

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)	MC621-0053-0068
	SUN	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- 05

REVISION#: 1 08/07/98

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

LRU:

CRITICALITY OF THIS

ITEM NAME: SUMMER DIFFERENTIAL

FAILURE MODE: 1/1

FAILURE MODE:

NO RPM/TORQUE OUTPUT, OPEN DRIVELINE

MISSION PHASE:

DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

FRACTURED OUTPUT SHAFT, OR GEAR

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) N/A
- B) N/A
- C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF FIRST STAGE SUMMER DIFFERENTIAL FUNCTION. THIRD HYDRAULIC MOTOR RPM/TORQUE OUTPUT BACKDRIVES INTO FIRST STAGE SUMMER DIFFERENTIAL/ OPEN DRIVELINE, RESULTING IN LOSS OF RUDDER OR SPEEDBRAKE FUNCTIONS.

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(B) INTERFACING SUBSYSTEM(S):

NONE.

(C) MISSION:

LOSS OF MISSION, CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

SAME AS (C)

-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. SHOT PEEN 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. BEARING DESIGNED FOR B-10 LIFE MINIMUM.

(B) TEST:

QUALIFICATION TESTS: QUALIFICATION TESTING INCLUDES OPERATING CYCLE TEST FOR MAXIMUM LOAD CYCLES PER MISSION X 4 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.

(C) INSPECTION:

RECEIVING INSPECTION

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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 VERIFIED.

ASSEMBLY/INSTALLATION
ASSEMBLY/INSTALLATIONS 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 PEENING AND GRIT BLASTING ARE VERIFIED. HEAT TREATING, INCLUDING CARBURIZATION, IS 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 : BNA : J. Kamura 8-18-98
TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009_02-2A