WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15400	**In-Flight Anomaly Number** --	**Contractor Report Number** S-076	**JSC#** --	**KSC#** --
Problem Title LH2 TANK THIN WEB FRAME				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 3
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** EXTERNAL TANK	**PART#** 80914801982-XXX	**SER/LOT#** NA	**MANUFACTURER** MCI
Test/Operation M - MFG	**Prevailing Condtion** N - INSPECTION	**F / U** UC	**Fail Mode** MS - STRUCT	**Cause** D - DESIGN
System STRUCTURAL	**Defect** MD - M SIZE	**Material** S - STRUCT	**Work Contact** M. BANKESTER	**Fail Date** 03/19/1993
Received at MSFC 05/12/1993	**Date Isolated** 03/19/1993	**FMEA Reference** N/A	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MU - MECH TOLRNCE		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 03/18/1994	**Contractor Req Defer Until Date** 03/19/1993	**LVL 3 Close** --	**Remark / Action** 02/18/1994	
Investigation / Resolution Summary				
Last MSFC Update 02/22/1995	**CN RSLV SBMT** 04/18/1994	**Defer Date** --	**Add Date** 05/12/1993	**R/C Codes** 1 - DES -- --
Assignee				
Design O. MOON	**Chief Engineer** M. PESSIN	**S & MA** M. D. SMILES	**Project** --	**Project MGR** P. COUNTS
Approval				
Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**

O. MOON	M. PESSIN	M. D. SMILES	--	C. SUMNER
PAC Assignee B. HURST	**PAC Review Complete** --	**MSFC Closure Date** 05/19/1994	**Status** C - CLOSED	**F/A Completion** 03/18/1994
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** T-125467			
Related Document Title MARS				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				

Problem Description

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THE 80914801980-050 (ET-72), -009 (ET-73) AND -009 (ET-75) FRAME
SEGMENT ASSEMBLIES HAVE THICKNESS VIOLATIONS IN THE ASSOCIATED
80914801982-XXX WEB DETAILS. WORST CASE THICKNESS VIOLATIONS ARE
0.0401", 0.0452" AND 0.0447" RESPECTIVELY (REQUIREMENT = 0.050"
+/-.004)
ET-60 THRU 68, 70 AND 71 ARE SUSPECT OF HAVING 80914801982-XXX
WEBS WHICH MAY BE BELOW DRAWING REQUIREMENTS FOR THICKNESS
NOTE 1: THIS IS A DISCRETIONARY CAPS (REFERENCE PARAGRAPH 1.6.2.3C
        OF MMC-ET-RAO3) REQUESTED BY THE ET PROJECT OFFICE. THE WEB
        DETAILS ARE STRUCTURAL PARTS WHICH WERE GROUND RULED OUT OF
        THE FMEA/CIL. ASSIGNMENT OF CRITICALITY 3 WAS DETERMINED TO
        BE APPLICABLE, BY MMMSS ENGINEERING/PRODUCT ASSURANCE AND
        NASA (MSFC)
NOTE 2: SPECIAL INVESTIGATION SI-93-S011 HAS BEEN OPENED AND PROVIDES
        DETAILED INVESTIGATIVE INFORMATION PERTAINING TO ALL WEB
        DISCREPANCIES REPORTED. COPIES OF SI-93-S011 ARE AVAILABLE
        UPON REQUEST
NOTE 3: THIS CAPS REVISION DELETES ALL REFERENCES TO THE MATERIAL
        PROPERTIES PROBLEM REPORTED IN S-076. CAPS S-077 HAS BEEN
        INITIATED TO ADDRESS THAT PROBLEM
NOTE 4: DURING THE COURSE OF THIS INVESTIGATION, A CONCERN WAS
        IDENTIFIED THAT IN SOME CASES SUPPLIERS HAD THE OPTION TO USE
        SHEET STOCK SIZES WHICH POTENTIALLY WOULD NOT SATISFY THE
        FACTOR-OF-SAFETY REQUIREMENTS. ALSO, THAT SUPPLIERS WERE NOT
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INTERPRETING THE ENGINEERING DRAWING TO USE THE ANSI DOCUMENT
RELATIVE TO SHEET STOCK THICKNESS REQUIREMENTS, BUT WERE
DEFERRING TO THE ENGINEERING DRAWING "BLOCK" TOLERANCES
(REV. "F": ADDS "NOTE 4" AND REVISES,"GENERAL","CAUSE", TASK I,
TASK II, TASK III, TASK IV AND CLOSES THIS CAPS--SEE ASTERISKS)

Contractor Investigation/Resolution

*GENERAL
IN AUGUST 1992 MAF PRODUCTION PERSONNEL NOTICED SURFACE TEXTURE WAS DIFFERENT IN WEB DETAIL OF AN LH2 FRAME SEGMENT ASSEMBLY ALLOCATED TO ET-73 AND CHECKED THICKNESS (MEASURED .039 - REQUIREMENT IS .050 +/- .004 INCH)
- ENGINEERING DISPOSITIONED UNACCEPTABLE FOR FLIGHT
- PRODUCT ASSURANCE SCRAPPED PART
- SEVEN PARTS ISSUED TO THE FLOOR WERE CHECKED AND FOUND ACCEPTABLE
- SCAD-92-126 WAS ISSUED TO MACHINE CRAFT INCORPORATED (MCI); STOCK INSPECTED AND CLEARED - ISOLATED CASE
  - EIGHTY (80) FRAME SEGMENT ASSEMBLIES THAT COMPLETED FINAL PROCESSING WERE INSPECTED AT MCI - NO DISCREPANT PARTS FOUND
    MCI ALSO INSPECTED 120 WEB DETAILS WHICH HAD BEEN FORMED BUT NOT ETCHED - NO DISCREPANT PARTS FOUND

IN MARCH 1993, AN UNDER THICKNESS CONDITION WAS DISCOVERED ON THE WEB DETAIL OF AN LH2 FRAME SEGMENT ASSEMBLY ALLOCATED TO ET-75 AND FURTHER INVESTIGATION WAS INITIATED

*TASK I. PROBLEM/FAILURE INVESTIGATION

1) QUALITY CONTROL WILL INSPECT 241 LH2 FRAME SEGMENT ASSEMBLIES FOR WEB THICKNESS VIOLATIONS. THESE INCLUDE 199 PARTS IN INVENTORY STORES AND 42 PARTS ISSUED TO, OR INSTALLED ON ETS 69, 72, 73, 74 AND 75
   RESPONSIBILITY: P. POWELL
   COMPLETE: 4/15/93
   CLOSURE STATEMENT
   - SEVENTEEN (17) PARTS WERE FOUND THAT VIOLATED THE WEB THICKNESS REQUIREMENTS
   - ALL PARTS (241) WERE RECEIVED FROM MCI
   - NO THICKNESS VIOLATIONS WERE FOUND ON ET-69 AND ET-74
2) PERFORM STATISTICAL ANALYSIS OF 241 WEB PANELS IN ORDER TO DETERMINE THE WORST CASE PREDICTED CONDITIONS AT A 99% PROBABILITY /95% CONFIDENCE LEVEL USING MINIMUM PANEL THICKNESS PER PANEL
   RESPONSIBILITY: D. KINCHEN/G. WHEELER
   COMPLETE: 4/30/93
   CLOSURE STATEMENT:
   WORST CASE PREDICTED CONDITION (MINIMUM VALUE PER PANEL) IS 0.0395" (99% PROBABILITY AND A 95% CONFIDENCE LEVEL) AND 0.036" (99.9% PROBABILITY AND A 95% CONFIDENCE LEVEL)
3) ENGINEERING TO EVALUATE WORST CASE PREDICTED CONDITIONS FOR THICKNESS AND PROVIDE RATIONALE FOR FLEET CLEARANCE
   RESPONSIBILITY: J. DYE/G. COPELAND
   COMPLETE: 5/14/93
   CLOSURE STATEMENT
   ENGINEERING DETERMINED THAT ANALYTICAL METHODOLOGY (REVISED TO REFLECT SEMI-TENSION FIELD CAPABILITY), VERIFIED BY TEST, ALLOWS WEBS WITH THICKNESS .039 INCH TO BE DISPOSITIONED "USE AS IS" (FS = 1.58 VS 1.26 REQUIRED)
4)A TOTAL OF 534 OTHER PART NUMBERS HAVE BEEN IDENTIFIED AS BEING MANUFACTURED BY MCI AND DELIVERED TO MMMSS
   - FORTY SIX (46) OF THE 534 MCI PART NUMBERS HAVE BEEN IDENTIFIED AS CRITICAL CONCERNS RELATIVE TO THE MINIMUM FACTOR-OF-SAFETY AND SAMPLE INSPECTED FOR THICKNESS ALONG WITH OTHER SELECTED PARTS (TOTAL OF 1,677 PARTS INSPECTED)
   - THREE ADDITIONAL PART NUMBERS (80914991997-009/-010, 80914091996-019 LH2 FRAME STABILIZERS) HAVE BEEN IDENTIFIED AS

HAVING MINOR UNDER THICKNESS DISCREPANCIES
- SPECIAL INVESTIGATION SI-93-S013 HAS BEEN INITIATED TO ADDRESS THE THICKNESS DISCREPANCIES ON THE LH2 FRAME STABILIZERS THESE ARE NOT CRITICAL PARTS PER STRESS ENGINEERING (ADEQUATE STRENGTH EXISTS FOR WORST CASE THICKNESS)

SHEET STOCK TOLERANCE ISSUE:

*1)ENGINEERING IDENTIFIED 854 PARTS WITH SHEET STOCK TOLERANCES. AN ENGINEERING ANALYSIS WILL BE PERFORMED ON ALL 854 PARTS TO ASSURE THAT FACTOR-OF-SAFETY REQUIREMENTS HAVE NOT BEEN IMPACTED. MATERIEL OPERATIONS WILL PROVIDE ACTUAL SHEET/PLATE STOCK SIZE INFORMATION FROM VENDORS ON MANUFACTURED PARTS, AS NECESSARY, TO SUPPORT THE ENGINEERING ANALYSIS
RESPONSIBILITY: M.R. SIMMS/G. COPELAND/N. JAMES
COMPLETED: 03/18/94
CLOSURE STATEMENT:
ENGINEERING HAS COMPLETED THE ANALYSIS OF ALL 854 IDENTIFIED PARTS USING WORST CASE MINIMUM THICKNESS OR ACTUAL SHEET/PLATE STOCK SIZE AND THICKNESS TOLERANCE INFORMATION PROVIDED BY MATERIEL OPERATIONS, AND HAS DETERMINED THAT ALL PARTS MEET EIS REQUIREMENTS
ENGINEERING WILL MAKE CHANGES TO THE DRAWINGS FOR ALL PARTS MADE FROM SHEET STOCK BY INSERTING A NOTE CALLING OUT THE NOMINAL SHEET THICKNESS AND TOLERANCE ALLOWED ON THE FINISHED PRODUCT. (REFERENCE CLASS 2 CHANGE SUMMARY J31148)
AN INTERIM MEMO (AP-0893-RJE-074) HAS BEEN ISSUED TO ALL AFFECTED SUPPLIERS FROM MAF MATERIEL OPERATIONS. THIS LETTER STATED THAT, "SHEET AND PLATE RAW MATERIAL THICKNESS TOLERANCES SHALL NOT EXCEED THOSE ANSI TOLERANCES SPECIFIED FOR MATERIALS 78.74 INCHES OR LESS IN WIDTH. STOCK MAY BE PROCURED IN WIDTHS GREATER THAN 78.74 INCHES BUT MUST MEET THE MINIMUM ANSI SPECIFIED THICKNESS TOLERANCES FOR THE NARROWER STOCK. THIS MEMO WILL BE PROVIDED TO ANY NEW SUPPLIERS UNTIL THE DRAWING UPDATES ARE RELEASED

* TASK II. CORRECTIVE ACTIONS

WEB THICKNESS ISSUE:

1) PI-3001-2 (CHEMICAL FILM APPLICATION/AUXILIARY LINE) HAS BEEN REVISED FOR THE TEMPORARY TANKS AT MCI, AND THE MANUFACTURING TRAVELERS HAVE BEEN REVISED TO PROVIDE APPROPRIATE BUY-OFFS
2) PROCESSES THAT ARE NOT A PART OF THE TRAVELER, SUCH AS BELT SANDING AND MULTIPLE ETCHING, WILL BE CONSIDERED REWORK AND WILL BE DOCUMENTED ON APPROPRIATE PAPER AND INCLUDE REVERIFICATION OF DIMENSIONS
* 3) THE TEMPORARY TANKS WILL BE REWORKED NOW THAT PI-3001-2 HAS BEEN APPROVED AND WILL BE USED TO PROCESS Z-FRAMES IN DECEMBER 1993
-ECD:12/6/93
-ECD:1/14/94: PENDING RECEIPT OF MATERIAL NEEDED TO COMPLETE THE REWORK (POOL LINERS). SCHEDULED FOR RECEIPT AROUND JANUARY 1, 1994
-COMPLETE: 2/18/94

CLOSURE STATEMENT
RELIABILITY ASSURANCE AND PROCUREMENT QUALITY ALONG WITH TWO NASA REPRESENTATIVES WITNESSED THE REVALIDATION PROCEDURES ON THE TEMPORARY ETCH TANKS AT MCI ON FEBRUARY 18, 1994. ONE Z-FRAME WAS PROCESSED AND MCI DEMONSTRATED THAT THE INTEGRITY OF THE PROCESS WILL BE ENSURED WITH THE ADDED IMPROVEMENTS:

- ELECTRIC TIMER WITH ALARM TO SIGNAL THE COMPLETION OF EACH STEP IN THE PROCESS
- STAINLESS STEEL SUPPORTS TO HOLD DOWN THE POOL LINERS AND THE PVC TUBING FOR AIR AGITATION
- RECORDED TEMPERATURE CHECKS AT BOTH ENDS OF THE ETCH TANK
- PLASTIC PERFORATED BOX TO ENCLOSE THE HEATER
- THICKNESS VERIFICATION ON FINISHED PRODUCTS

* 4) SCAR-93-046 WAS ISSUED TO THE SUPPLIER (MACHINE CRAFT

INCORPORATED)
SHEET STOCK TOLERANCE ISSUE:
ENGINEERING WILL MAKE A CLASS 2 CHANGE TO THE ENGINEERING DRAWING FOR ALL IDENTIFIED PARTS CALLING OUT NOMINAL SHEET THICKNESS AND TOLERANCE FOR THE FINISHED PRODUCT. ENGINEERING WILL ALSO REVISE PROCEDURES MANUALS TO REQUIRE THAT DESIGN THICKNESS AND TOLERANCE ARE CALLED OUT ON ALL FUTURE DRAWINGS (REF. CLASS 2 CHANGE #J11348)
AN INTERIM MEMO (REF MEMO AP-0893-RJE-074) HAS BEEN ISSUED BY MATERIEL OPERATIONS TO THE PRESENT SUPPLIERS AND WILL BE ISSUED TO THE FUTURE SUPPLIERS OF THE 854 AFFECTED PARTS. THIS MEMO STATES THAT THE SUPPLIERS SHALL NOT EXCEED ANSI TOLERANCES SPECIFIED FOR MATERIAL 78.74 INCHES OR LESS IN WIDTH. PROCUREMENT QUALITY WILL ASSURE THAT THE RESPONSIBLE SUPPLIER OPERATES IN ACCORDANCE WITH THIS MEMO UNTIL THE DRAWING REQUIREMENTS ARE CHANGED

*TASK III. FLEET CLEARANCE

WEB THICKNESS ISSUE:
ETS THROUGH ET-59 HAVE BEEN CLEARED SINCE THEY WERE ISSUED 80914801980-XXX PARTS FROM A PREVIOUS VENDOR (TELEDYNE AERO-CAL) BEFORE RECEIPT OF MCI PARTS IN JANUARY 1989

- DOCUMENTATION HAS BEEN PROVIDED TO VERIFY THAT THICKNESS MEASUREMENTS WERE TAKEN OF WEB DETAILS PRIOR TO ETCHING AND CHEM FILMING WITH RECORDED READINGS OF .050" +/- .004". THE WEBS WERE THEN SENT TO A SUBCONTRACTOR (DVI) FOR A CONTROLLED ETCHING PROCESS (DATA PROVIDED). UPON RETURN OF THE PARTS TO TELEDYNE AERO-CAL, THICKNESS MEASUREMENTS WERE TAKEN AGAIN AND ACCEPTED BY MMMSS PROCUREMENT QUALITY REPRESENTATIVE

ETS 60 THRU 68, 70 AND 71 HAVE BEEN CLEARED BY MULTI-EFFECTIVITY MARS T-125467, BASED ON ENGINEERING RATIONALE (FACTOR-OF-SAFETY = 1.58 VS 1.26 REQUIRED)
ETS 69 AND 74 HAVE BEEN INSPECTED PER DC&R S-93-006B AND PA157381 RESPECTIVELY AND NO WEB THICKNESS DISCREPANCIES WERE FOUND
ETS 72, 73 AND 75 WERE FOUND TO HAVE THICKNESS DISCREPANCIES ON ONE PANEL PER EACH EFFECTIVITY. THESE DISCREPANCIES HAVE BEEN CLEARED BY ENGINEERING RATIONALE BASED ON WORST CASE THICKNESS OF .039" (REF TASK I, ITEM 3)
MARS:

ET-72; MARS T-129062, MIN. THICKNESS = .0401"
ET-73; MARS T-125737, MIN. THICKNESS = .0452"
ET-75; MARS T-121893, MIN. THICKNESS = .0446"

ET-76 AND UP HAVE BEEN CLEARED BY INSPECTION OF MAF STOCK AND FUTURE FINISHED PRODUCT THICKNESS CHECKS AT THE SUPPLIER
SHEET STOCK TOLERANCE ISSUE:
ENGINEERING EVALUATE 854 PARTS FOR WORST CASE THICKNESS TOLERANCES USING EITHER THE ANSI OR "BLOCK" TOLERANCE REQUIREMENTS AND CLEARED 685 PARTS, AS MEETING THE EIS FACTOR-OF-SAFETY REQUIREMENT
ENGINEERING THEN EVALUATED THE 169 REMAINING PARTS WHICH COULD NOT BE CLEARED USING THE WORST CASE THICKNESS TOLERANCES. UTILIZING THE ACTUAL SHEET STOCK SIZES USED BY AND REPORTED BY THE SUPPLIERS, ENGINEERING DETERMINED THAT THERE WERE NO FACTOR-OF-SAFETY VIOLATIONS WITH THE 169 IDENTIFIED PARTS
THE RESULTS OF ENGINEERING'S EVALUATION OF ALL 854 PARTS IS ADDRESSED IN DETAIL IN MEMOS #4130-93-073, #4130-94-003 AND #4430-94-004 ("SHEET STOCK TOLERANCE ISSUE")
CAUSE:

1) INVESTIGATION OF SUBCONTRACTOR (MCI) BUILD PROCESS REVEALED LACK OF ADEQUATE CONTROLS ON THE ETCHING PROCESS AND NO THICKNESS VERIFICATION AFTER ETCHING
2) MCI REPORTED THAT 10-15 SHEETS OF MATERIAL WERE SANDED USING AN AUTOMATED GRINDING MACHINE TO REMOVE SCRATCHES FROM RAW STOCK DURING THE FIRST SHIPSET QUANTITIES

NOTE: THE CAUSE FOR THE PROBLEM ADDRESSED IN "NOTE 4" IS ATTRIBUTED TO AN ENGINEERING OVERSIGHT OF SHEET STOCK THICKNESS TOLERANCE

REQUIREMENTS, AND TO CERTAIN VENDORS MISINTERPRETING THE
ENGINEERING DRAWING REQUIREMENTS
*TASK IV. CAPS CLOSURE SUMMARY
WEB THICKNESS ISSUE:
RELATIVE TO ANSI THICKNESS REQUIREMENTS FOR SHEET STOCK THICKNESS TOLERANCES, VARIOUS DISCREPANCIES WERE FOUND IN THE WEB DETAILS OF LH2 FRAME SEGMENT ASSEMBLIES RECEIVED FROM MACHINE CRAFT INCORPORATED (MCI). BASED ON A WORST CASE PREDICTED CONDITION OF .039" (99% PROBABILITY AND A 95% CONFIDENCE LEVEL) ALL WEB DETAILS WERE DISPOSITIONED "USE AS IS". AN INVESTIGATION INTO MCI BUILD PROCESSES REVEALED A LACK OF CONTROLS ON THE ETCHING PROCESS AND REPORTS OF UNAUTHORIZED SANDING ON 10 - 15 SHEETS OF MATERIAL. MCI ADDRESSED CORRECTIVE ACTION BY REVISING PI-3001-2 (CHEMICAL FILM APPLICATION/AUXILIARY LINE) FOR THE TEMPORARY TANKS TO PROVIDE APPROPRIATE BUY-OFFS, AND HAS ALSO ENSURED THAT NO UNAUTHORIZED REWORK (EXAMPLE: SANDING) WILL BE PERFORMED WITHOUT PROPER DOCUMENTATION. THE TEMPORARY TANKS HAVE ALSO BEEN UPGRADED AND THE ETCH PROCESS REVALIDATED
SHEET STOCK TOLERANCE ISSUE:
DURING THE COURSE OF THIS INVESTIGATION, A CONCERN WAS IDENTIFIED THAT IN SOME CASES SUPPLIERS HAD THE OPTION TO USE SHEET STOCK SIZES WHICH POTENTIALLY WOULD NOT SATISFY THE FACTOR-OF-SAFETY REQUIREMENT IT WAS ALSO DISCOVERED THAT CERTAIN SUPPLIERS MISINTERPRETED THE DRAWINGS AND USED "BLOCK" TOLERANCES INSTEAD OF THE REQUIRED ANSI TOLERANCES FOR THEIR THICKNESS REQUIREMENTS. IN ORDER TO ENSURE THAT ADEQUATE MARGIN EXISTED WHETHER THE SUPPLIER USED EITHER THE "BLOCK" TOLERANCES OR WORST CASE ANSI TOLERANCES, A COMPREHENSIVE ANALYSIS WAS PERFORMED ON ALL 854 IDENTIFIED SHEET STOCK PARTS. ALL BUT 169 OF THESE PARTS WERE DETERMINED BY ENGINEERING TO MEET END ITEM SPECIFICATION REQUIREMENTS WITH THE WORST CASE ASSUMPTION. MATERIEL OPERATIONS CONTACTED THE SUPPLIERS OF THE REMAINING 169 PARTS AND OBTAINED THE ACTUAL SHEET SIZE AND TOLERANCES USED. UTILIZING THIS DATA, ENGINEERING CLEARED THE REMAINING 169 PARTS. TO ENSURE THAT THE SHEET THICKNESS REQUIREMENTS ARE NOT OPEN TO INTERPRETATION, ENGINEERING WILL:
A) REVISE THE EXISTING DRAWINGS FOR ALL 854 PARTS TO ADD A FIRM THICKNESS AND TOLERANCE CALL OUT
B) REVISE ITS PROCEDURE MANUALS TO REQUIRE A FIRM THICKNESS AND TOLERANCE CALL OUT ON THE FACE OF ALL FUTURE DRAWINGS
CHANGE SUMMARY J11348 IMPLEMENTS THE ABOVE CHANGES
PER MEMO #AP-0893-RJE-074, MATERIAL OPERATIONS WILL ENSURE THAT ALL PRESENT AND FUTURE SUPPLIERS OF THE AFOREMENTIONED 854 PARTS DO NOT EXCEED ANSI TOLERANCES SPECIFIED FOR MATERIALS 78.74 INCHES OF LESS IN WIDTH. PROCUREMENT QUALITY WILL ASSURE THAT THE APPLICABLE SUPPLIER OPERATES IN ACCORDANCE WITH THIS MEMO UNTIL THE DRAWING REQUIREMENTS ARE CHANGED
THIS CAPS IS CLOSED, NO FURTHER ACTION REQUIRED

MSFC Response/Concurrence

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15400	--	S-076	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
80914801982-XXX	LH2 TANK WEB FRAME	N/A

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**

--	1	D - DESIGN	MS - STRUCT
Asmnt FMEA N/A	**Asmnt FM** N/A	**FMEA CSE** N/A	**FMEA SCSE** N/A
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --
Correlated Part# --	**Correlated Part#** --	**Correlated Part#** --	

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15408	**In-Flight Anomaly Number** --	**Contractor Report Number** E-151	**JSC#** --	**KSC#** --
Problem Title ELECTRICAL CONNECTOR FAILED A DIELECTRIC WITHSTAND VOLTAGE TEST AT MAF				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** --	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ELECTRICAL CONNECTOR	**PART#** NB SERIES (18-32 INS	**SER/LOT#** N/A	**MANUFACTURER** ITT CANNON
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EL - SHORT	**Cause** MA - MFG-ASY
System ELECTRICAL	**Defect** CN - CONTAM	**Material** F - INSUL	**Work Contact** JOHN ADAMS	**Fail Date** 02/19/1993
Received at MSFC 05/19/1993	**Date Isolated** 02/19/1993	**FMEA Reference** 3.1.4.1 & 3.1.5.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** EL - SHORT		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 09/03/1993	**CN RSLV SBMT** 08/12/1993	**Defer Date** 06/11/1993	**Add Date** 05/19/1993	**R/C Codes** 2 - MFG -- --
Assignee				
Design R. MOYE	**Chief Engineer** R.A. MOYE	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS

Approval				
Design R. MOYE	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 08/25/1993	**Status** C - CLOSED	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** T-127033			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				

Problem Description

AN NB SERIES ELECTRICAL CONNECTOR FAILED A DIELECTRIC WITHSTAND
VOLTAGE TEST (DWV) AT MAF. FAILURE ANALYSIS OF THE CONNECTOR FOUND THE
CAUSE TO BE A FOREIGN PARTICLE, QUARTZ, IN THE CONNECTOR INSERT. THE
VENDOR OF THE CONNECTOR REVIEWED THE FAILURES REPORTED TO THEM BY
OTHER USERS AND FOUND A NEARLY IDENTICAL FAILURE. THIS SECOND FAILURE
OCCURED IN A CONNECTOR PRODUCED USING AN INSERT FROM THE SAME
PRODUCTION RUN AS THAT WHICH FAILED AT MAF. NOTIFICATION OF THE SECOND
FAILURE WAS RECEIVED FROM ITT CANNON ON MAY 13, 1993. AT THAT TIME THE
FAILURE WAS DETERMINED TO MEET THE PROBLEM REPORTING REQUIREMENTS
CRITICALITY: THE ORIGINAL FAILURE WAS A DWV FAILURE BETWEEN PINS "Y"
AND "Z" OF CONNECTOR 314W02J2. THESE CONTACTS ARE PART OF LOX LEVEL
SENSOR CIRCUITS FOR 326A09 AND 326A11. THESE CIRCUITS ARE CRIT. 3,
FMEA ITEM CODES 3.1.4.1 AND 3.1.5.1, "FAILS WITH FALSE WET SIGNAL."
HOWEVER, THE 18-32 INSERTS ARE USED IN OTHER APPLICATIONS ON THE ET
WHICH ARE CRIT. 1
*REVISION "B"--UPDATES AND CLOSES ALL TASKS. (SEE ASTERISKS)

Contractor Investigation/Resolution

GENERAL:
WIRE HARNESS 314W02 ON ET-68 FAILED A DIELECTRIC WITHSTAND VOLTAGE
TEST (DWV) DURING WORK IN THE FINAL ASSEMBLY AREA. THE HARNESS HAD

A RESISTANCE LESS THAN THE MINIMUM ACCEPTABLE VALUE OF 3 MEGOHMS AT
1500 VOLTS REQUIRED BY TEST PROCEDURE-6R101-FA. THE FAILURE OCCURRED
BETWEEN CONTACTS "Y" AND "Z" OF CONNECTOR JACK 2 (J2). TROUBLESHOOTING
OF THE HARNESS ISOLATED THE FAILURE TO THE CONNECTOR INSERT OF J2
THE TEST PROCEDURE WAS BEING PERFORMED IN FINAL ASSEMBLY DUE TO TEST
ERRORS DURING THE ORIGINAL ACCEPTANCE TESTS IN THE HARNESS FABRICATION
SHOP. THE TEST ERRORS WERE ADDRESSED IN CAPS E-148
THE DEFECTIVE CONNECTOR WAS AN NB7E18-32PWR ASSEMBLED BY TIME
ELECTRONICS FROM COMPONENTS MANUFACTURED BY ITT CANNON. THE CONNECTOR
HAD THE TIME ELECTRONICS LOT CODE 8517-71. THE LOT CODE INDICATES THAT
THE CONNECTOR WAS ASSEMBLED IN THE SEVENTEENTH WEEK OF 1985 AND WAS
THE SEVENTY-FIRST LOT OF THAT WEEK. FAILURE ANALYSIS T-127033 TRACED
THE CAUSE OF THE DWV FAILURE TO A QUARTZ PARTICLE INCLUSION IN THE
MOLDED PHENOLIC INSULATION MANUFACTURED BY CANNON
ITT CANNON HAD A VIRTUALLY IDENTICAL FAILURE REPORTED TO THEM IN MAY
OF 1990 BY ANOTHER CUSTOMER. THE OTHER FAILURE OCCURRED IN AN
NB6GE18-32PNT3 CONNECTOR ASSEMBLED BY TIME ELECTRONICS. THAT CONNECTOR
HAD A LOT CODE 8513-84. BOTH CONNECTORS HAD INSERTS FROM THE SAME ITT
CANNON PRODUCTION RUN
TASK I. FAILURE INVESTIGATION
*A.ITT CANNON IS INVESTIGATING THE PRODUCTION HISTORY OF THE TWO
FAILED CONNECTORS. THE GOAL IS TO IDENTIFY ALL CONNECTORS
ASSOCIATED WITH THE INSERT PRODUCTION RUN USED IN THE TWO FAILED
CONNECTORS
RESPONSIBILITY: D. HUDSON/3830 -- M.COMBS/3830
J. ADAMS/3741 -- D. WESTPHAL/3740
COMPLETE: JULY 26, 1993
CLOSURE STATEMENT
ITT CANNON WAS UNABLE TO IDENTIFY THE SPECIFIC CONNECTOR PART NUMBERS
AND LOT CODES THAT MAY BE AFFECTED. PROBLEMS AROSE DUE TO THE LENGTH
OF TIME WHICH ELAPSED SINCE MANUFACTURE OF THE CONNECTORS AND THE
COORDINATION WITH THE ASSEMBLY FIRM, TIME ELECTRONICS. THE RELATED
PARTS MAY BE ANY NON-HERMETIC CONNECTOR OF THE 18-32 INSERT
CONFIGURATION, PIN OR SOCKET CONTACT TYPE, MADE BETWEEN JANUARY 1984
AND DECEMBER 1985
*B.RELIABILITY ASSURANCE IS RECOVERING THE TRACEABILITY RECORDS FOR
ALL TIME ELECTRONICS AND ITT CANNON CONNECTORS, OF THE 18-32
CONFIGURATION, USED ON THE ET. THE SEARCH IS LIMITED TO THE 1984
THROUGH 1986 TIME FRAME
RESPONSIBILITY: J. ADAMS/3741 -- D. WESTPHAL/3740
COMPLETE: JULY 1, 1993
CLOSURE STATEMENT
OVER 170 CONNECTORS WERE IDENTIFIED AS HAVING BEEN RECEIVED FROM ITT
CANNON OR TIME. THE FAILED CONNECTOR WAS THE ONE RECEIVED WITH THAT
PART NUMBER AND LOT CODE
TASK CLOSED
TASK II. CORRECTIVE ACTION
*A.GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM (GIDEP) ALERT 9Q-A-93-02
ISSUED AGAINST ITT CANNON CONNECTORS WITH THE 18-32 INSERT
CONFIGURATION AND WITH LOT CODES 8401-## THROUGH 8552-##
RESPONSIBILITY: B. CORNAY/3742 D. WESTPHAL/3740
COMPLETE: JULY 26, 1993
*B.SUPPLIER CORRECTIVE ACTION REQUEST (SCAR) 93-076 WAS ISSUED TO ITT
CANNON FOR THE FAILED CONNECTOR. IN RESPONSE, CANNON CITED IMPROVED
MANUFACTURING CONTROLS, IMPLEMENTED IN THE EIGHT YEARS SINCE THE
FAILED PART WAS PRODUCED, WHICH REDUCE THE LIKELIHOOD OF A
RECURRENCE
RESPONSIBILITY: T. PASTORET/3742--D. WESTPHAL/3740
COMPLETE: JULY 13,1993
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
ALL ET'S CLEARED. THE CONNECTOR FAILED DURING ACCEPTANCE TESTING AND

ALL DELIVERED ETS HAVE PASSED THE ACCEPTANCE TESTS. THE FAILURE OCCURRED AT 1500 VOLTS; NO SERVICE VOLTAGE ON THE ET EXCEEDS 100 VOLTS. NO CRITICALITY 1 CIRCUIT HAS A SERVICE VOLTAGE EXCEEDING 32 VOLTS DC
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
TASK CLOSED
CAUSE:
VENDOR ERROR; THE CONNECTOR FAILED AS THE RESULT OF CONTAMINATION IN THE PHENOLIC INSULATION
TASK IV. CAPS CLOSURE SUMMARY
A SINGLE CONNECTOR FAILED A 1500 VOLTS TEST. NO SERVICE VOLTAGE OF A CRITICALITY 1 CIRCUIT ON THE ET EXCEEDS 32 VOLTS DC. ITT CANNON HAS IMPROVED THE MANUFACTURING CONTROLS FOR THE CONNECTORS. THE EXISTING PERFORMANCE TESTS IN THE ET BUILD CYCLE ARE SUFFICIENT TO ASSURE PERFORMANCE
TASK CLOSED
THIS CAPS IS CLOSED. NO FURTHUR ACTION IS REQUIRED

MSFC Response/Concurrence

6/2/93 - DEFERRAL RATIONALE:
BASED ON THE DEFERRAL RATIONALE IN "TASK III. CLEARANCE OF EFFECTIVITIES"(ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126 REV. E PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL TEST."
THE DEFERRAL STATUS HAS BEEN APPROVED BY THE EXTERNAL TANK PROJECT MANAGER, MR. PARKER V. COUNTS
_____PARKER V. COUNTS (SIGNED), 6/11/93_____

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15408	--	E-151	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
NB 18-32 INSERT	ELECTRICAL CONNECTOR	N/A

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1	MA - MFG-ASY	EL - SHORT

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.1.4.1	1	N/A	N/A

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15427	**In-Flight Anomaly Number** --	**Contractor Report Number** S-077	**JSC#** --	**KSC#** --
Problem Title ET WEB SUSPECTED OF LOW MATERIAL PROPERTIES				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 3
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** EXTERNAL TANK	**PART#** 80914801982-XXX	**SER/LOT#** NA	**MANUFACTURER** MCI
Test/Operation M - MFG	**Prevailing Condtion** N - INSPECTION	**F / U** UC	**Fail Mode** MS - STRUCT	**Cause** MAW - MFG-ASY-WORK
System STRUCTURAL	**Defect** MT - TYPE W	**Material** S - STRUCT	**Work Contact** M. BANKESTER	**Fail Date** 03/19/1993
Received at MSFC 05/25/1993	**Date Isolated** 03/19/1993	**FMEA Reference** N/A	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 02/22/1995	**CN RSLV SBMT** 07/28/1993	**Defer Date** --	**Add Date** 05/25/1993	**R/C Codes** 0 - EXPL -- --
Assignee				
Design O. MOON	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS
Approval				

Design	Chief Engineer	S & MA	Project	Project MGR
O. MOON	M. PESSIN	R. JACKSON	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	08/03/1993	C - CLOSED	--

Problem Type	SEV	Program Name	REVL	OPRINC
--	--	--	--	--

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
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RES PERSON L2	Approval Signature L3
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Related Document Type	Related Document ID
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Related Document Title
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Related Document Type	Related Document ID
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Related Document Type	Related Document ID
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Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

ET-60 AND UP 80914801982-XXX WEB DETAILS ARE SUSPECT OF HAVING
LOW MATERIAL PROPERTIES. (REQUIREMENT: YIELD = MIN 50 KSI;
ULTIMATE = 64 KSI)
NOTE 1: THIS IS A DISCRETIONARY CAPS (REFERENCE PARAGRAPH 1.6.2.3C
OF MMC-ET-RAO3) REQUESTED BY THE ET PROJECT OFFICE AND DOES
NOT SPECIFICALLY RELATE TO ANY CIL ITEM
NOTE 2: SPECIAL INVESTIGATION SI-93-S011 HAS BEEN OPENED AND PROVIDES
DETAILED INVESTIGATIVE INFORMATION PERTAINING TO ALL WEB
DISCREPANCIES REPORTED. COPIES OF SI-93-S011 ARE AVAILABLE
UPON REQUEST
NOTE 3: THIS CAPS DOCUMENTS THE MATERIAL PROPERTIES PROBLEM THAT WAS
PREVIOUSLY REPORTED ON CAPS S-076
(REV. "B": REVISED TO INCLUDE RESPONSE TO SCAR 93-049 (TASK II) AND
CLOSED CAPS---SEE ASTERISKS

Contractor Investigation/Resolution

GENERAL:
MAY 1993
AS A PART OF THE MATERIAL THICKNESS INVESTIGATION, A PANEL WAS
SELECTED FROM INVENTORY STORES AND TESTED TO DETERMINE ACTUAL
TENSILE STRENGTH VALUES. THIS PANEL FAILED WITH WORST CASE RECORDED
VALUES OF YIELD = 48.6 KSI AND ULTIMATE = 60.6 KSI (REQUIREMENT:

YIELD = 50.0 KSI; ULTIMATE = MIN 64 KSI)
- AN ADDITIONAL PANEL WAS TESTED AND BOTH YIELD AND ULTIMATE VALUES PASSED
- MCI DELIVERED AN ETCHED AND UNETCHED PANEL FOR MECHANICAL PROPERTIES TESTING, BOTH PASSED

TASK I. PROBLEM/FAILURE INVESTIGATION

1) ENGINEERING TO DEVELOP WORST CASE MECHANICAL PROPERTIES SCENARIO
RESPONSIBILITY: L. JOHNSTON/P. HINKELDEY
COMPLETE: 5/14/93

CLOSURE STATEMENT

BASED ON TESTS FOR MECHANICAL PROPERTIES PERFORMED AT MAF, MATERIALS ENGINEERING'S BEST ESTIMATE FOR LOWER BOUND YIELD AND ULTIMATE VALUES IS FTY = 47 KSI; FTU = 59 KSI

2) ENGINEERING TO EVALUATE WORST CASE PREDICTED CONDITIONS FOR MATERIAL PROPERTIES AND PROVIDE RATIONALE FOR FLEET CLEARANCE
RESPONSIBILITY: J. DYE/G. COPELAND
COMPLETE: 5/14/93

CLOSURE STATEMENT

ENGINEERING DETERMINED BY ANALYTICAL METHODOLOGY (REVISED TO REFLECT SEMI-TENSION FIELD CAPABILITY), VERIFIED BY TEST, THAT WEBS WITH LOW MECHANICAL PROPERTIES (FTY = 47.0 KSI AND FTU = 59.0 KSI) ARE ACCEPTABLE FOR FLIGHT

* TASK II. ENHANCEMENTS

MCI HAS RESPONDED TO SCAR 93-049 BY STATING THAT THEY INSTRUCTED ASTRO ALUMINUM HEAT TREATING (SUBCONTRACTOR) TO MONITOR QUENCH OPERATIONS MORE CLOSELY TO ENSURE THE CORRECT TIME REQUIREMENT IS MAINTAINED AND TO ASSURE PROPER AGITATION IS PERFORMED TO ELIMINATE STEAM POCKETS THESE PARTS WERE PROCESSED FIVE YEARS AGO. ASTRO ALUMINUM HAS MADE SIGNIFICANT IMPROVEMENTS DURING THAT TIME. THESE IMPROVEMENTS INCLUDE:

- MECHANIZATION AND TYPING OF ALL JOB FOLDERS
- COMPUTERIZED TYPING OF ALL JOBS
- CERTIFICATION PROGRAM FOR BOTH HEAT TREAT SHOP PERSONNEL AND INSPECTORS WHO DO HARDNESS TESTING
- RECORDING OF ACTUAL QUENCH TIMES (FURNACE TO SUBMERSION)
- IMPLEMENTATION OF IMPROVEMENT TEAMS

RELIABILITY ASSURANCE FEELS THAT NO FURTHER ACTION IS NECESSARY

TASK III. FLEET CLEARANCE

ETS THROUGH ET-59 HAVE BEEN CLEARED SINCE THEY WERE ISSUED 80914801980-XXX PARTS FROM A PREVIOUS VENDOR (TELEDYNE AERO-CAL) BEFORE RECEIPT OF MCI PARTS IN JANUARY 1989

ETS 60 THROUGH 75 HAVE BEEN CLEARED BY USE AS IS DISPOSITION FROM ENGINEERING ON MULTI-EFFECTIVITY MARS T-125467

ETS 76 AND UP HAVE BEEN CLEARED BY USE AS IS DISPOSITION FROM ENGINEERING ON MARS T-123598 (ADDRESSING ALL WEB FRAMES IN INVENTORY STORES) AND MARS T-119710 (ADDRESSING 160 FORMED BUT NOT ETCHED PARTS AT MCI)

NOTE: THE INFORMATION IN THIS SECTION IS ALSO THE DEFERRAL RATIONALE

PROBABLE CAUSE:

1) SLACK QUENCH - TIME FROM FURNACE TO QUENCH WATER > 15 SECONDS, OR STEAM POCKETS FORMED DECREASING COOLING RATE
2) OVER AGED - APPROXIMATELY 18 HOURS COULD GIVE SIMILAR PROPERTIES (DOUBLE NORMAL AGE TIME)

TASK IV. CAPS CLOSURE SUMMARY

AS A RESULT OF THE WEB MATERIAL THICKNESS INVESTIGATION, A PANEL WAS TESTED FOR TENSILE STRENGTH AND WORST CASE RECORDED VALUES OF YIELD= 48.6 KSI AND ULTIMATE =60.6 KSI WAS OBTAINED (REQUIREMENT: YIELD=MIN 50 KSI; ULTIMATE=MIN 64 KSI). THREE ADDITIONAL PANELS WERE TESTED AND ALL PASSED BOTH ULTIMATE AND YIELD. ENGINEERING THEN DETERMINED BY ANALYTICAL METHODOLOGY THAT WEBS WITH LOW MECHANICAL PROPERTIES (FTY= 47.0 KSI AND FTU=59.0 KSI) ARE ACCEPTABLE FOR FLIGHT. PROBABLE CAUSE WAS ATTRIBUTED TO SLACK QUENCH OR OVER AGING OF THE PART. MCI INSTRUCTED ASTRO ALUMINUM HEAT TREATING TO MONITOR THEIR QUENCH

OPERATIONS MORE CLOSELY TO ENSURE THE CORRECT TIME REQUIREMENT IS MAINTAINED AND TO ASSURE PROPER AGITATION IS PERFORMED TO ELIMINATE STEAM POCKETS. THESE PARTS WERE PROCESSED FIVE YEARS AGO AND ASTRO ALUMINUM HAS MADE SIGNIFICANT IMPROVEMENTS DURING THAT TIME. NO FURTHER ACTION IS REQUIRED THIS CAPS IS CLOSED
MSFC Response/Concurrence

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report# A15427	**IFA#** --	**Contractor RPT#** S-077	**JSC#** --	**KSC#** --	**EICN#** --
Asmnt Part# 8091401982-XXX	**Asmnt Part Name** EXTERNAL TANK	**Asmnt Serial/Lot#** N/A			
HCRIT CD --	**FCRIT CD** 1	**CAUSE CD** MAW - MFG-ASY-WORK	**FAIL MODE** MS - STRUCT		
Asmnt FMEA N/A	**Asmnt FM** N/A	**FMEA CSE** N/A	**FMEA SCSE** N/A		
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --		
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --		
Correlated Part# --	**Correlated Part#** --	**Correlated Part#** --			
Associated LRU# --	**Associated LRU#** --	**Associated LRU#** --			
MAJOR DESIGN CHANGES					
APRV DATE --	**DESCRIPTION OF CHANGES** --				
ASSESSMENT TEXT					

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15483	**In-Flight Anomaly Number** --	**Contractor Report Number** E-152	**JSC#** --	**KSC#** --
Problem Title LOX ULLAGE PRESSURE TRANSDUCER FAILED OUTPUT VOLTAGE TEST AT MAF				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 3
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LOX PRESS TRANSDUCER	**PART#** 80931003731-009	**SER/LOT#** 0000028	**MANUFACTURER** TAVIS CORP
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EG - SIG HI OR LO	**Cause** MAW - MFG-ASY-WORK
System ELECTRICAL	**Defect** MW - MISWIR	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 08/17/1992
Received at MSFC 06/24/1993	**Date Isolated** 08/17/1992	**FMEA Reference** 3.2.1.1C & 3.2.1.2C	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** EG - SIG HI OR LO		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 01/17/1994	**Contractor Req Defer Until Date** 02/08/1994	**LVL 3 Close** --	**Remark / Action** 02/08/1994	
Investigation / Resolution Summary				
Last MSFC Update 02/09/1995	**CN RSLV SBMT** 02/09/1994	**Defer Date** --	**Add Date** 06/24/1993	**R/C Codes** 2 - MFG -- --
Assignee				
Design R. MOYE	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS

Approval				
Design R. MOYE	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 02/23/1994	**Status** C - CLOSED	**F/A Completion** 06/15/1993
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --

FUNC MOD	**Software Effectivity**	**Software Fail CD**	**SUBTYPE**	**Software Closure CD**
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RES PERSON L2	**Approval Signature L3**
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Related Document Type	**Related Document ID**
--	T-123647

Related Document Title
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Related Document Type	**Related Document ID**
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Related Document Type	**Related Document ID**
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

A LOX ULLAGE PRESSURE TRANSDUCER FAILED A TEST OF OUTPUT VOLTAGE
VERSUS APPLIED PRESSURE DURING ACCEPTANCE TESTING OF ET-65/LWT-58
FAILURE ANALYSIS OF THE TRANSDUCER, COMPLETED JUNE 15, 1993,
IDENTIFIED THE ROOT CAUSE OF THE FAILURE AS A DEFECTIVE TRANSISTOR
THE NATURE OF THE TRANSISTOR DEFECT INDICATES A LOT RELATED PROBLEM
THE TRACING OF ALL USES OF THE DEFECTIVE LOT OF TRANSISTORS WAS
RECEIVED ON JUNE 17, 1993
CRITICALITY: THE PD7400239-009 TRANSDUCERS ARE USED ON ET-64/
SUBSEQUENT AND ARE CRIT. 3; FMEA ITEM CODE 3.2.1.1C, "FAILS WITH HIGH
READING;" AND FMEA ITEM CODE 3.2.1.2C, "FAILS WITH LOW READING."
NOTE: THE TRANSDUCERS ARE LIMITED LIFE CONTROLLED
PREVIOUS CAPS: CAPS E-132, E-133, AND E-141 ADDRESSED UNRELATED
PROBLEMS WITH PD7400239 TRANSDUCERS
REVISION "E" CLOSES ALL TASKS. SEE ASTERISKS FOR CHANGES

Contractor Investigation/Resolution

GENERAL:
A LOX ULLAGE PRESSURE TRANSDUCER INSTALLED ON ET-65/LWT-58 FAILED A
TEST OF THE ACCURACY OF THE OUTPUT VOLTAGE PRESSURE VERSUS THE APPLIED
PRESSURE. THE TEST, TP7C201-AT, WAS BEING PERFORMED IN THE MAF
BUILDING 420, FINAL ACCEPTANCE AND TEST WORK AREA

THE TRANSDUCER WAS A PART NUMBER 80931003731-009, SERIAL NUMBER 28, INSTALLED ON THE ET IN THE REFERENCE DESIGNATOR 327A04 POSITION. AT AN APPLIED PRESSURE OF 21.006 PSIG, THE OUTPUT VOLTAGE WAS 3.581 VDC THE MAXIMUM ALLOWABLE OUTPUT VOLTAGE AT THAT PRESSURE IS 3.560 VDC THE 0.021 VDC OUT-OF-TOLERANCE CONDITION IS EQUIVALENT TO AN ERROR OF 0.4% OF FULL SCALE. THE 80931003731-009 TRANSDUCER IS AN ASSEMBLY OF A PD4800280-019 METAL SCREEN FILTER INSTALLED ON THE REFERENCE PORT OF A PD7400239-009 PRESSURE TRANSDUCER. THE PD7400239 TRANSDUCER, SERIAL NUMBER 85, USED IN THIS ASSEMBLY HAD AN OUTPUT VOLTAGE THAT WAS LOWER BY 0.9% AT 21 PSIG DURING THE ORIGINAL SUPPLIER ACCEPTANCE TEST THE TRANSDUCER WAS RETURNED TO THE SUPPLIER, TAVIS CORPORATION, FOR FAILURE ANALYSIS. THE TRANSDUCER IS A HERMETICALLY SEALED DESIGN WITH A TUBULAR STAINLESS STEEL CASE. ANALYSIS PROVED DIFFICULT AS THE FAILURE WAS INTERMITTENT AND VARIABLE IN NATURE. THE ANALYSIS AT TAVIS CONCLUDED IN APRIL 1993, BY IDENTIFYING A DEFECTIVE TRANSISTOR. THE DEFECTIVE TRANSISTOR WAS SENT TO THE MARTIN MARIETTA ASTRONAUTICS GROUP IN DENVER, COLORADO,FOR FURTHER ANALYSIS
THE DEFECTIVE TRANSISTOR WAS A 2N2946A JANTXV, PRODUCED BY TELEDYNE CRYSTALONICS, LOT CODE 8619. IT WAS FOUND TO HAVE EXCESSIVE ELECTRICAL LEAKAGE AT ALL TEMPERATURES; THE GREATEST OUT OF TOLERANCE CONDITION OCCURRED AT 75 DEGREE F. TESTING FOUND THE TRANSISTOR CASE HERMETICITY WAS WITHIN SPECIFICATION. RESIDUAL GAS ANALYSIS (RGA) OF THE CONTENTS OF THE HERMETICALLY SEALED CASE FOUND THE MOISTURE CONTENT WAS 6.79%; THE MAXIMUM ALLOWABLE VALUE IS 0.5%. FOLLOWING RGA, WITH THE MOISTURE HAVING BEEN REMOVED, THE TRANSISTOR NO LONGER HAD EXCESSIVE ELECTRICAL LEAKAGE. EXCESSIVE INTERNAL MOISTURE INDICATES LOSS OF CONTROL DURING THE MANUFACTURING PROCESS AND BRINGS INTO QUESTION THE RELIABILITY OF THE ASSOCIATED PRODUCTION LOT
TAVIS CORPORATION IDENTIFIED ALL PARTS PRODUCED FOR MARTIN MARIETTA MANNED SPACE SYSTEMS WHICH USED THE SAME LOT OF TELEDYNE CRYSTALONICS TRANSISTORS AS THAT IN THE ORIGINAL FAILURE; LOT CODE 8619. A TOTAL OF TWENTY-SEVEN PD7400239-009/80931003731-009 LOX ULLAGE PRESSURE TRANSDUCERS ARE AFFECTED. A TOTAL OF THIRTY PD7400239-019 LH2 ULLAGE PRESSURE TRANSDUCERS ARE AFFECTED. THE LH2 TRANSDUCERS WERE DEVELOPED TO REPLACE THE EXISTING PD7400098-089 PARTS BUT HAVE NEVER BEEN QUALIFIED FOR FLIGHT
TASK I. FAILURE INVESTIGATION

A ENGINEERING IS REVIEWING THE LOX ULLAGE PRESSURE TRANSDUCER TEST DATA TAKEN IN MAF BLDG. 420 ON THE ETS WHICH HAVE THE 80931003731-009 TRANSDUCERS. THE DATA WILL BE COMPARED WITH THE LAST SUPPLIER CALIBRATION TESTS TO DETERMINE IF THE TRANSDUCERS HAVE CHANGED
RESPONSIBILITY: L. COLON/4120--J. COOL/4120
COMPLETE: JUNE 28, 1993
CLOSURE STATEMENT
SEVERAL OF THE EIGHTEEN INSTALLED AND TESTED TRANSDUCERS HAD MINOR CHANGES IN THE OUTPUT VOLTAGE AS COMPARED TO THE SUPPLIER ATP. ANY ACTIONS NECESSARY WILL BE ADDRESSED FOLLOWING THE COMPLETION OF THE OTHER FAILURE INVESTIGATION TASKS

B PURCHASING IS OBTAINING FROM TAVIS CORPORATION THE TRACEABILITY DATA ON THE 2N2946A TRANSISTORS USED IN ALL TRANSDUCERS OTHER THAN THOSE INVOLVED WITH THE SUSPECT LOT
RESPONSIBILITY: G. PICHON/3830 M. COMBS/3830
COMPLETE: JUNE 28, 1993
CLOSURE STATEMENT
TWENTY-FOUR PD7400239-009/80931003731-009 LOX ULLAGE PRESSURE TRANSDUCERS AND TWENTY-TWO PD7400239-019 LH2 ULLAGE PRESSURE TRANSDUCERS WERE IDENTIFIED WITH THE LOT CODES OF TRANSISTORS

C ALL PD7400239 LOX AND LH2 ULLAGE PRESSURE TRANSDUCERS IN MAF STORES WERE DOCUMENTED ON MARS AS BEING SUSPECT OF BEING

INACCURATE AND WILL BE RETURNED TO TAVIS FOR TESTING. THIRTY LOX TRANSDUCERS WERE DOCUMENTED ON MARS T-127791. FIFTY-TWO LH2 TRANSDUCERS WERE DOCUMENTED ON MARS T-127790
RESPONSIBILITY: J. ADAMS/3741--D. WESTPHAL/3740
COMPLETE: JUNE 28, 1993

D TESTING OF THE PD7400239 LOX AND LH2 ULLAGE PRESSURE TRANSDUCERS AT TAVIS WILL CONSIST OF THE POST-VIBRATION PORTION OF THE SUPPLIER ATP
RESPONSIBILITY: G. PICHON/3830--M. COMBS/3830
L. COLON/4120--J. COOL/4120
COMPLETE: NOVEMBER 30, 1993

CLOSURE STATEMENT

1. THIRTY LOX PRESSURE TRANSDUCERS WERE TESTED AT TAVIS CORPORATION:
   A. TEN TRANSDUCERS WERE FOUND TO HAVE SMALL ERRORS IN OUTPUT VOLTAGE AND WERE DOCUMENTED ON MARS T-121303 AND T- 121304 THE TRANSDUCERS HAVE BEEN DISPOSITIONED TO BE READJUSTED AND RETURNED TO MAF
   B. ONE TRANSDUCER HAD GALLED THREADS ON THE REFERENCE PORT FITTING, AS A RESULT OF FILTER REMOVAL FOR TESTING, AND WAS DOCUMENTED ON MARS T-121306. THE TRANSDUCER WAS DISPOSITIONED "USE-AS-IS."
   C. ONE TRANSDUCER HAD AN OUTPUT VOLTAGE ERROR SIMILAR TO THAT OF THE ORIGINAL FAILURE WHICH OPENED THIS CAPS. THE TRANSDUCER WAS DOCUMENTED ON MARS T-121302 AND DISPOSITIONED FOR FAILURE ANALYSIS TO BE PERFORMED; SEE TASK I.G. BELOW
2. FIFTY TWO LH2 PRESSURE TRANSDUCERS WERE TESTED AT TAVIS CORPORATION:
   A. TWO TRANSDUCERS WERE FOUND TO HAVE SMALL ERRORS IN OUTPUT VOLTAGE AND WERE DOCUMENTED ON MARS T-121305.THE TRANSDUCERS WILL BE READJUSTED AND RETURNED TO MAF
   B. ONE TRANSDUCER HAD AN OUTPUT VOLTAGE ERROR AND WAS DOCUMENTED ON MARS T121307. THE MARS WAS DISPOSITIONED FOR FAILURE ANALYSIS; SEE TASK I.I BELOW

E NINETEEN TELEDYNE CRYSTALONICS TRANSISTORS FROM TAVIS STOCK ARE BEING TESTED TO DETERMINE THEIR CONDITION. THE TRANSISTORS ARE NEW UNITS WHICH HAVE BEEN UPGRADED BY TEST TO LEVEL "S" FOR USE IN THE PD7400239 TRANSDUCERS. EIGHTEEN OF THE TRANSISTORS ARE FROM THE SAME LOT CODE AS THE ORIGINAL FAILURE. THE TESTING IS BEING PERFORMED AT THE MARTIN MARIETTA ASTRONAUTICS GROUP IN DENVER, COLORADO
RESPONSIBILITY: G. PICHON/3830--M. COMBS/3830
L. COLON/4120-- J. COOL/4120
COMPLETE: AUGUST 12. 1993

CLOSURE STATEMENT

ALL NINETEEN TRANSISTORS PASSED THE ELECTRICAL PERFORMANCE TESTS. RESIDUAL GAS ANALYSIS OF FOURTEEN TRANSISTORS FOUND ONE UNIT THAT WAS NOT HERMETICALLY SEALED AND TWO WHICH HAD EXCESSIVE LEVELS OF MOISTURE. ONE OF THE TWO TRANSISTORS WITH EXCESSIVE MOISTURE WAS THE LOT CODE 8611 PART. THE GIDEP ALERT WAS REVISED TO INCLUDE THE ADDITIONAL INFORMATION AND LOT CODE; SEE TASK II.A

F ELECTRICAL ENGINEERING DEPT. 4120, WILL RECOMMEND A COURSE OF ACTION FOR THE TRANSDUCER PROBLEMS BASED ON AN EVALUATION OF THE DATA FROM THE TRANSDUCERS IN TASK I.D., THE TRANSISTORS IN TASK I.E., AND THE RESULTS OF THE FAILURE ANALYSES IN TASK I.G AND TASK I.I
RESPONSIBILITY: G. PICHON/3830--M. COMBS/3830
L. COLON/4120-- J. COOL/4120

* COMPLETED: JANUARY 17, 1994

CLOSURE STATEMENT

1. REVIEW OF THE TRANSDUCER TEST DATA FROM THIRTY LOX AND FIFTY-TWO LH2 PRESSURE TRANSDUCERS, OBTAINED AS PART OF I.D., FOUND NO INDICATION OF PROBLEMS ASSOCIATED WITH AN INDIVIDUAL LOT OF TRANSISTORS

*2. REVIEW OF THE TEST DATA FROM TASK I.D., FOUND THAT THE TRANSDUCERS HAD SMALL, BUT UNEXPECTED, CHANGES IN THE CALIBRATION DATA WHEN COMPARED WITH THE ORIGINAL ATP DATA. AS A RESULT, TEN LH2 PRESSURE TRANSDUCERS WERE SELECTED BY ELECTRICAL ENGINEERING TO BE TESTED FOR LONG TERM (LIFE) STABILITY OF THE PD7400239 DESIGN. SEE TASK I.H

*3. THE FAILURES COVERED BY TASK I.G. AND TASK I.I. WERE THE RESULT OF WORKMANSHIP/QUALITY ESCAPES AND WERE JUDGED TO HAVE NO EFFECT ON THE OVERALL PERFORMANCE OF THE TRANSDUCERS

G. FAILURE ANALYSIS T-121302 IS IN PROGRESS AT TAVIS CORPORATION
THE FAILED PART IS A LOX TRANSDUCER, P/N 80931003731-009, S/N 0000020, AND UTILIZES TRANSISTORS WITH THE SAME LOT CODE THAT WAS ASSOCIATED WITH THE ORIGINAL FAILURE
RESPONSIBILITY: G. PICHON/3830--M. COMBS/3830
J. ADAMS/3741--D. WESTPHAL/3740
COMPLETE: NOVEMBER 9, 1993
CLOSURE STATEMENT
ANALYSIS FOUND THE CAUSE OF THE FAILURE TO BE A DEFECTIVE SOLDER JOINT BETWEEN A CIRCUIT BOARD TERMINAL AND ONE OF THE LEADS TO A DIAPHRAGM POSITION SENSING INDUCTOR. THE WIRE HAD BEEN WRAPPED ONTO THE TERMINAL BUT HAD NOT BEEN SOLDERED. THE MANUFACTURING PROCESSES INSPECT THE SOLDER JOINTS. THE DEFECT IS THE RESULT OF A QUALITY CONTROL ESCAPE AT TAVIS CORP

H. AN ENGINEERING TEST PROGRAM TO DETERMINE THE LONG TERM STABILITY OF THE TRANSDUCERS HAS BEEN ESTABLISHED. TEN LH2 ULLAGE PRESSURE TRANSDUCERS, PART NUMBER PD7400239-019, WERE SELECTED BY ENGINEERING FROM AMONG THE FIFTY-TWO PARTS NOW EXISTING. THE TRANSDUCERS ARE TO BE TESTED FOR ACCURACY AT 90 DAY INTERVALS UNTIL THE FIRST FLIGHT OF AN ET WITH PD7400239-009 TRANSDUCERS THEREAFTER, THE TEN TRANSDUCERS WILL BE TESTED AT 180 DAY INTERVALS UNTIL THE PARTS ARE FIVE YEARS OLD (I.E. DECEMBER 1996)
THE TESTING IS CONTROLLED BY OPERATIONS DIRECTIVE 93-OD-0643

I. A PD7400239-019 LH2 ULLAGE PRESSURE TRANSDUCER, SERIAL NUMBER 0000065, FAILED THE TESTS AT TAVIS CORP DOCUMENTED IN TASK I.D
THE TRANSDUCER OUTPUT WAS 676MV REGARDLESS OF APPLIED PRESSURE, AT AN OPERATING TEMPERATURE OF 150 DEGREES FAHRENHEIT. THE TRANSDUCER WILL BE DOCUMENTED ON MARS T-121307 AND DISPOSITIONED FOR FAILURE ANALYSIS
RESPONSIBILITY: G. PICHON/3830--M. COMBS/3830
J. ADAMS/3741--D. WESTPHAL/3740
* COMPLETE: JANUARY 17, 1994
* CLOSURE STATEMENT
ANALYSIS FOUND THAT THE INSULATION ON A WIRE HAD BEEN DAMAGED AND WAS CAUSING A SHORT CIRCUIT BETWEEN TRANSDUCER COMPONENTS. THE DAMAGE WAS THE RESULT OF A WORKMANSHIP/QUALITY ESCAPE WHICH IMPROPERLY POSITIONED THE WIRE IN THE ASSEMBLY
TASK CLOSED

CAUSE
ORIGINAL FAILURE - THE TRANSISTOR WAS DEFECTIVE AS SUPPLIED FROM THE MANUFACTURER
PROBLEMS DISCOVERED DURING THE TASK I INVESTIGATION - SEE TASK II CORRECTIVE ACTION FOR DETAILS

TASK II. CORRECTIVE ACTION

A. THE CORRECTIVE ACTIONS FOR THE DEFECTIVE TRANSISTORS ARE LISTED BELOW. REVIEW BY ELECTRICAL ENGINEERING, TASK I,F.1., DID NOT RECOMMEND FURTHER ACTIONS
1. GIDEP ALERT 9Q-A-93-03 WAS ORIGINALLY RELEASED BY THE GIDEP SYSTEM AND WAS BASED ON THE SINGLE ORIGINAL DEFECTIVE

TRANSISTOR. THE ALERT WAS SUBSEQUENTLY REVISED TO 9Q-A-93-03A TO INCLUDE INFORMATION ON OTHER FAILURES DISCOVERED AS PART OF TASK I.E
RESPONSIBILITY: B. CORNAY/3742 D. WESTPHAL/3740
COMPLETE: SEPTEMBER 9, 1993

2. SCAD 92-132 WAS ISSUED TO TAVIS CORP
RESPONSIBILITY: T. PASTORET/3742--D. WESTPHAL/3740
COMPLETE: JULY 29, 1993

*B. CORRECTIVE ACTION FOR THE CHANGES IN THE TRANSDUCER CALIBRATIONS, IDENTIFIED DURING ELECTRICAL ENGINEERING REVIEW OF TEST DATA IN TASK I.F.2., WAS ADDRESSED BY INSTITUTING A LONG TERM TEST OF TRANSDUCER PERFORMANCE. REFERENCE: TASK I.H AND OPERATION DIRECTIVE 93-OD-0643. SHOULD THE TEST RESULTS INDICATE THAT FURTHER ACTION IS NECESSARY, IT WILL BE ADDRESSED BY ENGINEERING CHANGES

*C. CORRECTIVE ACTIONS FOR THE FAILURE CAUSED BY A WIRE CONNECTION WHICH HAD NOT BEEN SOLDERED WERE TO REVISE THE SOLDER INSPECTION CRITERIA OF THE MANUFACTURING TRAVELERS AT THE APPLICABLE STAGE OF ASSEMBLY. REFERENCE: TAVIS CORPORATION TEST TRAVELER 10345-1, STEP 340, FOR THE PD7400239-009; AND TAVIS CORPORATION PRODUCTION TEST TRAVELER 10346-1, STEP 330, FOR THE PD7400239-019

*D CORRECTIVE ACTIONS FOR THE FAILURE CAUSED BY DAMAGED WIRE INSULATION WERE TO REVISE THE MANUFACTURING TRAVELERS, ENGINEERING DRAWINGS, AND TO CREATE A TOOL TO CONTROL THE ASSEMBLY AND PREVENT NICKED WIRES

1. PD7400239-009 LOX TRANSDUCER; TAVIS CORPORATION PRODUCTION TEST TRAVELER 10345-1, STEP 240, ALIGNMENT TOOL #T0215; TAVIS CORPORATION PRODUCTION TEST TRAVELER 10345-1, STEP 350, WIRE ROUTING; AND TAVIS CORPORATION ENGINEERING DRAWING 18131, REVISION C., DOCUMENTATION ACCOUNTABILITY SHEET (DAS) BBE-061
2. PD7400239-019 LH2 TRANSDUCER: TAVIS CORPORATION PRODUCTION TEST TRAVELER 10346-1, STEP 230, ALIGNMENT TOO #T0215; TAVIS CORPORATION PRODUCTION TEST TRAVELER 10346-1, STEP 340, WIRE ROUTING; AND TAVIS CORPORATION ENGINEERING DRAWING 18913, REVISION B., DOCUMENTATION ACCOUNTABILITY SHEET (DAS) BBG-056

TASK CLOSED

TASK III. CLEARANCE OF EFFECTIVITIES

ALL ETS CLEARED. TESTING OF THE EIGHTY-TWO PD7400239 TRANSDUCERS, NOT INSTALLED ON ETS, FOUND NO INDICATION OF A TRANSISTOR LOT RELATED PROBLEM. REVIEW OF THE TEST DATA FROM TRANSDUCERS INSTALLED ON ETS FOUND NO INDICATION OF A TRANSISTOR LOT RELATED PROBLEM. REVIEW OF THE TEST DATA FROM TRANSDUCERS INSTALLED ON ETS FOUND NO INDICATION OF A TRANSISTOR LOT RELATED PROBLEM. THERE ARE SUFFICIENT TESTS OF TRANSDUCER PERFORMANCE AT THE SUPPLIER, MAF, AND KSC TO ASSURE PERFORMANCE DURING PROPELLANT LOADING AND FLIGHT
ETS 64 AND SUBSEQUENT HAVE THREE ACTIVE PD7400239-009 LOX ULLAGE PRESSURE TRANSDUCERS CONNECTED TO THE ORBITER AT A TIME. THE LAUNCH COMMIT CRITERIA (LSS) REQUIRES THAT TWO OF THE THREE BE FUNCTIONING THROUGH THE PRE-PRESS EVENT OF PROPELLANT LOADING. NONE ARE REQUIRED FOR FLIGHT

TASK CLOSED

*TASK IV. CAPS CLOSURE SUMMARY

A FAILURE OF A PD7400239 LOX ULLAGE PRESSURE TRANSDUCER WAS TRACED TO A DEFECTIVE TRANSISTOR. A GIDEP ALERT WAS ISSUED AGAINST THE TRANSISTOR LOT AND WAS BACKED BY TESTS OF OTHER TRANSISTORS FROM THE SAME LOT. THE MAF TEST DATA FOR ALL INSTALLED TRANSDUCERS WAS REVIEWED ALONG WITH TEST DATA OBTAINED BY RETURNING ALL UNINSTALLED PARTS TO THE SUPPLIER FOR CALIBRATION TESTING. NO DEFINITE LINK COULD BE FOUND BETWEEN THE TRANSISTOR LOTS AND THE PERFORMANCE OF THE COMPLETED TRANSDUCERS

DURING THE INVESTIGATION ASSOCIATED WITH THE FIRST FAILURE, THREE
OTHER PROBLEMS OCCURRED. THE FIRST WAS CALIBRATION SHIFTS NOTED IN THE
TRANSDUCERS RETURNED TO THE SUPPLIER. AS A RESULT OF SHIFTS, A LONG
TERM TEST HAS BEEN INITIATED TO VERIFY TRANSDUCER STABILITY. THE
SECOND AND THIRD PROBLEMS WERE TWO SEPARATE TRANSDUCER FAILURES
RESULTING FROM WORKMANSHIP ESCAPES DURING TRANSDUCER MANUFACTURE
THESE FAILURES WERE ADDRESSED BY PLACING ADDITIONAL CONTROLS IN THE
SUPPLIERS MANUFACTURING TRAVELERS AND DRAWINGS
TASK CLOSED
THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED

MSFC Response/Concurrence

MSFC Problem Reporting and Corrective Action (PRACA) System
ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15483	--	E-152	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
80931003731-009	LOX PRES TRANSDUCER	0000028

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	3	MAW - MFG-ASY-WORK	EG - SIG HI OR LO

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.2.1.1C	1C	E	4
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15506	**In-Flight Anomaly Number** --	**Contractor Report Number** E-153	**JSC#** --	**KSC#** --
Problem Title LH2 ULLAGE PRESSURE TRANSDUCER FAILED VIBRATION TEST (ATP) AT SUPPLIER				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1R
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LH2 ULLAGE PRESSURE	**PART#** PD7400098-089	**SER/LOT#** 0001657	**MANUFACTURER** GULTON-STATH
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EG - SIG HI OR LO	**Cause** MM - MFG-MOV
System ELECTRICAL	**Defect** DC - BROKEN	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 07/07/1993
Received at MSFC 07/09/1993	**Date Isolated** 07/07/1993	**FMEA Reference** 3.4.1.1, 3.4.1.2	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location GULTON		**Symptom** EG - SIG HI OR LO		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 02/09/1995	**CN RSLV SBMT** 08/16/1993	**Defer Date** 07/13/1993	**Add Date** 07/09/1993	**R/C Codes** 0 - EXPL -- --
Assignee				

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	R. MOYE	R. JACKSON	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	08/25/1993	C - CLOSED	07/07/1993

Problem Type	SEV	Program Name	REVL	OPRINC
--	--	--	--	--

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
--	-- -- -- -- --	--	--	--

RES PERSON L2	Approval Signature L3
--	--

Related Document Type	Related Document ID
--	T-119554

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

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A TRANSDUCER FAILED THE VIBRATION TEST SEGMENT OF THE SUPPLIER
ACCEPTANCE TEST PLAN (ATP)
CRITICALITY: THE PRESSURE TRANSDUCER IS LISTED AS CRIT.1R: FMEA ITEM
CODE 3.4.1.1, "FAILS WITH HIGH READING;" AND FMEA CODE 3.4.1.2, "FAILS
WITH LOW READING."
PREVIOUS CAPS: THERE HAVE BEEN NO VIBRATION TEST FAILURES DURING THE
SUPPLIER ATP SINCE THE MANUFACTURING PROCESSES FOR ALL PD7400098-XXX
TRANSDUCERS WERE REVISED AS PART OF CAPS E-082. UNRELATED FAILURES OF
PD7400098-XXX TRANSDUCERS HAVE BEEN DOCUMENTED ON CAPS E-150, 145,
143, 137, 125, 123, 122, 121, 120, 119, 118, 117, 115, 112, 111, 110,
106, 101, 092, 091, 087 AND 082
NOTE: THE TRANSDUCERS ARE LIMITED LIFE CONTROLLED
*REVISION "A"--CLOSES ALL TASKS. SEE ASTERISKS FOR CHANGES
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Contractor Investigation/Resolution

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GENERAL:
A LH2 ULLAGE PRESSURE TRANSDUCER WAS BEING TESTED AT THE SUPPLIER,
GULTON-STATHAM TRANSDUCERS, PER ACCEPTANCE TEST PLAN (ATP) 3031-13803
DURING THE VIBRATION TEST, PER ATP PARAGRAPH 5.4, THE TRANSDUCER
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EXCEEDED THE PEAK-TO-PEAK (P-P) NOISE REQUIREMENT IN THE 50 TO 80
HERTZ BAND. THE MAXIMUM ALLOWABLE NOISE IS 0.16 VOLTS P-P; THE ACTUAL
VALUE WAS 0.20V P-P
THE TRANSDUCER IS USED TO MEASURE THE ULLAGE PRESSURE IN THE LIQUID
HYDROGEN PROPELLANT TANK DURING BOTH GROUND PROPELLANT LOADING AND
IN FLIGHT. THE TRANSDUCER IS ATTACHED TO A SHOCK MOUNT ON THE FORWARD
DOME OF THE HYDROGEN TANK, WITHIN THE INTERTANK. THE TRANSDUCER COVERS
THE RANGE OF 12 TO 52 PSIA. THE ORBITER PROVIDES 5 VDC TO THE
TRANSDUCER AND RECEIVES A VOLTAGE FROM THE TRANSDUCER PROPORTIONAL TO
THE ULLAGE PRESSURE. THE PRESSURE MEASUREMENT IS USED TO CONTROL THE
SPACE SHUTTLE MAIN ENGINE (SSME) GASEOUS HYDROGEN FLOW CONTROL VALVE
TASK I. FAILURE INVESTIGATION
THE TRANSDUCER FAILURE WAS DOCUMENTED ON MARS T-119554. THE MARS WILL
BE DISPOSITIONED FOR FAILURE ANALYSIS TO BE PERFORMED AT GULTON-
STATHAM
RESPONSIBILITY: J. ADAMS/3741 -- D. WESTPHAL/3740
L. COLON/4120 -- J. COOL/4120
G. PICHON/3830 -- M. COMBS/3830
COMPLETE: AUGUST 12, 1993
*CLOSURE STATEMENT
THE TRANSDUCER WAS ONE OF APPROXIMATELY THIRTY-FIVE PARTS WHICH WERE
REWORKED TO REPLACE THE OUTPUT LEAD WIRES, AS DOCUMENTED ON MARS
T-119553. THE FAILURE DOCUMENTED IN THIS CAPS OCCURRED DURING SUPPLIER
ATP FOLLOWING RETURN OF THE PART TO GULTON-STATHAM AND THE LEAD WIRE
REWORK. FAILURE ANALYSIS REPORT T-119554 FOUND THAT THE TRANSDUCER
INTERNAL POTENTIOMETER WIPER PIVOT BEARINGS HAD EXCESSIVE END PLAY
THE EXCESSIVE PLAY WAS PROBABLY THE RESULT OF HANDLING DAMAGE, A
PHYSICAL SHOCK, AT SOME TIME DURING TRANSPORTATION TO AND FROM MAF OR
DURING THE REWORK. DETERMINATION OF THE ROOT CAUSE OF THE FAILURE WAS
NOT POSSIBLE. REVIEW AND OBSERVATION OF THE REWORK PROCESS AND THE
PACKAGING OF TRANSDUCERS FOR TRANSPORTATION FAILED TO REVEAL A LIKELY
CAUSE
TASK CLOSED
*CAUSE: THE ROOT CAUSE IS UNKNOWN. AMONG THE POSSIBLE CAUSES IS
HANDLING DAMAGE
TASK II. CORRECTIVE ACTION
*NO CORRECTIVE ACTION FOR THE FAILURE IS POSSIBLE. THE TIME, PLACE,
AND CIRCUMSTANCES OF THE DAMAGE WHICH CAUSED THE FAILURE COULD NOT
BE DETERMINED. REVIEW OF THE ASSOCIATED MANUFACTURING AND
TRANSPORTATION CONTROLS AND PROCESSES FOUND NO LIKELY CAUSE
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
*THIS IS AN EXPLAINED CLOSURE OF THE CAPS
ALL ETS CLEARED. THE TRANSDUCER FAILED DURING THE SUPPLIER ACCEPTANCE
TESTS AND ALL DELIVERED TRANSDUCERS HAVE PASSED THE TESTS. ONLY THE
SUPPLIER ATP CONTAINS A TRANSDUCER VIBRATION TEST
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
TASK CLOSED
TASK IV. CAPS CLOSURE SUMMARY
*THIS IS AN EXPLAINED CLOSURE OF THE CAPS
THE TRANSDUCER FAILED THE VIBRATION TEST SEGMENT OF THE SUPPLIER ATP
FOLLOWING RETURN OF THE PART FROM MAF TO THE SUPPLIER AND LEAD WIRE
REPLACEMENT. IT WAS NOT POSSIBLE TO DETERMINE THE ROOT CAUSE OF THE
FAILURE. THE INABILITY TO DETERMINE THE CAUSE PREVENTED IMPLEMENTATION
OF APPROPRIATE CORRECTIVE ACTION
TASK CLOSED

MSFC Response/Concurrence

7/9/93 - DEFERRAL RATIONALE:
BASED ON THE DEFERRAL RATIONALE IN "TASK III. CLEARANCE OF
EFFECTIVITIES" (ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX
MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS

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08126, REV. E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM
CONDITION IS CLEARLY SCREENED BY SPECIAL TESTS."
THE DEFERRAL RATIONALE HAS BEEN APPROVED BY THE EXTERNAL TANK PROJECT
MANAGER, MR. PARKER V. COUNTS
SIGNED: _PARKER V. COUNTS__      DATE:____7/13/93_________
```

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15506	--	E-153	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
PD7400098-089	LH2 ULL PRES TRNSDCR	0001657

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1R	MM - MFG-MOV	EG - SIG HI OR LO
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.4.1.2	2	AB	N/A
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record #	**In-Flight Anomaly Number**	**Contractor Report Number**	**JSC#**	**KSC#**
A15509	--	E-154	--	--
Problem Title				
LH2 ULLAGE PRESSURE TRANSDUCER FAILED CALIBRATION TEST (ATP) AT SUPPLIER				
EICN#	**ELEMENT**	**Contractor**	**FSCM#**	**FCRIT**
--	ET	MMMSS	--	1R
HCRIT	**Sys_Lvl**	**Misc Codes**		
--	N	A B C D E F G H I J K L M N O		
HARDWARE	**NOMENCLATURE**	**PART#**	**SER/LOT#**	**MANUFACTURER**
EIM	--	--	--	--
HARDWARE	**NOMENCLATURE**	**PART#**	**SER/LOT#**	**MANUFACTURER**
LRU	--	--	--	--
HARDWARE	**NOMENCLATURE**	**PART#**	**SER/LOT#**	**MANUFACTURER**
NCA	LH2 ULLAGE PRESSURE	PD7400098-089	0001660	GULTON-STATH
Test/Operation	**Prevailing Condtion**	**F / U**	**Fail Mode**	**Cause**
A - ATP	F - FUNCTIONAL	F	EG - SIG HI OR LO	MM - MFG-MOV
System	**Defect**	**Material**	**Work Contact**	**Fail Date**
ELECTRICAL	DC - BROKEN	C - EEE	JOHN ADAMS	07/09/1993
Received at MSFC	**Date Isolated**	**FMEA Reference**	**IFA: Mission Phase**	**Mission Elapsed Time**
07/12/1993	07/09/1993	3.4.1.2	--	--
Location		**Symptom**		**Time Cycle**
GULTON		EG - SIG HI OR LO		--
Effectivity Text				
--				
Vehicle Effectivity Codes				
Vehicle 1	**Vehicle 2**	**Vehicle 3**	**Vehicle 4**	**Vehicle 5**
--	--	--	--	--
Mission Effectivity Codes				
Mssn 1	**Mssn 2**	**Mssn 3**	**Mssn 4**	**Mssn 5**
--	--	--	--	--
Estimated Completion Dates				
MSFC Approved Defer Until Date	**Contractor Req Defer Until Date**	**LVL 3 Close**	**Remark / Action**	
--	--	--	--	

Investigation / Resolution Summary

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THIS PROBLEM REPORT (PR) DOCUMENTS ONE OF TWO OR MORE OCCURRENCES OF
THE SAME PROBLEM.  ADDITIONAL PRS WILL BE OPENED FOR EACH OCCURRENCE
ALL INVESTIGATION/RESOLUTION INFORMATION FOR ALL OCCURRENCES WILL BE
TRACKED ON THIS PR.  THE FOLLOWING REPORTS ARE CONSIDERED CLOSED
AND TRACKED ON THIS PR: A15556
```

Last MSFC Update	CN RSLV SBMT	Defer Date	Add Date	R/C Codes
02/09/1995	08/16/1993	07/14/1993	07/12/1993	0 - EXPL -- --

Assignee

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	R.A. MOYE	R. JACKSON	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
R.MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	08/25/1993	C - CLOSED	07/09/1993

Problem Type	SEV	Program Name	REVL	OPRINC
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FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
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RES PERSON L2	Approval Signature L3
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Related Document Type	Related Document ID
--	T-126693

Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

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 A.AN LH2 ULLAGE PRESSURE TRANSDUCER FAILED THE HIGH RESOLUTION
   CALIBRATION TEST SEGMENT OF THE SUPPLIER ACCEPTANCE TEST PLAN. THE
   TRANSDUCER HAD A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE. REFERENCE:
   MARS T-126693; SERIAL NUMBER 0001660; FAILURE DATE JULY 9, 1993
 B.AN LH2 ULLAGE PRESSURE TRANSDUCER FAILED AN IN-PROCESS
   MANUFACTURING CONFIDENCE TEST WHILE INSTALLED ON ET-69/LWT-62 AT
   MAF. THE TRANSDUCER HAD A LOWER THAN ACCEPTABLE RESISTANCE DURING
   AN IN-PROCESS CHANNELIZATION TEST. AFTER REMOVAL FROM THE ET,
   TESTING FOUND THAT THE TRANSDUCER HAD A LOWER THAN ACCEPTABLE OUTPUT
   VOLTAGE. REFERENCE: MARS T-127533; SERIAL NUMBER 0001645; FAILURE
   DATE JULY 29, 1993
CRITICALITY: THE PRESSURE TRANSDUCER IS LISTED AS CRIT.1R: FMEA ITEM
CODE 3.4.1.2, "FAILS WITH LOW READING."
NOTE: THE TRANSDUCERS ARE LIMITED LIFE CONTROLLED
*REVISION "B"--CLOSES ALL TASKS. (SEE ASTERISKS)
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Contractor Investigation/Resolution

GENERAL:
A. A LH2 ULLAGE PRESSURE TRANSDUCER WAS BEING TESTED AT THE SUPPLIER, GULTON-STATHAM TRANSDUCERS, PER ACCEPTANCE TEST PLAN (ATP) 3031-13803. THE TRANSDUCER FAILED THE HIGH RESOLUTION CALIBRATION TEST SEGMENT CONTAINED IN PARAGRAPH 5.6 OF THE ATP. AT AN APPLIED PRESSURE OF 47 PSIA THE TRANSDUCER HAD AN ERROR OF APPROXIMATELY -102 MILLIVOLTS DC (MVDC). THE MAXIMUM ALLOWABLE ERROR AT THAT PRESSURE IS +/-100 MVDC
THE TRANSDUCER WAS ONE OF THIRTY-FIVE WHICH WERE RETURNED TO GULTON -STATHAM TO HAVE THE LEAD WIRES REPLACED. THE REPLACEMENT OF THE WIRES IS ACCOMPLISHED BY MACHINING AWAY THE WIRES AND THE ASSOCIATED STRAIN RELIEF. AFTER TERMINATING NEW WIRES ON THE HERMETICALLY SEALED WIRE FEEDTHROUGHS A NEW STRAIN RELIEF IS INSTALLED AND POTTED. THE DATA FROM THE ATP FAILURE WAS COMPARED WITH BOTH AN IN-PROCESS CALIBRATION CHECK PERFORMED AFTER LEAD REPLACEMENT AS WELL AS WITH THE ORIGINAL ATP. THE DATA COMPARISON FOUND THAT BEGINNING WITH THE IN-PROCESS CALIBRATION TEST AND INCREASING IN THE FINAL ATP, THE TRANSDUCER WAS INDICATING A LOWER PRESSURE THAN DURING ORIGINAL ATP
*B.AN LH2 ULLAGE PRESSURE TRANSDUCER, SERIAL NUMBER OOO1645, WAS BEING TESTED IN THE BUILDING 103 FINAL ASSEMBLY AREA OF MAF AS INSTALLED ON ET-69/LWT-62. THE TEST, TP-7C07-FA, CONTAINS TESTS THAT ASSURES PROPER CONNECTION OF THE WIRE HARNESSES TO THE VARIOUS COMPONENTS ON THE ET BY MEASURING THE RESISTANCE OF THE CIRCUITS. THIS TYPE OF TEST IS KNOWN AS "CHANNELIZATION." THE TEST RESULTS INDICATED A LOWER THAN ACCEPTABLE RESISTANCE VALUE BETWEEN THE TRANSDUCER INTERNAL POTENTIOMETER WIPER AND THE LOW END OF THE POTENTIOMETER THIS RESISTANCE IS NOT A PROPERTY COVERED BY THE REQUIREMENTS OF PD7400098. HOWEVER, THE LOW RESISTANCE IS INDICATIVE OF A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE DURING PRESSURE MEASUREMENT. THE TRANSDUCER WAS REMOVED FROM THE ET AND DOCUMENTED ON MARS T-127533 TESTING OF THE TRANSDUCER PER T-127533 VERIFIED THAT THE TRANSDUCER WAS IN FACT PRODUCING A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE. AT AN APPLIED PRESSURE OF 33 PSIA THE TRANSDUCER HAD AN ERROR OF -185 MVDC. THE MAXIMUM ALLOWABLE ERROR AT THAT PRESSURE IS +/- 50 MVDC
THE TRANSDUCER WAS ONE OF THE THIRTY-FIVE WHICH HAD BEEN REWORKED AS DESCRIBED IN "A" ABOVE. COMPARISON OF THE DATA FROM THE SUPPLIER ATP FOLLOWING REWORK WITH THE DATA FROM THE FAILURE FOUND THAT THE TRANSDUCER OUTPUT HAD SHIFTED LOWER BY APPROXIMATELY 150 MVDC
C.THE PD7400098-089 TRANSDUCER IS USED TO MEASURE THE ULLAGE PRESSURE IN THE LIQUID HYDROGEN PROPELLANT TANK DURING BOTH GROUND PROPELLANT LOADING AND IN FLIGHT. THE TRANSDUCER IS ATTACHED TO A SHOCK MOUNT ON THE FORWARD DOME OF THE HYDROGEN TANK, WITHIN THE INTERTANK. THE TRANSDUCER COVERS THE RANGE OF 12 TO 52 PSIA. THE ORBITER PROVIDES 5 VDC TO THE TRANSDUCER AND RECEIVES A VOLTAGE FROM THE TRANSDUCER PROPORTIONAL TO THE ULLAGE PRESSURE. THE PRESSURE MEASUREMENT IS USED TO CONTROL THE SPACE SHUTTLE MAIN ENGINE (SSME) GASEOUS HYDROGEN FLOW CONTROL VALVE
TASK I. FAILURE INVESTIGATION
A. FAILURE ANALYSES WILL BE PERFORMED ON THE TRANSDUCERS
RESPONSIBILITY: J. ADAMS/3741 -- D. WESTPHAL/3740
L. COLON/4120 -- J. COOL/4120
G. PICHON/3830 -- M. COMBS/3830
COMPLETE: AUGUST 13, 1993
*CLOSURE STATEMENT
1. FAILURE ANALYSIS T-126693, ON THE FAILURE DURING SUPPLIER ATP, FOUND THAT THE PROBABLE CAUSE OF FAILURE WAS A MECHANICAL SHOCK TO THE TRANSDUCER DURING THE HANDLING AND REWORK AT THE SUPPLIER THE HANDLING AND REWORK, ASSOCIATED WITH THE LEAD WIRE REPLACEMENT, CONSISTS OF MANY TESTS AND MACHINING OPERATIONS

REVIEW AND OBSERVATION OF THE REWORK PROCESSES FOUND NONE WHICH INHERENTLY RESULT IN DAMAGE TO THE TRANSDUCER. SINCE THE CAUSE OF THE DAMAGE COULD NOT BE NARROWED TO A SPECIFIC AREA OR OPERATION, NO EFFECTIVE CORRECTIVE ACTION WAS POSSIBLE

2. FAILURE ANALYSIS T-127533, ON THE FAILURE AT MAF, FOUND THAT THE ANEROID CAPSULE WITHIN THE TRANSDUCER WAS LEAKING ATMOSPHERE INTO THE TRANSDUCER CASE. THE SPECIFIC DEFECT WITH ANEROID COULD NOT BE IDENTIFIED. IN ADDITION TO THE DIFFICULTIES IN FINDING A LIKELY CAUSE IN THE LEAD REWORK PROCESS, THIS TRANSDUCER HAD BEEN SHIPPED TO MAF AND INSTALLED ON AN ET BEFORE THE FAILURE WAS DETECTED SINCE THE EVENTS WHICH CAUSED THE FAILURE ARE UNKNOWN, THE ROOT CAUSE OF THE FAILURE COULD NOT BE DETERMINED AND NO EFFECTIVE CORRECTIVE ACTION WAS POSSIBLE

B.THE ACCEPTANCE TEST DATA FOR ALL THIRTY-THREE REMAINING TRANSDUCER WHICH ARE HAVING THE LEAD WIRES REPLACED WILL BE REVIEWED BY GULTON -STATHAM TO ASSURE THAT NO OTHER TRANSDUCERS ARE LEAKING
RESPONSIBILITY: G. PICHON/3830 -- M. COMBS/3830
COMPLETE: TASK CANCELED AUGUST 13, 1993

*CLOSURE STATEMENT
THE TRANSDUCER WHICH FAILED AT MAF HAD A CLEAR OUTPUT SHIFT WHEN COMPARING THE DATA FROM THE FAILURE WITH THE SUPPLIER ATP FOLLOWING LEAD WIRE REWORK. HOWEVER, GULTON-STATHAM TRANSDUCERS HAD ALREADY PERFORMED THE REVIEW OF ATP DATA FOR THIS UNIT PRIOR TO THE TIME OF THE MAF FAILURE. THE REVIEW FOUND NO INDICATIONS OF A SHIFT THEREFORE, THE DATA REVIEW IS NOT AN EFFECTIVE MEANS OF PREDICTING THIS TYPE OF PROBLEM AND THE TASK WAS CANCELED

TASK CLOSED

CAUSE:

*A. SUPPLIER ERROR--THE PROBABLE CAUSE OF THE FAILURE WAS AN INADVERTENT MECHANICAL SHOCK TO THE TRANSDUCER WHILE AT THE SUPPLIER FOR LEAD WIRE REWORK. IDENTIFICATION OF ROOT CAUSE WAS NOT POSSIBLE

*B. THE ROOT CAUSE OF THE FAILURE COULD NOT BE DETERMINED. AMONG THE MORE PROBABLE CAUSES IS HANDLING DAMAGE DURING EITHER TRANSPORTATION OR REWORK

TASK II. CORRECTIVE ACTION

* NO CORRECTIVE ACTION WAS POSSIBLE FOR EITHER FAILURE. IN NEITHER CASE COULD THE ROOT CAUSE OF THE FAILURE BE IDENTIFIED. REVIEW OF THE WORK PROCESSES ASSOCIATED WITH THESE TRANSDUCERS DID NOT FIND AREAS OF CONCERN FOR FUTURE PRODUCTION

TASK CLOSED

TASK III. CLEARANCE OF EFFECTIVITIES

* THIS IS AN EXPLAINED CLOSURE OF THE CAPS

ALL ETS CLEARED. THE INITIAL TRANSDUCER FAILED DURING THE SUPPLIER ACCEPTANCE TESTS. THE SECOND TRANSDUCER FAILURE OCCURRED DURING AN IN-PROCESS TEST OF AN ET AT MAF. IN ADDITION TO THE SUPPLIER ATP, THE TRANSDUCERS ARE TESTED FOR ACCURACY AFTER INSTALLATION ON AN ET BY TESTS CONDUCTED IN MAF BLDG. 420 FINAL ACCEPTANCE. ADDITIONAL TESTS OF ACCURACY OCCUR AT KSC AS PART OF FILE IV TESTING

THE TRANSDUCERS INSTALLED ON ET-59 WERE NOT ONES THAT HAD THE LEAD WIRES REWORKED. NEVERTHELESS, THE CALIBRATION TEST DATA FROM FILE IV AT KSC AND MAF ACCEPTANCE TESTING WERE COMPARED WITH THE SUPPLIER ATP; NONE OF THE TRANSDUCERS HAVE INDICATIONS OF SHIFTS IN THE OUTPUT VOLTAGE

NOTE: THIS IS ALSO THE DEFERRAL RATIONALE

TASK CLOSED

TASK IV. CAPS CLOSURE SUMMARY

THIS IS AN EXPLAINED CLOSURE OF THE CAPS

THE ROOT CAUSES OF THE TWO TRANSDUCER FAILURES COULD NOT BE IDENTIFIED. NO CORRECTIVE ACTION WAS POSSIBLE FOR REASON. THE EXISTING TESTS OF THE TRANSDUCERS AT THE SUPPLIER, MAF AND KSC ARE ADEQUATE TO DETECT SUCH FAILURES

TASK CLOSED

MSFC Response/Concurrence

7/13/93 - DEFERRAL RATIONALE:
BASED ON THE DEFERRAL RATIONALE IN "TASK III. CLEARANCE OF EFFECTIVITIES" (ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126, REV. E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS CLEARLY SCREENED BY SPECIAL TESTS."
THE DEFERRAL RATIONALE HAS BEEN APPROVED BY THE DEPUTY EXTERNAL TANK PROJECT MANAGER, MR. CRAIG E. SUMNER
SIGNED: CRAIG E. SUMNER (SIGNED) DATE: 7/14/93

MSFC Problem Reporting and Corrective Action (PRACA) System
ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15509	--	E-154	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
PD7400098-089	LH2 ULL PRES TRNSDCR	0001660

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1R	MM - MFG-MOV	EG - SIG HI OR LO
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.4.1.2	2	AB	N/A
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15556	**In-Flight Anomaly Number** --	**Contractor Report Number** E-154-1	**JSC#** --	**KSC#** --
Problem Title LH2 ULLAGE PRESSURE TRANSDUCER FAILED AN IN-PROCESS CONFIDENCE TEST AT MAF				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1R
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LH2 ULLAGE PRESSURE	**PART#** PD7400098-089	**SER/LOT#** 0001645	**MANUFACTURER** GULTON-STATH
Test/Operation M - MFG	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EG - SIG HI OR LO	**Cause** MAW - MFG-ASY-WORK
System ELECTRICAL	**Defect** --	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 07/29/1993
Received at MSFC 08/05/1993	**Date Isolated** 08/03/1993	**FMEA Reference** 3.4.1.2	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** EG - SIG HI OR LO		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary THIS PROBLEM REPORT (PR) DOCUMENTS AN IDENTICAL OCCURRENCE OF A PREVIOUSLY REPORTED PROBLEM. THIS REPORT IS INITIATED TO RECORD THE OCCURRENCE OF THIS ANOMALY FOR TRENDING PURPOSES. ALL INVESTIGATION/ RESOLUTION INFORMATION RELATING TO THIS PR SHALL BE TRACKED ON MSFC RECORD NO. A15509. THEREFORE, THIS PR IS CONSIDERED CLOSED				

Last MSFC Update	CN RSLV SBMT	Defer Date	Add Date	R/C Codes
02/09/1995	--	--	08/10/1993	-- -- --

Assignee

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
N/A	M. PESSIN	R. JACKSON	--	N/A

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	08/10/1993	C - CLOSED	--

Problem Type	SEV	Program Name	REVL	OPRINC
--	--	--	--	--

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
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RES PERSON L2	Approval Signature L3
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Related Document Type	Related Document ID
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Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

(NOTE: THIS PROBLEM REPORT DOCUMENTS AN IDENTICAL OCCURRENCE OF A PREVIOUSLY REPORTED PROBLEM. THIS REPORT IS INITIATED TO RECORD THE OCCURRENCE OF THIS ANOMALY FOR TRENDING PURPOSES. ALL INVESTIGATION/RESOLUTION INFORMATION RELATING TO THIS PROBLEM REPORT SHALL BE TRACKED ON MSFC RECORD NUMBER A15509. THEREFORE, THIS PROBLEM REPORT IS CONSIDERED CLOSED.)
AN LH2 ULLAGE PRESSURE TRANSDUCER FAILED AN IN-PROCESS MANUFACTURING CONFIDENCE TEST WHILE INSTALLED ON ET-69/LWT-62 AT MAF. THE TRANSDUCER HAD A LOWER THAN ACCEPTABLE RESISTANCE DURING AN IN-PROCESS CHANNELIZATION TEST. AFTER REMOVAL FROM THE ET, TESTING FOUND THAT THE TRANSDUCER HAD A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE. REFERENCE: MARS T-127533; SERIAL NUMBER 0001645; FAILURE DATE JULY 29, 1993
CRITICALITY: THE PRESSURE TRANSDUCER IS LISTED AS CRIT. 1R: FMEA ITEM CODE 3.4.1.2, "FAILS WITH LOW READING."
NOTE: THE TRANSDUCERS ARE LIMITED LIFE CONTROLLED

Contractor Investigation/Resolution

MSFC Response/Concurrence
AN LH2 ULLAGE PRESSURE TRANSDUCER, SERIAL NUMBER 0001645, WAS BEING TESTED IN THE BUILDING 103 FINAL ASSEMBLY AREA OF MAF AS INSTALLED ON ET-69/LWT-62. THE TEST, TP-7C07-FA, CONTAINS TESTS THAT ASSURES PROPER CONNECTION OF THE WIRE HARNESSES TO THE VARIOUS COMPONENTS ON THE ET BY MEASURING THE RESISTANCE OF THE CIRCUITS. THIS TYPE OF TEST IS KNOWN AS "CHANNELIZATION." THE TEST RESULTS INDICATED A LOWER THAN ACCEPTABLE RESISTANCE VALUE BETWEEN THE TRANSDUCER INTERNAL POTENTIOMETER WIPER AND THE LOW END OF THE POTENTIOMETER. THIS RESISTANCE IS NOT A PROPERTY COVERED BY THE REQUIREMENTS OF PD7400098. HOWEVER, THE LOW RESISTANCE IS INDICATIVE OF A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE DURING PRESSURE MEASUREMENT. THE TRANSDUCER WAS REMOVED FROM THE ET AND DOCUMENTED ON MARS T-127533. TESTING OF THE TRANSDUCER PER T-127533 VERIFIED THAT THE TRANSDUCER WAS IN FACT PRODUCING A LOWER THAN ACCEPTABLE OUTPUT VOLTAGE AT AN APPLIED PRESSURE OF 33 PSIA THE TRANSDUCER HAD AN ERROR OF -185 MVDC. THE MAXIMUM ALLOWABLE ERROR AT THAT PRESSURE IS +/- 50 MVDC THE TRANSDUCER WAS ONE OF THE THIRTY-FIVE WHICH HAD BEEN REWORKED AS DESCRIBED IN PROBLEM REPORT A15509 (PART A). COMPARISON OF THE DATA FROM THE SUPPLIER ATP FOLLOWING REWORK WITH THE DATA FROM THE FAILURE FOUND THAT THE TRANSDUCER OUTPUT HAD SHIFTED LOWER BY APPROXIMATELY 150 MVDC

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15556	--	E-154-1	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
--	--	--

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1R	MAW - MFG-ASY-WORK	EG - SIG HI OR LO

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.4.1.2	2	AB	N/A
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES	
APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15681	**In-Flight Anomaly Number** --	**Contractor Report Number** E-155	**JSC#** --	**KSC#** --
Problem Title A TRANSDUCER FAILED THE SUPPLIER ACCEPTANCE TEST PLAN (ATP)				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1R
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LH2 ULLAGE PRESSURE	**PART#** PD7400098-089	**SER/LOT#** 0001736	**MANUFACTURER** GULTON-STATH
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EG - SIG HI OR LO	**Cause** MAP - MFG-ASY-INST
System ELECTRICAL	**Defect** MA - ME ADJ	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 11/01/1993
Received at MSFC 11/02/1993	**Date Isolated** 11/01/1993	**FMEA Reference** 3.4.1.2	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location GULTON		**Symptom** EG - SIG HI OR LO		**Time Cycle** --
Effectivity Text NONE				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 11/18/1993	**Contractor Req Defer Until Date** 11/01/1993	**LVL 3 Close** --	**Remark / Action** 11/18/1993	
Investigation / Resolution Summary				
Last MSFC Update 02/09/1995	**CN RSLV SBMT** 11/19/1993	**Defer Date** 11/10/1993	**Add Date** 11/02/1993	**R/C Codes** 5 - TRNG -- --
Assignee				

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	11/24/1993	C - CLOSED	11/18/1993

Problem Type	SEV	Program Name	REVL	OPRINC
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FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
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RES PERSON L2	Approval Signature L3
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Related Document Type	Related Document ID
--	T-126694

Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Related Document Type	Related Document ID
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Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

A TRANSDUCER FAILED THE VIBRATION TEST SEGMENT OF THE SUPPLIER
ACCEPTANCE TEST PLAN (ATP)
CRITICALITY: THE TRANSDUCER IS LISTED AS CRIT.1R: FMEA ITEM
CODE 3.4.1.1, "FAILS WITH HIGH READING;" AND FMEA ITEM CODE 3.4.1.2
"FAILS WITH LOW READING."
NOTE: THE TRANSDUCERS ARE LIMITED LIFE CONTROLLED
*REVISION "A"--CLOSES ALL TASKS. (SEE ASTERISKS)

Contractor Investigation/Resolution

GENERAL:
A LH2 ULLAGE PRESSURE TRANSDUCER WAS BEING TESTED AT THE SUPPLIER,
GULTON-STATHAM TRANSDUCERS, PER ACCEPTANCE TEST PLAN (ATP)
3031-13803. DURING THE X-AXIS VIBRATION TEST, PER ATP PARAGRAPH
5.4, THE TRANSDUCER EXCEEDED THE PEAK-TO-PEAK (P-P) NOISE REQUIREMENT
IN THE 100 TO 2000 HERTZ BAND. THE MAXIMUM ALLOWABLE NOISE IS 0.28
VOLTS P-P; THE ACTUAL VALUE WAS 0.40 V P-P
THE TRANSDUCER IS USED TO MEASURE THE ULLAGE PRESSURE IN THE LIQUID
HYDROGEN PROPELLANT TANK DURING BOTH GROUND PROPELLANT LOADING AND IN
FLIGHT. THE TRANSDUCER IS ATTACHED TO A SHOCK MOUNT ON THE FORWARD

DOME OF THE HYDROGEN TANK, WITHIN THE INTERTANK. THE TRANSDUCER COVERS
THE RANGE OF 12 TO 52 PSIA. THE ORBITER PROVIDES 5 VDC TO THE
TRANSDUCER AND RECEIVES A VOLTAGE FROM THE TRANSDUCER PROPORTIONAL TO
THE ULLAGE PRESSURE. THE PRESSURE MEASUREMENT IS USED TO CONTROL THE
SPACE SHUTTLE MAIN ENGINE (SSME) GASEOUS HYDROGEN FLOW CONTROL VALVE
TASK I. FAILURE INVESTIGATION
THE TRANSDUCER FAILURE WAS DOCUMENTED ON MARS T-126694. THE MARS WILL
BE DISPOSITIONED FOR FAILURE ANALYSIS TO BE PERFORMED AT
GULTON-STATHAM
   RESPONSIBILITY: J. ADAMS/3741 -- D. WESTPHAL/3740
                   L. COLON/4120 -- J. COOL/4120
                   G. PICHON/3830 -- M. COMBS/3830
* COMPLETE:NOVEMBER 18, 1993
* CLOSURE STATEMENT
  FAILURE ANALYSIS FOUND THE CAUSE OF THE VIBRATION TEST FAILURE TO BE
  EXCESSIVE END PLAY IN THE WIPER PIVOT BEARINGS. INVESTIGATION BY
  GULTON ENGINEERING FOUND THAT THE PRODUCTION WORKER PERFORMING THE
  BEARING END PLAY ADJUSTMENT WAS UNFAMILIAR WITH THE CORRECT USE OF
  THE TOOLING FOR ADJUSTING THE END PLAY
  TASK CLOSED
TASK II. CORRECTIVE ACTION
* A. THE PRODUCTION WORKER WAS RETRAINED IN THE USE OF THE TOOLING
     USED TO MEASURE/SET THE BEARING END PLAY. REFERENCE: GULTON-
     STATHAM TRANSDUCERS, INCORPORATED MEMORANDUM PB:93-57, DATED
     NOVEMBER 17, 1993
  B. THE GULTON PRODUCTION TRAVELER FOR THE LH2 TRANSDUCER WAS REVISED
     TO INCLUDE MORE DETAILED WORK INSTRUCTIONS FOR THE BEARING
     ADJUSTMENT. REFERENCE: GULTON-STATHAM TRANSDUCERS, INC. SHOP
     TRAVELER 3031-13803, STEPS 50 AND 60
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
ALL ETS CLEARED. THE TRANSDUCER FAILED DURING THE SUPPLIER ACCEPTANCE
TESTS AND ALL DELIVERED TRANSDUCERS HAVE PASSED THE TESTS
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
TASK CLOSED
TASK IV. CAPS CLOSURE SUMMARY
* AN LH2 ULLAGE PRESSURE TRANSDUCER FAILED THE VIBRATION TEST SEGMENT
  OF THE SUPPLIER ACCEPTANCE TEST PLAN. FAILURE ANALYSIS OF THE
  TRANSDUCER FOUND THAT THE CAUSE WAS EXCESSIVE END PLAY IN THE WIPER
  PIVOT BEARINGS. THE EXCESSIVE END PLAY WAS THE RESULT OF WORKER
  ERROR DURING ASSEMBLY OF THE TRANSDUCER. THE WORKER WAS RETRAINED
  AND THE MANUFACTURING SHOP TRAVELER WAS REVISED TO INCLUDE MORE
  DETAILED INSTRUCTIONS FOR SETTING END PLAY
TASK CLOSED
THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED

MSFC Response/Concurrence

11/2/93 - DEFERRAL RATIONALE:
BASED ON THE DEFERRAL RATIONALE IN "TASK III. CLEARANCE OF
EFFECTIVITIES" (ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX
MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS
08126, REV. E, PARAGARPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM
CONDITION IS CLEARLY SCREENED BY SPECIAL TESTS."
THE DEFERRAL RATIONALE HAS BEEN APPROVED BY THE EXTERNAL TANK PROJECT
MANAGER, MR. PARKER V. COUNTS
SIGNED: _____PARKER V. COUNTS_____ DATE: ___11/10/93_____

MSFC Report#	IFA#	Contractor RPT#	JSC#	KSC#	EICN#
A15681	--	E-155	--	--	--

Asmnt Part#	Asmnt Part Name	Asmnt Serial/Lot#
PD7400098-089	LH2 ULL PRES TRNSDCR	0001736

HCRIT CD	FCRIT CD	CAUSE CD	FAIL MODE
--	1R	MAP - MFG-ASY-INST	EG - SIG HI OR LO

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
3.4.1.2	2	G	2
--	--	--	--
--	--	--	--

Correlated Part#	Correlated Part#	Correlated Part#
--	--	--

Associated LRU#	Associated LRU#	Associated LRU#
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	DESCRIPTION OF CHANGES
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15695	**In-Flight Anomaly Number** STS-58-T-1	**Contractor Report Number** T-066	**JSC#** --	**KSC#** --
Problem Title MISSING FOAM ON INTERTANK AND BIPOD JACK PAD CLOSEOUT				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G **(X)** H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ET COMPLETE	**PART#** 80901000000-229	**SER/LOT#** ET-57	**MANUFACTURER** MMMSS
Test/Operation F - FLT	**Prevailing Condtion** F - FUNCTIONAL	**F / U** UC	**Fail Mode** MSI - INSULATION	**Cause** MP - MFG-PRC
System TPS	**Defect** DD - DETACH	**Material** F - INSUL	**Work Contact** K. KILLIAN	**Fail Date** 10/18/1993
Received at MSFC 11/16/1993	**Date Isolated** 11/15/1993	**FMEA Reference** 5.6.2.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location KSC		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text ET-60 AND SUBSEQUENT. DEFERRED THROUGH 11/18/94				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary THIS PROBLEM REPORT (PR) DOCUMENTS TWO OCCURRENCES OF MISSING TPS FOAM ADDITIONAL PRS WILL BE OPENED FOR EACH OCCURRENCE. ALL INVESTIGATION/ RESOLUTION INFORMATION FOR ALL OCCURRENCES WILL BE TRACKED ON THIS PR THE FOLLOWING REPORTS ARE CONSIDERED CLOSED AND TRACKED ON THIS PR: A15696				
Last MSFC Update	**CN RSLV SBMT**	**Defer Date**	**Add Date**	**R/C Codes**

08/30/1994	08/04/1994	05/18/1994	11/17/1993	2 - MFG 4 - TEST --
Assignee				
Design C. BRAMON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** --	**Project MGR** P. COUNTS
Approval				
Design C. BRAMON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** --	**Project MGR** C. SUMNER
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 08/29/1994	**Status** C - CLOSED	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				
Problem Description ISSUE 1. POST SEPARATION FILM OF THE INTERTANK FROM THE UMBILICAL CAMERAS SHOW AN AREA OF MISSING FOAM. THIS AREA IS APPROXIMATELY TWENTY-EIGHT (28) INCHES LONG AND THREE (3) INCHES WIDE. APPROXIMATELY EIGHTEEN (18) INCHES OF PRIMER IS EXPOSED WITHIN THIS AREA. IT APPEARS TO BE LOCATED ON THE HEAD OF A STRINGER, FORWARD OF THE BIPODS AND AFT OF THE +Z AEROVENT ISSUE 2. POST SEPARATION FILM OF THE INTERTANK FROM THE UMBILICAL CAMERAS SHOW THAT THE +Y AND -Y BIPOD JACK PAD CLOSEOUT FOAM IS MISSING PRIMER APPEARS TO BE EXPOSED IN BOTH JACK PAD CAVITIES THESE ISSUES ARE DOCUMENTED ON IFA-STS-58-T-1 ITEM 1 AND ITEM 2 ARE BOTH CRITICALITY 1 FAILURES AS DESIGNATED BY PARAGRAPHS 5.6.2.1 AND 5.6.4.1 RESPECTIVELY IN THE FMEA DOCUMENT (MMC-ET-RA04A-K)				
Contractor Investigation/Resolution				

MSFC Response/Concurrence

GENERAL:
*ISSUE 1:
EFFECTIVE ET-51 AND SUBSEQUENT, INTERTANK TPS APPLICATION USES A TWO GUN SPRAY OPERATION. THIS PROCESS FILLS THE VALLEYS BETWEEN THE STRUCTURAL STRINGERS AND COVERS THE STRINGERS IN A SINGLE SPRAY
PRIOR TO ET-51, THE INTERTANK HAD:
1) CPR 488 APPLIED OVER PRIMED SUBSTRATE
2) CPR 488 FOAM APPLIED OVER BX250 FOAM IN THE VALLEYS BETWEEN THE STRINGERS OF THE +/-Y THRUST PANELS AND AN AREA OF THE +Z PANELS. AN ADHESIVE INTERFACE OF EITHER ISOCHEM OR CONOTHANE IS BETWEEN THE CPR AND BX IN THESE AREAS. VENT HOLES ARE DRILLED INTO THE CPR OVER BX AREAS AT KSC. THESE ONE-EIGHTH-OF-AN-INCH DIAMETER HOLES ARE LOCATED IN THE VALLEYS BETWEEN THE STRINGERS AND PENETRATE THROUGH THE CPR488/ADHESIVE INTERFACE TO ALLOW VENTING OF ANY LOCALIZED VOIDS THAT MAY BE PRESENT
*ISSUE 2:
ET-1 THROUGH ET-6 THE JACK PAD CLOSEOUT USED BX-250. (STANDARD WEIGHT TANKS). ET-8 THROUGH ET-10 THE JACK PAD CLOSEOUT USED BOTH BX-250 AND PDL MATERIAL. ET-11 AND SUBSEQUENT, PDL ALONE HAS BEEN USED
ET-32 AND SUBSEQUENT, ISOCHEM ADHESIVE WAS REPLACED BY CONATHANE ADHESIVE
ET-42 THROUGH ET-45 AND ET-48 AND SUBSEQUENT, THE FORWARD SIDE OF THE CLOSEOUT AREA IS CHAMFERED 15 TO 30 DEGREES WITH EPOXY PRIMER RE-APPLIED TO THE SUBSTRATE
EFFECTIVE ET-57, ET-59 AND SUBSEQUENT THE KEENSERT HOLES IN THE CLOSEOUT AREA ARE CLOSED OUT PRIOR TO THE JACK PAD CAVITY CLOSEOUT
A TEAM HAS BEEN FORMED AT MAF TO WORK ISSUE 1, THE INTERTANK FOAM LOSS ISSUE. THE TEAM LEAD IS MR. MICHAEL JAVERY
A TASK TEAM HAS BEEN FORMED AT KSC TO WORK ISSUE 2, THE JACK PAD CLOSEOUT FOAM LOSS ISSUE. MARTIN MARIETTA LAUNCH SUPPORT SERVICE PERSONNEL AND MAF PERSONNEL ARE SUPPORTING THE KSC PROCESSING TEAM
NOTE: THE TASK TEAM AT KSC UNDER THE LEADERSHIP OF MR. B. FERRELL HAS COMPLETED AND CLOSED TASK I, FAILURE/PROBLEM INVESTIGATION FOR ISSUE 2 OF THIS CAPS. RESPONSIBILITY FOR RESOLUTION OF CORRECTIVE ACTION FOR ISSUE 2 OF THIS CAPS HAS BEEN ASSIGNED TO MR. E. HORAK, TECHNICAL OPERATIONS MATERIALS ENGINEERING AT MAF
TASK 1 FAILURE/PROBLEM INVESTIGATION
ISSUE 1: MISSING INTERTANK FOAM
1A. REVIEW NONCONFORMANCE HISTORY FOR MATERIALS (CPR-488, CONATHANE, ETC) AND PROCESSING; PRIMER APPLICATION THROUGH INTERTANK SOFI ACREAGE, L02 AND LH2 INTERTANK FLANGE CLOSEOUT APPLICATION AND VEHICLE DELIVERY FOR ET-57 AND ET-60
ORIGINAL ECD: 11/17/93 (ADDITIONS WERE MADE TO THIS ACTION ITEM)
NEXT ECD: 12/17/93 (HIGHER PRIORITIES PREVAILED)
COMPLETE: 1/24/94
CLOSURE STATEMENT
RELIABILITY ASSURANCE PERFORMED A REVIEW OF MPPS ENCOMPASSING THE BUILD PROCESS FLOW FROM RECEIPT OF THE INTERTANK PANELS THROUGH L02 AND LH2 INTERTANK FLANGE CLOSEOUTS. INTERTANK VENDOR (AVCO) PAPER WORK IS UNAVAILABLE DUE TO A FIRE AT THEIR FACILITY IN WHICH ALL BUILD RECORDS WERE DESTROYED. IN SUMMARY, THIS REVIEW DID NOT REVEAL ANY NONCONFORMANCE OR PRIMER TOUCH-UPS RELATIVE TO THE AREA OF MISSING FOAM ON THE INTERTANK
1B. REVIEW BUILD PAPER (MPPS) FOR INTERTANK SOFI ACREAGE APPLICATION, L02/INTERTANK FLANGE CLOSEOUT, LH2/INTERTANK FLANGE CLOSEOUT, AND L02 SOFI ACREAGE APPLICATION. REVIEW IPRAS. REVIEW WEDGE APPLICATION
OLD ECD: 11/17/93 (ADDITIONS WERE MADE TO THIS ACTION ITEM)
NEXT ECD: 12/17/93 (HIGHER PRIORITIES PREVAILED)
COMPLETE: 2/4/94
CLOSURE STATEMENT
RELIABILITY ASSURANCE PERFORMED A REVIEW OF MPPS ENCOMPASSING THE BUILD

PROCESS FLOW FROM INTERTANK ACREAGE APPLICATION THROUGH L02 AND LH2 INTERTANK FLANGE CLOSEOUTS. IN SUMMARY, THIS REVIEW DID NOT REVEAL ANY NONCONFORMANCE OR PRIMER TOUCH-UPS RELATIVE TO THE AREA OF MISSING FOAM ON THE INTERTANK

1C. REVIEW STS-56 AND STS-42 IFA ACTION ITEMS LIST TO DETERMINE APPLICABILITY

OLD ECD: 11/17/93 (MAF TEAM RESPONSIBILITY ADDED)
NEW ECD: 12/17/93
COMPLETE: 12/14/93

CLOSURE STATEMENT

ALL ISSUES FROM PRIOR IFAS HAVE BEEN REVIEWED. THOSE ITEMS CONSIDERED APPLICABLE HAVE BEEN CARRIED FORTH INTO THIS CURRENT IFA

1D. REVIEW STS-58/ET-57 KSC PROCESS FLOW AND NONCONFORMANCES FOR RELATIVITY TO MISSING INTERTANK FOAM

OLD ECD: 12/17/93
COMPLETE. 1/7/94

CLOSURE STATEMENT

KSC PROCESS FLOW AND NONCONFORMANCES WERE REVIEWED WITH NO ISSUES FOUND TO CONTRIBUTE TO THE INTERTANK FOAM LOSS. THE AREA IN QUESTION IS NOT ACCESSIBLE BY PLATFORMS IN EITHER OF THE CELLS AT KSC. NO RELATIVE ANOMALIES WERE NOTED DURING REVIEW OF THE PR/DR LIST SUPPLIED BY KSC

1E. REVIEW BLDG. 114 INTERTANK PROCESS FLOW CHART. REVIEW CLEANING AND PRIMER TOUCH UP PRACTICES/METHODS. REVIEW IPRAS

ECD: 12/17/93 (HIGHER PRIORITIES PREVAILED)
COMPLETE: 2/4/93

CLOSURE STATEMENT

IPRAS WERE NOT IN EXISTENCE AT THE TIME OF THIS BUILD AND ARE NOT APPLICABLE. IT WAS NOTED THAT THE CLEANING PRACTICE SUBSEQUENT TO ET-57 PROCESSING WAS ENHANCED. CLEANING PRACTICE AT THE TIME OF ET-57 PROCESSING WAS TO PERFORM A SOLVENT WIPE ON ALL 8 INTERTANK PANELS, FOLLOWED B A FREON WIPE, THEN VISUAL INSPECTION BY SHOP AND QUALITY PERSONNEL. PRIMER TOUCH-UP IS PERFORMED AFTER VERIFICATION OF VISUAL CLEAN. SUBSEQUENT TO THIS BUILD, SHOP PERSONNEL, ALONG WITH PRODUCTION SUPERVISION ELECTED TO ALTER THE SEQUENCE BY PERFORMING THE SOLVENT WIPE, FREON WIPE AND PRIMER APPLICATION PANEL BY PANEL TO REDUCE THE TIME BETWEEN CLEANING AND PRIMER APPLICATION. IN ALL CASES, BEFORE THE CHANGE AND AFTER, THE 24 HOUR TIME LIMIT BETWEEN CLEANING AND PRIMER APPLICATION WAS EITHER NOT VIOLATED, OR IF IT WAS VIOLATED, A RECLEANING WAS PERFORMED

PRIMER APPLICATION TECHNIQUES VARY DEPENDING ON TYPE OF TOUCH UP TO BE DONE. IN SOME CASES, SMALL SPOTS OF BARE METAL ARE TOUCHED UP USING Q-TIPS OR AN AIR BRUSH. SOME TECHNICIANS ELECT TO USE A BINKS MODEL 15 OR MODEL 18 PRIMER GUN AND SPRAY A LIGHT COATING OF PRIMER OVER THE ENTIRE SURFACE. ALL THESE METHODS HAVE BEEN VALIDATED AS ACCEPTABLE AND ARE FULLY TESTED AFTER THE PRIMER HAS CURED

NO CHANGES HAVE BEEN MADE IN THE MATERIALS USED FOR CLEANING OR PRIMING PRINT CLOTH IS USED DURING CLEANING OF THE INTERTANK RATHER THAN "RYMPLE CLOTH" DUE TO ITS SUPERIOR "NON-SNAGGING" CHARACTERISTICS AROUND THE NUMEROUS RIVETS, BOLTS, HI-LOC FASTENERS AND PROTRUSIONS ON THE INTERTANK SURFACES

1F. REVIEW STS-58/ET-57 MISSION ENVIRONMENTS (PRE LAUNCH CONDITIONS, MISSION PROFILE, AND TRAJECTORY)

ECD: 12/17/93 (HIGHER PRIORITIES PREVAILED)
COMPLETE: 12/21/93

CLOSURE STATEMENT

TRAJECTORY PARAMETERS REVIEWED FOR STS-58/ET-57 WERE NOMINAL AND WITHIN PRIOR FLIGHT HISTORY DATABASE. PRE-LAUNCH CONDITIONS AND MISSION PROFILE DATA DOES NOT INDICATE DISCERNIBLE DIFFERENCES OR PATTERNS RELATED TO DEBRIS DIVOT HISTORY FOR STS-58

1G. REVIEW AND PROVIDE SEPARATION PHOTOGRAPHS OF STS-58/ET-57 AND PRIOR FLIGHTS

ECD: 12/17/93

COMPLETE: 12/14/93
CLOSURE STATEMENT
PHOTOGRAPHS HAVE BEEN REVIEWED
1H. EVALUATE THE MISSION SPECIFIC INTERTANK ENVIRONMENTS
ECD: 12/17/93   (HIGHER PRIORITIES PREVAILED)
NEXT ECD: 01/18/94
COMPLETE: 1/17/94
CLOSURE STATEMENT
THE MISSION SPECIFIC INTERTANK ENVIRONMENTS HAVE BEEN EVALUATED AND ALL APPEAR TO BE NOMINAL. THERMAL ENVIRONMENTS WERE REVIEWED AND FOUND TO BE WITHIN THE HISTORICAL AS WELL AS THE DESIGN DATABASE. IN ADDITION, AS NOTED IN ACTION ITEM "J", THE STRUCTURAL LOADS WERE APPROXIMATELY 78% OF DESIGN LOADS
1I. REVIEW WALKING LOAD LIMITS
ECD: 12/17/93
NEXT ECD: 01/18/94
COMPLETE: 01/17/94
CLOSURE STATEMENT
PERSONNEL WALKING LOAD LIMITATION FOR LWTS ARE SPECIFIED IN 80900000031 REQUIREMENTS ARE APPLICABLE TO THE ET AFTER TPS APPLICATION AND WHEN IN FINAL ASSEMBLY. PERSONNEL ARE NOT PERMITTED ON ANY PORTION OF TPS NOT COVERED BY PROTECTIVE PADS. THE SAME TYPE OF PROTECTIVE PADS HAVE BEEN USED ON THE ET SINCE THE BEGINNING OF THE PROGRAM. THE WEIGHT LIMITS SPECIFIED IN 80900000031 ARE NOT STRICTLY CHECKED, HOWEVER THE TECHNICIANS DOING INSTALLATION WORK APPEAR TO MEET THE REQUIREMENT
INSPECTION OF THE TPS FOR DAMAGE IS SEEN FROM A DISTANCE AS NO ACCESS FOR CLOSER INSPECTION EXISTS AFTER THE PROTECTIVE MATS ARE REMOVED
THE TPS IS INSPECTED CLOSER DURING FINAL WALK DOWN, BUT NOT TO THE POINT THAT SMALL CRACKS WOULD BE NOTICED. THE CPR NET SPRAYED TPS CONFIGURATION CHANGE ON THE INTERTANK PANELS DID NOT RESULT IN ANY NEW VERIFICATION OF THE PROTECTIVE PAD CONCEPT. ETHAFOAM FILLER BLOCKS (WEDGES) HAVE APPARENTLY ALWAYS BEEN USED UNDER THE PROTECTIVE MATS TO FILL THE VALLEYS BETWEEN THE STRINGERS. HOWEVER, THE PART NUMBER SPECIFIED (TOOL # TL-1330-100) IN THE FINAL ASSEMBLY MPP AND BUILDING 420 MPP IS NOT ALWAYS AVAILABLE AND HAND CUT BLOCKS OF VARYING CONFIGURATIONS ARE THEN SUBSTITUTED. THE BLOCKS ARE NOT TAPERED TO MATCH LOCAL CONTOUR, WHICH VARIES FROM LOCATION TO LOCATION AND TANK TO TANK. ETHAFOAM WEDGES ARE 3 AND 5/8" X 5" X 3" THICK BY 48 INCHES LONG
1J. REVIEW STRUCTURAL LOADING
ECD: 12/17/93   (HIGHER PRIORITIES PREVAILED)
NEXT ECD: 01/18/94
COMPLETE: 01/17/94
CLOSURE STATEMENT
ANALYSIS SHOWS THAT STRESS LEVELS IN THE AREA OF THE FOAM LOSS DID NOT CAUSE THE FOAM LOSS. ALSO, LOSS OF FOAM IN THAT SPECIFIC AREA WOULD NOT HAVE BEEN STRUCTURALLY DETRIMENTAL TO THE ET EVEN IF THE FOAM WAS LOST AT LIFT OFF. THE STRUCTURAL LOADS AND STRESSES REVIEWED WERE WITHIN THE CAPABILITY OF THE FOAM
THE TPS FACTOR OF SAFETY (F.S.) FOR SUBSTRATE STRAIN =5.73 (REQUIRED F.S. = 1.1). THE ISSUE OF LOCAL BUCKLING OF A STRINGER LEADING TO FOAM LOSS WAS ASSESSED AND FOUND TO BE OF NO CONCERN (MINIMAL STRUCTURAL F.S.=2.16, STABILITY). A F.S. WAS CALCULATED USING TEMPERATURES GENERATED UNDER THE ASSUMPTION THAT THE TPS ON THE STRINGER TOP WAS LOST AT LIFT OFF. THIS ANALYSIS SHOWED THE FOLLOWING
F.S. (WITH TPS ON STRINGER TOP) = 2.16 (FAILURE MODE: STABILITY)
F.S. (WITHOUT TPS ON STRINGER TOP) = 1.76 (FAILURE MODE: STABILITY)
THE ABOVE FACTORS OF SAFETY ARE BASED ON GENERIC LOADING, WHICH IS CONSERVATIVE. THE PERCENTAGE OF STRUCTURAL LOADING FOR STS-58 COMPARED TO GENERIC IS APPROXIMATELY 78%
1K. REVIEW CAD STRUCTURAL OVERLAY ON TO SCANNED STS-58/ET-57 SEPARATION PHOTOGRAPHS
ECD: 12/17/93   (HIGHER PRIORITIES PREVAILED)

NEXT ECD: 01/18/94
COMPLETE: 01/11/94
CLOSURE STATEMENT
TEAM CONSENSUS IS TO DELETE THIS ACTION AS NO VALUE IS ADDED TO THE INVESTIGATION
1L. COMPARE ACCEPTANCE DATA FROM ET-57 WITH ACCEPTANCE DATA FROM ET-55, ET-56, ET-58 AND ET-59, NO DIVOT INTERTANK FLIGHTS
ECD: 12/17/93   (HIGHER PRIORITIES PREVAILED)
NEXT ECD: 02/04/94
COMPLETE: 02/04/94
CLOSURE STATEMENT
LEAD-IN AND LEAD-OUT TENSILE AND DENSITY, HARDWARE TENSILE DATA AND ACREAGE THICKNESS MEASUREMENTS WERE COMPARED. ET-57 WAS THE ONLY TANK TO HAVE PLUG PULL FAILURE ON THE ACREAGE, WITH RETESTS ACCEPTABLE (REFERENCE MARS T-85827). ETS 55, 57 AND 58 HAD THICKNESS DISCREPANCIES WHICH WERE ADDRESSED APPROPRIATELY ON NONCONFORMANCE PAPER. THE REVIEW DID NOT SHOW ANY OUTSTANDING DIFFERENCES WITHIN THE DATA REVIEWED
1M. CONSTRUCT A FAULT TREE
ECD: 12/17/93   (HIGHER PRIORITIES PREVAILED)
NEXT ECD: 01/18/94
COMPLETE: 02/04/94
CLOSURE STATEMENT
TEAM CONSENSUS IS TO DELETE THIS ACTION SINCE MOST PROBABLE CAUSE HAS BEEN DETERMINED
1N. REVIEW SHOP AID FOAM WEDGES USED TO PROTECT FLIGHT HARDWARE IN WORK HORIZONTALLY. STOCK ITEMS OR SHOP MADE
ECD: 01/04/94   MORE INFORMATION REQUIRED
      01/18/94   HIGHER PRIORITIES PREVAILED
      02/04/94
COMPLETE: 02/04/94
CLOSURE STATEMENT
PERSONNEL WALKING LOAD LIMITATIONS (REQUIREMENTS) FOR WORKING ON THE ET ARE FOUND IN 80900000031. SUBSEQUENT TO TPS APPLICATION, ALL WORK PERFORMED ON THE INTERTANK REQUIRES USE OF ETHAFOAM WEDGES (TOOL # TL-1330-100) AND PROTECTIVE MATS (TOOL # TL-0956-010). IN FINAL ASSEMBLY AND BUILDING 420, THE GENERAL SET-UP MPP (80911001000-OP105 AND 80911001000-OP110 RESPECTIVELY) DIRECTS THAT PROTECTIVE PADS AND FOAM WEDGES ARE POSITIONED (ON TOP OF THE TANK) PER THE GENERAL FOREMAN/PRODUCTION SUPERVISOR'S DIRECTION/DISCRETION
MEMBERS OF THE IFA/CAPS TEAM HAS OBSERVED INCORRECT PLACEMENT OF PROTECTIVE MATS AND WEDGES ON AN ET (NO WEDGES UNDER MATS ON THE INTERTANK). "SHOP-MADE" WEDGES WERE ALSO FOUND IN USE. THE "SHOP-MADE" WEDGES PROTECT, HOWEVER DO NOT ALWAYS MEET TL-1330-100 TOOL DRAWING DIMENSIONS
MPPS PERFORMING WORK ON TOP OF THE ET CONTAIN NO RE-VERIFICATION THAT THE WEDGES AND MATS ARE IN PLACE BEFORE THE START OF AND DURING WORK OPERATIONS. THE ETHAFOAM WEDGE TOOL DRAWING DOES NOT AUTHORIZE SUBSTITUTION OF "SHOP-MADE" WEDGES
SUFFICIENT QUANTITIES OF TOOL # TL-1330-100 FOAM WEDGES ARE NOT AVAILABLE TO FLOOR PERSONNEL TO USE
THE 80900000031 DRAWING REFERS TO TOOL DRAWING # T12A0056 FOR PROTECTIVE PADS IN FLAG NOTES TWO(2) AND FOUR(4). TOOL DRAWING # T12A0056 WAS CANCELED AND REPLACED WITH THE CURRENT TL TOOL DRAWING NUMBERS FOR MATS AND WEDGES IN 1984
1O. GENERATE AND COMPLETE A TEST PLAN - WORK AUTHORIZATION TO SIMULATE POSSIBLE CAUSE SCENERIOS FOR INTERTANK FOAM LOSS
ECD: 01/18/94   (PENDING AVAILABILITY OF GVTA)
NEXT ECD: 02/04/94   (TEST PLAN COMPLETE, PENDING CLOSURE STATEMENT
                       GENERATION. HIGHER PRIORITIES EXIST.)
COMPLETE: 03/18/94
CLOSURE STATEMENT
VARIOUS ASSUMED CONTAMINATION CONFIGURATIONS WERE APPLIED TO INTERTANK

STRINGER TOPS SUBSTRATE. TOTAL DEBOND WAS ALSO SIMULATED BY
APPLYING TEFLON TAPE TO STRINGER TOP SUBSTRATE. SOFI WAS APPLIED OVER
THESE AREAS (NORMAL SOFI APPLICATION). THE WALKING LOAD LIMITATION IS
250 POUNDS FOR MAN AND TOOLS. A SAFETY FACTOR OF 1.2 WAS USED FOR A
RESULTANT TEST LOAD OF 300 POUNDS. THIS LOAD WAS APPLIED TO THE
INTERTANK, OVER EACH CONTAMINATED AREA, IN THE VALLEY AND ON THE
STRINGER TOP USING CONFIGURATIONS OF MATS AND FOAM WEDGES AND MATS
WITHOUT FOAM WEDGES
DURING TESTING, A CRACK WAS INDUCED IN THE AREA WHERE TOTAL DEBOND WAS
SIMULATED AND LOAD WAS APPLIED OVER A MAT WITHOUT USING FOAM WEDGES
THIS CRACK DID NOT GO TO SUBSTRATE
==========
ISSUE 2: MISSING BIPOD JACK PAD CLOSEOUT FOAM
2A. CONSTRUCT A FAULT TREE AND RESOLVE IDENTIFIED ISSUES/EVENTS
ECD: 12/17/93 (HIGHER PRIORITIES PREVAILED)
COMPLETE: 2/25/94
CLOSURE STATEMENT
A FAULT TREE WAS GENERATED AND THE EVENTS IDENTIFIED WERE EVALUATED AND
CLOSURE STATEMENTS GENERATED
2B. REVIEW ACTUAL FLIGHT DYNAMIC LOADS VERSUS DESIGN QUALIFICATION FOR
THIS CONFIGURATION AND MATERIAL
DIMENSIONS
ECD: COMPLETE. 12/16/93
CLOSURE STATEMENT
STS-58 ASCENT FLIGHT ENVIRONMENTS DID NOT EXCEED THE PREVIOUS FLIGHT
MAX/MIN HISTORIES. THE DESIGN ASCENT ENVIRONMENTS ARE EVEN MORE SEVERE
THAN PREVIOUS FLIGHT HISTORIES
LOCAL PRESSURE DISTRIBUTIONS AT THE JACK PAD REGION SHOWS EXPECTED
RESULTS. NO ANOMALOUS ENVIRONMENTS WERE SEEN ON THIS CLOSEOUT
2C. REVIEW LOAD INCREASE OR RELAXATION DURING CRYOGENIC LOADING
ECD: COMPLETE. 1/13/94
CLOSURE STATEMENT
ANY TWIST DURING LH2/INTERTANK MATE AND OTHER MECHANICAL ACTIONS
INCLUDING ET/ORBITER MATE, ARE ALL INCURRED PRIOR TO POURING THE JACK
PAD CLOSEOUT. THE POUR CONFORMS TO A SHAPE THAT MAY BE DEFORMED, BUT
THE POUR INTERFACE HAS NOT BEEN STRAINED, THUS THESE MECHANICAL ACTIONS
ARE NOT A FACTOR. THE JACK PAD CLOSEOUT WILL NOT EXPERIENCE A
RELAXATION OF LOADS DUE TO ANY TWIST OR MOVEMENT RESULTING FROM
CRYOGENIC LOADING RELATED TO LH/INTERTANK MATE OR ET/ORBITER MATE
2D. REVIEW LOADING DURING ASCENT
ECD: COMPLETE. 12/16/93
CLOSURE STATEMENT
ANY TWIST DURING LH2/INTERTANK MATE AND OTHER MECHANICAL ACTIONS
INCLUDING ET/ORBITER MATE, ARE ALL INCURRED PRIOR TO POURING THE JACK
PAD CLOSEOUT. THE POUR CONFORMS TO A SHAPE THAT MAY BE DEFORMED, BUT
THE POUR INTERFACE HAS NOT BEEN STRAINED, THUS THESE MECHANICAL ACTIONS
ARE NOT A FACTOR. THE JACK PAD CLOSEOUTS ARE NOT AT ET LOCATIONS
SUSCEPTIBLE TO EITHER SRB STAGING OR ORBITER/ET SEPARATION PYROTECHNIC
SHOCK SPECTRA. ALSO THSE LOCATIONS ARE NOT SUSCEPTIBLE TO ET STRUCTURAL
REACTIONS INCURRED DUE TO THESE EVENTS. VIBRATION DURING THESE EVENTS
IS SIGNIFICANTLY REDUCED FROM LIFT-OFF OR MAXIMUM BOOST LEVELS (

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15695	STS-58-T-1	T-066	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
80901000000-229	ET COMPLETE	ET-57

HCRIT CD	FCRIT CD	CAUSE CD	FAIL MODE
--	1	MP - MFG-PRC	MSI - INSULATION
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
5.6.2.1	1	B	N/A
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Correlated Part#	**Correlated Part#**	**Correlated Part#**	
--	--	--	
Associated LRU#	**Associated LRU#**	**Associated LRU#**	
--	--	--	

MAJOR DESIGN CHANGES	
APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15696	**In-Flight Anomaly Number** STS-58-T-1	**Contractor Report Number** T-066-1	**JSC#** --	**KSC#** --
Problem Title MISSING FOAM ON BIPOD JACK PAD CLOSEOUT				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G **(X)** H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ET COMPLETE	**PART#** 80901000000-229	**SER/LOT#** ET-57	**MANUFACTURER** MMMSS
Test/Operation F - FLT	**Prevailing Condtion** F - FUNCTIONAL	**F / U** UC	**Fail Mode** MSI - INSULATION	**Cause** --
System TPS	**Defect** DD - DETACH	**Material** F - INSUL	**Work Contact** K. KILLIAN	**Fail Date** 10/18/1993
Received at MSFC 11/16/1993	**Date Isolated** 11/15/1993	**FMEA Reference** 5.6.4.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location KSC		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text ET-60 AND SUBSEQUENT				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary THIS PROBLEM REPORT (PR) IS INITIATED TO RECORD THE OCCURRENCE OF THIS PROBLEM FOR TRENDING PURPOSES (IT WAS OFFICIALLY SUBMITTED ALONG WITH ANOTHER MISSING FOAM PROBLEM ON CONTRACTOR CAPS T-066). ALL INVESTIGATION/RESOLUTION INFORMATION RELATING TO THIS PR SHALL BE TRACKED ON MSFC NO. A15695				
Last MSFC Update	**CN RSLV SBMT**	**Defer Date**	**Add Date**	**R/C Codes**

12/07/1993	--	--	11/17/1993	-- -- --

Assignee

Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**
C. BRAMON	M. PESSIN	R. JACKSON	--	P. COUNTS

Approval

Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**
N/A	M. PESSIN	R. JACKSON	--	N/A

PAC Assignee	**PAC Review Complete**	**MSFC Closure Date**	**Status**	**F/A Completion**
B. HURST	BH	11/17/1993	C - CLOSED	--

Problem Type	**SEV**	**Program Name**	**REVL**	**OPRINC**
--	--	--	--	--

FUNC MOD	**Software Effectivity**	**Software Fail CD**	**SUBTYPE**	**Software Closure CD**
--	-- -- -- -- --	--	--	--

RES PERSON L2	**Approval Signature L3**
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Related Document Type	**Related Document ID**
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Related Document Title
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Related Document Type	**Related Document ID**
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Related Document Title
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Related Document Type	**Related Document ID**
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Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

```
POST SEPARATION FILM OF THE INTERTANK FROM THE UMBILICAL CAMERAS SHOW
THAT THE +Y AND -Y BIPOD JACK PAD CLOSEOUT FOAM IS MISSING.  PRIMER
APPEARS TO BE EXPOSED IN BOTH JACK PAD CAVITIES
THIS ISSUE IS DOCUMENTED ON IFA-STS-58-T-1
```

Contractor Investigation/Resolution

```
 THIS PROBLEM REPORT (PR) IS INITIATED TO RECORD THE OCCURRENCE OF THIS
PROBLEM FOR TRENDING PURPOSES (IT WAS OFFICIALLY SUBMITTED ALONG WITH
ANOTHER MISSING FROM PROBLEM ON CONTRACTOR CAPS T-066).  ALL
INVESTIGATION/RESOLUTION INFORMATION RELATING TO THIS PR SHALL BE
TRACKED ON MSFC PR NO. A15695.  THEREFORE, THIS PR IS CONSIDERED CLOSED
```

MSFC Response/Concurrence

ASSESSMENT ADDENDUM REPORT

MSFC Report#	IFA#	Contractor RPT#	JSC#	KSC#	EICN#
A15696	STS-58-T-1	T-066-1	--	--	--

Asmnt Part#	Asmnt Part Name	Asmnt Serial/Lot#
80901000000-229	ET COMPLETE	ET-57

HCRIT CD	FCRIT CD	CAUSE CD	FAIL MODE
--	1	--	MSI - INSULATION

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
5.6.4.1	1	--	--
--	--	--	--
--	--	--	--

Correlated Part#	Correlated Part#	Correlated Part#
--	--	--

Associated LRU#	Associated LRU#	Associated LRU#
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	DESCRIPTION OF CHANGES
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15743	**In-Flight Anomaly Number** --	**Contractor Report Number** P-070	**JSC#** --	**KSC#** --
Problem Title LO2 FEEDLINE JOINT 2 LEAKAGE				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** EXTERNAL TANK	**PART#** 80901006000-059	**SER/LOT#** NA	**MANUFACTURER** MAF
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MV - EXT LEAK	**Cause** MAW - MFG-ASY-WORK
System PROPULSION	**Defect** MA - ME ADJ	**Material** P - SEAL	**Work Contact** D. O'NEAL	**Fail Date** 12/20/1993
Received at MSFC 12/23/1993	**Date Isolated** 03/19/1993	**FMEA Reference** 2.1.14.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MV - EXT LEAK		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 01/04/1994	**Contractor Req Defer Until Date** 01/31/1994	**LVL 3 Close** --	**Remark / Action** 01/31/1994	
Investigation / Resolution Summary				
Last MSFC Update 04/12/1994	**CN RSLV SBMT** 02/01/1994	**Defer Date** 01/13/1994	**Add Date** 12/23/1993	**R/C Codes** 5 - TRNG -- --
Assignee				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS

Approval				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 02/14/1994	**Status** C - CLOSED	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				

Problem Description

THE LO2 FEEDLINE JOINT 2 LEAKED AT 90 SCCM AND EXCEEDED THE
ALLOWABLE LEAKAGE RATE OF 2.7 SCCM PER TP-8C101-FA
CRITICALITY: PARA. 2.1.14.1 REFLECTS SEAL LEAKAGE AS A FAILURE MODE
WHICH MAY RESULT IN LOSS OF MISSION
REV "A", REVISES GENERAL, TASKS I, II, III, AND IV (SEE ASTERISKS) AND
CLOSES CAPS

Contractor Investigation/Resolution

* GENERAL:
DURING THE DUAL SEAL CAVITY LEAK CHECK OF JOINT 2 (LO2 FWD FLEX ASSY
TO LO2 FWD ELBOW), A 90 SCCM LEAK WAS DETECTED. THE ALLOWABLE LEAKAGE
IS 2.7 SCCM MAXIMUM AT 50.0 +/-.5 PSIG GHE, AS TESTED PER TP-8C101-FA
TROUBLE SHOOTING STEPS DETECTED NO TEST EQUIPMENT MALFUNCTION AND
VERIFIED THAT THE LEAKAGE WAS ISOLATED TO THE PRIMARY SEAL. UPON
JOINT DISASSEMBLY DAMAGE TO THE RACO SEAL (PRIMARY SEAL) WAS FOUND
WHICH SHOWED THE SEAL WAS MISALIGNED DURING INSTALLATION. NO DAMAGE
WAS FOUND ON EITHER FLANGE SURFACE
THE FEEDLINES ARE MANUFACTURED BY ARROWHEAD PRODUCTS. THE FORWARD FLEX
ASSEMBLY IS IDENTIFIED AS A PD4800175-099 AND THE FORWARD ELBOW IS
IDENTIFIED AS A PD4800175-089. THE RACO SEAL WAS MANUFACTURED BY
FLUOROCARBON AND IS IDENTIFIED AS A 55L2-5 SEAL

TASK I. PROBLEM/FAILURE INVESTIGATION
REVIEW ASSEMBLY PROCEDURES AND FLANGE/SEAL CONFIGURATIONS FOR FACTORS WHICH WOULD HAVE CONTRIBUTED TO THE SEAL MISALIGNMENT DURING INSTALLATION
RESPONSIBILITY: D. O'NEAL/3741 -- D. WESTPHAL/3740
COMPLETED 01/04/94
* CLOSURE STATEMENT
  THE ORIENTATION OF THIS JOINT DURING ASSEMBLY IS SUCH THAT THE FLANGES ARE HORIZONTAL, THE UPPER FLANGE (LO2 FORWARD ELBOW) CONTAINING BOTH THE PRIMARY (RACO) AND SECONDARY (CREAVY) SEALS IN GROOVES, WHICH IS LOWERED ONTO THE SMOOTH FLANGE OF THE LO2 FORWARD FLEX ASSEMBLY. DUE TO THIS ORIENTATION ACLAR STRIPS ARE USED TO ENSURE RETENTION OF THE SEALS IN THEIR GROOVES UNTIL IMMEDIATELY PRIOR TO FLANGE MATE WHERE THE STRIPS ARE REMOVED AND THE FLANGES ARE ALLOWED TO CONTACT. DISCUSSIONS WITH THE PERSONNEL THAT PERFORMED THIS PARTICULAR ASSEMBLY NOTED THAT THIS RACO SEAL TENDED TO SLIP FROM ITS GROOVE, UNUSUAL AS NORMALLY THERE IS ENOUGH OF AN INTERFERENCE FOR TO THE GROOVE FOR THE SEAL TO RETAIN ITSELF BOTH THE RACO SEAL AND THE GROOVE OUTER DIAMETER REQUIREMENTS ARE THE SAME, 17.805 +/- .005 INCHES. NOTE THAT THE TOLERANCES WOULD ALLOW THE LOOSE SEAL CONDITION REPORTED DURING ASSEMBLY
  A REVIEW OF THE DATA PACK FOR THE FORWARD ELBOW SHOWED THE DIMENSIONAL REQUIREMENT FOR THE FLANGE SEAL GROOVE DIAMETER TO BE ACCEPTABLE PER A DISCRETE VERIFICATION DURING FINAL INSPECTION. THE SEAL DIAMETER IS VERIFIED AT THE SUPPLIER BY FIT CHECKING TO FIXED TOOLING. NO POST-REMOVAL DIMENSIONAL INSPECTION OF THE SEAL WAS POSSIBLE DUE TO ITS DAMAGED CONDITION
* CAUSE
  PRIMARY SEAL DAMAGED DURING INSTALLATION
* TASK II. CORRECTIVE ACTION
  PRODUCTION OPERATIONS AND QUALITY CONTROL PERSONNEL HAVE BEEN MADE AWARE OF THE INSTALLATION ERROR AND CAUTIONED TO USE EXTREME CARE TO ASSURE PROPER SEAL ALIGNMENT PRIOR TO FLANGE MATE. REFERENCE IOM 3725-94-05
  NO OTHER CORRECTIVE ACTION IS NECESSARY. THIS TEST FAILURE IS ISOLATED, A DIRECT RESULT OF A DAMAGED PRIMARY SEAL CAUSED BY IMPROPER ALIGNMENT DURING JOINT ASSEMBLY
* TASK III. FLEET CLEARANCE
  ET-71 JOINT NUMBER 2 ASSEMBLY SUCCESSFULLY REWORKED AND RETESTED
  ALL OTHER JOINTS SUCCESSFULLY COMPLETED LEAK TESTS
  ALL OTHER ETS CLEARED BASED ON SUCCESSFULLY COMPLETING LEAK TESTS
* TASK IV. CAPS CLOSURE SUMMARY
  THE LEAK DETECTED DURING ACCEPTANCE TESTING OF THE LO2 FEEDLINE JOINT OCCURRED AS A RESULT OF A MISALIGNED SEAL WHICH HAD SLIPPED FROM ITS GROOVE IMMEDIATELY PRIOR TO FLANGE MATE, UNDETECTED BY; ASSEMBLY PERSONNEL. NO REASON WAS FOUND TO INDICATE THAT EITHER THE SEAL OR FLANGE GROOVE WAS AT FAULT AS THE DIAMETERS ARE CHECKED AT THE SUPPLIERS AND DIMENSIONAL TOLERANCES CAN ALLOW A CLEARANCE FIT IN A WORST CASE CONDITION (MAXIMUM GROOVE DIAMETER COUPLED WITH MINIMUM SEAL DIAMETER). THIS ANOMALY IS AN ISOLATED OCCURRENCE, DETECTABLE THROUGH TEST AND AFFECTS NO OTHER ET. ASSEMBLY PERSONNEL ARE AWARE OF THEIR ERROR. NO OTHER CORRECTIVE ACTION IS NECESSARY
* THIS PROBLEM CONDITION IS CLEARLY SCREENED BY SPECIAL TESTS AND SHOULD NOT OCCUR FOLLOWING THE TESTS
THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED

MSFC Response/Concurrence

12/23/93 - DEFERRAL RATIONALE:
BASED ON THE DEFERRAL RATIONALE IN "TASK III. FLEET CLEARANCE" (ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126, REV. E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS CLEARLY SCREENED

BY PREFLIGHT CHECKOUT OR SPECIAL TESTS (I.E., FAILURE MODE SHOULD NOT
OCCUR FOLLOWING THE TEST)."
THE DEFERRAL RATIONALE HAS BEEN APPROVED BY THE EXTERNAL TANK PROJECT
MANAGER, MR. PARKER V. COUNTS
SIGNED:___PARKER V. COUNTS (SIGNED)_______ DATE:___1/13/94_____

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15743	--	P-070	--	--	--
Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**			
80901006000-059	ET COMPLETE	N/A			
HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**		
--	1	MAW - MFG-ASY-WORK	MV - EXT LEAK		
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**		
2.1.14.1	1	A	1		
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**		
--	--	--	--		
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**		
--	--	--	--		
Correlated Part#	**Correlated Part#**	**Correlated Part#**			
--	--	--			
Associated LRU#	**Associated LRU#**	**Associated LRU#**			
--	--	--			
MAJOR DESIGN CHANGES					
APRV DATE	**DESCRIPTION OF CHANGES**				
--	--				
ASSESSMENT TEXT					

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15773	**In-Flight Anomaly Number** --	**Contractor Report Number** E-156	**JSC#** --	**KSC#** --
Problem Title LIQUID LEVEL SENSOR FAILED ATP				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1R
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LOX LEVEL SENSOR	**PART#** 74L4-1	**SER/LOT#** 1649	**MANUFACTURER** SIMMONDS
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EN - OPEN	**Cause** U - UNKNOWN
System ELECTRICAL	**Defect** DC - BROKEN	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 01/10/1994
Received at MSFC 01/12/1994	**Date Isolated** 01/10/1994	**FMEA Reference** 3.6.1.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location SIMMONDS		**Symptom** EN - OPEN		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 01/21/1994	**Contractor Req Defer Until Date** 01/31/1994	**LVL 3 Close** --	**Remark / Action** 01/31/1994	
Investigation / Resolution Summary				
Last MSFC Update 04/12/1994	**CN RSLV SBMT** 01/31/1994	**Defer Date** 01/20/1994	**Add Date** 01/12/1994	**R/C Codes** 0 - EXPL -- --
Assignee				
Design R. MOYE	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS

Approval				
Design R. MOYE	**Chief Engineer** M. PESSIN	**S & MA** R. JACKSON	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 02/10/1994	**Status** C - CLOSED	**F/A Completion** 01/10/1994
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --

RES PERSON L2 --	**Approval Signature L3** --
Related Document Type --	**Related Document ID** T-121356

Related Document Title
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Related Document Type --	**Related Document ID** --

Related Document Title
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Related Document Type --	**Related Document ID** --

Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

A LOX LEVEL SENSOR FAILED THE SUPPLIER ACCEPTANCE TEST. THE
SENSING ELEMENT DEVELOPED AN OPEN CIRCUIT UPON IMMERSION IN CRYOGENIC
FLUID DURING THE FIRST THERMAL SHOCK TEST
CRITICALITY: THE 74L4-1 LOX LEVEL SENSOR IS CRIT. 3 IN ALL POSITIONS
ON THE ET FOR THE SENSING ELEMENT OPEN CIRCUIT. HOWEVER, THE 74L4-1
SENSOR IS VIRTUALLY IDENTICAL TO THE 74L4-2 LH2 LEVEL SENSOR. THE
74L4-2 LEVEL SENSOR IS CRIT. 1R; FMEA ITEM CODE 3.6.1.1; " FAILS WITH
FALSE WET SIGNAL."
NOTE: THE SENSOR IS LIMITED LIFE CONTROLLED
* REVISION "A" CLOSES ALL TASKS. SEE ASTERISKS FOR CHANGES

Contractor Investigation/Resolution

GENERAL:
THE 74L4-1 LOX LEVEL SENSOR WAS UNDERGOING THE ACCEPTANCE TEST AT
THE SUPPLIER, B.F. GOODRICH AEROSPACE, SIMMONDS PRECISION DIVISION,
VERGENNES, VERMONT. THE TESTING IS CONTROLLED BY ACCEPTANCE TEST
PLAN 946, REVISION S. THE TRANSDUCER DEVELOPED AN OPEN CIRCUIT WHEN
IMMERSED IN LN2 FOR THE FIRST OF THE SEVEN THERMAL SHOCK CYCLES PER
PARAGRAPH 6.4.10 OF THE ATP. THE SENSOR WAS REMOVED FROM THE LN2
AND EXAMINED; THE BROKEN SENSING ELEMENT COULD BE SEEN WITHIN THE
SENSOR HOUSING. THE FAILURE WAS DOCUMENTED ON MARS T121356

THE LEVEL SENSOR UTILIZES THE DECREASE IN THE ELECTRICAL RESISTANCE
OF A METAL WHEN COOLED TO DETECT THE PRESENCE OF A CRYOGENIC FLUID
THE SENSOR USES A GOLD FLASHED PLATINUM WIRE, .0005 INCH IN DIAMETER,
AS THE SENSING ELEMENT. THE LEVEL SENSOR SIGNAL CONDITIONER, WHICH
IS MOUNTED IN THE ORBITER, PROVIDES A CONSTANT CURRENT TO THE SENSING
ELEMENT WHICH CAUSES IT TO RISE IN TEMPERATURE. THE TEMPERATURE AND
RESISTANCE OF THE ELEMENT DECREASE RADICALLY WHEN IMMERSED IN A
CRYOGENIC LIQUID. THE SIGNAL CONDITIONER DETECTS THE DECREASE IN
RESISTANCE AND CONVERTS IT TO A "WET" OUTPUT SIGNAL. THE SIGNAL
CONDITIONER IS ALSO DESIGNED TO GIVE A "WET" SIGNAL IN THE EVENT OF
AN OPEN CIRCUIT IN THE LEVEL SENSOR
THE SENSOR HAS AN ALUMINUM CASE WHICH IS PRODUCED BY INVESTMENT
CASTING. VERY FEW OF THE INTERNAL SURFACES, AND NONE OF THE EXTERNAL
SURFACES, ARE FINISH MACHINED FOR DIMENSIONAL CONTROL. THE INTERNAL
SURFACES OF THE CASE AND THE COVER ARE PAINTED WITH A SPRAYED-ON,
BAKED, TEFLON PAINT. THE PAINT PREVENTS WETTING OF THE CASE, I.E
RETENTION OF CRYOGENICS, AND ALSO PROVIDES SOME ELECTRICAL INSULATION
BETWEEN THE CASE AND THE SENSOR ELEMENT. THE ELEMENT IS SUPPORTED BY
A CERAMIC SUBSTRATE. THE SUBSTRATE HAS FIRED-ON GOLD CIRCUIT PATHS
WHICH PROVIDE A MEANS TO TERMINATE THE ELEMENT WIRE BY WELDING. THE
SENSOR OUTPUT WIRES ARE ATTACHED TO THE SUBSTRATE BY STEEL TERMINALS
HELD IN PLACE WITH RIVETS AND SPRING WASHERS
TASK I. FAILURE INVESTIGATION
THE FAILED SENSOR WAS DOCUMENTED ON MARS T121356. THE MARS WAS
DISPOSITIONED FOR FAILURE ANALYSIS, TO BE PERFORMED AT MAF
   RESPONSIBILITY: R. RAMSEY/3830 -- M. COMBS/3830
                   J. ADAMS/3741--D, WESTPHAL/3840
* COMPLETED: JANUARY 21, 1994
* CLOSURE STATEMENT
  THE SENSOR WAS RECEIVED FROM SIMMONDS PRECISION IN GOOD CONDITION
  VISUAL EXAMINATION OF THE SENSOR CONFIRMED THAT ONE END OF THE
  FRACTURED ELEMENT WIRE COULD BE SEEN WITHIN THE SENSOR. WHEN THE
  CASE WAS OPENED IT WAS DETERMINED THAT THE FRACTURE HAD OCCURRED
  NEAR THE CENTER OF THE ELEMENT. THE TWO ENDS OF THE WIRE AT THE
  FRACTURE WERE REMOVED FROM THE ELEMENT ASSEMBLY AND MOUNTED ON A
  SAMPLE CARRIER FOR EXAMINATION IN A SCANNING ELECTRON MICROSCOPE
  (SEM). THE FRACTURE FACES OF THE WIRE WERE INDICATIVE OF A TENSILE
  OVERLOAD IN A DUCTILE MATERIAL. THE EXTREME DELICACY OF THE SENSING
  ELEMENT MAKES IT SUSCEPTIBLE TO IMPACT DAMAGE FROM FOREIGN MATERIALS
  IN THE LIQUID NITROGEN USED DURING ACCEPTANCE TESTING AND TO
  INSUFFICIENT SLACK IN THE ELEMENT. THERE WERE NO INDICATIONS AS TO
  WHICH OF THE TWO LIKELY POSSIBILITIES WAS THE CAUSE
  TASK CLOSED
* CAUSE
  THE ROOT CAUSE IS UNKNOWN. THE MOST PROBABLE CAUSE WAS EITHER:
  1) IMPACT DAMAGE FROM A FOREIGN OBJECT IN THE LN2; OR
  2) PERSONNEL ERROR DURING SENSING ELEMENT MANUFACTURE WHICH
     RESULTED IN EXCESSIVE TENSION IN THE ELEMENT
TASK II. CORRECTIVE ACTION
* NO CORRECTIVE ACTION FOR THE FAILURE IS POSSIBLE. THE CAUSE OF THE
  FAILURE COULD NOT BE DETERMINED. REVIEW OF THE ASSOCIATED TEST AND
  MANUFACTURING STEPS FOUND NO INDICATIONS THAT THE EXISTING CONTROLS
  HAD BEEN DEVIATED FROM OR THAT THE CONTROLS WERE INADEQUATE. THERE
  HAS BEEN A SINGLE PREVIOUS SUPPLIER ATP FAILURE OF A 74L4 SENSOR
  DUE TO IMPACT DAMAGE CAUSING FRACTURE OF THE ELEMENT. THERE HAS BEEN
  NO SUPPLIER ATP FAILURE OF A 74L4 SENSOR DUE TO INCORRECT TENSION
  CAUSING FRACTURE OF THE ELEMENT
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
* THIS IS AN EXPLAINED CLOSURE OF THE CAPS
* ALL ETS CLEARED. THE SENSOR FAILED DURING VENDOR ACCEPTANCE TESTING
  AND ALL INSTALLED SENSORS HAVE PASSED THE VENDOR TESTS. THERE ARE

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  TESTS OF SENSOR RESISTANCE AFTER INSTALLATION ON THE ET THAT WOULD
  DETECT THE FAILURE
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
TASK CLOSED
TASK IV. CAPS CLOSURE SUMMARY
* THIS IS AN EXPLAINED CLOSURE OF THE CAPS
* THE CAUSE OF THE FAILURE OF THE LEVEL SENSOR DURING SUPPLIER ATP
  COULD NOT BE DETERMINED. NO CORRECTIVE ACTION WAS POSSIBLE. REVIEW
  OF THE SUPPLIERS TEST AND MANUFACTURE CONTROLS FOUND NO
  DEFICIENCIES. THERE ARE SUFFICIENT TESTS OF SENSOR PERFORMANCE IN
  THE ET BUILD CYCLE TO ASSURE PERFORMANCE ON THE FLIGHT VEHICLE
TASK CLOSED
```

MSFC Response/Concurrence

```
1/12/94 - DEFERRAL RATIONALE:
BASED ON THE INFORMATION IN "TASK III.  CLEARANCE OF EFFECTIVITIES"
(ABOVE), THIS PROBLEM HAS BEEN DEFERRED FOR THE NEXT SIX (6) MONTHS PER
NSTS 08126, REVISION E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE
PROBLEM CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL
TESTS (I.E., FAILURE MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
APPROVED: ____PARKER V. COUNTS(SIGNED)____  DATE:____1/20/94______
           PARKER V. COUNTS
           ET PROJECT MANAGER
```

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15773	--	E-156	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
74L4-1	L02 LEVEL SENSOR	1649

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1R	U - UNKNOWN	EN - OPEN
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.6.1.1	1	A	2
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15785	**In-Flight Anomaly Number** --	**Contractor Report Number** E-157	**JSC#** --	**KSC#** --
Problem Title TRANSDUCER FAILED ATP				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1R
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LH2 ULLAGE PRESSURE	**PART#** PD7400098-089	**SER/LOT#** 1618	**MANUFACTURER** GULTON
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** EL - SHORT	**Cause** ESW - EI-SHIP-WORK
System ELECTRICAL	**Defect** DD - DETACH	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 01/19/1994
Received at MSFC 01/24/1994	**Date Isolated** 01/19/1994	**FMEA Reference** 3.4.1.2	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location GULTON		**Symptom** EL - SHORT		**Time Cycle** --
Effectivity Text NONE				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 04/12/1994	**CN RSLV SBMT** 03/03/1994	**Defer Date** 01/25/1994	**Add Date** 01/24/1994	**R/C Codes** 0 - EXPL -- --
Assignee				
Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**

R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

Approval

Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**
R. MOYE	M. PESSIN	R. JACKSON	--	P. COUNTS

PAC Assignee	**PAC Review Complete**	**MSFC Closure Date**	**Status**	**F/A Completion**
B. HURST	BH	03/10/1994	E - CLOSED-E	01/10/1994

Problem Type	**SEV**	**Program Name**	**REVL**	**OPRINC**
--	--	--	--	--

FUNC MOD	**Software Effectivity**	**Software Fail CD**	**SUBTYPE**	**Software Closure CD**
--	-- -- -- -- --	--	--	--

RES PERSON L2	**Approval Signature L3**
--	--

Related Document Type	**Related Document ID**
--	T-119553

Related Document Title
--

Related Document Type	**Related Document ID**
--	--

Related Document Title
--

Related Document Type	**Related Document ID**
--	--

Related Document Title
--

Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

```
A TRANSDUCER FAILED A TEST OF APPLIED PRESSURE VERSUS OUTPUT VOLTAGE
ACCURACY DURING SUPPLIER ACCEPTANCE TESTING(ATP).  THE TRANSDUCER
INDICATED A LOWER PRESSURE THAN THAT WHICH WAS APPLIED
CRITICALITY:  THE TRANSDUCER IS  LISTED AS CRIT. 1R: FMEA ITEM CODE
3.4.1.2 "FAILS WITH LOW READING"
NOTE: THE TRANSDUCER IS LIMITED LIFE CONTROLLED
* REVISION "B" CLOSES ALL TASKS.  SEE ASTERISKS FOR CHANGES
```

Contractor Investigation/Resolution

```
GENERAL:
AN LH2 ULLAGE PRESSURE TRANSDUCER WAS BEING TESTED AT THE SUPPLIER
GULTON-STATHAM TRANSDUCERS, PER ACCEPTANCE TEST PLAN(ATP) 3031-13803
THE TRANSDUCER FAILED THE CALIBRATION ACCURACY TEST OF ATP PARAGRAPH
5.2 WHICH FOLLOWS THE PROOF PRESSURE TEST.  AT AN APPLIED PRESSURE OF
32 PSIA THE OUTPUT VOLTAGE WAS 2.427 V; THE MINIMUM ACCEPTABLE
VOLTAGE IS 2.450 V
THE TRANSDUCER IS USED TO MEASURE THE ULLAGE PRESSURE IN THE LIQUID
HYDROGEN PROPELLANT TANK DURING BOTH GROUND PROPELLANT LOADING AND IN
FLIGHT.  THE TRANSDUCER IS ATTACHED TO A SHOCK MOUNT ON THE FORWARD
DOME OF THE HYDROGEN TANK, WITHIN THE INTERTANK.  THE TRANSDUCER
```

COVERS THE RANGE OF 12 TO 52 PSIA. THE ORBITER PROVIDES 5 VDC TO THE
TRANSDUCER AND RECEIVES A VOLTAGE FROM THE TRANSDUCER PROPORTIONAL
TO THE ULLAGE PRESSURE. THE PRESSURE MEASUREMENT IS USED TO CONTROL
THE SPACE SHUTTLE MAIN ENGINE(SSME) GASEOUS HYDROGEN FLOW CONTROL
VALVE
TASK I. FAILURE INVESTIGATION
THE TRANSDUCER FAILURE WAS DOCUMENTATED ON MARS T-119553, ITEM 4. THE
MARS WILL BE DISPOSITIONED FOR FAILURE ANALYSIS TO BE PERFORMED AT
GULTON-STATHAM
   RESPONSIBILITY: J. ADAMS/3741 -- D. WESTPHAL/3740
                   L. COLON/4120--J. COOL/.4120
                   G. PICHON/3830--M. COMBS/3830
* COMPLETE
* CLOSURE STATEMENT
  ANALYSIS IDENTIFIED THE "STOP SHAFT" OF THE TRANSDUCER MECHANISM AS
  HAVING BECOME LOOSE. THE STOP SHAFT SERVES TO BOTH LIMIT THE
  CAPSULE TRAVEL AND TO SECURE THE WIPER DRIVE MECHANISM TO THE
  CAPSULE. THE LOOSENESS OF THE STOP SHAFT ACCOUNTS FOR THE
  CALIBRATION SHIFT FOLLOWING PROOF PRESSURE TEST. EPOXY GLUE,
  INTENDED AS STAKING TO PREVENT LOOSENING OF THE SHAFT, WAS STILL
  IN PLACE ON THE SHAFT BUT NO LONGER ADHERED TO THE ADJACENT PARTS
  A DENT WAS FOUND IN THE TRANSDUCER CASE; THIS INTRODUCED THE
  POSSIBILITY OF HANDLING DAMAGE INDUCED MECHANICAL SHOCK HAVING
  CAUSED THE EPOXY BOND TO FAIL. THE TRANSDUCER HAD FAILED IN
  SUPPLIER ATP FOLLOWING REWORK OF THE TRANSDUCER LEAD WIRES; THIS
  ALLOWS THE POSSIBILITY OF REWORK INDUCED FAILURE. OTHER POSSIBLE
  CAUSES ALSO EXIST. REVIEW OF THE SUPPLIERS MANUFACTURING PROCESSES
  FAILED TO DISCOVER ANY ESCAPE WHICH COULD HAVE DIRECTLY CAUSED THE
  FAILURE
TASK CLOSED
TASK II. CORRECTIVE ACTION
*NO CORRECTIVE ACTION FOR THE FAILURE IS POSSIBLE. THE ROOT CAUSE IS
UNKNOWN. THE TRANSDUCER FAILED FOLLOWING REWORK OF THE LEAD WIRES
REVIEW OF THE SUPPLIERS DOCUMENTATION AND DIRECT OBSERVATION OF THE
LEAD WIRE REWORK PROCESSES, ACCOMPLISHED AS PART OF CAPS E-153, FOUND
NO DEFICIENCIES OR LACK OF CONTROLS. REVIEW OF THE FAILURE HISTORY
OF THIS TRANSDUCER TYPE FOUND NO SIMILAR PREVIOUS FAILURES
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
*THIS IS AN EXPLAINED CLOSURE OF THE CAPS
ALL ETS CLEARED. THE TRANSDUCER FAILED DURING THE SUPPLIER ACCEPTANCE
TESTS AND ALL DELIVERED TRANSDUCERS HAVE PASSED THE TESTS
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
TASK CLOSED
TASK IV. CAPS CLOSURE SUMMARY
*WHILE THE MECHANICAL DEFECT RESPONSIBLE FOR THE FAILURE WAS
IDENTIFIED, THE ROOT CAUSE REMAINS UNKNOWN. THIS PRECLUDES EFFECTIVE
CORRECTIVE ACTION. REVIEW OF THE SUPPLIERS PROCESSES FOUND NO
DEFICIENCIES. THERE HAVE BEEN NO PREVIOUS FAILURES DUE TO THIS TYPE
OF PROBLEM. THE SUPPLIER ATP IS AN EFFECTIVE SCREEN FOR THE PROBLEM
TASK CLOSED
THIS CAPS IS CLOSED

MSFC Response/Concurrence

1/24/94 - DEFERRAL RATIONALE:
BASED ON THE INFORMATION IN "TASK III. CLEARANCE OF EFFECTIVITIES"
(ABOVE), THIS PROBLEM HAS BEEN DEFERRED FOR THE NEXT SIX (6) MONTHS PER
NSTS 08126, REVISION E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE
PROBLEM CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL
TESTS (I.E., FAILURE MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
APPROVED:__PARKER V. COUNTS_(SIGNED) DATE:__1/25/94_____
          PARKER V. COUNTS

ET PROJECT MANAGER

MSFC Problem Reporting and Corrective Action (PRACA) System
ASSESSMENT ADDENDUM REPORT

MSFC Report# A15785	**IFA#** --	**Contractor RPT#** E-157	**JSC#** --	**KSC#** --	**EICN#** --
Asmnt Part# PD480098-089	**Asmnt Part Name** LH2 PRES TRANSDUCER	**Asmnt Serial/Lot#** 1618			
HCRIT CD --	**FCRIT CD** 1R	**CAUSE CD** ESW - EI-SHIP-WORK	**FAIL MODE** EL - SHORT		
Asmnt FMEA 3.4.1.2	**Asmnt FM** 2	**FMEA CSE** G	**FMEA SCSE** 4		
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --		
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --		
Correlated Part# --	**Correlated Part#** --	**Correlated Part#** --			
Associated LRU# --	**Associated LRU#** --	**Associated LRU#** --			
MAJOR DESIGN CHANGES					
APRV DATE --	**DESCRIPTION OF CHANGES** --				
ASSESSMENT TEXT					

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15852	**In-Flight Anomaly Number** --	**Contractor Report Number** E-158	**JSC#** --	**KSC#** --
Problem Title FEEDTHROUGH FAILED LEAK TEST DURING ATP AT MAF				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ELECTRICAL CONNECTOR	**PART#** 809010100000-009	**SER/LOT#** ET-71	**MANUFACTURER** MAF
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MW - INT LEAK	**Cause** MA - MFG-ASY
System ELECTRICAL	**Defect** DA - ROUGH	**Material** P - SEAL	**Work Contact** DAVID O'NEAL	**Fail Date** 03/04/1994
Received at MSFC 03/08/1994	**Date Isolated** 01/19/1994	**FMEA Reference** 3.11.6.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MW - INT LEAK		**Time Cycle** --
Effectivity Text NONE				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 04/12/1994	**CN RSLV SBMT** 03/15/1994	**Defer Date** 03/21/1994	**Add Date** 03/08/1994	**R/C Codes** 5 - TRNG -- --
Assignee				

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	M. SMILES	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	M. SMILES	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	04/01/1994	C - CLOSED	03/04/1994

Problem Type	SEV	Program Name	REVL	OPRINC
--	--	--	--	--

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
--	-- -- -- -- --	--	--	--

RES PERSON L2	Approval Signature L3
--	--

Related Document Type	Related Document ID
--	NCD N009554

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

THE 81L2-2 ELECTRICAL FEEDTHROUGH CONNECTOR, LOCATED ON THE LH2
FORWARD DOME LEAKED AT THE JAM NUT TO FEEDTHROUGH PLATE JOINT WHEN
LEAK TESTED IN FINAL TEST AND CHECKOUT (BLD 420). THE TEST CONSISTED
OF CHECKING THE JOINT WITH LEAK DETECTION SOLUTION WITH THE
REQUIREMENT BEING NO DETECTABLE BUBBLES FOR THREE MINUTES. BUBBLES
WERE PRESENT
CRITICALITY: K-SEAL 55L5-16L IS CRIT 1; FMEA PARA. 3.11.6.1 REFLECTS
SEAL LEAKAGE AS A FAILURE MODE WHICH MAY RESULT IN LOSS OF MISSION
AND VEHICLE/CREW
REVISION A: REVISES TASKS I, II AND IV (SEE ASTERISKS) AND CLOSES CAPS

Contractor Investigation/Resolution

GENERAL:
DURING THE LEAK CHECK OF VARIOUS MECHANICAL JOINTS IN FINAL TEST AND
CHECKOUT (BUILDING 420), THE JOINT BETWEEN THE 81L2-2 FEEDTHROUGH
CONNECTOR-RECEPTACLE AND THE FEEDTHROUGH PLATE LEAKED. THE LEAK CHECK
AT THIS JOINT CONSISTS OF APPLYING LEAK DETECTION SOLUTION TO THE
JOINT AND MONITORING FOR BUBBLES FOR THREE MINUTES; THE REQUIREMENT
PER MMC-ET-TM04K-B (PARA. 2.1..2.11.9) BEING "NO DETECTABLE BUBBLES"

THE REPORTED LEAKAGE RATE WAS APPROXIMATELY "...16 TO 18 BUBBLES PER MINUTE WITH THE BUBBLE SIZE ABOUT THE DIAMETER OF A DIME"
THE FEEDTHROUGH CONNECTOR-RECEPTACLE IS ASSEMBLED TO THE FEEDTHROUGH PLATE IN THE DETAIL FABRICATION VALVE SHOP WITH INSTALLATION OF THE COMPLETED LH2 FEEDTHRU PLATE ASSY PERFORMED IN FINAL ASSEMBLY
AN INITIAL INVESTIGATION HAS SHOWN THAT SUBSEQUENT TO INSTALLATION OF THE FEEDTHROUGH PLATE ASSY ON THIS ET, THE CONNECTOR-RECEPTACLE WAS NOTED TO BE MISCLOCKED 180 DEGREES. DISCREPANCY REPORT (DR) D214546 DIRECTED THE CORRECTION OF THIS PROBLEM BY DISASSEMBLING THE RECEPTACLE-CONNECTOR TO PLATE JOINT, INSPECTING THE COMPONENTS FOR DAMAGE, RECLOCKING AND REASSEMBLING. TWO ATTEMPTS WERE NECESSARY BEFORE CORRECT CLOCKING WAS ACHIEVED. THE SAME SEAL (K-55L5-16L) WAS USED FOR ALL THREE ASSEMBLIES, ON INITIAL AND TWO DR DIRECTED ASSEMBLIES
TASK I. FAILURE INVESTIGATION
1. DISASSEMBLE THE RECEPTACLE-CONNECTOR TO FEEDTHROUGH PLATE JOINT AND INSPECT FOR DAMAGE WHICH WOULD HAVE CREATED THE LEAK CONDITION
   RESPONSIBILITY: D. O'NEAL/3741 -- D. WESTPHAL/3740
   COMPLETE: 3/11/94
   CLOSURE STATEMENT
   THE DISASSEMBLY AND INSPECTION OF THE PLATE, SEAL AND CONNECTOR SEALING SURFACES REVEALED A SUBTLE RIDGE (HIGH SPOT) RUNNING RADIALLY ON THE PLATE SEALING SURFACE (CHAMFERED AREA) IN THE LOCATION WHERE THE LEAK OCCURRED. WITNESS MARKS FROM THE SEAL ON THE CHAMFERED AREA AND WITNESS MARKS ON THE SEAL RESULTING FROM THE RIDGE INDICATE THAT NO CONTACT OCCURRED ON EITHER SIDE OF THE RIDGE, CREATING A LEAK PATH IN THAT AREA. THE RIDGE APPEARS TO BE A START/STOP POINT OF THE MACHINING OPERATION AND EXTENDS THROUGH THE FEEDTHROUGH BORE, MORE PRONOUNCED AND DISCERNIBLE INSIDE THE BORE ITSELF
*2.COMMODITY SHOP TO INSPECT CHAMFER AREA OF PLATE AND DETERMINE HEIGHT OF THE RIDGE
   RESPONSIBILITY: F. WILLIAMS/3724 - P. POWELL/3720
   COMPLETE: 3/11/94
   CLOSURE STATEMENT
   THE RIDGE HEIGHT RANGED IN HEIGHT FROM 0.0007 TO 0.0009 INCHES
   REFERENCE NCD N009560
TASK CLOSED
* CAUSE
  DEFECTIVE SEALING SURFACE OF FEEDTHROUGH PLATE, I.E. HIGH SPOT ON SEALING AREA PREVENTED PROPER CONFORMING OF SEAL TO SURFACE
* TASK II. CORRECTIVE ACTION
  PRODUCTION OPERATIONS AND QUALITY CONTROL PERSONNEL INVOLVED WITH THE ASSEMBLY OF THE FEEDTHROUGH PLATE ASSEMBLY HAVE BEEN MADE AWARE OF THE DEFECT ON THE SEALING SURFACE AND CAUTIONED TO BE AWARE OF THE SUBTLE DEFECTS OF THIS NATURE WHICH MAY CONTRIBUTE TO LEAKS. REFERENCE IOM 3670-94-ER-05
  NO OTHER CORRECTIVE ACTION IS NECESSARY. NO HISTORY EXISTS FOR THIS TYPE K-SEAL JOINT FAILURE. THIS TEST FAILURE IS ISOLATED, A DIRECT RESULT OF IMPROPER MACHINING AT THE SUPPLIER. NO SCAR HAS BEEN ISSUED, SUPPLIER (TOLO INC) NO LONGER ON CONTRACT
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
ET-71 PENDING REWORK AND RETEST OF JOINT ASSEMBLY
ALL OTHERS, NO ISSUE. PROBLEMS OF THIS NATURE ARE DETECTED DURING ACCEPTANCE TEST
NOTE: THIS IS ALSO THE DEFERRAL RATIONALE
* TASK IV. CAPS CLOSURE SUMMARY
  THE LEAK DETECTED DURING ACCEPTANCE TESTING OF THE LH2 FORWARD ELECTRICAL FEEDTHROUGH CONNECTOR OCCURRED AS A RESULT OF AN IMPROPERLY MACHINED FEEDTHROUGH PLATE SEALING SURFACE. THE MACHINING OPERATION CREATED A HIGH SPOT THAT RAN RADIALLY ACROSS

THE SEALING AREA, CREATING A LEAK PATH THAT COULD NOT BE ADEQUATELY
SEALED BY THE K_SEAL. THIS DEFECT WAS VERY SUBTLE AND NOT DETECTED
BY THE SUPPLIER OR MMMSS ASSEMBLY PERSONNEL. THIS ANOMALY IS AN
ISOLATED OCCURRENCE, DETECTABLE THROUGH TEST AND AFFECTS NO OTHER
ET. ASSEMBLY PERSONNEL ARE AWARE THIS TYPE OF DEFECT AND SENSITIZED
TO THE POTENTIAL SUBTLENESS OF THE CONDITION. NO OTHER CORRECTIVE
ACTION IS NECESSARY
TASK CLOSED
THIS CAPS IS CLOSED. NO FURTHER ACTION REQUIRED

MSFC Response/Concurrence

3/8/94 - DEFERRAL RATIONALE:
BASED ON THE INFORMATION IN "TASK III. CLEARANCE OF EFFECTIVITIES"
(ABOVE), THIS PROBLEM HAS BEEN DEFERRED FOR THE NEXT SIX (6) MONTHS PER
NSTS 08126, REVISION E, PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE
PROBLEM CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL
TESTS (I.E., FAILURE MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
APPROVED: _PARKER V. COUNTS (SIGNED)_____ DATE: ___3/21/94_____
PARKER V. COUNTS
ET PROJECT MANAGER

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15852	--	E-158	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
55L5-16L	K-SEAL	ET-71

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1	MA - MFG-ASY	MW - INT LEAK
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
3.11.6.1	1	B	5
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A15945	**In-Flight Anomaly Number** --	**Contractor Report Number** P-071	**JSC#** --	**KSC#** --
Problem Title LO2 FEEDLINE JOINT LEAK				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ET COMPLETE	**PART#** 80901006000-059	**SER/LOT#** ET-73	**MANUFACTURER** MAF
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MV - EXT LEAK	**Cause** MAP - MFG-ASY-INST
System PROPULSION	**Defect** --	**Material** P - SEAL	**Work Contact** D. O'NEAL	**Fail Date** 04/14/1994
Received at MSFC 04/18/1994	**Date Isolated** 04/14/1994	**FMEA Reference** 2.1.12.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MV - EXT LEAK		**Time Cycle** --
Effectivity Text ET-73				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date 05/25/1994	**Contractor Req Defer Until Date** 05/26/1994	**LVL 3 Close** --	**Remark / Action** 05/26/1994	
Investigation / Resolution Summary				
Last MSFC Update 06/16/1994	**CN RSLV SBMT** 05/31/1994	**Defer Date** 05/19/1994	**Add Date** 04/18/1994	**R/C Codes** 2 - MFG -- --
Assignee				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** --	**Project MGR** P. COUNTS

Approval				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** A. ADAMS	**Project** --	**Project MGR** C. SUMNER
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 06/16/1994	**Status** C - CLOSED	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** NCD N003330			
Related Document Title NON CONFORMANCE DOCUMENT				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				

Problem Description

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THE LO2 FEEDLINE JOINT 8 LEAKED AT 40 TO 45 SCCM AND EXCEEDED THE
ALLOWABLE LEAKAGE RATE OF 2.7 SCCM PER TP-8C101-FA
CRITICALITY: FMEA PARA. 2.1.12.1/2.1.13.1/2.1.14.1 REFLECTS SEAL/JOINT
LEAKAGE AS A FAILURE MODE WHICH MAY RESULT IN LOSS OF MISSION
REV."A", REVISES TASKS I, II, III AND IV (SEE ASTERISKS) AND CLOSES
CAPS
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Contractor Investigation/Resolution

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GENERAL:
DURING THE DUAL SEAL CAVITY LEAK CHECK OF JOINT 8 (LO2 AFT ELBOW TO
LO2 FLEXIBLE SECTION), A 40 TO 45 SCCM LEAK WAS DETECTED. THE
ALLOWABLE LEAKAGE IS 2.7 SCCM MAXIMUM AT 50.0 +/- 5.0 PSIG GHE, AS
TESTED PER TP-8C101-FA
TROUBLE SHOOTING STEPS DETECTED NO TEST EQUIPMENT MALFUNCTION AND
HAVE INDICATED A PRIMARY SEAL LEAK EXISTS. UPON JOINT DISASSEMBLY
NO DETECTABLE DAMAGE WAS FOUND ON EITHER THE PRIMARY (RACO) OR THE
SECONDARY (CREAVY) SEALS
REFERENCE: - LO2 AFT ELBOW (SUBSTRATE), 80921011911, S/N 0000143
           - LO2 AFT FLEXIBLE SECTION (SUBSTRATE), PD4800175-090
             S/N0000620
TASK I. PROBLEM/FAILURE INVESTIGATION
```

A. INSPECT FLANGE/SEAL CONFIGURATIONS FOR FACTORS WHICH COULD HAVE CONTRIBUTED TO THE LEAKAGE
RESPONSIBILITY: D. O'NEAL/3741 -- D. WESTPHAL/3740
C. CAMPBELL/4120 - R. PONTIFF/4100
COMPLETE: 04/20/94
* CLOSURE STATEMENT
AN INSPECTION OF THE LO2 AFT ELBOW REVEALED A ROUGH ETCHED SURFACE EXISTING ON THE PRIMARY AND SECONDARY SEALING SURFACE AREAS WITHIN THE SEAL GROOVES. THE SURFACE CONDITION APPEARED TO HAVE RESULTED FROM ETCHING SUBSEQUENT TO FINAL FINISHING OF THE SEALING SURFACES THE SURFACE CONDITION NO LONGER MET THE REQUIRED SURFACE FINISH REQUIREMENTS, I.E. THE FINISH WAS UNIFORMLY ETCHED WITH NO CIRCULAR LAY. NO ENGINEERING DRAWING VIOLATIONS WERE FOUND WITH THE LO2 AFT FLEX SECTION FLANGE. REFERENCE NCD N003330

B. REVIEW DATA PACKS AND NCDRS FOR DISCREPANCIES OR ISSUES WHICH COULD HAVE CONTRIBUTED TO THE LEAKAGE
RESPONSIBILITY: D. O'NEAL/3741 - D. WESTPHAL/3740
COMPLETE: 04/18/94
* CLOSURE STATEMENT
A REVIEW OF STADCO (ELBOW SUPPLIER) PROCESS REQUIREMENTS AND MARS WRITTEN AGAINST THIS ELBOW REVEALED THAT THE SEALING SURFACES WERE ETCHED TWICE FOR PENETRANT INSPECTION ACTIVITIES SUBSEQUENT TO FINAL FINISHING OF THE SEALING SURFACES. THE FIRST ETCH WAS PERFORMED DURING NORMAL PROCESSING AND THE SECOND DURING WORK ACTIVITY DIRECTED BY MARS T-81118 WHICH ADDRESSED A QUESTION OF EXCESS POROSITY THE LINE (ULTIMATELY DISPOSITIONED "NO DEFECT")
A TOTAL OF SIX LINES WITH IDENTICAL CONCERNS WERE ADDRESSED BY THIS MARS; SERIAL NUMBERS 0000143 THROUGH 0000148

*C. REVIEW/EVALUATE STADCO'S PROCESSING DATA AND PRACTICES FOR COMPLIANCE TO ENGINEERING REQUIREMENTS
RESPONSIBILITY: D. O'NEAL/3741 - D. WESTPHAL/3740
COMPLETE 5/25/94
CLOSURE STATEMENT
A REVIEW OF STADCO PLANNING SHOWS THE PENETRANT INSPECTION PROCESS IS PERFORMED AFTER MACHINING OF THE SEALING SURFACES WITH A LATER REQUIREMENT TO HAND LAP CRITICAL SEALING SURFACES, IF NECESSARY, TO ENSURE ENGINEERING DRAWING REQUIREMENTS ARE MET

*D. INSPECT THE FLANGE SEALING SURFACES OF ALL NON-INSTALLED LO2 AFT ELBOWS CURRENTLY AT MAF AND DETERMINE IF FINISH REQUIREMENTS HAVE BEEN MET. IF FINISH DISCREPANCIES EXIST, DOCUMENT ON THE APPROPRIATE NON-CONFORMANCE DOCUMENT
RESPONSIBILITY: D. O'NEAL/3741 - D. WESTPHAL/3740
COMPLETE 5/25/94
CLOSURE STATEMENT
NCDS WERE INITIATED TO DIRECT THE INSPECTION OF ALL NON-INSTALLED LO2 ELBOWS AT MAF. REFERENCE THE FOLLOWING NCDS:
NCD N003333 - TPS'D ELBOW STAGED FOR ET-74 INSTALLATION; ETCHED SEALING SURFACES FOUND. SEALING SURFACES OF BOTH FLANGES WERE LAPPED; THE GROOVED END WAS CONFIDENCE LEAK TESTED. S/N 0000144
NCD N009047 - EPOXY PRIMED ELBOW STAGED FOR INTERNAL CLEANING; ETCHED SEALING SURFACES FOUND. SEALING SURFACES OF BOTH FLANGES WERE LAPPED; THE GROOVED END WAS CONFIDENCE LEAK TESTED. (S/N 0000146)
NCD N009045 - SIX ELBOWS AT SUBSTRATE LEVEL. THREE WERE PART OF THE SIX IDENTIFIED IN SEALING SURFACES (S/N 0000145, 0000147, 0000148). THE OTHER THREE HAVE BEEN VERIFIED TO HAVE BEEN FINAL FINISHED AFTER ETCHING

*E. DETERMINE IF OTHER STADCO SUPPLIED ET HARDWARE MAY BE AFFECTED BY SIMILAR PROCESSING
RESPONSIBILITY: J. MAJOR
COMPLETE 4/25/94

CLOSURE STATEMENT
THE 80921011911-001 LO2 ELBOW IS THE ONLY ET HARDWARE SUPPLIED BY STADCO

*F.IDENTIFY ALL PARTS WITH CRITICAL SEALING SURFACES. DETERMINE IF A GENERIC ISSUE MAY EXIST RELATIVE TO OTHER SUPPLIERS ETCHING CRITICAL SEALING SURFACES AND NOT FINAL FINISHING AFTER ETCHING
RESPONSIBILITY: J. MAJOR
COMPLETE 5/10/94
CLOSURE STATEMENT
THE MANUFACTURING PROCESSING OF ALL PARTS WITH CRITICAL SURFACES (SEALING/FINE FINISH) WAS REVIEWED FOR COMPLIANCE TO ENGINEERING REQUIREMENTS. STADCO AND TOLO, INC. WERE THE ONLY SUPPLIERS FOUND TO HAVE REQUIREMENT VIOLATIONS, THE SEALING SURFACES OF THE LO2 ELBOW MANUFACTURED BY STADCO AND TWO PARTS MANUFACTURED BY TOLO, INC (LH2 ULLAGE PLATES, 80931003717-010 AND LH2 DIFFUSER PLATES, 80921021047-010) WERE NOT FINAL FINISHED AFTER ETCHING
NCDS HAVE BEEN WRITTEN TO ADDRESS ALL NON-INSTALLED TOLO PLATES AND DISPOSITIONED TO CONFIDENCE LEAK TEST PRIOR TO INSTALLATION
ALL INSTALLED PLATES HAVE BEEN/WILL BE LEAK TESTED AS PART OF NORMAL PROCESSING TO PROVE THEIR SEALING CAPABILITY. TOLO IS NO LONGER ON CONTRACT. REFERENCE CCMAIL FROM PROCUREMENT QUALITY, DATED 5/10/94
CAUSE
LO2 AFT ELBOW SEALING SURFACES NOT FINAL FINISHED TO ACHIEVE SURFACE ROUGHNESS REQUIREMENT AFTER ETCHING (PENETRANT INSPECTED)

* TASK II. CORRECTIVE ACTION
PROCUREMENT QUALITY/MATERIEL OPERATIONS TO ENSURE REVISIONS TO STADCO PLANNING ARE IMPLEMENTED REQUIRING PROPER SEQUENCING OF PENETRANT INSPECTION (ETCHING) AND FINAL FINISHING OF SEALING SURFACES
RESPONSIBILITY: J. MAJOR/3760
N. JAMES/3880
COMPLETE 5/26/94
CLOSURE STATEMENT
THE STADCO PLANNING HAS BEEN REVISED TO ABSOLUTELY REQUIRE LAPPING (FINAL FINISHING) OF THE SEALING SURFACES AFTER PENETRANT INSPECTION TO ASSURE FINISH REQUIREMENTS ARE MET. REFERENCE STADCO "MANUFACTURING OUTLINE" 80921011911, OPER.NO.10.1

* TASK III. CLEARANCE OF EFFECTIVITIES
ET-73 - LAPPING OF THE ELBOW PRIMARY AND SECONDARY SEALING SURFACES, COUPLED WITH LIGHTLY LAPPING THE FLEX SECTION FLANGE'S CADMIUM PLATING, RESULTED IN AN ACCEPTABLE INSTALLATION
ALL OTHERS, NO ISSUE. PROBLEMS OF THIS NATURE ARE DETECTED DURING ACCEPTANCE TEST
NOTE: THIS IS ALSO DEFERRAL RATIONALE

* TASK IV. CAPS CLOSURE SUMMARY
THE LEAK AT THE LO2 AFT ELBOW TO LO2 AFT FLEX SECTION JOINT RESULTED FROM AN IMPROPER SURFACE CONDITION EXISTING ON THE ELBOW'S PRIMARY AND SECONDARY SEALING SURFACES. A MANUFACTURING DATA REVIEW REVEALED THAT THIS LINE HAD BEEN ETCHED FOR PENETRANT INSPECTION TWICE SUBSEQUENT TO FINISHING THE SEALING SURFACES CREATING A UNIFORM, ROUGH ETCHED SURFACE, ABSENT OF ANY CIRCULAR MACHINING LAY AS REQUIRED BY ENGINEERING DRAWING. RELAPPING THE SEALING SURFACES TO DRAWING REQUIREMENTS RESULTED IN AN ACCEPTABLE INSTALLATION
FIVE OTHER SIMILARLY AFFECTED LO2 ELBOWS HAVE BEEN IDENTIFIED AND ARE BEING REWORKED PRIOR TO INSTALLATION. RELATIVE TO CORRECTIVE ACTION, THE MANUFACTURING PLANNING AT THE SUPPLIER (STADCO) HAS BEEN REVISED TO REQUIRE, WITH NO EXCEPTION, RELAPPING AFTER PENETRANT INSPECTION (ETCHING)
IN ADDITION TO THE LO2 ELBOW, A PROCESS REVIEW OF ALL SUPPLIERS FOR PARTS WITH SEALING SURFACES/FINE FINISHES FOUND THAT TOLO, INC

SUPPLIED AN LH2 ULLAGE PLATE AND AN LH2 DIFFUSER PLATE WITH ETCHED SEALING SURFACES. ALL NON-INSTALLED PLATES HAVE BEEN IDENTIFIED AND ARE BEING LEAK TESTED PRIOR TO INSTALLATION. TOLO IS NO LONGER ON CONTRACT. ALL OTHER SUPPLIERS PROCESS PER ENGINEERING REQUIREMENTS NO INSTALLED LO2 AFT ELBOWS, LH2 ULLAGE PLATES OR LH2 DIFFUSER PLATES ARE OF CONCERN AS PROBLEMS OF THIS NATURE ARE DETECTED DURING ACCEPTANCE TESTING FOR LEAKAGE

MSFC Response/Concurrence

4/18/94 DEFERRAL RATIONALE:
BASED ON THE RATIONALE LISTED IN "TASK III FLEET CLEARANCE" (ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX MONTHS PER NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126 REV. E PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL TESTS (I.E., FAILURE MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
THE DEFERRAL STATUS HAS BEEN APPROVED BY THE ET DEPUTY PROJECT MANAGER, MR. CRAIG E. SUMNER
SIGNED: _____CRAIG E. SUMNER (SIGNED)_ DATE:___5/19/94_____

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A15945	--	P-071	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
80921011911-XXX	L02 FEEDLINE	--

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1	MAP - MFG-ASY-INST	MV - EXT LEAK

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
2.1.13.1	1	B	1
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES	
APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A16045	**In-Flight Anomaly Number** --	**Contractor Report Number** P-073	**JSC#** --	**KSC#** --
Problem Title LH2 FEEDLINE FAILED ATP FOR VACUUM LOSS				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** LH2 EXTERNAL FEEDLIN	**PART#** PD4800184-039	**SER/LOT#** 0000160	**MANUFACTURER** ARROWHEAD
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MU - MECH TOLRNCE	**Cause** U - UNKNOWN
System PROPULSION	**Defect** DC - BROKEN	**Material** N - HOLE	**Work Contact** D. O'NEAL	**Fail Date** 06/16/1994
Received at MSFC 06/21/1994	**Date Isolated** 06/16/1994	**FMEA Reference** 2.5.8.2	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location ARROWHEAD		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** 06/22/1994	**LVL 3 Close** --	**Remark / Action** 07/05/1994	
Investigation / Resolution Summary				
Last MSFC Update 02/09/1995	**CN RSLV SBMT** 07/06/1994	**Defer Date** 06/22/1994	**Add Date** 06/21/1994	**R/C Codes** 0 - EXPL 4 - TEST --
Assignee				
Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**

W. PATTERSON	M. PESSIN	M. SMILES	--	P. COUNTS

Approval

Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**
M. MOORE	M. PESSIN	M. SMILES	--	C. SUMNER
PAC Assignee	**PAC Review Complete**	**MSFC Closure Date**	**Status**	**F/A Completion**
B. HURST	BH	07/26/1994	C - CLOSED	07/05/1994
Problem Type	**SEV**	**Program Name**	**REVL**	**OPRINC**
--	--	--	--	--

FUNC MOD	**Software Effectivity**	**Software Fail CD**	**SUBTYPE**	**Software Closure CD**
--	-- -- -- -- --	--	--	--

RES PERSON L2	**Approval Signature L3**
--	--
Related Document Type	**Related Document ID**
--	N8812

Related Document Title
FAILURE ANALYSIS REPORT

Related Document Type	**Related Document ID**
--	--

Related Document Title
--

Related Document Type	**Related Document ID**
--	--

Related Document Title
--

Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

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THE LH2 FEEDLINE WAS UNDERGOING SUPPLIER ATP AT ARROWHEAD. THE VACUUM
JACKET WAS BEING EVACUATED PRIOR TO PERFORMING THE ARGON BACKFILL
THE REQUIRED VACUUM COULD NOT BE ACHIEVED. A GH2 LEAK CHECK WAS
PERFORMED AND DETERMINED THAT THE BURST DISK AREA WAS LEAKING
CRITICALITY: THE LH2 EXTERNAL FEEDLINE IS CRIT. 1 FMEA ITEM CODE
2.5.8.2, REFLECTS "LOSS OF VACUUM" AS A FAILURE MODE WHICH MAY RESULT
IN LOSS OF MISSION
REVISION "B" - REVISES GENERAL, TASKS I.D.,II.,IV AND CLOSES CAPS
SEE ASTERISKS
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Contractor Investigation/Resolution

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* GENERAL:
  THE EXTERNAL FEEDLINE IS A 42 INCH LONG SECTION INCORPORATING AN
  ARTICULATED BELLOWS ASSEMBLY WITH A "CRYO-PUMPED ARGON INSULATION
  JACKET" WHICH TRANSPORTS LH2 FROM THE UPPER LH2 AFT DOME TO THE
  ET/ORBITER DISCONNECT. WHEN EXPOSED TO LH2 THE ARGON WITHIN THE
  JACKET FREEZES, CREATING A VACUUM WITHIN THE JACKET WHICH INSULATES
  THE OUTER SURFACE OF THE LINE AND BELLOWS AND PREVENTS ICE
  FORMATION. THE JACKET ANNULUS IS PROTECTED AGAINST EXCESSIVE
  POSITIVE PRESSURE IN THE EVENT OF LH2 LEAKAGE BY A RUPTURE DISC
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ASSEMBLY INSTALLED IN THE OUTER WALL OF THE JACKET
THE RUPTURE DISC ASSEMBLY CONSISTS OF A PERFORATED HOLDER (347 CRES) TO WHICH IS WELDED A 0.003 INCH THICK DIAPHRAGM OF INCONEL 625, PROTECTED BY A PERFORATED SHIELD OF 321 CRES. THE DIAPHRAGM IS MANUFACTURED BY FORMING TO SHAPE AND COINING (SINGLE INDENT ACROSS DIAMETER) TO SUIT A 35 +/- 15 PSIG BURST REQUIREMENT. TO MEET THIS REQUIREMENT, BEFORE BEGINNING A PRODUCTION RUN OF DIAPHRAGM MANUFACTURE, FIFTEEN CONSECUTIVE DIAPHRAGMS ARE DESTRUCTIVELY TESTED (BURST) TO ASSURE THE MANUFACTURING SETUP IS CORRECT. ONCE THE PROPER SETUP IS DEMONSTRATED, THE PRODUCTION BEGINS FOLLOWED BY A HELIUM MASS SPECTROMETER LEAK TEST OF ALL DIAPHRAGMS MANUFACTURED. AFTER WELDING TO THE HOLDER, EACH DIAPHRAGM/HOLDER ASSEMBLY IS TESTED TO IMPLOSION REQUIREMENTS BY APPLYING 18.1 PSIG NEGATIVE PRESSURE (MINIMUM REQUIRED BY DESIGN), FOLLOWED BY 10 CYCLES OF LESSER NEGATIVE PRESSURE, FOLLOWED BY A SECOND HELIUM LEAK TEST. FIFTEEN CONSECUTIVE DIAPHRAGM/HOLDER ASSEMBLIES ARE THEN DESTRUCTIVELY TESTED (BURST) PRIOR TO THIS PRODUCTION RUN BEGINNING, DURING WHICH EVERY FOURTH ASSEMBLY IS DESTRUCTIVELY TESTED (BURST) TO ENSURE THE OVERALL PROCESS REMAINS IN CONTROL. THE LAST STEP IN THE MANUFACTURING OPERATION IS TACK WELDING THE SHIELD IN PLACE
THE SUPPLIER OF THE RUPTURE DISC ASSEMBLY IS PRESSURE SPECIALTIES, FORMERLY STARLINE ENGINEERING
UPON RECEIPT AT ARROWHEAD PRODUCTS, EACH RUPTURE DISC ASSEMBLY IS LEAK TESTED PRIOR TO ACCEPTANCE FOR STOCK AND SEVERAL TIMES AT VARIOUS FEEDLINE MANUFACTURING STAGES PRIOR TO ATP. DURING ATP (ATP 14184-339) THE DISC ASSEMBLY IS TESTED PER THE VACUUM ANNULUS LEAK CHECK (PARA. 5.6) PRIOR TO THE LINE BEING BAKED AT 400 DEGREES F IN PREPARATION FOR THE ARGON BACKFILL. DURING THE ANNULUS LEAK CHECK AND THE 400 DEGREE F BAKEOUT THE ANNULUS IS SUBJECTED TO A 25 MICRON HG OR LESS VACUUM. BY THE END OF THE PRODUCTION AND TEST CYCLE, THE RUPTURE DISC HAS SEEN A MINIMUM OF 8 VACUUM CYCLES, 5 OF WHICH ARE MASS SPEC LEAK TESTS. IN NO OPERATION WAS A LEAK INDICATED. IT WAS NOT UNTIL SUBSEQUENT TO THE BAKEOUT, DURING EVACUATION OF THE ANNULUS IN PREPARATION FOR THE ACTUAL ARGON BACKFILL, THAT THE LEAK WAS INDICATED
THE MAXIMUM ALLOWABLE LEAK RATE IS 1X10-6 SCC/SEC
THE DISCREPANT RUPTURE DISC IS ONE OF THE LAST THREE OF A LOT OF 62 DELIVERED TO AHP IN 1985. TWO IDENTICAL RUPTURE DISC ASSEMBLIES ARE USED ON THE LH2 RECIRCULATION LINE

TASK I. PROBLEM/FAILURE INVESTIGATION

A. REVIEW PLANNING TO DETERMINE BUILD HISTORY OF BURST DISK AND LINE. LOOK FOR ANY NONSTANDARD OCCURRENCES
RESPONSIBILITY: J. MAJOR/3760
COMPLETE: 6/21/94
CLOSURE STATEMENT
THE REVIEW SHOWED NO ABNORMAL OCCURRENCES IN MANUFACTURE UP TO THE PREPARATION FOR BACKFILL WHERE THE LEAK TEST FAILURE WAS DETECTED

B. HAVE BURST DISK SUBTIER SUPPLIER REVIEW FAILURE HISTORY FOR PAST OCCURRENCES
RESPONSIBILITY: J. MAJOR/3760
COMPLETE: 6/23/94
CLOSURE STATEMENT
A FAILURE HISTORY REVIEW BY THE SUPPLIER SHOWS NO PAST OCCURRENCES OF ANOMALIES ON ACCEPTED PRODUCTION HARDWARE,I.E HARDWARE MANUFACTURED DURING THEIR PRODUCTION RUNS, NOTE THAT PRESSURE SPECIALTIES DESTRUCTIVELY TESTS (BURST) FIFTEEN CONSECUTIVE PARTS PRIOR TO BEGINNING A PRODUCTION RUN AND, THEREAFTER, EVERY FOURTH PART TO ENSURE THE PROCESS REMAINS IN CONTROL

C. DEVELOP FAILURE ANALYSIS PLAN TO ISOLATE EXACT LOCATION OF LEAKAGE

RESPONSIBILITY: J. MAJOR/3760 -- ARROWHEAD PRODUCTS
COMPLETE: 6/21/94
CLOSURE STATEMENT
FAILURE ANALYSIS PLAN SUBMITTED AND APPROVED. REFERENCE NCD N-8812 AND FAILURE ANALYSIS REPORT N-8812

* D. MMMSS AND AHP PERSONNEL TO PERFORM FAILURE ANALYSIS ON FEEDLINE AS SPECIFIED ON F/A PLAN. DETERMINE LOCATION OF LEAKAGE AND FAILURE MODE FOR LEAKAGE
RESPONSIBILITY: J. ADAMS/3741
J. SEIFERT/41
AHP
COMPLETE: 7/05/94
CLOSURE STATEMENT
THE LEAK HAS BEEN CONFIRMED TO ORIGINATE FROM AN APPROXIMATE 0.070 INCH LONG CRACK LOCATED IN THE BOTTOM OF THE STAMPED DEPRESSION RUNNING ACROSS THE DISC DIAPHRAGM. THIS CONFIRMATION WAS MADE BY LEAK CHECK AND BY VISUAL (OPTICAL MICROSCOPY) EXAMINATION.SCANNING ELECTRON MICROSCOPY (SEM) FURTHER CONFIRMED THE CRACK AND FOUND IT "CLOSED", THAT IS THE FACES STILL TOUCHING. CROSS-SECTIONAL EXAMINATION DETERMINED THE THICKNESS ON THE FLAT FACE OF THE DIAPHRAGM AT 0.0028 INCHES AND THE METAL A THE BOTTOM OF THE STAMPED DEPRESSION AT 0.0004 INCHES. ADDITIONAL ANALYSIS CONFIRMED THE DIAPHRAGM MATERIAL TO BE INCONEL 625
A REVIEW OF DOCUMENTATION FOR BOTH PRESSURE SPECIALTIES AND ARROWHEAD PRODUCTS FOUND ALL MATERIAL CERTIFICATIONS, TEST RECORDS, PRODUCTION TRAVELERS, ETC., IN ORDER AND WITHOUT ANY INDICATION AS TO THE CAUSE OF THE FAILURE. THERE WERE NO REWORKS OR REPAIRS TO THE PART AT ANY STAGE OF ASSEMBLY AT EITHER COMPANY. REFERENCE FAILURE ANALYSIS REPORT N008812

* E.DETERMINE IF ANY FAILURE HISTORY EXISTS RELATIVE TO VACUUM JACKET LEAKAGE OCCURRING AT KSC
RESPONSIBILITY: D. O'NEAL/3741
COMPLETE: 7/05/94
CLOSURE STATEMENT
NO LEAKAGE INDICATION HAS OCCURRED. ARGON LEAKAGE WOULD BE INDICATED BY INSULATION LOSS RESULTING IN ICE FORMATION ON THE FEEDLINE DURING LH2 FILL
CAUSE
APPROXIMATE 0.070 INCH LONG CRACK LOCATED IN THE STAMPED DEPRESSION OF THE RUPTURE DISC DIAPHRAGM
TASK II. CORRECTIVE ACTION
A. NO SPECIFIC CORRECTIVE ACTION IS NECESSARY, THIS ANOMALY IS AN ISOLATED INCIDENT. ACCEPTABILITY OF THE RUPTURE DISC ASSEMBLY IS DETERMINED BY DEMONSTRATION (DESTRUCTIVE TEST OF SAMPLE OF PRODUCTION PARTS) AND LEAK TEST DURING MANUFACTURING OF DETAIL AND LH2 FEEDLINE ASSEMBLY
B. AS AN ENHANCEMENT TO ARROWHEAD'S ATP, PROCESS SEQUENCING HAS BEEN CHANGED TO PERFORM THE ANNULUS VACUUM LEAK CHECK SUBSEQUENT TO THE 400 DEGREE F BAKEOUT PERFORMED AS PART OF THE ARGON BACKFILL PROCEDURE. REFERENCE ATP 14184-339, DAS APPROVAL BBM 040
TASK III. FLEET CLEARANCE
NO CONCERN EXISTS FOR ANY COMPLETED LH2 FEEDLINE. ATP PROCESS CONSISTING OF BOTH LEAK TESTS AND VACUUM REQUIREMENTS PROVIDE A POSITIVE FILTER FOR LEAK DETECTION. THIS ANOMALY IS AN ISOLATED INCIDENT
NOTE: THIS IS ALSO DEFERRAL RATIONALE
TASK IV. CAPS CLOSURE SUMMARY
THE LEAK THAT OCCURRED ON THE LH2 FEEDLINE VACUUM JACKET ANNULUS RESULTED FROM A 0.070 INCH LONG CRACK LOCATED IN THE BOTTOM OF THE SINGLE STAMPED DEPRESSION RUNNING ACROSS THE

DIAMETER OF THE RUPTURE DISC DIAPHRAGM. THE LEAK WAS FOUND
DURING THE EVACUATION ATTEMPT PERFORMED FOR THE ARGON BACKFILL
THE LEAKAGE EXCEEDED THE REQUIREMENT OF 1X10-6 SCC/SEC OF
HELIUM, MAXIMUM; THE LEAK WAS ESTIMATED TO EXCEED 1X10-3
SCC/SEC
FAILURE ANALYSIS PERFORMED ON THE RUPTURE DISC ASSEMBLY FAILED
TO DETERMINE THE ROOT CAUSE OF THE FAILURE. ALL SUPPLIER
MATERIAL CERTIFICATIONS, TEST RECORDS ETC. AS WELL AS MATERIAL
ANALYSIS PERFORMED AT MAF FOUND ALL IN ORDER AND TYPICAL TO
APPROVED PROCESSING. GIVEN THAT THE ACCEPTABILITY OF THE DISC
MANUFACTURE IS DETERMINED BY DEMONSTRATION (DESTRUCTIVE TEST
OF A SAMPLE OF PRODUCTION PARTS TO PROVE PROCESS CONTROL),
FOLLOWED BY LEAK TESTS PERFORMED AT BOTH PRESSURE SPECIALTIES
AND AHP AND THAT NO PRIOR INDICATIONS OF LEAKAGE HAVE OCCURRED
AT THE SUPPLIERS, MAF OR KSC, THIS INCIDENT IS DETERMINED TO
BE ISOLATED. NO CORRECTIVE ACTION IS NECESSARY
ONE ENHANCEMENT TO AHP'S ATP PROCESS WAS IMPLEMENTED. THE
VACUUM ANNULUS LEAK TEST PREVIOUSLY PERFORMED PRIOR TO THE
ARGON BACKFILL OPERATION HAS NOW BEEN MOVED TO AFTER THE
BACKFILL'S 400 DEGREE F BAKEOUT

MSFC Response/Concurrence

6/22/94 - deferral rationale:
based on the rationale listed in "task III. Fleet clearance" (above),
this report has been deferred for the next six months per nsts 07700,
volume xi, paragraph 3.4.1, item c and nsts 08126 rev. e paragraph
3.3.10.1, item d which states "the problem condition is clearly screened
by preflight checkout or special test."
deferral approval:_____parker v. counts__(signed) Date: 6/22/94
et project manager

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A16045	--	P-073	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
PD4800184-039	LH2 FEEDLINE	0000160

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	1	U - UNKNOWN	MU - MECH TOLRNCE

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
2.5.8	2	A	N/A
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A16199	**In-Flight Anomaly Number** --	**Contractor Report Number** P-074	**JSC#** --	**KSC#** --
Problem Title LH2 FEEDLINE JOINT 1 FAILED LEAK CHECK AT MAF				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ET COMPLETE	**PART#** 80901006000-059	**SER/LOT#** ET-76	**MANUFACTURER** MAF
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MV - EXT LEAK	**Cause** U - UNKNOWN
System PROPULSION	**Defect** DB - BENT	**Material** P - SEAL	**Work Contact** D. O'NEAL	**Fail Date** 09/06/1994
Received at MSFC 09/07/1994	**Date Isolated** 09/01/1994	**FMEA Reference** 2.5.7.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MV - EXT LEAK		**Time Cycle** --
Effectivity Text ET-76				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** 09/23/1994	**LVL 3 Close** --	**Remark / Action** 09/23/1994	
Investigation / Resolution Summary				
Last MSFC Update 10/06/1994	**CN RSLV SBMT** 09/23/1994	**Defer Date** 09/07/1994	**Add Date** 09/07/1994	**R/C Codes** 0 - EXPL 5 - TRNG --
Assignee				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** N/A	**Project MGR** P. COUNTS

Approval				
Design M. MOORE	**Chief Engineer** M. PESSIN	**S & MA** A. ADAMS	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 10/04/1994	**Status** E - CLOSED-E	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
--	-- -- -- -- --	--	--	--

RES PERSON L2	Approval Signature L3
--	--

Related Document Type	Related Document ID
--	NCD N002803

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

THE LH2 FEEDLINE AT JOINT 1 LEAKED AT 27 SCCM AND EXCEEDED THE
ALLOWABLE LEAK RATE OF 2.7 SCCM PER TP-8C101-FA
CRITICALITY: FMEA PARA.2.5.7.1 REFLECTS SEAL LEAKAGE AS A FAILURE MODE
WHICH MAY RESULT IN LOSS OF MISSION
REVISION "A": REVISES TASKS I, II, III AND IV AND CLOSES CAPS. SEE
ASTERISKS

Contractor Investigation/Resolution

GENERAL:
DURING THE DUAL SEAL CAVITY LEAK CHECK OF JOINT 1 (LH2 EXTERNAL
FEEDLINE TO LH2 TANK), A 27 SCCM LEAK WAS DETECTED. THE ALLOWABLE
LEAKAGE IS 2.7 SCCM MAXIMUM AT 50.0+/- 5.0 PSIG GHE, AS TESTED PER
TP-8C101-FA. THIS JOINT USES RACO (PRIMARY) AND CREAVY (SECONDARY)
SEALS, THE SEAL RETAINING GROOVES CUT INTO THE LH2 FEEDLINE FLANGE
THE FLANGE FOR THE LH2 TANK IS FLAT. THE FLANGE ORIENTATION DURING
ASSEMBLY IS HORIZONTAL WITH THE LH2 FEEDLINE LOWERED ONTO THE TANK
FLANGE
TROUBLE SHOOTING STEPS DETECTED NO TEST EQUIPMENT MALFUNCTION AND
NO INDICATION OF SECONDARY SEAL LEAKAGE WAS FOUND
THE LH2 EXTERNAL FEEDLINE (SUBSTRATE) WAS IDENTIFIED AS A PD4800184
-039, SERIAL NUMBER 0000159; MANUFACTURED BY ARROWHEAD PRODUCTS

THE RACO SEAL WAS MANUFACTURED BY FLUOROCARBON AND IS IDENTIFIED AS
A 55L2-4 SEAL
* TASK I. PROBLEM/FAILURE INVESTIGATION
THE FAILURE AND THE ASSOCIATED CAUSES ARE BEING INVESTIGATED
RESPONSIBILITY: D. O'NEAL/3741 - D.P. WESTPHAL/3740
COMPLETE 9/22/94
CLOSURE STATEMENT
WITH NO SECONDARY SEAL LEAKAGE INDICATED, THE JOINT WAS
DISASSEMBLED FOR INSPECTION OF BOTH THE TANK AND FEEDLINE
FLANGES AND RACO AND CREAVY SEALS. NO PROBLEMS WERE FOUND
WITH EITHER FLANGE OR WITH THE CREAVY SEAL. TWO DISCONTINUITIES
ACROSS THE PRIMARY SEAL SURFACE WERE FOUND ON THE RACO SEAL. THESE
DISCONTINUITIES WERE ON ONE SIDE OF THE SEAL APPROXIMATELY
90 DEGREES APART AND WERE MOST READILY DETECTED BY FEEL RATHER THAN
BY VISUAL INSPECTION. UNDER MAGNIFICATION ONE AREA WAS NOTED TO BE
A DEPRESSION APPROXIMATELY 0.09 INCHES IN LENGTH RUNNING CIRCUM-
FERENTIALLY ALONG THE PRIMARY SEAL LIP. WITNESS MARKS WERE ALSO
PRESENT ON THE OUTER SEAL AREA IN THIS LOCATION. NO VISUAL DEFECT
COULD BE SEEN IN THE AREA OF THE OTHER DISCONTINUITY
THESE SEALS ARE RECEIVED IN A CLEANED CONDITION AND INSPECTED FOR
OBVIOUS DAMAGE TO THE PACKAGING WITH DETAILED INSPECTIONS PERFORMED
AT THE POINT OF INSTALLATION. NO DAMAGE WAS DETECTED PRIOR TO
INSTALLATION, BUT IT SHOULD ALSO BE NOTED THAT NO CONCERNS WERE
SEEN DURING INSTALLATION THAT WOULD LEAD TO IDENTIFYING THE
INSTALLATION AS BEING THE POINT OF DAMAGE. THE ACTUAL CAUSE OR
POINT OF DAMAGE COULD NOT BE DETERMINED
CAUSE
DAMAGE TO THE PRIMARY SEAL
TASK II. CORRECTIVE ACTION
* MEETINGS WERE HELD WITH THE APPROPRIATE INSTALLATION PERSONNEL
WITH THE ACTUAL DISCREPANT SEAL PRESENTED FOR "HANDS-ON"
EDUCATION RELATIVE TO THE SUBTLE DEFECT
* NO FURTHER CORRECTIVE ACTION REQUIRED. ACTUAL LOCATION WHERE
DAMAGE CREATED COULD NOT BE DETERMINED. SEALS ARE INSPECTED
PRIOR TO INSTALLATION
TASK III. FLEET CLEARANCE
* ET-76 JOINT 1 REWORKED. INSTALLATION ACCEPTABLE
* ALL OTHERS NO ISSUE. PROBLEMS OF THIS NATURE ARE DETECTED DURING
ACCEPTANCE TEST
NOTE: THIS IS ALSO DEFERRAL RATIONALE
TASK IV. CAPS CLOSURE SUMMARY
THE LEAK EXPERIENCED ON ET-76 RESULTED FROM A DAMAGED PRIMARY SEAL
(RACO). TWO AREAS WITH SURFACE DISCONTINUITIES ACROSS THE PRIMARY
SEAL LIP WERE VISUALLY DETECTED UPON JOINT DISASSEMBLY WITH ONE
AREA SHOWING A DEPRESSION APPROXIMATELY 0.09 INCHES IN LENGTH
RUNNING CIRCUMFERENTIALLY ALONG THE LIP. THE CAUSE OR POINT OF
DAMAGE COULD NOT BE DETERMINED. ET-76 WAS SUCCESSFULLY REWORKED
BY SEAL REPLACEMENT. THIS IS AN ISOLATED CASE
THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED

MSFC Response/Concurrence

09/07/94 - DEFERRAL RATIONALE:
PER THE RATIONALE LISTED IN "TASK III. CLEARANCE OF EFFECTIVITIES"
(ABOVE), THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX (6) MONTHS PER
NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126 REV. E
PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS
CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL TESTS (I.E., FAILURE
MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
SIGNED: PARKER V. COUNTS (SIGNED) DATE: SEPTEMBER 7, 1994
ET PROJECT MANAGER

ASSESSMENT ADDENDUM REPORT

MSFC Report#	IFA#	Contractor RPT#	JSC#	KSC#	EICN#
A16199	--	P-074	--	--	--

Asmnt Part#	Asmnt Part Name	Asmnt Serial/Lot#
55L2-4	RACO SEAL	--

HCRIT CD	FCRIT CD	CAUSE CD	FAIL MODE
1	--	U - UNKNOWN	MV - EXT LEAK

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
2.5.7.1	1	C	1
--	--	--	--
--	--	--	--

Correlated Part#	Correlated Part#	Correlated Part#
--	--	--

Associated LRU#	Associated LRU#	Associated LRU#
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	DESCRIPTION OF CHANGES
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A16204	**In-Flight Anomaly Number** --	**Contractor Report Number** P-075	**JSC#** --	**KSC#** --
Problem Title LH2 FEEDLINE JOINT LEAKED				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ET COMPLETE	**PART#** 80901006000-059	**SER/LOT#** ET-76	**MANUFACTURER** MAF
Test/Operation A - ATP	**Prevailing Condtion** F - FUNCTIONAL	**F / U** F	**Fail Mode** MV - EXT LEAK	**Cause** U - UNKNOWN
System PROPULSION	**Defect** --	**Material** P - SEAL	**Work Contact** D. O'NEAL	**Fail Date** 09/08/1994
Received at MSFC 09/08/1994	**Date Isolated** 09/08/1994	**FMEA Reference** 2.5.8.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** MV - EXT LEAK		**Time Cycle** --
Effectivity Text ET-76				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** 09/15/1994	**LVL 3 Close** --	**Remark / Action** 09/15/1994	
Investigation / Resolution Summary				
Last MSFC Update 10/06/1994	**CN RSLV SBMT** 09/19/1994	**Defer Date** 09/09/1994	**Add Date** 09/08/1994	**R/C Codes** 0 - EXPL -- --
Assignee				
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** N/A	**Project MGR** P. COUNTS

Approval				
Design M. MOORE	**Chief Engineer** M. PESSIN	**S & MA** A. ADAMS	**Project** --	**Project MGR** P. COUNTS
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 10/04/1994	**Status** E - CLOSED-E	**F/A Completion** --
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --	**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --			
Related Document Type --	**Related Document ID** NCD N002804			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Related Document Type --	**Related Document ID** --			
Related Document Title --				
Contractor Status Summary				
Reliability/Quality Assurance Concerns, Recommendations:				

Problem Description

```
THE LH2 FEEDLINE AT JOINT 2 LEAKED AND EXCEEDED THE
ALLOWABLE LEAK RATE OF 20 SCCM PER TP-8C101-FA
 * CRITICALITY: THE FAILURE IS CRIT. 1. FMEA ITEM CODE 2.5.8.1;
    "LEAKAGE"
 * PREVIOUS CAPS: THIS CAPS IS THE FIRST OCCURRENCE OF PRIMARY SEAL
    LEAKAGE AT THE LH2 FEEDLINE TO UMBILICAL DISCONNECT. THIS JOINT
    UTILIZES A NAFLEX SEAL
    REVISION "A" CLOSES ALL TASKS. SEE ASTERISKS FOR CHANGES
```

Contractor Investigation/Resolution

```
  GENERAL:
  DURING THE DUAL SEAL CAVITY LEAK CHECK OF JOINT 2 (LH2 EXTERNAL
  FEEDLINE TO LH2 DISCONNECT), AN 80 SCCM LEAK WAS DETECTED. THE
  ALLOWABLE LEAKAGE IS 20 SCCM MAXIMUM AT 6.0+/- 0.5 PSIG GHE, AS
  TESTED PER TP-8C101-FA. THIS JOINT USES A GFP SUPPLIED NAFLEX SEAL
  TROUBLE SHOOTING STEPS DETECTED NO TEST EQUIPMENT MALFUNCTION AND
  NO INDICATION OF SECONDARY SEAL LEAKAGE WAS FOUND
  TASK I. PROBLEM/FAILURE INVESTIGATION
  THE FAILURE AND THE ASSOCIATED CAUSES ARE BEING INVESTIGATED
         RESPONSIBILITY: D. O'NEAL/3741--D. WESTPHAL/3740
                                      J. ADAMS/3741--D. WESTPHAL/3740
```

COMPLETE: 9/15/94

```
* CLOSURE STATEMENT
   THE LEAK TEST FAILURE WAS DOCUMENTED ON NCD N002804. THE EXACT
   CAUSE OF THE LEAK IS UNKNOWN. THE SEAL WAS REPLACED PER THE
   DISPOSITION OF THE NCD. UPON RETEST, THE JOINT PASSED THE LEAK
   TEST REQUIREMENTS
   THE SEAL WHICH HAD BEEN REMOVED FROM THE JOINT WAS DOCUMENTED ON
   NCD N002197. THE SEAL WAS CLOSELY EXAMINED BY RELIABILITY ASSURANCE
   AND LIAISON ENGINEERING. NO DEFECT COULD BE FOUND THAT WOULD HAVE
   CAUSED THE LEAK WHICH OCCURRED ON THE ET
    TASK CLOSED
    CAUSE
*  UNKNOWN. THE ROOT CAUSE OF THE LEAK COULD NOT BE DETERMINED
  TASK II. CORRECTIVE ACTION
* NO CORRECTIVE ACTION FOR THE FAILURE IS POSSIBLE. THE ROOT CAUSE OF
   THE LEAK IS UNKNOWN. IN-PROCESS INSPECTIONS OF THE COMPONENTS
   INVOLVED, AS WELL AS ADDITIONAL INSPECTIONS ASSOCIATED WITH THE
   NON-CONFORMANCE DOCUMENT, WERE UNABLE TO FIND A DEFECT THAT WOULD
   HAVE CAUSED THE HIGH LEAK RATE
   TASK CLOSED
  TASK III. FLEET CLEARANCE
  * THIS IS AN EXPLAINED CLOSURE OF THE CAPS
  * ET-76 CLEARED. THE FEEDLINE JOINT PASSED ACCEPTANCE TEST
     FOLLOWING REPLACEMENT OF THE NAFLEX SEAL
  * ALL OTHERS CLEARED. ALL ETS MUST PASS LEAK TESTS OF ALL FEEDLINE
     JOINTS PRIOR TO DELIVERY OF THE VEHICLE
     NOTE: THIS IS ALSO DEFERRAL RATIONALE
     TASK CLOSED
  TASK IV. CAPS CLOSURE SUMMARY
 * THE LH2 FEEDLINE/UMBILICAL JOINT FAILED THE MAF ACCEPTANCE TEST
    FOR LEAK RATE. THE SEAL IN THE JOINT WAS REPLACED AND THE JOINT
    SUCCESSFULLY PASSED A RETEST OF THE LEAK REQUIREMENT. NEITHER
    IN-PROCESS INSPECTIONS OF THE JOINT COMPONENTS NOR EXAMINATION
    OF THE SEAL REMOVED FROM JOINT WERE ABLE TO DETERMINE THE CAUSE
    OF THE LEAK. THE ACCEPTANCE TEST IS AN EFFECTIVE SCREEN FOR JOINT
     LEAKAGE AND PREVENTS DELIVERY OF DISCREPANT HARDWARE
     TASK CLOSED
     THIS IS AN EXPLAINED CLOSURE
      THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED
```

MSFC Response/Concurrence

```
9/8/94 - DEFERRAL RATIONALE:
PER THE RATIONALE LISTED IN "TASK III. FLEET CLEARANCE" (ABOVE),
THIS REPORT HAS BEEN DEFERRED FOR THE NEXT SIX (6) MONTHS PER
NSTS 07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126
REV. E PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM
CONDITION IS CLEARLY SCREENED BY PREFLIGHT CHECKOUT OR SPECIAL TESTS
(I.E., FAILURE MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
SIGNED: PARKER V. COUNTS (SIGNED)    DATE:  SEPTEMBER 9, 1994
        ET PROJECT MANAGER
```

MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A16204	--	P-075	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
PD4800184	LH2 EXT FEEDLINE	--

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**

--	1	U - UNKNOWN	MV - EXT LEAK
Asmnt FMEA 2.5.8.1	**Asmnt FM** 1	**FMEA CSE** N/A	**FMEA SCSE** N/A
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --
Asmnt FMEA --	**Asmnt FM** --	**FMEA CSE** --	**FMEA SCSE** --
Correlated Part# --	**Correlated Part#** --	**Correlated Part#** --	
Associated LRU# --	**Associated LRU#** --	**Associated LRU#** --	
MAJOR DESIGN CHANGES			
APRV DATE --	**DESCRIPTION OF CHANGES** --		
ASSESSMENT TEXT			

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A16207	**In-Flight Anomaly Number** --	**Contractor Report Number** P-076	**JSC#** --	**KSC#** --
Problem Title BELLOWS CONVOLUTE HAS "BLISTERED"				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** 1
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** GH2 PRESSURIZATION L	**PART#** PD4800205-009	**SER/LOT#** 0000468	**MANUFACTURER** ARROWHEAD
Test/Operation A - ATP	**Prevailing Condtion** N - INSPECTION	**F / U** UC	**Fail Mode** MV - EXT LEAK	**Cause** MP - MFG-PRC
System PROPULSION	**Defect** DB - BENT	**Material** N - HOLE	**Work Contact** D. O'NEAL	**Fail Date** 09/09/1994
Received at MSFC 09/12/1994	**Date Isolated** 09/01/1994	**FMEA Reference** 2.7.1.1	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location ARROWHEAD		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text --				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** 10/04/1994	**LVL 3 Close** --	**Remark / Action** 10/04/1994	
Investigation / Resolution Summary				
Last MSFC Update 11/07/1994	**CN RSLV SBMT** 10/05/1994	**Defer Date** 09/27/1994	**Add Date** 09/12/1994	**R/C Codes** 2 - MFG -- --
Assignee				
Design	**Chief Engineer**	**S & MA**	**Project**	**Project MGR**

W. PATTERSON	M. PESSIN	M. SMILES	N/A	P. COUNTS	
Approval					
Design W. PATTERSON	**Chief Engineer** M. PESSIN	**S & MA** M. SMILES	**Project** --	**Project MGR** P. COUNTS	
PAC Assignee B. HURST	**PAC Review Complete** BH	**MSFC Closure Date** 11/03/1994	**Status** C - CLOSED	**F/A Completion** 09/06/1994	
Problem Type --	**SEV** --	**Program Name** --	**REVL** --	**OPRINC** --	
FUNC MOD --	**Software Effectivity** -- -- -- -- --	**Software Fail CD** --		**SUBTYPE** --	**Software Closure CD** --
RES PERSON L2 --	**Approval Signature L3** --				
Related Document Type --	**Related Document ID** NCD N004352				
Related Document Title --					
Related Document Type --	**Related Document ID** --				
Related Document Title --					
Related Document Type --	**Related Document ID** --				
Related Document Title --					
Contractor Status Summary					
Reliability/Quality Assurance Concerns, Recommendations:					

Problem Description

A. WHILE UNDERGOING DEFLECTION TESTING AS PART OF ATP 14205-309, A BELLOWS CONVOLUTE OF THE BSTRA ASSEMBLY ADJACENT TO THE OUTLET FLANGE WAS VISUALLY DETECTED TO BE DISTORTED (BULGED)
B. FIFTEEN PARTS PREVIOUSLY RECOGNIZED AS SUSPECT OF HAVING INTERPLY WATER INTRUSION WERE ALLOWED TO ENTER THE MANUFACTURING FLOW WITHOUT A CORRECTIVE BAKEOUT OF THE INTERPLY AREA
CRITICALITY: FMEA PARA. 2.7.1.1 REFLECTS "LEAKAGE: AS A FAILURE MODE WHICH MAY RESULT IN LOSS OF MISSION
REVISION "A": REVISED PROBLEM, GENERAL, TASKS I, II, III AND IV AND CLOSES THIS CAPS. SEE ASTERISKS

Contractor Investigation/Resolution

GENERAL:
AFTER SUCCESSFULLY PASSING A HYDROSTATIC PROOF TEST (1530 +/- 10 PSIG, 60 SECONDS MAXIMUM), THE GH2 LINE WAS UNDERGOING DEFLECTION TESTING WHILE HYDROSTATICALLY PRESSURIZED TO 600 +10/-0 PSIG, WHEN A DISTORTION (BULGE) OF THE FIRST BELLOWS CONVOLUTE OF THE FIRST BELLOWS FROM THE OUTLET FLANGE WAS NOTED. THE DISTORTION EXTENDED IN EXCESS OF TWO-THIRDS THE CIRCUMFERENCE OF THE BELLOWS
REFERENCE AHP PART NUMBER 14205-309, SERIAL NUMBER 08-94-017

THE BSTRA ASSEMBLY IS A FLEXIBLE JOINT CONTAINING A PRESSURE CARRIER
BELLOWS AND A BALL-STRUT TIE ROD ASSEMBLY (BSTRA). IT IS THE
BELLOWS THAT IS OF CONCERN. THE BELLOWS IS MANUFACTURED OF THREE
PLIES OF CRES 21-6-9, EACH PLY .008 INCHES THICK
MANUFACTURE OF THE FLEXIBLE JOINT IS PERFORMED IN THREE PHASES:
1) BELLOWS - FORM INDIVIDUAL TUBES, TELESCOPE TUBES (JOIN BY
SLIDING TOGETHER), FORM CONVOLUTES, TEST, TRIM. WET RESISTANCE
WELDING IS USED DURING THIS PHASE
2) BELLOWS ASSEMBLY - ASSEMBLE AND WET RESISTANCE WELD TOGETHER
THE BELLOWS COLLAR, SHIELD AND SUPPORT; TRIM AND TEST
3) BSTRA ASSEMBLY - ASSEMBLE AND FILLET WELD TOGETHER THE BELLOWS
ASSEMBLY, FLOW LINER AND BSTRA
IN SEPTEMBER 1992, DURING GO2/GH2 PRESSLINE COMPONENT PROCESSING
AT AHP A SIMILAR ANOMALY WAS FOUND ON SEVERAL IN-PROCESS BSTRA
ASSEMBLIES. THE ENSUING INVESTIGATION DETERMINED THAT WATER
INTRUSION BETWEEN THE BELLOWS PLIES DURING THE BELLOWS OR BELLOWS
ASSEMBLY STAGE OF MANUFACTURE (WET RESISTANCE WELDING) WAS THE
CAUSE, THE WATER VAPORIZING AND CAUSING A HIGH PRESSURE BUILDUP
BETWEEN THE PLIES DURING SUBSEQUENT HIGH HEAT WELDING OPERATIONS TO
AN EXTENT THAT THE BELLOWS PLIES SEPERATED. THE DISCREPANT BELLOWS
WERE DETERMINED TO HAVE BEEN MANUFACTURED TO A THEN RECENTLY
REVISED PROCESS THAT HAD DELETED A BAKEOUT OF THE BELLOWS PLIES
DURING RESISTANCE WELDING BY LEAVING A GAP IN THE WELD, BAKING THE
PART TO ENSURE INTERPLY DRYNESS, THEN CLOSING THE WELD DRY. THIS
PROCESS AFFECTED SEVENTEEN PRESSLINES (50 BSTRA ASSEMBLIES) HAVING
BEEN RECEIVED BY MAF AT THE TIME AND 189 BSTRA ASSEMBLIES IN VARIOUS
STAGES OF ASSEMBLY OR INSTALLED IN HIGHER ASSEMBLIES AT AHP
INCLUDED IN THIS 189 AT AHP WERE 82 THAT WERE AT A RECOVERABLE STAGE
WHERE A BAKEOUT COULD STILL BE PERFORMED TO DRY THE INTERPLY AREA
ALL SUSPECT BSTRAS WERE INSPECTED AT MAF OR AHP FOR ACCEPTABILITY BY
X-RAY OR SCRAPPED. REFERENCE SPECIAL INVESTIGATION SI-93-P003
TASK I. PROBLEM/FAILURE INVESTIGATION
* A. THE FAILURE AND THE ASSOCIATED CAUSES ARE BEING INVESTIGATED
RESPONSIBILITY: D. O'NEAL/3741 - D.P. WESTPHAL/3740
COMPLETED 9/21/94
CLOSURE STATEMENT
AN X-RAY INSPECTION CONDUCTED OF THE BULGED BELLOWS SHOWED THE
DEFORMATION TO RESULT FROM THE MIDDLE AND OUTER PLIES INVERTED
ACROSS A TWO CONVOLUTE SPAN WITH SOME DEGREE OF DEFORMATION
EXTENDING CIRCUMFERENTIALLY FOR MORE THAN 270 DEGREES. THE INNER
PLY WAS COLLAPSED. PENETRATION OF THE CAVITY FORMED BY THE
INVERSION FOUND WATER TO BE PRESENT WITH A SUBSEQUENT GHE MASS
SPECTROMETER LEAK TEST FINDING A LEAK PATH THROUGH THE INNER PLY
TO LINE INTERIOR. IN THE AREA OF THE GREATEST DEFORMATION THE
BELLOWS WAS DISCOLORED FROM EXCESSIVE HEAT, THE DISCOLORATION
ALIGNING DIRECTLY WITH AN INTERNAL STRUT-TO-HOUSING WELD
ENGINEERING ANALYSIS AT AHP SHOWED THE TWO BALLOONED PLIES WOULD
NOT HAVE YIELDED AT THE PROOF PRESSURE OF 1500 PSIG
A SECTIONING OF THE BELLOWS WAS PERFORMED AT MAF TO GAIN VISUAL
ACCESS TO THE BELLOWS INTERIOR. OPTICAL MICROSCOPY EXAMINATION
OF THE INTERNAL DAMAGE SHOWED THAT THE INNER PLY CONVOLUTES
APPEARED TO HAVE EXPANDED INTERNALLY INITIALLY THEN COLLAPSED BACK
ON THEMSELVES, POSSIBLY AS A RESULT OF THE HYDROSTATIC TESTING
THIS COLLAPSE CAUSED SEVERE DEFORMATION OF THE INNER PLY WITH
KINKED, BENT AND FOLDED-OVER REGIONS. IT WAS IN THIS COLLAPSED
AREA THAT THE MOST PROBABLE LEAK PATH WAS FOUND, A TIGHT CRACK
APPROXIMATELY 0.012 INCHES LONG RUSTED SHUT PRESUMABLY BY WATER
INTRUSION DURING HYDROSTATIC TESTING, SURROUNDED BY A LARGE NUMBER
OF SMALL STRESS CRACKS. THE CRACKING WAS STRESS RELATED, NO
CORROSION-ASSISTED FRACTURE WAS INDICATED. REFERENCE TECHNOLOGY
LABORATORY TEST REPORT 94A223
A PROCESSING/HISTORICAL REVIEW HAS SHOWN THAT THIS BSTRA ASSEMBLY

WAS ONE OF 15 OF THE 82 DESCRIBED IN SI-93-P003 AS AT A RECOVERABLE STAGE, TO BE BAKED OUT TO DRY THE BELLOWS INTERPLY AREAS AT THE BELLOWS ASSEMBLY LEVEL. THESE FIFTEEN WERE AT A COMPLETED BELLOWS LEVEL. AS THE PROCESS CHANGE EVOLVED TO CORRECT THE PROCESSING DEFICIENCIES THAT CREATED THE INTERPLY MOISTURE PROBLEM, THE BAKE-OUT TO ASSURE INTERPLY DRYNESS MOVED FROM THE BELLOWS ASSEMBLY LEVEL TO THE LOWER BELLOWS LEVEL. THE SUBJECT 15 PARTS WERE ALREADY COMPLETED AT THIS LEVEL AND AS THEY ENTERED THE MANUFACTURING FLOW NO BAKEOUT WAS PERFORMED. ALL 15 PARTS HAVE BEEN ACCOUNTED FOR WITH NONE INSTALLED ON ANY ET
THE CONCLUSION DRAWN RELATIVE TO THIS ANOMALY IS THAT THIS PROBLEM IS A CONTINUATION OF THE SI-93-P003 ISSUE AND THE DEFORMED BELLOWS CONVOLUTE WAS A PRE-EXISTING CONDITION CREATED AT A LOWER MANUFAC-TURING LEVEL AND NOT DETECTED UNTIL ATP DURING VISUAL INSPECTION

* B. ARROWHEAD PRODUCTS AND MAF TO ADDRESS THE INSPECTION OF ALL SUSPECT BSTRAS FOR ACCEPTANCE
RESPONSIBILITY: D. O'NEAL/3741 - D. WESTPHAL/3740
ARROWHEAD PRODUCTS
COMPLETED 9/20/94
CLOSURE STATEMENT
MAF TO INSPECT TWO BSTRAS INSTALLED ON TWO DELIVERED GH2 PRESSLINES (PD4800205-029) BY X-RAY. REFERENCE NCDS N007615 AND N002196
AHP TO INSPECT ELEVEN BSTRAS AT AHP, THOSE DEDICATED TO THE GO2 SYSTEM BY BAKEOUT AT 625 DEGREES F (TO SIMULATE MAXIMUM FLIGHT TEMPERATURES, APPROXIMATELY 619 DEGREES F) FOLLOWED BY X-RAY AND THOSE DEDICATED TO THE GH2 SYSTEM BY X-RAY ONLY. THE GH2 SYSTEM BSTRAS HAVE ALREADY BEEN EXPOSED TO IN-PROCESS TEMPERATURES GREATER THAN THEY SEE IN FLIGHT (APPROXIMATELY 129 DEGREES F). ONE BSTRA OF THE FIFTEEN IS AT THE BELLOWS LEVEL AND WILL BE SCRAPPED
REFERENCE AHP LETTER CT-GKF-33-94 AND MMMSS LETTER AP-0994-RDR-029

* C. PROCUREMENT QUALITY TO ADDRESS THE SYSTEM FAILURE THAT ALLOWED THE PREVIOUSLY IDENTIFIED 15 PARTS TO ENTER THE MANUFACTURING FLOW WITHOUT A CORRECTIVE BAKEOUT
RESPONSIBILITY: J. MAJOR/3760
COMPLETE 10/4/94
CLOSURE STATEMENT
THE SYSTEM FAILURE THAT OCCURRED AND ALLOWED THE 15 PARTS TO ENTER THE MANUFACTURING FLOW WITHOUT A CORRECTIVE BAKEOUT RESULTED FROM AN AHP MANAGEMENT DECISION AT THE TIME NOT TO TAG THE PARTS AS SUSPECT. IT WAS REASONED AT THAT TIME THAT NO MRB WAS REQUIRED BECAUSE IT WAS ASSUMED THE NEXT MANUFACTURING PROCESS WOULD CORRECT THE PROBLEM IN THE SAME MANNER AS THE OTHER 67 PARTS IDENTIFIED AS BEING AT A RECOVERABLE STAGE WERE CORRECTED - BY REVISED PLANNING THAT PROVIDED A BAKEOUT AT THE BELLOWS ASSEMBLY LEVEL. THIS ASSUMPTION BY MANAGEMENT AT AHP WAS EVENTUALLY OVERRIDDEN MONTHS LATER BY ENGINEERING (MAF) CONTRACT DIRECTION WHEN THE FINAL PROCESSING CHANGES WERE APPROVED THAT REQUIRED THE BAKEOUT TO BE PERFORMED AT THE EARLIER MANUFACTURING LEVEL. CONSEQUENTLY, THE BELLOWS WERE NOT INVENTORIED AND WERE ALLOWED TO PROCEED THROUGH THE MANUFACTURING PROCESS WITHOUT THE REQUIRED WORK THAT WOULD HAVE CONVERTED THEM TO AN ACCEPTABLE CONFIGURATION
ARROWHEAD PRODUCT'S MANAGEMENT HAS RECOGNIZED THEIR FAILURE TO PROVIDE ENOUGH PROCEDURAL CONTROL OF SUSPECT HARDWARE AND HAS ADDED A WRITTEN PROCEDURE WITH SPECIFIC CONTROLS AND CHECKS TO ENSURE THAT FUTURE STOCK CHECKS AND INVENTORIES OF DISCREPANT HARDWARE WILL BE ADEQUATELY DOCUMENTED AND CONTROLLED
REFERENCE MMMSS LETTER 3760-94-131 AND AHP LETTER AMQ4-082.MMC

* CAUSE
A. WATER ENTRAPMENT BETWEEN THE BELLOWS PLIES DURING RESISTANCE WELDING WHICH VAPORIZED AND PRESSURIZED THE INTERPLY AREA DURING SUBSEQUENT HIGH HEAT WELDING OPERATION

NOTE: THIS ANOMALY WAS NOT AN ATP FAILURE BUT RATHER A PRE-EXISTING
CONDITION RECOGNIZED DURING ATP
B. LACK OF PROCEDURAL CONTROL TO FORCE PROPER DOCUMENTATION AND
CONTROL OF SUSPECT HARDWARE
* TASK II. CORRECTIVE ACTION
A. NO PROCESSING CHANGES REQUIRED. THIS ANOMALY IS ISOLATED TO 15
PARTS MANUFACTURED TO AN OBSOLETE PROCESS
B. ARROWHEAD PRODUCTS HAS DEVELOPED AND RELEASED A WRITTEN
PROCEDURE TO ASSURE POSITIVE IDENTIFICATION, TIMELY SEGREGATION
AND FEEDBACK ON THE INSPECTION STATUS OF SUSPECT HARDWARE
THIS PROCEDURE HAS BEEN RELEASED AS QS-226, "SUSPECT
PARTS - WIP AND STOCK PURGE PROCEDURE". REFERENCE AHP LETTER
AMQ4-082.MMC
* TASK III. CLEARANCE OF EFFECTIVITIES
THIS DISCREPANCY IS ISOLATED TO 15 PARTS (BSTRA ASSEMBLIES) FOUND
TO HAVE NOT BEEN BAKED OUT DURING PROCESSING TO ENSURE INTERPLY
DRYNESS. ALL 15 PARTS HAVE BEEN ACCOUNTED FOR, NONE HAVING BEEN
INSTALLED ON ANY PRESSURIZATION LINE INSTALLED ON ANY ET. NO ET
IS AFFECTED. ALL 15 SUSPECT PARTS ARE BEING INSPECTED FOR PLY
SEPARATION BY X-RAY OR WILL BE SCRAPPED
THE REMAINDER OF PRESSURIZATION LINE BELLOWS ON ETS OR IN MAF OR
AHP INVENTORY ARE NOT SUSCEPTIBLE TO THIS CONCERN OR WERE INSPECTED
BY X-RAY PER SPECIAL INVESTIGATION SI-93-P003 DIRECTION
THIS IS ALSO DEFERRAL RATIONALE
* TASK IV. CAPS CLOSURE SUMMARY
THE DEFORMED BELLOWS NOTED DURING ATP RESULTED FROM WATER ENTRAPMENT
BETWEEN THE BELLOWS PLIES OCCURRING DURING RESISTANCE WELDING WHICH
VAPORIZED AND PRESSURIZED THE INTERPLY AREA DURING SUBSEQUENT HIGH
HEAT WELDING OPERATIONS. THE CAUSE OF THIS ANOMALY WAS FIRST
RECOGNIZED IN 1992 AND ADDRESSED BY INSPECTING ALL PARTS WHICH HAD
THIS POTENTIAL CONDITION AND BY CHANGES TO THE MANUFACTURING PROCESS
THAT REQUIRE A BAKEOUT OF THE INTERPLY AREAS DURING RESISTANCE
WELDING TO ENSURE THE PLIES WERE DRY. THE SUBJECT PART IS ONE OF
FIFTEEN PARTS THAT WERE AT A LEVEL OF MANUFACTURE KNOWN TO BE
CORRECTABLE BUT DUE TO A PROCESS REVISION THAT CHANGED THE POINT OF
INTERPLY BAKEOUT TO AN ALREADY COMPLETED STEP, WERE ALLOWED TO
BYPASS THE INTERPLY DRYING OPERATION. THIS ANOMALY IS ISOLATED TO
THESE FIFTEEN PARTS AND ALL HAVE BEEN ACCOUNTED FOR WITH NONE
INSTALLED ON ANY ET. ALL ARE BEING INSPECTED FOR ACCEPTANCE OR
SCRAPPED. THIS ANOMALY WAS NOT A FAILURE THAT OCCURRED DURING ATP
BUT RATHER A PRE-EXISTING CONDITION OF THE BELLOWS THAT WAS NOT SEEN
UNTIL ATP VISUAL INSPECTIONS
THIS CAPS IS CLOSED. NO FURTHER ACTION IS REQUIRED

MSFC Response/Concurrence

09/27/94 - DEFERRAL RATIONALE:
THE CLOSURE RATIONALE SUBMITTED BY MAF ON 09/23/94 WAS CONSIDERED
INCOMPLETE AND WAS REJECTED BY MIKE SMILES/CR70. IN LIEU OF CLOSURE,
THIS PROBLEM REPORT HAS BEEN DEFERRED FOR THE NEXT (6) MONTHS PER NSTS
07700, VOLUME XI, PARAGRAPH 3.4.1, ITEM C AND NSTS 08126 REV. E
PARAGRAPH 3.3.10.1, ITEM D WHICH STATES "THE PROBLEM CONDITION IS
CLEARLY SCREEND BY PREFLIGHT CHECKOUT OR SPECIAL TESTS (I.E., FAILURE
MODE SHOULD NOT OCCUR FOLLOWING THE TEST)."
_____PARKER V. COUNTS (SIGNED) 09/27/94_____
ET PROJECT MANAGER

MSFC Report#	IFA#	Contractor RPT#	JSC#	KSC#	EICN#
A16207	--	P-076	--	--	--

Asmnt Part#	Asmnt Part Name	Asmnt Serial/Lot#
PD4800205-009	PROPULSION LINE	0000468

HCRIT CD	FCRIT CD	CAUSE CD	FAIL MODE
--	1	MP - MFG-PRC	MV - EXT LEAK

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
2.7.1.1	1	A	1

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
--	--	--	--

Asmnt FMEA	Asmnt FM	FMEA CSE	FMEA SCSE
--	--	--	--

Correlated Part#	Correlated Part#	Correlated Part#
--	--	--

Associated LRU#	Associated LRU#	Associated LRU#
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	DESCRIPTION OF CHANGES
--	--

ASSESSMENT TEXT

MSFC PRACA : 2003-02-12 08:41

MSFC Problem Reporting and Corrective Action (PRACA) System
WHOLE RECORD REPORT(+ ADDENDUM)

MSFC Record # A16244	**In-Flight Anomaly Number** --	**Contractor Report Number** E-159	**JSC#** --	**KSC#** --
Problem Title DEUTSCH FEEDTHRU CONNECTOR CHANGES NOT APPROVED BY COQ				
EICN# --	**ELEMENT** ET	**Contractor** MMMSS	**FSCM#** --	**FCRIT** --
HCRIT --	**Sys_Lvl** N	**Misc Codes** A B C D E F G H I J K L M N O		
HARDWARE EIM	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE LRU	**NOMENCLATURE** --	**PART#** --	**SER/LOT#** --	**MANUFACTURER** --
HARDWARE NCA	**NOMENCLATURE** ELEC CONNECTOR, CRYO	**PART#** 81L2-X	**SER/LOT#** N/A	**MANUFACTURER** DEUTSCH CO
Test/Operation L - FLD	**Prevailing Condtion** N - INSPECTION	**F / U** UC	**Fail Mode** ZZ - NO PROBLEM	**Cause** --
System ELECTRICAL	**Defect** MT - TYPE W	**Material** C - EEE	**Work Contact** JOHN ADAMS	**Fail Date** 10/05/1994
Received at MSFC 10/06/1994	**Date Isolated** 10/05/1994	**FMEA Reference** NONE	**IFA: Mission Phase** --	**Mission Elapsed Time** --
Location MAF		**Symptom** UC - UNSAT		**Time Cycle** --
Effectivity Text NONE				
Vehicle Effectivity Codes				
Vehicle 1 --	**Vehicle 2** --	**Vehicle 3** --	**Vehicle 4** --	**Vehicle 5** --
Mission Effectivity Codes				
Mssn 1 --	**Mssn 2** --	**Mssn 3** --	**Mssn 4** --	**Mssn 5** --
Estimated Completion Dates				
MSFC Approved Defer Until Date --	**Contractor Req Defer Until Date** --	**LVL 3 Close** --	**Remark / Action** --	
Investigation / Resolution Summary				
Last MSFC Update 01/26/1995	**CN RSLV SBMT** 01/17/1995	**Defer Date** --	**Add Date** 10/06/1994	**R/C Codes** 4 - TEST 5 - TRNG --
Assignee				

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	M. SMILES	--	P. COUNTS

Approval

Design	Chief Engineer	S & MA	Project	Project MGR
R. MOYE	M. PESSIN	M. SMILES	--	P. COUNTS

PAC Assignee	PAC Review Complete	MSFC Closure Date	Status	F/A Completion
B. HURST	BH	01/25/1995	N - CLOSED-N	--

Problem Type	SEV	Program Name	REVL	OPRINC
--	--	--	--	--

FUNC MOD	Software Effectivity	Software Fail CD	SUBTYPE	Software Closure CD
--	-- -- -- -- --	--	--	--

RES PERSON L2	Approval Signature L3
--	--

Related Document Type	Related Document ID
--	SI-94-E002

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
--

Related Document Type	Related Document ID
--	--

Related Document Title
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Contractor Status Summary

Reliability/Quality Assurance Concerns, Recommendations:

Problem Description

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THE SOCKET CONTACTS CURRENTLY BEING SUPPLIED FOR USE IN BOTH OF THE
PLUGS WHICH MATE TO THE CRYOGENIC ELECTRICAL FEEDTHROUGH CONNECTOR
ARE NOT MANUFACTURED TO THE ORIGINAL DESIGN USED IN QUALIFICATION
TESTING.  CHANGES HAVE ALSO BEEN MADE TO THE WAVE SPRINGS USED IN
THE COUPLING MECHANISM OF BOTH PLUGS AND TO THE GLASS IN THE HERMETIC
SEAL OF THE FEEDTHROUGH CONNECTOR.  THE CONNECTOR MANUFACTURER
PROPERLY SUBMITTED DESIGN CHANGES TO MMMSS AND THE CHANGES WERE
APPROVED ON DOCUMENTATION ACCOUNTABILITY SHEETS (DAS).  AT THE TIME
THE CHANGES WERE APPROVED, MMMSS DID NOT CONSIDER CHANGES TO THE
CERTIFICATE OF QUALIFICATION (COQ).  AT THIS TIME, REVIEW OF THE
CHANGES SUGGESTS THAT THE QUALIFICATION DOCUMENTATION SHOULD HAVE
BEEN UPDATED
CRITICALITY: NONE.  THIS IS A DISCRETIONARY CAPS, ISSUED AT THE
REQUEST OF MSFC, MR. M. SMILES, TO ADDRESS A SYSTEM PROBLEM
CONCERNING TIMELY UPDATING OF COQ'S.  THERE HAVE BEEN NO HARDWARE
FAILURES OR MANUFACTURING PROCESS CONTROL PROBLEMS
*REVISION "C" CLOSES ALL TASKS.  SEE ASTERISKS
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Contractor Investigation/Resolution

GENERAL:
THE 81L2-4 SOCKET FOR THE INTERNAL 81L2-1 PLUG AND THE 81L2-5 SOCKET FOR EXTERNAL 81L2-3 PLUG IN THE ORIGINAL DESIGN USED A SEPARATE LEAF SPRING TO PROVIDE POSITIVE CONTACT FORCE WITH THE MATING PINS. THE CURRENTLY SUPPLIED SOCKETS ARE MANUFACTURED BY SLITTING THE SOCKET AND FORMING TWO "TINES" WHICH CREATE CONTACT FORCE
THE WAVE SPRING USED IN THE COUPLING MECHANISMS OF BOTH THE 81L2-1 AND THE -3 PLUGS WAS ORIGINALLY A SINGLE TURN, BERYLLIUM-COPPER DESIGN. THE CURRENT WAVE SPRING IS A TWO-TURN STAINLESS STEEL DESIGN
THE THICKNESS OF THE GLASS IN THE HERMETIC SEAL OF THE 81L2-2 WAS ALSO CHANGED AT THE SAME TIME AS THE ABOVE DESCRIBED CHANGES
TASK I. FAILURE INVESTIGATION
A. AT THE DEUTSCH CO., REVIEW THE COMPLETE HISTORY OF DESIGN CHANGES ON THE 81L2 CONNECTORS AND DETERMINE IF ANY OTHER CHANGES SHOULD BE INCLUDED IN THE UPDATED CONNECTOR QUALIFICATION DOCUMENTS
RESPONSIBILITY: J. HART/4630 - E. HORAK/4600
R. TORTORICH/3760 - J. MAJOR/3760
J. GARCIA/3830 - N. JAMES/3840
COMPLETE: OCTOBER 19, 1994
CLOSURE STATEMENT
THE DEUTSCH CO. ENGINEERING DOCUMENTATION WAS REVIEWED AND COMPARED WITH THE DOCUMENTATION ACCOUNTABILITY SHEETS (DAS) FOR 1984 AND LATER. NO CONFIGURATION CHANGES WERE IDENTIFIED OTHER THAN THOSE PREVIOUSLY DESCRIBED IN THE "GENERAL" STATEMENT ABOVE INVESTIGATION ACCOMPLISHED AS PART OF SPECIAL INVESTIGATION 94-E002 HAD FOUND THAT THE OLDEST CONNECTOR LOT DATE CODES NOW EXISTING ARE FROM MID-1986. THEREFORE, ALL CONNECTORS NOW IN EXISTENCE ON DELIVERED ETS, OR IN STOCK AT MAF, WERE COVERED BY THE REVIEW. SEE IOM 3741-94-047 FOR DETAILS
B. RE-QUALIFY THE 81L2 CONNECTORS BY TEST
RESPONSIBILITY: J. HART/4630 - E. HORAK/4600
E. COLON/4120 - J.DEGENERES/4100
R. LANDERS/4220 - J. JOHNSON/4200
COMPLETE: OCTOBER 19, 1994
CLOSURE STATEMENT
THE QUALIFICATION TEST WAS SUCCESSFULLY COMPLETED. CERTIFICATE OF QUALIFICATION (COQ) MMC-ET-TM06-116B HAS BEEN APPROVED
C. REVIEW THE CONTROLS ON THE COQ DOCUMENTATION SYSTEMS
DETERMINE IF THE EXISTING CONTROLS ARE ADEQUATE
RESPONSIBILITY: H. FACIANE/3750
COMPLETE: OCTOBER 28, 1994
CLOSURE STATEMENT
THE AUDIT DEPT. REVIEWED APPROXIMATELY 10 ADDITIONAL COQ'S AND THE ASSOCIATED DAS FILES. THE TEAM ALSO REVIEWED THE COMMAND MEDIA AND INTERVIEWED THE PERSONNEL WHO PROCESS THE DOCUMENTS
REFERENCE: IOM 3750-94-131A
THE RESULTS OF THE AUDIT WERE:
1. THE DAS SYSTEM REVIEW FOUND THAT THERE ARE CONTROLS TO PREVENT MISHAPS OR OVERSIGHTS. HOWEVER, THE CONTROL OF FIELD APPROVING PROCESSES COULD BE IMPROVED
2. THE COQ SYSTEM REVIEW FOUND THAT TWO SYSTEM ENHANCEMENTS ARE IN ORDER:
   A. CLARIFY THE COMMAND MEDIA TO ELIMINATE ANY POSSIBLE MISUNDERSTANDINGS OR MISINTERPRETATIONS OF THE PROCESS ROLES AND RESPONSIBILITIES
   B. RE-EMPHASIZE THE COMMAND MEDIA TO THE PERSONNEL INVOLVED WITH THE PROCESS
3. TWO COQ'S, WHICH COVER THE LH2 AND LOX ULLAGE PRESSURIZATION FLOW DIFFUSERS, NEEDED REVISION TO REFLECT THE CURRENT MANUFACTURER
4. AN ASSESSMENT OF POTENTIAL DESIGN CHANGES AND THE EFFECT ON

THE COQ'S IS WARRANTED TO ENSURE THAT THE COQ DATA FILES ARE COMPLETE AND ACCURATE

D. THE COQ'S FOR THE LH2 AND LOX ULLAGE PRESSURIZATION FLOW DIFFUSERS REQUIRE REVISION TO LIST THE CURRENT MANUFACTURER
RESPONSIBILITY: H. FACIANE/3750
COMPLETE: OCTOBER 28, 1994
CLOSURE STATEMENT
CERTIFICATES OF QUALIFICATION MMC-ET-TM06-90A AND MMC-ET-TM06-91B HAVE BEEN APPROVED

E. PROCUREMENT QUALITY FIELD PERSONNEL WILL RECEIVE ADDITIONAL TRAINING AND FAMILIARIZATION REGARDING THE COMMAND MEDIA WHICH GOVERNS DAS FIELD APPROVALS
RESPONSIBILITY: C. PEMBO/3760--S. PARIKH/3760
COMPLETE: DECEMBER 7, 1994

* CLOSURE STATEMENT
INTEROFFICE MEMORANDUM 3760-94-168, DATE NOVEMBER 9, 1994, WAS SENT TO ALL PROCUREMENT QUALITY FIELD PERSONNEL. IT CLARIFIES AND EMPHASIZES THE REQUIREMENTS OF THE DAS FIELD APPROVAL PROCESS

F. REVISION OF THE COQ STANDARD PROCEDURES WILL BE ACCOMPLISHED TO ELIMINATE ANY POSSIBLE MISUNDERSTANDINGS
RESPONSIBILITY: P. LEWIS/4220--J. JOHNSON/4200
COMPLETE: JANUARY 9, 1995

* CLOSURE STATEMENT
STANDARD PROCEDURE 75.2, "MAINTENANCE OF COMPONENT QUALIFICATION," REVISION 4, WAS RELEASED. THE MOST SIGNIFICANT CHANGE WAS TO ADD A REQUIREMENT FOR MATERIAL SOURCING TO HAVE THE ASSIGNED BUYER/CONTACT ADMINISTRATOR NOTIFY THE COQ ASSESSMENT TEAM/SYSTEMS ENGINEERING WHEN CHANGING A COMPONENT MANUFACTURING SOURCE OR WHEN AN EXISTING SOURCE IS RELOCATING ITS OPERATIONS

G. CONDUCT BRIEFING/COORDINATION TO RE-EMPHASIZE COMMAND MEDIA TO THE PERSONNEL INVOLVED WITH THE COQ SYSTEM
RESPONSIBILITY: P. LEWIS/4220--J. JOHNSON/4200
COMPLETE: JANUARY 12, 1995

* CLOSURE STATEMENT
A MEETING WAS HELD WITH REPRESENTATIVES FROM TECHNICAL OPERATIONS AND PRODUCT ASSURANCE IN WHICH THE REQUIREMENTS OF STANDARD PROCEDURE 75.2, "MAINTENANCE OF COMPONENT QUALIFICATION," WERE DISCUSSED. THE SYSTEM ENGINEERING & INTEGRATION DEPARTMENT WILL USE THE "REMARKS" SECTION OF THE DAS FORM TO ENTER THE "NO QUALIFICATION IMPACT STATEMENT" PRIOR TO ROUTING THE DAS FOR APPROVAL

H. DEVELOP A PLAN TO ASSESS ALL COQ'S WITH DESIGN CHANGE IMPACTS
RESPONSIBILITY: P. LEWIS/4220--J. JOHNSON/4200
TASK TRANSFERRED TO SPECIAL INVESTIGATION-94-E002, ITEM 22

* CLOSURE STATEMENT
A PLAN TO REVIEW ALL COQ'S FOR THE EFFECTS OF ANY DESIGN OR MANUFACTURING CHANGES WHICH HAVE OCCURRED WAS SUBMITTED ON NOVEMBER 22, 1994. IT CALLS FOR THE REVIEW TO BE COMPLETED BY THE FIRST WEEK OF JUNE 1995

TASK CLOSED

* CAUSE: THE REQUIREMENTS OF THE COMMAND MEDIA FOR MAINTENANCE OF THE COQ'S, PRIMARILY STANDARD PROCEDURE 75.2, WERE NOT PROPERLY CARRIED OUT. SPECIFICALLY, THE "NO QUALIFICATION IMPACT STATEMENT", WITH SUPPORTING RATIONALE FOR THE COMPONENT CHANGES, WAS NOT FORMALLY PROCESSED PRIOR TO DAS APPROVAL

TASK II. CORRECTIVE ACTION

* A. STANDARD PROCEDURE 75.2, "MAINTENANCE OF COMPONENT QUALIFICATION", WAS REVISED TO REQUIRE THE MATERIAL SOURCING DEPARTMENT TO NOTIFY THE SYSTEMS ENGINEERING PERSONNEL WHEN CHANGING THE

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      SOURCE OF A PART OR WHEN AN EXISTING SOURCE RELOCATES A
      MANUFACTURING FACILITY
* B.  TECHNICAL OPERATIONS, PRODUCT ASSURANCE AND MATERIEL SOURCING
      PERSONNEL WERE BRIEFED ON THE PROGRAM REQUIREMENTS FOR
      MAINTAINING THE CERTIFICATE OF QUALIFICATION RECORDS
TASK CLOSED
TASK III. CLEARANCE OF EFFECTIVITIES
NOT APPLICABLE
NOTE:  THE 81L2 CONNECTORS HAVE SUCCESSFULLY PASSED
RE-QUALIFICATION TESTING; SEE TASK I.B
TASK CLOSED
TASK IV. CAPS CLOSURE SUMMARY
* THE RECORDS ASSOCIATED WITH THE MAINTENANCE OF THE CERTIFICATE OF
  QUALIFICATION FOR THE 81L2 ELECTRICAL CONNECTORS HAD NOT INCLUDED
  A "NO QUALIFICATION IMPACT STATEMENT" FOR DESIGN AND MANUFACTURING
  CHANGES WHICH HAD BEEN MADE.  THE 81L2 CONNECTORS WERE REQUALIFIED
  BY TEST.  STANDARD PROCEDURE 75.2, "MAINTENANCE OF COMPONENT
  QUALIFICATION", WAS REVISED.  ALL OTHER COQS ARE BEING REVIEWED FOR
  PROPER RECORD KEEPING AND THE WORK IS BEING TRACKED BY SPECIAL
  INVESTIGATION-94-E002 (SEE TASK 1.H)
TASK CLOSED
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MSFC Response/Concurrence

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10/06/94 - PAC NOTE:
THE PROBLEM ASSESSMENT CENTER (PAC) DOES NOT INTERPRET THIS TO BE A
REPORTABLE PROBLEM PER NSTS 08126 OR MCC-ET-RA06.  FOR PROJECT
MANAGEMENT VISIBILITY PURPOSES, MIKE SMILES/CR70 DIRECTED MARTIN
MARIETTA TO SUBMIT THIS AS A DISCRETIONARY CAPS.  SINCE THIS IS A
BREAKDOWN IN CONFIGURATION, AND NOT AN ACTUAL FAILURE OF FLIGHT
HARDWARE, THERE IS NOT AN APPLICABLE FMEA NUMBER OR CORRESPONDING
CRITICALITY.  THEREFORE, THE CRITICALITY FIELD IS LEFT BLANK; HOWEVER,
THE PAC WILL PROCESS THIS PROBLEM AS THOUGH IT WERE A CRITICALITY 3
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MSFC Problem Reporting and Corrective Action (PRACA) System

ASSESSMENT ADDENDUM REPORT

MSFC Report#	**IFA#**	**Contractor RPT#**	**JSC#**	**KSC#**	**EICN#**
A16244	--	E-159	--	--	--

Asmnt Part#	**Asmnt Part Name**	**Asmnt Serial/Lot#**
81L2-X	ELECTRICAL CONNECTOR	N/A

HCRIT CD	**FCRIT CD**	**CAUSE CD**	**FAIL MODE**
--	--	--	ZZ - NO PROBLEM

Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
NA	NA	NA	NA
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--
Asmnt FMEA	**Asmnt FM**	**FMEA CSE**	**FMEA SCSE**
--	--	--	--

Correlated Part#	**Correlated Part#**	**Correlated Part#**
--	--	--

Associated LRU#	**Associated LRU#**	**Associated LRU#**
--	--	--

MAJOR DESIGN CHANGES

APRV DATE	**DESCRIPTION OF CHANGES**
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ASSESSMENT TEXT