

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 02-2A-011112 -X****SUBSYSTEM NAME: FLIGHT CONTROL MECH - RUDDER SPEED BRAKE & BF****REVISION: 0 02/02/88****PART DATA**

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
ASSY	: RUDDER/SPEEDBRAKE (R/SB) SUN	MC621-0053-0068 5004918B
SRU	: SUMMER DIFFERENTIALS	

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

FOR 02-2A-011112-01:

SUMMER DIFFERENTIAL (SECOND STAGE)

FOR 02-2A-011112-02, 02-2A-011112-05:

SUMMER DIFFERENTIALS (FIRST STAGE)

REFERENCE DESIGNATORS:**QUANTITY OF LIKE ITEMS: 4**2 PER RUDDER &
SPEEDBRAKE**FUNCTION:**

FIRST AND SECOND STAGE DIFFERENTIALS SUM THE RPM/TORQUE OUTPUT FROM THREE RUDDER OR SPEED BRAKE HYDRAULIC MOTORS INTO A SINGLE SHAFT RPM/TORQUE OUTPUT. FIRST STAGE SUMS OUTPUT FROM TWO HYDRAULIC MOTORS. SECOND STAGE SUMS OUTPUT FROM FIRST STAGE DIFFERENTIAL AND THIRD HYDRAULIC MOTOR.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-2A-011112- 02

REVISION#: 1 08/07/98

SUBSYSTEM NAME: FLIGHT CONTROL MECH - RUDDER SPEED BRAKE & BF

LRU:

CRITICALITY OF THIS

ITEM NAME: SUMMER DIFFERENTIAL

FAILURE MODE: 1R2

FAILURE MODE:

NO RPM/TORQUE OUTPUT, JAMMED DRIVELINE

MISSION PHASE: DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

CAUSE:

BROKEN GEAR TOOTH/TEETH, SEIZED BEARING.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS REDUNDANCY SCREEN "B" SINCE THE HALF-RATE EFFECT OF THE FIRST FAILURE MAY NOT BE DETECTABLE BY CREW.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF TWO HYDRAULIC MOTOR RPM/TORQUE INPUTS INTO DIFFERENTIAL SUMMER, CAUSING RUDDER OR SPEEDBRAKE TO OPERATE AT HALF-RATE.

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(B) INTERFACING SUBSYSTEM(S):
NONE.

(C) MISSION:
NONE.

(D) CREW, VEHICLE, AND ELEMENT(S):
LOSS OF MISSION, CREW/VEHICLE AFTER TWO FAILURES - FIRST STAGE DIFFERENTIAL GEAR JAM AND LOSS OF THIRD HYDRAULIC MOTOR RPM/TORQUE INPUT, RESULTING IN LOSS OF RUDDER OR SPEEDBRAKE FUNCTION.

-DISPOSITION RATIONALE-

(A) DESIGN:
SEALED GEARBOXES ACCEPTED BY PROGRAM PER MCR 231. MANUFACTURING PROCESSES ELIMINATE SURFACE DEFECTS AND INTERNAL CARBIDES. GEARS/SHAFTS DESIGNED FOR MAXIMUM TORQUE WITH 1.4 SAFETY FACTOR. CARBURIZED STEEL VACUUM MELT PER AMS 6265 CARBURIZING TO AGMA 246.01. SHOTPEEN TO MIL-S-13165. HEAVILY LOADED GEARS ARE GRIT BLASTED FOR REMOVAL OF SURFACE INTERGRANULAR OXIDATION (IGO), LIGHTLY LOADED GEARS GROUND FOR IGO REMOVAL. GEAR STRESS ANALYSIS PER LEWIS EQUATION. FATIGUE ANALYSIS BASED ON GREATEST MISSION DUTY CYCLES X 4 FOR DESIGN REQUIREMENTS. BEARINGS DESIGNED FOR B-10 LIFE MINIMUM.

(B) TEST:
QUALIFICATION TESTS: INCLUDES OPERATING CYCLE TEST FOR MAXIMUM LOAD CYCLES PER MISSION 4 X WITH A RUN IN AND STATIC PROOF TORQUE TO 1.5 X OPERATIONAL HYDRAULIC PRESSURE, THERMAL CYCLE -40 DEG F TO +275 DEG F, VIBRATION FROM 20 TO 2,000 HZ RANDOM, ULTIMATE LOAD, STIFFNESS, AND FATIGUE LIFE.

ACCEPTANCE TESTS: IMPULSE AND THERMAL CYCLING. OPERATING HINGE MOMENT AND SURFACE RATE.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

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(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL AND PROCESSES CERTIFICATIONS VERIFIED, INCLUDING GEAR CERTIFICATIONS, CONTROLS, AND MATERIAL IDENTIFICATION, CODE, MILL SOURCE, HEAT NUMBER, CHEMICAL ANALYSIS, AND HARDNESS VERIFICATION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCEDURES AND PRACTICES ARE VERIFIED.

ASSEMBLY/INSTALLATION

ASSEMBLY/INSTALLATION OPERATIONS VERIFIED BY SHOP TRAVELER MIPS. ALIGNMENT REQUIREMENTS VERIFIED TO DRAWING. SHAFT MATERIAL INSPECTED TO DRAWING REQUIREMENTS. INSPECTION VERIFIES SURFACE TEMPER INSPECTION (MICROSTRUCTURE EVALUATION WITH NITAL ETCH).

NONDESTRUCTIVE EVALUATION

ULTRASONIC INSPECTION AND MAGNETIC PARTICLE INSPECTION ARE VERIFIED.

CRITICAL PROCESSES

DRY FILM LUBRICANT, ELECTROLESS NICKEL PLATING, SHOT PEEN, AND GRIT BLASTING ARE VERIFIED. HEAT TREATING, INCLUDING CARBURIZATION, VERIFIED.

TESTING

CERTIFICATION OF ACCEPTANCE TESTS VERIFIED.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED.

(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:

NONE.

- APPROVALS -

EDITORIALLY APPROVED
TECHNICAL APPROVAL

: BNA
: VIA APPROVAL FORM

: J. Kemura 8-18-98
: 95-CIL-009_02-2A