Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-01	OMS/RCS
PROP-01	**GMT:**		**SPR** 63RF01	**UA**	**Manager:**
			IPR	**PR** RP03-22-0678	
					Engineer:

Title: Primary Thruster R1U Fail Off/Fail Leak (ORB)

Summary: INVESTIGATION/DISCUSSION: Reaction control subsystem (RCS) primary thruster R1U (S/N 497) was declared failed-off when used during the External Tank (ET) separation maneuver. This was the first attempted firing of thruster R1U during the mission. When the fire command was initiated, the thruster chamber pressure indication increased to only 2.4 psia prior to deselection by redundancy management (RM) at 320 msec. RM declares a thruster failed-off after receiving three consecutive chamber pressure discretes indicating a chamber pressure of less than 36 psia. The nominal chamber pressure for a primary thruster is approximately 152 psia. Immediately after the fail-off, the oxidizer valve began leaking as indicated by the rapid drop of the oxidizer injector temperature. RM declared the thruster failed-leak approximately 70 seconds after the fail-off when the oxidizer injector temperature dropped below the 30 deg F leak-detection limit. The initial leak rate was determined to be approximately 800 cc/hr.

The fail-leak of this thruster resulted in significant concerns regarding the Mir rendezvous, the primary objective of the STS-63 mission. Although the leak rate decreased to approximately 150 cc/hr after about 2 days, it was apparent that the leak was not going to heal itself. The Russians were uncomfortable with the Orbiter approaching the Mir with a leaking thruster, however, closing the right manifold 1 would result in the loss of primary thruster R1A and therefore low-Z redundancy, which was a Russian requirement for the rendezvous. As a result of these concerns, the right manifold 1 isolation valve was cycled on four occasions in an attempt to stop the leak. It was hoped that the resulting pressure surges within the manifold would clear any contamination that might have caused the leak. No significant change in the leak signature was noted as a result of the manifold valve cycles. After discussions with the Russians, it was agreed to proceed with the rendezvous with the manifold closed, and the manifold would be re-opened if was needed to regain redundancy. No additional thruster failures occurred during the rendezvous and fly-around operations. The S/N 497 thruster had been flown on 11 missions prior to STS-63, all on orbital maneuvering system (OMS) pod RP03 in the R1U position. The thruster had no previous flight failures. However, the thruster did have reported oxidizer vapor leakage during the STS-63 flow. The leakage occurred following an incident in which the oxidizer manifold pressures dropped to 30 psia due to cold temperatures during a night roll-out of the vehicle from the Orbiter Processing Facility to the Vehicle Assembly

Building. This event resulted in severe oxidizer valve leakage on thruster R3A, which subsequently had to be removed and replaced at the pad (along with thruster R3R). Prior to rolling to the pad, the system was pressurized to 150 psia, at which time the thruster R1U leakage was noted. The leakage was deemed manageable and the decision was made to fly as-is. Based on previous flight experience, the most probable cause of the fail-off and fail-leak was metallic-nitrate contamination of the thruster's oxidizer valve. The oxidizer-valve main-stage probably failed to open fully due to metallic-nitrate contamination of the pilot stage. Pilot-stage contamination results in only partial pilot flow. This in turn causes the failure of the upper valve cavity pressure to bleed off to provide the differential pressure necessary to operate the main stage. Metallic-nitrate contamination migrating between the the seal and the poppet during the limited pilot flow is the likely casue of the subsequent leak. It is also likely that the leakage encountered on the ground aggravated the formation of metallic-nitrates at the seal interface. The thruster was removed and replaced at KSC and shipped to the WSTF for deionized water flushing of the oxidizer valve (the oxidizer and fuel valves are -506s and are therefore water flushable). Pending successful completion of the water flush and the post-flush leak check, the thruster will be returned to spares at KSC. If the oxidizer valve fails the leak check, the valve will be replaced and the thruster will be re-acceptance tested prior to being returned to spares. CAUSE(s)/PROBABLE Cause(s): The cause of the thruster fail-off and subsequent fail-leak was most probably metallic-nitrate contamination in the oxidizer- valve pilot-stage that prevented its proper operation. CORRECTIVE_ACTION: KSC removed and replaced thruster R1U, and the thruster was transferred to the WSTF for deionized water flushing. Results of the water flushing will be reported to the Orbiter Action Tracking List (OATL) as required by CAR 63RF01. Due to the frequency of primary thruster failures, a team was formed to look into the causes of the failures and consider solutions. These solutions include possible hardware changes for the future and processing changes for the near term. Among the recommended processing procedures, many are already in place. Metallic-nitrate contamination, the cause of the fail-off, is assisted by the presence of water (moisture) in the oxidizer system. Therefore, the primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system.   Also, RCS break-ins are minimized to preclude the introduction of contamination and the propellant manifolds are maintained whenever possible at an elevated pad pressure to maintain sealing integrity. Periodic water flushing of the valves, hardfilled-manifold pod processing, and improved thermal conditioning for all flow phases, are among several proposed processing changes that are being considered.   A program to develop a direct- acting valve, which would be less susceptible to failure from metallic-nitrate contamination, is currently in progress. Additionally, an evaluation of modifications to improve the existing valve will be pursued. RATIONALE FOR FLIGHT: System redundancy is adequate to support the failure rate of the primary RCS thrusters. There have been no changes to the thruster design or to the RCS turnaround processing procedures that would adversely affect this failure rate.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-02	OMS/RCS
PROP-02	**GMT:**		**SPR** 63RF02	**UA**	**Manager:**
			IPR	**PR** LP01-24-0672	
					Engineer:

Title: Primary Thruster L2D Fail Off (ORB)

Summary: INVESTIGATION/DISCUSSION: Reaction control subsystem (RCS) primary thruster L2D (S/N 328) was declared failed-off when used during the External

Tank (ET) separation maneuver. This was the first attempted firing of thruster L2D during the mission. When the fire command was initiated, the thruster chamber pressure indication increased to only 13 psia prior to deselection by redundancy management (RM) at 320 msec. RM declares a thruster failed-off after receiving three consecutive chamber pressure discretes indicating a chamber pressure of less than 36 psia. The nominal chamber pressure for a primary thruster is approximately 152 psia. Injector tube temperature data indicate both oxidizer and fuel flow occurred. The injector temperature data also indicate that the thruster failed to fire as evidenced by the lack of a post-firing temperature rise due to soakback heating.

The data seen during flight is the classic signature for a fail-off due to metallic-nitrate contamination of the thruster oxidizer valve. The oxidizer flow seen in the injector tube temperature data was most probably pilot-valve- only (or limited) flow, which accounted for the low chamber pressure. The oxidizer-valve main-stage probably failed to open fully due to metallic- nitrate contamination of the pilot stage. The RCS primary thruster oxidizer valve has a solenoid-operated pilot stage and a pressure-operated main stage and a failure to operate due to metallic-nitrate contamination in the pilot stage is the most common failure mode. The thruster was left deselected for the remainder of the mission. The S/N 328 thruster had been flown on 21 missions prior to STS-63, 7 flights on orbital maneuvering system (OMS) pod RP03 in the R3D position and 14 flights on OMS pod LP01 in the L2D position. The thruster had no previous flight failures and no reported history of ground leaks. The oxidizer and fuel valves are -505s, and are therefore water flushable at the White Sands Test Facility (WSTF). The thruster was removed and replaced at KSC and shipped to the WSTF for deionized water flushing of the oxidizer valve. Pending successful completion of the water flush and the post-flush leak check, the thruster will be returned to spares at KSC. If the oxidizer valve fails the leak check, the valve will be replaced and the thruster will be re-acceptance tested prior to being returned to spares.
CAUSE(s)/PROBABLE Cause(s): The cause of the thruster fail-off was most probably metallic-nitrate contamination in the oxidizer-valve pilot-stage that prevented its proper operation. CORRECTIVE_ACTION: KSC removed and replaced thruster L2D, and the thruster was transferred to the WSTF for deionized water flushing. Results of the water flushing will be reported to the Orbiter Action Tracking List (OATL) as required by CAR 63RF02. Due to the frequency of primary thruster failures, a team was formed to look into the causes of the failures and consider solutions. These solutions include possible hardware changes for the future and processing changes for the near term. Among the recommended processing procedures, many are already in place. Metallic-nitrate contamination, the cause of the fail-off, is aggravated by the presence of water (moisture) in the oxidizer system. Therefore, the primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system. Also, RCS break-ins are minimized to preclude the introduction of contamination and the propellant manifolds are maintained whenever possible at an elevated pad pressure to maintain sealing integrity. Periodic water flushing of the valves, hardfilled-manifold pod processing, and improved thermal conditioning for all flow phases, are among several proposed processing changes that are being considered. A program to develop a direct- acting valve, which would be less susceptible to failure from metallic-nitrate contamination, is currently in progress. Additionally, an evaluation of modifications to improve the existing valve will be pursued. RATIONALE FOR FLIGHT: System redundancy is adequate to support the failure rate of the primary RCS thrusters. There have been no changes to the thruster design or to the RCS turnaround processing procedures that would adversely affect this failure rate.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-63-V-03	OMS/RCS
PROP-03	GMT:		SPR 63RF03	UA	Manager:
			IPR	PR FRC3-21-0466	x39030
					Engineer:

Title: Primary Thruster F1F Fail Leak (ORB)

Summary: INVESTIGATION/DISCUSSION: Primary reaction control system (RCS) thruster F1F was declared 'fail leak' by redundancy management (RM) software at 035:19:16 G.m.t. (001:13:54 MET) when the oxidizer injector temperature fell to 16.5 ?F following a nominal firing of the thruster. The observed temperature drop was characteristic of an oxidizer leak. The fuel injector temperature eventually dropped below 40 ?F in response to the oxidizer leak, prompting closure of the forward RCS manifold 1 isolation valves at 035:20:28 G.m.t. (001:15:06 MET).

Forward RCS manifold 1 isolation valves were opened at 036:04:21 G.m.t. (01:22:59 MET) to allow the force of repressurizing the oxidizer manifold to clear potential contaminants from the oxidizer valve seat. No further leakage was detected, and three nominal firings of the thruster were performed. The thruster was returned to normal operation, but was not fired again during the mission. No unusual leakage was noted on the thruster during ground testing. CAUSE(s)/PROBABLE Cause(s): Primary RCS thruster F1F probably leaked oxidizer because a transient contaminant was trapped somewhere on the oxidizer valve's main-stage seating surfaces. Since the leak occurred after a nominal firing rather than a fail-off firing attempt, the amount of contamination involved is likely to have been small. CORRECTIVE_ACTION: Rapid repressurization of forward RCS oxidizer manifold 1 while on orbit allowed a small amount of oxidizer to flush the transient contaminant from the F1F oxidizer valve seat. The thruster was successfully fired three times and was reselected for the remainder of the mission. No further leakage was noted in flight or during ground testing, and no further corrective action is required. RATIONALE FOR FLIGHT: The transient contaminant was cleared from the F1F oxidizer valve seat during the mission and the thruster was subsequently fired three times with nominal performance. No further leakage has been detected during flight or ground operations, and thruster performance is acceptable for continued service.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-63-V-04	D&C - C&W
DPS-01	GMT:		SPR 63RF04	UA	Manager:
			IPR 70V-0004	PR OEL-3-21-0602	
					Engineer:

Title: Recurring Loss of CRT-4 Display (ORB)

Summary: INVESTIGATION/DISCUSSION: During post-insertion activities, approximately 1/2 hour after CRT-4 was powered up, the crew noticed that the CRT-4 display was blank. Data showed that the Display Electronics Unit (DEU) 4 Built In Test Equipment (BITE) flag was tripped at 034:07:04 G.m.t. (00:01:42 MET). The applicable malfunction procedure was performed and the CRT-4 function was restored when power to the unit was cycled. The failure recurred three times at random intervals during the flight. Each time, the CRT was recovered by cycling the power.

During the STS-63 vehicle processing flow, a similar failure had resulted in replacement of DEU-4. The low probability of a subsequent identical in-flight failure involving a different DEU in the same slot indicated a probable intermittent power anomaly, rather than a DEU problem. CAUSE(s)/PROBABLE Cause(s): Postflight troubleshooting determined that the failures were being caused by intermittent power from the remote power controller (RPC) 46 circuit in forward power control assembly (FPCA) 3. FPCA- 3 changeout was performed and the unit was sent to NSLD, where further troubleshooting confirmed the problem. Testing of the RPC (part number MC450- 0017-1100) has further isolated the problem to a leaderless inverted device (LID) within the RPC. Failure analysis, in which the LID’s potting was removed to allow microscopic analysis, found a separated bond wire in the device. This is a known failure mode of the LID’s in the -1XXX RPC’s, which has been corrected in the subsequent -2XXX and -3XXX versions of the hardware. A review of the failure history revealed nine failures in which an RPC failed off. Six of the nine occurred in the -1XXX hardware series and the remaining three involved the -2XXX series. There have been no fail-off problems involving the later -3XXX series. Each Orbiter has 668 RPC's, and there are 3,088 flight units currently in the fleet including spares. Four hundred of these are -1XXX RPC's. Since the number of similar failures is insignificant when compared the large number of healthy RPC's in the fleet, this failure does not represent a concern. CORRECTIVE_ACTION: The Orbiter condition has been corrected by hardware replacement. Failure analysis conducted under CAR 63RF04 determined that the problem involved a known RPC failure mode. Corrective actions have already been implemented to eliminate this condition in subsequent hardware. It is considered acceptable to continue to fly as-is with -1XXX RPC’s because of the low probability of failure. RATIONALE FOR FLIGHT: System redundancy is adequate to mitigate the effects of loss of a CRT display (criticality 1R3). There is one criticality 1 effect for the loss of an RPC's output, which involves loss of power to the remote manipulator system (RMS) manipulator controller interface unit (MCIU) during arm operations. This results in loss of the prime (auto) control mode and possible incomplete rigidization of the arm, leading to potential vehicle damage because of unexpected arm or payload motion. The probability of vehicle damage is considered remote due to the ability to restore control of the RMS using either the direct or the back-up control modes. Loss of the mission could occur due to the inability to perform payload operations in the RMS direct and back-up control modes, and subsequent failure of the other control modes could lead to EVA and/or jettison of the RMS. Since the failure history indicates that this anomaly has a low probability of occurrence, the likelihood that a critical RPC failure will result in the loss of a mission or vehicle is considered remote.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-05	MECH
MMACS-01	**GMT:**		**SPR** 63RF05	**UA**	**Manager:**
			IPR 70V-0003	**PR**	

Engineer:

Title: Port Radiator Latch 1-6 Actuator Latch A Indication Toggling (ORB)

Summary: INVESTIGATION/DISCUSSION: At 037:20:06 G.m.t. (003:14:43:56 MET), two days after the port radiator was stowed, the latch system 1 indication (V37X3528E) for the port radiator latch gang 1-6 actuator began toggling off and on. During the next 1.5 hours, the indication toggled approximately 250 times and then stayed on through the remainder of the flight. The redundant system 2 indication (V37X3533E) remained in the on position for the duration of the system 1 toggling. This intermittent failure was detected by the ground operators. The failure is not readily detectable by the flight crew.

Postflight troubleshooting on the latch 1-6 power drive unit (PDU), (s/n 8181700000VP106) which includes the limit switches, was performed under KSC IPR IV6-053005. Prior to unlatching the port radiator, the PDU sill-connector was demated and return voltage from the latch limit switch was measured and found to be nominal. The port radiator was deployed and the wiring inspected and no damage was noted. A shake test of the wiring was also performed with nominal results. Prior to latch PDU removal, the rigging of the six forward latches was checked. The rigging was determined not to be a contributor. The vehicle testing indicated the source of the anomalous condition was the PDU. The probable causes of the toggling indicator could be the mechanical rigging of the suspect limit switch, electrical wiring within the PDU, or particles within the limit switches. Because of the past history of particles in limit switches, a particle impact noise detection (PIND) test was developed to screen the hardware. The limit switches in this PDU have not been PIND tested. The limit switches are scheduled to be replaced with PIND-tested switches on an attrition basis. The port radiator latch 1-6 PDU was removed and sented to the NASA Shuttle Logistics Depot (NSLD) for teardown, testing and evaluation (TT&E). After refurbishment of the PDU with PIND-tested limit switches, the PDU will be tested per acceptance test procedure (ATP) and returned to spares. A replacement PDU was installed and cycled to verify proper operation prior to being connected to the latch mechanism. All cycles were nominal. CAUSE(s)/PROBABLE Cause(s): The specific failure is unknown at this time; however, the problem has been isolated to the PDU. The PDU has been sent to NSLD for TT&E. The Depot will verify the mechanical rigging of the suspect switch and the electrical wiring, and all non-PIND tested limit switches will be replaced with PIND-tested switches. CORRECTIVE_ACTION: The port radiator latch 1-6 PDU was removed. The PDU was sent to NSLD for failure analysis and repair. The failure analysis will be tracked by the CAR 63RF05-010. A replacement PDU was installed and cycled to verified proper operation prior to its connection to the latch mechanism. All cycles were nominal. RATIONALE FOR FLIGHT: A repeat of an intermittent toggling indicator in-flight would have no impact to the mission. If the toggling occurred prior to radiator latching, the motor controlled by the limit switch could be inhibited and the latch gang would be latched by a single motor.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-06	Atmospheric Rev
EECOM-01	**GMT:**		**SPR** 63RF06	**UA**	**Manager:**
			IPR 70V-0005	**PR**	
					Engineer:

Title: Cabin Pressure Sensor Shifted Low (ORB)

Summary: INVESTIGATION/DISCUSSION: At 034:21:50 G.m.t. (00:16:28 MET), the cabin pressure transducer experienced a 0.23 psi shift from 14.64 to 14.41 psi. Other data indicate that the cabin pressure was constant at the time of the shift. The pressure transducer in the Spacehab module indicated 14.8 psi and did not provide any evidence of a cabin pressure fluctuation.

The sensor was removed from the vehicle. The 0.23 psi shift remained constant during bench testing, confirming that the failure was internal to the sensor and was not caused by a failure in any of the Orbiter instrumentation. The failed sensor has been sent to the vendor for failure analysis. The results of this analysis will be documented on CAR 63RF06. CAUSE(s)/PROBABLE Cause(s): The most probable cause of the cabin-pressure- sensor shift was a failure internal to the sensor. CORRECTIVE_ACTION: The cabin pressure sensor has been replaced and the failed sensor has been sent to the vendor for failure analysis. The new cabin pressure sensor has been tested and is performing nominally. RATIONALE FOR FLIGHT: The cabin pressure sensor is not a constraint for flight as long as the cabin pressure rate-of-change measurement is available as a backup. As this is the first in-flight failure for this type of sensor it is not considered a generic flaw. The replacement sensor is functioning nominally.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-07	Hand Controller
GNC-01	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR None	**PR**	x37478
					Engineer:

Title: Inadvertent Firing of L1L, L1U, R4U, F3L, and F3U (ORB)

Summary: INVESTIGATION/DISCUSSION: Primary reaction control system (RCS) thrusters L1L, L1U, R4U, F3L, and F3U inadvertently fired simultaneous 80-msec pulses at 035:11:41:06 G.m.t. (001:06:19:02 MET) when aft flight controller power was switched on. The firing was consistent with a +Y/+Z translation command response. The crew reported that the aft station translational hand controller (THC) had not been deflected.

A THC translation command is produced when two of the three THC contact outputs for a given translation direction are set high. When a THC translation command output is present while the output is being sampled by the general purpose computer (GPC) at 160-msec intervals, a command is issued to fire the associated thrusters. GPC software invalidates all translation commands if any simultaneous commands for translation in opposing directions are detected when the sample takes place. When flight controller power is switched on, a 40-msec transient occurs while capacitors in the THC contact output circuitry charge causing each of the THC's eighteen contact outputs (three contacts for each of the six translation directions) to be set high during the transient. This condition produces THC translation command outputs in all six directions. If THC command outputs are sampled during the middle of a power-on transient while all THC contact outputs are still set high, software invalidates all translation commands because opposing commands will be present. However, at the end of the power-on transient, the eighteen THC contact outputs do not return to the low state simultaneously due to within- tolerance charging circuit time constant variations; therefore, THC translation command outputs produced by the contact outputs are also not set off simultaneously. If THC command outputs are sampled at the end of the power-on transient while unopposed translation commands are still present, an inadvertent thruster firing command is issued. If the reaction jet drivers (RJDs) are powered, an inadvertent firing of the commanded thrusters occurs. A similar event occurred during STS-66 when the forward flight controller power was switched on resulting in deselection of thrusters that were commanded to fire while RJD power was off. This event was initially attributed to the possiblity that a crewmember in the vicinity of the forward station may have bumped the THC, although the crewmember did not recall bumping the THC. The power-on transient phenomenon was thought to be too improbable to be the most likely cause at the time, but the subsequent occurrence of an inadvertent firing on STS-63 induced by the application of flight controller power indicated the THC power-on transient phenomenon may be the more likely cause of the STS-66 event. Shuttle Avionics Integration Laboratory (SAIL) testing accomplished after the STS-66 mission determined that SAIL hardware had a 375-microsecond window produced by the variation in charging times between the eighteen THC contacts at the end of the power-on transient during which a sample of THC command outputs might produce an inadvertent firing command, but this single data point cannot be extrapolated to predict a probability that the phenomenon will be experienced on other flight THC hardware. Inadvertent primary RCS translation firings are not desirable, but they do not pose a concern for most flight operations. Firing duration is limited, accelerations are small, and propellant usage is not significant. Where concerns exist, such as operations with a payload attached to the remote manipulator system, flight crews are being trained to disable guidance, navigation, and control (GN&C) switch redundancy management (RM) using an ITEM 16 entry on the SPEC 025 page when flight controller power is switched on to inhibit THC command processing. A software change proposal is under review that would allow the THC hotstick logic to be turned on and off as necessary to prevent automatic moding to primary thrusters for a translation firing in response to a THC power-on transient or a bumped stick. CAUSE(s)/PROBABLE Cause(s): The inadvertent firing of primary RCS thrusters was probably caused by a power-on transient in the aft station THC circuitry that was induced by application of aft station flight controller power. THC translation command outputs were probably sampled by the GPC at the end of the power-on transient when THC contact outputs were returning to their normal state after being set high by the transient. CORRECTIVE_ACTION: Flight crews are being trained to disable GN&C switch RM using an ITEM 16 entry on the SPEC 025 page when flight controller power is switched on to inhibit THC command processing. A software change proposal is under review that would allow the THC hotstick logic to be turned on and off as necessary to prevent automatic upmode to primary thrusters for a translation firing in response to a THC power-on transient or a bumped stick. RATIONALE FOR FLIGHT: Inadvertent primary RCS translation firings do not pose a concern for most flight operations. Firing duration is limited, accelerations are small, and propellant usage is not significant. Where concerns exist, such as operations with a payload attached to the remote manipulator system, flight crews are being trained to prevent inadvertent firings as necesary by disabling GN&C switch RM when flight controller power is switched on.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-63-V-08	MECH
MMACS-01	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR 70V-0006	**PR**	
					Engineer:

Title: Spacehab Pressure Decay During EVA (ORB)

Summary: INVESTIGATION/DISCUSSION: The Spacehab pressure decayed from 14.8 psia to 14.16 psia during the 5 hour and 18 minute period that the airlock was depressurized. The was no change in the Spacehab temperature during this period. During the EVA the consumable use was nominal, therefor the leakage rate is thought to have occurred across the tunnel adapter (TA) and Spacehab interface. The most likely component is the TA duct isolation valve and cap.

The function of the TA ducting is to supply the crew module cabin air to the Spacehab cabin fan assembly. In this configuration, the isolation valve is open and the cap is removed. During launch and landing the valve is closed and the cap is installed to prevent the loss of Spacehab atmosphere in the event of a Tunnel adapter leak. The valve is also closed and the cap installed to prevent the loss of Spacelab atmosphere during EVA activities. Troubleshooting at KSC consisted of performing a leak check of the isolation valve and the cap together which is the same configuration during the EVA. The results were 31.5 sccm with an allowable of 15 sccm (maximum). This finding is insignificant because the leakage seen was less than 1 percent of that experienced inflight (~ 0.8 lb/hr). Lint was found on the isolation valve and cleaned with isopropyl alcohol per problem report ECL 3-21-1020. The valve was then leak checked with the cap removed and was within specification. The cap was then leak checked with the valve open. This resulted in a leak of approximately 3 lb/hr, which is the highest the ground service equipment (GSE) in-line flowmeter would read. The cap was then removed and inspected. Some paint chips from possible over-spray were noted and cleaned. Another leak check resulted in 0.8 lb/hr (same as noted inflight). The Marman clamp, used to secure the cap to the valve assembly, was inspected. A bent pin in the saddle of the clamp was found. A new clamp was installed and the leak check for the cap was then within specification. Troubleshooting of the equalization valves on the hatch 'D' indicated no leakage across either 'A' or 'B'. A special test was performed in an attempt to emulate the leakage found inflight. This special test included reverse flowing the valves open, with the caps installed. This test indicated no leakage with up to 14 psig applied. When the TA ducts were removed, an internal inspection with photography was performed. An excessive amount of blue lint was found caked to the inner wall throughout the ducting. This is most likely due to the ducts having flown three times without being removed and cleaned. These ducts for Spacehab are exposed to much more contamination than those of Spacelab because of a screened housing installed at the crew module middeck interface. The coarse screen housing was designed to provide more airflow to Spacehab's cabin fan. Because Spacehab's fan requires more air the than the cabin fan delivers to that duct, a vacuum exists at the screened housing, drawing in crew module contaminants. The initial postflight leak check of the cap alone indicated a leak rate larger than that experienced inflight. If the isolation valve had hair and lint trapped across its sealing surface when the crew configured it for the EVA, it could have leaked the 0.8 lb/hr experienced inflight without the cap acting as a redundant seal. This contamination should have been released when the crew configured the valve and cap for normal flight operations, and then reconfigured for landing operations. Because of the movement of the valve and any possible contamination post-EVA, the exact leakage experienced could not be repeated. Therefore, leakage across the valve combined with the cap anomalies found, present a basis for the most probable cause. More frequent cleaning of the ducts will be recommended to be performed to prevent the problem from occurring in the future. CAUSE(s)/PROBABLE Cause(s): The most probable cause for the pressure decay during EVA is leakage across the valve combined with the cap anomalies. CORRECTIVE_ACTION: The isolation valve was cleaned and leak checked. The valve cap was cleaned and leak checked. The tunnel adapter ducting was removed, cleaned, and reinstalled. A crew procedure change for inspection of the isolation valve sealing surface and valve cap is to be developed. A Operations Maintenance Requirements and Specifications Document requirement is to be developed to inspect the isolation valve sealing surface and valve cap prior to installation of the tunnel adapter. RATIONALE FOR FLIGHT: The isolation valve and valve cap have been verified to be within maximum leakage specifications.