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EARTH RESOURCES TECHNOLOGY SATELLITE
FINAL REPORT

# 11. FAILURE REPORTING PLAN

PREPARED FOR

GODDARD SPACE FLIGHT CENTER
NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

UNDER CONTRACT NAS5-11260

TRW SYSTEMS GROUP

IBM FEDERAL SYSTEMS DIVISION

Itek OPTICAL SYSTEMS DIVISION

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# EARTH RESOURCES TECHNOLOGY SATELLITE

## FINAL REPORT

## Volume 11. Failure Reporting Plan

April 17, 1970

prepared for

National Aeronautics and Space Administration
Goddard Space Flight Center

Contract NAS5-11260
item 5a

TRW Systems Group
One Space Park · Redondo Beach
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ROAD MAP

REVISIONS AND ADDITIONS TO FEBRUARY SUBMITTAL

Subsequent to the 90 day proposal submittal this volume has been expanded or changed to include system or GDHS inputs. To facilitate NASA review, additional or changed information appears only on yellow pages. The changes on each yellow page, identified by shading in the entire area of change, are on the pages listed below. Yellow colored pages with no shaded portions contain all new input.

| Page | Change |
|---|---|
| i | New title page |
| iii | Page number changes |
| 2 | Software definitions are included |
| 3 | Software requirements are included |
| 4 | Software included |
| 5 | New paragraph for software |
| 6 | New paragraph for software |
| 7 | New paragraph for software |
| 8 | Paragraph number change |
| 9 | New paragraph for software |
| 11 | Paragraph number change |
| 12 | New paragraph for software |
| 13 | Software included |
| 19 | New paragraph for software |
| 20 | Software clarification |
| 25 | New paragraph for software |
| 27 | New paragraph for software |
| 32 | Software included |

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## 1A306 Problem/Failure Reporting and Correction

### 1A306.1 Introduction

This document defines the TRW Systems Problem/Failure Reporting and Correction Plan for the ERTS Project. The plan is applicable to both spacecraft and GDHS equipment and is in conformance with paragraph 3.7 of NPC250-1 and GMI 5310.1A.

The reporting medium for in-house TRW-generated failures will be the revised TRW Systems Test Discrepancy Report (TDR). The TDR combines discrepancy reporting and failure reporting into one form to report all functional failures. Each reportable failure will be transferred to GSFC Form 4-2 for submittal to NASA/GSFC. (Figure 1)

### 1A306.2 Purpose

The purpose of the procedures defined in this plan is to utilize to the fullest extent, hardware and software experience gained through comprehensive failure reporting, analysis and corrective action to ensure that probability of failure recurrence is reduced to acceptable levels on both hardware and software items.

### 1A306.3 Applicable Documents

1) NPC250-1 Paragraph 3.7 "Reliability Program Provisions for Space System Contractors

2) GMI 5310.1A "GSFC Malfunction Reporting System"

3) TRW Quality Assurance Forms Facsimile Manual

- Form Number 1075 - TDR (Rev. 6-69)
- Form Number 3714 - TDR Continuation Sheet
- Form Number 1076 - Test Discrepancy Follow-Up Sheet

### 1A306.4 Definition of Failure

A failure is defined as a functional discrepancy wherein an equipment is incapable of performing its intended function, or does not operate satisfactorily within limits of its specified functional requirements for one or more operational parameters, or otherwise shows potential trouble symptoms.

A software problem is defined as when a) a function has no output, incomplete output, or the output values exceeds established deviations from the expected value, b) a function fails to interface (link) or c) a function execution time exceeds timing constraints (if any).

Software itself does not fail in the sense that hardware deteriorates. That is, once a software program computes a result from a given input, it will always compute that result from the same input unless the software is changed, or is disturbed by an indirect problem, e.g., errors in the operating procedure, program input, program setup, or errors created by the computing hardware or operator.

NOB 00481

(1) Project | (2) Spacecraft | (3) Operation | (4) Units 1 ☐ Hrs 2 ☐ Cys

(5) System or Experiment | (6) Date & Time of Malfunction Yr Mo Day Time | (7) Date of Report Mo Day | (8) Critical 1 ☐ Yes 2 ☐ No

| NAME | IDENTIFICATION NUMBER | SERIAL NUMBER | MANUFACTURER |
|---|---|---|---|
| (9) Component | | | |
| (10) Assembly | | | |
| (11) Sub-Assembly | | | |
| (12) Part | Manufacturers Part Number | Circuit Des. | |

| | | | | |
|---|---|---|---|---|
| (13) Malfunction Occurred During | 1 ☐ Qualification Test | 3 ☐ Integration Test | 5 ☐ Launch Operations | 7 ☐ Bench Test |
| | 2 ☐ Acceptance Test | 4 ☐ Pre Launch | 6 ☐ System Test | 8 ☐ Post Launch |
| (14) Environment When Failed | 1 ☐ Acceleration | 3 ☐ Thermal-Vacuum | 5 ☐ Humidity | 7 ☐ Ambient |
| | 2 ☐ Shock | 4 ☐ Temperature | 6 ☐ Vibration | 8 ☐ Acoustic |

(15) Action to be Taken on Failed Unit:

Document Number that Authorized Failure Analysis:

(16) REFERENCE

Spacecraft Log Book # _____ Page _____ Test Procedure _____ Para _____

(17) Description of the Malfunction:

(18) Originator: | Phone: | Organization:

Do Not Write in This Space

(19) Cause of the Malfunction:

Do Not Write in This Space

(20) Corrective Action Taken:

If Corrective Action is Required on Other Units, List Units:

Do Not Write in This Space

| | | |
|---|---|---|
| (21) Failure Analysis Performed? | 1 ☐ Yes 2 ☐ No | Organization That Performed Failure Analysis _____ Failure Analysis Report Number _____ Date _____ |
| (22) Rework of Unit | 1 ☐ Repaired 2 ☐ Modified 3 ☐ Discarded | Date _____ Organization that Performed Rework _____ |
| (23) Is Retest Required? | 1 ☐ Yes 2 ☐ No | If Yes, State Retest Requirements _____ |
| (24) Retest Results | 1 ☐ Satisfactory 2 ☐ Unsatisfactory | Remarks: |
| (25) Unit May Be Used For | 1 ☐ Flight 2 ☐ Test Only | |

| Yr | Mo | Day | Date MR Closed | GSFC Project Approval | GSFC MRRT Approval Date | Contractor Approval Date |
|---|---|---|---|---|---|---|

Figure 1

GSFC MALFUNCTION REPORT

## 1A306.5 Level of Reporting

Test discrepancies that occur beginning with the first functional test of a subassembly and continuing through the mission until spacecraft power is turned off will be reported. For software, all problems occurring beginning with the first use or signoff (whichever occurs first) of the software item will be reported. GDHS hardware, malfunction reporting will be initiated on the assembly (component) during and after receipt at TRW Systems for off-the-shelf equipment and during and after the first functional test on the component level for new and modified design equipment. For software, malfunction reporting will be initiated on the functional level during first use or signoff, whichever comes first. Software levels are defined as:

- Routine. The smallest collection of serial code which has a recognizable input and output and performs one or more tasks.
- Module. A single computer program with a given function.
- Function. A group of computer programs working together to perform a major task.

During the early phases of software testing many design and development errors are usually detected. Most of these errors are due to faulty interface definition, erroneous code, and input/output format errors. Due to the large number of errors usually encountered, problem reporting will be on an informal basis throughout the software integration phase. Problems detected will be logged in an engineering notebook and followed up to ensure that they were corrected and retested.

Immediately following the completion of software integration and continuing throughout the life of the contract, formal software problem reporting procedures will be implemented. Software problems of the following types which are detected during system tests will be reported:

- Design errors
- Development errors
- Test procedure errors

- Configuration setup errors
- Input errors
- Test operator errors
- Computing hardware errors
- Undefined errors.

1A306.6 Responsibilities

1A306.6.1 Divisional Failure Control

Each Divisional Failure Control Engineer assigned to the ERTS Project has the responsibility to review, document, analyze and followup corrective action on all reportable failures occurring on equipment and/or software within his division's jurisdiction. The specific duties include:

- Review and process test discrepancy reports for hardware failures and software problems.
- Interface with other Divisional Failure Control Engineers, Project Failure Control and other performance assurance personnel.
- Failure analysis of each reportable failure to positively identify mode and cause of failure. Utilize specialists when necessary (such as parts, materials, and processes) to determine cause of failure.
- Follow-up each verified and reportable failure to ensure that satisfactory corrective action is taken before the report is closed out.
- Attend and provide details of each failure analysis and recommended corrective action at the monthly formal Failure Review Board Meeting.
- Provide project office with required documentation to report each failure to the customer. (Copies 1 and 2 of GSFC Form 4-2 for initial notification and copies 4 and 5 for the final notification after completion)
- Assist Unit Engineer in establishing rework/retest requirements for units requiring rework.

1A306.6.1.2 Software Failure Control

The Divisional Software Failure Control Engineer assigned to the ERTS Project has the responsibility to review, document, analyze, and follow-up corrective action on reportable problems occurring in software within his division's jurisdiction. The specific duties include:

- Review and process software TDR's.
- Interface with other Divisional Failure Control Engineers, Project Failure Control, and other performance assurance personnel.
- Perform problem analysis on each reportable software problem to positively identify the responsible software unit and cause of the problem. Utilize computer programmers and other software specialists as necessary.
- Assist computer programmer in establishing and documenting the changes required to correct the problem, and retest requirements.
- Follow-up each TDR to assure that satisfactory corrective action is taken before the report is closed out.
- Attend and provide details on each problem analysis and recommended corrective action at the monthly formal failure Review Board Meeting.
- Provide the project office with required documentation to report each software problem to the customer. (Copies 1 and 2 of GSFC Form 4-2 for initial notification and copies 4 and 5 for the final notification after completion.

1A306.6.2 Quality

1A306.6.2.1 Divisional Quality Inspection and Test Surveillance

1A306.6.2.1.1 Hardware Quality Inspection and Test Surveillance

The responsibilities of Quality Inspection and Test Surveillance include:

- Originate TDR's for hardware failures and software problems as defined in paragraph 1A306.5 above
- Distribute copies of TDR's

- Initiate supplemental documentation as required (e. g., Nonconforming Material Reports)
- Participate in failure analyses
- Control the movement of failed items until properly released to the Material Review Board (MRB) or the rework activity.
- Subsequent to satisfactory rework and production testing, review TDR and Troubleshooting and Tear Down Record (TSTR) for completeness and signoff.
- Transmit Copy Number 1 of the TDR parts replacement requisition (PRR) and failed parts to the Divisional Reliability Failure Control Engineer.
- Record operating times on Quality Activity Record (QAR) and forward to Corporate Product Assurance for computer input.

1A306. 6. 2. 1. 2 Software Quality Inspection and Test Surveillance

The responsibilities of the Quality Assurance Software Test Surveillance Engineers include:

- Originate TDR's for software problems detected during software system tests
- Distribute copies of TDR's
- File supplemental documentation as required for subsequent problem analysis
- Participate in problem analysis as required
- Review status of open TDR's
- Rerun software system test as required to retest software problem corrections.

1A306. 2. 2 Divisional Project Quality Manager

The responsibilities of the Divisional Project Quality Manager are:

- Conduct training on the preparation of TDR's
- Provide consultation during failure analysis
- Implement corrective action as required

- Determine quality trends from failure summaries
- Participate in MRB activities
- Assist in establishing rework/retest requirements for units requiring rework and including subcontractor supplied items.

1A306. 6. 3 Responsible Unit Engineer

The Unit Engineer responsibilities include:

- Participate in all phases of failure analyses
- With assistance from Project Office, Quality, Reliability, and Test, establish rework/retest requirements for units requiring rework and including subcontractor supplied items
- Participate in Failure Review Board Meetings
- Develop and implement corrective action documentation
- Complete inputs to TDF's and submit to Reliability.

1A306. 6. 4 Manufacturing

The Manufacturing responsibilities include:

- Troubleshoot, rework and perform production testing of failed items in conformance with the Manufacturing Shop Order (MSO) developed for the item and the Quality Plan.
- Complete TDR rework information on the TDR and TSTR and submit with the failed parts to Quality Inspection
- Participate in Failure Review Board Meetings when requested
- Implement corrective action.

1A306. 6. 5 Software Engineer

The Software Engineer responsibilities include:

- Troubleshoot, revise, and perform retest of software problems
- Complete TDR revision information on the TDR to document the software revision and submit to Reliability
- Participate in Failure Review Board Meetings
- Implement corrective action.

## 1A306.6.6 Divisional Failure Analysis Sections

The Divisional Failure Analysis Sections responsibilities include:

- Failure analyses on items submitted by the Divisional Failure Control Engineer
- Confer with other specialists as required for additional detailed analysis
- Submit recommended preferred parts, materials, and processes lists modifications, resulting from knowledge gained from failure analyses
- Complete failure analysis reports and distribute
- Participate in Failure Review Board Meetings.

## 1A306.6.7 Manager of Performance Assurance

The manager of Performance Assurance responsibilities include:

- Direct and control all failure reporting and corrective action activities
- Serve as chairman of the Monthly Failure Review Board Meetings
- Perform customer liaison and report failures to customer on GSFC Form 4-2
- Determine the level of failure analysis to be performed on each part failure
- Publish minutes of the Monthly Failure Review Board Meetings.

## 1A306.6.8 Corporate Product Assurance

The responsibilities of the Corporate Product Assurance include:

- Conduct training on the preparation of TDR's
- Enter TDR and TDF information into the Test Information Retrieval System (TIRS)
- Supply TIRS computer printouts as required by ERTS project requirements.

### 1A306.6.9 Interface With Other Project Personnel

The interface with other project personnel will be through the ERTS manager of Performance Assurance, or his designated representative for all matters where responsibility and/or costs are involved.

## 1A306.7 Failure Analysis

### 1A306.7.1 Hardware Failure Analysis

Failure analysis of hardware items and problem analysis of software items are performed by each Reliability Failure Control Engineer to the depth required to determine the true cause of failure . It is their responsibility to arrange for facilities and personnel required to perform the analysis. The extent of detailed part analysis required will be determined with project office concurrence. With software problems the failure analysis will also be coordinated through the project office to ensure that sufficient technical assistance is available. Each hardware and software failure report will be closed out through formal Failure Review Board action.

### 1A306.7.2 Software Problem Analysis

Software test result analysis must usually be accomplished by intensive evaluation of large quantities of computer output printing. When a discrepancy is encountered with the expected result, the cause of the discrepancy is not necessarily obvious. Since many errors are self-perpetuating, the actual error could exist almost anywhere within the software, and could have occurred at any time prior to the erroneous print. For example, an error within an input routine could have erroneously stored a value which is not used until 30 minutes into the run. If the value is not printed but is used in the computation of an equation, the equation will usually be suspected as the source of the problem.

To determine the source of an error, it is frequently necessary to print out in machine language selected portions of the contents of the computer memory. Detailed knowledge of the computer program is

required for analysis of these printouts. To locate the error, it is sometimes necessary to modify the program with temporary debugging routines and rerun it to trace the program flow or detect when the contents of a memory location changes.

In addition, the error may not be in the program. The error may have been in the test procedure, input value or format, configuration setup, or the computing hardware or operator may have created an error.

When a software error is discovered, it is often imperative that the error be corrected as soon as possible without awaiting approval of the Failure Review Board; however, the change will be documented and submitted to the Failure Review Board for formal approval. This is necessary, because software tests usually must stop until encountered errors are corrected.

## 1A306.8 Subcontractor Failure Reports

### 1A306.8.1 Level of Reporting

The level of failure reporting described above will be invoked on each major subcontractor as detailed in the individual subcontractor purchase orders or requirements document. Each subcontractor required to report failures will use a failure report form acceptable to TRW System.

### 1A306.8.2 Responsibility

It is the responsibility of the cognizant Reliability Failure Control Engineer to document and analyze the subcontractor failure reports and present the data at the monthly Failure Review Board Meetings. Where information and analysis are required from the subcontractor, the cognizant Reliability Subcontractor Control Engineer or the cognizant Reliability Failure Control Engineer is responsible for obtaining and presenting the data at the Failure Review Board Meeting.

### 1A306.8.3 Failure Summaries

Subcontractor failure reports will be integrated into the TRW Systems monthly failure report summaries by use of the TDF and will be treated as TRW failure reports for documentation considerations. The subcontractor failure reports will be coded in the TIRS input for ready retrieval and data will be transferred to GSFC 4-2 Form for submittal to NASA/GSFC.

### 1A306.8.4 Failures at TRW

The decision to return a failed item to a vendor is documented on the Non-Conforming Material Report (NCMR) through the formal Material Review Board (MRB). Reliability is not a member of MRB and therefore has no official vote in the decision to return to vendor (RTV). Reliability may, however, recommend to RTV through the Failure Review Board. When the failed item is dispositioned on the NCMR as RTV, the item is handled through the cognizant TRW Buyer. Reliability is notified of this decision by Copy Number 1 of the TDR. Reliability followup of the failed item at the vendor is handled by the cognizant Reliability Subcontractor Control Engineer.

Vendor items that fail in TRW and are dispositioned to repair or rework, scrap or use as is are handled through the normal TRW failure reporting system.

Details of the failure analysis and corrective action at the vendor are reported at the monthly FRB meeting by the cognizant Reliability Subcontractor Control Engineer or by the cognizant Reliability Failure Control Engineer.

### 1A3. 5.9 TDR Suspense System

### 1A306.9.1 Hardware TDR

The ERTS TDR suspense system will be based on the following normal control times:

a) TDR pickup daily

b) TDR distribution – within 24 hours after receipt at the Failure Control Center

c) Preliminary failure analysis inputs – 2 weeks

d) Final failure analysis inputs – 3 weeks

e) Implementation of corrective action – 5 weeks

f) Normal Failure Review Board disposition – one month

g) Special presentations to Failure Review Board by Unit Engineer on action items assigned – 4 to 8 weeks

h) Failure Review Board request for special action by manager of Performance Assurance – 8 to 12 weeks

i) Manager of Performance Assurance requests special action by Project Manager – 12 weeks

j) NASA/GSFC notification of GSFC Form 4-2 – arrive at GSFC within 5 working days of the failure

k) NASA/GSFC final closeout of Form 4-2 – within 5 working days of completion.

1A306.9.2 Software TDR

The ERTS TDR suspense system for software will be based on the following normal control times:

a) TDR initiation and distribution – 24 hours

b) Preliminary problem analysis – 2 hours

c) Implementation of temporary corrective action – 2 hours

d) Final problem analysis – 24 hours

e) Normal Failure Review Board disposition – one month

f) Final corrective action – 24 hours after Failure Review Board disposition

g) Special presentations to the Software Failure Review Board by computer programmer on action items assigned – 4 to 8 weeks

h) Software Failure Review Board request for special action by Manager of Performance Assurance – 8 to 12 weeks

i) Manager of Performance Assurance requests special action by Project Manager – 12 weeks

j) NASA/GSFC notification of GSFC Form 4-2 – arrive at GSFC with 5 working days of the software problem detection

k) NASA/GSFC final closeout of Form 4-2 – within 5 working days of completion.

## 1A306.10 Failure Reporting

### 1A306.10.1 Failure Reporting Procedure

The details of filling out and processing the TDR's for functional failures are described in the Quality Assurance Forms Facsimile Manual. Reliability is notified on flash Copy Number 2 of the TDR that is detached and deposited in a TDR pickup station. Figures 2, 3, and 4 illustrate the TDR, TDR Continuation Sheet and TDF's. Figure 5 shows the approved code lists for use on the TDR and TDF for hardware failures. A detailed code list will be developed in Phase D for software for use on the TDR/TDF.

For software, level 3 is the lowest level reported on the TDR. This is the function level and corresponds to the assembly or component level for hardware.

### 1A306.10.2 TDR Collection Stations

TDR Collection Stations are established in all areas where manufacturing, testing of hardware and/or use of software takes place. Each station is marked with the number of the station and with the name, phone number and location of the reliability courier responsible for the collection of TDR's. TDR's will be collected on a daily basis.

### 1A306.10.3 Failure Report Processing Sequence

#### 1A306.10.3.1 Hardware

The processing sequence for each TDR consists of the following steps:

1) Write Test Discrepancy Report (TDR) and deposit Copy Number 2 in TDR Collection Station – Originator.

PROJECT _____

REPORT NUMBER T 72403

ACTIVITY/LOCATION _____ PAGE _____ OF _____

01 | 11 MO | DAY | YR | TL | TEST TYPE | ENV | DT | 22 MSO/R&O NUMBER | OPER. NO. | 32 REF TDR NO. | 38 ORIGINATOR'S LAST NAME | INITIALS | EXT | TEST EQUIP. P/N | 52 TEST EQUIP. S/N

02 | 10 JOB NUMBER | 16 TEST PROCEDURE NO. | 27 FAILED PARAGRAPH NO. | 39 CUM OPER TIME | CUM CYCLES | 48 TEST/RUN NO. | 56 RESPONSIBLE ENGINEER'S LAST NAME | INITIALS | EXT

GO TO LINE NUMBER CORRESPONDING TO "TL" (TEST LEVEL)

1 -SYSTEM TEST 2 -SUBSYSTEM TEST 3 -ASSEMBLY TEST 4 -SUBASSEMBLY TEST 5 DETAIL SUBASSEMBLY TEST 6 -COMPONENT PART TEST

**1 & 2**

03 | 10 SYSTEM/ENG # | 15 SUBSYSTEM NAME | PART NO. | 27 MFG/TEST CCC | 32 DEFECT CODE | 36 ANAL TIME | 40 REWORK TIME | REWORK DOCUMENT NUMBER | 44 INSTLD ASSY S/N | 50 REF NCMR NO

DESCRIPTION OF SYSTEM/SUBSYSTEM MALFUNCTION AND REWORK

QA REWORK DATE | STAMP

QA RETEST DATE | STAMP

SIGNATURE DATE

**3**

04 | 10 ASSEMBLY PART NO. | 26 SERIAL NO. | 32 ASSEMBLY NAME | 44 DISPOSITION [0,1] ADJUST [0,2] REWORK [0,3] RETURN TO | 52 (SEE CODE LIST) | OTHER

STOP HERE IF THE DISCREPANCY WAS DETECTED AT SYSTEM/SUBSYSTEM LEVEL TEST AND THE ASSEMBLY WILL BE REWORKED BY ANOTHER DIVISION/COST CENTER

05 | 10 MFG/TEST CCC | 15 VERIFICATION [Y] YES [N] NO | 16 DEFECT CODE | 20 FAILURE TYPE [P] PRIMARY [S] SECONDARY | 21 ANAL TIME | 25 REWORK TIME | 29 MANUFACTURER'S NAME | REWORK DOCUMENT NO. | 39 INSTALLED S/A S/N | 45 REF NCMR NO

DESCRIPTION OF ASSEMBLY MALFUNCTION AND REWORK

QA REWORK DATE | STAMP

QA RETEST DATE | STAMP

SIGNATURE DATE

**4**

06 | 10 SUBASSEMBLY PART NO. | 26 SERIAL NO. | 32 SUBASSEMBLY NAME | 44 CIRCUIT DESIGN. | 50 DISPOSITION [0,1] ADJUST [0,2] REWORK [0,3] RETURN TO | 52 (SEE CODE LIST) | OTHER

STOP HERE IF THE DISCREPANCY WAS DETECTED AT ASSEMBLY LEVEL TEST OR ABOVE AND THE SUBASSEMBLY WILL BE REWORKED BY ANOTHER DIVISION/COST CENTER

07 | 10 MFG/TEST CCC | 15 VERIFICATION [Y] YES [N] NO | 16 DEFECT CODE | 20 FAILURE TYPE [P] PRIMARY [S] SECONDARY | 21 ANAL TIME | 25 REWORK TIME | 29 MANUFACTURER'S NAME | REWORK DOCUMENT NUMBER | 39 INSTLD DET ASSY S/N | 45 REF NCMR NO

DESCRIPTION OF SUBASSEMBLY MALFUNCTION AND REWORK

QA REWORK DATE | STAMP

QA RETEST DATE | STAMP

SIGNATURE DATE

**5**

08 | 10 DETAIL SUBASSEMBLY PART NO. | 26 SERIAL NO. | 32 DETAIL SUBASSEMBLY NAME | 44 CIRCUIT DESIGN. | 50 DISPOSITION [0,1] ADJUST [0,2] REWORK [0,3] RETURN TO | 52 (SEE CODE LIST) | OTHER

STOP HERE IF THE DISCREPANCY WAS DETECTED AT SUB/ASSY LEVEL TEST OR ABOVE AND THE DETAIL SUB/ASSY WILL BE REWORKED BY ANOTHER DIVISION/COST CENTER

09 | 10 MFG/TEST CCC | 15 VERIFICATION [Y] YES [N] NO | 16 DEFECT CODE | 20 FAILURE TYPE [P] PRIMARY [S] SECONDARY | 21 ANAL TIME | 25 REWORK TIME | 29 MANUFACTURER'S NAME | REWORK DOCUMENT NO.

DESCRIPTION OF DETAIL SUBASSEMBLY MALFUNCTION AND REWORK

45 REF NCMR NO

QA REWORK DATE | STAMP

QA RETEST DATE | STAMP

SIGNATURE DATE

**6**

COMPLETE THE FOLLOWING FOR EACH COMPONENT PART ADJUSTED, REWORKED OR REPLACED

| | CIRCUIT DESIGNATION | COMPONENT PART NO. | COMPONENT NAME | LOT NO. OR S/N | DEFECT CODE | MANUFACTURER'S NAME | DISP |
|---|---|---|---|---|---|---|---|
| 10 | 1 | 10 / 16 | 26 | 48 | 59 | 63 | 73 |
| 11 | 2 | 10 / 16 | 26 | 48 | 59 | 63 | 73 |
| 12 | 3 | 10 / 16 | 26 | 48 | 59 | 63 | 73 |
| 13 | 4 | 10 / 16 | 26 | 48 | 59 | 63 | 73 |

COMMENTS/RETEST INSTRUCTIONS

T 72403

SIGNATURE DATE

THE FOLLOWING LINE MUST BE COMPLETED FOR ALL TEST DISCREPANCY REPORTS

14 | FAILURE CAUSE | CODE | RESPONSIBILITY | CODE | CORRECTIVE ACTION | CODE | 19 CAR NO. | SIGNATURE AND DATE OF COMPLETION | 24 MO | DAY | YR

SYSTEMS FORM 1075 REV 6-69

RELIABILITY

Figure 2

TEST DISCREPANCY REPORT

TDR NO. T

PROJECT _____ PAGE _____ OF _____ DATE _____

| REF. TEST LEVEL | PART NUMBER | SERIAL NO. | PART NAME | MSO/RO NUMBER | OPERATION NO. |
|---|---|---|---|---|---|
| | | | | | |

| ITEM NO. | DESCRIPTION OF MALFUNCTION AND REWORK — ORIGINATOR'S NAME _____ | MFG. EMP. | INSP. STAMP |
|---|---|---|---|
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SIGNATURE DATE

COMPLETE THE FOLLOWING FOR EACH COMPONENT PART ADJUSTED, REWORKED OR REPLACED

| NO. | CIRCUIT DESIGNATION | COMPONENT PART NO. | COMPONENT NAME | LOT NO. OR S/N | DEFECT CODE | MANUFACTURER'S NAME | DISP |
|---|---|---|---|---|---|---|---|
| | 10 | 16 | 36 | 48 | 59 | 63 | 73 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

COMMENTS/RETEST INSTRUCTIONS

TDR NO. T

SIGNATURE DATE

SYSTEMS 3714 RELIABILITY

Figure 3

TEST DISCREPANCY REPORT (continuation sheet)

PROJECT _____ REPORT NO. T 2

11 RELIABILITY ENGINEER LAST NAME INITIALS | 25 CCC | 30 RELEVANT FAILURE [Y] YES [N] NO | PAGE ____ OF ____ | DATE OF FAILURE _____

21

| FAILURE CAUSE | 31 CODE | CRITICALITY | 33 CODE | RESPONSIBILITY | 35 CODE | CORRECTIVE ACTION | 37 CODE | FRB CLOSEOUT DATE | 39 MO DAY YR |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

22

| HARDWARE NAME | SYSTEM I.D. CODE | PART NO. | SERIAL NO. | COMPONENT PART IDENTIFICATION | PART TYPE CODE | FAILURE VERIFIED | FAILURE TYPE | DEFECT CODE |
|---|---|---|---|---|---|---|---|---|
| 1 SYSTEM | 11 | | | 1 | 15 | 19 [Y] YES [N] NO | 20 [P] PRI [S] SEC | 21 |
| 2 SUBSYSTEM | 25 | | | 2 | 29 | 33 [Y] YES [N] NO | 34 [P] PRI [S] SEC | 35 |
| 3 ASSEMBLY | 39 | | | 3 | 43 | 47 [Y] YES [N] NO | 48 [P] PRI [S] SEC | 49 |
| 4 SUBASSEMBLY | 53 | | | 4 | 57 | 61 [Y] YES [N] NO | 62 [P] PRI [S] SEC | 63 |
| 5 DETAIL SUBASSEMBLY | 67 | | | | | | 71 REF TDR NO. | |

| | | | |
|---|---|---|---|
| 23 | DESCRIPTION OF FAILURE | SUMMARY | 11 ... 51 MO DAY YR |
| 25 | FAILURE ANALYSIS | SUMMARY | 11 ... 51 MO DAY YR |
| 27 | CORRECTIVE ACTION | SUMMARY | 11 ... 51 MO DAY YR |

DETAIL:

10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

SYSTEMS 1076 REV. 8-69

Figure 4

TEST DISCREPANCY FOLLOW-UP SHEET

# PRODUCT ASSURANCE CODE LIST

**DOCUMENTS**
**NCMR, QAR, DR, TDR**

**AUGUST 1969**

**REVISION B**

Published by

Product Assurance Staff

*For Additional Information Call:* 61260

TRW SYSTEMS GROUP

## RESPONSIBILITY CODES

ORGANIZATION (Select One)

| CODE | ABBREVIATION | DESCRIPTION |
|---|---|---|
| 1 | CUS | Customer |
| 2 | ESD | Electronic Systems Division |
| 3 | SISD | Software and Information System Division |
| 4 | STD | Science and Technology Division |
| 5 | SUP | Supplier |
| 6 | SVD | Space Vehicles Division |
| 7 | CNTRL | Central Support |
| 8 | SEID | Systems Engineering & Integration Division |

FUNCTION (Select One)

| CODE | DESCRIPTION |
|---|---|
| 1 | Engineering |
| 2 | Field Support |
| 3 | Manufacturing |
| 4 | Manufacturing Support |
| 5 | Materiel |
| 6 | Product Assurance |
| 7 | Test |
| 8 | Test Support |
| - | Not Determinable (Non-TRW Functions Only) |

RESPONSIBILITY CODE EXAMPLE: 23 is the code for Electronic Systems Division - Manufacturing

CORRECTIVE ACTION CODES

| CODE | ABBREVIATION | DESCRIPTION |
|---|---|---|
| 01 | TOOL | Tooling Change Initiated |
| 02 | SPEC CHG | Specification Change Initiated |
| 03 | DR/EO | Drawing/EO Change Initiated |
| 04 | PLAN CHG | Planning Change Initiated |
| 05 | PROC | Process Change Initiated |
| 06 | PKG CHG | Packaging Change Initiated |
| 07 | WK STD | Workmanship Standard Change Initiated |
| 08 | EQUIP | Equipment Change Initiated |
| 09 | PROC CHG | Procedure Change Initiated |
| 10 | EMP INS | Employee Instructed/ Cautioned |
| 11 | ENG ANAL | Engineering Analysis In Process |
| 12 | SUP CAR | Supplier Notified For Required Corrective Action |
| 13 | NR | None Required |
| 14 | TRW CAR | Inhouse CAR Initiated |
| 15 | UI | Under Investigation |
| 16 | HWD CHG | Hardware Design Change |

DEFINITIONS

SYSTEM TEST - A System is a combination of Subsystems and/or Assemblies, generally individually operable, joined together to perform specific operational functions (i.e., Spacecraft).

SUBSYSTEM TEST - A Subsystem is a functioning entity within a System, made up of two or more Assemblies (i.e., Communications Subsystem, Power Subsystem).

ASSEMBLY TEST - An Assembly is a group or combination of Component Parts and Subassemblies mounted together, normally capable of independent operation (i.e., Unit, Black Box).

SUBASSEMBLY TEST - A Subassembly is a number of Component Parts and/or Detail Subassemblies, or any combination thereof, which perform a specific function.

DETAIL SUBASSEMBLY TEST - A Detail Subassembly is the lowest level of equipment assembly, tested as an entity, which is normally made up of two or more Component Parts which are individually replaceable (i.e., Cards, Welded Wire Modules).

COMPONENT PART TEST - A Component Part is the least subdivision of a System, or an item which cannot ordinarily be disassembled without being destroyed (i.e., Resistor, Capacitor).

CRITICAL - A defect that judgment and experience indicates is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending on the product; or that is likely to prevent performance of the tactical function of the major end item.

MAJOR - A defect other than critical that is likely to result in failure or to reduce materially the useability of the unit of product for its intended purpose.

MINOR - A defect that is not likely to reduce materially the useability of the unit of product for its intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the unit.

Primary - A failure attributed to the hardware or internal to the hardware.

Secondary - A failure induced in the hardware by external causes (i.e., test equipment malfunction, operator error, etc.).

Figure 5

PRODUCT ASSURANCE CODE LIST

LABOR ACTIVITY CODES

2 Initial Inspection/Test
4 Reinspection/Retest

DOCUMENT TYPE CODES

1 Testing Routing and Operation Order (TR&O)
2 Routing and Operations Order (R&O)
3 Manufacturing Shop Order (MSO)
4 Master Shop Order (MSO)
5 Procurement Document
6 Engineering Work Order
7 Other
8 Test Procedure
9 Planning Change Notice

SPECIAL COST CENTER CODES

When documenting DCAS Inspections use the following codes:

| Division | Special "CCC" Number |
|---|---|
| SVD - MHO | 0010 |
| ESD - EHO | 0011 |
| STD | 0012 |
| SVD-Excluding MHO | 0013 |
| ESD-Excluding EHO | 0014 |
| SISD | 0015 |
| SEID | 0016 |

TEST LEVEL CODES

1 System
2 Subsystem
3 Assembly
4 Subassembly
5 Detail Subassembly
6 Component Part

TEST TYPE CODES

| | | | |
|---|---|---|---|
| 01 | ACCEPTANCE | 09 | INTEGRATION |
| 02 | BENCH | 10 | ORBITAL |
| 03 | BURN IN | 11 | PRODUCTION MONITORING |
| 04 | CALIBRATION | | |
| 05 | DESIGN VERIFICATION | 12 | PROTOTYPE QUALIFICATION |
| 06 | DEVELOPMENT | 14 | SPECIAL |
| 07 | ENGINEERING EVALUATION | 15 | TEST EQUIPMENT COMPATIBILITY |
| 08 | FIELD | 16 | VISUAL |

CRITICALITY CODES

01 Critical
02 Major
03 Minor

ENVIRONMENT CODES

| | | | |
|---|---|---|---|
| 01 | ACCELERATION | 13 | SALT SPRAY |
| 02 | ACOUSTIC | 14 | SAND |
| 03 | ALTITUDE | 15 | SHOCK |
| 04 | AMBIENT | 16 | SUNSHINE |
| 05 | CENTRIFUGAL | 17 | SPACE |
| 06 | HOT FIRE | 18 | SPACE SIMULATION |
| 07 | HUMIDITY | 19 | TEMP. ALTITUDE |
| 08 | MAGNETIC | 20 | TEMPERATURE |
| 09 | PRESSURE | 21 | THERMAL VACUUM |
| 10 | RADIATION | 22 | VACUUM |
| 11 | RADIO FREQ INTF | 23 | VIBRATION |
| 12 | RAIN | 24 | X-RAY |

OPERATING TIME CODE

| CODE | DEFINITION |
|---|---|
| S | Seconds |
| M | Minutes |
| H | Hours |

DISPOSITION CODES

01 Adjust
02 Rework to specification
03 Return to _____
04 Acceptance of developmental hardware, tooling and other items not requiring formal disposition action
05 Transfer to NCMR
06 Transferred to a new Discrepancy Report/Test Discrepancy Report
07 Reinspect/Retest
08 Repair per Standard Repair
09 Scrap
10 Repair or Replace Test Equipment

NOTE: Use only last digit for DR entries

DESTINATION CODES

| | |
|---|---|
| ESD | Electronic Systems Division |
| SISD | Software and Information Systems Division |
| STD | Science and Technology Division |
| SUP | Supplier |
| SVD | Space Vehicles Division |
| SEID | Systems Engineering and Integration Division |

FAILURE CAUSE CODES

| CODE | ABBREVIATION | DESCRIPTION |
|---|---|---|
| 01 | MTL | Part/Material |
| 02 | DRG/EO | Drawing/EO |
| 03 | HANDG | Handling/ Transportation |
| 04 | INST | Instructions |
| 05 | N/C | Numerical Control |
| 06 | PKG | Packaging |
| 07 | PLAN | Planning |
| 08 | PROCESS | Process |
| 09 | SALVAGE | Salvage Operation |
| 10 | SPEC | Specification |
| 11 | S LIFE | Storage/Shelf Life |
| 12 | TEST EQ | Test Equipment |
| 13 | OPER | Operator |
| 14 | PROC | Procedure |
| 15 | R HWD | Related Hardware |
| 16 | REQ | Requirement Change |
| 17 | TOOL | Tooling |
| 18 | WEAR | Wearout |
| 19 | WORK | Workmanship |
| 20 | FIRED | Fired Unit |

# DEFECT CODES

## PART 1

DEFECT CATEGORY

GENERAL

01 DAMAGE
02 DOCUMENTATION
03 HARDWARE
04 HANDLING
05 IDENTIFICATION/MARKING
06 KITTING
99 MATERIAL
07 PACKAGING/PRESERVATION
08 SAMPLES/COUPONS
09 SHELF/POT LIFE
10 STORAGE
11 EQUIPMENT
12 TOOLING/PATTERN

MECHANICAL FEATURES

13 ALIGNMENT
14 ANGLE
15 BONDING
16 BRAZING
17 BURRS/SHARP EDGES
18 CIRCUITRY (P.C. BOARD)
19 CLEANING/PASSIVATION
20 CLEARANCE
21 CONFIGURATION
22 CONCENTRICITY
23 CONFORMAL COATING
24 CONTOUR
25 CRIMPING
26 DEPTH
27 DIAMETER/HOLES
28 DIMENSION (LINEAR)
29 ETCHING
30 FINISH/SURFACE
31 FIT
32 FLATNESS
33 HARNESS/SHIELDING/LACING
34 HOLE PATTERN
35 LUBE FILM
36 PAINT
37 PARALLELISM
38 PERPENDICULARITY
39 PLATING
40 POTTING/ENCAPSULATION
41 RADIUS
42 ROUNDNESS
43 ROUTING
44 SILK SCREENING
45 SOLDER
46 TAPER
47 THREAD
48 VACUUM DEPOSIT
49 WELD
50 WIRE/CABLE/LEADS

PERFORMANCE FEATURES

51 ATTENUATION
52 BANDWIDTH
53 BURST STRENGTH
54 CAPACITANCE
55 CHEMICAL
56 CURRENT
57 DIELECTRIC STRENGTH
58 E.M.I.
59 ENGINE RUN
60 FLOW
61 FREQUENCY
62 GAIN
63 HARDNESS
64 HYSTERESIS
65 IMPEDANCE
66 INDUCTANCE
67 INSULATION RESISTANCE
68 LEAK
69 MIXTURE RATIO
70 MODULATION
71 NON DESTR. TEST
72 NOISE LEVEL
73 NULL
74 PHASE
75 POLARITY
76 POWER
77 PRESSURE/PROOF TEST
78 PULL
79 "Q"
80 RATE
81 REGULATION
82 RESISTANCE
83 RESPONSE
84 R.F.I.
85 RPM
86 SIGNAL LEVEL
87 SPECTRUM
88 SYNCHRONIZATION
89 TEMPERATURE
90 TENSION
91 THRUST
92 TIME DELAY
93 TIMING
94 TORQUE
95 VACUUM
96 VOLTAGE (INPUT/OUTPUT)
97 WAVEFORM
98 VSWR

## PART 2

DEFECT CONDITION

01 ARCING
02 BIRD CAGED
03 BLISTERED/BUBBLED
04 BLOW HOLE
05 BENT/CRACKED/BROKEN
06 BREAKDOWN
07 BURNED
08 COLD/INCOMPLETE FUSION/PENETRATION
09 CONTAMINATED/DIRTY
10 CORRODED/RUSTY
11 DELAMINATED
12 DETERIORATED
13 DISCOLORED
14 DRIFT
15 ERRATIC
16 EXCESSIVE
17 EXPIRED
18 GROUNDED
19 HIGH
20 ILLEGIBLE
21 INADEQUATE
22 INTERMITTENT
23 INCOMPLETE
24 INCORRECT
25 INOPERATIVE
26 INCLUSION
27 INSUFFICIENT/THIN
55 LIFTED
28 LOOSE
29 LOW
30 MISALIGNMENT
31 MISLOCATED/OUT OF TRUE POSITION
32 MISSING
33 NOISY
34 NONE
35 NOT READY FOR INSPECTION
36 OPEN
37 ORIENTATION
38 OSCILLATING
39 OUT OF CALIBRATION
40 OUT OF TOLERANCE
41 PEELING/FLAKING
42 POROUS
43 PITTED
44 PULSING
45 REVERSED
46 SHORT (ELECT/LENGTH)
47 SCRATCH/DENT/CHIP/NICK
48 SHIFT
49 SPLATTER
50 STRIPPED
51 VOIDS/PINHOLE
52 WARPED
53 WICKING
54 WORN

Figure 5

PRODUCT ASSURANCE CODE LIST (continued)

2) Collect TDR from Collection Station – Divisional Reliability Courier

3) Enter TDR Log and distribute as follows:

   (a) Copy to Reliability Failure Control Center

   (b) Copy to Unit Engineer

   (c) Copy to Project Office

4) Review TDR and determine if failure analysis is required – Divisional Reliability Failure Control Engineer.

5) Prepare TDF if failure analysis is required – Divisional Reliability Failure Control Engineer

6) If analysis is required, forward copy of TDR and TDF to Unit Engineer – Divisional Reliability Failure Control Center

7) If part analysis is required, submit copy of TDF and part to Failure Analysis Group – Divisional Reliability Failure Control Center

8) Perform part analysis, complete TDF and forward to Reliability – Unit Engineer

9) Perform unit analysis, complete TDF and forward to Reliability – Unit Engineer

10) Review analysis and submit results and corrective action recommendations to Failure Review Board – Divisional Reliability Failure Control Engineer

11) Complete TDF and submit to Product Assurance Staff -- Divisional Reliability Failure Control Engineer

12) Publish bi-weekly and monthly failure report summaries -- Product Assurance Staff.

1A306.10.3.2 Software

The processing sequence for each TDR consists of the following steps:

1) Write TDR and deliver Copy Number 2 to Software Failure Control – Originator

2) Enter TDR log and distribute as follows: Divisional Software Failure Control

   a) Copy to Software Failure Control Engineer

   b) Copy to Computer Programmer

   c) Copy to Project Office

3) Review TDR and determine if software problem analysis is required - Divisional Software Failure Control Engineer

4) Prepare TDF if software problem analysis is required - Divisional Software Failure Control Engineer

5) If analysis is required, forward copy of TDR and TDF to Computer Programmer - Divisional Software Failure Control Center

6) Perform software function analysis - Computer Programmer

7) Review analysis and submit results and corrective action recommendations to Software Failure Review Board - Divisional Software Failure Control Engineer

8) Complete TDF and submit to Product Assurance Staff - Divisional Software Failure Control Engineer

9) Publish bi-weekly and monthly Software Failure Report summaries - Product Assurance Staff.

1A306.10.4 Failed Part Processing Sequence

The failed part processing sequence consists of the following steps:

1) Attach copies of TDR to the failed equipment

2) Deliver failed equipment to repair facility

3) Perform troubleshooting and remove failed part and complete TSTR

4) Deliver failed part to the store room with a Part Replacement Request Tag (PRR)

5) Enter the TDR Number on the PRR Tag

6) Obtain replacement part and rework the failed item

7) Place the failed part with the copy of the PRR, TSTR and Copy Number 1 of the TDR in the Failed Part Transmittal Envelope. Route other copies of TDR as defined in Appendix I of Q. I. 9. 0. 3. 1.

8) Deposit the completed Failed Part Transmittal Envelope in the TDR Collection Station

9) Deliver failed parts to Reliability Engineer

10) Determine if failure analysis is required

11) If failure analysis is required, prepare Failure Analysis Request (FAR) and deliver failed parts to Failure Analysis Section

12) Perform failure analysis, store failed part in Failure Analysis File, or return to MRB if directed to do so by NCMR.

**For software, no comparable analysis is required.**

1A306. 10. 5 Failed Part Disposition

Control of failed parts removed during rework operations is covered in paragraphs 16. 2 and 17. 5 of Quality Instruction (Q. I. ) 9. 0. 3. 1 "Functional Test Discrepancies." Figure 6 shows the troubleshooting and teardown record completed during rework of the failed hardware.

1A306. 11 Failure Summary Reports

**1A306. 11. 1 Hardware Failure Summary Reports**

A monthly summary of open failure reports closed during the reporting period will include the following items:

- Failure Report Number - The numerical designation assigned to each individual failure report
- Mission design, series - The designated description to identify the system, equipment, etc.

| TROUBLESHOOTING AND TEARDOWN RECORD | | | 1 PAGE ____ OF ____<br>2 DATE _____ |
|---|---|---|---|
| 3 DIVISION | 4 CCC | 5 MSO/RWK MSO NO. | 6 TDR NO. |
| 7 DESCIPTION OF FAILED ITEM: PART NAME | 8 PART NO. | 9 REV | 10 S/N |

| PARTS REMOVAL AND TEARDOWN | | | FAILED PARTS AND/OR OTHER DISCREPANCIES | | | |
|---|---|---|---|---|---|---|
| Item No. | | MFG Initial Date | | PRR No. | MFG Initial Date | Insp Verify Date |
| | 11 | 12 | 13 | 14 | 15 | 16 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| 17 Rework instructions for block 13 entered on MSO/rwk MiSO No. | 18 MFG PLG DATE | 19 INSP PLG DATE |
|---|---|---|

SYSTEMS 3692

**Figure 6**

**TROUBLESHOOTING AND TEARDOWN RECORD**

Instructions for Completion of Entries

TROUBLESHOOTING PERSONNEL

(1) Enter page number and total number of pages to this TSTR.

(2) Enter date TSTR is initiated.

(3) Enter name of Division performing troubleshooting and teardown.

(4) Enter number of Cost Center performing troubleshooting and teardown.

(5) Enter Manufacturing Shop Order number and PCN if applicable.

(6) Enter Test Discrepancy Report serial number.

(7) Enter name of failed test item.

(8) Enter part number of failed test item.

(9) Enter revision number (or letter) if applicable.

(10) Enter serial number of failed test item if applicable.

(11) Enter part name, part number, revision number (when applicable), serial number (when applicable) of every part disturbed, lifted, or removed. Where more than one of a specific part was used in the assembly, enter the Reference Designation from the design drawing (i.e., C5, R8, Q4, CR4, etc.). Enter any other rework performed and any damage that occurs during the troubleshooting and teardown operations.

(12) Enter initials of troubleshooting personnel and date.

(13) Enter part name, part number, revision number (when applicable), serial number (when applicable) and reference designation of every failed part or other probable causes of failure.

(14) Enter Parts Replacement Requisition serial number when new part(s) have been obtained on a PRR.

(15) Enter initial and date for each line entry made in block (11) .

INSPECTION PERSONNEL

△13 Enter any discrepancies observed while inspecting areas of part removal and teardown.

△16 Enter inspection acceptance stamp and date to indicate inspection verification of the information recorded under instructions (11) and (13) .

MANUFACTURING PLANNING

⟨17⟩ Enter the Number of the MSO/rwk MSO upon which you will record rework instructions for the discrepancies recorded in blocks (11) and (13) of this TSTR.

⟨18⟩ Enter planning stamp and date of preparation of the rework and inspection instructions.

QUALITY PLANNING

[19] Enter planning stamp and date of approval of the documented rework and inspection instructions entered by Manufacturing Planning on the MSO/ rwk MSO number recorded in block

Figure 6
TROUBLESHOOTING AND TEARDOWN RECORD (continued)

- Serial number - The serial number used to identify the particular failed system, equipment, etc.

- Date of failure - The calendar date of the failure

- Identification by subsystem and/or assembly - The designated description to identify failed subsystem and/or assembly

- Subsystem/assembly serial number - The serial number assigned to identify the failed subsystem/assembly

- Failed component - The designated descriptor to identify the failed component (black box)

- Failed component serial number - The serial number used to identify the particular failed component.

- Failed component manufacturer - The noun descriptor of the company who assembled the failed component

- Piece part number - The drawing number descriptor of the failed part

- Identification by circuit location - The grid location on the assembly drawing and/or circuit location identifier; e.g., 101A, Q6 for grid right 101, up A and Transistor Q6

- Reference failure report number - FR number of associated failures at time FR is written

- Description and cause of Failure - Short narrative explanation of the failure and probable cause of the failure including the type of test

- Trouble severity - The effect of the failure on the mission safety/completion as determined after the failure analysis is completed

- Categorization of failure - The failure category of primary or secondary as determined after the failure analysis is completed

- Corrective Action - The corrective action to be taken as recommended by the Failure Review Board

- Dates of completion and final closeout of corrective action - The agreed upon date of incorporation of the corrective action in the system and component serial number effectivity as well as the final date of closeout of the corrective action

- Responsible Engineer - Design engineer or production engineer responsible for the design and/or manufacture of the failed component

- Test and operation where failure occurred - Description of test being performed at time of failure.

- Manufacturer of failed item - Manufacturer of the item identified as failed on the failure report

- Manufacturer of next assembly - Manufacturer of the next lower assembly

- Test procedure and applicable paragraph - The test procedure and paragraph being followed at time of failure

- Status - Open or closed as determined by Failure Review Board.

1A306.11.2 Software Problem Summary Reports

A monthly summary of TDR's not closed prior to the reporting period will be prepared by the Manager of Software Performance Assurance. These reports will include:

- TDR Number - The numerical designation assigned to each individual failure report

- System ID Number - System designation

- Failed Component ID - The program name and number used to identify the particular system component which failed

- Date of Failure - The calendar date the problem was detected

- Problem Description - Brief description of the problem and probable cause

- Test ID - Identification of test procedure which detected the problem

- Classification of Failure - The category of the failure as defined in Paragraph 1A306.12 below

- Corrective Action - The corrective action to be taken as approved by the Software Failure Review Board

- Dates of Completion and Final Closeout of Corrective Action - The agreed upon date of incorporation of the corrective action in the system and component serial number effectivity as well as the final date of closeout of the corrective action

- Responsible Programmer - Computer programmer responsible for the design or development of the software function.

## 1A306.12 Classification of Failures

### 1A306.12.1 Classification of Hardware Failures

The following categories are to be used in classifying hardware test failures:

1) Wear out - Those failure of items that could be avoided by careful preventive maintenance and/or replacement

2) Workmanship - Failures resulting from manufacturing errors

3) Test Operator Error - Failures resulting from test operator failing to follow test procedures

4) Test Procedure Error - Failures resulting from inadequate test procedures

5) Design Errors - Failure that may require design change to rectify

6) Marginal Performance - Indications that the equipment being tested will not meet specification limits if test is continued or otherwise shows trouble symptoms

7) Adjustments - Adjustment must be made to bring equipment into specification limits

8) Nonoperational Defects - These are not failures but are associated with replacement of parts for convenience

9) Dependent Failures - These are secondary failures resulting from an initial failure

10) Random failure - Failure not definable as to cause.

### 1A306.12.2 Classification of Software Problems

The following categories are to be used in classifying software problems:

1) Design error

2) Development error

3) Test procedure error

4) Test operator error

5) Computing hardware error

6) Undefined error

## 1A306.13 Failure Review Board

### 1A306.13.1 Introduction

#### 1A306.13.1.1 Purpose

The purpose of the ERTS Failure Review Board is to provide formal evaluation and control of all reportable failures, failure analyses and recommended corrective action generated on ERTS equipment. The Failure Review Board does not replace the monthly Failure Report Summary but uses the summary as one of the major documents for discussion.

#### 1A306.13.1.2 Scope

The requirements of this procedure are mandatory for all ERTS reportable failures and include subcontractor failures.

#### 1A306.13.1.3 Schedule

Failure Review Board Meetings are scheduled monthly, beginning with the initiation of failure reporting. Project commitments or frequency of failure report concurrences may require revision of these time intervals.

1A306.13.2 Organization

1A306.13.2.1 Board Members

The ERTS Failure Review Board will consist of the following members:

- Chairman — Responsible for proper direction of each meeting plus assignment of action items. ERTS Manager of Performance Assurance.
- Vice-Chairman — Serve in the absence of the Chairman. Followup corrective action and action items.
- Secretary — Publish agenda, location and schedule for each meeting; notify all participants by phone prior to the meeting of the meeting and their responsibility. Prepare and publish minutes of meeting with Chairman's approval within five working days after each Failure Review Board Meeting.
- Design — Responsible for failure analysis and corrective action followup on design problems.
- Manufacturing — Responsible for corrective action followup on all failures attributable to manufacturing to ensure compliance.
- Quality — Verify corrective followup on all failures to ensure compliance. ERTS Project Quality Manager (PQM).
- Customer — Participates to assure correct identification of the problem and suitability of proposed corrective action.

Each Failure Review Board Member or alternate is responsible for:

- Reviewing the current status of each Failure Report in the agenda prior to the meeting
- Attending FRB Meeting and completing action items assigned to them by the Chairman

- Preparing written comments for discussion during the meeting
- Accepting the failure analysis and corrective action as presented or stating reasons for rejection
- Presenting additional information relative to the Failure Reports on the agenda or other pertinent information (e. g., alerts from other projects).

1A306. 13. 2. 2 Unit Engineers

Each failure considered to be open status on the agenda shall be described in detail by the Unit Engineer responsible for the failure analysis of the failed unit or by the Reliability Failure Control Engineer. The status of the failure analysis and corrective action shall be described and expected completion date shall be stated. The Unit Engineers and Reliability Failure Control Engineers are responsible for ensuring that the necessary information and data are available at the meeting for the Board to review.

Failure reports should be completely resolved during the month following the failure event. Where this is impossible, a memo should be sent to the Chairman at least one week prior to the Failure Review Board Meeting stating the current status of the open failure reports. This action is required to ensure that failure analyses of all failures having serious impact on the project schedule are not delayed.

1A306. 13. 3 Implementation

1A306. 13. 3. 1 Conduct of Failure Review Board

The first order of business is the review of all open action items remaining from previous Failure Review Board Meetings and proposed problem resolutions. Previously submitted action items acceptable to the Board are closed out on an individual basis. Action items requiring additional information and those not completed by the due date are reassigned as new action items. All action items assigned also include an information copy to the assignee's immediate supervisor to ensure prompt attention.

Action items assigned during Failure Review Board Meetings require a written answer from the individual assigned the action item. The answer shall be addressed to the Chairman with copies to the other Board Members.

The second order of business is a review of each failure report by the Unit Engineer or Reliability Failure Control Engineer (and other specialists, as required), including the description of the failure, the analysis of the failure and the proposed corrective action. The Board at this time can ask for additional information or can accept the analysis and corrective action as presented. Close out of each reportable failure is by formal FRB acceptance. Where a documented corrective action is indicated, such as Test Change Request (TCR), or Engineering Order (E. O.), the failure report is held open until the changes have been formally incorporated. Action items are assigned and agreements noted as required.

The third order of business is to summarize the failure reports closed by the Board and to summarize the failure reports in the open status including closed failure reports that have been reopened by the Board for additional analyses. At this time, the action items assigned and agreements are also reviewed for completeness and timeliness.

The final order of business is the closing of the meeting with a reminder of the next scheduled meeting.

1A306.13.3.2 Failure Review Board Tasks

- Review all failure reports originating during the report month plus all open failure reports carried over from previous months.
- Review all completed analysis of failures for completeness and effectiveness.
- Review all open action analyses of failures to ensure timeliness.
- Inquire into circumstances and effectiveness of corrective actions assigned, as indicated by failure analysis.
- Close out completed failure reports.

In performing these tasks, the Board Members examine failed items for the following points:

- Accurate documentation
- Complete documentation
- Depth of analysis
- Decisiveness
- Alternatives
- Interface compatibility
- Tolerance accumulations
- Applicability to other serial numbers
- Effect on schedule and cost
- Experimental proof
- Use of preferred parts, materials and processes
- Similarity to other projects.

1A306.13.4 Documentation

1A306.13.4.1 Minutes of Meeting

Detailed minutes listing action items, agreements and failure report status of each Failure Review Board are prepared by the Secretary for approval by the Chairman. The minutes are distributed to the approved project distribution list.

1A306.13.4.2 Documents Required for Meeting

The following documentation shall be available at the meeting for each failure report to be discussed:

- Copy of TDR
- Copy of TDF
- Photograph of hardware involved or actual hardware where available
- Monthly failure summary.

The following documentation shall be available as applicable:

- Additional photographs or X-rays
- Schematics
- Documented corrective action
- Additional data such as test reports
- Backup data such as impact of and corrective action on similar failures from other projects
- Vendor supplied data.

1A306.13.5 Definitions

- Failure Review Board - Formal board to review all hardware failure reports and software problems generated on the ERTS Project.
- Test Discrepancy Report - Document written to describe the physical or functional discrepancy of a part, or higher assembly or problem with a software item.
- Unit Engineer - Engineer responsible for the design, manufacture and test of a specified equipment.
- Action Item - Formal request by the Failure Review Board and assigned to an individual for additional specified documentation
- Agreement - Informal resolution of a problem where an action item is not required
- Test Discrepancy Followup - Preprinted supplemental form to TDR to document request for failure analysis and to enter the TDR into the TIRS as a reportable failure.
- Software Engineer - Engineer responsible for the development and test of a specified software item.