

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-221313-X

SUBSYSTEM NAME: AFT REACTION CONTROL SYSTEM (RCS)

REVISION : 2 12/12/89

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	THRUSTER, PRIMARY	MC467-002B
SRU :	NOZZLE EXTENSION	234240

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
NOZZLE EXTENSION, COATED COLUMBIUM (WITH INSULATION BLANKET)

QUANTITY OF LIKE ITEMS: 24
ONE PER THRUSTER

FUNCTION:

TO PROVIDE ISENTROPIC EXPANSION OF COMBUSTION GASES FOR MAX EFF IN VACUUM. NOZ EXT IS CONSTRUCTED OF C-103 COLUMBIUM WITH R-512A OXIDATION RESISTANT COATING. THE NOZZLE EXPANSION RATIO IS 22 TO 1. THE NOZ EXT IS INTEGRAL WITH THE COMB CHAMB AND ENCLOSED IN AN INSULATION SHROUD (DYNAFLEX FOR OV102, 099 CERACROME FOR OV103, 104) SO THAT THE EXTERNAL TEMPERATURE IS MAINTAINED WITHIN REQUIREMENTS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-221313-01

SUBSYSTEM: AFT REACTION CONTROL SYSTEM (RCS)	REVISION# 2 12/12/89
LRU :THRUSTER, PRIMARY	
ITEM NAME: NOZZLE EXTENSION	CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
HOT GAS LEAKAGE, BURN THROUGH.

MISSION PHASE:
LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT

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

CAUSE:
HIGH TEMPERATURE IN LOCAL SPOT, CONTAMINATED INJECTOR COOLANT HOLES,
WELD OR MAT'L DEFECT, COATING DAMAGE, VIBRATION SHOCK

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 REDUNDANCY-POSS LOSS OF 3 THRUSTERS IF MANIFOLD ISOL VALVE MUST
BE CLOSED. POSSIBLE PRESSURIZED LINE OR TANK RUPTURE DUE TO HOT GAS
IMPINGEMENT. LEAKAGE OF HOT GAS INTO THE COMPARTMENT.

(B) INTERFACING SUBSYSTEM(S):
INCREASED GN&C AND USE OF ALTERNATE THRUSTERS. POSSIBLE DAMAGE TO TPS.
POSSIBLE DAMAGE TO THE POD DUE TO OVERPRESSURIZATION.

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(C) MISSION:

MISSION MODIFICATION/ABORT DECISION IF FAILURE CAUSES DAMAGE PROPAGATION.

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

LOSS OF CREW/VEHICLE BURN THRU MAY CAUSE HIGH TEMP DAMAGE TO SURROUNDING STRUCT & ADJ THRUSTERS RESULTING IN POSS ENTRY HAZ IF TPS IS DAMAGED. OVERPRESSURIZATION MAY OCCUR.

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

(A) DESIGN:

HIGH THERMAL MARGINS IN NOZZLE EXTENSION WILL MINIMIZE FAILURE EFFECT. THRUSTER DESIGNED TO INGEST 15 CUBIC IN. OF GAS.

THRUSTER CAN BE ISOLATED AT INLET OR MANIFOLD VALVE. INTERMETALLIC DIFFUSION LAYER FORMS AN INTEGRAL BOND BETWEEN THE DISILICIDE COATING AND THE PARENT COLUMBIUM MATERIAL AND TENDS TO RESIST SHOCK LOADING.

STRUCTURAL MARGINS (2.0 TO 4.0) MINIMIZE FAILURE EFFECT(S). THRUSTERS HAVE LIMITED LIFE BASED ON USAGE.

(B) TEST:

THE QUALIFICATION TEST PROGRAM INCLUDED ROUGH HANDLING, VIBRATION (34 MIN/AXIS), FORWARD AND REVERSE INTERNAL LEAKAGE, EXTERNAL LEAKAGE, ABNORMAL OPERATION, ACCELERATED LIFE DUTY CYCLE, PROPELLANT COMPATIBILITY, BURST, HEATER OUT IGNITION, NOZZLE THERMAL TRANSIENT, MISSION DUTY CYCLE.

ACCEPTANCE TESTING INCLUDES PROOF PRESSURE OF THE NOZZLE (150 PSIG), EXTERNAL LEAKAGE, CLEANLINESS, THRUSTER PERFORMANCE.

OMRSD PERFORMS THE FOLLOWING: A THRUSTER VISUAL INSPECTION EACH FLIGHT BEGINNING WITH THE 2ND FLIGHT USING A FLASHLIGHT AND MIRROR. THRUSTER INSPECTION ON A FIFTH FLIGHT INTERVAL USING A BORESCOPE. THRUSTER INSPECTION AFTER USING PRESSURE PLUGS ON A CONTINGENCY BASIS. COATING SURFACE PROTECTION.

(C) INSPECTION:

RECEIVING INSPECTION

RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIAL AND PHYSICAL PROPERTIES (RAW MATERIAL, ANNEALING).

ASSEMBLY/INSTALLATION

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FINAL INSPECTION OF ALL DIMENSIONS IS VERIFIED. SURFACE FINISHES ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

FUSED DISILICIDE COATING THICKNESS IS VERIFIED BY EDDY CURRENT. WELDS ARE RADIOGRAPHIC INSPECTED PER MPS-909 AND ARE ALSO EITHER MAGNETIC PARTICLE OR PENETRANT INSPECTED.

CRITICAL PROCESSES

WELDING AND APPLICATION OF DISILICIDE COATING IS VERIFIED BY INSPECTION. TEST SPECIMENS OF THE COATING ARE INSPECTED AND TESTED PER MPS-0545 REQUIREMENTS. THE COATED ASSEMBLIES ARE ALSO HEATED TO 2500 DEG F TO VERIFY COATING INTEGRITY. THE SURFACE IS THEN INSPECTED WITH A BORESCOPE AND A VIDEO TAPE RECORD IS MADE OF THE COATING CONDITION.

TESTING

ATP IS WITNESSED AND VERIFIED BY INSPECTION. WATER FLOW TESTS, PER INTERNAL TEST PROCEDURE, VERIFIES BY INSPECTION NO OCCLUDED PASSAGES IN THE INJECTOR. TEST FIRING WITH HEAT SENSORS VERIFY BY INSPECTION THAT THERE ARE NO HOT SPOTS.

(D) FAILURE HISTORY:

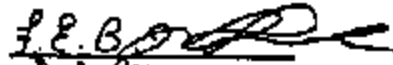



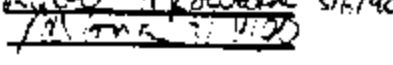
CARS AD169 KSC, AD1606 ATP, AND AD1705 ATP:
COATING DAMAGE WAS REPORTED ON THREE THRUSTERS. INSTALLATION AND REMOVAL OF THE RCS THROAT PLUG CAUSED THE DAMAGE.
CORRECTIVE ACTION - TO PRECLUDE DAMAGE WHEN INSTALLING THE THROAT PLUGS, THE OMRSD LIMITS THE PRESSURE APPLIED FOR TESTING WHEN PLUG IS INSTALLED. THE THRUSTERS ARE INSPECTED WITH BORESCOPE AFTER PLUG USAGE AND AFTER EVERY FLIGHT FOR COATING DAMAGE.

ONE THRUSTER WITH COATING DAMAGE WAS FIRED TO DETERMINE IF THE ENGINE COULD GO ONE MISSION WITH MINOR COATING DAMAGE. NO DEGRADATION OF COATING WAS OBSERVED IN THE AREA OF DAMAGE.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

RELIABILITY ENGINEERING:	F. E. BARCENAS	:	
DESIGN ENGINEERING	: B. DIPONTI	:	
QUALITY ENGINEERING	: M. SAVALA	:	
NASA RELIABILITY	:	:	
NASA SUBSYSTEM MANAGER	:	:	
NASA QUALITY ASSURANCE	:	:	