FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER:M8-1SS-M020 -X

SUBSYSTEM NAME: MECHANICAL - CREW EQUIPMENT
REVISION: 0 06/28/96

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:TOOL STOWAGE ASSEMBLY	V849-000150-001
SRU	:LATCH ASSEMBLY	V849-000400-001

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
TOOL STOWAGE ASSEMBLY (TSA) DRAWER/DOOR LATCH

QUANTITY OF LIKE ITEMS: 8
EIGHT - TWO PER DRAWER & DOOR, TWO DRAWERS & TWO DOORS PER TSA

FUNCTION:
THE TSA CONTAINS TWO DRAWERS AND TWO DOORS. EACH DRAWER AND DOOR CONTAINS TWO REDUNDANT LATCHES THAT KEEP THEM IN A CLOSED AND LOCKED POSITION. LATCHES CAN BE MANUALLY RELEASED ON ORBIT.

REFERENCE DOCUMENTS:
V849-000150
V849-000400
V849-000410
V849-000420
V849-000430
V849-000440
V849-000450
V849-000455
V849-000460

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: M8-1SS-M020-01

REVISION#: 2 05/08/97

SUBSYSTEM NAME: MECHANICAL - CREW EQUIPMENT
LRU: TOOL STOWAGE ASSEMBLY
ITEM NAME: LATCH ASSEMBLY

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
BREAKS UNDER FLIGHT LOAD (PREMATURE RELEASE)

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT
LS LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
VIBRATION, MECHANICAL SHOCK, MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) FAIL

PASS/FAIL RATIONALE:
A)

B)
FAILS SCREEN "B" SINCE A LATCH BREAKING UNDER FLIGHT LOAD CANNOT BE DETECTED AT TIME OF FAILURE.

C)
FAILS SCREEN "C" SINCE EXCESSIVE LOADS COULD BREAK BOTH LATCHES, AS WELL AS DISLODGE TOOLS FROM THE TSA COMPARTMENT RESTRAINING HARDWARE OR CAUSE A STRUCTURAL FAILURE OF THE DRAWER STOPS RESULTING IN A DRAWER SEPARATING FROM ITS SLIDE ASSEMBLY.

METHOD OF FAULT DETECTION:
NONE DURING LIFT OFF. A LATCH BREAKING UNDER FLIGHT LOAD CANNOT BE DETECTED AT TIME OF FAILURE. VISUAL OBSERVATION OF PAYLOAD BAY AREA DURING SUBSEQUENT MISSION PHASES, COULD DETECT AN UNSECURED DRAWER OR DOOR ONLY FOLLOWING FAILURE OF SECOND LATCH.

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REMARKS/RECOMMENDATIONS:
EACH DRAWER/DOOR OF THE TSA CONTAINS TWO LATCHES, ANY ONE OF WHICH WILL KEEP IT CLOSED UNDER NOMINAL FLIGHT LOAD CONDITIONS. IN ADDITION, TOOLS ARE RESTRAINED WITHIN EACH DRAWER AND WITHIN EACH DOOR COMPARTMENT AREA. HOWEVER, RESTRAINING HARDWARE IS NOT DESIGNED TO CARRY LAUNCH/LANDING LOADS. AS SUCH, IF THE DRAWERS OR DOORS WERE TO OPEN DURING LAUNCH OR LANDING, IT IS ASSUMED THAT THE TOOLS WILL COME LOOSE. DRAWERS ARE PREVENTED FROM COMPLETELY SEPARATING FROM THE TSA BY MEANS OF A STOP ON EACH OF THE TWO SLIDES.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF CAPABILITY TO LATCH ONE OF TWO SIDES OF A DRAWER OR DOOR. NO EFFECT SINCE REDUNDANT LATCH WILL KEEP THE DRAWER OR DOOR IN PLACE.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT FIRST FAILURE. HOWEVER, SIMILAR FAILURE OF THE REDUNDANT LATCH OR A FAILURE OF BOTH DRAWER MECHANICAL STOPS, COULD RESULT IN LOOSE TOOLS OR DRAWER WITHIN THE PAYLOAD BAY AREA. THESE LOOSE TOOLS OR DRAWER COULD DAMAGE OTHER ORBITER HARDWARE LOCATED IN THE PAYLOAD BAY.

(C) MISSION:
NO EFFECT FIRST FAILURE. FAILURE TO PROPERLY RESTRAIN TOOLS OR DRAWER WITHIN THE TSA FOLLOWING SECOND LATCH FAILURE COULD RESULT IN DAMAGE TO THE PAYLOAD BAY DOORS, ODS HARDWARE, AND/OR OTHER ORBITER SYSTEMS THAT MAY PRECLUDE MISSION OBJECTIVES.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE. POSSIBLE LOSS OF CREW AND VEHICLE FOLLOWING SECOND LATCH FAILURE IF UNSECURED TOOLS ARE FREE TO MOVE AROUND WITHIN PAYLOAD BAY.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST FAILURE (ONE LATCH BREAKS UNDER LOAD) - NO EFFECT, REDUNDANT LATCH WILL KEEP AFFECTED DRAWER OR DOOR CLOSED.
SECOND FAILURE (REDUNDANT LATCH BREAKS UNDER LOAD) - AFFECTED TSA DRAWER OR TOOLS ARE FREE TO MOVE. UNRESTRAINED TOOLS CAN MOVE FREELY WITHIN PAYLOAD BAY. WORST CASE, POSSIBLE LOSS OF CREW AND VEHICLE IF DAMAGE TO ORBITER SUBSYSTEMS CAUSED BY THE LOOSE TOOLS BECAME CATASTROPHIC.

ESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

] RATIONALE FOR CRITICALITY DOWNGRADE:

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THERE IS NO WORKAROUND TO CIRCUMVENT LOOSE TOOLS IN THE PAYLOAD BAY DURING LIFTOFF, DE-ORBIT, OR LANDING FOLLOWING SECOND LATCH FAILURE. CRITICALITY REMAINS AT 1R2. HOWEVER, A DRAWER WOULD BE PREVENTED FROM SEAPARATING FROM THE TSA BY THE MECHANICAL STOPS ON THE DRAWER SLIDE ASSEMBLIES.
THIRD FAILURE (STRUCTURAL FAILURE OF MECHANICAL DOOR STOPS) - DRAWERS CAN MOVE FREELY WITHIN PAYLOAD BAY. WORST CASE, POSSIBLE LOSS OF CREW AND VEHICLE IF DAMAGE TO ORBITER SUBSYSTEMS CAUSED BY A LOOSE DRAWER BECAME CATASTROPHIC. - CRITICALITY 1R3 CONDITION.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION IF THE TOOLS OR DRAWER BECOME DISLODGED AND ARE ALLOWED TO MOVE FREELY WITHIN THE PAYLOAD BAY DURING LIFT-OFF, DE-ORBIT, OR LANDING.

HAZARD REPORT NUMBER(S): AOHA14 (ISS HAZARD ANALYSIS #)

HAZARD(S) DESCRIPTION:
DAMAGE TO ORBITER SYSTEMS DUE TO LOOSE EQUIPMENT/DESRIS IN PAYLOAD BAY.

-DISPOSITION RATIONALE-

(A) DESIGN:
EACH DRAWER AND DOOR OF THE TSA CONTAINS TWO LATCHES, EITHER OF WHICH WILL KEEP THE DRAWER OR DOOR CLOSED UNDER NOMINAL LOAD CONDITIONS. EACH LATCH CONTAINS A HANDLE THAT WHEN STOWED (POSITIONED DOWN) KEEPS THE LATCH IN A LOCKED POSITION. (A SPRING IS USED TO KEEP THE HANDLE IN THE DOWN POSITION.) WHEN THE HANDLE IS POSITIONED UP, THE LATCH IS FREE TO ROTATE (1/4 TURN) TO THE OPEN POSITION. THE LATCH HARDWARE, INCLUDING THE HANDLE AND RECEIVER, IS FABRICATED FROM A-286 STAINLESS STEEL.

TWO METHODS ARE USED TO HOLD THE TOOLS WITHIN THE TSA: (1) CUT CUSHIONS WHICH ARE BONDED TOGETHER TO FORM A POCKET FOR EACH TOOL AND COVERED WITH BETA CLOTH; AND (2) A FOAM "RIM" AROUND THE TOP OF A TOOL COMPARTMENT WHICH RESTRAINS THE TOOL. HOWEVER, RESTRAINING HARDWARE IS NOT DESIGNED TO CARRY LAUNCH/LANDING LOADS.
STRUCTURAL LOADS ANALYSIS IS PERFORMED ON THE TSA WHICH INCLUDES THE LATCH ASSEMBLIES - ANALYSIS HAS SHOWN THAT ALL COMPONENTS HAVE OF FACTOR

OF SAFETY OF AT LEAST 1.4. REFER TO TSA STRESS ANALYSIS REPORT #SSD96D0466, DATED SEPT 1996, FOR DETAILS.

(B) TEST:
LATCH CERTIFICATION - CERTIFICATION OF THE LATCHES AND RESTRAINING HARDWARE WILL BE PERFORMED BY TEST, ANALYSIS, AND SIMILARITY TO EXISTING LATCHES. ANALYSIS/SIMILARITY DATA IS PREVIOUSLY ADDRESSED IN THE "DESIGN" SECTION AND TEST DATA IS SHOWN BELOW:

A. TESTING AT NASA (TSA) - THERMAL, LIFE CYCLE, AND DYNAMIC TESTING OF THE TSA AND ITS COMPONENTS IS PERFORMED BY NASA AS FOLLOWS.
1. THERMAL CERTIFICATION TESTING - TSA'S WERE SUBJECTED TO THE FOLLOWING THERMAL PROFILE. FIRST, A PRETEST OBJECTIVE FUNCTIONAL TEST (OPENING/CLOSING DRAWERS AND DOORS USING A FORCE GAUGE) WAS PERFORMED AT AMBIENT CONDITIONS. THE CHAMBER TEMPERATURE WAS RAMPED TO -70°F +/-5°F AT A RATE OF 4°F/MIN AND THE TEMPERATURE REMAINED CONSTANT AT -70°F FOR ABOUT 5 MINUTES AND A SUBJECTIVE FUNCTIONAL TEST (OPENING/CLOSING DRAWERS AND DOORS USING THE HAND INSTEAD OF A FORCE GAUGE) WAS PERFORMED. THE CHAMBER TEMPERATURE WAS THEN RAMPED DOWN TO -125°F +/-5°F AT A RATE OF 4°F/MIN. THE TSA'S WERE SOAKED FOR 30 MINUTES AND THE COLD CASE OBJECTIVE FUNCTIONAL TEST WAS PERFORMED. THEN, THE CHAMBER TEMPERATURE WAS RAMPED UP TO 205°F +/-5°F. THE TSA'S WERE SOAKED AT THIS TEMPERATURE FOR 30 MINUTES AND THE HOT CASE OPERATIVE FUNCTIONAL TEST WAS PERFORMED. LAST, THE CHAMBER TEMPERATURE WAS RETURNED TO AMBIENT CONDITIONS AND A FULL POST OBJECTIVE FUNCTIONAL TEST WAS PERFORMED.
2. LIFE CYCLE TESTING - PRIOR TO PERFORMING THE LIFE CYCLE TEST OF THE LATCHES AND DRAWERS, A FUNCTIONAL TEST IS PERFORMED ON A SINGLE LATCH AND THE FOLLOWING IS VERIFIED: (A) THE FORCE REQUIRED TO PULL UP THE LATCH HANDLE TO THE VERTICAL POSITION FROM THE HANDLE CENTER OF GRAVITY IS IN THE 5 TO 10 LB RANGE; (B) THE FORCE REQUIRED TO PUSH THE LATCH HANDLE INTO THE LOCKED POSITION IS IN THE 5 TO 10 LB RANGE; AND (C) THE TORQUE REQUIRED TO TURN THE LATCH TO THE UNLOCKED POSITION (ONCE THE LATCH IS LIFTED AND THE HANDLE IS VERTICAL), AND THEN BACK TO THE LOCKED POSITION IS IN THE 2 TO 30IN-LB RANGE. WITH THE LATCH IN THE LATCHED POSITION (FULLY ENGAGED IN THE RECEIVER), THE LATCH IS TURNED FROM THE LOCKED POSITION TO THE UNLOCKED POSITION AND THEN BACK TO THE LOCKED POSITION. DURING THIS CYCLE, THE SMALL PRELOAD ON THE LATCH PAWL TO PRECLUDE VIBRATION OF THE PAWL AGAINST THE RECEIVER IS VERIFIED WHEN THE LATCH PAWL IS ROTATED INTO THE RECEIVER. THIS CYCLE IS REPEATED A TOTAL OF 400 TIMES. FOLLOWING THIS LIFE CYCLE TEST THE FUNCTIONAL TEST, AS PREVIOUSLY DESCRIBED IN STEPS A, B, AND C ABOVE, IS REPEATED.
3. DYNAMIC TESTING - A RANDOM VIBRATION TEST IS PERFORMED ON FOUR (4) TSA FLIGHT ARTICLES FOR TWO ENVIRONMENTS; FLIGHT VIBRATION AND ACCEPTANCE VIBRATION AS FOLLOWS.

FLIGHT VIBRATION LEVELS ARE SHOWN IN THE TABLE BELOW:

20 TO 50 HZ:	+ 5 DB/OCTAVE
50 TO 400 HZ:	0.01 G^2/HZ
400 TO 2000 HZ:	- 4 DB/OCTAVE
GRMS:	3.0
DURATION:	AS DEFINED IN THE NEXT SECTIONS
TEST TOLERANCES:	GRMS = +15%, - 5% G^2/HZ = + 4 DB, - 1 DB

ACCEPTANCE VIBRATION LEVELS ARE SHOWN IN THE TABLE BELOW:

20 TO 80 HZ:	+ 3 DB/OCTAVE
80 TO 350 HZ:	0.04 G^2/HZ
350 TO 2000 HZ:	- 3 DB/OCTAVE
GRMS:	6.1
DURATION:	1.0 MINUTE IN EACH OF X, Y, AND Z AXES
TEST TOLERANCES:	GRMS = +15%, - 5% G^2/HZ = + 4 DB, - 1 DB

TSA NO. 1 RANDOM VIBRATION TEST - WITH TSA FILLED WITH LIMIT DESIGN WEIGHT, RANDOM VIBRATION TEST PERFORMED AT 6 DB BELOW FLIGHT LEVEL ENVIRONMENT FOR A DURATION OF 1.0 MINUTE, IN ALL 3 AXES (X,Y,Z). THEN TSA CONTENTS REMOVED AND TSA EXPOSED TO ACCEPTANCE VIBRATION ENVIRONMENT FOR 1.0 MINUTE IN ALL 3 AXES.
TSA NO. 2 RANDOM VIBRATION TEST - WITH TSA FILLED WITH LIMIT DESIGN WEIGHT, RANDOM VIBRATION TEST PERFORMED AT FLIGHT LEVEL ENVIRONMENT FOR A DURATION OF 16.7 MINUTES, IN ALL 3 AXES.
TSA NO. 3 RANDOM VIBRATION TEST - WITH TSA EMPTY, RANDOM VIBRATION TEST PERFORMED AT ACCEPTANCE VIBRATION ENVIRONMENT FOR 1.0 MINUTE IN ALL 3 AXES.
TSA NO. 4 RANDOM VIBRATION TEST - WITH TSA EMPTY, RANDOM VIBRATION TEST PERFORMED AT ACCEPTANCE VIBRATION ENVIRONMENT FOR 1.0 MINUTE IN ALL 3 AXES.

6. ATP AT BOEING (LATCHES/DRAWERS/DOORS) - ACCEPTANCE TESTING AT BOEING WILL VERIFY PROPER FUNCTIONING OF THE DRAWERS, DOORS, AND LATCHES AS FOLLOWS:
1. LATCH TESTING - PRIOR TO THE FUNCTIONAL TEST, ALL LATCHES ARE VERIFIED TO BE IN THEIR LATCHED POSITION. THEN EACH LATCH IS TESTED, IN ANY SEQUENCE, AS FOLLOWS: (A) THE LATCH PAWL IS ROTATED AND THE FOLLOWING IS VERIFIED: THE HANDLE TURNS SMOOTHLY AND THERE IS NO INTERFERENCE BETWEEN THE LATCH AND LATCH HOUSING OR THE LATCH RECEIVER; (B) THE LATCH HANDLE IS POSITIONED AGAINST THE HOUSING AND THE FOLLOWING IS VERIFIED: THE HANDLE IS FIRMLY IN PLACE BY THE SPRING AND THE LATCH/HANDLE IS UNABLE TO MOVE; (C) THE FORCE REQUIRED TO PULL UP THE LATCH HANDLE TO THE VERTICAL POSITION, TAKEN FROM THE CENTER OF GRAVITY OF THE HANDLE, IS VERIFIED TO BE IN THE RANGE OF 5 TO 10 LB; (D) THE FORCE REQUIRED TO PUSH THE LATCH HANDLE IN THE LOCKED POSITION FROM THE CENTER OF GRAVITY IS VERIFIED TO BE IN THE RANGE OF 5 TO 10 LB; (E) AFTER THE LATCH HANDLE IS LIFTED TO ITS VERTICAL POSITION, THE TORQUE REQUIRED TO TURN THE LATCH TO THE UNLOCKED POSITION AND THEN BACK TO THE LOCKED POSITION IS LESS THAN OR EQUAL TO 30IN-LB.

2. DRAWER TESTING - DURING OPERATION OF THE DRAWINGS (OPENING AND CLOSING) THE FOLLOWING IS VERIFIED: (A) ALL LATCHES ARE FULLY DISENGAGED BEFORE OPENING THE DRAWERS; (B) THE FORCE REQUIRED TO OPEN EACH DRAWER IS IN THE 0.5 LB TO 10 LB RANGE, NOT INCLUDING THE WEIGHT OF THE TOOLS AND DRAWERS; (C) SMOOTH OPERATION OF THE DRAWERS WHEN THEY ARE PULLED OUT TO THEIR STOPS AND PUSHED BACK INTO THE EMPTY TSA BOX; AND (D) THE FORCE REQUIRED TO CLOSE EACH DRAWER IS IN THE 8 LB TO 16 LB RANGE, NOT INCLUDING THE WEIGHT OF THE TOOLS AND DRAWERS.
3. DOOR TESTING - DURING OPERATION OF THE DOORS (OPENING AND CLOSING) THE FOLLOWING IS VERIFIED: (A) EACH DOOR OPENS SMOOTHLY WITHOUT INTERFERENCE, WHEN THE DOORS ARE CLOSED THAT THEY REST EVENLY ON THE DOOR SUPPORTS; (B) ALL LATCHES AND RECEIVERS FOR THE DOORS ARE IN ALIGNMENT WHEN THE DOORS ARE CLOSED; AND (C) THE FORCE REQUIRED TO OPEN EACH DOOR IS IN THE 0.5 LB TO 5 LB RANGE, NOT INCLUDING THE WEIGHT OF THE DOOR.

C. TESTING (TOOL RESTRAINING HARDWARE) - A "PULL TEST" IS PERFORMED ON BOTH THE "CUT CUSHION" AND "FOAM RIM" METHODS FOR RESTRAINING THE TOOLS WITHIN THE TSA DRAWER AND DOOR COMPARTMENT AREA. THIS TEST MEASURES THE AMOUNT OF FORCE REQUIRED TO PULL OUT EACH TOOL. THE FORCE MUST FALL WITHIN A PREDEFINED MINIMUM AND MAXIMUM VALUE. THE MINIMUM EXTRACTION FORCE FOR HARDWARE WEIGHING LESS THAN ONE (1) POUND WILL BE THE WEIGHT OF THE ITEM PLUS ONE (1) POUND AND TO THE NEXT HIGHEST 0.1 LB INCREMENT IF EXTRACTION FORCE IS NOT IN AN EVEN 0.1 LB INCREMENT. THE MINIMUM EXTRACTION FOR ITEMS WEIGHING ONE (1) POUND OR MORE WILL BE THE WEIGHT OF THE ITEM MULTIPLIED BY A FACTOR OF 1.1 AND TO THE NEXT HIGHEST 0.1 LB INCREMENT IF THE EXTRACTION FORCE IS NOT AN EVEN 0.1 LB INCREMENT. THE MAXIMUM EXTRACTION FORCE FOR ANY ITEM WILL NOT EXCEED THE WEIGHT OF THE ITEM PLUS FIFTEEN (15) POUNDS AND TO THE NEXT LOWEST 0.1 LB INCREMENT IF THE EXTRACTION FORCE IS NOT AN EVEN 0.1 LB INCREMENT.

MISSION MANIFEST VERIFICATION - PRIOR TO EACH FLIGHT, THE ORBITER IS CONFIGURED TO SUPPORT A MISSION AS DEFINED IN THE MISSION MANIFEST. AT THIS TIME, IF THE MISSION IS TO SUPPORT ISS, THE TSA WILL BE INSTALLED ON THE EXTERNAL AIRLOCK TRUSS ASSEMBLY AND THE FOLLOWING WILL BE VERIFIED: THE TSA CONTAINS THE CORRECT TOOLS FOR THAT MISSION; THE TOOLS ARE INSTALLED PROPERLY; AND ALL DOOR AND DRAWER LATCHES ARE IN THEIR CLOSED AND LOCKED POSITION.

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION. CLEANLINESS LEVEL GC PER MA0110-301.

ASSEMBLY/INSTALLATION
ALL PARTS FABRICATED AND INSPECTED AT THE DETAIL LEVEL AND AT THE ASSEMBLY LEVEL. BONDED ASSEMBLY OF THE BOX, I.E. WITHOUT PARTITIONS, CLOSE-OUTS, AND

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COVERS. INSPECTED AT MANDATORY INSPECTION POINTS. INSTALLATION OF LATCHES PER TSA ASSEMBLY TOP LEVEL DRAWING V849-000100.

NONDESTRUCTIVE EVALUATION
PRIOR TO PAINTING, LATCHES INSPECTED AT DETAIL LEVEL USING DYE PENETRANT PER MTOS01-508.

TESTING
CERTIFICATION TEST/PULL TEST/MISSION MANIFEST CHECKLIST VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:
THERE IS NO CORRECTIVE ACTION IF ONE OR BOTH LATCHES BREAK UNDER LOAD DURING LIFTOFF, DE-ORBIT, OR LANDING PHASE. THE TOOL RESTRAINING SYSTEM IS ADEQUATE TO KEEP THE TOOLS WITHIN THE TSA DURING ON-ORBIT OPERATIONS ONLY. MECHANICAL STOPS WILL PREVENT THE DRAWERS FROM SEPARATING FROM THEIR SLIDE ASSEMBLIES UNDER NOMINAL LOAD CONDITIONS.

- APPROVALS -

SS & PAE ENGINEER	:	M. W. GUENTHER	:
SS & PAE MANAGER	:	C. A. ALLISON	:
DESIGN ENGINEER	:	R. C. GROO	:
NASA SS/MA	:		: 5/29/97
NASA SUBSYSTEM MANAGER	:		: 6-2-97
JSC MOD	:		: 5-30-97