWERTRAIN TYPE*,I4,* -- *A8,F9.3,*≤*,
43150		+ //,* PARAMETER*,5X,I2,9(7X,I2),4X,*UNION*)
43160		DO 540 K=KSTART,KSTOP
43170		J=JJ+5*(K-1)
43180		WRITE (6,530) NAME(K+3),(HPP(M,J,N),M=1,NPAR),HPC(J,N)
43190		WRITE (6,535) (HPS(L,J,N),L=1,NMODE),HPCS(J,N)
43200	530	FORMAT(2X,A8,11F9.3)
43210	535	FORMAT(4X,*MODE*,2X,6F9.3,36X,F9.3)
43220	540	CONTINUE
43230	550	CONTINUE
43240	560	CONTINUE
43250		WRITE (6,999)
43260	999	FORMAT(1H1)
43270		RETURN
43280		END

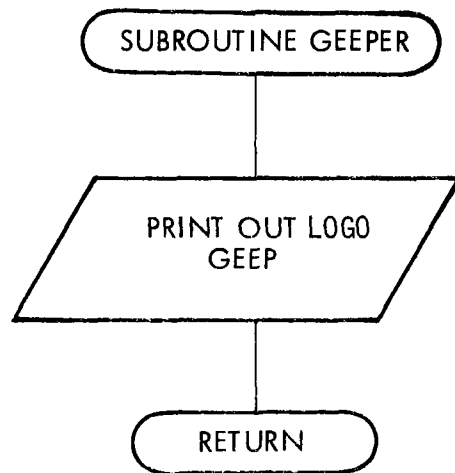


Figure 5-42 Subroutine GEEPER Flowchart

Table 5-42 SUBROUTINE GEEPER LISTING

43290	SUBROUTINE GEEPER
43300	DO 2 I=1,1
43310	WRITE (6,999)
43320	WRITE(6,50)
43330	WRITE(6,51)
43340	WRITE(6,52)
43350	WRITE(6,51)
43360	WRITE(6,50)
43370	WRITE(6,53)
43380	WRITE(6,54)
43390	WRITE(6,55)
43400	WRITE(6,56)
43410	WRITE(6,57)
43420	WRITE(6,50)
43430	WRITE(6,51)
43440	WRITE(6,52)
43450	WRITE(6,51)
43460	WRITE(6,50)
43470	WRITE(6,49)
43480	WRITE(6,58)
43490	WRITE(6,59)
43500	WRITE(6,60)
43510	WRITE(6,60)
43520	WRITE(6,61)
43530	WRITE(6,62)
43540	WRITE(6,63)
43550	WRITE (6,64)
43560	WRITE(6,64)
43570	WRITE(6,65)
43580	WRITE(6,66)
43590	WRITE(6,67)
43600	2 CONTINUE
43610	49 FORMAT(//////)
43620	50 FORMAT(19X,9(1HC))
43630	51 FORMAT(18X,11(1HC))
43640	52 FORMAT(18X,3(1HC))
43650	53 FORMAT(/3X,12(1HT),3X,10(1HR),4X,2(1HW),9X,2(1HW))
43660	54 FORMAT(3X,12(1HT),3X,2(1HR),7X,2(1HR),4X,2(1HW),3X,1HW,3X,2(1HW))
43670	55 FORMAT(8X,2(1HT),8X,10(1HR),6X,2(1HW),1X,3(1HW),1X,2(1HW))
43680	56 FORMAT(8X,2(1HT),8X,2(1HR),4X,2(1HR),9X,3(1HW),1X,3(1HW))
43690	57 FORMAT(8X,2(1HT),8X,2(1HR),5X,2(1HR),9X,1HW,3X,1HW /)

Table 5-42 SUBROUTINE GEEPER LISTING (cont.)

43700	58 FORMAT(27X,6(1HG),7X,10(1HE),5X,10(1HE),5X,9(1HP))
43710	59 FORMAT(26X,8(1HG),6X,10(1HE),5X,10(1HE),5X,10(1HP))
43720	60 FORMAT(25X,2(1HG),6X,2(1HG),5X,2(1HE),13X,2(1HE),13X,2(1HP),6X,
43730	X2(1HP))
43740	61 FORMAT(25X,2(1HG),13X,2(1HE),13X,2(1HE),13X,2(1HP),6X,2(1HP))
43750	62 FORMAT(25X,2(1HG),13X,5(1HE),10X,5(1HE),10X,10(1HP))
43760	63 FORMAT(25X,2(1HG),13X,5(1HE),10X,5(1HE),10X,9(1HP))
43770	64 FORMAT(25X,2(1HG),4X,4(1HG),5X,2(1HE),13X,2(1HE),13X,2(1HP))
43780	65 FORMAT(25X,2(1HG),6X,2(1HG),5X,2(1HE),13X,2(1HE),13X,2(1HP))
43790	66 FORMAT(26X,8(1HG),6X,10(1HE),5X,10(1HE),5X,2(1HP))
43800	67 FORMAT(27X,6(1HG),7X,10(1HE),5X,10(1HE),5X,2(1HP))
43810	999 FORMAT(1H1)
43820	RETURN
43830	
43840	END

5.14.5 Subroutine EPLLOT

Subroutine EPLLOT graphically displays two parameter distributions - usually before and after maintenance. EPLLOT accepts as input the two distributions stored in AX, AY and BX, BY respectively and N, containing the number of points in the two distributions. Computations include Y axis values for labeling and individual Y values to be plotted. Subroutine EPLLOT calls the GEEP utility program PLOT JK to output each plot line. Figure 5-43 contains a flowchart for subroutine EPLLOT. Table 5-43 contains a detailed listing of subroutine EPLLOT which describes the techniques involved.

5.14.6 Subroutine PLOTJK

Subroutine PLOTJK is a standard utility plot program for displaying continuous information on a digital output device. Subroutine PLOTJK accepts as input three functions, their minimum and maximum values and an independent variable value to be printed. PLOTJK computes the appropriate column in which a character is to be plotted for each of the three functions and fills an output array (initialized blank) with the respective output characters. Figure 5-44 presents a flowchart of subroutine PLOTJK while Table 5-44 contains a computer listing.

5.14.7 Subroutine PLOT

Subroutine PLOT is the GEEP output routine which displays the emission rate time histories in graphical form. PLOT calls PLOTJK to print each individual line of output.

Figure 5-45 contains a flowchart of PLOT. The listing in Table 5-45 explains the looping required to set up the output plot.

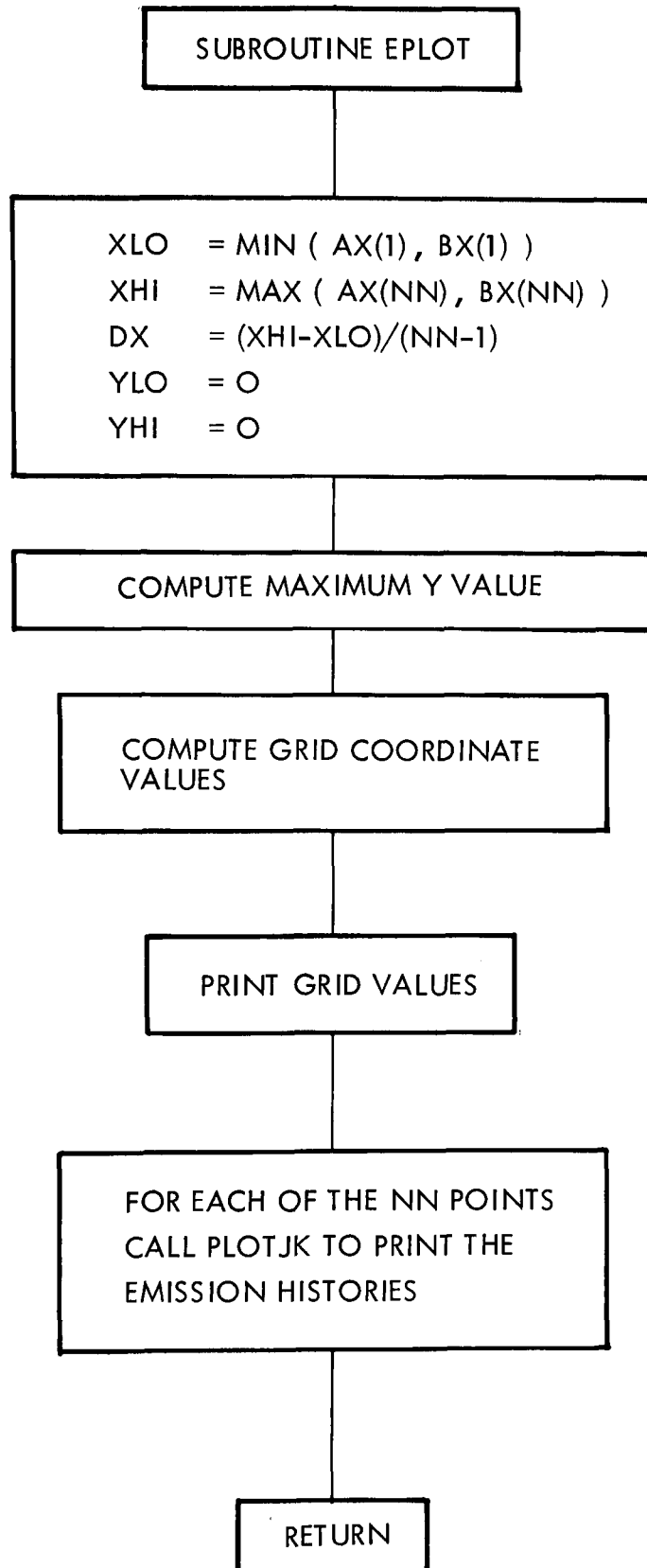


Figure 5-43 Subroutine EPlot Flowchart

Table 5-43 SUBROUTINE EPL0T LISTING

43850		SUBROUTINE EPL0T(BX, BY, AX, AY, NN, LINT)
43860		DIMENSION BX(NN), BY(NN), AX(NN), AY(NN)
43870		XLO=AMIN1(BX(1), AX(1))
43880		XHI=AMAX1(BX(NN), AX(NN))
43890		DX=(XHI-XLO)/(NN-1)
43900		YLO=0.
43910		YHI=0.
43920		DO 10 I=1, NN
43930		YHI=AMAX1(BY(I), YHI)
43940	10	CONTINUE
43950		Y2=YHI/6.
43960		Y3=YHI/3.
43970		Y4=YHI/2.
43980		Y5=YHI*.66666666
43990		Y6=YHI*.5/6.
44000		WRITE(6, 105) YLO, Y2, Y3, Y4, Y5, Y6, YHI
44010	105	FORMAT(6X, F8.2, 6(7X, F8.2))
44020		DO 100 I=1, NN
44030		X=XLO+DX*(I-1)
44040		Y1=FUN1(X, BX, BY, NN)
44050		Y2=FUN1(X, AX, AY, NN)
44060		IF(LINT.EQ.1.AND.X.LT.BX(1)) Y1=0.
44070		IF(LINT.EQ.2.AND.X.GT.BX(NN)) Y1=0.
44080		CALL PLCTJK(2, X, Y1, YHI, 0., Y2, YHI, 0., 0., 0., 0.)
44090	100	CONTINUE
44100		RETURN
44110		END

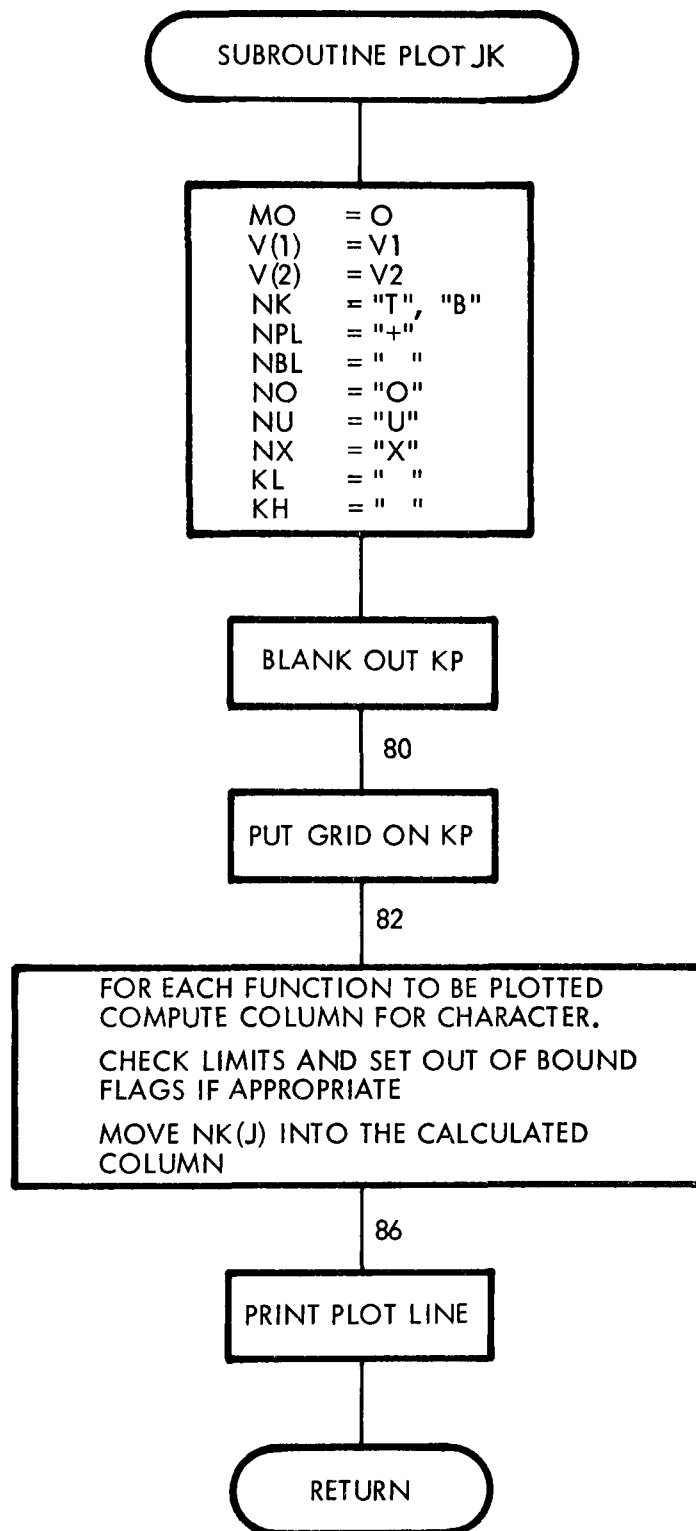


Figure 5-44 Subroutine PLOTJK Flowchart

Table 5-44 SUBROUTINE PLOTJK LISTING

44120		SUBROUTINE PLOTJK(NC,T,V1,VMX1,VMN1,V2,VMX2,VMN2,V3,VMX3,VMN3)
44130		DIMENSION V(3),VMX(3),VMN(3),CHI(3),NK(3),KP(91),II(3)
44140		REAL NK,NPL,NBL,NO,NU,NX
44150		REAL KL,KP,KH
44160		MO=0
44170		MU=0
44180		V(1)=V1
44190		V(2)=V2
44200		V(3)=V3
44210		VMX(1)=VMX1
44220		VMX(2)=VMX2
44230		VMX(3)=VMX3
44240		VMN(1)=VMN1
44250		VMN(2)=VMN2
44260		VMN(3)=VMN3
44270		NK(1)=1HB
44280		NK(2)=1HA
44290		NK(3)=1H=
44300		NPL=1H+
44310		NBL=1H
44320		NO=1HO
44330		NU=1HU
44340		NX=1HX
44350		DO 80 I=1,91
44360		KP(I)=NBL
44370	80	CONTINUE
44380		DO 82 I=1,91,15
44390		KP(I)=NPL
44400	82	CONTINUE
44410		DO 86 J=1,NC
44420		CHI(J)=(VMX(J)-VMN(J))/90.
44430		II(J)=(V(J)-VMN(J))/CHI(J)+1.5
44440		IF(II(J)) 83,83,84
44450	83	MU=MU-1
44460		GO TO 86
44470	84	IF(92-II(J)) 85,85,101
44480	85	MO=MO+1
44490		GO TO 86
44500	101	KK=II(J)
44510		KP(KK)=NK(J)
44520	86	CONTINUE

Table 5-44 SUBROUTINE PLOTJK LISTING (cont.)

44530		IF(NC.EQ.1) GO TO 111
44540		NC1=NC-1
44550		DO 303 I=1,NC1
44560		IP1=I+1
44570		DO 303 J=IP1,NC
44580		IF(II(I)-II(J)) 303,301,303
44590	301	IF(II(I)* (92-II(I))) 303,303,302
44600	302	KK=II(I)
44610		KP(KK)=NX
44620	303	CONTINUE
44630	111	IF(MU) 201,202,202
44640	201	KL=NU
44650		GO TO 203
44660	202	KL=NBL
44670	203	IF(MO) 204,204,205
44680	204	KH=NBL
44690		GO TO 206
44700	205	KH=NO
44710	206	WRITE(6,150) T,KL,KP,KH
44720		RETURN
44730	150	FORMAT(1X,1E9.2,103A1)
44740		END

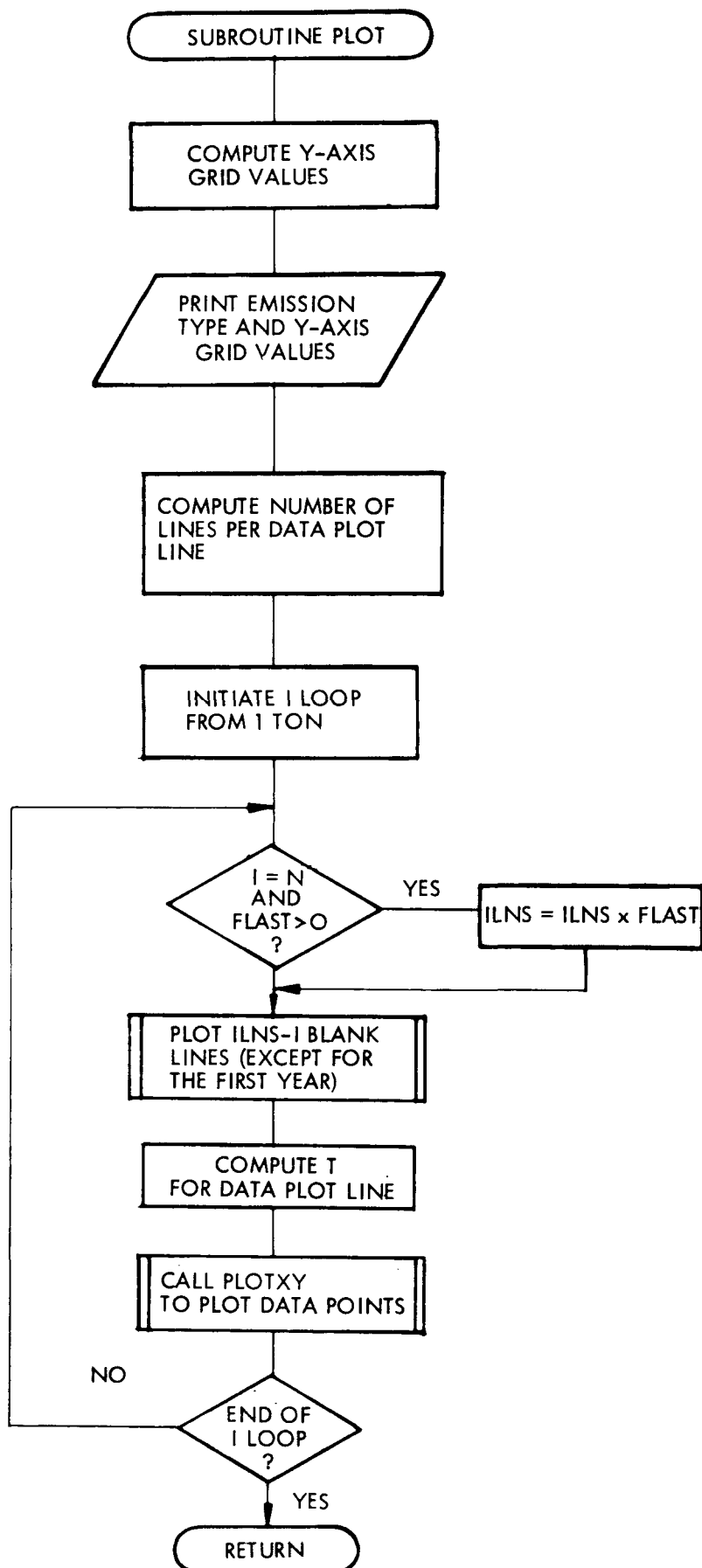


Figure 5-45 Subroutine PLOT Flowchart
5-280

Table 5-45 SUBROUTINE PLOT LISTING

44750		SUBROUTINE PLOT(A,B,N,FLAST,LENGTH,XO,DX,YMN,YMX,II)
44760		DIMENSION A(3,16),B(3,16)
44770		DIMENSION NAME(3)
44780		REAL NAME
44790		DATA NAME/2HHC,2HCO,2HNO/
44800		Y2=(5.*YMN+YMX)/6.
44810		Y3=(4.*YMN+2.*YMX)/6.
44820		Y4=(3.*YMN+3.*YMX)/6.
44830		Y5=(2.*YMN+4.*YMX)/6.
44840		Y6=(YMN+5.*YMX)/6.
44850		WRITE (6,10) NAME(II)
44860	10	FORMAT(1H1,30X,A2,
44870		+ * DATA HISTORY -- EMISSION(GPM) VS. TIME(MO.)*,
44880		+ * B = BASE T = TEST*//)
44890		WRITE(6,105) YMN,Y2,Y3,Y4,Y5,Y6,YMX
44900	105	FORMAT(6X,F8.2,6(7X,F8.2))
44910		ILNS=LENGTH*6/N
44920		DO 100 I=1,N
44930		IF (I.EQ.N.AND.FLAST.GT..05) ILNS=ILNS*FLAST
44940		KK=ILNS-1
44950		IF(I.EQ.1) GO TO 95
44960		IF(KK.LE.0) GO TO 95
44970		DO 90 J=1,KK
44980		T=XO+(I-2)*DX+J*DX/ILNS
44990		IF(I.EQ.N.AND.FLAST.GT..05) T=XO+(I-2)*DX+J*DX/ILNS*FLAST
45000	90	CALL PLOTXY (0,T,0.,0.,0.,0.)
45010	95	CONTINUE
45020		T=XO+(I-1)*DX
45030		IF (I.EQ.N.AND.FLAST.GT..05) T=T-DX+DX*FLAST
45040		CALL PLOTXY(2,T,A(II,I),B(II,I),YMX,YMN)
45050	100	CONTINUE
45060		RETURN
45070		END

5.14.8 Subroutine PLOTXY

Subroutine PLOTXY is a modified version of the utility routine PLOTJK which outputs one line of plotted data. PLOTXY uses a slightly different format than PLOTJK for grid spacing and independent variable display.

Figure 5-46 contains a flowchart and Table 5-46 a listing.

5.14.9 Array Output Routines

The array output routines were designed to provide the user with a maximum amount of debugging information in a compact tabular format. Each of the five subroutines outputs the values of a matrix of fixed dimensions along with its identifier name. Various other information labeling the dimensions of the matrix is also displayed.

5.14.10 Subroutine PRINT1

Subroutine PRINT1 displays two variables, each dimensioned $10 \times 5 \times 3$. Inputs to PRINT1 are the variable names for the two matrices and their respective values. Figure 5-47 presents a flowchart of subroutine PRINT1 and Table 5-47 a listing.

5.14.11 Subroutine PRINT2

Displays output similar to PRINT1 (10×3 matrix). See 5.14.10 for flowchart and listing format.

5.14.12 Subroutine PRINT3

Displays output similar to PRINT1 (10×15 matrix). See 5.14.10 for flowchart and listing format.

5.14.13 Subroutine PRINT4

Displays output similar to PRINT1 ($10 \times 15 \times 4$ matrix). See 5.14.10 for flowchart and listing format.

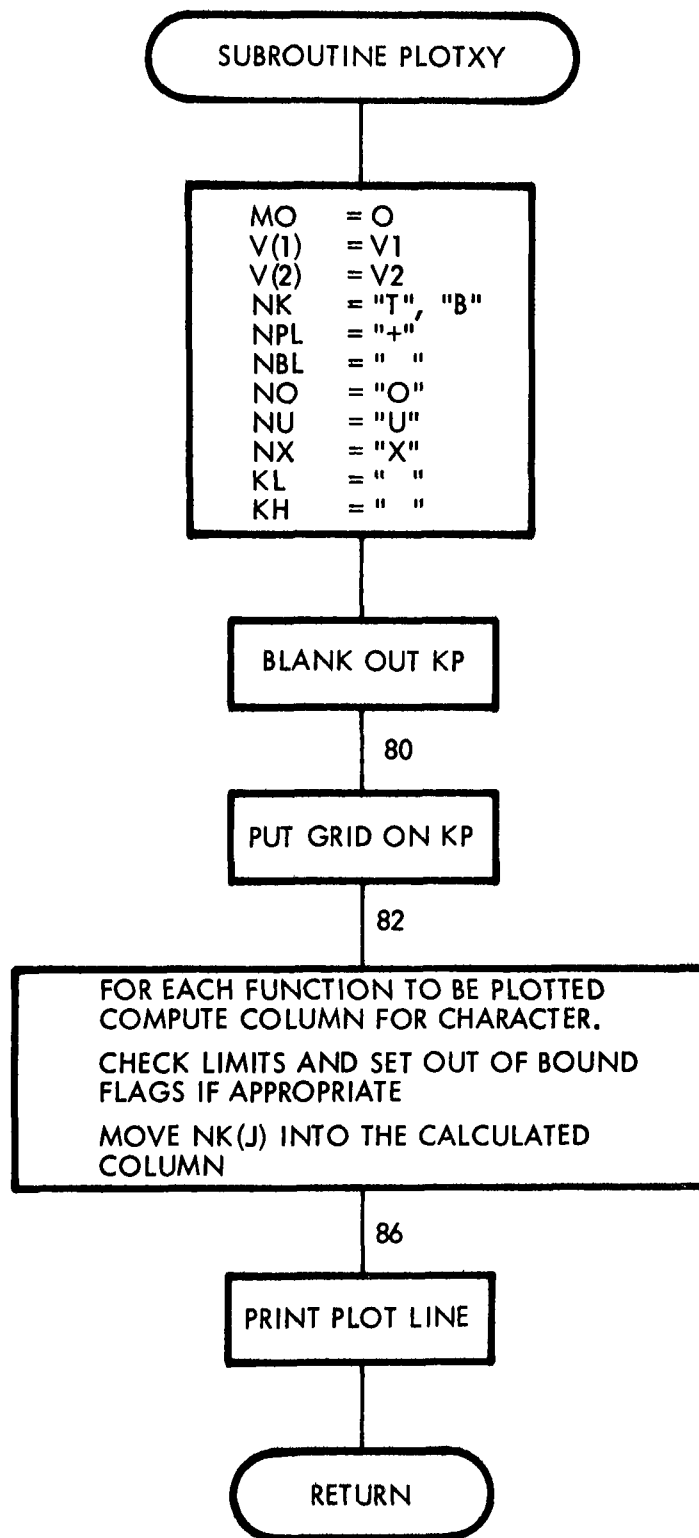


Figure 5-46 Subroutine PLOTXY Flowchart

Table 5-46 SUBROUTINE PLOTXY LISTING

45080		SUBROUTINE PLOTXY(NC,T,V1,V2,VMX,VMN)
45090		DIMENSION KP(91),V(2),NK(2)
45100		MO=0
45110	C	
45120	C	DEFINE SYMBOLS
45130	C	
45140		V(1)=V1
45150		V(2)=V2
45160		NK(1)=1HT
45170		NK(2)=1HB
45180		NPL=1H+
45190		NBL=1H
45200		NU=1HU
45210		NU=1HU
45220		NX=1HX
45230		KL=NBL
45240		KH=NBL
45250	C	
45260	C	FILL IN BLANK FIELD
45270	C	
45280		DO 80 I=1,91
45290	80	KP(I)=NBL
45300	C	
45310	C	SET UP GRID
45320	C	
45330		DO 82 I=1,91,15
45340	82	KP(I)=NPL
45350		DO 86 J=1,NC
45360		IF (NC.EQ.0) GOTO 206
45370	C	
45380	C	COMPUTE COLUMN NUMBER FOR EACH POINT
45390	C	
45400		CHI=(VMX-VMN)/90
45410		II=(V(J)-VMN)/CHI+1.5
45420		IF (II) 83,83,84
45430	83	MU=MU-1
45440		GO TO 86
45450	84	IF (92-II) 85,85,101
45460	85	MO=MO+1
45470		GO TO 86
45480	101	M=II

Table 5-46 SUBROUTINE PLOTXY LISTING (cont.)

45490		KP(M)=NK(J)
45500		86 CONTINUE
45510	C	
45520	C	CHECK FOR POINTS THAT ARE OUT OF BOUNDS
45530	C	
45540		111 IF(MU) 201,202,202
45550		201 KL=NU
45560		GO TO 203
45570		202 KL=NBL
45580		203 IF(MU) 204,204,205
45590		204 KH=NBL
45600		GO TO 206
45610		205 KH=NO
45620	C	
45630	C	PRINT LINE
45640	C	
45650		206 IT=T
45660		WRITE (6,150) IT,KL,KP,KH
45670		150 FORMAT(5X,I3,2X,93A1)
45680		RETURN
45690		END

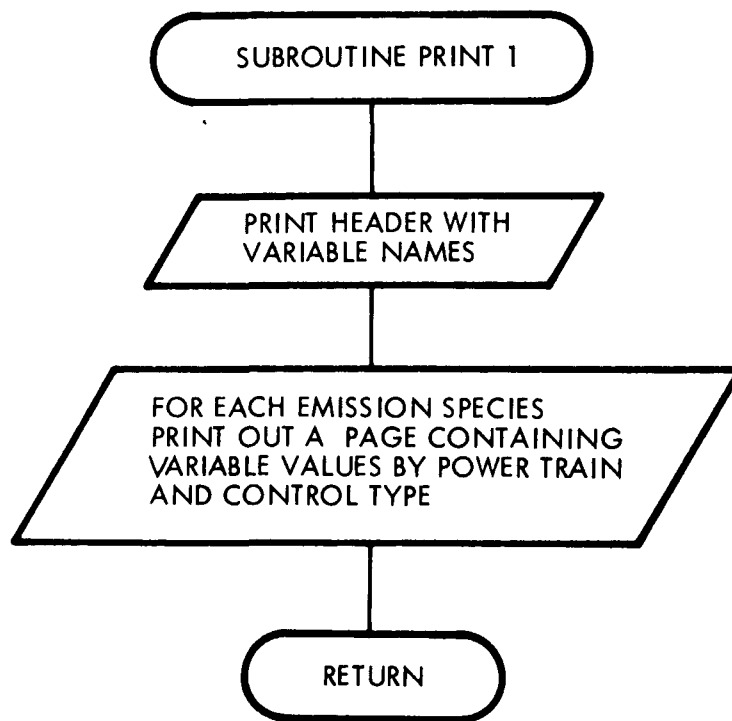


Figure 5-47 Subroutine PRINT1 Flowchart

Table 5-47 SUBROUTINE PRINT1 LISTING

```

45700      SUBROUTINE PRINT1(VAR1,VNAME1,VAR2,VNAME2)
45710      DIMENSION VAR1(10,15,3),VNAME1(5)
45720      DIMENSION VAR2(10,15,3),VNAME2(5)
45730      COMMON /COM01/ AMB(3),ALAB,      AVV, BINT,
45740      +      BAREA(3), BLD1,      BLD2,      BSIG(3), BXTA,      BSIZE,
45750      +      BHIST(3,16),      BMMI(10,15,3),
45760      +      ATABLEX(9,10,3),ATABLEY(9,10,3),ASTABLX(9,6,3),ASTABLY(9,6,3)
45770      COMMON /COM02/      CARA,      CARIY,      CARMY,      CARPOP(16),
45780      +      CARSY,      CBSUM,      CCOEF(10),CCOSTI,      CCOSTM,      CGTT,
45790      +      CINCON,      CPCB,      CPI,      CPVPY,      CSUM,      CARAY,
45800      +      CN(15,3,16),      COEFB(15,3),      COEFBP(10,15),
45810      +      CPART(10,15)
45820      CC ADD2
45830      COMMON /COM03/      DELPCV,      DP(10,15),DELEM(3,16),DELI(3),
45840      +      EMW(3),      EP(10,15),EFF(10),      DELIT(3),
45850      +      FREQA,      FREQB,      FPERC(10,3),
45860      +      HORZN,      HORZNY,
45870      +      HPC(15,16),      HPCS(15,16),      HPP(10,15,16),
45880      +      HPS(6,15,16),      HPT(5,16),      HPTOT(16),
45890      +      HPTCTS(16)
45900      CC ADD3
45910      COMMON /COM04/      ITE,      ITL,      ITP,      ITIME(16),
45920      +      KSTART,      KSTOP,      LOPT, LPICK(10),LLPICK,
45930      +      LIDLE,      LINT(16), LPSP(10),LSTART,      LSTOP,
45940      +      MBASE,      MPH,      MSPEC(10),MSTART,      MSTOP,
45950      +      MU(10,3),      MMS(10,15),      MVPR(10,15)
45960      CC ADD4
45970      COMMON /COM05/      NAME(50), NCNTR,      NEMIS,      NEMP,
45980      +      NINTR,      NINTRB,      NMODE,      NO,      NOPTS,      NPAR,
45990      +      NPTRN,      NPTS,      NSTEPS,      NTR,      NTRB,      NPICK(16),
46000      +      OCIY,      OCMY,      OPTI,      OPTM,OPTS(50),OVCHI(3),OVCHM(3)
46010      CC ADD5
46020      COMMON /COM06/ PARM(3,3), PART,      PAYNEW,      PAYOFF(3),
46030      +      PC(15),      PCS(15), PHI(14),      PLO(14),      PLTMAX(3),PMODEL,
46040      +      PP(10,15),PS(6,15), PT(5),      PTOT,      PTS(5),      PAYADJ,
46050      +      PAR(10,15,3),      PAR1(10,3,3),      PLUS(10,15),
46060      +      PM(10,15),      PPICK(10),PPPICK,PSTAR,PI(15,10),
46070      +      PSA(15),      PTA(5),      PCONF,      PARINT(10,10,9)
46080      +      ,PAYFIN
46090      COMMON /COM07/      REINSP,      RNAME,      RSIZE,      RSTOP,
46100      +      RTYPE,

```

Table 5-47 SUBROUTINE PRINT1 LISTING (cont.)

46110	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,
46120	+	SMODEL,	START(15,3),	STAT,	STIME(3),	SUMBM(3),	
46130	+	SCALEBM(3),		SM(6,15),		SPAR(10,15,6),	
46140	+	SXCUT(6,3),		SIG(10,3),		SIGCE(3),	
46150	+	SIGME(10),		SIGMNE(10),		SIGP(10,15),	
46160	+	SIGRATE,	SIST,	SIGS(6,15),		SIGSDE(3),	
46170	+	STABLEX(33,6,15),		STABLEY(33,6,15)			
46180		COMMON /COM10/		TAREA(3),	TDIST(10,3),	TIDLE,	TIMEI(3,16),
46190	+	TINT,	TOBE(3),	TONX,	TOTE(3),	TPDR(3),	TPOT(3),
46200	+	TXTRA,	TSIZE,	TSIG(3),	TPER(16,15),	TMIL(16,15),	
46210	+	THIST(5,3,16),		THISTT(3,15),		TIMEC(10,15),	
46220	+	TIMEM(10,15),		TABLEX(33,10,15),		TABLEY(33,10,15)	
46230		CC ADD10					
46240		COMMON /COM11/		WF(10),			
46250	+	X1BP(3,3,6),	XINT,	XINTB,	XLANE,	XSUM,	XCUT(10,3),
46260	+	XTM(16),	XBASE(9,3),	YBASE(9,3)			
46270		CC ADD11					
46280		COMMON /COM12/		Y1BP(3,3,10),		Y2BP(3,3,10),	
46290	+	YES,	YSUM,	YTM(16),		Y1DBP(4,4,10),	Y2DBP(4,4,10),
46300	+	Z1,	Z2,	Z3,	Z4,	Z5,	Z6,
46310	+	Z7,	Z8,	Z9,	Z10,	Z11,	Z12,
46320	+	Z13,	Z14,	Z15,	Z16,	Z17,	
46330	+	ZCARI,	ZCARM,	ZIC,	ZSUM,		
46340	+	ZZ(3,3)					
46350		CC ADD12					
46360		COMMON /DEBUG/		ADEBUG,	BDEBUG,	CDEBUG,	DDEBUG,
46370	+	LDEBUG,	MDEBUG,	PDEBUG,	QDEBUG,	SDEBUG,	TDEBUG
46380		CC ADDD					
46390		REAL	ITE,	ITL,	ITP,	ITIME,	
46400	+	MMS,	MPH,	MSPEC,	MU,	MVPR,	
46410	+	NAME,	NO,	LDEBUG,	MDEBUG,		
46420	+	IN,	MISFIRE				
46430		INTEGER	RNAME,	SITEI,	SITEM,	STAT,	
46440	+	TDIST,	XLANE,	OPTI,	PPICK,	PPPICK	
46450		WRITE (6,10) VNAME1,VNAME2					
46460	10	FORMAT(35X,*VARIABLE - A - *5A10/					
46470		+ 35X,*VARIABLE - B - *5A10)					
46480		DO 100 I=1,NEMIS					
46490		IF(I.GT.1) WRITE (6,999)					
46500		WRITE (6,200) NAME(I)					
46510	200	FORMAT(/,43X,A2,* EMISSION DELTA*)					
46520		DO 50 JJ=1,NPTRN					

Table 5-47 SUBROUTINE PRINT1 LISTING (cont.)

46530		WRITE (6,20) JJ,NAME(JJ+10),(M,M=1,NPAR)
46540	20	FORMAT(/,40X,*POWERTRAIN*,I3,* -- *,A10//
46550		+ * PARAMETER*,10(3X,I2,5X))
46560		DO 90 K=KSTART,KSTOP
46570		J=JJ+5*(K-1)
46580		WRITE (6,40) NAME(K+3),(VAR1(M,J,I),M=1,NPAR),
46590		+ (VAR2(M,J,I),M=1,NPAR)
46600	40	FORMAT(/,A8,* A*,10E10.2/8X,* B*,10E10.2)
46610	90	CONTINUE
46620	50	CONTINUE
46630	100	CONTINUE
46640	999	FORMAT(1H1)
46650		RETURN
46660		END

5.14.14 Subroutine PRINT5

Displays output similar to PRINT1 (6×15 matrix). See 5.14.10 for flowchart and listing format.

5.14.15 Subroutine PRINT6

Subroutine PRINT6 is the main output routine for the attrition model. PRINT6 displays a summary of the vehicle population and annual miles travelled distributions along with a summary level emission rate report by control type. Figure 5-48 contains a flowchart of PRINT6 and Table 5-48 a listing.

5.15 BLOCK DATA ROUTINE

The majority of the data in GEEP is normally invariant under the various inspection/maintenance alternatives. Consequently, nominal values for all data sets are permanently stored in the BLOCK DATA routine. BLOCK DATA is a non-executable function, but provides a convenient method of grouping the data.

The listing in Table 5-49 contains detailed information concerning the values of the various data sets.

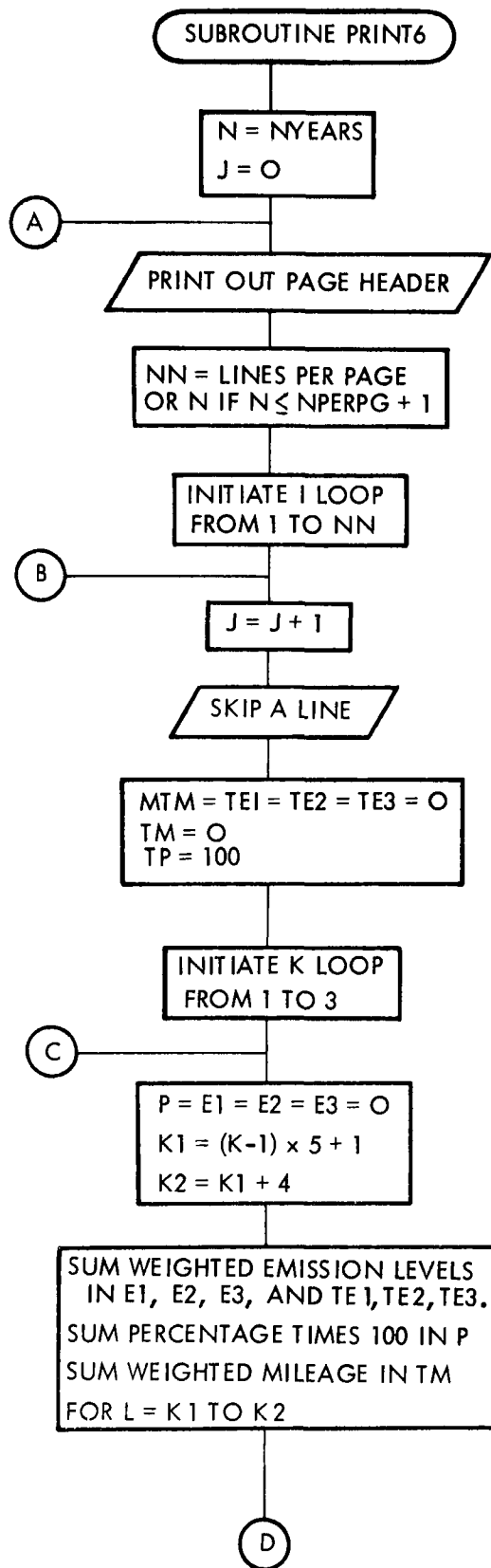


Figure 5-48 Subroutine PRINT6 Flowchart

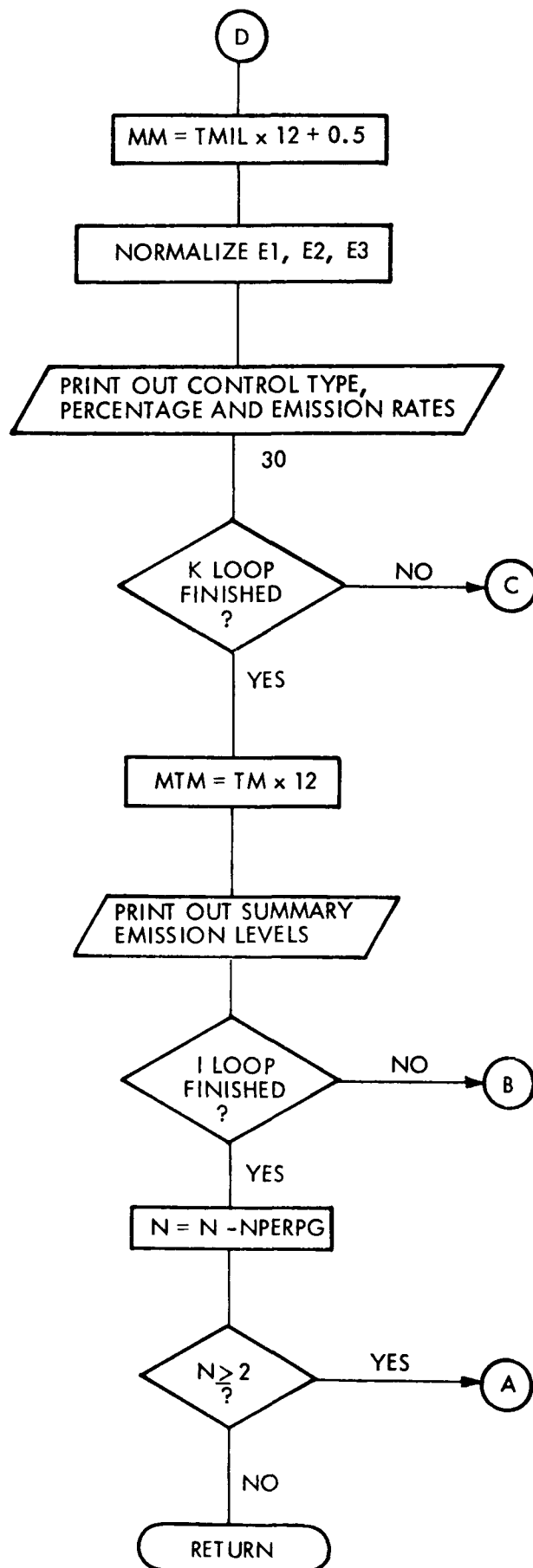


Figure 5-48 Subroutine PRINT6 Flowchart (cont.)

Table 5-48 SUBROUTINE PRINT6 LISTING

51750		SUBROUTINE PRINT6(EMIS,TPER,TMIL,NYEARS,CARPOP)
51760		DIMENSION CARPOP(16)
51770		DIMENSION EMIS(15,3,16),TPER(16,15),TMIL(16,15)
51780		DIMENSION HEAD(4,4)
51790		DATA HEAD/
51800		* 6HPRECCN,6HTROLLE,6HD ,6H
51810		*,6HCONTRO,6HLLD (,6H1966-1,6H970)
51820		*,6HPOST 1,6H970 ,6H ,6H
51830		*,6H ,6HTOTALS,6H ,6H
51840		* /
51850		DATA NPERPG/6/
51860		N=NYEARS
51870		J=0
51880	10	WRITE(6,100)
51890		NN=NPERPG
51900		IF(N.LE.NPERPG+1) NN=N
51910		DO 20 I=1,NN
51920		J=J+1
51930		WRITE(6,110)
51940		MTM=TE1=TE2=TE3=0
51950		TM=0
51960		TP=100.
51970		DO 30 K=1,3
51980		P=0
51990		E1=0
52000		E2=0
52010		E3=0
52020		K1=(K-1)*5+1
52030		K2=K1+4
52040		DO 40 L=K1,K2
52050		P=P+TPER(J,L)*100
52060		E1=E1+EMIS(L,1,J)*TPER(J,L)
52070		E2=E2+EMIS(L,2,J)*TPER(J,L)
52080		E3=E3+EMIS(L,3,J)*TPER(J,L)
52090		TE1=TE1+EMIS(L,1,J)*TPER(J,L)
52100		TE2=TE2+EMIS(L,2,J)*TPER(J,L)
52110		TE3=TE3+EMIS(L,3,J)*TPER(J,L)
52120		TM=TM+TMIL(J,L)*TPER(J,L)
52130	40	CONTINUE
52140		MMM=TMIL(J,K1)*12.+0.5
52150		IF(P.GT.0.0001) E3=E3*100./P

Table 5-48 SUBROUTINE PRINT6 LISTING (cont.)

52160		IF(P.GT.0.0001) E2=E2*100./P
52170		IF(P.GT.0.0001) E1=E1*100./P
52180		WRITE(6,120) (HEAD(M,K),M=1,4),P,MMM,E1,E2,E3
52190	30	CONTINUE
52200		MTM=TM*12.
52210		WRITE(6,140) J,(HEAD(M,4),M=1,4),TP,MTM,TE1,TE2,TE3,CARPOP(J)
52220	20	CONTINUE
52230		N=N-NPERPG
52240		IF(N.GE.2) GOTO 10
52250		RETURN
52260	100	FORMAT(1H1,/,44X,*VEHICLE POPULATION CHARACTERISTICS*,
52270		* //, 1X,*YEAR*,24X,
52280		* *VEHICLE DISTRIBUTION INCREMENTAL ODOMETER*,
52290		* * VEHICLE EMISSION LEVELS VEHICLE*,
52300		/,36X,*PERCENT*,17X,
52310		* *READING*,9X,*HC*,7X,*CO*,6X,*NO POPULATION*,/,
52320		* 61X,*MILES*,15X,*GRAMS/MILE*)
52330	110	FORMAT(1H)
52340	120	FORMAT(7X,4A6,3X,F8.1,17X,I6,4X,F10.2,F9.2,F8.2)
52350	140	FORMAT(2X,I2,3X,4A6,3X,F8.1,17X,I6,4X,F10.2,F9.2,F8.2,F12.0)
52360	130	FORMAT(1H1)
52370		END

Table 5-49 BLOCK DATA ROUTINE LISTING

02740		BLUCK DATA					
02750		COMMON /COM01/	AMB(3),	ALAB,	AVV,	BINT,	
02760	+	BAREA(3),	BLD1,	BLD2,	BSIG(3),	BXTRA,	BSIZE,
02770	+	BHIST(3,16),		BMMI(10,15,3),			
02780	+	ATABLEX(9,10,3),	ATABLEY(9,10,3),	ASTABLX(9,6,3),	ASTABLY(9,6,3)		
02790		COMMON /COM02/	CARA,	CARIY,	CARMY,	CARPOP(16),	
02800	+	CARSY,	CBSUM,	CCOEF(10),	CCOSTI,	CCOSTM,	CGTT,
02810	+	CINCON,	CPCB,	CPI,	CPVPY,	CSUM,	CARAY,
02820	+	CN(15,3,16),		COEFB(15,3),		COEFBP(10,15),	
02830	+	CPART(10,15)					
02840		CC ADD2					
02850							
02860		COMMON /COM03/		DELPCV,	DP(10,15),	DELEM(3,16),	DELI(3),
02870	+	EMW(3),	EP(10,15),	EFF(10),	DELIT(3),		
02880	+	FREQA,	FREQB,	FPERC(10,3),			
02890	+	HORZN,	HORZNY,				
02900	+	HPC(15,16),		HPCS(15,16),		HPP(10,15,16),	
02910	+	HPS(6,15,16),		HPT(5,16),		HPTOT(16),	
02920	+	HPTOTS(16)					
02930		CC ADD3					
02940		COMMON /COM04/		ITE,	ITL,	ITP,	ITIME(16),
02950	+	KSTART,	KSTOP,	LOPT,	LPICK(10),	LLPICK,	
02960	+	LIDLE,	LINT(16),	LPSP(10),	LSTART,	LSTOP,	
02970	+	MBASE,	MPH,	MSPEC(10),	MSTART,	MSTOP,	
02980	+	MU(10,3),	MMS(10,15),		MVPR(10,15)		
02990		CC ADD4					
03000		COMMON /COM05/		NAME(50),	NCNTR,	NEMIS,	NEMP,
03010	+	NINTR,	NINTRB,	NMODE,	NU,	NOPTS,	NPAR,
03020	+	NPTRN,	NPTS,	NSTEPS,	NTR,	NTRB,	NPICK(16),
03030	+	OCY,	OCMY,	OPTI,	OPTM,	OPTS(50),	OVCHI(3),
03040		CC ADD5					
03050		COMMON /COM06/	PARM(3,3),	PART,	PAYNEW,	PAYOFF(3),	
03060	+	PC(15),	PCS(15),	PHI(14),	PLO(14),	PLTMAX(3),	PMODEL,
03070	+	PP(10,15),	PS(6,15),	PT(5),	PTOT,	PTS(5),	PAYADJ,
03080	+	PAR(10,15,3),		PAR1(10,3,3),		PLUS(10,15),	
03090	+	PM(10,15),		PPICK(10),	PPPICK,	PSTAR,	PI(15,10),
03100	+	PSA(15),	PTA(5),	PCONF,	PARINT(10,10,9)		
03110	+	PAYFIN					
03120		COMMON /COM07/		REINSP,	RNAME,	RSIZE,	RSTOP,
03130	+	RTYPE,					
03140	+	SALE,	SALL,	SALP,	SITEI,	SITEM,	SLANE,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

```

03150      +      SMODEL,   START(15,3), STAT,      STIME(3), SUMBM(3),
03160      +      SCALEBM(3),      SM(6,15),      SPAR(10,15,6),
03170      +      SXCUT(6,3),      SIG(10,3),      SIGCE(3),
03180      +      SIGME(10),      SIGMNE(10),      SIGP(10,15),
03190      +      SIGRATE,   SIST,      SIGS(6,15),      SIGSDE(3),
03200      +      STABLEX(33,6,15),      STABLEY(33,6,15)
03210      COMMON /COM10/      TAREA(3), TDIST(10,3), TIDLE, TIMEI(3,16),
03220      +      TINT,      TOBE(3),      TONX,      TOTE(3), TPDB(3), TPDT(3),
03230      +      TXTRA,      TSIZE,      TSIG(3), TPER(16,15), TMIL(16,15),
03240      +      THIST(5,3,16),      THISTT(3,16),      TIMEC(10,15),
03250      +      TIMEM(10,15),      TABLEX(33,10,15),      TABLEY(33,10,15)
03260      CC ADD10
03270      COMMON /COM11/      WF(10),
03280      +      X1BP(3,3,6), XINT,      XINTB,      XLANE,      XSUM, XCUR(10,3),
03290      +      XTM(16),      XBASE(9,3), YBASE(9,3)
03300      CC ADD11
03310      COMMON /COM12/      Y1BP(3,3,10),      Y2BP(3,3,10),
03320      +      YES,      YSUM,      YTM(16),      Y1DBP(4,4,10), Y2DBP(4,4,10),
03330      +      Z1,      Z2,      Z3,      Z4,      Z5,      Z6,
03340      +      Z7,      Z8,      Z9,      Z10,      Z11,      Z12,
03350      +      Z13,      Z14,      Z15,      Z16,      Z17,
03360      +      ZCARI,      ZCARM,      ZIC,      ZSUM,
03370      +      Z2(3,3)
03380      CC ADD12
03390      COMMON /DEBUG/      ADEBUG,      BDEBUG,      CDEBUG,      DDEBUG,
03400      +      LDEBUG,      MDEBUG,      PDEBUG,      QDEBUG,      SDEBUG,      TDEBUG
03410      CC ADD0
03420      REAL      ITE,      ITL,      ITP,      ITIME,
03430      +      MMS,      MPH,      MSPEC,      MU,      MVPR,
03440      +      NAME,      NO,      LDEBUG,      MDEBUG,
03450      +      IN,      MISFIRE
03460      INTEGER      RNAME,      SITEI,      SITEM,      STAT,
03470      +      TDIST,      XLANE,      OPTI,      PPICK,      PPPICK
03480      DATA PI/150*1.0/
03490      DATA NAME/2HHC,2HCO,2HNO,8H UNCONTR,8H CONTR ,8H POST 70,
03500      + 10H IDLE ,10H IGNITION ,10H INDUCTION ,
03510      + 1H ,8H GM ,8H FORD ,8H CHRY ,
03520      + 8H AMC ,8H IMPORTS ,5*1H ,
03530      + 10H LOS ANG,10HELES BASIN,10H NEW YORK/,
03540      + 10HNEW JERSEY,10H WASHIN,10HGTN D. C.,
03550      + 10H ,10H DENVER,10HDETROIT ,1H ,
03560      + 10H IDLE CO ,10H RP4 ,10H TIMING ,

```

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

03570		+ 10H MISFIRE ,10H NOX ,10H AIR PUMP ,
03580		+ 10H PCV ,10HAIR CLEAN ,10HVAC KICK ,
03590		+ 10HHEAT RISER,
03600		+ 10H HC - IDLE,10H CO - IDLE,10H NO - IDLE ,
03610		+ 10H HC - 45 ,10H CO - 45 ,10H NO - 45 /
03620	CC	DATA FOR SUBROUTINE COST
03630		DATA REINSP,XLANE,TIDLE/0.,1,1./
03640		DATA BLD1,BLD2,ALAB,AVV/600.,600.,1250.,30./
03650		DATA SALE,SALL,SALP,ZIC,ITE,ITL,ITP/0.,1.,0.,.07,4.,30.,30./
03660		DATA NEMP/2/
03670		DATA CPCB/40./
03680		DATA Z1,Z2,Z3,Z4,Z5/.33,10.,10.,.07/
03690		DATA Z6,Z7,Z8,Z9,Z10/500.,.25,0.,2.,10./
03700		DATA Z11,Z12,Z13,Z14,Z15/16000.,5000.,2.,.5,1./
03710		DATA Z16,Z17/3.5,7000./
03720		DATA ZZ/20000.,33000.,45000.,32000.,>4000.,76000.,
03730		+ 35000.,60000.,85000./
03740		DATA STAT/80/
03750		DATA LIDLE/1/
03760		DATA YES,NU/3HYES,2HNO/
03770		DATA RSTOP,RTYPE/2HNO,9HPARAMETER/
03780		DATA PMODEL,SMODEL/9HPARAMETER,9HSIGNATURE/
03790		DATA BDEBUG,MDEBUG,TDEBUG,CDEBUG,ADEBUG,LDEBUG,PDEBUG,
03800		+ DDEBUG,QDEBUG,SDEBUG/10*2HNO/
03810		DATA PLTMAX/10.,150.,10./
03820		DATA OPTS/10HDEBUG ,10HPARAMETER ,10HSIGNATURE ,
03830		+ 10HSTOP ,10HUNCONTROL ,10HCONTROL ,
03840		+ 10HPOST 70 ,10HIDLE ,10HIGNITION ,10HINDUCTION ,
03850		+ 10HBLINE ,10HMICRO ,10HTEST ,
03860		+ 10HCOSTS ,10HAREA ,10HCUTPTS ,10HPDECAY ,
03870		+ 10HDATA ,10HMDDECAY ,10HSTATS ,
03880		+ 10HLA ,10HNY ,10HWASH ,
03890		+ 10HDENVER ,10HLOADED ,10HUNLOADED ,10HHYBRID ,
03900		+ 10HSTATE ,10HGARAGE ,
03910		+ 10HICO ,10HIHC ,10HHC45 ,10HCO45 ,
03920		+ 10HMISFIRE ,10HDETROIT ,10HINO ,10HNO45 /
03930		DATA NPICK/16*0/
03940		DATA NOPTS/37/
03950		DATA DELPCV/5./
03960		DATA FPERC/.8,25.,1.0,.005,0.,0.,0.1,20.,0.,0.,
03970		* .9,30.,1.0,.005,0.,0.,0.1,30.,0.,0.,
03980		* 1.0,35.,1.0,.006,.1,0.,0.1,40.,0.,0./

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

03990		DATA LPSP/2,1,1,4,0,5,5,5,0,0/
04000		DATA LINT /2,1,2,0,0,0,1,2,1,0,2,2,0,2,2,0/
04010		DATA PLO/.01,0.,0.,0.,0.,0.,-.4,0.,0.,0.,4*.01/
04020		DATA PHI/8.,0.,0.,5.,0.,0.,1.6,180.,0.,0.,8.,700.,
04030		+ 500.,6./
04040		DATA SCALEBM/3*1./
04050		DATA HORZN,MBASE,TINT/00., 685 ,12./
04060		DATA NEMIS,NPTRN,NCNTR,NPAR,NSTEPS,NPTS/3,5,3,10,32,9/
04070		DATA NMODE/6/
04080		DATA MMS/150*0./
04090		DATA FREQA,FREQB/.4.,.6/
04100		DATA CGTT/9.08E5/
04110		DATA BINT/12./
04120		DATA OVCHI/1.5,5.0,5.0/
04130		DATA OVCHM/0.,12.,15./
04140	CC	TIME ELEMENTS USED IN CALCULATION OF COSTS
04150		DATA TIMEM/
04160		+ 0.1,0.1,0.1,1.0,0.,0.,0.1,0.05,0.25,0.25,
04170		+ 0.1,0.1,0.1,1.0,0.,0.,0.1,0.05,0.25,0.25,
04180		+ 0.1,0.1,0.1,1.0,0.,0.,0.1,0.05,0.25,0.25,
04190		+ 0.1,0.1,0.1,1.0,0.,0.,0.1,0.05,0.25,0.25,
04200		+ 0.1,0.1,0.1,1.0,0.,0.,0.1,0.05,0.25,0.25,
04210		+ 0.1,0.1,0.1,1.0,0.,0.7,0.1,0.05,0.25,0.25,
04220		+ 0.1,0.1,0.1,1.0,0.,0.7,0.1,0.05,0.25,0.25,
04230		+ 0.1,0.1,0.1,1.0,0.,0.7,0.1,0.05,0.25,0.25,
04240		+ 0.1,0.1,0.1,1.0,0.,0.7,0.1,0.05,0.25,0.25,
04250		+ 0.1,0.1,0.1,1.0,0.,0.7,0.1,0.05,0.25,0.25,
04260		+ 0.1,0.1,0.1,1.0,0.75,0.,0.1,0.05,0.25,0.25,
04270		+ 0.1,0.1,0.1,1.0,0.75,0.,0.1,0.05,0.25,0.25,
04280		+ 0.1,0.1,0.1,1.0,0.75,0.,0.1,0.05,0.25,0.25,
04290		+ 0.1,0.1,0.1,1.0,0.75,0.,0.1,0.05,0.25,0.25,
04300		+ 0.1,0.1,0.1,1.0,0.75,0.,0.1,0.05,0.25,0.25/
04310		DATA STIME/1.5,2.4,2.4/
04320		DATA TIMEC/
04330		+ 0.05,0.05,0.05,0.15,0.,0.,0.1,0.05,0.1,0.05,
04340		+ 0.05,0.05,0.05,0.15,0.,0.,0.1,0.05,0.1,0.05,
04350		+ 0.05,0.05,0.05,0.15,0.,0.,0.1,0.05,0.1,0.05,
04360		+ 0.05,0.05,0.05,0.15,0.,0.,0.1,0.05,0.1,0.05,
04370		+ 0.05,0.05,0.05,0.15,0.,0.,0.1,0.05,0.1,0.05,
04380		+ 0.05,0.05,0.05,0.15,0.,0.25,0.1,0.05,0.1,0.05,
04390		+ 0.05,0.05,0.05,0.15,0.,0.25,0.1,0.05,0.1,0.05,
04400		+ 0.05,0.05,0.05,0.15,0.,0.25,0.1,0.05,0.1,0.05,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

04410	+ 0.05,0.05,0.05,0.15,0.,0.25,0.1,0.05,0.1,0.05,
04420	+ 0.05,0.05,0.05,0.15,0.,0.25,0.1,0.05,0.1,0.05,
04430	+ 0.05,0.05,0.05,0.15,0.10,0.,0.1,0.05,0.1,0.05,
04440	+ 0.05,0.05,0.05,0.15,0.10,0.,0.1,0.05,0.1,0.05,
04450	+ 0.05,0.05,0.05,0.15,0.10,0.,0.1,0.05,0.1,0.05,
04460	+ 0.05,0.05,0.05,0.15,0.10,0.,0.1,0.05,0.1,0.05,
04470	+ 0.05,0.05,0.05,0.15,0.10,0.,0.1,0.05,0.1,0.05/
04480	DATA CPART/
04490	+ 0.,0.,0.,17.,0.,0.,2.0,5.0,0.,0.,
04500	+ 0.,0.,0.,17.,0.,0.,2.0,5.0,0.,0.,
04510	+ 0.,0.,0.,17.,0.,0.,2.0,5.0,0.,0.,
04520	+ 0.,0.,0.,17.,0.,0.,2.0,5.0,0.,0.,
04530	+ 0.,0.,0.,17.,0.,0.,2.0,5.0,0.,0.,
04540	+ 0.,0.,0.,17.,0.,47.,2.0,5.0,0.,0.,
04550	+ 0.,0.,0.,17.,0.,47.,2.0,5.0,0.,0.,
04560	+ 0.,0.,0.,17.,0.,47.,2.0,5.0,0.,0.,
04570	+ 0.,0.,0.,17.,0.,47.,2.0,5.0,0.,0.,
04580	+ 0.,0.,0.,17.,0.,47.,2.0,5.0,0.,0.,
04590	+ 0.,0.,0.,17.,20.,0.,2.0,5.0,0.,0.,
04600	+ 0.,0.,0.,17.,20.,0.,2.0,5.0,0.,0.,
04610	+ 0.,0.,0.,17.,20.,0.,2.0,5.0,0.,0.,
04620	+ 0.,0.,0.,17.,20.,0.,2.0,5.0,0.,0.,
04630	+ 0.,0.,0.,17.,20.,0.,2.0,5.0,0.,0./
04640	DATA EFF/.60,.85,.70,.85,.20,.20,.80,.75,.20,.40/
04650	DATA WF/1.,2.,2.,7*1./
04660	DATA OPTI,OPTM/1,1/
04670	DATA (COEFBP(I),I=1,50) /
04680	+ 2.50E-4,-1.0E-3,8.00E-5,5.2E-6,0.,0.,-5.00E-5,6.86E-3,-2.4E-6,
04690	+ 5.99E-5,
04700	+ 2.50E-4,-1.0E-3,8.00E-5,5.2E-6,0.,0.,-5.00E-5,6.86E-3,-2.4E-6,
04710	+ 5.99E-5,
04720	+ 2.50E-4,-1.0E-3,8.00E-5,5.2E-6,0.,0.,-5.00E-5,6.86E-3,-2.4E-6,
04730	+ 5.99E-5,
04740	+ 2.50E-4,-1.0E-3,8.00E-5,5.2E-6,0.,0.,-5.00E-5,6.86E-3,-2.4E-6,
04750	+ 5.99E-5,
04760	+ 2.50E-4,-1.0E-3,8.00E-5,5.2E-6,0.,0.,-5.00E-5,6.86E-3,-2.4E-6,
04770	+ 5.99E-5/
04780	DATA (COEFBP(I),I=51,100) /
04790	+1.5E-4,-7.5E-4,6.7E-5,3.E-6,0.,8.15E-6,-3.25E-5,5.0E-3,-2.3E-6,
04800	+ 3.76E-5,
04810	+1.5E-4,-7.5E-4,6.7E-5,3.E-6,0.,8.15E-6,-3.25E-5,5.0E-3,-2.3E-6,
04820	+ 3.76E-5,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

04830		+1.5E-4,-7.5E-4,0.7E-5,3.E-6,0.,3.15E-6,-3.25E-5,5.0E-3,-2.3E-6,
04840		+ 3.76E-5,
04850		+1.5E-4,-7.5E-4,6.7E-5,3.E-5,0.,3.15E-6,-3.25E-5,5.0E-3,-2.3E-6,
04860		+ 3.76E-5,
04870		+1.5E-4,-7.5E-4,5.7E-5,3.E-6,0.,3.15E-6,-3.25E-5,5.0E-3,-2.3E-6,
04880		+ 3.76E-5/
04890		DATA (CCEFBP(I),I=101,150) /
04900		+ 1.0E-4,-4.0E-4,4.E-5,1.5E-6,5.93E-6,0.,-2.00E-5,3.0E-3,
04910		+ -1.8E-6,0.,
04920		+ 1.0E-4,-4.0E-4,4.E-5,1.5E-6,5.93E-6,0.,-2.00E-5,3.0E-3,
04930		+ -1.8E-6,0.,
04940		+ 1.0E-4,-4.0E-4,4.E-5,1.5E-6,5.93E-6,0.,-2.00E-5,3.0E-3,
04950		+ -1.8E-6,0.,
04960		+ 1.0E-4,-4.0E-4,4.E-5,1.5E-6,5.93E-6,0.,-2.00E-5,3.0E-3,
04970		+ -1.8E-6,0.,
04980		+ 1.0E-4,-4.0E-4,4.E-5,1.5E-6,5.93E-6,0.,-2.00E-5,3.0E-3,
04990		+ -1.8E-6,0./
05000		DATA PARM/3.E-5,9.6E-6,5.2E-6,2.E-4,1.2E-4,9.9E-5,
05010		+ -8.8E-6,-6.6E-7,-5.9E-6/
05020	CC	PARTIALS -- DELTA EMISSION/DELTA PARAMETER
05030		DATA (PAR(I),I=1,150)/
05040		+ 0.3756,-3.73E-3,.08683,27.23,0.,0.,0.06192,7.48E-3,-1.372E-3,0.,
05050		+ 0.3756,-3.73E-3,.08683,27.23,0.,0.,0.06192,7.48E-3,-1.372E-3,0.,
05060		+ 0.3756,-3.73E-3,.08683,27.23,0.,0.,0.06192,7.48E-3,-1.372E-3,0.,
05070		+ 0.3756,-3.73E-3,.08683,27.23,0.,0.,0.06192,7.48E-3,-1.372E-3,0.,
05080		+ 0.3756,-3.73E-3,.08683,27.23,0.,0.,0.06192,7.48E-3,-1.372E-3,0.,
05090		+ 0.0286,-5.5E-3,0.0498,22.71,0.,0.602,-0.0801,9.1E-4,0.,0.,
05100		+ 0.0286,-5.5E-3,0.0498,22.71,0.,0.602,-0.0801,9.1E-4,0.,0.,
05110		+ 0.0286,-5.5E-3,0.0498,22.71,0.,0.602,-0.0801,9.1E-4,0.,0.,
05120		+ 0.0286,-5.5E-3,0.0498,22.71,0.,0.602,-0.0801,9.1E-4,0.,0.,
05130		+ 0.0286,-5.5E-3,0.0498,22.71,0.,0.602,-0.0801,9.1E-4,0.,0.,
05140		+ 0.09798,3.43E-4,0.11294,18.89,0.601,0.,-0.1758,1.31E-3,0.,0.,
05150		+ 0.09798,3.43E-4,0.11294,18.89,0.601,0.,-0.1758,1.31E-3,0.,0.,
05160		+ 0.09798,3.43E-4,0.11294,18.89,0.601,0.,-0.1758,1.31E-3,0.,0.,
05170		+ 0.09798,3.43E-4,0.11294,18.89,0.601,0.,-0.1758,1.31E-3,0.,0.,
05180		+ 0.09798,3.43E-4,0.11294,18.89,0.601,0.,-0.1758,1.31E-3,0.,0./
05190		DATA (PAR(I),I=151,300)/
05200		+ 6.6214,0.0434,-1.066,0.,0.,0.,-2.729,0.1472,-0.041,0.,
05210		+ 6.6214,0.0434,-1.066,0.,0.,0.,-2.729,0.1472,-0.041,0.,
05220		+ 6.6214,0.0434,-1.066,0.,0.,0.,-2.729,0.1472,-0.041,0.,
05230		+ 6.6214,0.0434,-1.066,0.,0.,0.,-2.729,0.1472,-0.041,0.,
05240		+ 6.6214,0.0434,-1.066,0.,0.,0.,-2.729,0.1472,-0.041,0.,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

05250	+ 7.178,0.02124,-0.342,0.,0.,7.51,-1.912,0.0764,-0.2978,2.999,
05260	+ 7.178,0.02124,-0.342,0.,0.,7.51,-1.912,0.0764,-0.2978,2.999,
05270	+ 7.178,0.02124,-0.342,0.,0.,7.51,-1.912,0.0764,-0.2978,2.999,
05280	+ 7.178,0.02124,-0.342,0.,0.,7.51,-1.912,0.0764,-0.2978,2.999,
05290	+ 7.178,0.02124,-0.342,0.,0.,7.51,-1.912,0.0764,-0.2978,2.999,
05300	+ 11.433,0.04845,-1.3477,0.,-7.302,0.,-9.751,0.1142,-0.2978,2.999,
05310	+ 11.433,0.04845,-1.3477,0.,-7.302,0.,-9.751,0.1142,-0.2978,2.999,
05320	+ 11.433,0.04845,-1.3477,0.,-7.302,0.,-9.751,0.1142,-0.2978,2.999,
05330	+ 11.433,0.04845,-1.3477,0.,-7.302,0.,-9.751,0.1142,-0.2978,2.999,
05340	+ 11.433,0.04845,-1.3477,0.,-7.302,0.,-9.751,0.1142,-0.2978,2.999/
05350	DATA (PAR(I),I=301,450)/
05360	+ -0.1714,1.05E-3,0.1724,0.,0.,0.,0.037,-4.2E-3,0.1710,-0.439,
05370	+ -0.1714,1.05E-3,0.1724,0.,0.,0.,0.037,-4.2E-3,0.1710,-0.439,
05380	+ -0.1714,1.05E-3,0.1724,0.,0.,0.,0.037,-4.2E-3,0.1710,-0.439,
05390	+ -0.1714,1.05E-3,0.1724,0.,0.,0.,0.037,-4.2E-3,0.1710,-0.439,
05400	+ -0.1714,1.05E-3,0.1724,0.,0.,0.,0.037,-4.2E-3,0.1710,-0.439,
05410	+ 0.0 ,2.5E-4,0.095,0.,0.,0.,0.0801,-2.1E-3,0.,0.,
05420	+ 0.0 ,2.5E-4,0.095,0.,0.,0.,0.0801,-2.1E-3,0.,0.,
05430	+ 0.0 ,2.5E-4,0.095,0.,0.,0.,0.0801,-2.1E-3,0.,0.,
05440	+ 0.0 ,2.5E-4,0.095,0.,0.,0.,0.0801,-2.1E-3,0.,0.,
05450	+ 0.0 ,2.5E-4,0.095,0.,0.,0.,0.0801,-2.1E-3,0.,0.,
05460	+ -0.0271,4.34E-4,0.1558,0.,0.716,0.,0.132,-2.62E-3,0.,0.,
05470	+ -0.0271,4.34E-4,0.1558,0.,0.716,0.,0.132,-2.62E-3,0.,0.,
05480	+ -0.0271,4.34E-4,0.1558,0.,0.716,0.,0.132,-2.62E-3,0.,0.,
05490	+ -0.0271,4.34E-4,0.1558,0.,0.716,0.,0.132,-2.62E-3,0.,0.,
05500	+ -0.0271,4.34E-4,0.1558,0.,0.716,0.,0.132,-2.62E-3,0.,0./
05510	DATA CCUEF/.165,.0066,.006,.2,0.,.02,2.,1.,.2,20./
05520	DATA (SPAR(I),I=1,150)/
05530	+ 36.162,-1.655,17.81,137.57,0.,0.,0.,0.04749,0.,0.,
05540	+ 36.162,-1.655,17.81,137.57,0.,0.,0.,0.04749,0.,0.,
05550	+ 36.162,-1.655,17.81,137.57,0.,0.,0.,0.04749,0.,0.,
05560	+ 36.162,-1.655,17.81,137.57,0.,0.,0.,0.04749,0.,0.,
05570	+ 36.162,-1.655,17.81,137.57,0.,0.,0.,0.04749,0.,0.,
05580	+ 8.2706,-0.549,7.97,137.57,0.,56.85,0.,0.1755,0.,0.,
05590	+ 8.2706,-0.549,7.97,137.57,0.,56.85,0.,0.1755,0.,0.,
05600	+ 8.2706,-0.549,7.97,137.57,0.,56.85,0.,0.1755,0.,0.,
05610	+ 8.2706,-0.549,7.97,137.57,0.,56.85,0.,0.1755,0.,0.,
05620	+ 8.2706,-0.549,7.97,137.57,0.,56.85,0.,0.1755,0.,0.,
05630	+ 13.53,-0.3424,11.55,137.57,105.8,0.,-2.968,-0.09418,0.,0.,
05640	+ 13.53,-0.3424,11.55,137.57,105.8,0.,-2.968,-0.09418,0.,0.,
05650	+ 13.53,-0.3424,11.55,137.57,105.8,0.,-2.968,-0.09418,0.,0.,
05660	+ 13.53,-0.3424,11.55,137.57,105.8,0.,-2.968,-0.09418,0.,0.,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

05670	+ 13.53,-0.3424,11.55,137.57,105.8,0.,-2.963,-0.09418,0.,0./
05680	DATA (SPAR(I),I=151,300)/
05690	+ 0.951,0.,3.207E-3,0.,0.,0.,-0.01358,0.,0.,0.,
05700	+ 0.951,0.,3.207E-3,0.,0.,0.,-0.01358,0.,0.,0.,
05710	+ 0.951,0.,3.207E-3,0.,0.,0.,-0.01358,0.,0.,0.,
05720	+ 0.951,0.,3.207E-3,0.,0.,0.,-0.01358,0.,0.,0.,
05730	+ 0.951,0.,3.207E-3,0.,0.,0.,-0.01358,0.,0.,0.,
05740	+ 0.8712,3.4E-4,1.19E-3,0.,0.,0.9796,0.,1.8E-4,0.,0.,
05750	+ 0.8712,3.4E-4,1.19E-3,0.,0.,0.9796,0.,1.8E-4,0.,0.,
05760	+ 0.8712,3.4E-4,1.19E-3,0.,0.,0.9796,0.,1.8E-4,0.,0.,
05770	+ 0.8712,3.4E-4,1.19E-3,0.,0.,0.9796,0.,1.8E-4,0.,0.,
05780	+ 0.8712,3.4E-4,1.19E-3,0.,0.,0.9796,0.,1.8E-4,0.,0.,
05790	+ 1.027,-4.219E-4,3.08E-4,0.,0.02534,0.,-0.0125,7.942E-5,0.,0.,
05800	+ 1.027,-4.219E-4,3.08E-4,0.,0.02534,0.,-0.0125,7.942E-5,0.,0.,
05810	+ 1.027,-4.219E-4,3.08E-4,0.,0.02534,0.,-0.0125,7.942E-5,0.,0.,
05820	+ 1.027,-4.219E-4,3.08E-4,0.,0.02534,0.,-0.0125,7.942E-5,0.,0.,
05830	+ 1.027,-4.219E-4,3.08E-4,0.,0.02534,0.,-0.0125,7.942E-5,0.,0./
05840	DATA (SPAR(I),I=301,450)/
05850	+ -9.845,0.05804,0.7348,0.,0.,0.,-1.043,-7.923E-3,0.,0.,
05860	+ -9.845,0.05804,0.7348,0.,0.,0.,-1.043,-7.923E-3,0.,0.,
05870	+ -9.845,0.05804,0.7348,0.,0.,0.,-1.043,-7.923E-3,0.,0.,
05880	+ -9.845,0.05804,0.7348,0.,0.,0.,-1.043,-7.923E-3,0.,0.,
05890	+ -9.845,0.05804,0.7348,0.,0.,0.,-1.043,-7.923E-3,0.,0.,
05900	+ -2.752,0.1153,-0.230,0.,0.,-2.848,-2.548,0.0150,0.,0.,
05910	+ -2.752,0.1153,-0.230,0.,0.,-2.848,-2.548,0.0150,0.,0.,
05920	+ -2.752,0.1153,-0.230,0.,0.,-2.848,-2.548,0.0150,0.,0.,
05930	+ -2.752,0.1153,-0.230,0.,0.,-2.848,-2.548,0.0150,0.,0.,
05940	+ -2.752,0.1153,-0.230,0.,0.,-2.848,-2.548,0.0150,0.,0.,
05950	+ -38.35,0.3857,0.4285,0.,40.0,0.,-3.941,-0.04358,0.,0.,
05960	+ -38.35,0.3857,0.4285,0.,40.0,0.,-3.941,-0.04358,0.,0.,
05970	+ -38.35,0.3857,0.4285,0.,40.0,0.,-3.941,-0.04358,0.,0.,
05980	+ -38.35,0.3857,0.4285,0.,40.0,0.,-3.941,-0.04358,0.,0.,
05990	+ -38.35,0.3857,0.4285,0.,40.0,0.,-3.941,-0.04358,0.,0./
06000	DATA (SPAR(I),I=451,600)/
06010	+ 1.959,-0.02213,4.201,128.0,0.,0.,-5.916,0.08041,0.,0.,
06020	+ 1.959,-0.02213,4.201,128.0,0.,0.,-5.916,0.08041,0.,0.,
06030	+ 1.959,-0.02213,4.201,128.0,0.,0.,-5.916,0.08041,0.,0.,
06040	+ 1.959,-0.02213,4.201,128.0,0.,0.,-5.916,0.08041,0.,0.,
06050	+ 1.959,-0.02213,4.201,128.0,0.,0.,-5.916,0.08041,0.,0.,
06060	+ 0.969,-0.0451,3.256,128.0,0.,-18.457,-0.541,-0.0744,0.,0.,
06070	+ 0.969,-0.0451,3.256,128.0,0.,-18.457,-0.541,-0.0744,0.,0.,
06080	+ 0.969,-0.0451,3.256,128.0,0.,-18.457,-0.541,-0.0744,0.,0.,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

06090	+ 0.969,-0.0451,3.256,128.0,0.,-18.457,-0.541,-0.0744,0.,0.,
06100	+ 0.969,-0.0451,3.256,128.0,0.,-18.457,-0.541,-0.0744,0.,0.,
06110	+ 0.6026,-0.02285,4.049,128.0,11.2,0.,-6.854,0.08607,0.,0.,
06120	+ 0.6026,-0.02285,4.049,128.0,11.2,0.,-6.854,0.08607,0.,0.,
06130	+ 0.6026,-0.02285,4.049,128.0,11.2,0.,-6.854,0.08607,0.,0.,
06140	+ 0.6026,-0.02285,4.049,128.0,11.2,0.,-6.854,0.08607,0.,0.,
06150	+ 0.6026,-0.02285,4.049,128.0,11.2,0.,-6.854,0.08607,0.,0./
06160	DATA (SPAR(I),I=601,750)/
06170	+ 0.01607,4.529E-5,8.585E-3,0.,0.,0.,-0.05327,1.619E-3,0.,0.,
06180	+ 0.01607,4.529E-5,8.585E-3,0.,0.,0.,-0.05327,1.619E-3,0.,0.,
06190	+ 0.01607,4.529E-5,8.585E-3,0.,0.,0.,-0.05327,1.619E-3,0.,0.,
06200	+ 0.01607,4.529E-5,8.585E-3,0.,0.,0.,-0.05327,1.619E-3,0.,0.,
06210	+ 0.01607,4.529E-5,8.585E-3,0.,0.,0.,-0.05327,1.619E-3,0.,0.,
06220	+ 0.01736,0.,-2.96E-3,0.,0.,0.0815,-3.42E-3,2.79E-3,0.,0.,
06230	+ 0.01736,0.,-2.96E-3,0.,0.,0.0815,-3.42E-3,2.79E-3,0.,0.,
06240	+ 0.01736,0.,-2.96E-3,0.,0.,0.0815,-3.42E-3,2.79E-3,0.,0.,
06250	+ 0.01736,0.,-2.96E-3,0.,0.,0.0815,-3.42E-3,2.79E-3,0.,0.,
06260	+ 0.01736,0.,-2.96E-3,0.,0.,0.0815,-3.42E-3,2.79E-3,0.,0.,
06270	+ -0.0108,0.,-0.01158,0.,-0.01464,0.,-0.1424,2.93E-3,0.,0.,
06280	+ -0.0108,0.,-0.01158,0.,-0.01464,0.,-0.1424,2.93E-3,0.,0.,
06290	+ -0.0108,0.,-0.01158,0.,-0.01464,0.,-0.1424,2.93E-3,0.,0.,
06300	+ -0.0108,0.,-0.01158,0.,-0.01464,0.,-0.1424,2.93E-3,0.,0.,
06310	+ -0.0108,0.,-0.01158,0.,-0.01464,0.,-0.1424,2.93E-3,0.,0./
06320	DATA (SPAR(I),I=751,900)/
06330	+ 0.,0.2014,73.28,0.,0.,0.,-72.29,-0.9249,0.,0.,
06340	+ 0.,0.2014,73.28,0.,0.,0.,-72.29,-0.9249,0.,0.,
06350	+ 0.,0.2014,73.28,0.,0.,0.,-72.29,-0.9249,0.,0.,
06360	+ 0.,0.2014,73.28,0.,0.,0.,-72.29,-0.9249,0.,0.,
06370	+ 0.,0.2014,73.28,0.,0.,0.,-72.29,-0.9249,0.,0.,
06380	+ 0.,0.0886,55.59,0.,0.,-99.44,9.429,0.5536,0.,0.,
06390	+ 0.,0.0886,55.59,0.,0.,-99.44,9.429,0.5536,0.,0.,
06400	+ 0.,0.0886,55.59,0.,0.,-99.44,9.429,0.5536,0.,0.,
06410	+ 0.,0.0886,55.59,0.,0.,-99.44,9.429,0.5536,0.,0.,
06420	+ 0.,0.0886,55.59,0.,0.,-99.44,9.429,0.5536,0.,0.,
06430	+ -1.773,-0.04294,91.62,0.,313.6,0.,53.78,-0.6949,0.,0.,
06440	+ -1.773,-0.04294,91.62,0.,313.6,0.,53.78,-0.6949,0.,0.,
06450	+ -1.773,-0.04294,91.62,0.,313.6,0.,53.78,-0.6949,0.,0.,
06460	+ -1.773,-0.04294,91.62,0.,313.6,0.,53.78,-0.6949,0.,0.,
06470	+ -1.773,-0.04294,91.62,0.,313.6,0.,53.78,-0.6949,0.,0./
06480	DATA X1BP/.45,.28,.08,.36,.26,.2,.44,.31,.26,.41,.28,.18,
06490	+ .41,.3,.19,.43,.3,.21,9*0.,9*1.,.44,.24,.1,.4,.21,
06500	+ .05,.32,.17,.05,9*0./

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

```

06510      DATA Y1BP/.34,.28,.18,.35,.30,.19,.35,.3,.2,
06520      +.041,.027,.013,.11,.09,.07,.11,.10,.09,
06530      +.2,.11,.03,.13,.10,.08,.16,.07,.09,
06540      +.02,.02,.02,.02,.02,.02,.02,.02,
06550      +9*0.,
06560      +3*0.,.01,.01,.01,3*0.,
06570      +.047,.047,.024,.027,.022,.014,.065,.044,.029,
06580      +.072,.043,.014,.043,.022,.007,.046,.023,.008,
06590      +13*0./
06600      DATA Y2BP/5.3,3.7,4.3,3.1,3.4,4.0,2.4,3.2,3.9,
06610      + -122.,-123.,-150.,-155.,-155.,-155.,-152.,-153.,-154.,
06620      * 3.0,4.0,5.3,5.3,5.7,5.8,4.2,4.7,4.8,
06630      +9*13.,9*0.,3*0.,3*1.0,3*0.,
06640      * -2.,-2.,-2.,-1.,-1.,-1.,-.6,-.6,-.6,
06650      +136.,142.,1+3.,1+0.,1+3.,160.,137.,137.,150.,9*0.,9*0./
06660      CC      DATA FJR SUBROUTINE STATS
06670      DATA SIGSDF/.15,1.3,0./
06680      DATA SIGMNE/10*0./
06690      DATA SIGME/.043,9*0./
06700      DATA SIGCE/.6,.8,.6/
06710      DATA XBASE/1.,3.,4.,5.,6.,8.,12.,15.,20.,
06720      +10.,30.,40.,50.,60.,100.,130.,160.,200.,
06730      +1.,2.,3.,4.,7.,9.,11.,13.,15./
06740      DATA YBASE/.021,.106,.113,.107,.095,.071,.035,.018,.008,
06750      +.002,.0035,.0093,.0091,.0084,.0056,.0038,.0026,.0013,
06760      +.03,.13,.17,.158,.075,.04,.022,.011,.005/
06770      DATA TSIZE,BSIZE/2*150./
06780      DATA PCUNE/90./
06790      DATA SIG,BSIG/.25,37.,2.,1.9,37.,2.1/
06800      DATA (PARINT(I),I=1,100)/
06810      * 0.,-.00039,.001254,0.,0.,0.,-3.38E-4,-1.56E-5,0.,0.,
06820      * 0.,0.,-.0006305,0.,0.,0.,0.,0.,0.,
06830      * 0.,0.,0.,0.,0.,0.,1.23E-5,9.11E-7,0.,0.,
06840      * 10*0.0,
06850      * 10*0.,
06860      * 10*0.,
06870      * 10*0.,
06880      * 10*0.,
06890      * 10*0.,
06900      * 10*0.,
06910      * /
06920      DATA (PARINT(I),I=101,200)/

```

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

06930	* 0.,-.00016,0.,0.,0.,-.0726,0.,0.00046,0.,0.,
06940	* 0.,0.,-.000056,0.,0.,0.,0.,0.,0.,0.,
06950	* 0.,0.,0.,0.,0.,.0023,0.,.00005,0.,0.,
06960	* 0.,0.,0.,0.,6*0.,
06970	* 10*0.,
06980	* 10*0.,
06990	* 10*0.,
07000	* 10*0.,
07010	* 20*0./
07020	DATA (PARINT(I),I=201,300)/
07030	* 0.,.000532,-.01211,0.,-.0379,0.,-.0.117,4.54E-5,0.,0.,
07040	* 0.,0.,-.0000823,0.,-.0001623,0.,6.17E-5,0.,0.,0.,
07050	* 0.,0.,0.,0.,.00743,0.,0.,-2.13E-7,0.,0.,
07060	* 0.,0.,0.,0.,6*0.,
07070	* 0.,0.,0.,0.,0.,0.,-7.72E-6,0.,0.,
07080	* 0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
07090	* 7*0.,-5.05E-7,0.,0.,
07100	* 8*0.,0.,0.,
07110	* 20*0./
07120	DATA (PARINT(I),I=301,400)/
07130	* 0.,.002938,-.10158,0.,0.,0.,0.,-6.43E-4,0.,0.,
07140	* 0.,0.,8*0.,
07150	* 3*0.,0.,0.,0.,1.71E-3,8.98E-7,0.,0.,
07160	* 4*0.,6*0.,
07170	* 5*0.,5*0.,
07180	* 6*0.,4*0.,
07190	* 7*0.,1.16E-6,0.,0.,
07200	* 10*0.,
07210	* 20*0./
07220	DATA (PARINT(I),I=401,500)/
07230	* 0.,.00738,-.102,0.,0.,-.7736,0.,-.0015,0.,0.,
07240	* 0.,0.,3*0.,
07250	* 3*0.,0.,0.,-.0102,-.0033,-.00017,0.,0.,
07260	* 4*0.,6*0.,
07270	* 5*0.,5*0.,
07280	* 6*0.,0.,-.0043,0.,0.,
07290	* 7*0.,-.00031,0.,0.,
07300	* 10*0.,
07310	* 20*0./
07320	DATA (PARINT(I),I=501,600)/
07330	* 0.,.00802,.01105,0.,.1342,0.,-.84,1.58E-4,0.,0.,
07340	* 2*0.,-.001986,0.,-.00708,0.,-8.95E-3,0.,0.,0.,

Table 5-49 BLOCK DATA ROUTINE LISTING (cont.)

07350	* 3*0.,0.,,3624,0.,-0.1043,-7.2E-5,0.,0.,
07360	* 4*0.,6*0.,
07370	* 5*0.,0.,1.380,-4.0E-4,0.,0.,
07380	* 6*0.,4*0.,
07390	* 7*0.,-4.62E-4,0.,0.,
07400	* 8*0.,0.,0.,
07410	* 9*0.,,01167,10*0./
07420	DATA (PARINT(I),I=601,700)/
07430	* 0.,-.0000971,-.000998,0.,0.,0.,.0105,-4.9E-3,0.,0.,
07440	* 2*0.,8*0.,
07450	* 3*0.,0.,0.,0.,-.002151,1.625E-5,0.,0.,
07460	* 4*0.,6*0.,
07470	* 5*0.,5*0.,
07480	* 10*0.,
07490	* 10*0.,
07500	* 10*0.,
07510	* 20*0./
07520	DATA (PARINT(I),I=701,800)/
07530	* 0.,0.,,00148,0.,0.,0.,,004,,00026,0.,0.,
07540	* 0.,0.,,0000037,0.,0.,0.,0.,0.,0.,0.,
07550	* 3*0.,0.,0.,0.,,0088,,000028,0.,0.,
07560	* 4*0.,6*0.,
07570	* 10*0.,
07580	* 10*0.,
07590	* 10*0.,
07600	* 10*0.,
07610	* 20*0./
07620	DATA (PARINT(I),I=801,900)/
07630	* 0.,,0000348,-.01426,0.,-.04487,0.,8.79E-3,-3.14E-5,0.,0.,
07640	* 2*0.,-.000014,0.,-.000231,0.,5.58E-5,1.06E-7,0.,0.,
07650	* 3*0.,0.,,02487,0.,-0.01938,-1.45E-6,0.,0.,
07660	* 4*0.,6*0.,
07670	* 5*0.,0.,-7.73E-4,-3.4E-5,0.,0.,
07680	* 6*0.,4*0.,
07690	* 10*0.,
07700	* 10*0.,
07710	* 20*0./
07720	DATA Y1DBP,Y2DBP/160*0.,160*0./
07730	DATA LOPT/2/
07740	DATA PPICK/2,9*0/
07750	RETURN
07760	END

APPENDIX A

PROGRAM NOMENCLATURE

APPENDIX A
PROGRAM NOMENCLATURE

Table A-1 contains a complete nomenclature list for the General Economic Effectiveness Program. Variable names for all subroutines are included in alphabetical order. For those identifiers with more than one SIGNIFICANT meaning, several entries in the nomenclature list have been made. This list was designed for use by a FORTRAN IV programmer in conjunction with the flowcharts and listings in Section 5.

Table A-1 PROGRAM NOMENCLATURE

* * * CRC ECONOMIC EFFECTIVENESS PROGRAM NOMENCLATURE * * *

INSPECTION TYPE

IDLE

IDLE

EXTENSIVE A

IGNITION

EXTENSIVE B

INDUCTION

INSPECTION FACILITIES

STATE LANE

STATE

FRANCHISED GARAGE

GARAGE

REGION

LOS ANGELES

LA

NEW YORK

NY

WASHINGTON

WASH

DENVER

DEN

DETROIT

DET

* * ENGINE PARAMETERS * *

M=1 IDLE CO

M=2 DELTA RPM

M=3 DELTA TIMING

M=4 MISFIRE

M=5 NOX CONTROL

M=6 AIR PUMP

M=7 PCV

M=8 AIR CLEANER

M=9 BLADE SETTING (VACUUM KICK)

M=10 HEAT RISER

* * MODE EMISSIONS * *

L=1 ICO

L=2 IHC

L=3 INO

L=4 CCO (45)

L=5 CHC (45)

L=6 CNO (45)

NAME	DESCRIPTION	RANGE	UNITS
A	MEAN EMISSION LEVELS BEFORE DETERIORATION		GR/MI
A	PERCENTAGE SUMMATION VARIABLE - UNCONTROLLED		
AA	SUMMING VARIABLE IN MILEAGE CALCULATION		MILES/YEAR
AAA	AVERAGE ANNUAL MILEAGE - UNCONTROLLED		MILES/YEAR
AA1	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
AA2	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
AA3	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		

Table A-1 PROGRAM NOMENCLATURE (cont.)

ADD	RATE OF EMISSION DETERIORATION X MILAGE ACCUMULATION	G/M
ADD	RATE OF MODE DETERIORATION X MILAGE ACCUMULATION	
	- HC	PPM/MILE
	- CO	PPM/MILE
	- NO	PPM/MILE
ADD	THE CHANGE IN PARAMETER SETTING DUE TO DECAY	
ADD1	MODE EMISSION DETERIORATION	G/MIL/MIL
ADEBUG	AREA DEBUG FLAG	2HNO
ALAB	AREA REGIONAL BASIN	1250(LA) SQ.MI.
AM	EMISSION AFTER MAINTENANCE	
AMB	FEDERAL 1976 AIR QUALITY CRITERIA HC,NOX- UG/M3, CO- MG/M3	
ANAME		
ANNUAL	ANNUAL MILEAGE AS A FUNCTION OF AGE.	
ANNUA1	ANNUAL MILEAGE DISTRIBUTION FOR LOS ANGELES FLEET	
ANNUA2	ANNUAL MILEAGE DISTRIBUTION FOR NEW YORK FLEET	
ANNUA3	ANNUAL MILEAGE DISTRIBUTION FOR WASHINGTON FLEET	
ANNUA4	ANNUAL MILEAGE DISTRIBUTION FOR DENVER FLEET	
ANNUA5	ANNUAL MILEAGE DISTRIBUTION FOR DETROIT FLEET	
AR	1- TARGET AREA IN XPT	0.-1.
ASTABLX	MODE EMISSION INPUT DISTRIBUTION.X VALUES. 9 POINT	
ASTABLY	MODE EMISSION INPUT DISTRIBUTION.Y VALUES. 9 POINT	
ASTABX	INPUT MODE EMISSION DISTRIBUTION BY REGION -X	
ASTABY	INPUT MODE EMISSION DISTRIBUTION BY REGION -Y	
ATABLEX	PARAMETER INPUT DISTRIBUTION. X VALUES. 9 POINTS.	
ATABLEY	PARAMETER INPUT DISTRIBUTION. Y VALUES. 9 POINTS.	
ATABX	INPUT PARAMETER DISTRIBUTION BY REGION -X	
ATABY	INPUT PARAMETER DISTRIBUTION BY REGION -Y	
AVE	AVERAGE PARAMETER VALUE IN STATS	
AVEFAIL	AVERAGE FRACTION OF CARS FAILED FOR OUTPUT	0.-1.
AX	TEMPORARY STORAGE FOR DISTRIBUTIONS TO BE PLOTTED	
AY	TEMPORARY STORAGE FOR DISTRIBUTIONS TO BE PLOTTED	
A1	TEMPORARY INTEGRAL (AT LAST POINT) IN XPT	0.-1.
A1	X1-Y1 DISTRIBUTION POINT AT X3 IN ADD	
A2	X2-Y2 DISTRIBUTION POINT AT X3 IN ADD	
B	MEAN EMISSION LEVELS AFTER DETERIORATION	G/M
B	PERCENTAGE SUMMATION VARIABLE - CONTROLLED	
BAREA	INTEGRATED EMISSION LEVEL	GRAMS
BB	SUMMING VARIABLE IN MILEAGE CALCULATION	MILES/YEAR
BBB	AVERAGE ANNUAL MILEAGE - CONTROLLED	MILES/YEAR
BDEBUG	BASELINE DEBUG FLAG	2HNO
BDEL	EMISSION RATE IMPROVEMENT	

Table A-1 PROGRAM NOMENCLATURE (cont.)

RHIST	BASELINE EMISSION HISTORY		G/M
RHIST	EMISSION LEVEL AT TIME N FOR BASELINE		GR/MI
RINT	BASELINE INSPECTION TIME INTERVAL		MONTHS
BLD1	SURFACE AREA INSPECTION SHED	300	SQ.FT.
BLD2	SURFACE AREA INSPECTION LANE	300	SQ.FT.
BM	POST MAINTENANCE EMISSION RATES		G/MILE
BMU	MEAN EMISSION RATE FOR BASE CASE		
BSAVE	STORED CONSTRAINT VALUES BY OPTI IN OPTMUM		
RSD	EMISSION RATE STANDARD DEVIATION FOR BASE CASE		
RSIG	BASELINE EMISSION DISTRIBUTION ERROR		
RSIZE	SAMPLE SIZE FOR THE BASELINE FLEET		CARS
RUP	ADDITION AT MANUFACTURERS SPEC FOR MAINTENANCE		
RX	TEMPORARY STORAGE FOR DISTRIBUTIONS TO BE PLOTTED		
RXTRA	THAT PORTION OF THE FINAL TEST INTERVAL THAT WOULD EXTEND PAST THE TOTAL TEST DURATION		MONTHS
RY	TEMPORARY STORAGE FOR DISTRIBUTIONS TO BE PLOTTED		
RI	CONSTRAINT ARRAY FOR INPUT TO CUTPNT FROM OPTMUM		
C	EMISSION DELTA AFTER DECAY AND MAINTENANCE		GR/MI
C	PERCENTAGE SUMMATION VARIABLE - POST 1970		
CA	COEFFICIENT FOR NEW CUTPOINT GUESS IN CUTPNT	0.-1.	
CAF	CAPITAL EQUIPMENT COST\$		\$
CAL	CAPITAL LAND COSTS		\$
CAP	CAPITAL FACILITIES COST		\$
CAPFL	CAPITAL COST FOR INSPECTION STATION(DISCOUNTED)		
CARA	SUM OF CARS INSPECTED OVER HORIZON		CARS
CARAV	AVERAGE NUMBER OF CARS IN POPULATION		CARS
CARB	SUM OF CARS MAINTAINED OVER HORIZON		CARS
CARC	TOTAL CARS FAILING SIGNATURE INSPECTION OVER TIME		CARS
CARI	NO. OF CARS UNDERGOING INSPECTION		CARS
CARIY	AVERAGE NO. OF CARS INSPECTED PER YEAR		CAR/YEAR
CARM	NO. OF CARS MAINTAINED		CARS
CARMY	AVERAGE NO. OF CARS MAINTAINED PER YEAR		CAR/YEAR
CARPOP	REGIONAL CAR POPULATION	4M(LA)	CARS
CARPOP	VEHICLE POPULATION		CARS
CARS	TOTAL CARS FAILING SIGNATURE INSPECTION		CARS/YEAR
CARSY	AVERAGE NUMBER OF MODE REJECTED CARS		CARS/YEAR
CAT	TRAINING COST		DOLLARS
CR	COEFFICIENT FOR NEW CUTPOINT GUESS IN CUTPNT	0.-1.	
CBSUM	VOLUNTARY I/M COST		DOLLARS
CC	SUMMING VARIABLE IN MILEAGE CALCULATION		MILES/YEAR
CCC	AVERAGE ANNUAL MILEAGE - POST 70		MILES/YEAR

Table A-1. PROGRAM NOMENCLATURE (cont.)

CCOSTI	INSPECTION CAPITAL COSTS		\$
CCOSTM	MAINTENANCE CAPITAL COSTS		\$
CC1	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
CC2	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
CC3	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
CDEBUG	COST DEBUG FLAG	2HNO	
CELLWTH	DELTA ON X-AXIS OF A DISTRIBUTION		
CF	J FACTORIAL IN QUEUE		
CGTT	CONVERT GRAMS TO TONS	9.08M	G/TONS
CHI	CHANGE IN Y PER COLUMN		
CINCON	USER INCONVENIENCE COST		DOLLARS
CMAXI	MAXIMUM NO. OF CARS INSPECTED IN ANY ONE YEAR		CARS
CN	POST MAINTENANCE EMISSION RATES		GRAMS/MILE
COEFB	EMISSION DECAY RATES		G/MIL/MIL
COEFBP	PARAMETER DECAY RATE		
CONST	CUTPOINT OPTIMIZATION CONSTRAINT FACTOR	0.-1.	
CON1	CONSTANT REFLECTING MODE EMISSION NON-INDEPENDANCE		
CON2	CONSTANT REFLECTING MODE EMISSION NON-INDEPENDANCE		
COST	DISCOUNTED OCOST		\$/YEAR
COSTB	BASELINE VOLUNTARY MAINTENANCE COST		DOLLARS
CPART	COST OF PARTS FOR MAINTENANCE		
CPCB	COST OF BASE MAINTENANCE TUNEUP	35-85	DOLLARS
CPI	COST PER INSPECTION		\$/INSPECTION
CPVPY	COST PER VEHICLE PER YEAR		\$/CAR/YEAR
CSUM	TOTAL COST FOR TEST PROGRAM		\$
CUT	CURRENT CUTPOINT GUESS IN CUTPNT		
CUTIN	STARTING CUTPOINT GUESSES IN CUTPNT		
CUTMAX	UPPER LIMIT OF DISTRIBUTED PARAMETERS IN CUTPNT		
CUTMIN	LOWER LIMIT OF DISTRIBUTED PARAMETERS IN CUTPNT		
CUTN	NEW CUTPOINTS FROM L.P. MODEL IN CUTPNT		
C1	UTILITY FUNCTION COEFFICIENTS IN CUTPNT		
D	TEMPORARY DISTRIBUTION STORAGE IN CONVOL		
DD	TEMPORARY DISTRIBUTION STORAGE IN CONVOL AND DISTPR		
DDDI	SECOND PARTIAL CONTRIBUTION TO EMISSION DELTA		
DDEBUG	DATA DEBUG FLAG	2HNO	
DD1	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
DD2	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
DD3	COEFFICIENT FOR POLYNOMIAL CURVE-FIT		
DELB	EMISSION REDUCTION BASE MAINTENANCE		G/M
DELEM	DIFFERENCE BETWEEN TEST AND BASE EMISSION RATES		GRAMS/MILE
DELI	INTEGRAL OF BASE-TEST EMISSION RATES		GRAMS

Table A-1 PROGRAM NOMENCLATURE (cont.)

DELIT	INTEGRAL OF BASE-TEST EMISSION RATES		TONS
DELT	EMISSION REDUCTION TEST MAINTENANCE		G/M
DELTA	PARAMETER SETTING CHANGE DUE TO MAINTENANCE-CUTPNT		
DELTAN	NEW PARAMETER DELTA IN CUTPNT		
DELX	DELTA ON X-AXIS OF A DISTRIBUTION		
DELXD	DUMMY X VALUE FOR DETERIORATION. RANGES 0 TO 2		
DELXH	DELTA X IN MAINTAINED DISTRIBUTION		
DEFX	TEST FLEET EMISSION SPECIE DECREMENT ERROR DIST.-X		
DEY	TEST FLEET EMISSION SPECIE DECREMENT ERROR DIST.-Y		
DIFF	ATTRITION RATES. DIFF(N)=PERCENTAGE OF N YEAR OLD CARS STILL IN USE		
DP	THE CHANGE IN PARAMETER MEANS FOR MAINTENANCE (SIG. ONLY)		
DPO	SUMMATION VARIABLE IN QUEUE FOR PO CALCULATION		1/PROBAB.
DROP	EMISSION REDUCTION FROM I/M OF NON-DISTRIBUTED P'S		
DUM	TEMPORARY STORAGE IN SWITCH		
DUMX	TEMPORARY DISTRIBUTION STORAGE		
DUMY	TEMPORARY DISTRIBUTION STORAGE		
DUM1	TEMPORARY REJECTION RATE STORAGE FOR UNION		
DX	DELTA X IN A DISTRIBUTION		
EFF	MAINTENANCE EFFECTIVENESS FACTOR	100	
FMIS	EMISSION RATES FOR ATTRITION MODEL OUTPUT		
FMW	EMISSION WEIGHTING FACTORS		
EP	EXPECTED VALUE OF REJECTED PARAMETER		
F1	EMISSION SUMMING VARIABLE IN PRINT6 - HC		UG/M3
F2	EMISSION SUMMING VARIABLE IN PRINT6 - CO		MG/M3
F3	EMISSION SUMMING VARIABLE IN PRINT6 - NOX		UG/M3
F	VALUE OF CHEBYSHEV ORTHOGONAL POLYNOMIAL		
FACT0	INITIAL FACTOR FOR ITERATION IN CUTPNT		
FACTOR	CONVERGENCE FACTOR IN CUTPNT		
FIXCOST	FIXED COST FOR I/M OF DISTRIBUTED PARAMETERS		DOLLARS
FLAST	FRACTION OF INSPECTION INTERVAL AT END		
FPERC	THAT PORTION OF THE BASELINE MAINTENANCE THAT AFFECTS THE PARAMETER DECAY RATES		
GROWTH	POPULATION GROWTH FACTOR		
HEAD	HEADING ARRAY CONTAINING CONTROL TYPE NAMES		
HORZN	PROGRAM HORIZON	60	MONTHS
HORZNY	PROGRAM HORIZON		YEARS
HPC	HISTORY OF PC		
HPCS	UNION OF SIGNATURE INSPECTION REJECTION RATES	0.-1.	
HPP	HISTORY OF PP	0.-1.	
HPS	STORED SIGNATURE INSPECTION REJECTION RATES	0.-1.	
HPT	HISTORY OF PT		

Table A-1. PROGRAM NOMENCLATURE (cont.)

HPTOT	HISTORY OF PTOT		
HPTOTS	TOTAL UNION OF SIGNATURE REJECTION RATES	0.-1.	
I	EMISSION LOOP INDEX. 1=HC,2=CO,3=NOX	1-3	
ICOST	INCONVENIENCE COSTS		\$
IERR	ERROR FLAG OUTPUT FROM LPAX IN CUTPNT	0	
IGO	COMPUTED GOTO INDEX. USED FOR ALL COMPUTED BRANCHES		
II	MISCELLANEOUS INDEX		
IJ	INDEX IN CONVOL		
ILNS	NUMBER OF LINES PER PAGE REQUESTED IN PLOT		LINES
IMAX	CONSTANT IN CONVOL	50	
IMAXU	ITRY AT MAXIMUM UTILITY FUNCTION IN OPTMUM		
IN	INPUT KEYWORD VECTOR.		
INT	NUMBER OF INSPECTION INTERVALS - TEST CASE		
INTB	NUMBER OF INSPECTION INTERVALS - BASE CASE		
IOPT	INTEGRATE F(X) OR X*F(X) FLAG		
IOPT	EMPIRICAL OR THEORETICAL STATISTICAL ANALYSIS FLAG		
IPLUS	TEMPORARY INDEX INCREASE IN PRINT2		
IPRINT	PRINT FLAG IN CUTPNT	0	
IPRNT	PRINT FLAG IN CUTPNT	0	
IP1	I PLUS 1 IN PLOTJK		
IT	INTEGRAL VALUE OF INDEPENDENT VARIABLE IN PLOTXY		
ITE	EQUIPMENT AMMORIZATION	4	YEARS
ITERAT	NUMBER OF ITERATIONS IN CUTPNT		
ITIME	INCONVENIENCE TIME		MIN
ITL	LAND AMMORIZATION	30	YEARS
ITP	FACILITY AMMORIZATION	30	YEARS
ITRY	COUNTER FOR ITRYS - COMB. OF NON-DISTR. PARAMETERS		
ITRYS	ARRAY OF POSSIBILITIES FOR NON-DISTR. PARAMETERS.		
I1	DO LOOP INDEX		
I1	INDEX FOR CONVOLUTION FUNCTION		
I2	INDEX FOR CONVOLUTION FUNCTION		
I3	INDEX FOR CONVOLUTION FUNCTION		
I4	INDEX FOR CONVOLUTION FUNCTION		
J	CONTROL TYPE-POWERTRAIN COUNTER=JJ+3*(K-1).	1-15	
JCNT	CUTPNT COUNTER FOR CUT POINT OPTIMIZATION	1-10	
JJ	POWER TRAIN TYPE INDEX		
K	CONTROL TYPE INDEX. 1=GM, 2=FORD, 3=CHRY, 4=AMC, 5=IMPORTS		
KH	OUT OF BOUND-HIGH PLOT FLAG	1H OR 1HO	
KI	USES K=2 FOR K=3 CASE FOR DETROIT - NO CONTROLLED		
KILL	FATAL ERROR FLAG. IF KILL=1 THEN A SUBCASE ABORTS		
KK	TEMPORARY STORAGE OF COLUMN TO BE PLOTTED		

Table A-1 PROGRAM NOMENCLATURE (cont.)

K1	OUT OF BOUNDS-LOW PLOT FLAG		
KP	PLOTTING WORK AREA		
KSTART	LOWER BOUND FOR CONTROL TYPE. (K)	1	
KSTOP	UPPER BOUND FOR CONTROL TYPE. (K)		
K1	DO LOOP INDEX IN PXCOEF		
K1	STARTING J VALUE FOR CONTROL TYPE K	1,6,11	
K2	ENDING J VALUE FOR CONTROL TYPE K	5,10,15	
L	MODE EMISSION INDEX AND DISTRIBUTION MOVING DO-LOOP-INDEX		
LCODE	ARRAY DESIGNATING THE FOUR NON-DISTR. PARAMETERS.		
LDEBUG	LINEAR PROGRAM DEBUG FLAG	2HNO	
LENGTH	LENGTH OF PLOT		INCHES
LIDLF	LOADED INSPECTION FLAG. 1=UNLOADED, 2=LOADED, 3=HYBRID		
LINT	LIMITS OF INTEGRATION	48	MONTHS
LL	MISCELLANEOUS DO LOOP INDEX		
LLPICK	COUNTER FOR LPICK		
LPICK	CUTPOINT OPTIMIZATION TIME PERIOD VECTOR		
LPLUS	TEMPORARY INDEX FOR HIGH OR LOW DECAY	0 OR 2	
LPSP	A CORRELATION BETWEEN THE FOUR EMISSION MOPES AND THE TEN PARAMETER		
LPSP	MODE EMISSION TO PARAMETER RELATION		
LQ	LENGTH OF THE INSPECTION QUEUE		CARS
LSTART	LOWER LIMIT FOR MODE EMISSION INDEX. (L)	1-6	
LSTOP	UPPER LIMIT FOR MODE EMISSION INDEX. (L)	1-6	
L1	COUNTER FOR NPICK - STATS PICK VECTOR	1-NTR	
L1	SIZE OF INPUT CONVOLUTION DISTRIBUTION 1	33 NOMINALLY	
L2	SIZE OF INPUT CONVOLUTION DISTRIBUTION 2	33 NOMINALLY	
M	PARAMETER INDEX. RANGE IS MSTART TO MSTOP		
MATCH	VECTOR USED TO STORE INPUT KEYWORD CODE NUMBERS		
MAXIT	MAXIMUM ITERATIONS BEFORE DEBUG PRINT IN CUTPNT		
MBASF	BASE FLEET INSPECTION INTERVAL	12000	MILES
MDEBUG	MAINTENANCE DEBUG FLAG	2HNO	
MEAN	MIDPOINT OF DISTRIBUTION IN CONVOL		
MED1	MEDIAN OF INPUT CONVOLUTION DISTRIBUTION 1		
MED2	MEDIAN OF INPUT CONVOLUTION DISTRIBUTION 2		
MED3	MEDIAN OF OUTPUT CONVOLUTION DISTRIBUTION		
MID	LOCATION OF MANUFACTURERS SPEC IN DISTRIBUTION		
MISFIRE	MISFIRE FLAG. =3HYES FOR MISFIRE INSPECTION	2HNO	
MM	NAME VECTOR POINTER		
MMM	YEARLY MILEAGE, ROUNDED OFF (BY CONTROL TYPE)		MILES/YEAR
MMS	MANUFACTURERS RECOMMENDED PARAMETER SPECIFICATIONS 0		
MO	FLAG INDICATING OUT OF BOUNDS HIGH POINTS		

Table A-1 PROGRAM NOMENCLATURE (cont.)

MPH	AVERAGE TRIP SPEED		MPH
MSTART	LOWER LIMIT FOR PARAMETER INDEX (M)		
MSTOP	UPPER LIMIT FOR PARAMETER INDEX (M)		
MTM	AVERAGE YEARLY MILEAGE		MILES/YEAR
MU	FLAG INDICATING OUT OF BOUNDS LOW POINTS -PLOTJK		
MU	MEAN VALUE FOR A DISTRIBUTION		
MU1	MEAN OF PRINTOUT DISTRIBUTION IN DISTPR		
MU2	MEAN OF PRINTOUT DISTRIBUTION IN DISTPR		
MU3	MEAN OF PRINTOUT DISTRIBUTION IN DISTPR		
MVPR	MEAN VALUE OF THE REJECTED PARAMETER		
M1	DO LOOP INDEX IN PXCOEF		
N	TIME INTERVAL COUNTER		
NAME	MISCELLANEOUS NAME ARRAY		
NBL	CONSTANT	1H	
NC	NUMBER OF VARIABLES TO BE PLOTTED IN PLOTJK		
NCNTR	NO. OF POLLUTION CONTROL TYPES	3	
NCODE	ARRAY DESIGNATING THE SIX DISTRIBUTED PARAMETERS.		
NC1	NC-1 IN PLOTJK. NC=NUMBER OF VARIABLES FOR PLOTTING		
NEMIS	NO. OF EMISSION TYPES	3	
NEMP	NUMBER OF EMPLOYEES AT INSPECTION STATION		
NF	N FACTORIAL IN QUEUE		
NINS	NUMBER OF KEYWORDS INPUT		
NINTR	INTEGERIZED XINT		MONTHS
NINTRB	INTEGERIZED XINTB		MONTHS
NK	CONSTANT IN PLOTJK (PLOT CHARACTERS)	1HA,B,C	
NMODE	NO. OF THE EMISSION MODES		FOUR
NN	GENERALLY NUMBER OF POINTS IN A DISTRIBUTION		
NO	CONSTANT	2HNO	
NOPTS	NUMBER OF KEYWORD OPTIONS AVAILABLE	37	
NPAR	NO. OF ENGINE PARAMETERS CONSIDERED	10	
NPERPG	NUMBER OF YEARS PER PAGE TO BE DISPLAYED		YEARS
NPICK	TIME PERIOD FOR PAYOFF DELTA CALCULATIONS		
NPL	CONSTANT IN PLOTJK	1H+	
NPTRN	NO. OF POWER TRAIN TYPES	5	
NPTS	NUMBER OF POINTS IN A DISTRIBUTION		
NRUN	RUN NUMBER		
NS	INDEX FOR REGION NAME OUTPUT		
NSTEPS	NO. OF STEPS TAKEN FOR SIMPSON INTEGR. SCHEME		
NTR	NINTR+1=TIME HORIZON FOR TEST CASE		MONTHS
NTRB	NINTRB+1=TIME HORIZON FOR BASE CASE		MONTHS
NU	CONSTANT IN PLOTJK	1HU	

Table A-1 PROGRAM NOMENCLATURE (cont.)

NX	CONSTANT IN PLOTJK	IHX	
NYEARS	NUMBER OF YEARS TO BE PRINTED		YEARS
N1	ENDING YEAR OF UNCONTROLLED AGE GROUP		
N2	STARTING YEAR OF UNCONTROLLED AGE GROUP		
N3	ENDING YEAR OF CONTROLLED AGE GROUP		
N4	STARTING YEAR OF CONTROLLED AGE GROUP		
N5	ENDING YEAR OF POST 70 AGE GROUP		
N6	STARTING AGE YEAR FOR POST 70 CARS		
OC1Y	AVERAGE INSPECTION OPERATING COSTS PER YEAR		\$/YEAR
OCMY	AVERAGE MAINTENANCE OPERATING COSTS PER YEAR		\$/YEAR
OCOST	OCOSTI+OCOSTM		\$/YEAR
OCOSTI	YEARLY INSPECTION COSTS		\$/YEAR
OCOSTM	YEARLY MAINTENANCE COSTS		\$/YEAR
OPTI	INSPECTION TYPE INDEX, 1=IDLE, 2=IGNITION, 3=INDUCTION		
OPTS	ARRAY OF KEYWORD OPTIONS		
OVCHI	OVERCHARGE FOR INSPECTION		
OVCHM	OVERCHARGE FOR MAINTENANCE		
P	TEMPORARY DISTRIBUTION STORAGE IN CONVOL		
PAR	EMISSION RESPONSE SURFACES	(SEE LISTING)	DE/DP
PARINT	SECOND PARTIAL DERIVATIVES OF E/P		
PARM	EMISSION DECAY NON-ATTRIBUTABLE TO PARAMETER DECAY		
PART	THAT PART OF THE TEST INTERVAL AT WHICH A PARTICULAR POWERTRAIN IS TESTED		
PAR1	DE/DP AVERAGED BY CONTROL TYPE		
PAR2	AVERAGE DE/DP FOR ALL VEHICLES		
PAYADJ	PAYOFF FUNCTION IN COST		
PAYFIN	PAYOFF FUNCTION IN COST		
PAYNEW	PAYOFF FUNCTION		\$/DE
PAYOFF	PERCENTAGE REDUCTION IN EMISSIONS		
PC	UNION OF PARAMETER REJECTION RATES BY POWER TRAIN		
PC(J)	PROBABILITY OF REJECTION(CONTROL)		
PCONF	DESIRED CONFIDENCE LEVEL FOR STATS		
PCXBP	TSTAR TABLE BY CONFIDENCE LIMIT		
PCYBP	TSTAR TABLE BY CONFIDENCE LIMIT		
PDEBUG	PARAMETER DECAY DEBUG FLAG	2HNO	
PI	SUCCESSFUL INSPECTION PERCENTAGE		
PLTMAK	MAXIMUM PLOT LIMITS	- HC 10 G/M - CO 50 G/M - NO 10 G/M	
PLUS	THE TOTAL CHANGE DUE TO DECAY AND MAINTENANCE		
PM	PARAMETER DISTRIBUTION MEAN VALUES		

Table A-1 PROGRAM NOMENCLATURE (cont.)

PMILES	MONTHLY MILEAGE ON -J- PARAMETER. BASED ON YEARLY ATTRITION		
PMODEL	CONSTANT. PARAMETER CASE WHEN EQUAL TO RTYPE	9HPARAMETER	
PP	REJECTION RATE FOR PARAMETER INSPECTION	0.-1.	
PPER	YEARLY POPULATION DISTRIBUTION BY -J- PARAMETER		
PPICK	VECTOR OF TIME PERIODS FOR PLOTTED OUTPUT		
PPPICK	COUNTER FOR PPICK - PLOT FLAG		
PO	PROBABILITY OF NO CARS IN THE INSPECTION QUEUE	0-1	
PRATE	PARAMETER DECAY FACTOR		
PS	MODE EMISSION REJECTION RATE	0.0-1.0	
PSA	UNION OF MODE EMISSION REJECTION RATES OVER MODES	0.0-1.0	
PSTAR	INPUT CONSTANT REJECTION RATE		
PSTARC	PSTAR CONSTRAINT COEFFICIENTS		
PT	UNION OF PARAMETER REJECTION RATES OVER POWER TRAIN		
PTOT	TOTAL REJECTION PROBABILITY		
PTOTS	TOTAL SIGNATURE REJECTION RATE		
PTS	UNION OF MODE EMISSION REJECTION RATES OVER JJ		
P1	INPUT DISTRIBUTIONS TO CONVOL		
P2	INPUT DISTRIBUTIONS TO CONVOL		
P3	INPUT DISTRIBUTIONS TO CONVOL		
QDEBUG	MODE EMISSION DECAY DEBUG FLAG		
QRATE	PARAMETER DECAY FACTOR		
RANGE	RANGE OF DISTRIBUTION IN XPT		
RANGE1	RANGE OF DISTRIBUTION IN CONVOL		
RANGE2	RANGE OF DISTRIBUTION IN CONVOL		
RANGE3	RANGE OF DISTRIBUTION IN CONVOL		
RCS	RATIO OF MANDATORY TO VOLUNTARY COST (PERCENT)		PERCENT
REINSP	PERCENTAGE OF CARS REINSPECTED	0	
RHO	RATIO OF CAR ARRIVALS TO DEPARTURES		
RNAME	RUN TYPE - SIGNATURE OR PARAMETER		
RPERC			
RSIZE	REGIONAL SIZE		SQ. MI.
RSTOP	PROGRAM STOPS EXECUTION AFTER SUBSEQUENTIAL	3HYES	2HNO
RTEST	TEST VALUE FOR RANGE3 EVEN		
RTYPE	PARAMETER MODEL ANALYSIS	9HPARAMETER	9HPARAMETER
	SIGNATURE ANALYSIS	9HSIGNATURE	
R1	1 PERCENT POINT IN DISTRIBUTION - PACKD		
R2	99 PERCENT POINT IN DISTRIBUTION - PACKD		
S	EMISSION RATE SUMMING VARIABLE		
SALE	EQUIPMENT SALVAGE FRACTION	0	
SALL	LAND SALVAGE FRACTION	100	
SALP	FACILITIES SALVAGE FRACTION	0	

Table A-1 PROGRAM NOMENCLATURE (cont.)

SCALEBM	A SCALING VECTOR FOR BASELINE MAINTENANCE	
SD	STANDARD DEVIATION OF A DISTRIBUTION	
SDEBUG	STATS DEBUG FLAG	2HNO
SD1	STANDARD DEVIATION OF PRINTOUT DISTRIBUTION	
SD2	STANDARD DEVIATION OF PRINTOUT DISTRIBUTION	
SD3	STANDARD DEVIATION OF PRINTOUT DISTRIBUTION	
SIG	STANDARD DEVIATION OF PARAMETER DISTRIBUTIONS	
SIGCF	PARAMETER-EMISSION CORRELATION ERROR	
SIGDIFF	SIGNIFICANT DIFFERENCE	
SIGMF	INSPECTION MEASUREMENT ERROR (INSTRUMENTATION)	
SIGMNE	MAINTENANCE EFFECTIVENESS ERROR - STANDARD DEVIATION	
SIGSDE	STANDARD DEVIATION OF DETERIORATION RATE ERRORS	
SIGP	PARAMETER DISTRIBUTION ERRORS	
SIGP	STANDARD DEVIATION PARAMETER SETTINGS	
SIGS	SIGNATURE MODE DISTRIBUTION ERRORS	
SIST	SIZE OF INSPECTION STATION	SQUARE FT
SITFI	NUMBER OF STATE LANE INSPECTION STATIONS	
SITFM	NO. OF MAINTENANCE SITES	SITES
SLANE	STATE LANE VS GARAGE FLAG. =10HSTATE, OR 10HGARAGE	
SM	SIGNATURE MODE DISTRIBUTION MEAN VALUES	
SMALL	SMALLER OF RANGE1 AND RANGE2 IN CONVOL	
SMODEL	CONSTANT. SIGNATURE CASE WHEN EQUAL TO RTYPE	9HSIGNATURE
SMS	MODE EMISSION MEAN	
SPAR	SIGNATURE (EMISSION) RESPONSE SURFACES	
SSIG	MODE EMISSION STANDARD DEVIATION	
SSI7E	SIZE OF INSPECTION FACILITY FOR OUTPUT -FACILITIES	SQUARE FT
STARLEX	MODE EMISSION DISTRIBUTION X VALUES. 33 POINTS.	
STARLEY	MODE EMISSION DISTRIBUTION Y VALUES. 33 POINTS.	
START	POPULATION STARTING EMISSION RATES	
START1	STARTING EMISSION LEVELS FOR LOS ANGELES FLEET	
START2	STARTING EMISSION LEVELS FOR NEW YORK FLEET	
START3	STARTING EMISSION LEVELS FOR WASHINGTON FLEET	
START4	STARTING EMISSION LEVELS FOR DENVER FLEET	
START5	STARTING EMISSION LEVELS FOR DETROIT FLEET	
STAT	TOTAL NUMBER OF LANES	LANES
STATSV	STAT SAVING VARIABLE IN CASE STAT IS CHANGED	
STIME	INSPECTION TIME IN A STATE LANE STATION	
SUM	EFFECT OF VOLUNTARY MAINTENANCE ON MODE EMISSIONS	
SUM	THE CHANGE IN PARAMETER SETTING DUE TO BASELINE MAINTENANCE	
SUMI	SUMMING VARIABLE IN MAINT	
SUMJ	BASELINE EMISSION TIME HISTORY SUMMING VARIABLE	

Table A-1 PROGRAM NOMENCLATURE (cont.)

SUMP	TOTAL MODE EMISSION DECAY		
SUM1	EFFECT OF MANDATORY MAINTENANCE ON MODE EMISSIONS		
SXCUT	EMISSION PASS/FAIL CRITERIA		
SXCUTI	INPUT MODE EMISSION CUTPOINTS BY REGION		
T	FRACTION COUNTER FOR NORMALIZATION	0.-1.	
TABLEX	INITIAL PARAMETER DISTRIBUTION (X-AXIS)		
TABLEY	INITIAL PARAMETER DISTRIBUTION (Y-AXIS)		
TAREA	INTEGRATED THISTT		G
TCP	TOTAL PARTS COST PER PERIOD		\$
TDEBUG	TEST DEBUG FLAG	2HNO	
TDEL	DELTA E STORAGE FOR PRINTOUT IN MAINT		
TDIST	ENGINE PARAMETER DISTRIBUTION TYPE 1-NORMAL		
TDST	INPUT PARAMETER USAGE FLAG VECTOR BY REGION		
TE1	OVERALL EMISSION SUMMING VARIABLES IN PRINT6		UG/M3
TE2	OVERALL EMISSION SUMMING VARIABLES IN PRINT6		MG/M3
TE3	OVERALL EMISSION SUMMING VARIABLES IN PRINT6		UG/M3
TH	FRACTION COUNTER FOR NORMALIZATION	0.-1.	
THIST	HISTORY OF EMISSIONS FOR EACH POWERTRAIN FOR TEST FLEET		GR/MI
THISTT	EMISSION LEVEL PER EMISSION TYPE FOR THE TEST FLEET		GR/MI
TIME	TIME AT INSPECTION INTERVAL		MONTHS
TIMEC	INSPECTION TIME BY PARAMETER AND VEHICLE TYPE		HOURS
TIMEI	ENGINE PARAMETER INSPECTION TIMES	(SEE LISTING)	MINUTES
TIMEM	ENGINE PARAMETER MAINTENANCE TIMES		MINUTES
TINT	INSPECTION INTERVAL	6-24	MONTHS
TM	MILEAGE SUMMING VARIABLE IN PRINT6		MILES/YEAR
TMIL	MONTHLY MILEAGE ON -J- PARAMETER. BASED ON TINT		
TMU	MEAN EMISSION RATE FOR TEST CASE		
TOBE	TOTAL EMISSION QUANTITY FOR BASE FLEET		TONS
TONX	WEIGHTED SUM OF DIFFERENCE OF BASE-TEST		TONS
TONY	STATISTICALLY SIGNIFICANT BASE-TEST EMISSION RATES		TONS/YEAR
TONZ	BASE-TEST EMISSIONS BASED ON LAST TIME PERIOD		TONS/YEAR
TOTE	TOTAL EMISSION QUANTITY FOR TEST FLEET		TONS
TP	CONSTANT IN PRINT6	100.	PERCENT
TPDB	BASELINE EMISSION RATES		TONS/DAY
TPDT	TEST FLEET EMISSION LEVEL		TONS/DAY
TPER	POPULATION DISTRIBUTION B -J- PARAMETER BASED ON TINT.		
TSD	EMISSION RATE SIGMA FOR TEST CASE		
TSIG	TEST EMISSION DISTRIBUTION ERROR		
TSIZE	SAMPLE SIZE FOR THE TEST FLEET		
TSTAR	STATISTICAL SIGNIFICANCE TESTING PARAMETER		
TT	TOTAL FRACTION FOR NORMALIZING		

Table A-1 PROGRAM NOMENCLATURE (cont.)

TTI	TOTAL INSPECTION TIME PER PERIOD	MIN
TTM	TOTAL MAINTENANCE TIME	1
TTTTT	TOTAL FRACTION FOR NORMALIZING	
TXTRA	NINTR-XINT	MONTHS
U	UTILITY FUNCTION IN OPTMUM	
UTIL	MAXIMUM UTILITY FUNCTION IN OPTMUM	
V	ARRAY OF VARIABLE VALUES TO BE PLOTTED	
VAR1	VARIABLE VALUE TO BE PRINTED	
VAR2	VARIABLE VALUE TO BE PRINTED	
VAR3	VARIABLE VALUE TO BE PRINTED	
VEHPOP	STARTING VEHICLE POPULATION IN MILLIONS (OUTPUT)	CARS*10**6
VMN	ARRAY OF VARIABLE MINIMUMS	
VMN1	MINIMUM VALUE FOR VARIABLE 1 IN PLOTJK	
VMN2	MINIMUM VALUE FOR VARIABLE 2	
VMN3	MINIMUM VALUE FOR VARIABLE 3	
VMX	ARRAY OF VARIABLE MAXIMUMS	
VMX1	MAXIMUM VALUE FOR VARIABLE 1 IN PLOTJK	
VMX2	MAXIMUM VALUE FOR VARIABLE 2	
VMX3	MAXIMUM VALUE FOR VARIABLE 3	
VNAME1	VARIABLE NAME FOR ARRAY OUTPUT	
VNAME2	VARIABLE NAME FOR ARRAY OUTPUT	
VNAME3	VARIABLE NAME FOR ARRAY OUTPUT	
V1	VALUE OF VARIABLE 1 TO BE PLOTTED IN PLOTJK	
V2	VALUE OF VARIABLE 2 TO BE PLOTTED IN PLOTJK	
V3	VALUE OF VARIABLE 3 TO BE PLOTTED	
WIDTH	X AXIS POINT SPREAD FOR PACKED DISTRIBUTION-PACKD	
WF	PARAMETER DECAY WEIGHTS	
WQTI	WAITING TIME IN THE INSPECTION QUEUE	
WTIME	WAITING TIME IN THE INSPECTION QUEUE	MINUTES
WW1	TOTAL SUBPOPULATION PERCENTAGE FOR NORMALIZING	
X	VEHICLE AGE DISTRIBUTION OVER 15 YEARS	0.-1.
XBASE	DISTRIBUTION DISCRIPTION FOR BASELINE (X-AXIS)	
XBP	DUMMY ARRAY USED FOR MANIPULATING THE PARAMETER DIST.	
XCUT	PARAMETER PASS/FAIL CRITERIA	
XCUTI	INPUT PARAMETER CUTPOINTS BY REGION	
XCUTLO	MINIMUM SIGNIFICANT PARAMETER SETTING	
XCUTM	CUTPOINTS AT MAXIMUM UTILITY FUNCTION	
XDUM	TEMPORARY DISTRIBUTION STORAGE	
XHI	UPPER X INTEGRATION LIMIT	
XHIA	UPPER INTEGRATION LIMIT FOR ACCEPTED DISTRIBUTION	
XHIR	UPPER INTEGRATION LIMIT FOR REJECTED DISTRIBUTION	

Table A-1 PROGRAM NOMENCLATURE (cont.)

XINT	NO. OF INSPECTION INTERVALS(TEST)	48	MONTHS
XINTB	NO OF MAINTENANCE INTERVALS(BASELINE)	48	MONTHS
XKZE	AMORTIZATION CONSTANT FOR EQUIPMENT		
XKZL	AMORTIZATION CONSTANT FOR LAND		
XKZP	AMORTIZATION CONSTANT FOR FACILITIES		
XLAM	LAMBDA - ARRIVAL RATE		
XLANE	NO OF LANES PER STATION	1-4	LANES
XLO	LOWEST X VALUE		
XLOA	LOWER INTEGRATION LIMIT FOR ACCEPTED DISTRIBUTION		
XLOR	LOWER INTEGRATION LIMIT FOR REJECTED DISTRIBUTION		
XM	INTERPOLATED PERCENTAGE		
XMAX	LAGEST X VALUE IN X1 OR X2 IN ADD		
XMIN	SMALLEST X VALUE IN X1 OR X2 IN ADD		
XN	OPTIMAL REJECTION RATES RETURNED FROM CUTPNT	0.-1.	
XNAME	INSPECTION TYPE NAMES -OUTPUT ONLY		
XNM	OPTIMAL REJECTION RATES AT MAX UTILITY FUNCTION	0-1.	
XO	MINIMUM X VALUE IN A DISTRIBUTION OR PLOT		
XOPT	INTEGRATE F(X) OR X*F(X) FLAG		
XR	PARAMETER SETTING CHANGE DUE TO MAINTENANCE-CUTPNT		
XRATE	MODE EMISSION DECAY FACTOR		
XRN	NEW PARAMETER DELTA IN CUTPNT		
XSUM	SUMMING VARIABLE IN COST		
XTM	AVERAGE MAINTENACE TIME FOR TEST FLEET		
XX	TEMPORARY STORAGE		
X1	INITIAL VEHICLE DISTRIBUTION FOR LOS ANGELES FLEET		
X1BP	INTERPOLATION BREAK PTS (X-AXIS) FOR PP AND MVPR ESTIMATIONS (SIGNATURE ONLY)		
X2	INITIAL VEHICLE DISTRIBUTION FOR NEW YORK FLEET		
X3	INITIAL VEHICLE DISTRIBUTION FOR WASHINGTON FLEET		
X4	INITIAL VEHICLE DISTRIBUTION FOR DENVER FLEET		
X5	INITIAL VEHICLE DISTRIBUTION FOR DETROIT FLEET		
Y	TEMPORARY STORAGE OF DISTRIBUTION IN CONVOL		
YBASE	DISTRIBUTION DISCRIPTION FOR BASELINE (Y-AXIS)		
YBP	DUMMY ARRAY USED FOR MANIPULATING THE PARAMETER DIST.		
YES	CONSTANT FOR CHECKING FOR FLAGS ON OR OFF	3HYES	
YHI	MAXIMUM Y VALUE TO BE PLOTTED IN EPLT		
YLO	LOWEST Y VALUE TO BE PLOTTED (ALWAYS ZERO) - EPLT		
YMN	LOWEST Y VALUE TO BE PLOTTED (ALWAYS ZERO) - PLOT		
YMX	HIGEST Y VALUE TO BE PLOTTED IN PLOT		
YR	TIME AT AN INSPECTION INTERVAL		
YSUM	SUMMING VARIABLE IN COST		

Table A-1 PROGRAM NOMENCLATURE (cont.)

YTM	AVERAGE PARTS COST FOR TEST FLEET		
YY	TEMPORARY STORAGE OF DISTRIBUTION IN CONVOL		
Y1	VALUE OF FIRST FUNCTION POINT TO BE PLOTTED-EPLOT		
Y1BP	INTERPOLATION BREAK PTS (Y-AXIS) FOR PP		
Y1DUM	TEMPORARY STORAGE FOR PARAM. REJECTION RATE TABLE		
Y2	Y AXIS NUMERICAL IDENTIFIER		
Y2	VALUE OF SECOND FUNCTION POINT TO BE PLOTTED-EPLOT		
Y2BP	INTERPOLATION BREAK PTS (Y-AXIS) FOR MVPR		
Y2DUM	TEMPORARY STORAGE FOR PARAM. EXPECTED VALUE TABLE		
Y3	Y AXIS NUMERICAL IDENTIFIER		
Y4	Y AXIS NUMERICAL IDENTIFIER		
Y5	Y AXIS NUMERICAL IDENTIFIER		
Y6	Y AXIS NUMERICAL IDENTIFIER IN EPLOT		
ZIC	COST OF CAPITAL	7	
ZQUEI	LENGTH OF WAITING LINE AT INSPECTION STATION		CARS
ZSUM	SUMMING VARIABLE IN COST		
ZX	TEMPORARY STORAGE OF CAPITAL COSTS		DOLLRS/DAY
ZZ	TEMPORARY STORAGE VARIABLE		
Z1	NUMBER OF SUPERVISORS PER LANE	50.	
Z2	MECHANICS HOURLY PAY RATE	10.	\$/HOUR
Z3	FRANCHISED GARAGE PROFIT MARGIN	10.	
Z4	INFLATION RATE	6.	/YEAR
Z5	DISCOUNT RATE	7.	/YEAR
Z6	NOT USED	0	
Z7	NOT USED	0	
Z8	NOT USED	0	
Z9	INCONVENIENCE RATE(OF HOURLY RATE)	42.	
Z10	FACILITIES CONSTRUCTION COSTS	10.	\$/SQ.FT.
Z11	FIXED EQUIPMENT COSTS	16000.	\$/SITE
Z12	VARIABLE EQUIPMENT COSTS	2000.	\$/LANE
Z13	LAND PURCHASING COSTS	2.	\$/SQ.FT.
Z14	FIXED INFO. SYSTEM COSTS	0	\$
Z15	INFO. PROCESSING COSTS	0.5	\$/CAR
Z16	ATTENDENT HOURLY PAY RATE	3.5	\$/HOUR
Z17	DYNAMOMETER COSTS	5000.	\$/LANE

APPENDIX B

SAMPLE PROBLEMS

APPENDIX B

SAMPLE PROBLEMS

This appendix presents two sample cases which are designed to illustrate many of GEEP's input/output options. The data for the first case, consisting of an Engine Inspection coupled with Extensive B Maintenance, is given in Table B-1. In this example, the input includes all three control groups (Uncontrolled, Controlled and Post 1970). Shown in Table B-2 is computer output of the input data. This page is useful in checking for input errors. Tables B-3 through B-7 show typical output data for the selected case. These include a results summary, vehicle population characteristics, Los Angeles Basin data, pass/fail analysis for engine inspection, developed pass/fail inspection criteria, and resultant engine parameter rejection rates. Depending on the applications, the pass/fail criteria can be inputted directly or determined from the optimization algorithm. The XCUT vector specifies the pass/fail criteria for each of the ten engine parameters for each control fleet. The SXCUT vector performs a similar function for six exhaust mode emissions.

The program also generates a set of emission time history plots as depicted in Figures B-1 through B-3 for HC, CO and NO_x, respectively. These plots are augmented by actual numerical data as shown in Table B-9. Here, the emission histories are given by power train type for each inspection interval. Finally, Table B-10 presents the results of a statistical analysis for predicted emission reductions. In this example, results are shown for each exhaust emission at year six. This completes the standard output generated during a normal run. More detailed

information can be obtained through the use of PLOT and DEBUG options.

The second sample case selected for presentation involves an Emission Inspection with Extensive B Maintenance. The required input data is shown in B-11. It should be noted that only the data that is different from the first case need to be inputted. For example, both cases utilized all three control types and consequently it was not necessary to respecify them again in the second case. Table B-12 shows a computer generated listing of the input data for the second case. This output corresponds to the data shown in Table B-2. Table B-13 presents inputted and calculated data specific to the State Lane Emission Inspection Strategy. Input data includes total number of lanes for system, inspection times and equipment costs. Calculated output consists of total user time and facilities configuration. Lastly, Table B-14 gives the summary results for case 2. Results depicting the remaining standard output have not been shown since they are analogous to those presented in the first case.

Table B-1 SAMPLE PROBLEM #1 (ENGINE INSPECTION EXTENSIVE B PROGRAM)

c c 1	
<u>KEYWORD</u>	<u>DESCRIPTION</u>
PARAMETER	Parameter Inspection
LA	Los Angeles Area
CONTROL	} Include all three control types.
UNCONTROL	
POST 70	
CUTPTS	Cutpoint optimization debug output.
IDLE	} Include all ten parameters.
IGNITION	
INDUCTION	
LOADED	Test under loaded conditions
THAT'S ALL	End of keyword data flag.
P\$NAM1	Namelist input card.
PPICK = 0	No plotted output.
LPICK = 2	Optimize cutpoints at first period only.
NPICK = 6	Statistical analysis at last period only.
\$END	End of namelist data and end of case flag.

Table B-2 INPUT DATA FOR FIRST CASE

RUN TYPE --	PARAMETER MODEL
AREA CONSIDERED --	LOS ANGELES BASIN
CAR POPULATION TYPE --	UNCONTR
	CONTR
	POST 70

PARAMETERS CONSIDERED --	1	IDLE CO
	2	RPM
	3	TIMING
	4	MISFIRE
	5	NOX
	6	AIR PUMP
	7	PCV
	8	AIR CLEAN
	9	VAC KICK
	10	HEAT RISER

DEBUG OPTIONS FOR THE FOLLOWING SUBROUTINES:

BLINE	NO
MICRO	NO
TEST	NO
COSTS	NO
AREA	NO
LINPRO	YES
PDECAY	NO
DATA	NO
STATS	NO

\$NAM1
 PPICK=0
 LPICK=2
 NPICK=6
 \$END

Table B-3 SUMMARY RESULTS FOR CASE 1

 * TRW INSPECTION/MAINTENANCE *
 * SYSTEM MODEL *

SUMMARY INFORMATION

ENGINE PARAMETER STRATEGY EXTENSIVE B
 INSPECTION PERIOD IS 12.0 MONTHS

PAYOFF FUNCTION UNADJUSTED (DOLLARS/WEIGHTED EMISSION)	1863.76
PAYOFF FUNCTION STATISTICALLY ADJUSTED (DOLLARS/WEIGHTED EMISSION)	932.76
PAYOFF FUNCTION AT END OF LAST YEAR (DOLLARS/WEIGHTED EMISSION)	633.72
HC EMISSION REDUCTION (PERCENT)	10.70
CO EMISSION REDUCTION (PERCENT)	6.14
NO EMISSION REDUCTION (PERCENT)	-0.87
HC AVERAGE EMISSIONS (TONS/DAY)	715.42
CO AVERAGE EMISSIONS (TONS/DAY)	9318.10
NO AVERAGE EMISSIONS (TONS/DAY)	541.08
TOTAL COSTS FOR MANDATORY PROGRAM (DOLLARS/YEAR)	105171879.78
TOTAL COSTS FOR VOLUNTARY PROGRAM (DOLLARS/YEAR)	172490930.25
RATIO OF MANDATORY TO VOLUNTARY COSTS (PERCENT)	60.97
INSPECTION CAPITAL COSTS (DOLLARS/STATION)	0.00
AVERAGE INSPECTION OPERATING COSTS (DOLLARS/YEAR)	56762290.23
MAINTENANCE CAPITAL COSTS (DOLLARS)	0.00
AVERAGE MAINTENANCE OPERATING COSTS (DOLLARS/YEAR)	48409289.55
USER COSTS (DOLLARS/CAR)	1.93
COST PER INSPECTION	24.04
COST PER VEHICLE MAINTAINED	33.09
AVERAGE NUMBER OF CARS INSPECTED/YEAR	4374727.91
AVERAGE NUMBER OF CARS REJECTED/YEAR	2406155.68
AVERAGE NUMBER OF CARS MAINTAINED/YEAR	2406155.68
AVERAGE FAILURE PERCENTAGE	.55
TOTAL PROGRAM DURATION (YEARS)	5.00

Table B-4 VEHICLE POPULATION CHARACTERISTICS

YEAR		VEHICLE DISTRIBUTION PERCENT	INCREMENTAL ODOMETER READING MILES	VEHICLE EMISSIONS LEVELS HC CO NO _x GRAMS/MILE	VEHICLE POPULATION		
1	PRECONTROLLED	32.5	4157	11.94	129.80	5.87	4000000
	CONTROLLED (1966-1970)	46.2	5413	7.28	85.30	5.34	
	POST 1970	21.3	14014	4.43	63.40	5.00	
	TOTALS	100.0	3225	8.18	95.70	5.50	
2	PRECONTROLLED	24.5	3908	12.34	133.32	3.74	4120000
	CONTROLLED (1966-1970)	43.5	7262	7.37	93.24	6.28	
	POST 1970	32.0	13002	4.17	73.87	5.84	
	TOTALS	100.0	8281	7.39	98.92	5.21	
3	PRECONTROLLED	18.1	3733	12.38	132.54	3.35	4245000
	CONTROLLED (1966-1970)	39.7	6265	7.56	93.26	6.18	
	POST 1970	42.3	12192	4.69	75.06	5.64	
	TOTALS	100.0	8312	7.23	92.87	5.43	
4	PRECONTROLLED	13.2	3562	12.67	134.43	3.23	4373900
	CONTROLLED (1966-1970)	34.6	5409	7.73	93.49	6.07	
	POST 1970	52.2	11471	4.34	78.20	5.41	
	TOTALS	100.0	8323	6.77	90.91	5.35	
5	PRECONTROLLED	9.7	3403	12.74	135.82	2.94	4502000
	CONTROLLED (1966-1970)	28.7	4743	7.87	92.69	5.98	
	POST 1970	61.6	10763	4.56	79.96	5.20	
	TOTALS	100.0	8335	6.30	89.00	5.21	
6	PRECONTROLLED	7.1	3268	12.78	136.35	2.86	4637096
	CONTROLLED (1966-1970)	22.7	4442	8.01	91.31	5.90	
	POST 1970	70.2	10106	4.47	80.39	4.99	
	TOTALS	100.0	8336	5.86	88.64	5.03	

Table B-5 LOS ANGELES BASIN DATA

EMISSION SURVEILLANCE DATA SOURCE	TRW/ARB
FEDERAL 1975 MOTOR VEHICLE STANDARDS	
HC	.41 G/MI
CO	3.40 G/MI
NO	3.00 G/MI
EMISSION SPECIE WEIGHTING FUNCTION	
HC	.60
CO	.10
NO	.30
MINIMUM EMISSION REDUCTION GOALS	
HC	10.00 PERCENT
CO	10.00 PERCENT
NO	0.00 PERCENT
REGIONAL AREA	1250.00 SQ MI
AVERAGE VEHICLE SPEED	30.00 MPH
VEHICLE POPULATION	4.00 MILLION
NUMBER OF CLASS #A# FRANCHISED GARAGES	1000

Table B-6 PASS/FAIL ANALYSIS FOR ENGINE INSPECTION

DISCRETE PARAMETER														
PARAMETER REJECTION RATES								EMISSION DELTA			WEIGHTED			
4	5	6	10	1	2	3	7	8	9	I/M COSTS	PERCENT	EMISSION		
											HC	CO	NO	DROP
0	0	0	0	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.00	0.0000	0.0000	0.0000	0.0000
0	0	0	1	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	.50	0.0000	0.0000	0.0000	0.0000
0	1	0	0	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	1.58	.0021	-.0018	.0018	0.0000
0	1	0	1	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	2.08	.0021	-.0018	.0018	0.0000
1	0	0	0	.42	0.00	0.00	.39	.44	.14	6.38	.1023	.2074	-.0160	1.5581
1	0	0	1	.42	0.00	0.00	.39	.44	.14	6.88	.1023	.2074	-.0160	1.5581
1	1	0	0	.42	0.00	0.00	.39	.44	.14	7.96	.1044	.2056	-.0141	1.5557
1	1	0	1	.42	0.00	0.00	.39	.44	.14	8.46	.1044	.2056	-.0141	1.5557

Table B-7 PASS/FAIL INSPECTION CRITERIA

PARAMETER	1	2	3	4	5	6	7	8	9	10
UNCONTR	1.00	-999	10.00	1	0	0	-.1173	10.63	-1.0000	0
CENR	1.00	-12	1.03	1	0	1	-.1138	10.60	-.0520	1
PCST 7C	1.00	-999	10.00	1	0	0	-.1124	10.32	-.0521	0

MODE EMISSIONS	1	2	3	4	5	6
UNCONTR	3000	6.00	4000	450	3.50	4000
CENR	250	4.00	5000	250	1.50	5000
POST 7C	2000	3.00	4000	200	1.00	4000

Table B-8 ENGINE PARAMETER REJECTION RATES FOR FIRST TIME INTERVAL

		TIME HISTORY POINT 2 12.0 MONTHS					TOTAL FAILURE IS				.9025
		POWERTRAIN TYPE 1 -- GM									.8985
PARAMETER	1	2	3	4	5	6	7	8	9	10	UNION
UNCONTR	.354	0.000	0.000	.020	0.000	0.000	.477	.559	0.000	0.000	.856
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
CONTR	.457	.510	.354	.022	0.000	.059	.430	.504	.129	.273	.972
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
POST 70	.434	0.000	0.000	.020	0.000	0.000	.381	.434	.128	0.000	.830
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
		POWERTRAIN TYPE 2 -- FORD									.9005
PARAMETER	1	2	3	4	5	6	7	8	9	10	UNION
UNCONTR	.354	0.000	0.000	.020	0.000	0.000	.477	.559	0.000	0.000	.856
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
CONTR	.471	.510	.354	.022	0.000	.059	.430	.504	.129	.273	.972
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
POST 70	.450	0.000	0.000	.020	0.000	0.000	.381	.434	.128	0.000	.835
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
		POWERTRAIN TYPE 3 -- CHRY									.9025
PARAMETER	1	2	3	4	5	6	7	8	9	10	UNION
UNCONTR	.372	0.000	0.000	.020	0.000	0.000	.477	.559	0.000	0.000	.856
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
CONTR	.432	.510	.354	.022	0.000	.059	.430	.504	.129	.273	.972
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000
POST 70	.464	0.000	0.000	.020	0.000	0.000	.381	.434	.128	0.000	.837
MODE	0.000	0.000	0.000	0.000	0.000	0.000					0.000

B-10

HC DATA HISTORY -- EMISSION(GPM) VS. TIME(MO.) B = BASE T = TEST

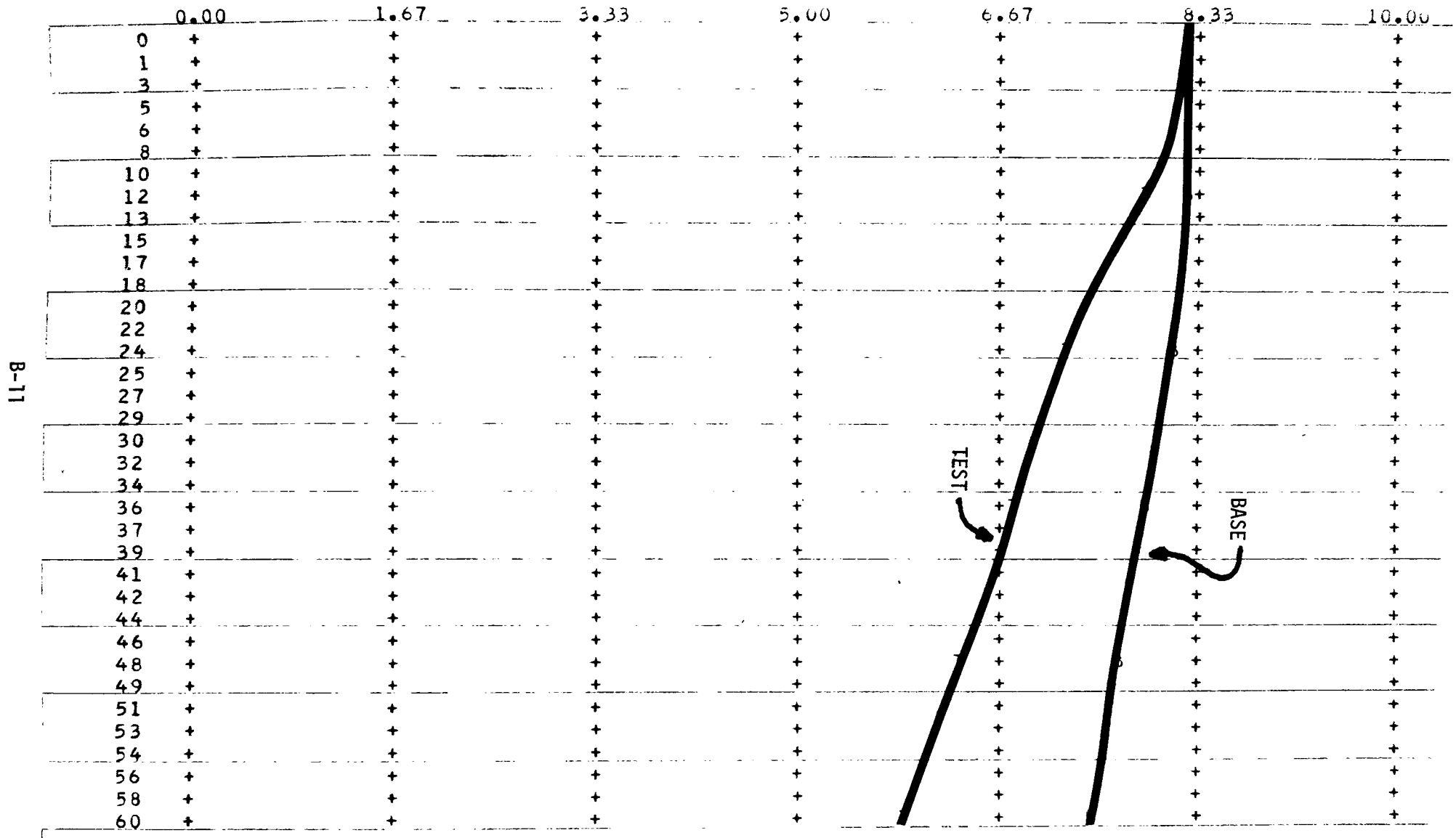


Figure B-1 HC Emission Time History Plot

CO DATA HISTORY -- EMISSION(GPM) VS. TIME(MIN.) E = BASE I = TEST

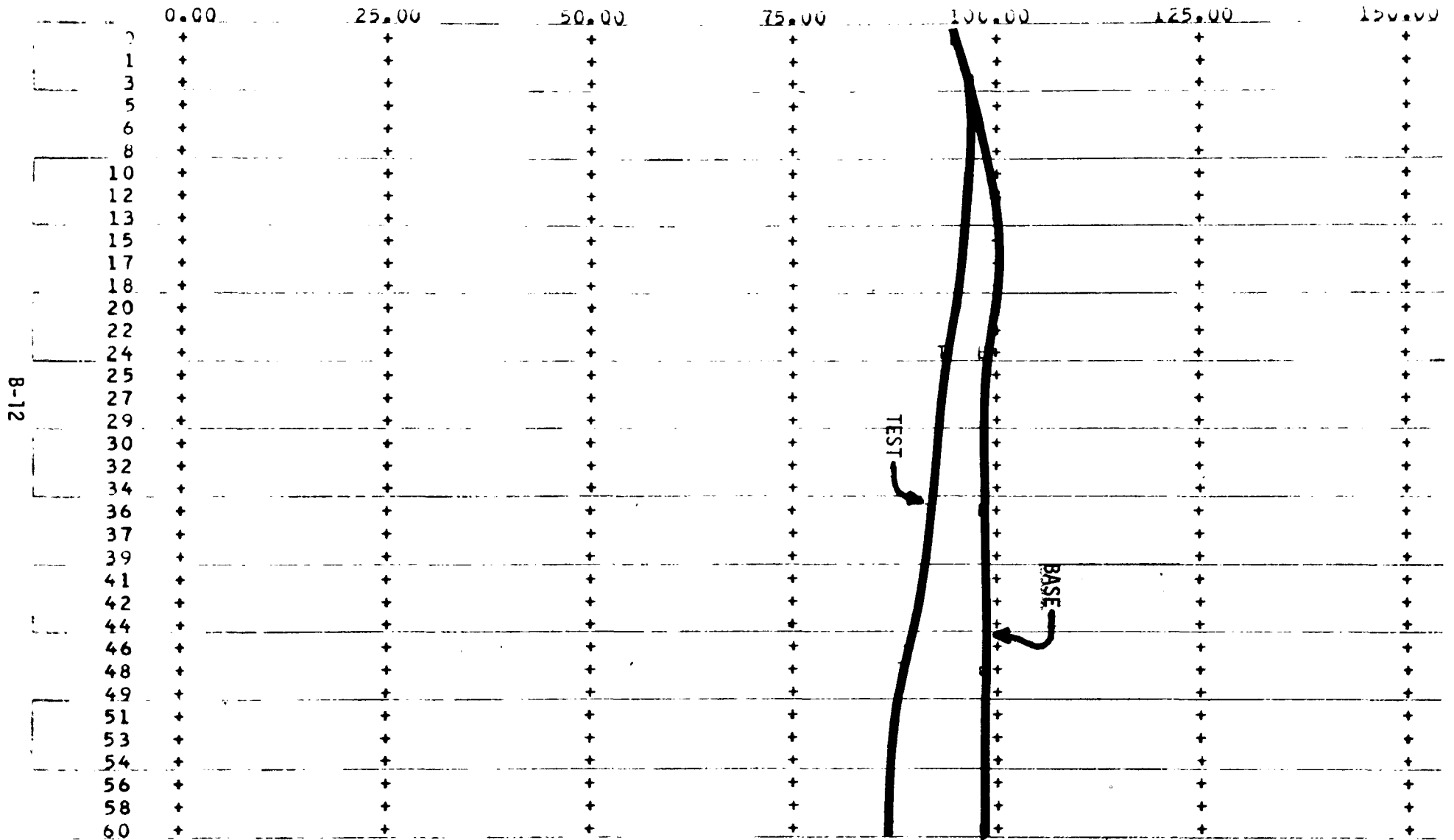


Figure B-2 CO Emission Time History Plot

NO DATA HISTORY -- EMISSION(GPM) VS. TIME(MO.) B = BASE T = TEST

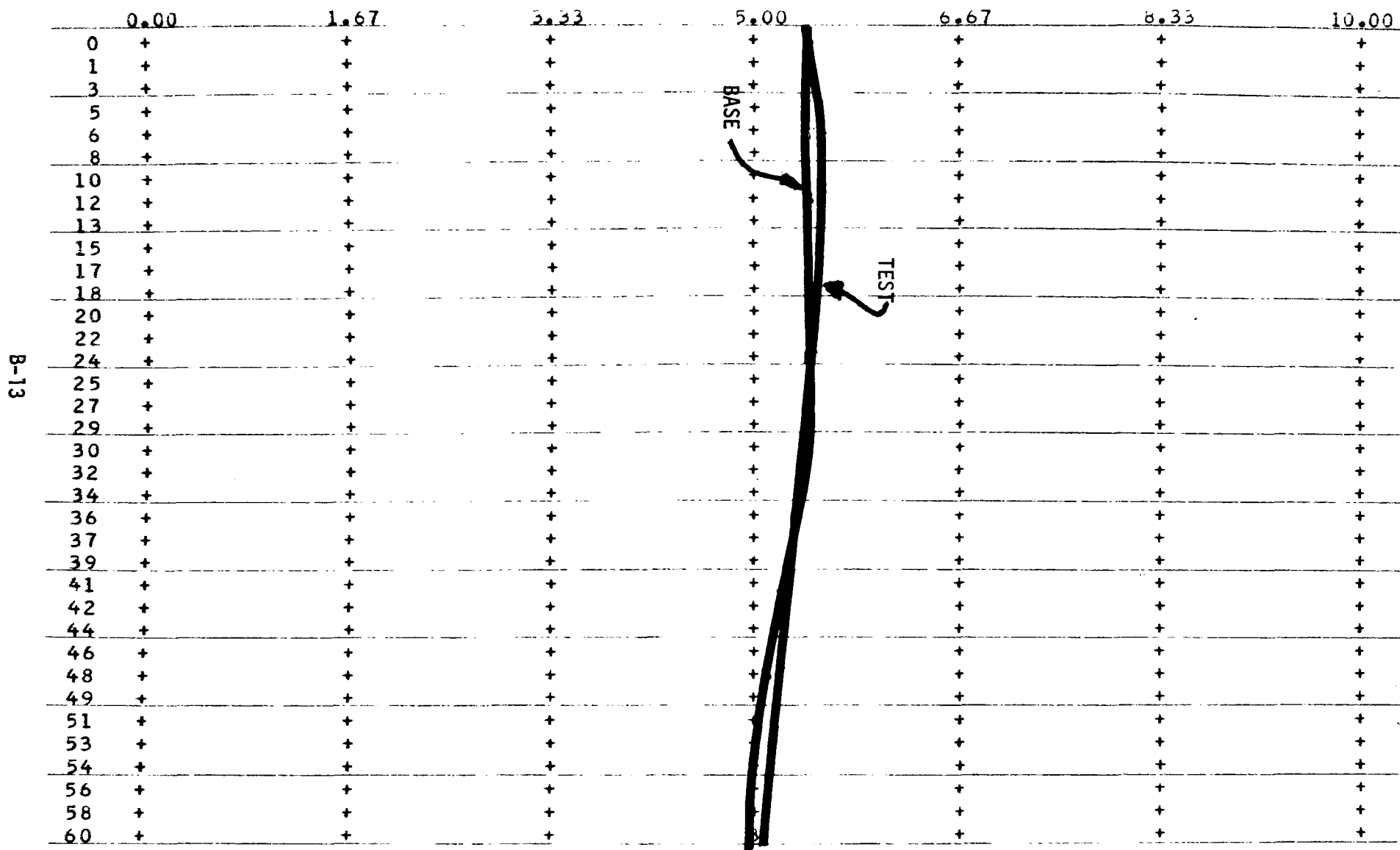


Figure B-3 NO_x Emission Time History Plot

Table B-9 EMISSION HISTORY SUMMARY

*****HC LEVEL -- END OF INSPECTION INTERVAL (GR/VEHICLE-MILE) *****

POWERTRAIN TYPE

TEST NO.	GM	FORD	CHRY	AMC	IMPORTS
1	8.1782	8.1782	8.1782	8.1782	8.1782
2	7.8958	7.8930	7.8909	7.8885	7.8862
3	7.2623	7.2571	7.2529	7.2483	7.2438
4	6.7786	6.7730	6.7682	6.7631	6.7581
5	6.3151	6.3091	6.3037	6.2981	6.2926
6	5.8697	5.8640	5.8589	5.8538	5.8490

*****CO LEVEL -- END OF INSPECTION INTERVAL (GR/VEHICLE-MILE) *****

POWERTRAIN TYPE

TEST NO.	GM	FORD	CHRY	AMC	IMPORTS
1	95.6984	95.6984	95.6984	95.6984	95.6984
2	97.2012	97.0448	96.9169	96.7786	96.6391
3	93.2939	92.9554	92.6685	92.3718	92.0685
4	91.7503	91.3432	90.9815	90.6204	89.8616
5	90.1879	89.7160	89.2778	88.5066	87.2906
6	88.3403	87.8751	87.2194	86.1241	84.6374

Table B-9 EMISSION HISTORY SUMMARY (cont.)

*****NO LEVEL -- END OF INSPECTION INTERVAL (GR/VEHICLE-MILE) *****

POWERTRAIN TYPE

TEST NO.	GM	FORD	CHRY	AMC	IMPORTS
1	5.4973	5.4973	5.4973	5.4973	5.4973
2	5.5064	5.5078	5.5089	5.5102	5.5114
3	5.4606	5.4630	5.4648	5.4668	5.4688
4	5.3489	5.3510	5.3527	5.3547	5.3565
5	5.2015	5.2035	5.2052	5.2071	5.2089
6	5.0273	5.0290	5.0305	5.0321	5.0335

SUMMARY EMISSION HISTORIES

TEST NO	TIME MC	BASE HC	TEST	BASE CO	TEST	BASE NO	TEST
1	0.0	8.178	8.178	95.698	95.698	5.497	5.497
2	12.0	8.228	7.891	99.817	96.916	5.470	5.509
3	24.0	8.071	7.253	99.120	92.672	5.398	5.405
4	36.0	7.877	6.768	98.535	90.911	5.293	5.353
5	48.0	7.663	6.304	98.103	88.996	5.147	5.205
6	60.0	7.445	5.859	97.761	80.839	4.972	5.030

Table B-10 STATISTICAL ANALYSIS OF PREDICTED EMISSION REDUCTIONS

YEAR 6

HC EMISSION

REJECT NULL HYPOTHESIS.

THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

AT A CONFIDENCE LEVEL OF 90.00

THE LOWER CONFIDENCE LIMIT IS 1.3855E+00

T = 1.0135E+01 TSTAR = 1.2800E+00

TEST MU = 5.8591E+00 BASE MU = 7.4449E+00

CO EMISSION

REJECT NULL HYPOTHESIS.

THERE IS A SIGNIFICANT DIFFERENCE IN THE MEANS

AT A CONFIDENCE LEVEL OF 90.00

THE LOWER CONFIDENCE LIMIT IS 5.4533E+00

T = 2.5564E+00 TSTAR = 1.2800E+00

TEST MU = 8.6839E+01 BASE MU = 9.7761E+01

NO EMISSION

ACCEPT THE NULL HYPOTHESIS.

THERE IS NOT A SIGNIFICANT DIFFERENCE IN THE MEANS

AT A CONFIDENCE LEVEL OF 90.00

T = -2.4512E-01 TSTAR = 1.2800E+00

TEST MU = 5.0305E+00 BASE MU = 4.9724E+00

Table B-11 SAMPLE PROBLEM #2
(EMISSION INSPECTION EXTENSIVE B PROGRAM)

(8
1)

SIGNATURE	Mode emission inspection
IHC	} Mode emissions (signatures) inspected
ICO	
CO45	
HC45	
STOP	Last case flag
THAT S ALL	End of case flag
P\$NAM1	
NPICK=6	Statistical analysis at last time period
STAT=100	100 inspection stations
\$END	

Note: Keyword and namelist input data from
the previous cases is still in affect

Table B-12 INPUT DATA FOR SECOND CASE

RUN TYPE --	SIGNATURE	MODEL
AREA CONSIDERED --	LOS ANGELES BASIN	
CAR POPULATION TYPE --	UNCNTR	
	CONTR	
	POST 70	

PARAMETERS CONSIDERED --	1	IDLE CO
	2	RPM
	3	TIMING
	4	MISFIRE
	5	NOX
	6	AIR PUMP
	7	PCV
	8	AIR CLEAN
	9	VAC KICK
	10	HEAT RISER

SIGNATURE MODES CONSIDERED --	1	HC - IDLE
	2	CO - IDLE
	3	NO - IDLE
	4	HC - 45
	5	CO - 45
	6	NO - 45

DEBUG OPTIONS FOR THE FOLLOWING SUBROUTINES:

BLINE	NO
MICRO	NO
TEST	NO
COSTS	NO
AREA	NO
LINPRJ	NO
PDECAY	NO
DATA	NO
STATS	NO

Table B-13 INSPECTION LANE SYSTEM

TOTAL NUMBER OF STATE OPERATED INSPECTION LANES	100
NUMBER OF LANES PER SITE	1
TOTAL NUMBER OF SITES	100
VEHICLE INSPECTION TIMES	
IDLE	1.50 MIN
LOADED	2.40 MIN
HYBRID	2.40 MIN
EQUIPMENT REQUIREMENTS AND COSTS	
NOIR	2000 DOLLARS/LANE
COMPUTER	15000 DOLLARS/LANE
MISC.	5000 DOLLARS/LANE
OYNG	7000 DOLLARS/LANE
INFORMATION PROCESSING COSTS	1.00 DOLLARS/CAR
USER TIME COSTS	2.00 DOLLARS/HR.
TOTAL USER TIME PER PERSON	28.90 MIN
NUMBER OF STATE EMPLOYEES PER LANE	2
STATION SIZE (FACILITIES ONLY)	600.00 SQ. FT.
STATION LAND SIZE	10153.33 SQ. FT.

Table B-14 SUMMARY RESULTS FOR CASE 2

 * TRW INSPECTION/MAINTENANCE *
 * SYSTEM MODEL *

SUMMARY INFORMATION

ENGINE SIGNATURE STRATEGY EXTENSIVE D
 INSPECTION PERIOD IS 12.0 MONTHS

PAYOFF FUNCTION UNADJUSTED (DOLLARS/WEIGHTED EMISSION)	1473.46
PAYOFF FUNCTION STATISTICALLY ADJUSTED (DOLLARS/WEIGHTED EMISSION)	1045.63
PAYOFF FUNCTION AT END OF LAST YEAR (DOLLARS/WEIGHTED EMISSION)	511.07
NO EMISSION REDUCTION (PERCENT)	0.09
CO EMISSION REDUCTION (PERCENT)	3.41
NO EMISSION REDUCTION (PERCENT)	-0.31
NO AVERAGE EMISSIONS (TONS/DAY)	139.75
CO AVERAGE EMISSIONS (TONS/DAY)	9569.50
NO AVERAGE EMISSIONS (TONS/DAY)	536.00
TOTAL COSTS FOR MANDATORY PROGRAM (DOLLARS/YEAR)	55576665.00
TOTAL COSTS FOR VOLUNTARY PROGRAM (DOLLARS/YEAR)	174989110.29
RATIO OF MANDATORY TO VOLUNTARY COSTS (PERCENT)	30.65
INSPECTION CAPITAL COSTS (DOLLARS/STATION)	163266.66
AVERAGE INSPECTION OPERATING COSTS (DOLLARS/YEAR)	10767139.75
MAINTENANCE CAPITAL COSTS (DOLLARS)	0.00
AVERAGE MAINTENANCE OPERATING COSTS (DOLLARS/YEAR)	43211543.32
USER COSTS (DOLLARS/CAR)	.97
COST PER INSPECTION	12.34
COST PER VEHICLE MAINTAINED	21.33
AVERAGE NUMBER OF CARS INSPECTED/YEAR	4374721.91
AVERAGE NUMBER OF CARS REJECTED/YEAR	2290254.92
AVERAGE NUMBER OF CARS MAINTAINED/YEAR	2290254.92
AVERAGE FAILURE PERCENTAGE	.52
TOTAL PROGRAM DURATION (YEARS)	5.00