ITEM 1 - EVENT INDICATOR MC432-0222-XXXX
ITEM 2 - METER TAPE MC432-0232-XXXX

THE FOLLOWING TABLE LISTS FAILURE MODES AND CAUSES WHICH WERE CONSIDERED IN DERIVING THE FAILURE MODES AND EFFECTS ANALYSIS (FMEA'S) FOR THE ITEMS LISTED ABOVE:

	ITEM 1	ITEM 2
FAILURE MODE / Failure Cause	EVENT INDICATOR	METER TAPE
LOSS OF INDICATION, FAILS TO CHANGE STATE		
(a) Piece Part Failure	X	X
(b) Contamination	X	X
(c) Vibration	X	X
(d) Mechanical Shock	X	X
(e) Processing Anomaly	X	X
(f) Thermal Stress	X	X
INADVERTENT INDICATION, INADVERTENT CHANGE OF STATE		
(a) Piece Part Failure	X	X
(b) Contamination	X	X
(c) Vibration	X	X
(d) Mechanical Shock	X	X
(e) Processing Anomaly	X	X
(f) Thermal Stress	X	X

APP-G-1

EXPEDITE PROCESSING

EXPEDITE PROCESSING

08/19/88

APPENDIX G ITEM 1 - EVENT INDICATOR
(MC432-0222-XXXX)

DISPOSITION & RATIONALE
(A) DESIGN, (B) TEST, (C) INSPECTION, (D) FAILURE HISTORY:

(A) DESIGN

PHYSICAL/ELECTRICAL/FUNCTIONAL DESCRIPTION

EVENT INDICATORS ARE PANEL MOUNTED ELECTRO-MECHANICAL DEVICES WHICH ALERT THE CREW THAT AN EVENT HAS TAKEN PLACE. THE INDICATOR IS A SIGNAL FLAG ACTUATED BY D'ARSONVAL MOVEMENT VIEWED THROUGH A WINDOW AND CONTAINED IN A NON-HERMETIC, SOLDER SEALED STEEL CASE. THERE ARE TWO BASIC TYPES: A TWO POSITION AND A THREE POSITION. EACH TYPE IS AVAILABLE IN TWO CLASSES: A 5 VDC OR A 28 VDC. FOR A TWO POSITION INDICATOR, A SHUTTER OF NON-CONTRASTING MEDIUM GRAY COLOR DROPS AWAY FROM IN FRONT OF ONE DESCRIPTOR AND COVERS THE EXPOSED DESCRIPTOR WHEN A SIGNAL IS RECEIVED. FOR A THREE POSITION INDICATOR, A SHUTTER CONTAINING THREE DIFFERENT INDICATIONS (TWO DESCRIPTORS AND ONE BLACK AND WHITE BARBER POLE) CHANGES FROM ONE STATE TO ANOTHER UPON RECEIPT OF THE APPROPRIATE SIGNAL.

DESIGN EVOLUTION

THE ORBITER'S EVENT INDICATOR WAS DERIVED FROM A SIMILAR APOLLO UNIT. THE APOLLO UNIT DIFFERED FROM THE ORBITER UNIT IN THAT IT CONTAINED INTEGRAL LIGHTING, A REAR MOUNTING FLANGE, AND A SMALLER VIEWING WINDOW AND HOUSING AREA. THE ORBITER DESIGN UTILIZES A FRONT BEZEL AND A REAR CAN COMPRESSION TYPE MOUNTING SIMILAR (SAME GENERAL SHAPE AND SIZE) TO THE APOLLO/SKYLAB PUSHBUTTON SWITCH DESIGN.

DURING ATP INSULATION RESISTANCE TESTING, AN ELECTRICAL SHORT BETWEEN THE MOVING COIL MECHANISM AND THE CASE WAS DETECTED (CAR A1380). CORRECTIVE ACTION INCLUDED MODIFYING THE CASE AND ADDING AN INSULATING FILM TO THE CASE INTERIOR.

DURING INITIAL QUALIFICATION VIBRATION TESTING, THE FLAG SUPPORT ARM BROKE (CAR A3014). A DESIGN CHANGE WAS IMPLEMENTED WHICH CHANGED THE ARM MATERIAL FROM BRASS TO HARD PHOSPHOR BRONZE AND INCREASED THE CROSS-SECTIONAL AREA WHICH RESULTED IN A PART NUMBER CHANGE.

DURING SUBSEQUENT QUALIFICATION VIBRATION TESTING, THE POINTER STOP WAS BROKEN (CAR A4579). THE STOP ARM MANUFACTURING PROCESS USED DURING INITIAL ADJUSTMENT WAS CHANGED FROM BENDING TO

EXPEDITE PROCESSING

DESIGN (CONTINUED)

APPENDIX G, ITEM 1
CONT'D

TORSIONAL MODE. THE UNIT WAS REPAIRED USING THE NEW PROCEDURE AND SUCCESSFULLY COMPLETED QUALIFICATION TESTING.

THE ABOVE DESIGN CHANGES WERE INCORPORATED INTO THE FLIGHT CONFIGURATION EVENT INDICATORS (-0013 and subs).

(B) TEST

CERTIFICATION

CERTIFICATION WAS BASED ON QUALIFICATION TESTS AND BY ANALYSIS AND SIMILARITY TO THE APOLLO UNITS.

QUALIFICATION TEST

TEST
ACCEPTANCE TEST
PERFORMANCE
VIBRATION QAVT - $0.067G^2/HZ$
ACCELERATION FLIGHT - $0.09G^2/HZ$
SHOCK
A. BENCH HANDLING
B. BASIC DESIGN
BONDING
THERMAL CYCLE TESTS
OPERATING LIFE TESTS
CABIN ATMOSPHERE
PACKAGE QUALIFICATION TESTS

ACCEPTANCE TEST

INSPECTION & TEST
EXAMINATION OF PRODUCT
FUNCTIONAL TEST
ACCEPTANCE VIBRATION TEST (AVT $0.04G^2$ HZ)
ACCEPTANCE THERMAL TEST (ATT)
PRESSURE/VACUUM/LEAK RATE

EXPEDITE PROCESSING

APPENDIX G, ITEM 1
CONT'D

(C) INSPECTION

RECEIVING INSPECTION -

RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF INCOMING PARTS. RAW MATERIAL CERTIFICATION ARE OBTAINED FROM SUPPLIERS, AND THE MATERIAL IS ALSO VERIFIED VIA A SAMPLING PLAN EVERY FIFTH LOT.

CONTAMINATION CONTROL -

PARTS ARE ASSEMBLED IN A LAMINAR FLOW MODULE WITHIN A CONTROLLED WORK AREA.

ASSEMBLY/INSTALLATION -

ASSEMBLY AND INSTALLATION OPERATIONS ARE VERIFIED BY A PRE-SEAL INSPECTION OF THE COMPLETE ASSEMBLY.

CRITICAL PROCESSES -

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION. THE CRITICAL PROCESSES ARE SOLDER PLATING, NICKEL PLATING, TIN PLATING, AND SOLDERING.

TESTING -

THE ACCEPTANCE TESTS ARE PERFORMED BY INSPECTION PERSONNEL DIRECTLY, PRECLUDING THE NEED FOR ADDITIONAL WITNESSING OR VERIFICATION.

HANDLING/PACKAGING -

HANDLING, PACKAGING, AND STORAGE REQUIREMENTS ARE VERIFIED AT THE PARTS LEVEL DURING PARTS INSPECTION, ON AN AUDIT BASIS DURING STOCKROOM AND ASSEMBLY DEPARTMENT AUDITS, AND ON THE FINAL END PRODUCT BY AN INSPECTION OF THE PACKAGE PROCESS.

ACCEPTED HARDWARE IS NOT STORED, BUT IS IMMEDIATELY PROCESSED FOR SHIPMENT. RETURNED HARDWARE IS STORED IN A BONDED AREA IN THE INSPECTION DEPARTMENT PENDING AUTHORIZATION TO PROCEED WITH REPAIR.

EXPEDITE PROCESSING

APPENDIX G, ITEM 1
CONT'D

(D) FAILURE HISTORY

CAR A5447

AFTER COMPLETION OF AVT AND ATT THE INDICATOR FAILED TO CHANGE DISPLAYS (HUNG UP) UPON APPLICATION OF ELECTRICAL POWER. FAILURE ANALYSIS DISCLOSED A SMALL METALLIC PARTICLE LODGED IN THE MAGNETIC AIR GAP THEREBY IMPEDING THE MOTION OF THE MOVING ELEMENT. THE PARTICLE WAS IDENTIFIED AS A BURR FROM A THREADED HOLE ON THE INDICATOR BACKCAP. THE SUPPLIER REINSPECTED ALL BACKCAPS IN STOCK AND ADDED A CAUTION NOTICE TAG REGARDING BURRS IN THREADED HOLES TO THE INSPECTION PROCEDURE. ALL ASSEMBLY AND INSPECTION PERSONNEL WERE CAUTIONED. THIS WAS CONSIDERED TO BE AN ISOLATED INSTANCE. THIS UNIT WAS REINSPECTED AND SUBSEQUENTLY PASSED ATP.

CAR 03F042

DURING STS-3 ON OV-102 THE PAYLOAD PRIMARY MAIN C POWER DOWNLINK MEASUREMENT INDICATED THAT THE POWER WAS "ON"; HOWEVER, THE EVENT INDICATOR WAS INDICATING "OFF". FAILURE ANALYSIS ISOLATED THE PROBLEM TO A HIGH RESISTANCE CONDITION AT THE COIL WIRE SOLDER JOINT. THIS WAS CONSIDERED TO BE AN ISOLATED INSTANCE. THIS IS SUPPORTED BY THE SUCCESSFUL USAGE OF THESE INDICATORS THROUGH THE APOLLO AND SHUTTLE PROGRAMS.

CAR AB0353

DURING PANEL MANUFACTURING FUNCTIONAL TESTING PRIOR TO CONFORMAL COATING, THE EVENT INDICATOR WAS INTERMITTENTLY STICKING OR HANGING UP. SLIGHT TAPPING ON THE PANEL ALLOWED FLAG MOVEMENT. THE ANOMALY COULD NOT BE VERIFIED OR DUPLICATED BY THE SUPPLIER. DISASSEMBLY DID DISCLOSE METALLIC PARTICLES (THE MAJORITY OF WHICH WERE INTRODUCED DURING THE UNSEALING PROCESS). HOWEVER, IN VIEW OF THE FAILURE EXPERIENCED, IT IS HIGHLY PROBABLE THAT SUCH A PARTICLE CAUSED THE ANOMALY. THE SUPPLIER HAS REVIEWED THEIR CLEANLINESS REQUIREMENTS AND CONSIDERS THEM TO BE ADEQUATE. THIS WAS CONSIDERED TO BE AN ISOLATED INSTANCE. THIS INDICATOR WAS SUCCESSFULLY RETESTED PER ATP REQUIREMENTS.

CAR AC8688

DURING OV-103 CHECKOUT AT KSC, THE O2 SYSTEM 1 SUPPLY VALVE EVENT INDICATOR WAS INOPERATIVE. FAILURE ANALYSIS ISOLATED THE PROBLEM TO A FRACTURED COIL LEAD AT THE EDGE OF THE COIL ARM. IT IS BELIEVED THAT THE WIRE WAS FRACTURED DURING ASSEMBLY BUT ELECTRICAL CONTINUITY WAS UNAFFECTED. CORRECTIVE ACTION INITIATED IN APRIL OF 1985 INCLUDED THE ADDITION OF A FILLET OF

EXPEDITE PROCESSING

FAILURE HISTORY (CONTINUED)

APPENDIX G ITEM 1
CONT'D

CEMENT OVER THE EDGE OF THE COIL ARM FOR ALL INDICATORS USING THIS MOVING COIL CONFIGURATION. INDICATORS DELIVERED ARE CONSIDERED ACCEPTABLE FOR THEIR INTENDED USAGE AS THIS WAS CONSIDERED TO BE AN ISOLATED INSTANCE. THIS IS SUPPORTED BY THE SUCCESSFUL USAGE OF THESE INDICATORS THROUGHOUT THE APOLLO AND SHUTTLE PROGRAMS.

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DESIGN	E. MURPHY	DES	SSM
RELIABILITY	M. HOVE	REL	REL 9/2/88
QUALITY	J. COURSEN	QE	QE 9/1/88