

Shuttle Flight Operations Manual

Volume 10B
Active Vent Doors

Flight Operations Directorate
Crew Training and Procedures Division

Preliminary
February 28, 1979

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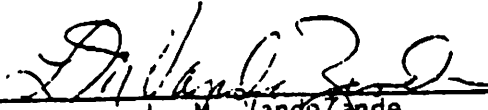


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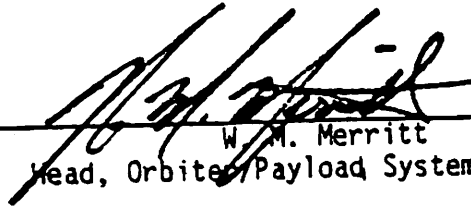
Volume 108 Active Vent Doors

Prepared by Flight Training Branch

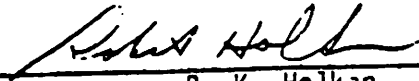


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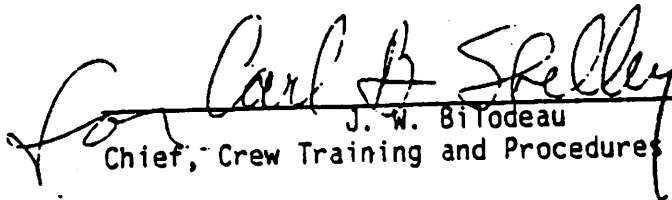
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CONTENTS

Section		Page
1.	<u>INTRODUCTION</u>	1-1
1.1	PURPOSE OF ACTIVE VENT SYSTEM	1-3
1.2	DESCRIPTION	1-3
1.2.1	Vent Door Location	1-3
1.2.2	Internal Vents and One-Way Valves	1-4
2.	<u>SYSTEMS INTERFACES</u>	2-1
2.1	OVERVIEW	2-3
2.2	DATA PROCESSING SYSTEM INTERFACE	2-3
2.2.1	Pulse Commanding	2-3
2.3	ELECTRICAL POWER INTERFACE	2-3
3.	<u>SYSTEMS DESCRIPTION</u>	3-1
3.1	PURGE SYSTEM	3-3
3.2	SOUND PRESSURE LEVEL	3-3
3.3	HAZARDOUS GAS CONCENTRATION DURING ASCENT	3-7
3.4	MOLECULAR VENTING	3-7
3.5	VENT DOOR SEQUENCING	3-7
3.6	HARDWARE DESCRIPTION	3-9
3.6.1	Vents 1 And 2	3-9
3.6.2	Single Door Actuators (Vents 3,5 and 6)	3-9
3.6.3	Vents 4 And 7	3-9
3.6.4	Vents 9 And 8	3-11
3.6.5	Door Actuator	3-11
3.6.5.1	3 ϕ motor control	3-11
3.6.5.2	Torque limiter	3-11
3.6.5.3	Microswitch position indicator	3-11
3.7	POWER SWITCHING AND CONTROL	3-13
3.8	VENT DOOR THERMAL BARRIER	3-13
4.	<u>DISPLAY AND CONTROL</u>	4-3
4.1	CREW INTERFACE	4-3
4.1.1	Control Panel MA73C	4-3
4.1.1.1	RM sensor set display	4-5
4.1.1.2	DPS utility display	4-6
4.2	SWITCH AND CB FUNCTION TABULATION	4-7
4.3	TABLE II - VENT MOTOR POWER/CONTROL	4-11
4.4	TABLE III - POWER CONTROL GROUPS	4-11
5.	ACTIVE VENT SYSTEM CONSTRAINTS	5-3

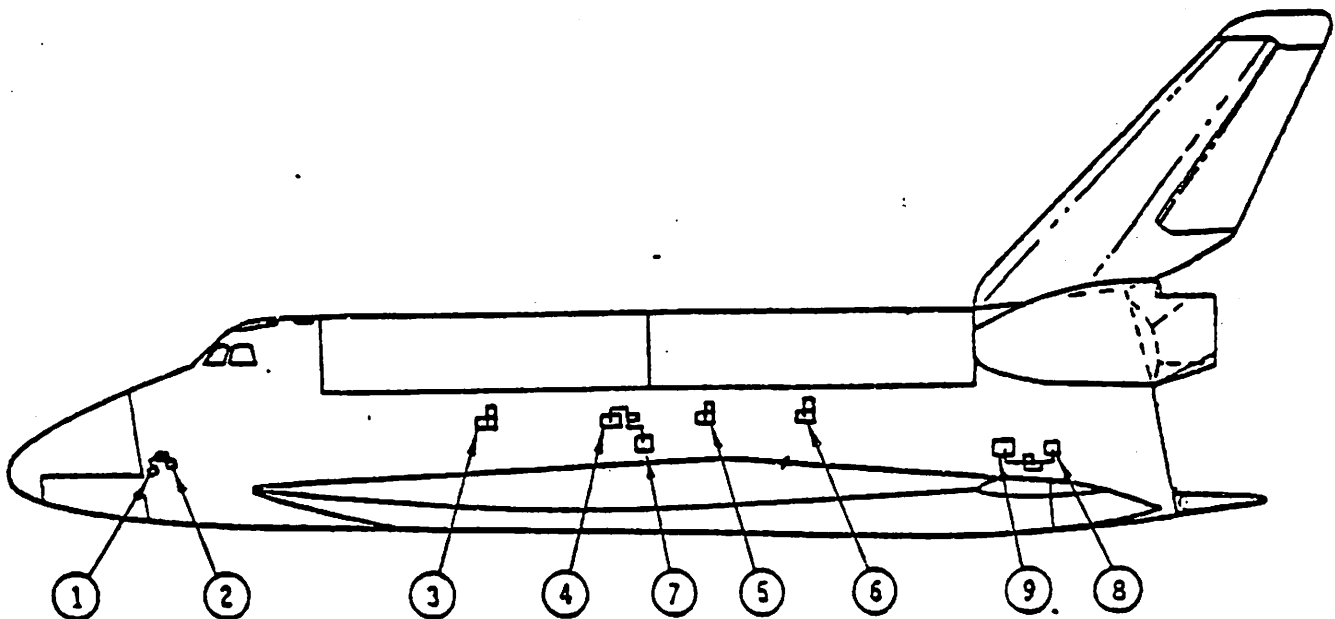
TABLES

Table		Page
4-I	SWITCH AND CB FUNCTION TABULATION	4-7
4-II	VENT MOTOR POWER CONTROL	4-12
4-III	POWER/CONTROL GROUPS	4-13

FIGURES

Figure		Page
1-1	Vent door mechanisms location	1-2
1-2	Vented Orbiter compartments - OV 102	1-4
2-1	Active vent system interface overview	2-4
3-1	Purge system - OV 102	3-2
3-2	Sound pressure levels	3-4
3-3	Hazardous gas concentration	3-5
3-4	Vent door sequencing during ascent	3-6
3-5	Vent doors 1 and 2 actuator assembly	3-8
3-6	Single door actuator assembly	3-8
3-7	Vent doors 4 and 7 actuator assembly	3-10
3-8	Vent doors 8 and 9 actuator assembly	3-10
3-9	PBL vent door actuator	3-12
3-10	Motor control	3-14
3-11	Vent door thermal barrier concept	3-15
4-1	Control panel MA73C	4-2
4-2	RM sensor generic display	4-5
4-3	DPS utility generic display	4-6

SECTION 1
INTRODUCTION



VENT NO.*	COMPT VENTED	VENT DOOR SUBSYSTEM
1	FWD RCS	FORWARD
2	FWD FUS	
7	WING	PAYLOAD BAY AND WING
4	MID FUS	
5	MID FUS	PAYLOAD BAY
3	MID FUS	
6	MID FUS	
8	OMS POD	AFT
9	AFT FUS	

*LH AND RH

Figure 1-1.- Vent door mechanisms location.

SECTION 1 INTRODUCTION

The Active Vent System of OV102 consists of 18 vent ports in the Orbiter fuselage, and the doors and control system to open and close these ports as required.

1.1 PURPOSE

The purpose of the Active Vent System is to provide venting of the Orbiter unpressurized volumes for the rapid pressure change of launch and entry, and to control the internal environment of the Orbiter by door configuration while in orbit or on the ground.

1.2 DESCRIPTION OF THE VENT SYSTEM

Venting of the Orbiter unpressurized volumes is a requirement of its structural design. The vent openings are sized according to the volume to be vented.

The control of the vent doors utilizes the Data Processing System (DPS) and software contained in the General Purpose Computer (GPC's). The system operates automatically except for the preentry configuration which is commanded by the Orbiter crew at the appropriate time.

The doors for the vent ports are controlled to provide the capability to protect the internal environment of the Orbiter. This is achieved by purging with dry air or nitrogen while on the ground, by reducing acoustical levels in the payload bay at launch, or by excluding hazardous gases or contaminants.

1.2.1 Vent Door Location

The location of the vent doors is shown in Figure 1-1. Of the 18 vent doors, 9 are visible in Figure 1-1. For each door shown on the left side of the Orbiter, there is a corresponding vent door on the right-hand side. The numbering system begins at the front of the vehicle and increases to the rear. The exceptions are: Vent #9 is farther forward than Vent #8, and Vent #7 shares a drive mechanism with Vent #4.

The volumes that are vented are identified in the chart at the bottom of Figure 1-1. Each volume has two vents, left-hand and right-hand, providing redundant vent openings. Vent doors of the same number are driven simultaneously by separate commands and separate mechanisms. In this manual, when a vent is identified by number both left-hand and right-hand vents are being referenced.

Vent doors which are located near each other share common actuators and controls. Vents 1 and 2, 4 and 7, and 8 and 9 share drive mechanisms. Vent 7 is a wing vent, and left-hand and right-hand wing volumes are

not connected. Passive vents are added inside the Orbiter to provide redundancy to Vent 7.

1.2.2 Internal Vents and One-Way Check Valves

Internal vents are used to vent compartments which have no vent doors of their own such as the nose wheel well, the two main wheel wells and the vertical tail section. Figure 1-2 shows the Orbiter volumes in a block representation. The figure also shows passive vents used to backup Vent 7 of the forward wing compartment. The passive vents respond to the delta pressure between the wing and midfuselage volumes. On ascent, the wing will vent to the midbody if Vent 7 fails. On descent, the midfuselage will pressurize the wing volume for a failed Vent 7. The delta pressure required to open the passive vent is .72 to 1 psid. The payload bay 1307 (aft) bulkhead has 14 one-way check valves which vent the payload bay into the aft fuselage. This is the path of purge gas flow when the minimum purge flow is required for the payload bay and payloads. Each of these valves will crack at .004 psid and fully open with .04 psid.

Vent 8 vents the OMS/RCS Pods. The two pods are joined by a duct that will enable the pod to vent through the opposite side of the vehicle if a Vent 8 fails to open.

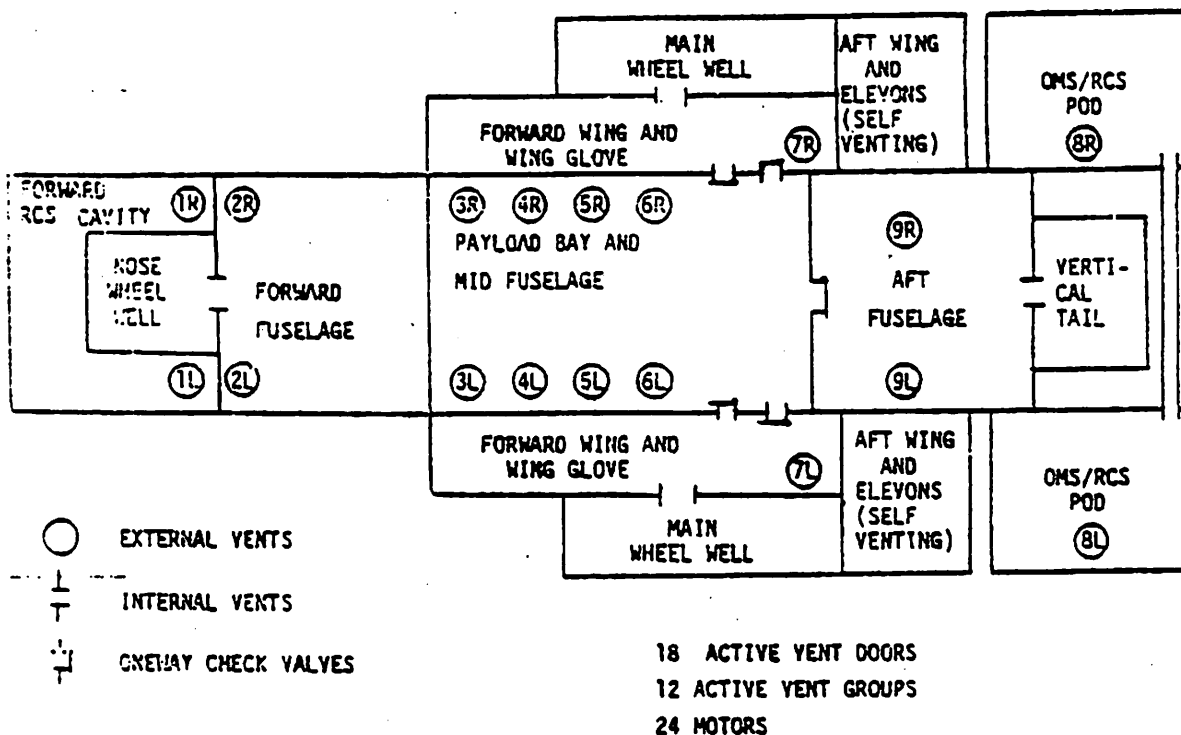


Figure 1-2.- Vented Orbiter compartments - OV 102.

SECTION 2
SYSTEMS INTERFACES

SECTION 2 SYSTEMS INTERFACES

2.1 INTERFACE OVERVIEW

The block diagram, Figure 2-1, summarizes the interface the vent system makes with other Orbiter systems. The Active Vent System receives electrical power from the Orbiter power generation system. Panel MA73C on the middeck is where logic power switching and circuit breaker protection is found.

The Data Processing System (DPS) provides the software control, the telemetry downlink, the command uplink, and the CRT and Keyboard interface used by the crew.

2.2 DATA PROCESSING SYSTEM INTERFACE

The Orbiter is designed to control and monitor mechanical systems using the General Purpose Computers (GPC's). The Data Processing System could be considered part of the Active Vent System because it provides control of the door position based on a software sequence. Vent door commands are sent from the GPC to the hardware as digital commands over a data bus. The Multiplexer/Demultiplexer (MDM's) respond to the digital commands by outputting control voltages to the door control logic. Position feedback from the door is monitored by the MDM and is placed on the downlink.

The control logic is located in the Motor Control Assemblies (MCA's) with the relays which switch power to the 3 ϕ motors of the door actuators. Each door position microswitch outputs a discrete when the door reaches that door position. All doors have the OPEN and CLOSED positions, and those doors used for purging have additional discrete outputs for purge positions.

2.2.1 Pulse Commanding

The Active Vent Door operation is initiated by the GPC according to the program loaded into the computer, using time cues or NAV system cues pertinent to the system configuration. A feature of this software is that it is inactive except at the times the door configuration is changed. It also sends commands to the MDM's for a 10 sec duration and then resets the commands. This is called "Pulse Commanding" and will remove power from the door motors if they are unable to drive the doors to the commanded position.

2.3 ELECTRICAL INTERFACE WITH THE ACTIVE VENT SYSTEM

The doors of the active vent system are driven by 3 ϕ motors. Relay switching is used to control the application of 3 ϕ power. The relays and relay control logic is housed in the Motor Control Assemblies. The MCA's have DC logic and 3 ϕ power buses.

The switching of DC power and the 3 ϕ AC circuit breakers that supply the MCA buses are found on Panel MA73C. The MA73C panel description is found in paragraph 4.1.1 (also see Figure 4-1).

The relays used for motor control are located in the MCA's. Logic circuitry which controls these relays requires a command from the DPS and position feedback from the door mechanism. When a command is present at the relay control logic the relay will close and remain closed until the door reaches the commanded position. The software sequence will remove the command after 10 sec if a problem exists which keeps the door from moving or reaching the commanded position.

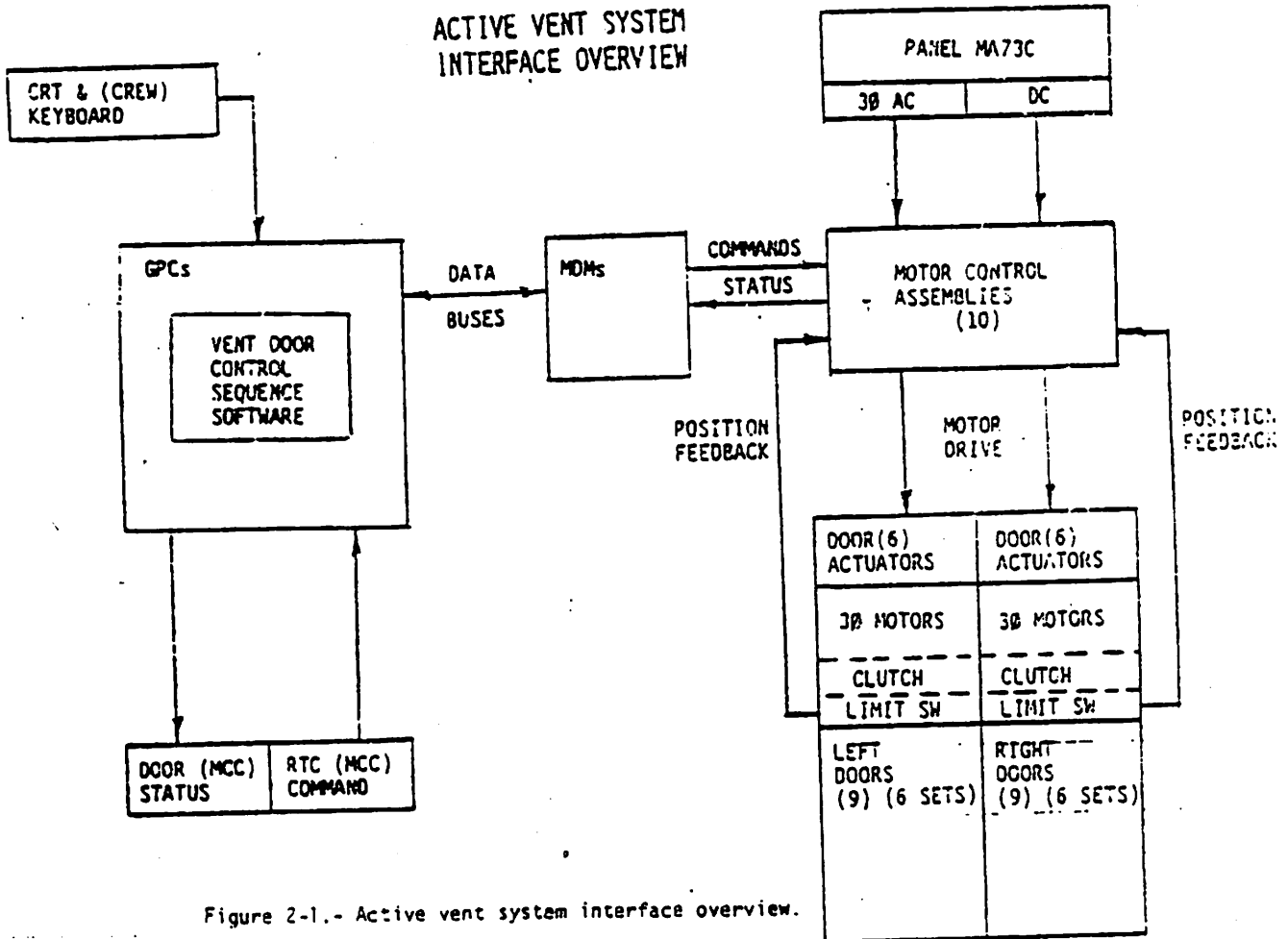


Figure 2-1.- Active vent system interface overview.

SECTION 3
SYSTEMS DESCRIPTION

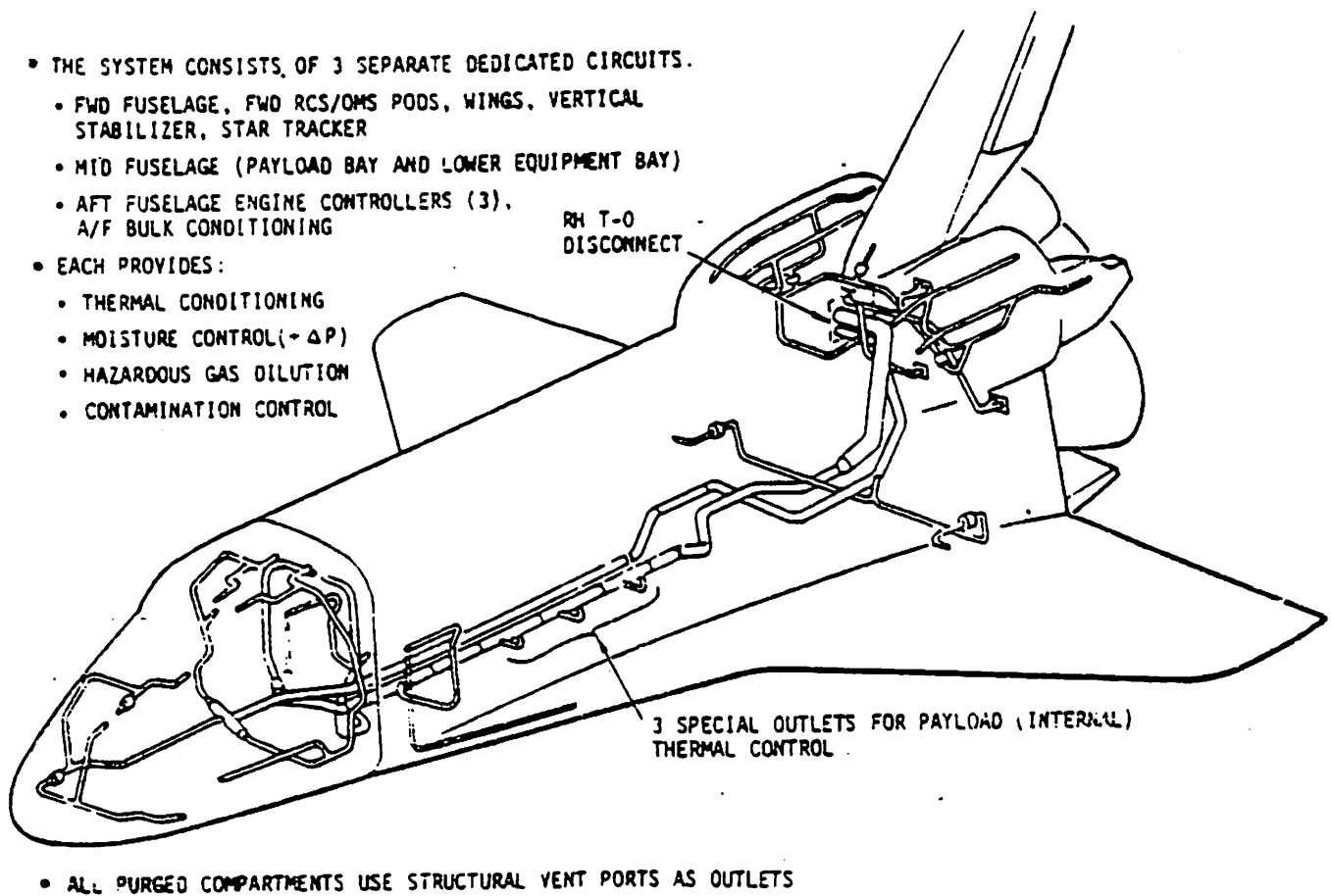


Figure 3-1.- Purge system - OV 102.

SECTION 3 SYSTEMS DESCRIPTION

3.1 PURGING SYSTEM

The environment within the Orbiter while it is on the ground is controlled by establishing a purge gas flow through the vehicle (see Figure 3-1). The purge gas may be cooled dry air or if an inert environment is required, N₂ can be used.

A small positive pressure is maintained within the vehicle to exclude contaminants, salt spray, warm and humid air, or hazardous gases.

Purging will also dilute and carry away hazardous gases which otherwise might accumulate from a small leak in an Orbiter line or tank. The active vent doors are used to establish the openings for purge gases to exit the vehicle. Vent Doors 1 & 2 and 8 & 9 have purge positions which control flow from the forward and aft volumes, respectively. Vents 6 have two PURGE positions and a CLOSED position which accommodates the different purge flow rates available to the payloads and payload bay.

Purging only takes place on the ground during both prelaunch and post-landing. GSE supplies the purge gas and interface to establish the purge which takes place up to the time of launch. The vent doors used for purging must be properly positioned for launch prior to lift-off. The purging of the Orbiter does not include the pressurized volumes which have their own environmental control systems.

3.2 SOUND PRESSURE LEVEL

The sound pressure levels at launch are high (see Figure 3-2). The active vent doors to the midbody/payload bay reduce the levels within the payload bay if they are closed.

The specified limit for sound pressure levels in the payload bay is 145db. If the doors are opened for launch, an estimate of sound pressure levels in the bay will exceed the specified limit.

The above requirement determines that the launch configuration of the Active Vent Doors 3, 4, 5, 6 and 7 be CLOSED.

At launch plus 10 sec, all the doors are commanded OPEN.

The sound pressure levels at launch will probably be measured on STS-1 because the payload bay will not carry payloads other than the Development Flight Instrumentation package (DFI).

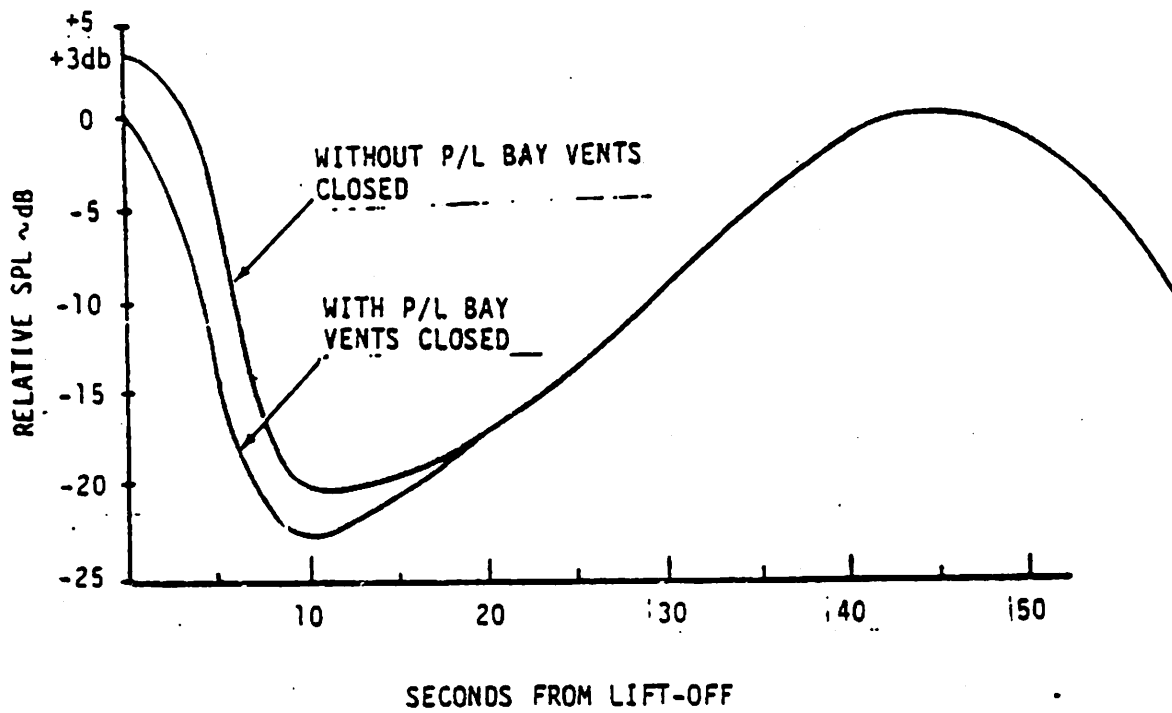


Figure 3-2.- Sound pressure levels.

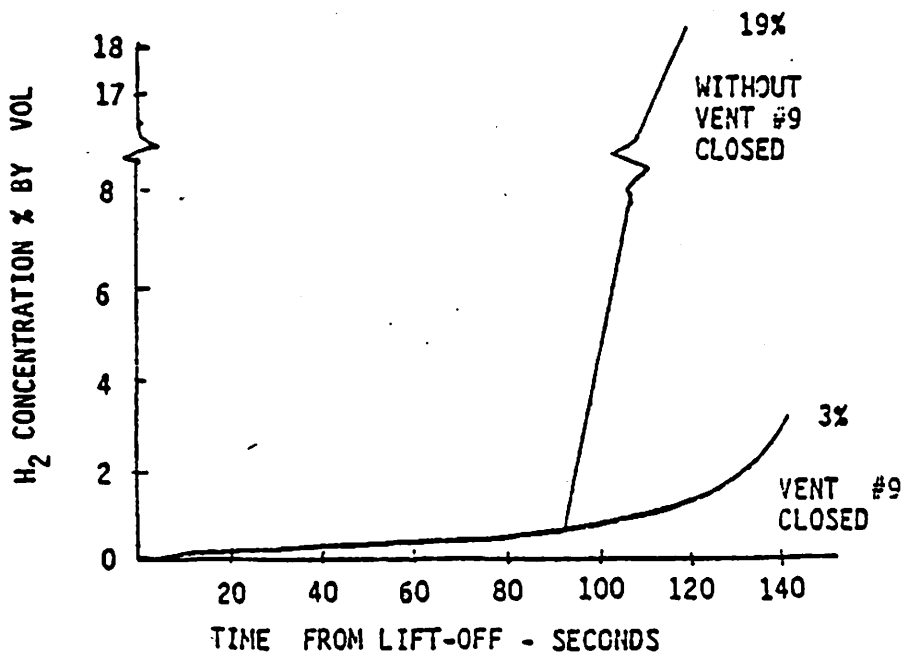
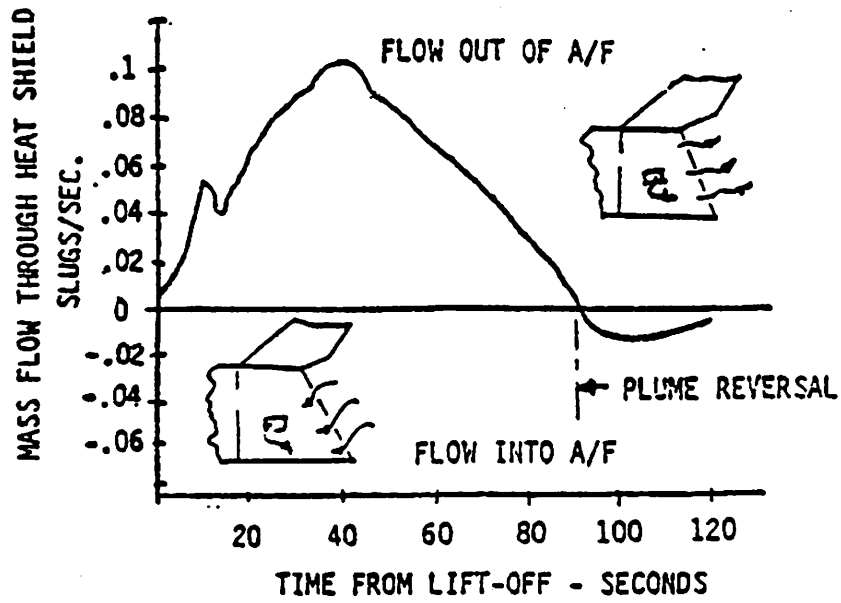


Figure 3-3.- Hazardous gas concentration.

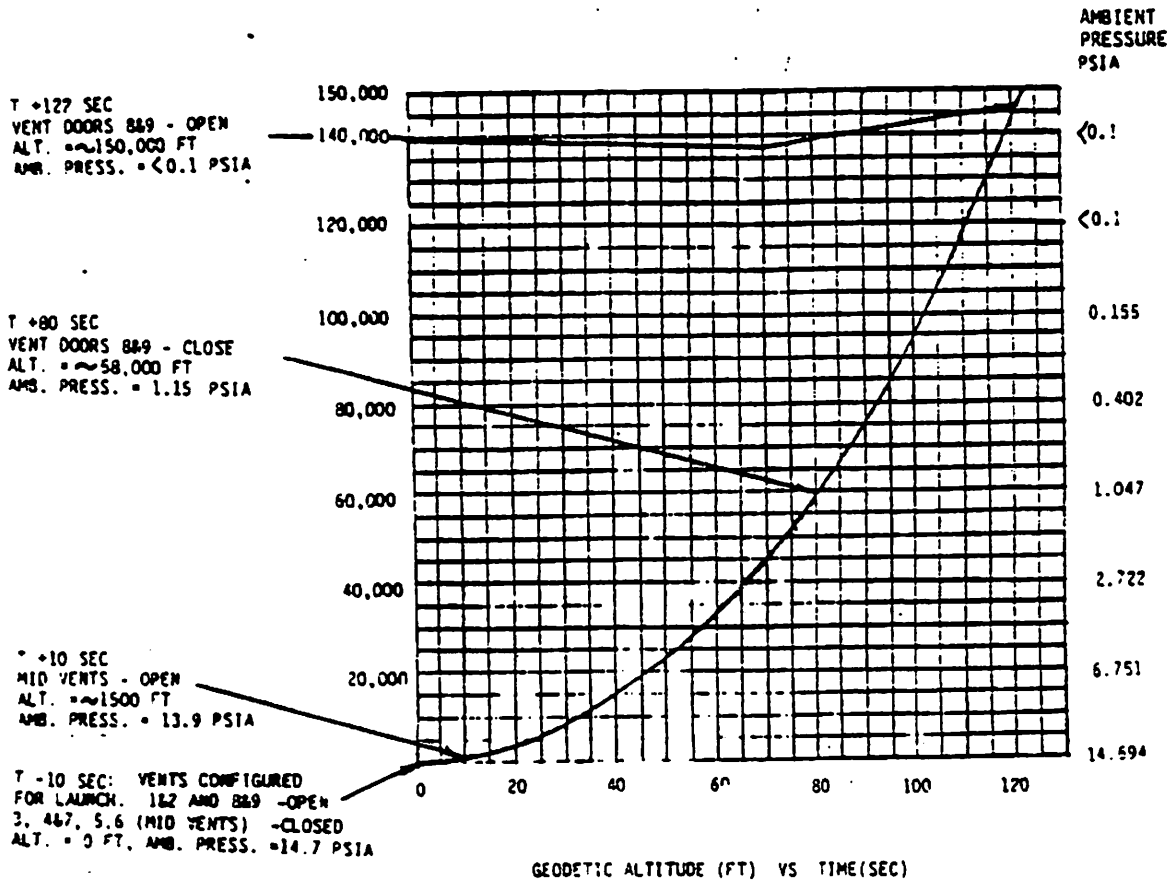


Figure 3-4. - Vent door sequencing during ascent.

3.3 HAZARDOUS GAS CONCENTRATION DURING ASCENT

During Ascent, the two solid rocket engines and three main engines generate exhaust gases (refer to Figure 3-3). The main engine exhaust is rich in hydrogen by design. As the vehicle reaches the lower pressure of high altitudes, the plume of the engine exhaust changes shape. The internal pressure of the aft fuselage is venting to ambient through Vents 9. At 90 sec into the flight the aft compartment pressure is so low that the hydrogen from the exhaust migrates through the aft heat shield.

The safety specification states the hydrogen concentration should not exceed 4% for pressures greater than 0.1 psia.

Closing Vents 8 & 9 at T+80 sec into the flight will retain a positive pressure in the aft compartment and slow any hydrogen migration through the aft heat shield.

After SRB burnout and separation, the conditions change so that the hydrogen concentration in the aft compartment will not exceed the specified limits. At T+122 seconds (SRB Sep), Doors 8 & 9 are opened for depressurization.

3.4 MOLECULAR VENTING

The active vent doors are all open for on-orbit operations. When the Orbiter has vented to very low pressure levels, the vacuum in the unpressurized spaces will continue to improve as individual molecules find the opening to space and do not return.

The quality of the insulation increases and the pressures are reduced by "molecular venting". After 12 hours of venting the pressure must be less than 5×10^{-5} torr in the vented spaces.

3.5 VENT DOOR SEQUENCING

The vent door configuration is managed automatically by the GPC's and data processing system (refer to Figure 3-4).

The prelaunch configuration is the purge configuration. This configuration has Doors 1 & 2, 8 & 9 and 6 in the PURGE position.

At 2 min 20 sec before launch, the launch processing system reduces the purge flow in anticipation of closing Vents 6.

T-35 sec: Vents 6 are commanded CLOSED.

T-25 sec: The Redundant Set (RS) launch sequence is enabled; GPC's take over sequences.

T-10 sec: The vents are configured for launch. Vents 1&2, 8&9 are OPENED.

T-4 sec: Any door out of configuration and not overridden will cause the RS to call a HOLD.

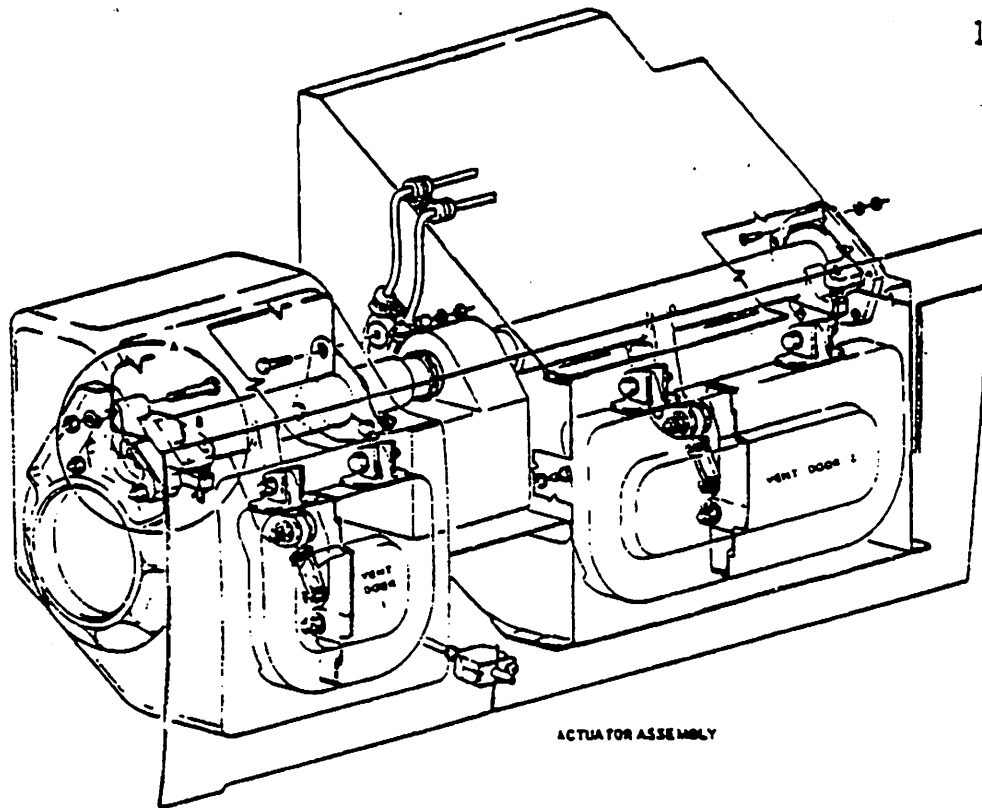


Figure 3-5.- Vent doors 1 & 2 actuator assembly.

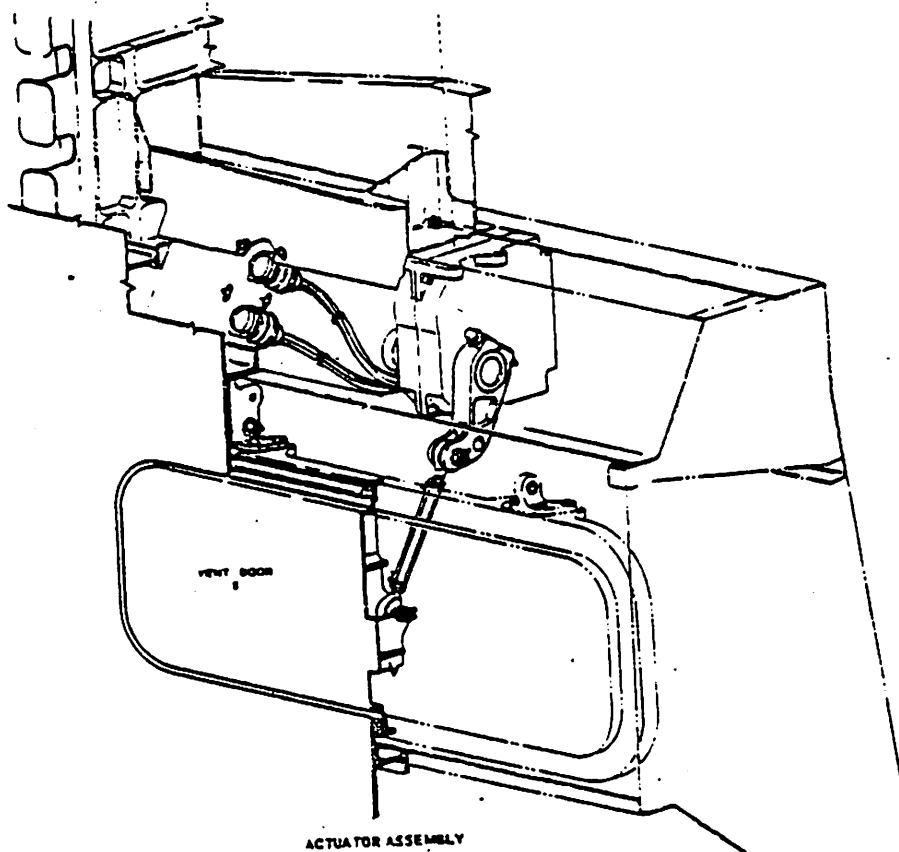


Figure 3-6.- Single door actuator assembly.

T+10 sec: All doors are commanded OPEN.

T+80 sec: Vents 8 & 9 are commanded CLOSED.

T+122 sec: Vents 8 & 9 are commanded OPEN.

Pre-Entry: Crew commands all doors CLOSED via keyboard entry.

2400 ft/sec: Cue GPC commands all vent doors OPEN.

Postlanding: Ground Service Equipment will configure vent doors for PURGE after sniffing for hazardous gases.

3.6 HARDWARE DESCRIPTION

The active vent doors and door actuators are located along the left-hand and right-hand side of the Orbiter as described previously in Figure 1-1 (page 1-2). The size of the openings is determined by the volume to be vented. The hardware used for the different door groups are addressed by grouping in the following paragraphs.

3.6.1 Vent Doors 1 And 2

Vent Doors 1 & 2 vent the forward RCS and forward fuselage volumes, respectively (refer to Figure 3-5). These doors have an OPEN, CLOSED, and PURGE position. The doors are open except during entry.

3.6.2 Single Door Actuators (Vents 3, 5 and 6)

Vent 3, Vent 5, and Vent 6 are single door and actuator units. The single door actuators are shown in Figure 3-6. It shows the dual electrical connectors required to provide redundant paths to the two three-phase drive motors. The actuator output shaft is splined and a bell crank is connected to the shaft to convert the rotational shaft motion to a push-pull motion for operating the door. A pushrod is a mechanical link between the door and the bell crank. Vent Doors 6 have two PURGE positions in addition to the OPEN and CLOSED position.

3.6.3 Vent Doors 4 and 7

Vent Doors 4 and 7 share a common actuator. Vent 4 is a vent to the midbody and payload area and Vent 7 vents the wing. Vent 7 is the only vent from the wing volume to the outside of the vehicle. Passive vents in the duct to the wing are used to back up Vent 7. The passive vent responds to Δ pressure and opens only if the Δ between the wing and midbody exceeds 1 psi (see Figure 3-7).

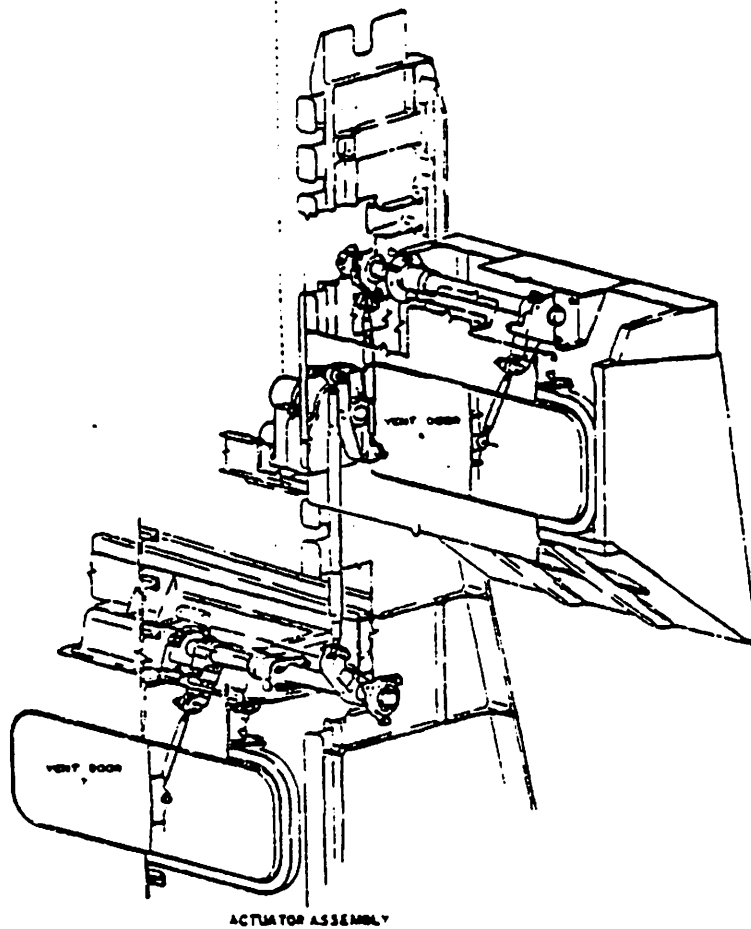


Figure 3-7.- Vent doors 4 & 7 actuator assembly.

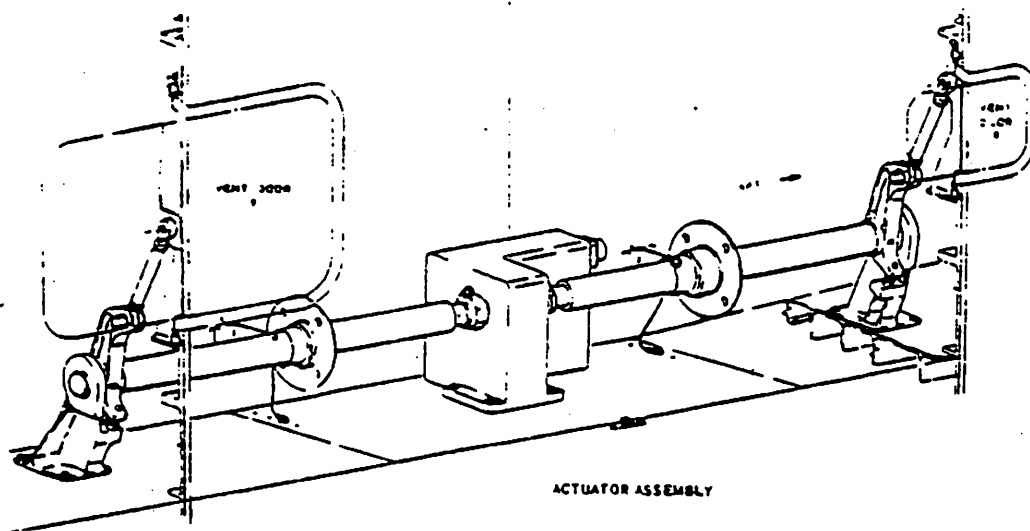


Figure 3-8.- Vent doors 9 & 8 actuator assembly.

3.6.4. Vents 9 and 8

Vents 9 & 8 in Figure 3-6 share a common actuator. The aft fuselage is vented through Vents 9. Vents 8 vent the OMS pads. Vent 8 "right" and Vent 8 "left" are connected with a duct that interfaces with both OMS pods.

3.6.5 Vent Door Actuator

Vent door actuators are used to mechanize the vent door opening and closing operations (see Figure 3-9).

3.6.5.1 3 ϕ motor control.- The driving power source for the actuator comes from two 3 ϕ motors. Both motors operate simultaneously and drive a gear train through a differential coupling.

The motors use separate power and control sources to retain redundancy. Either motor can drive the actuator should one motor fail. Only the time to close the door will double from 5 to 10 sec.

The drive motors of the active vent doors are 3 ϕ 400 Hz motors which are used in pairs for redundancy. The control of the 3 ϕ motors is by command from the GPC's via MDM's. Relays for power switching are located in Motor Control Assemblies. Two relays in series controlled by separate commands are required to drive a motor. Two other relays are required to reverse the motor. Therefore, the two motors of an actuator require eight relays for control.

Microswitches are used for position feedback and are operated by a cam-shaft driver by the actuator gear train. Each motor has separate control and separate position feedback sources. Each position of the actuator, OPEN, CLOSE and PURGE, requires a separate switch feedback source.

3.6.5.2 Torque limiter.- A torque limiting clutch is designed to limit the force to one and one-half the normal load to protect the gear train.

Pulse commanding is a software protection which limits the commands to the motors to a 10-sec duration.

3.6.5.3 Microswitch position indicators.- Microswitches are used to indicate the OPEN, CLOSED and PURGE positions to the control circuits. A cam-shaft driven by the gear train operates two switches each for the above positions so that the control circuits to the redundant motors are electrically isolated.

A bell crank and pushrod couples the door actuator to the door.

The 3 ϕ motors are reversible by switching the phases of input power. They are line replaceable items which means they can readily be replaced should a problem develop. Each motor has a brake that is applied when power is removed, and released when power is present. The motors are able to start and run with one of the three phases missing.

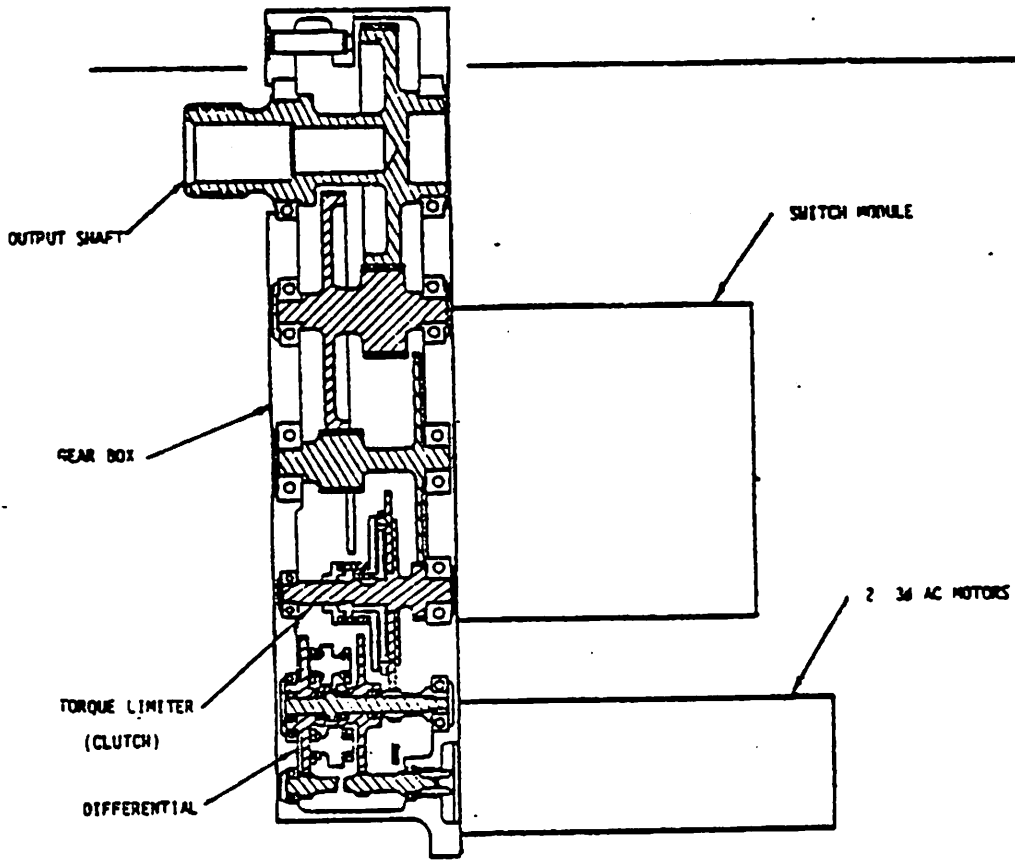


Figure 3-9.- PBL vent door actuator.

3.7 POWER SWITCHING AND CONTROL

The application of 3 ϕ AC power to the door motors is done with relays located in the Motor Control Assembly (MCA) (see Figure 3-10). The system uses two relays in series, each of which has a separate command coming from the MDM. The inputs required are 3 ϕ AC, DC logic power, an OPEN or CLOSE command for each relay and a NOT OPEN or NOT CLOSED signal from the position indicating limit switches.

The motor direction is reversed for the close function by switching phases B and C between the 3 ϕ power bus and the motor.

Motor B drive input is combined with Motor A, which through a Common Gear Box (GB) and shaft, will drive the door.

Each motor has two commands sent to it to open a door. OPEN 1A and OPEN 2A is sent through MDM #1 for Motor A and OPEN 1B and OPEN 2B for Motor B is sent through MDM #2. If only one motor runs the operating time of the door is doubled, 10 sec is required instead of 5 sec.

3.8 VENT DOOR THERMAL BARRIER

The doors are closed to exclude hot plasma on entry. The edge of the door has a thermal barrier which fills the space between the door and vent opening (see Figure 3-11). The barrier consists of ceramic fiber cloth over a form of Inconel X750 wire mesh which takes up the space. A pressure seal between the door and the skin prevents contaminants from entering and allows a small positive pressure to build up during purge of the vehicle.

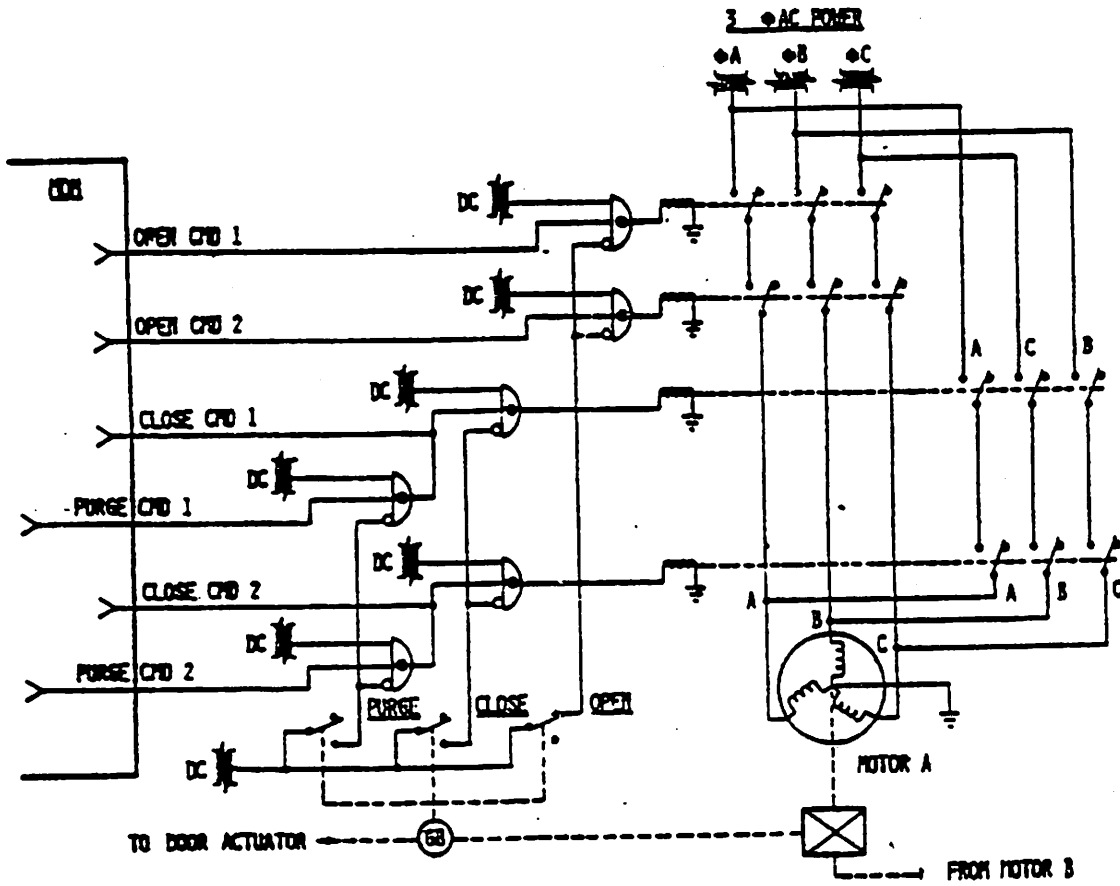


Figure 3-10.- Motor control.

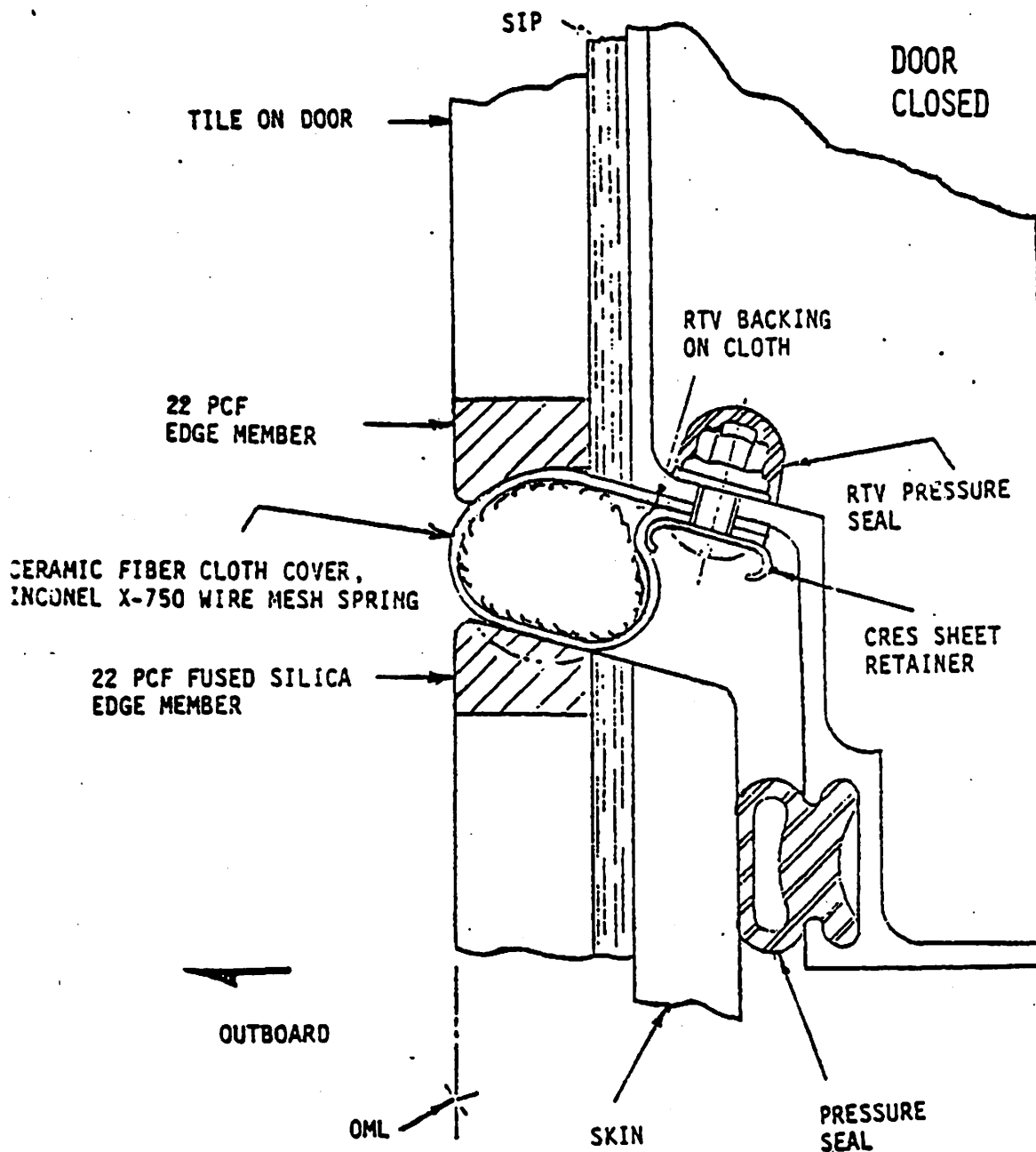
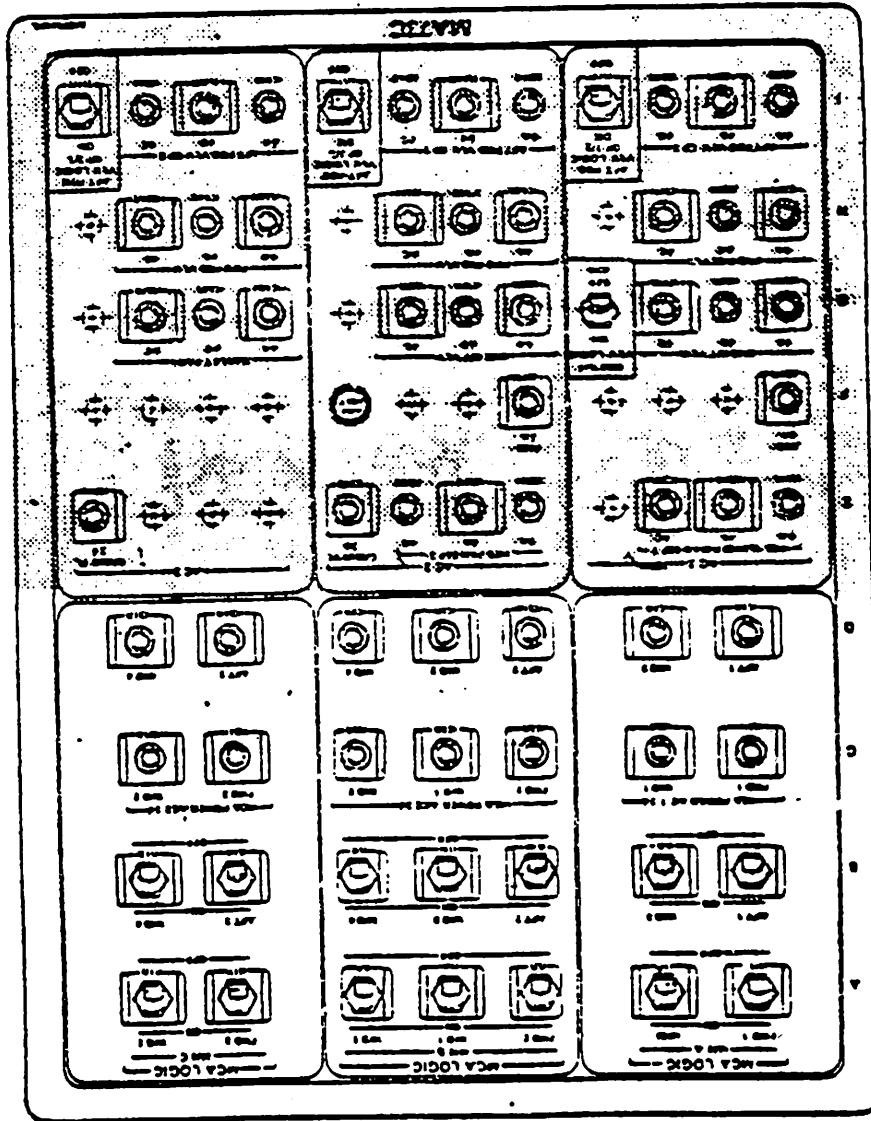


Figure 3-11.- Vent door thermal barrier concept.

SECTION 4
DISPLAY AND CONTROL

Figure 4-1. - Control panel MA73C.



SECTION 4 DISPLAY AND CONTROL

The vent door system operation is automatic except for the preentry configuration which is initiated by the crew.

The sequence of opening and closing the active vent doors is programmed into the General Purpose Computer (GPC) software.

The status of the doors, OPEN or CLOSED, is available on the ground via telemetry and to the motor control logic as position feedback. There is no onboard display which will indicate individual door position. The only information available to the crew is the last commanded position of the doors, OPEN or CLOSED.

If a door is out of configuration individual commands can be sent from the ground, or from the crew via the CRT and Keyboard. The commands required for a single door motor to drive consists of four eight-digit hexadecimal commands.

Commands to the doors originate through the GPC's using the digital data buses. At the appropriate MDM the digital command becomes a discrete command to the motor control logic located in a Motor Control Assembly (MCA).

The relays in the motor control assemblies switch 3 ϕ AC power to the motors and redundant motors drive the door to the commanded position.

4.1 CREW INTERFACE

The active vent doors are commanded by the computers based on a software sequence. The individual door status is available on the downlink but not onboard. If a door is out of configuration it can be commanded individually by an RTC from the ground or by the crew using the CRT and keyboard.

There are two motors for each door, each motor requires four commands to cause it to drive. The crew needs ground support to identify which door is out of configuration. Procedurally, the commands which are complementary commands are reset or zeroed before sending the two desired commands to an individual door. For example, to close left-hand Door #5: first, both of the LH Door 5 OPEN commands are reset, then the two LH Door 5 CLOSED commands are set for Motor 1. A second set of four commands are used for Motor 2 of LH Door 5.

4.1.1 Control Panel MA73C

Panel MA73C is located on the Orbiter Middeck (refer to Figure 4-1). The top half of the panel has switches and circuit breakers relating to the Active Vent Doors.

The Motor Control Assembly (MCA) logic switches are arranged with the MNA switches on the left subpanel, MNB switches on the middle subpanel and MNC switches on the right subpanel.

The AC circuit breakers for the MCA power are on the lower half of the MA73C subpanels. Notice that the circuit breaker arrangement corresponds to the switch arrangement and they supply corresponding MCA's. Also notice that MNA and AC1 are used together, MNB and AC2, and MNC and AC3. In order to retain the redundancy of power sources this combination of logic and power is required.

The switches and circuit breakers are used for many functions at the motor controller assemblies and will be powered continuously during the mission.

Table 4-II (Section 4.2), Vent Motor Power/Control, tabulates vent door motors with their MCA's, their power sources and MDM's.

Table 4-III (Section 4.2) tabulates the vents according to their power/control voltage sources.

4.1.1.1 RM sensor set display (Spec 0-51).- Available in Ops 1, 3 and 6. Two items allow the crew to command the vent doors OPEN or CLOSED. These items are mutually exclusive; an "*" is displayed next to the one currently selected. The display is initialized with the command signal set to the state last commanded by either crew entry or vent door sequences. The items are legal in Major Modes 301, 304, 305, 602 and 603 only. Execution of either item in any other Major Mode will result in operator error.

	1					2					3					4					5									
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
1	XXXX/XXX/XXX					RM SENSOR SEL					XX X 000/HH:MM:SS					000/HH:MM:SS														
2	ADTA																													
3											PRL																			
4	H					M					DES																			
5	L	1S	XXXXXX	±XX.X	X.XX						1X						AUT	DES												
6		3S	XXXXXX	±XX.X	X.XX						2X	SYS					8X	9X												
7	R	2S	XXXXXX	±XX.X	X.XX						3X						19X	11X												
8		4S	XXXXXX	±XX.X	X.XX						4X						12X	13X												
9																														
10	IMU																													
1	STAT					ATT					DES																			
2	1S	XXXX				X					5X																			
3	2S	XXXX				XXX					6X																			
4	3S	XXXX									7X																			
5																														
6																														
7																														
8																														
9																														
20																														
1																VENT DOOR CNTL														
2																OPEN 14X														
3																CLOSED 15X														
4																(XX)														
5																														
6																														

Figure 4-2.- RM sensor generic display.

4.1.1.2 DPS Utility display (Spec 0-01).- RTC Items 13 and 14 provide the capability to use the real-time command function. Eight hexadecimal characters which represent the contents of an RTC are entered via Item 13. The first four characters are hexadecimal representations of bit 33 through 48 of the RTC. Item 14 executes the data entered by the RTC item. The user is required to ensure that the Major function controlling the GPC Memory Spec has the data buses over which the RTC is requested to be transmitted.

```

      .      1      2      3      4      5
12345678901234567890123456789012345678901
1  XXXX/XXX/XXX      OPS UTILITY      2 000/HH:MM:SS
2                                     C00/HH:MM:SS
3  MMU ASSIGN
4      1 2      PORT ASSIGN
5      GNC 1X 2X      PRI SEC
6      SM 3X 4X      STRING 1 15X 16X
7      PL 5X 6X      2 17X 18X
8  OPS 0 7X 8X      3 19X 20X
9                                     4 21X 22X
10 MMU STATUS      PL 1/2 23X 24X
11      1 XXX
12      2 XXX
13                                     VARIABLE PARAM ID LIST
14                                     25 XXXXX
15 MMU SOURCE/BUS      26 XXXXX
16      GPC/MMU 9X      27 XXXXX
17      MMU/MMU 10X     28 XXXXX
18      GPC/LOS 11X     29 XXXXX
19                                     30 XXXXX
20      C<> RETRV ENA 12X 31 XXXXX
21                                     32 XXXXX
22 RTC      33 XXXXX
23      13 XXXX XXXX     34 XXXXX
24      CMD 14
25
26
27
28
29
30
31
32
33
34
35
36

```

Figure 2.4-2 DPS UTILITY Generic Display

Figure 4-3.- DPS utility generic display.

4.2 SWITCH AND CB FUNCTION TABULATION

TABLE 4-1.- SWITCH AND CB FUNCTION TABULATION

PANEL	TYPE	NOMENCLATURE POSITION	FUNCTION REMARKS
MA73C	2 POS TOGGLE S-1	MCA LOGIC MNA FWD-1 ON-OFF	ON-DC LOGIC POWER RH VENTS 1 & 2 MOTOR 1
	2 POS TOGGLE S-2	MCA LOGIC MNA MID 1 ON-OFF	ON-DC LOGIC POWER RH VENT 3 MOTOR 1 RH VENT 5 MOTOR 1 LH VENT 5 MOTOR 2 RH VENT 6 MOTOR 1
	2 POS TOGGLE S-5	MCA LOGIC MNB FWD 2 ON-OFF	ON-DC LOGIC POWER RH VENTS 1 & 2 MOTOR 2
	2 POS TOGGLE S-6	MCA LOGIC MNB MID 1 ON-OFF	ON-DC LOGIC POWER LH VENT 5 MOTOR 2
	2 POS TOGGLE S-7	MCA LOGIC MNB MID 2 ON-OFF	ON-DC LOGIC POWER LH VENT 3 MOTOR 2
	2 POS TOGGLE S-11	MCA LOGIC MNC FWD 3 ON-OFF	ON-DC LOGIC POWER LH VENTS 1 & 2 MOTOR 1
	2 POS TOGGLE S-12	MCA LOGIC MNC MID 2 ON-OFF	ON-DC LOGIC POWER RH VENTS 4 & 7 MOTOR 1 LH VENT 4 & 7 MOTOR 1 LH VENT 6 MOTOR 2

TABLE 4-I.- SWITCH AND CB FUNCTION TABULATION - Continued

PANEL	TYPE	NOMENCLATURE POSITION	FUNCTION REMARKS
MA73C	2 POS TOGGLE S-4	MCA LOGIC MNA AFT 1 ON-OFF	LH VENT 8 & 9 MOTOR 1
	2 POS TOGGLE S-3	MCA LOGIC MNA MID ON-OFF	ON-LOGIC POWER LH VENT 3 MOTOR 1
			LH VENT 5 MOTOR 1
			LH VENT 6 MOTOR 1
	2 POS TOGGLE S-10	MCA LOGIC MNB AFT 2 ON-OFF	ON-LOGIC POWER RH VENTS 8 & 9 MOTOR 2
	2 POS TOGGLE S-8	MCA LOGIC MNB MID 3 ON-OFF	LH VENTS 8 & 9 MOTOR 2
			ON-LOGIC POWER RH VENTS 4 & 7 MOTOR 2
	2 POS TOGGLE S-9	MCA LOGIC MNB MID 4 ON-OFF	ON-LOGIC POWER LH VENTS 4 & 7 MOTOR 2
RH VENT 6 MOTOR 2			
2 POS TOGGLE S-14	MCA LOGIC MNC AFT 3 ON-OFF	ON-LOGIC POWER RH VENTS 8 & 9 MOTOR 1	
2 POS TOGGLE S-13	MCA LOGIC MNC MID 4 ON-OFF	ON-LOGIC POWER RH VENT 3 MOTOR 2	
		RH VENT 5 MOTOR 2	

TABLE 4-I.- SWITCH AND CB FUNCTION TABULATION - Continued.

PANEL	TYPE	NOMENCLATURE POSITION	FUNCTION REMARKS
MA73C	CIRCUIT BREAKER CB-1	MCA POWER AC 1 3 ϕ FWD 1	3 PHASE AC TO RH VENT 1 & 2 MOTOR 1
	CIRCUIT BREAKER CB-2	MCA POWER AC1 3 ϕ MID 1	3 PHASE AC TO RH VENT 3 MOTOR 1 RH VENT 5 MOTOR 1 LH VENT 5 MOTOR 2 RH VENT 6 MOTOR 1
	CIRCUIT BREAKER CB-5	MCA POWER AC2 3 ϕ FWD-2	3 PHASE AC TO RH VENTS 1 & 2 MOTOR 2
	CIRCUIT BREAKER CB-6	MCA POWER AC2 3 ϕ MID 1	3 PHASE AC TO LH VENT 5 MOTOR 2
	CIRCUIT BREAKER CB-7	MCA POWER AC2 3 ϕ MID 2	3 PHASE AC LH VENT 3 MOTOR 2
	CIRCUIT BREAKER CB-11	MCA POWER AC3 3 ϕ FWD 3	3 PHASE AC TO LH VENTS 1 & 2 MOTOR 1
	CIRCUIT BREAKER CB-12	MCA POWER AC3 3 ϕ MID 2	3 PHASE AC TO RH VENTS 4 & 7 MOTOR 1 LH VENTS 4 & 7 MOTOR 1 LH VENT 6 MOTOR 2
	CIRCUIT BREAKER CB-4	MCA POWER AC1 3 ϕ AFT-1	3 ϕ AC POWER TO LH VENTS 8 & 9 MOTOR 1

TABLE 4-I.- SWITCH AND CB FUNCTION TABULATION - Concluded

PANEL	TYPE	NOMENCLATURE POSITION	FUNCTION REMARKS
MA73C	CIRCUIT BREAKER CB-3	MCA POWER AC 1 3 ϕ MID 3	3 ϕ AC POWER TO LH VENT 3 MOTOR 1 LH VENT 5 MOTOR 1 LH VENT 6 MOTOR 1
	CIRCUIT BREAKER CB-10	MCA POWER AC2 3 ϕ AFT 2	3 ϕ AC POWER TO RH VENT 8 & 9 MOTOR 2 LH VENT 8 & 9 MOTOR 2
	CIRCUIT BREAKER CB-8	MCA POWER AC2 3 ϕ MID 3	3 ϕ AC POWER TO RH VENTS 4 & 7 MOTOR 2
	CIRCUIT BREAKER CB-9	MCA POWER AC2 3 ϕ MID 4	3 ϕ AC POWER LH VENT 4 & 7 MOTOR 2 RH VENT 6 MOTOR 2
	CIRCUIT BREAKER CB-14	MCA POWER AC3 3 ϕ AFT 3	3 ϕ AC POWER TO RH VENTS 8 & 9 MOTOR 1
	CIRCUIT BREAKER CB-13	MCA POWER AC3 3 ϕ MID 4	3 ϕ AC POWER TO RH VENT 3 MOTOR 2 RH VENT 5 MOTOR 2

4.3 VENT MOTOR POWER/CONTROL TABLE

Table 4-II is a table which lists each vent door and the two motors which drive the door mechanism. The redundancy of two drive motors requires separate MDM's and separate Motor Control Assemblies (MCA's)

4.4 POWER/CONTROL GROUPS TABLE

Table 4-III is a table that classifies the motors according to power sources listing first those door motors controlled by Mu A DC and AC1 power. This tabulation enables the assessment of the effects of the loss of a power source on the active vent system.

TABLE 4-II.- VENT MOTOR POWER/CONTROL.

VENT	MTR	MCA	DC	AC	MDM
RH 1 AND 2	1	FMCA 1	A	1	FF 1
RH 1 AND 2	2	FMCA 2	B	2	FF 4
LH 1 AND 2	1	FMCA 3	C	3	FF 3
LH 1 AND 2	2	FMCA 2	B	2	FF 2
RH 3	1	MMCA 1	A	1	FF 1
RH 3	2	MMCA 4	C	3	FF 4
LH 3	1	MMCA 3	A	1	FF 3
LH 3	2	MMCA 2	B	2	FF 2
RH 5	1	MMCA 1	A	1	FF 1
RH 5	2	MMCA 4	C	3	FF 2
LH 5	1	MMCA 3	A	1	FF 3
LH 5	2	MMCA 1	B	2	FF 4
RH 4 AND 7	1	MMCA 2	C	3	FF 4
RH 4 AND 7	2	MMCA 3	B	2	FF 1
LH 4 AND 7	1	MMCA 2	C	3	FF 3
LH 4 AND 7	2	MMCA 4	B	2	FF 2
RH 6	1	MMCA 1	A	1	FF 3
RH 6	2	MMCA 4	B	2	FF 2
LH 6	1	MMCA 3	A	1	FF 1
LH 6	2	MMCA 2	C	3	FF 4
RH 8 AND 9	1	AMCA 3	C	3	FA 3
RH 8 AND 9	2	AMCA 2	B	2	FA 2
LH 8 AND 9	1	AMCA 1	A	1	FA 1
LH 8 AND 9	2	AMCA 2	B	2	FA 4

TABLE 4-III.- POWER/CONTROL GROUPS.

DC MN A	AC 1	MOTOR CONTROL	MDM
RH 1 AND 2 VENT 1	RH 1 AND 2 VENT 1	<u>FMCA 1</u>	<u>MDM FF 1</u>
RH 3 VENT 1	RH 3 VENT 1	RH 1 AND 2 VENT 1	RH 1 AND 2 VENT 2
LH 3 VENT 1	LH 3 VENT 1	<u>FMCA 2</u>	RH 3 VENT 1
RH 5 VENT 1	RH 5 VENT 1	RH 1 AND 2 VENT 2	RH 4 AND 7 VENT 2
LH 5 VENT 1	LH 5 VENT 1	LH 1 AND 2 VENT 2	RH 5 VENT 1
RH 6 VENT 1	RH 6 VENT 1	<u>FMCA 3</u>	LH 6 VENT 1
LH 6 VENT 1	LH 6 VENT 1	LH 1 AND 2 VENT 1	<u>MDM FF 2</u>
LH 8 AND 9 VENT 1	LH 8 AND 9 VENT 1	<u>MMCA 1</u>	LH 1 AND 2 VENT 2
		RH 3 VENT 1	LH 3 VENT 2
<u>DC MN B</u>	<u>AC 2</u>	RH 5 VENT 1	RH 5 VENT 2
RH 1 AND 2 VENT 2	RH 1 AND 2 VENT 2	LH 5 VENT 2	LH 4 AND 7 VENT 2
LH 1 AND 2 VENT 2	LH 1 AND 2 VENT 2	RH 6 VENT 1	RH 6 VENT 2
LH 3 VENT 2	LH 3 VENT 2	<u>MMCA 2</u>	<u>MDM FF 3</u>
LH 5 VENT 2	LH 5 VENT 2	LH 3 VENT 2	LH 1 AND 2 VENT 1
RH 4 AND 7 VENT 2	RH 4 AND 7 VENT 2	RH 4 AND 7 VENT 1	LH 5 VENT 1
LH 4 AND 7 VENT 2	LH 4 AND 7 VENT 2	LH 4 AND 7 VENT 1	LH 3 VENT 1
RH 6 VENT 2	RH 6 VENT 2	LH 6 VENT 2	LH 4 AND 7 VENT 1
RH 8 AND 9 VENT 2	RH 8 AND 9 VENT 2	<u>MMCA 3</u>	RH 6 VENT 1
LH 8 AND 9 VENT 2	LH 8 AND 9 VENT 2	LH 3 VENT 1	<u>MDM FF 4</u>
		LH 5 VENT 1	RH 1 AND 2 VENT 2
<u>DC MN C</u>	<u>AC 3</u>	RH 4 AND 7 VENT 2	RH 3 VENT 2
RH 1 AND 2 VENT 1	LH 1 AND 2 VENT 1	LH 6 VENT 1	LH 5 VENT 2
RH 3 VENT 2	RH 3 VENT 2	<u>MMCA 4</u>	RH 4 AND 7 VENT 1
RH 5 VENT 2	RH 5 VENT 2	RH 3 VENT 2	LH 6 VENT 2
RH 4 AND 7 VENT 1	RH 4 AND 7 VENT 1	RH 5 VENT 2	<u>MDM FA 1</u>
LH 4 AND 7 VENT 1	LH 4 AND 7 VENT 1	LH 4 AND 7 VENT 2	LH 8 AND 9 VENT 1
LH 6 VENT 2	LH 6 VENT 2	RH 6 VENT 2	<u>MDM FA 2</u>
RH 8 AND 9 VENT 1	RH 8 AND 9 VENT 1	<u>AMCA 1</u>	LH 8 AND 9 VENT 2
		LH 8 AND 9 VENT 1	<u>MDM FA 3</u>
		<u>AMCA 2</u>	RH 8 AND 9 VENT 1
		RH 8 AND 9 VENT 2	<u>MDM FA 4</u>
		LH 8 AND 9 VENT 2	LH 8 AND 9 VENT 2
		<u>AMCA 3</u>	
		RH 8 AND 9 VENT 1	

SECTION 5
ACTIVE VENT SYSTEM CONSTRAINTS

SECTION 5
ACTIVE VENT SYSTEM CONSTRAINTS

The payload bay specified limit for Sound Pressure Level is 145 db which requires midbody vents to be CLOSED for launch.

The thermal control system requires that the molecular venting provides a 5×10^{-5} pressure level or better in 12 hrs.

Venting of the unpressurized volumes during launch and landing is required for structural integrity of the vehicle.

Pulse commands are present for 10 sec and then reset. This removes 3 ϕ drive voltage from a stalled motor trying to drive a jammed door actuator mechanism.

Hydrogen gas concentration must be less than 4% for pressure greater than 0.1 psia in Orbiter compartments.

No onboard display of individual vent door status is available to the crew.

Individual doors may be commanded OPEN or CLOSED by CRT & keyboard. Each motor of a door system requires four eight-digit hexadecimal commands.

The Command Status of the doors are displayed and correspondingly reflect the last command to the system, i.e., OPEN or CLOSED.

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Active
Vent Doors

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