
FMEA/CIL DATA SHEET

FMEA NUMBER: DTO-OTD03-005

ORIGINATOR: JSC

PROJECT: EVA

PART NAME: Clutch Assy	LRU/ORU P/N: SEG33106254-301	QUANTITY: 1
PART NUMBER: SEG33108595-301	LRU/ORU PART NAME: OTD	
LSC CONTROL NO: N/A	DRAWING/REF DESIG: SEG33106375-301	SYSTEM: EVA
ZONE/LOCATION: Bay 7, Port Side	EFFECTIVITY/AFFECT STAGE: STS-80	SUBSYSTEM: TA&A

CRITICALITY

CRITICAL ITEM: No SUCCESS PATHS: 2
CRITICALITY CATEGORY: 1R / 2 SUCCESS PATH REMAINING: 1

END ITEM NAME: ORU Transfer Device (OTD) Clutch Assy
END ITEM FUNCTIONAL: Provides load absorption into boom stanchion.
END ITEM CAPABILITY: Has two disks that compress against the pressure plate.
END ITEM FAILURE TOLERANCE: The clutch Assy is single fault tolerant for below failure mode.

REDUNDANCY SCREENS:

- | | | |
|---|----|--|
| A | 1. | C/O PRELAUNCH: PASS |
| | 2. | C/O ON ORBIT: PASS |
| B | 3. | DETECTION FLIGHT CREW: N/A |
| | 4. | DETECTION GROUND CREW: N/A for DTO |
| C | 5. | LOSS OF REDUNDANCY FROM SINGLE CAUSE: PASS |
| | 6. | ON-ORBIT RESTORABILITY: N/A for DTO |

FUNCTION: The OTD Clutch Assembly Consists of a pitch/yaw spline, a pressure plate, a inner & outer disk and compression springs. The inner and outer disk react against the pressure plate to absorb applied loads from end of boom when boom is fully extended.

FAILURE MODE CODE: N/A for DTO
FAILURE MODE: FAILS TO DISENGAGE
CAUSE: Contamination, Binding/jamming, Thermal distortion.

REMAINING PATHS: 1 - Second disk - Both disks must fail to disengage for this failure to occur.

EFFECT/MISSION PHASE: On-orbit EVA operations

CORRECTIVE ACTION: Discontinue use of OTD when an increase in the force required to move the boom is observed. Crew grasps the ORU grid and repositions the boom during nominal operation. This action trips the clutch. Nominal force for a fully extended boom is below 20 lbs.

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-FAILURE EFFECTS-

END ITEM/LRU/ORU/ASSEMBLY: None after first failure. After second clutch jams and load is applied on end of boom, overload will cause structural damage to supporting structure

SUBSYSTEM/NEXT ASSEMBLY/INTERFACE: Structural damage to stanchion assembly.

SYSTEM/END ITEM/MISSION: None.

CREW/VEHICLE: Possible damage to supporting PLB structure. Possible loose hardware in PLB.

HAZARD INFORMATION:

HAZARD YES NO

HAZARD ORGANIZATION CODE: N/A

HAZARD NUMBER: N/A

TIME TO EFFECT: Minutes

TIME TO DETECT: Seconds

TIME TO CORRECT: Seconds

FAILURE DETECTION: Visual

REMARKS:

None.

-RATIONALE FOR ACCEPTABILITY-

PREPARED BY: G. Harvey

REVISION: N/A

DATE: June 1996

WAIVER NUMBER: N/A

FMEA/CIL DATA SHEET

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ORIGINATOR: JSC

PROJECT: EVA

PART NAME: Clutch Assy	LRU/ORU P/N: SEG33106254-301	QUANTITY: 1
PART NUMBER: SEG33108595-301	LRU/ORU PART NAME: OTD	
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-RATIONALE FOR ACCEPTABILITY-

A) **DESIGN:** The clutch assy is designed such that both the inner and outer disks must fail to disengage before worst case effects of this failure occur. The clutch assy is designed to a factor of safety of 2.0 with a positive margin of safety. The housing around the clutch is designed to eliminate debris from contaminating the pressure plate or disks. Thermal analysis of the clutch assy verifies that the clutch will operate properly in the expected thermal environment.

The clutch is designed to slip at 360 ft-lbs. The OTD is designed to stop a 600 lb mass moving at up to 11 in/sec with the boom fully extended in less than 2 ft. The clutch assy is designed to withstand the following launch and landing load factors without degradation of performance:

N _x (g's)	N _y (g's)	N _z (g's)	R _x (rad/sec ²)	R _y (rad/sec ²)	R _z (rad/sec ²)
-8.8	+/-10.6	+/-9.2	+/-219	+/-60	+/-70

B) **TEST:** (Per the applicable requirements of JSC 33518, OTD CARD)

Acceptance: Proto-flight Unit

Acceptance Testing includes: Verification of clutch assy operation is performed during each of these tests.

- 1.) OTD shall stop a 600 lb mass moving at 8 -3/-1 inch per second at maximum extension upon release of the pitch or yaw actuating control mechanism. Verified on precision air bearing floor at PDA and pre/post functional.
- 2.) Pitch/yaw clutch shall require 360 +/- 36 ft-lbs torque to rotate. Verified at PDA and pre/post functional and at protoflight thermal test.

Qualification: Proto-flight Unit

Qualification Testing includes: Vibration Test (VT), Thermal Test (TT), Fit Check (FC), & Load Test (LT). The OTD shall be verified to operate in the following temperature ranges.

1. Operational temperature range of -100 deg F to +150 deg F.
2. Remain functional after exposure to a non-operational temp. range of -175 deg F to +180 deg F

The OTD desing is vibration tested and certified for flight per TPS as follows:

For 60 seconds per axis:

<u>X-axis</u>		<u>Y-axis</u>		<u>Z-axis</u>	
20-80 Hz	+3 dB/oct	20-45 Hz	+10dB/oct	20-45 Hz	.009 g ² /Hz
45-350 Hz	.040 g ² /Hz	45-600 Hz	.060 g ² /Hz	45-70 Hz	+12 dB/oct
350-2k Hz	-3 db/oct	600-2k Hz	-6 db/oct	70-600 Hz	.050 g ² /Hz
Composite	6:1 Grms	Composite	7.7 Grms	600-2k Hz	-6 dB/oct
				Composite	7.0 Grms

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C) INSPECTION:

Fabrication - All OTD components are verified to visibly clean individually.

Test - Quality Assurance surveillance is required at all test and inspections. Discrepancy reports are written on all noncompliances.

D) FAILURE HISTORY: None - this will be the first flight use of an OTD Assembly.

E) OPERATIONAL USE:

1) Operational Effect - Failure of the first disk to disengage will not cause a structural overload situation. Failure of the second disk with applied end load on the boom will cause structural damage to the interfacing structure and stanchion Assy

2) Crew Action - At first failure - discontinue use of disk.

3) Crew Training - Crew is trained in the operations of the OTD.

4) Mission Constraint - Crew is constrained to pitch/yawing a loaded boom to less than 11 in/sec. and extending or retracting the boom to 4 in/sec (this is using the PGT set at a maximum rpm of 60).

5) In Flight Checkout - Proper function verified during STS-80 EVA operations.

PREPARED BY: G. Harvey

REVISION: N/A

DATE: June 1996

WAIVER NUMBER: N/A
