

CRITICAL ITEMS LIST (CIL)

No. 10-02-03-01R/02

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
SUBSYSTEM:	Nozzle Subsystem 10-02	PART NAME:	Flex Bearing Assembly (1)
ASSEMBLY:	Flex Bearing Assembly 10-02-03	PART NO:	(See Section 6.0)
FMEA ITEM NO.:	10-02-03-01R Rev M	PHASE(S):	Boost (BT)
CIL REV NO.:	M	QUANTITY:	(See Section 6.0)
DATE:	31 Jul 2000	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	346-1ff.	HAZARD REF.:	BN-06
DATED:	30 Jul 1999		
CIL ANALYST:	D. J. McGough		
APPROVED BY:		DATE:	
RELIABILITY ENGINEERING:	<u>K. G. Sanofsky</u>		<u>31 Jul 2000</u>
ENGINEERING:	<u>J. W. Edwards</u>		<u>31 Jul 2000</u>

- 1.0 FAILURE CONDITION: Failure during operation (D)
- 2.0 FAILURE MODE: 2.0 Inability of flex bearing assembly to meet torque or movement requirements.
- 3.0 FAILURE EFFECTS: Loss of Thrust Vector Control (TVC), causing loss of RSRM, SRB, crew, and vehicle.

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
2.1	Shear modulus of elastomer increases during storage or transportation	A
2.2	Increased shear modulus due to low temperature of elastomer during RSRM operation	B

5.0 REDUNDANCY SCREENS:

SCREEN A: N/A  
SCREEN B: N/A  
SCREEN C: N/A

6.0 ITEM DESCRIPTION:

- 1. Bearing Assembly, Nozzle Flexible (Figure 1). Materials are listed in Table 1.

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TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U52833	Aft End Ring (may be made from 1U50083)	D6AC Steel Alloy, High Strength	STW4-2709	1/motor
1U52834	Forward End Ring	D6AC Steel	STW4-2709	1/motor
1U50085	Ring, Bearing Assembly Forward	D6AC Steel	STW4-2709	1/motor
1U50097	Shim	D6AC Steel	STW4-2709	10 ea
1U51916	Cartridge (filled with Corrosion-Preventative Compound and O-Ring Lubricant)	Heavy-Duty Calcium Grease	STW5-2942	A/R
1U76888	Pressure Plug Type 303 or 304	Stainless Steel	ASTM A276	1/Flex Brng Assy
1U50228	Packing Preformed	Black Rubber	STW4-3339	1/Flex Brng Assy
AE99310E	Coupling, Bulkhead	Stainless Steel		1/Flex Brng Assy
	Rubber Compound, Natural Adhesive	Natural Rubber	STW5-2943	A/R
	Primer, Rubber-to-Metal, SRM Flex Bearing	Chlorinated Rubber	STW5-2656	A/R
	Adhesive Rubber-to-Metal, SRM Flex Bearing	Chlorinated Rubber	STW5-2657	A/R
	Cement, Natural Rubber Base	Natural Rubber	STW5-2783	A/R
	Adhesive Primer, Rubber-to-Metal	Adhesive Primer	STW5-2664	A/R
	Adhesive, Rubber-to-Metal	Chlorinated Rubber	STW5-2665	A/R
	Coatings, Epoxy-Polyamide	Epoxy and a Polyamide Resin Activator	STW5-3225	A/R
	Primer, Zinc-Rich Epoxy-Polyamide	Pigmented Epoxy Resin Base and a Polyamide Resin Activator	STW5-3226	A/R
	Sealing Compound, Temperature-Resistant, High-Adhesion	Synthetic Rubber	STW5-9072	A/R

6.1 CHARACTERISTICS:

1. The nozzle flex bearing provides capabilities of the nozzle to vector, that controls flight direction while maintaining internal motor chamber pressures.

7.0 FAILURE HISTORY/RELATED EXPERIENCE:

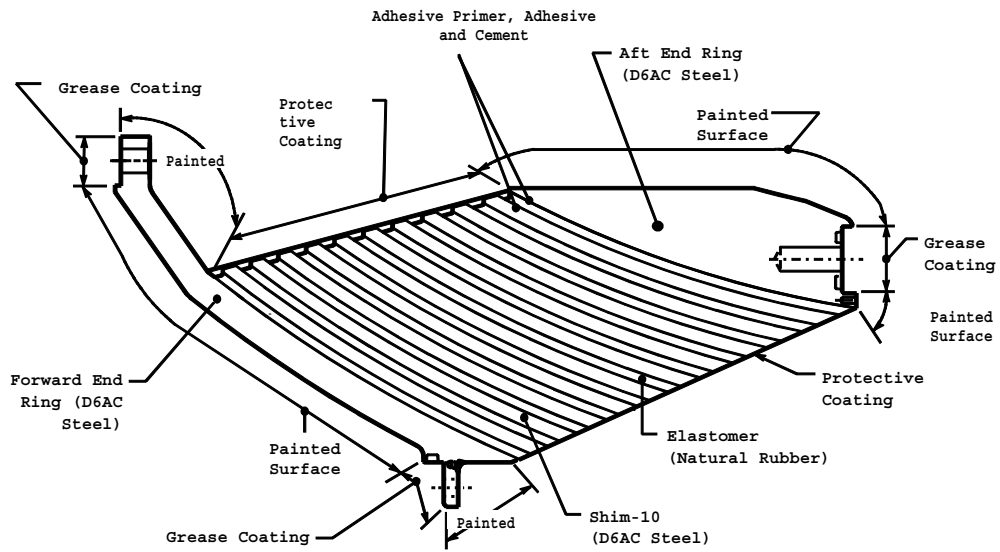
1. Current data on test failures, flight failures, unexplained failures, and other failures during RSRM ground processing activity can be found in the PRACA Database.

8.0 OPERATIONAL USE: N/A

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AM1112a

Figure 1. RSRM Flexible Bearing Assembly

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9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES

- |     |     |   |
|-----|-----|---|
| A,B | 1.  | The flex bearing shear modulus is demonstrated at the component level per engineering.  |
| A,B | 2.  | RSRM nozzle flex bearing torque versus temperature tests found that the bearing passed the five major objectives outlined in the test. The bearing passed all torque requirements for temperatures between 50 and 100 degrees per TWR-16831. A nozzle flex bearing was also tested that was 15 years old and used six times. This bearing was dissected and examination/tests determined that there was no degradation of flex bearing material properties per TWR-63806. |
| A,B | 3.  | The design factor of safety on the RSRM nozzle flex bearing assembly is 1.4. An analysis performed on the flex bearing showed a positive margin of safety per TWR-16975.  |
| A   | 4.  | Aging effect on nozzle flex bearings was evaluated and the predicted aging factor on a 20-year service life was determined per TWR-24344.   |
| A   | 5.  | Thermal analyses were performed for RSRM components during in-plant transportation and storage to determine acceptable temperature and ambient environment exposure limits per TWR-50083. Component temperatures and exposure to ambient environments during in-plant transportation or storage are controlled per engineering.   |
| A   | 6.  | Results of the flex bearing aging study per TWR-63806 determined there was no discernable degradation of flex bearings over a fifteen year time period. Only acceptable variations in material properties were realized. A flex bearing built with materials complying with engineering requirements will perform acceptably when stored for the required five years.   |
| B   | 7.  | Temperature requirements for the flex bearing prior to SRB ignition are defined in TWR-15832.   |
| B   | 8.  | Predicted temperature for the flex bearing at SRB ignition is defined in a thermal analysis per TWR-17416.  |
| B   | 9.  | Conditioned GN2 is used in the aft skirt to control temperature prior to launch at KSC per TWR-15832.   |
| B   | 10. | The acceptance report for flex bearing assemblies is per TWR-15896.   |

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9.2 TEST AND INSPECTION:

FAILURE CAUSES and			
<u>DCN</u>	<u>TESTS</u>	<u>(T)</u>	<u>CIL CODE</u>
		1. For New Bearing Assembly, Nozzle Flexible verify:	
A	(T)	a. Torque test of bearing	ADJ147
A	(T)	b. Pivot point characterization	ADJ149B
A		c. Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA033
A	(T)	d. Flat plate axial deflection test	ADJ029A
A	(T)	e. Tensile leak test	ADJ064
A	(T)	f. Thrust relief piston axial deflection test	ADJ141
B		g. Parts are thermally conditioned prior to acceptance testing	ADJ140
		2. For Refurbished Bearing Assembly, Nozzle Flexible verify:	
A	(T)	a. Pivot point characterization test	ADJ111
A	(T)	b. Torque test of bearing	ADJ147A
A		c. Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA033A
A	(T)	d. Tensile leak test	ADJ064A
A	(T)	e. Thrust relief piston axial deflection test	ADJ132C
A	(T)	f. Flat plate axial deflection test	ADJ132D
B		g. Part is thermally conditioned prior to acceptance testing	ADJ140A
		3. KSC verifies flex bearing integrity:	
A	(T)	a. SRB actuator individual channel ramp test (rock and tilt) per OMRSD, File II, Vol I, S00000.680	OMD005
A	(T)	b. SRB actuator frequency response test (rock and tilt) per OMRSD, File II, Vol I, S00000.720	OMD006
A	(T)	c. SRB actuator step response test per OMRSD, File II, Vol I, S00000.750	OMD007
B		d. Was maintained at the minimum average temperature or thermally conditioned prior to launch per OMRSD, File II, Vol I, S00FA0.776	OMD013
B		e. Temperature readings meet specification limits prior to vectoring per OMRSD, File II, Vol I, S00GEN.680.	OMD117