

## FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 02-2A-021111 -X

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

REVISION: 0 02/02/88

## PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
ASSY	: BODY FLAP ACTUATION	MC621-0056-0083
SRU	: SUMMER DIFFERENTIAL	

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
SUMMER DIFFERENTIAL (SECOND STAGE)

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS:** 2  
TWO REQUIRED

**FUNCTION:**

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

## FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-2A-021111-01

REVISION#: 1 08/07/98

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

LRU:

CRITICALITY OF THIS

ITEM NAME: SUMMER DIFFERENTIAL

FAILURE MODE: 1/1

## FAILURE MODE:

NO RPM/TORQUE OUTPUT. OPEN OR JAMMED DRIVELINE

MISSION PHASE: DO DE-ORBIT

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

## CAUSE:

FRACTURED OUTPUT SHAFT, OR GEAR, SEIZED BEARING

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 RPM/TORQUE INPUT INTO ROTARY ACTUATORS, RESULTING IN LOSS OF BODY FLAP FUNCTION.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
NUMBER: 02-2A-021111- 01**

**(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 X 1.4 SAFETY FACTOR. CARBURIZED STEEL FOR GEARS VACUUM MELT PER AMS 8285 WITH CARBURIZING TO AGMA 246.01. SHOTPEEN TO MIL-S-13165. HEAVILY LOADED GEARS ARE GRIT BLASTED TO REMOVE INTERGRANULAR OXIDATION (IGO). LIGHTLY LOADED GEARS GROUND FOR IGO. 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: 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 - 2,000 HZ RANDOM, ULTIMATE LOAD, STIFFNESS, AND FATIGUE LIFE.

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

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

**(C) INSPECTION:**  
RECEIVING INSPECTION

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE  
NUMBER: 02-2A-021111- 01**

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

CONTAMINATION CONTROL  
CONTAMINATION/CORROSION CONTROLS, PROCEDURES AND PRACTICES ARE VERIFIED.

ASSEMBLY/INSTALLATION  
ASSEMBLY AND INSTALLATIONS VERIFIED BY SHOP TRAVELER MANDATORY INSPECTION POINTS (MIPS) SHAFT MATERIAL INSPECTED TO DRAWING REQUIREMENTS ALIGNMENT REQUIREMENTS VERIFIED. 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 TESTING 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. Korman 8-18-98  
TECHNICAL APPROVAL : VIA APPROVAL FORM : 95-CIL-009\_02-2A