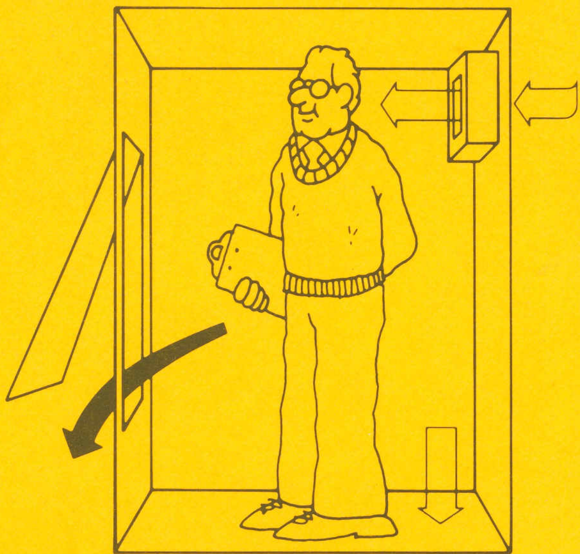
SINGLE ENGINE/ LIGHT TWIN PRESSURIZATION



STUDENT WORKBOOK

cessna training

MARKETING DIVISION • CESSNA AIRCRAFT COMPANY • WICHITA, KANSAS 67201

#3

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CESSNA SINGLE ENGINE/LIGHT TWIN PRESSURIZATION

THIS PROGRAM IS PRESENTED BY CESSNA TECHNICAL TRAINING IN ORDER TO PROVIDE A THOROUGH UNDERSTANDING OF THE THEORY, OPERATION, AND MAINTENANCE OF THE PRESSURIZED CENTURION AND PRESSURIZED SKYMASTER.

COMPONENT LOCATIONS, FUNCTIONS, INTERCONNECT BETWEEN COMPONENTS, AND KEY MAINTENANCE REQUIREMENTS WILL BE DISCUSSED IN DETAIL THROUGHOUT THE WORKBOOK, FILMSTRIP/TAPE PRESENTATION.

THIS PROGRAM DISCUSSES THE PRESSURIZATION SYSTEMS IN GENERAL WITHOUT PROVIDING SPECIFIC DETAILS ACCORDING TO AIRCRAFT SERIAL NUMBERS. THERE ARE SOME DIFFERENCES IN THE SYSTEMS AND THESE DIFFERENCES ARE SPECIFIED IN THE PUBLICATIONS WHICH MUST BE USED TO INSPECT AND MAINTAIN THESE AIRCRAFT. THE REQUIRED PUBLICATIONS ARE:

PRESSURIZED CENTURION SERVICE MANUAL
PRESSURIZED CENTURION PARTS CATALOG
PRESSURIZED CENTURION PILOTS OPERATING HANDBOOK
PRESSURIZED SKYMASTER SERVICE MANUAL
PRESSURIZED SKYMASTER PARTS CATALOG
PRESSURIZED SKYMASTER PILOTS OPERATING HANDBOOK

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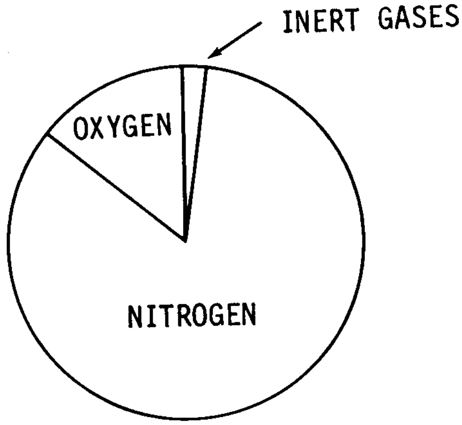
SECTION I - WHY PRESSURIZE?

Generally speaking, most light piston-driven aircraft in today's general aviation fleet are flown at low altitudes due to the economics of this type aircraft (cost vs. number of passengers, range and altitude).

The exception is the turbocharged piston-driven aircraft. Turbocharged aircraft are flown at higher altitudes where it is more economical to operate (at high altitudes a turbocharged piston-driven aircraft will burn less fuel for a given airspeed than it does for the same airspeed at lower altitudes). In other words, at higher altitudes the aircraft becomes more efficient. In addition, bad weather and turbulence can be avoided by flying above the weather in relatively smooth air; "no lumps and bumps". This can be accomplished with increased passenger comfort if the aircraft has a pressurization system.

Let us consider the composition of the earth's atmosphere. The air we breathe is made up of 78% Nitrogen, 1.1% inert gases and only 20.9% Oxygen. This proportion remains constant throughout the entire atmosphere. However, as we climb in altitude, the air becomes less dense, resulting in an oxygen deficiency.



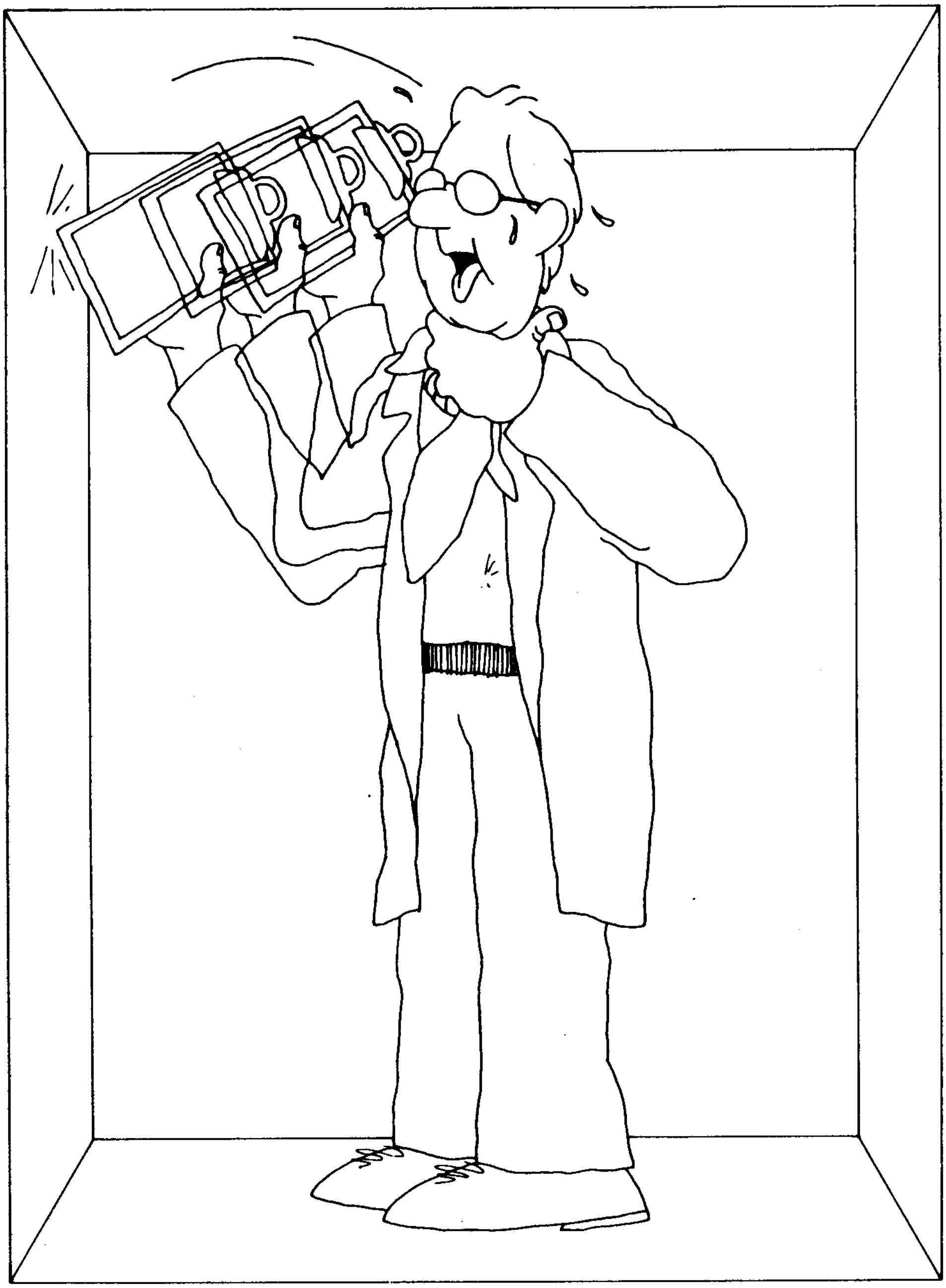
Standard day atmospheric pressure at sea level is 14.70 PSI or 29.92 inches of Mercury.

The following chart illustrates the relationship between altitude and pressure:

ALTITUDE	PSI	INCHES OF HG.
30,000	4.36	8.87
29,000	4.56	9.28
28,000	4.77	9.71
27,000	4.99	10.16
26,000	5.21	10.60
25,000	5.45	11.09
24,000	5.69	11.58
23,000	5.94	12.09
22,000	6.20	12.62
21,000	6.47	13.17
20,000	6.75	13.74
19,000	7.03	14.31
18,000	7.33	14.92
17,000	7.64	15.55
16,000	7.96	16.20
15,000	8.29	16.87
14,000	8.62	17.54
13,000	8.98	18.28
12,000	9.34	19.01
11,000	9.72	19.78
10,000	10.10	20.56
9,000	10.51	21.39
8,000	10.91	22.21
7,000	11.34	23.08
6,000	11.77	23.96
5,000	12.22	24.87
4,000	12.71	25.87
3,000	13.21	26.89
2,000	13.71	27.90
1,000	14.20	28.90
Sea Level	14.70	29.92

With respect to the air at high altitudes, the proportion of the oxygen remains the same, but the quantity of the oxygen per given volume of air becomes less.

PRESSURE AND DENSITY ARE DIRECTLY PROPORTIONAL. AS ALTITUDE INCREASES, PRESSURE DECREASES, AND LIKEWISE, AIR DENSITY DECREASES.



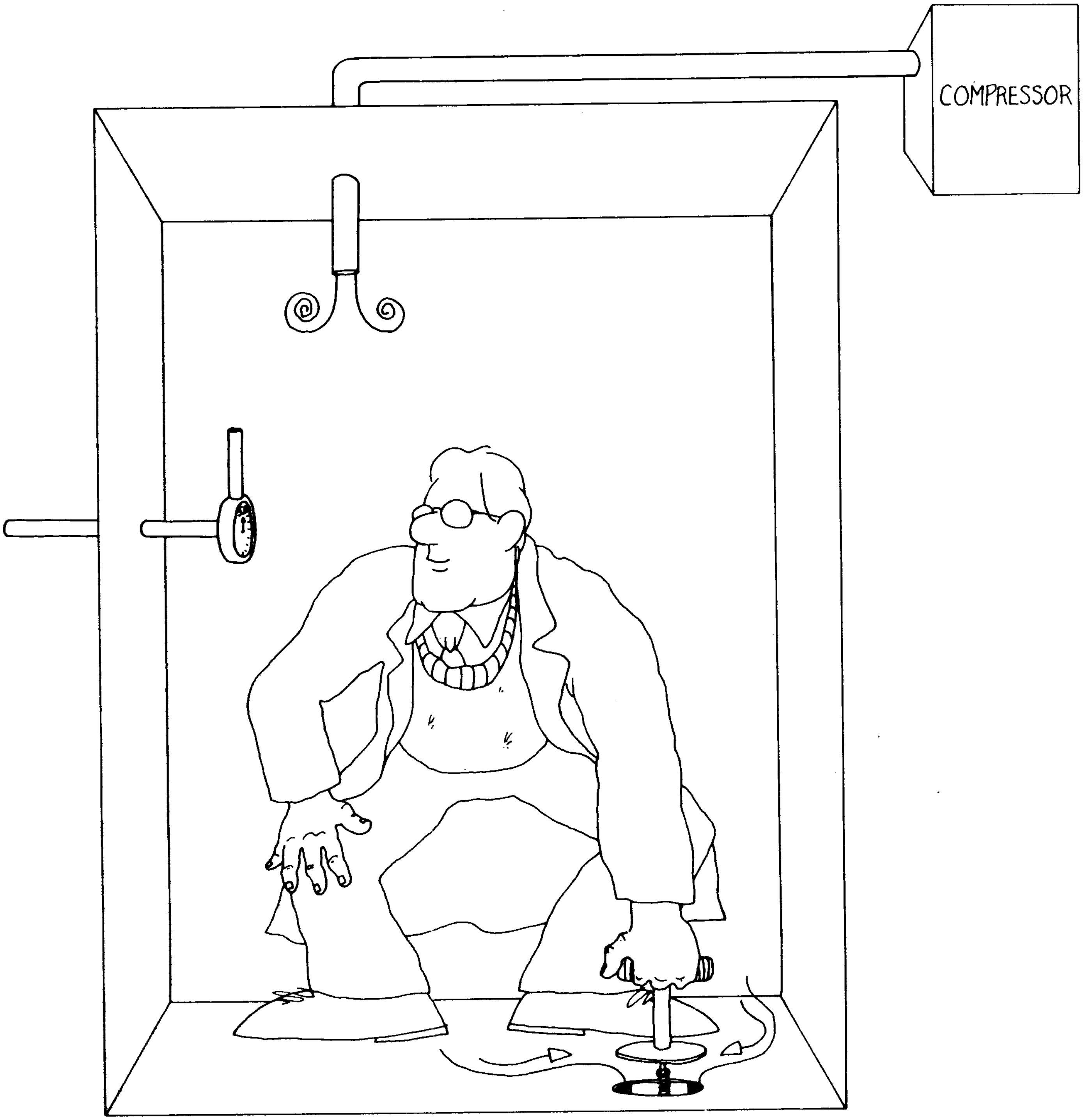
To illustrate the effects of altitude, consider for a moment a person in a sealed capsule with no ambient air influence. As soon as his oxygen supply diminishes, he will experience some discomfort, will suffer from fatigue and becomes irrational. If he is not supplied with oxygen soon, his physical and mental performance will be seriously affected. If the capsule is opened, and air is allowed to enter, a person can survive in relative comfort at LOWER altitudes.

But suppose we now take the capsule to HIGHER altitudes. Since the air pressure and air density is equal both inside and outside the capsule, the person inside the capsule will again experience discomfort and fatigue due to lack of oxygen. This lack of oxygen is called "HYPOXIA". The effects of hypoxia can be serious if a lower altitude environment is not encountered soon.

The following chart summarizes the most common symptoms of hypoxia:

ALTITUDE	TIME OF EXPOSURE	SYMPTOMS
10,000' to 14,000'	Several Hours	Headache, fatigue, deterioration of physical and mental performance.
15,000' to 18,000'	30 Minutes	Impairment of judgment, euphoria, disregard for sensory perceptions, poor coordination, sleepiness, dizziness
20,000' to 35,000'	5 Minutes	Same symptoms as 15,000' to 18,000' but more pronounced
35,000' to 40,000'	15 to 45 Seconds	Immediate unconsciousness (with little or no warning)

As you can see, a person subjected to an environment of significantly reduced air pressure, similar to that found at high altitudes, would only be of use as a crew member for an extremely short time.

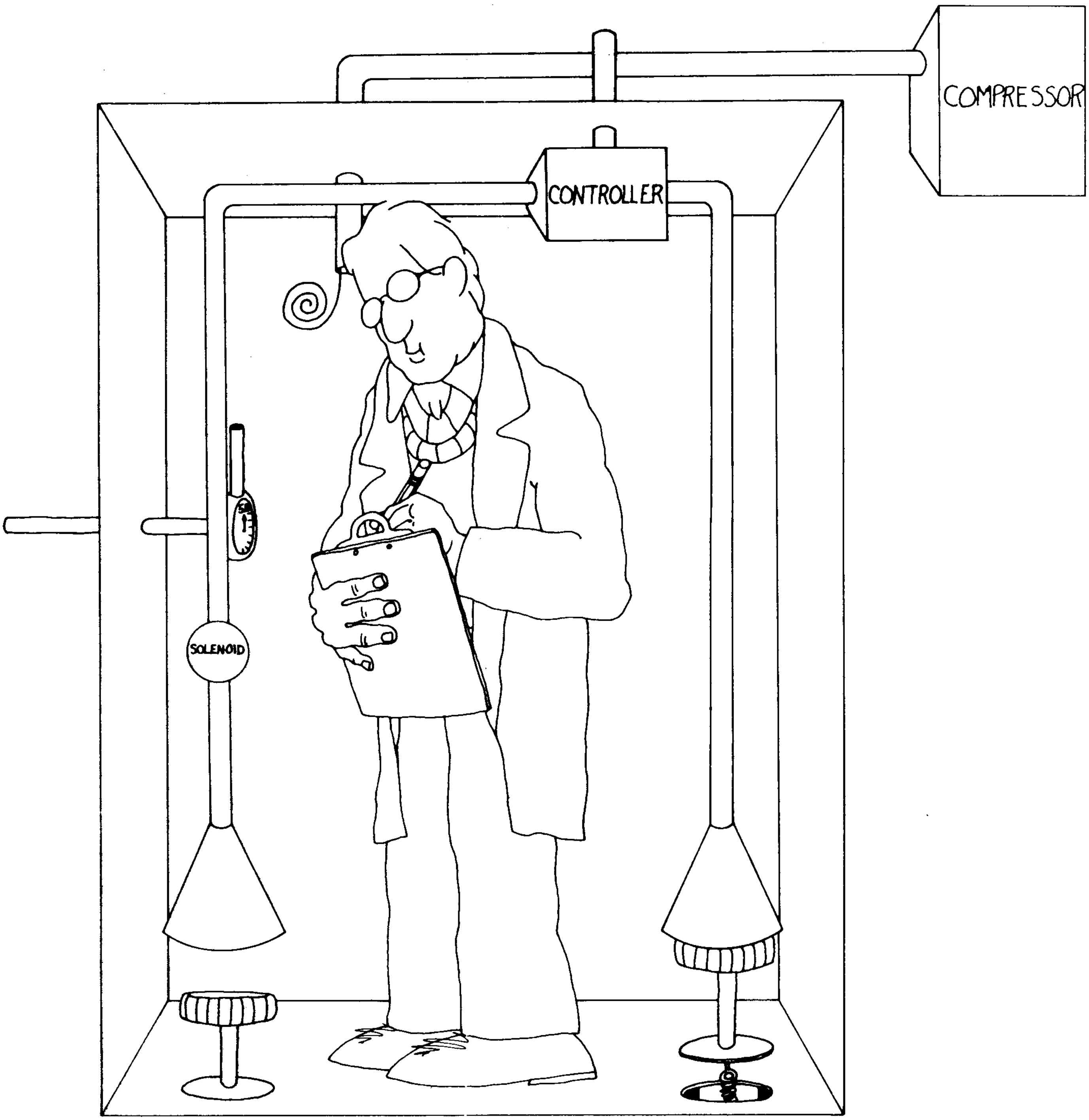

COMPRESSOR

One solution would be to provide the person inside the capsule with supplemental oxygen. However, this is only a short term remedy. When the oxygen supply is exhausted, the crew member once again suffers from hypoxia.

The easiest solution would be to keep the capsule at a LOWER altitude where normal activities can continue. This is not always practical. Perhaps if we take a look at the laws of physics, we might find a suitable solution. If we compress air, we can INCREASE its pressure and at the same time INCREASE its density. Thus, if we can compress ambient air and duct it into our capsule, we can produce an "artificial atmosphere" having the same pressure as that of a lower altitude, and thus provide the needed oxygen, regardless of altitude.

Obviously, if we introduce compressed air into a sealed capsule, we will increase the pressure, and likewise the oxygen supply, but what happens to the capsule structure? If we OVER-pressurize the capsule, structural damage is likely to occur. To preclude this possibility, we need a means of controlling the pressure.

We could provide a means to regulate the air entering the capsule; then the pressure would increase, but the air in the capsule would soon become depleted of oxygen since the air is not moving through the capsule. By adding an OUTFLOW VALVE to our capsule, we can regulate the pressure inside by controlling the outflow of air from the capsule, as well as exchanging the air in the capsule by creating air flow. To increase pressure, the OUTFLOW VALVE would close, and to DECREASE the pressure, the OUTFLOW VALVE would open.


COMPRESSOR
CONTROLLER
SOLENOID

We can monitor the pressure inside our capsule by the use of a DIFFERENTIAL PRESSURE GAUGE. It would be referenced to the INSIDE pressure as well as the OUTSIDE pressure, so it would indicate the difference between the two references and thus show cabin differential pressure.

The pressure in the capsule is now regulated by the position of the outflow valve. But what would happen if the outflow valve were to stick closed? One of two choices are available. First, we could turn off our compressor, which would eventually lead to our original problem--NO OXYGEN; or secondly, we could install a second outflow valve. This back-up outflow valve is referred to as the SAFETY VALVE. It is merely a redundant feature in our pressurization system for the purpose of insuring safety, and preventing serious damage to our capsule.

Now that we can control the pressure in our capsule, what about the task of flying the aircraft? We need a means of automating and selecting our system pressure to relieve the flight crew of manual pressure regulation and monitoring.

By adding a CONTROLLER, an ON-OFF SWITCH and a SAFETY SOLENOID in the system, automatic monitoring of pressure and safety is accomplished. The CONTROLLER permits selection of any desired cabin pressure between sea level and 10,000'. It monitors the pressure altitude inside the capsule, and at the same time, controls the outflow valve to a position that maintains a selected cabin pressure altitude.

The SAFETY SOLENOID is controlled by an ON-OFF switch, which in turn, controls the safety valve. When the switch is in the "ON" position (PRESSURIZE MODE) the SAFETY SOLENOID is de-energized allowing the safety valve to close and the capsule will pressurize. With the switch in the "OFF" position, (NON-PRESSURIZE MODE) the SAFETY SOLENOID is energized, which allows the safety valve to open, thus DE-PRESSURIZING the capsule.

THIS CONCLUDES SECTION ONE. ANSWER THE QUESTIONS ON THE FOLLOWING PAGES.

SECTION I - REVIEW QUESTIONS

INSTRUCTIONS: CIRCLE THE LETTER BY THE CORRECT ANSWER

1. WHAT IS CONSIDERED TO BE STANDARD DAY ATMOSPHERIC PRESSURE AT SEA LEVEL?

   A. 14.20 PSI, 28.90 IN. Hg.

   B. 14.70 PSI, 29.92 IN. Hg.

   C. 4.30 PSI, 8.87 IN. Hg.

   D. 14.75 PSI, 30.30 IN. Hg.

2. WHAT IS THE RELATIONSHIP BETWEEN ALTITUDE AND PRESSURE?

   A. As altitude increases, pressure increases

   B. As altitude decreases, pressure will remain the same

   C. As altitude increases, pressure decreases

   D. As altitude decreases, pressure decreases

3. WHAT COMPONENT PERMITS SELECTION OF CABIN PRESSURE ALTITUDE?

   A. Pressurization control switch

   B. Outflow valve

   C. Safety valve

   D. Controller

4. WHAT ARE THE PRESSURE REFERENCES USED TO DETERMINE CABIN DIFFERENTIAL PRESSURE?

   A. Upper deck pressure and outside pressure

   B. Outside pressure and cabin pressure

   C. Safety valve pressure and pitot pressure

   D. Outflow valve pressure and upper deck pressure

5. WHAT COMPONENT IS USED TO INDICATE CABIN DIFFERENTIAL PRESSURE?

   A. Differential pressure gauge

   B. Cabin rate-of-climb indicator

   C. Controller

   D. Flow control indicator

6. WHAT PREVENTS ULTIMATE DAMAGE TO THE PRESSURIZED CAPSULE UNDER PRESSURIZED CONDITIONS?

   A. Outflow valve

   B. Safety valve during pressurized mode

   C. Pressurization controller

   D. Safety valve when energized

7. WHAT COMPONENT IN THE PRESSURIZATION SYSTEM PHYSICALLY MOVES TO REGULATE CABIN PRESSURE?

   A. Pressurization controller

   B. Safety valve

   C. Outflow valve

   D. Safety solenoid

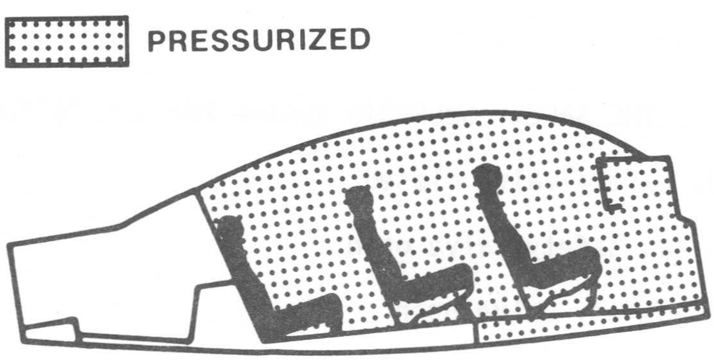
8. IN WHAT MODE IS THE SAFETY SOLENOID DURING PRESSURIZATION?

   A. Energized, safety valve closed

   B. De-energized, safety valve open

   C. Energized, safety valve open

   D. De-energized, safety valve closed



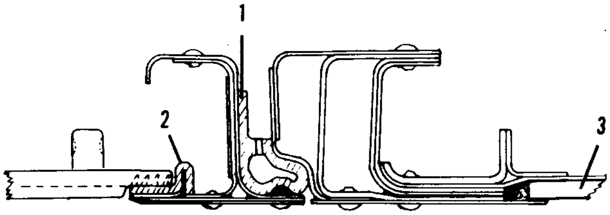
PRESSURIZED CAPSULE

SECTION 2 - PRESSURIZED CENTURION

As this point in your workbook, you should be fairly well acquainted with the pressurization system components and their immediate function. Understanding WHY pressurization is important, gives you the basis from which the purpose of each component can be further detailed.

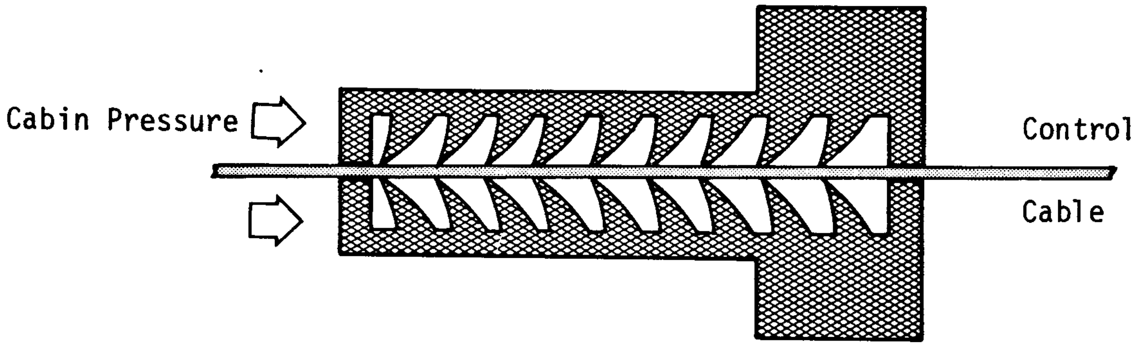
Previously, we discussed the capsule in which pressurization took place. Let's take a closer look at this capsule, its boundaries, construction, and related components.

The pressure capsule is the cabin area of the Pressurized Centurion bounded by the firewall on the front and extending to the aft cabin pressure bulkhead. The cabin floor, just aft of the rear doorpost, becomes the bottom boundary, while the outer skins compose the remainder of our "sealed capsule". Like the larger twin Cessnas, the Pressurized Centurion is built on a "fail-safe" construction principle. If any one structural part in the pressure capsule should fail, the remainder of the capsule would remain intact and functional. Double-row riveting, back-to-back formers, added reinforcement members, and heavier-gauge channels are items that provide the necessary strength to withstand the internal forces of pressurization. This construction method gives the Pressurized Centurion the same exceptional safety margin as cabin-class twin-engine aircraft. Increased reliability, safety, and infinite service life are the results of "fail-safe" construction.

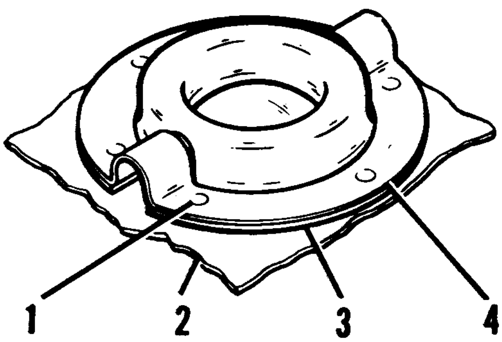


1. Door Seal.
2. Window Seal (Foul Weather)
3. Windshield.

CABIN DOOR SEAL INSTALLATION



LABYRINTH CABLE SEAL



1. Rivet	2. Retainer
2. Skin	3. Seal

PRESSURE DRAIN SEAL

Cabin sealing is accomplished in the same manner as the larger twins. First, the skins and formers are aligned and held in place securely, while all holes are drilled and reamed. The skins are removed and sealant is uniformly applied to the bare formers, then the skins are reinstalled. While the sealant is still workable, the formers and skins are riveted in place, resulting in an air-tight assembly. Should repair to the cabin pressure capsule be necessary, detailed instructions are outlined in the Pressurized Centurion Service Manual. Special types of sealants are used in different areas of the pressure capsule, so consult the Service Manual for proper sealant usage.

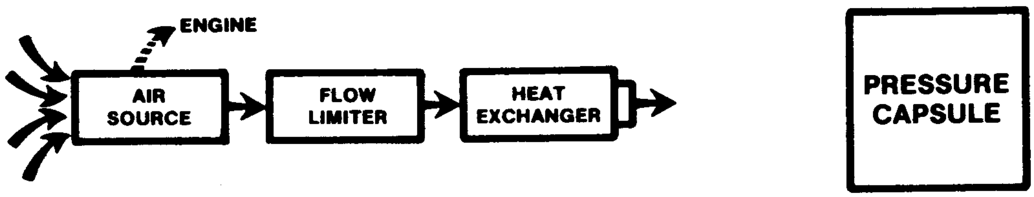
Not only does the pressure capsule require special sealing, but so does the cabin door and emergency exit. The seals are specially designed to provide pressure retention. They are inflated from the cabin side by pressurized air which enters through holes in the hollow seal. Inflating the seals causes them to expand against the cabin door, emergency exit and fuselage structure for positive sealing.

Pressurization has necessitated other changes in the Pressurized Centuiron. Stronger doors, redundant safety latches, and changes in window design provide safety and reliability.

Where cables and rods exit the pressure capsule, special labyrinth seals are installed to limit the escape of pressurized air from the cabin.

PRESSURE DRAIN SEALS are located in the lower skin of the fuselage. In the "unpressurized mode", the seal is relaxed and will allow moisture to drain from the fuselage. In the "pressurized mode", the seal expands and closes the drain holes to prevent loss of pressurization.

PRESSURIZED CENTURION



AIR DISTRIBUTION SYSTEM

Pressurization begins with compressed air. The source of this compressed air is the exhaust-driven TURBOCHARGER, located on the lower right-hand side of the engine. The primary function of the turbocharger is to provide the engine with compressed air for high altitude operation.

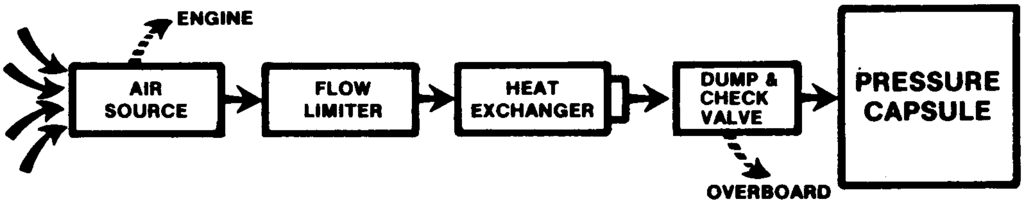
The turbocharger compresses air into the "UPPER DECK SYSTEM", which is the duct system between the compressor section of the turbocharger and the throttle plate of the induction system. A portion of this "UPPER DECK AIR" is extracted and routed to the cabin for pressurization.

The SONIC VENTURI is the means by which air is extracted from the upper deck. It functions as a fixed bleed-air orifice (flow limiter) to limit the amount of air taken from the upper deck, to prevent a deficiency of air to the engine.

Compressing the air causes the temperature of the air to increase. Thus the air from the compressor section is very warm. If this hot air were to be routed directly to the cabin, it would provide a source of heat for the cabin.

If heating the cabin is NOT desired, the air can be cooled <u>before</u> entering the cabin by the HEAT EXCHANGER, located on the lower left-hand side of the engine compartment. The HEAT EXCHANGER operates like a radiator. Ambient air flows through the fins of the heat exchanger, around the core, and exhausts overboard. The cool ambient air has thereby <u>cooled</u> the air

PRESSURIZED CENTURION

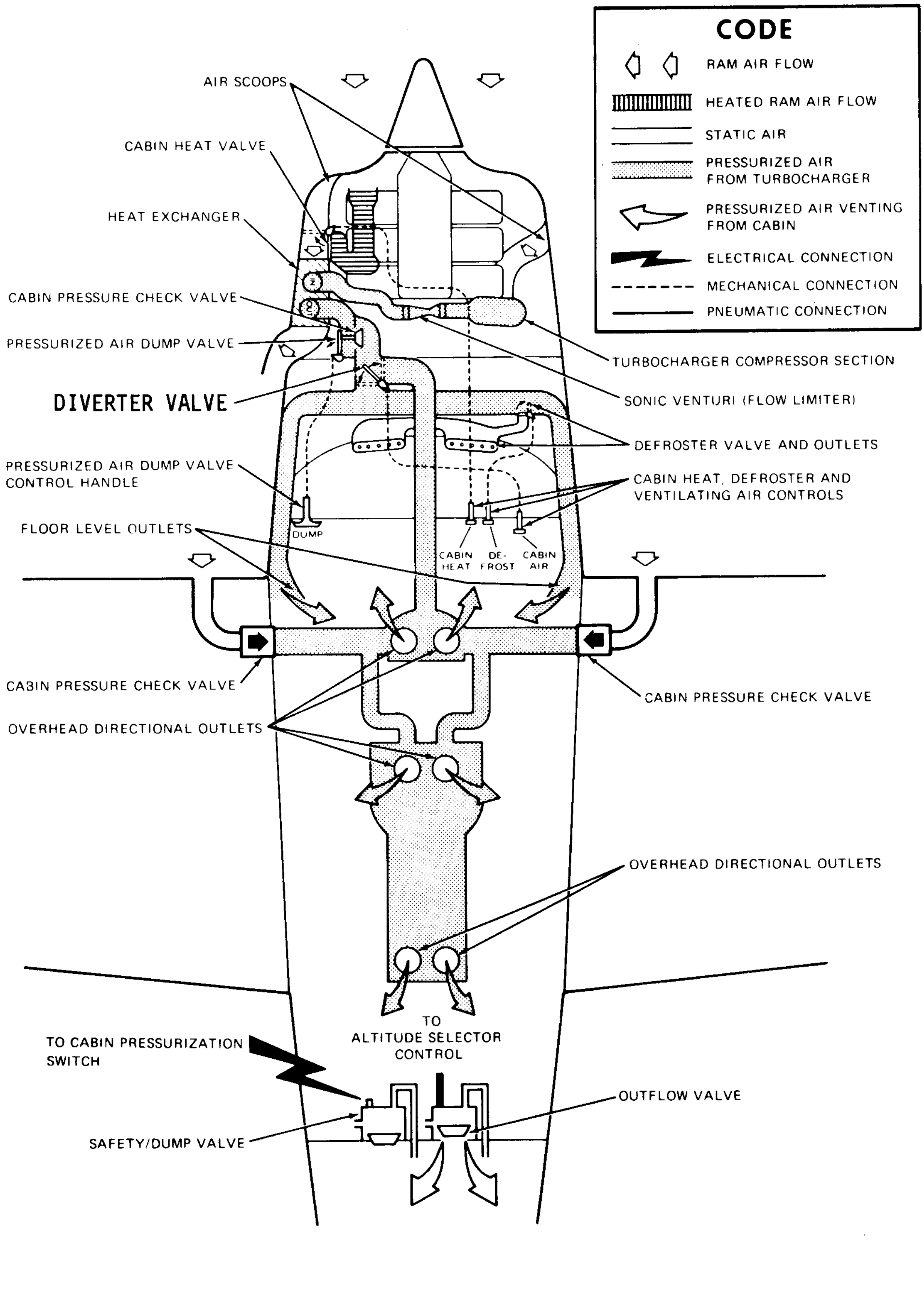


inside the core of the heat exchanger, and cool compressed air is allowed to enter the cabin. An air scoop in the lower forward left side of the nose structure, and an exhaust scoop located in the lower side cowl panel assures a high volume of ambient airflow through the heat exchanger.

A valve is included as part of the heat exchanger installation to enable the pilot to select either warm or cool airflow through the heat exchanger. In the "warm" position, the valve directs heated air from the engine exhaust shroud through the heat exchanger. A PUSH-PULL control, labeled "CABIN HEAT" is located on the lower right side in the instrument panel. This control operates the "air selector" valve in the heat exchanger assembly for cabin temperature control.

After passing through the heat exchanger, pressurized air is routed into the cabin through a MANUAL DUMP VALVE PLENUM, located on the forward side of the firewall. When the MANUAL DUMP VALVE is opened, the pressurized air is routed overboard. A push-pull control in the cabin gives the pilot this option. In the event contaminated air enters the cabin, the MANUAL DUMP VALVE should be opened to route the contaminated air overboard.

With the MANUAL DUMP VALVE closed, pressurized air enters the cabin through a flapper-type INLET CHECK VALVE installed on the aft side of the MANUAL DUMP VALVE PLENUM. In the event of a loss of incoming pressurized air, the check valve will trap pressurized air in the cabin and prevent back-flow. Loss of pressurized air could be the result of an engine malfunction or if the MANUAL DUMP VALVE is opened.



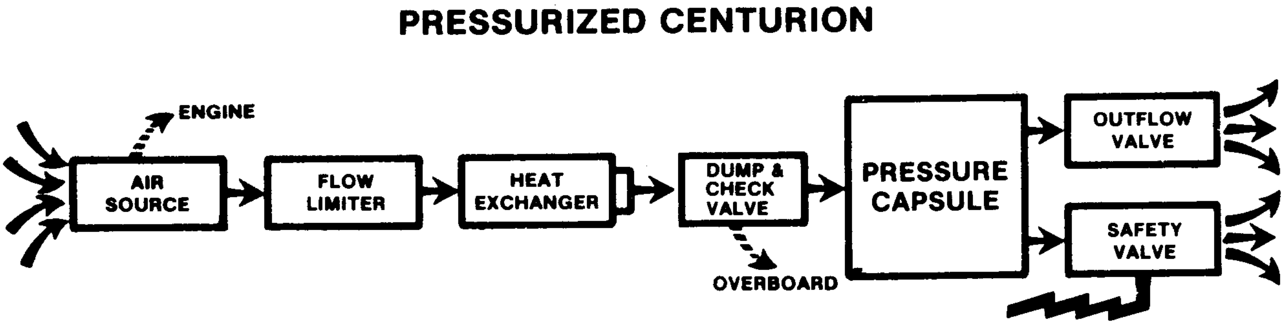
CODE
RAM AIR FLOW
HEATED RAM AIR FLOW
STATIC AIR
PRESSURIZED AIR FROM TURBOCHARGER
PRESSURIZED AIR VENTING FROM CABIN
ELECTRICAL CONNECTION
MECHANICAL CONNECTION
PNEUMATIC CONNECTION
AIR SCOOPS
CABIN HEAT VALVE
HEAT EXCHANGER
CABIN PRESSURE CHECK VALVE
PRESSURIZED AIR DUMP VALVE
DIVERTER VALVE
PRESSURIZED AIR DUMP VALVE CONTROL HANDLE
FLOOR LEVEL OUTLETS
DUMP
CABIN HEAT
DE-FROST
CABIN AIR
TURBOCHARGER COMPRESSOR SECTION
SONIC VENTURI (FLOW LIMITER)
DEFROSTER VALVE AND OUTLETS
CABIN HEAT, DEFROSTER AND VENTILATING AIR CONTROLS
CABIN PRESSURE CHECK VALVE
OVERHEAD DIRECTIONAL OUTLETS
CABIN PRESSURE CHECK VALVE
OVERHEAD DIRECTIONAL OUTLETS
TO ALTITUDE SELECTOR CONTROL
TO CABIN PRESSURIZATION SWITCH
OUTFLOW VALVE
SAFETY/DUMP VALVE

After passing through the inlet check valve, the pressurized air enters a DIVERTER CHAMBER. A valve within the diverter assembly is operated by a push-pull control labeled FLOOR-DEFROST/OVERHEAD. The valve directs the airflow from the diverter assembly to either the floor registers or to the overhead outlets. When the "CABIN HEAT" control is in the "COOL" mode, the air may be ducted to both the floor registers and the overhead outlets. When the control is in the "CABIN HEAT" mode, the warm air is ducted through the floor level outlets only. This is accomplished by an interconnect between the "FLOOR/OVERHEAD" control and the "CABIN HEAT" control.

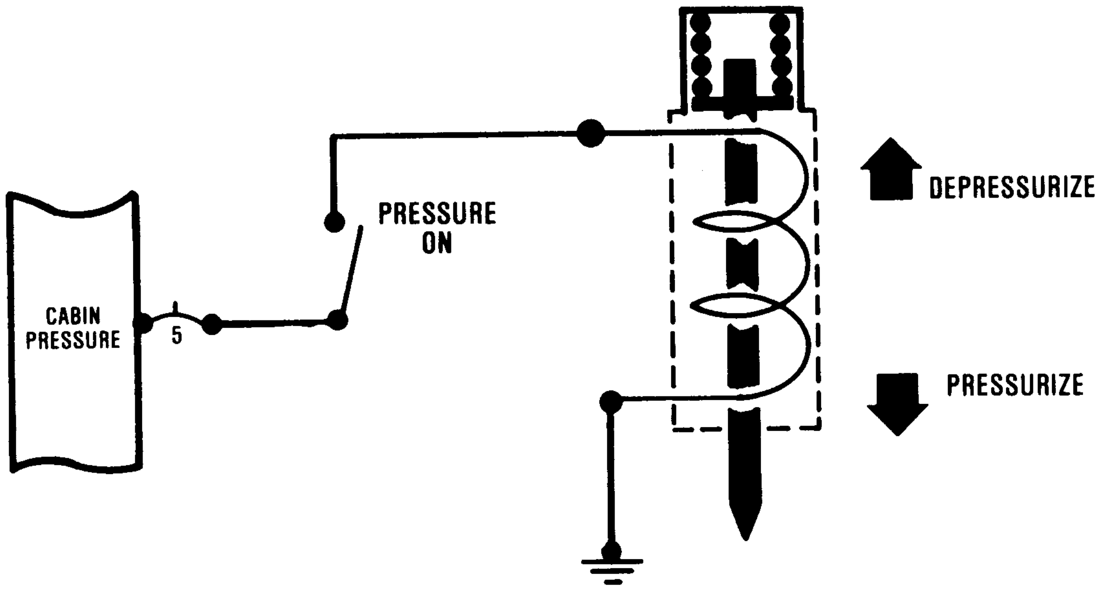
DEFROST air to the windshield is taken from the floor level distribution system.

Fresh air is routed into the cabin when pressurization is not in use. Leading edge openings located in the wings provide cool air which is ducted into the cabin through CABIN PRESSURE CHECK VALVES. There are two valves; one per wing, located above each of the two forward seats along the wing butt line. Their function is to provide fresh air when in the depressurized mode and to automatically close when the cabin is pressurized.

NOTES



PRESSURIZATION SYSTEM



SAFETY VALVE SOLENOID-ELECTRICAL SCHEMATIC

PRESSURIZATION CONTROL SYSTEM

To this point, we have discussed how air is INTRODUCED into the cabin providing cabin pressurization. How pressurization is regulated and controlled will be the topic of the next discussion.

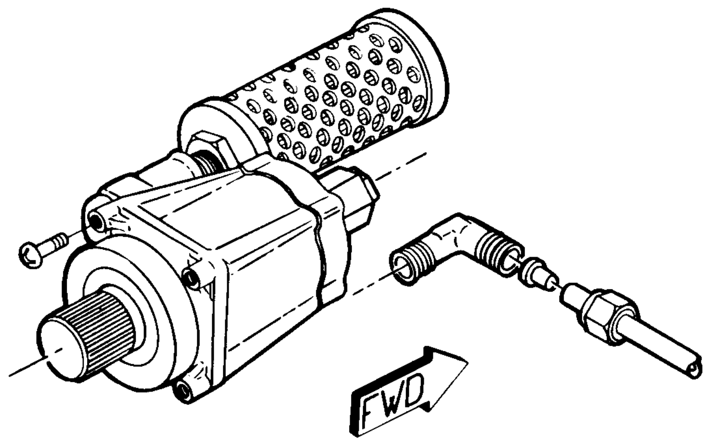
To provide an effective means of controlling cabin pressurization, an OUTFLOW VALVE is installed in a recess in the upper aft cabin pressure bulkhead. By locating the outflow valve in the aft section of the cabin, we produce a more effective exchange of air. Air enters the front of the cabin and exits the rear.

When the outflow valve is mentioned, the SAFETY VALVE should also be recalled. The function of the SAFETY VALVE is to relieve cabin pressure should the outflow valve malfunction. It is located next to the outflow valve on the aft cabin pressure bulkhead. It also incorporates a means of keeping the cabin de-pressurized when pressurization is not desired. A SAFETY SOLENOID is incorporated in the SAFETY VALVE itself, thereby directly controlling the position of the safety valve. When the cabin pressurization switch located to the left of the controller is in the "OFF" position, the SAFETY SOLENOID is energized, opening the SAFETY VALVE, and thereby maintaining an unpressurized cabin. Conversely, when the switch is in the "ON" position, the safety solenoid is de-energized, allowing the safety valve to close and the cabin to pressurize.

DO NOT CONFUSE THE TWO VALVES! The safety valve incorporates a safety solenoid and the outflow valve is connected to the controller by a polethylene tube. Both valves are accessible by removing the interior panel at the aft pressure bulkhead.

A cabin pressurization CIRCUIT BREAKER is provided to protect the electrical portion of the pressurization system.

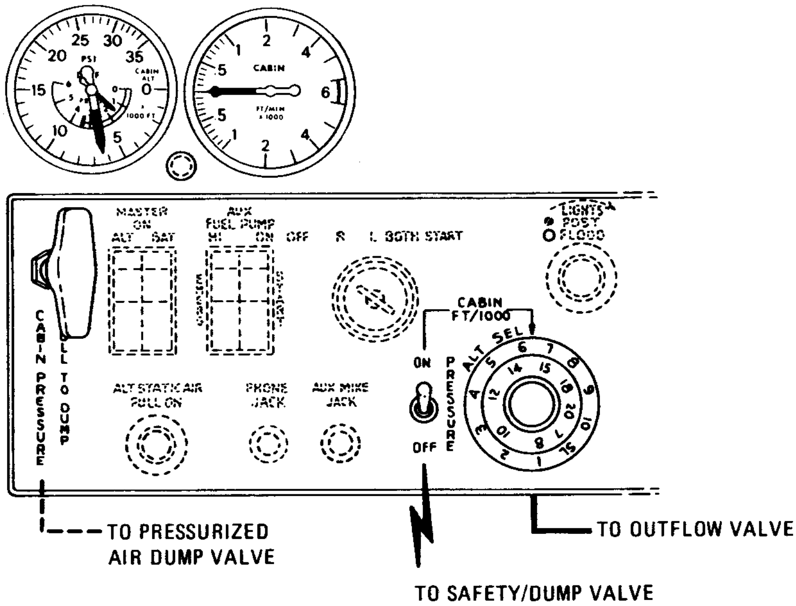
To select cabin altitude and meter reference pressure to the outflow valve, a CONTROLLER is installed on the lower left instrument panel within easy reach of the pilot. This is the "BRAINS" of the pressurization system.



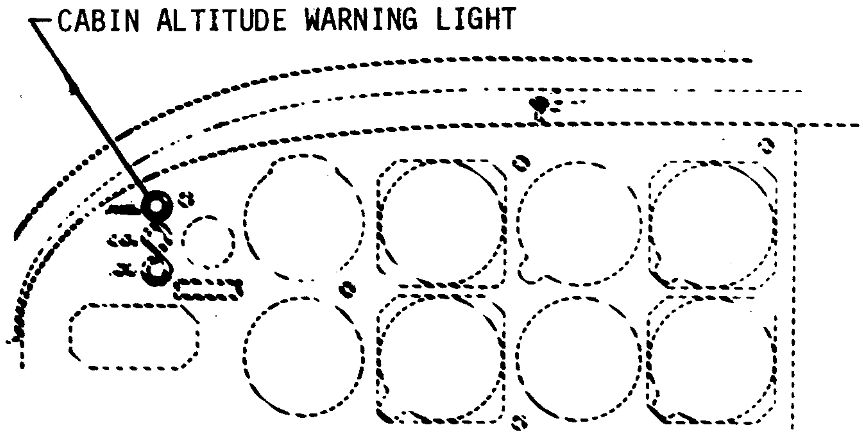
CONTROLLER

INSTRUMENTS AND WARNING DEVICES

To monitor the pressurization system, there are two gauges that indicate cabin pressure altitude, cabin altitude rate-of-climb, and cabin differential pressure.



PRESSURIZATION SYSTEM CONTROLS AND INSTRUMENTS



CABIN ALTITUDE and DIFFERENTIAL PRESSURE are combined into one instrument. The large needle indicates cabin pressure altitude, or the artificial altitude created by the pressurization system. The smaller needle indicates cabin differential pressure. DIFFERENTIAL PRESSURE is the difference in pressure between the inside and outside of the pressure capsule. A source from each pressure is referenced to the differential pressure gauge. The MAXIMUM CABIN DIFFERENTIAL PRESSURE is indicated by a "red-line" at 3.35 PSI.

The second instrument associated with cabin pressurization is the CABIN RATE-OF-CLIMB INDICATOR. It is located on the left side of the instrument panel above the dump valve control handle. It is vented directly to the cabin and senses changes in pressure within the cabin to show cabin rate-of-climb or descent.

A CABIN ALTITUDE WARNING LIGHT is incorporated to indicate when the cabin pressure altitude reaches and exceeds 12,400 ± 100 ft. The light is controlled by a barometric pressure switch located forward of the instrument panel. When this light illuminates, it reminds the pilot of OXYGEN REQUIREMENTS necessary when the cabin altitude is in excess of 12,400 ft. The switch will reset at an altitude of approximately 11,700 ft.

THIS CONCLUDES SECTION TWO. ANSWER THE QUESTIONS ON THE FOLLOWING PAGES.

SECTION 2 - REVIEW QUESTIONS

INSTRUCTIONS: CIRCLE THE LETTER BY THE CORRECT ANSWER

1. WHAT PREVENTS PRESSURIZED AIR FROM ESCAPING PAST THE CABIN DOOR AND EMERGENCY EXIT?

   A. Rubber o'ring seals

   B. Seals inflated by upper deck pressure

   C. Hollow rubber seals inflated by cabin pressure

   D. Solid rubber seals

2. WHAT LIMITS PRESSURIZED AIR FROM ESCAPING AROUND CONTROL CABLES GOING THROUGH THE PRESSURE CAPSULE?

   A. Rubber boots

   B. Rubber fairleads

   C. Dyno-seals

   D. Labyrinth seals

3. WHAT IS THE FUNCTION OF THE SONIC VENTURI?

   A. It limits the amount of upper deck air used for pressurization

   B. It is a variable orifice used to control cabin pressure

   C. Controls upper deck pressure

   D. Increases compressed air temperature

4. THE HEAT EXCHANGER IS USED TO:

   A. Provide fresh air to the cabin

   B. Condition air to desired temperature for the pressurized cabin

   C. Heat air for the cabin only

   D. Cool air for the cabin only

SECTION 2 - REVIEW QUESTIONS

5. THE PURPOSE OF THE MANUAL DUMP VALVE IS:

   A. To dump cabin pressure if desired

   B. To dump cabin pressure when the outflow valve malfunctions

   C. To route pressurized air overboard

   D. To pressurize the cabin

6. FRESH AIR IS PROVIDED BY:

   A. Wing leading edge openings routing air through the cabin pressure check valves

   B. Ram air from the heat exchanger

   C. Bleed air from the sonic venturi

   D. Upper deck air

7. THE CABIN RATE-OF-CLIMB INDICATOR INDICATES:

   A. Aircraft altitude above sea level

   B. Aircraft altitude above ground

   C. Cabin rate of descent or climb

   D. Cabin differential pressure

8. WHAT IS THE PURPOSE OF THE CABIN ALTITUDE WARNING LIGHT?

   A. To warn the pilot when the aircraft goes over 10,000 feet

   B. To warn the pilot when the cabin pressure altitude goes over 10,000 feet

   C. To warn the pilot when the aircraft goes over 12,400 feet

   D. To warn the pilot when the cabin pressure altitude goes over 12,400 feet

SECTION 2 - REVIEW QUESTIONS

9. AT WHAT PRESSURE IS THE MAXIMUM CABIN DIFFERENTIAL PRESSURE RED LINE MARKED ON THE DIFFERENTIAL PRESSURE GAUGE?

   A. 3.45 PSI

   B. 3.50 PSI

   C. 3.35 PSI

   D. 3.30 PSI

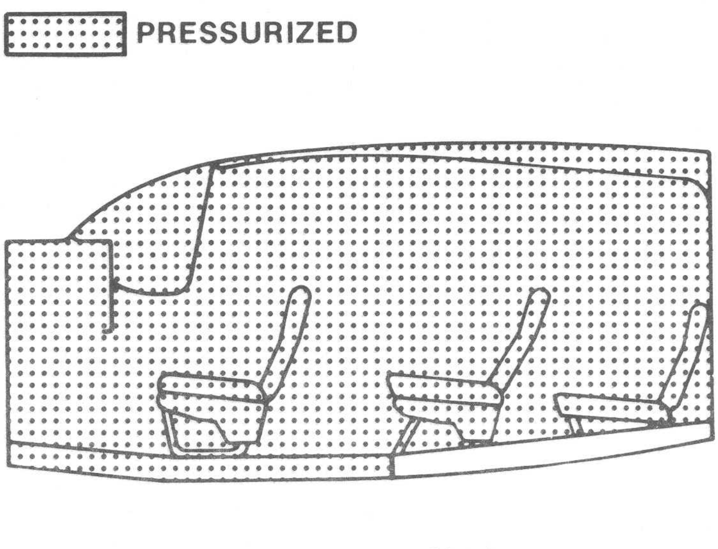
10. WHAT IS CONSIDERED THE BRAINS OF THE PRESSURIZATION SYSTEM?

   A. The controller

   B. The outflow valve

   C. The safety valve

   D. The sonic venturi



PRESSURIZED CAPSULE

SECTION 3 - PRESSURIZED SKYMASTER

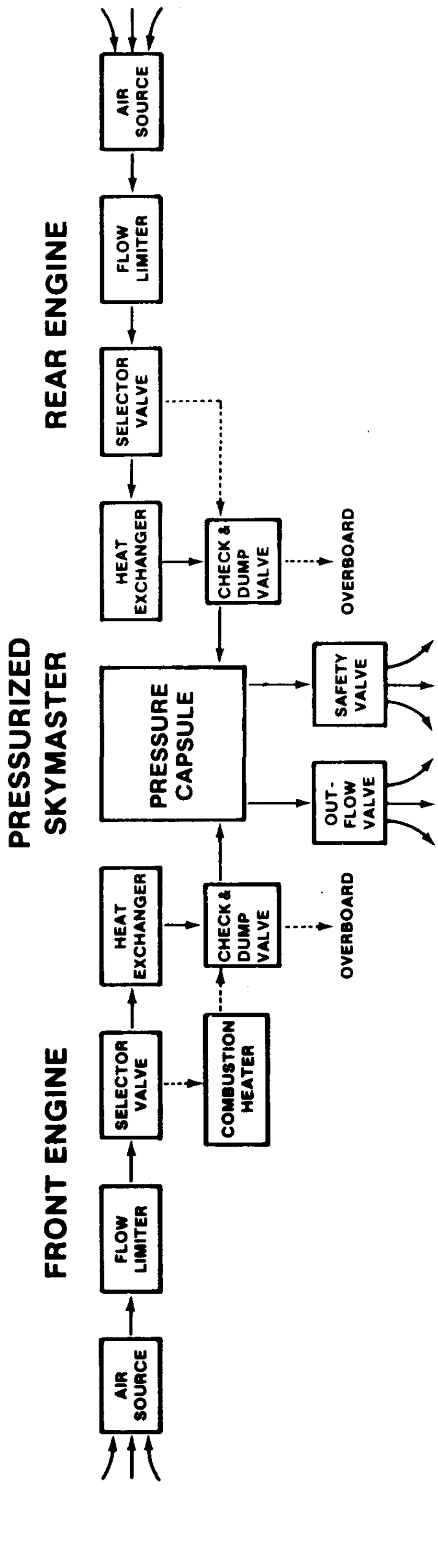
In this section, you will be able to relate the components of the Pressurized Centurion to those of the Pressurized Skymaster with only a few minor differences.

The major difference becomes immediately apparent when comparing the two aircraft. The Pressurized Skymaster utilizes airflow from TWO engines. One can basically assume that there will be TWO of each component in the DUAL AIR DISTRIBUTION SYSTEM.

The Pressurized Skymaster has a pressure capsule beginning at the forward firewall, and extends to the forward side of the rear firewall. The outside skins are the boundaries for the pressure capsule in all areas, except the area directly over the main landing gear strut wells. In this area, the cabin floor becomes the boundary. PRESSURE DRAIN SEALS are located in the lower skin of the fuselage.

The pressure capsule of the Pressurized Skymaster is constructed in the same manner as the Pressurized Centurion in that "FAIL-SAFE" methods are employed, and sealing techniques are the same. LABYRINTH SEALS are used wherever cables exit the pressure capsule.

Cabin pressurization is provided by both the front AND rear engines in normal operation, but pressurization can be easily maintained from the airflow produced by only one engine.


PRESSURIZED SKYMASTER
FRONT ENGINE
REAR ENGINE
AIR SOURCE
FLOW LIMITER
SELECTOR VALVE
HEAT EXCHANGER
COMBUSTION HEATER
CHECK & DUMP VALVE
OVERBOARD
PRESSURE CAPSULE
OUT-FLOW VALVE
SAFETY VALVE
HEAT EXCHANGER
CHECK & DUMP VALVE
OVERBOARD
SELECTOR VALVE
FLOW LIMITER
AIR SOURCE

FRONT AIR DISTRIBUTION

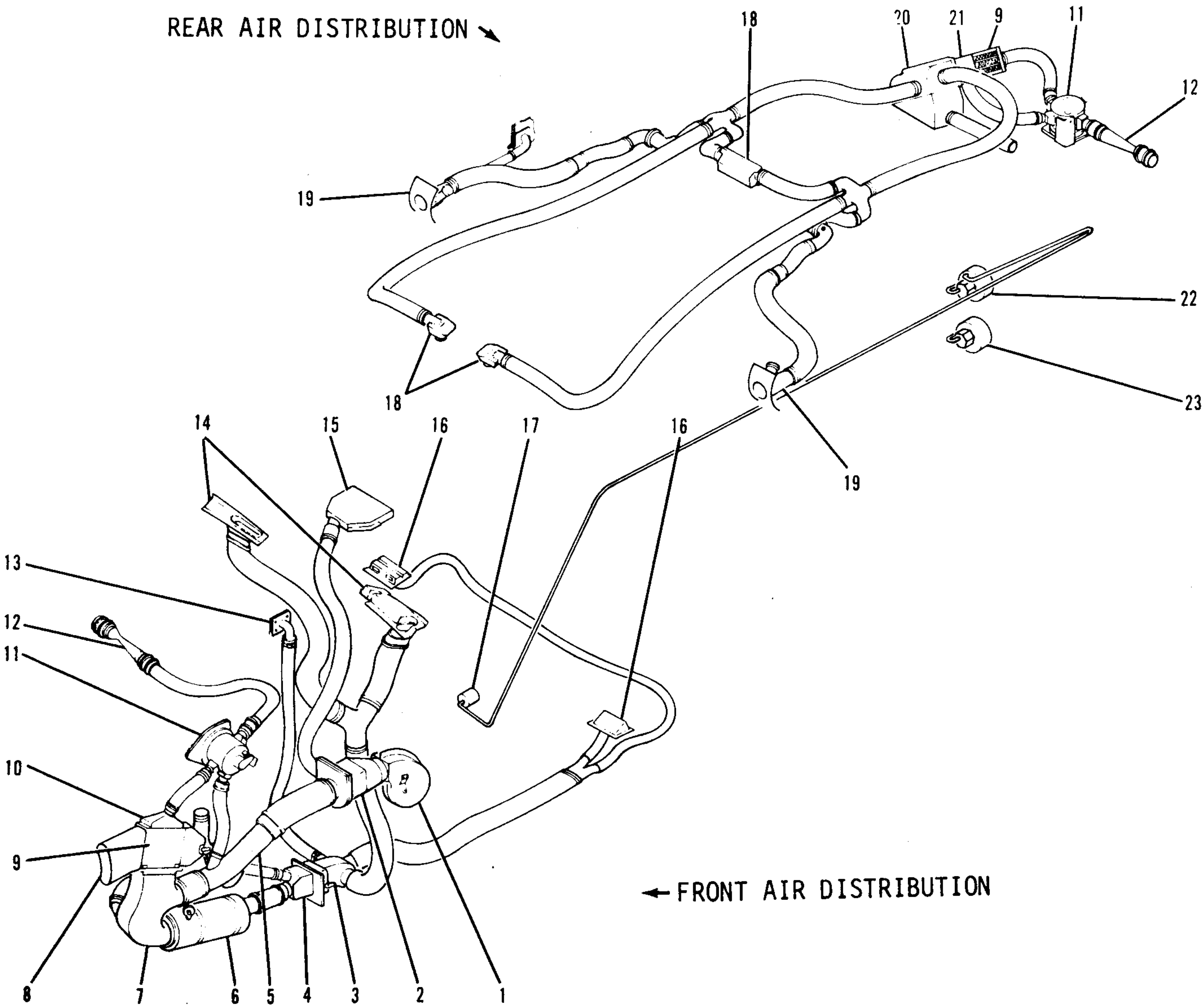
The front turbocharger is located on the lower right side of the engine, and is accessible by removing the lower right cowl panel. Compressed air is routed from the turbocharger into the "upper deck system", extracted by the SONIC VENTURI (flow limiter) and routed through the front AIR SELECTOR VALVE.

The AIR SELECTOR VALVE permits selection of either cool or warm pressurized air to enter the cabin, depending on the position of the front "PRESS AIR TEMP" control located on the instrument panel. If the control is in the "COOL" mode, the air is directed through the HEAT EXCHANGER, where it is cooled by ram ambient air and then routed to the cabin. The scoop for ram air to the heat exchanger is located in the left cowl nose cap.

When the "PRESS AIR TEMP" control is in the "WARM" mode, the CABIN AIR SELECTOR routes pressurized air through the cabin combustion heater, rather than through the heat exchanger. The heater can then be operated if additional cabin heat is desired.

After the air passes through either the cabin heater or through the heat exchanger, the air is then routed through the front MANUAL DUMP VALVE PLENUM, through the FIREWALL INLET CHECK VALVE, and into the cabin through the defrost network and cabin floor outlets.

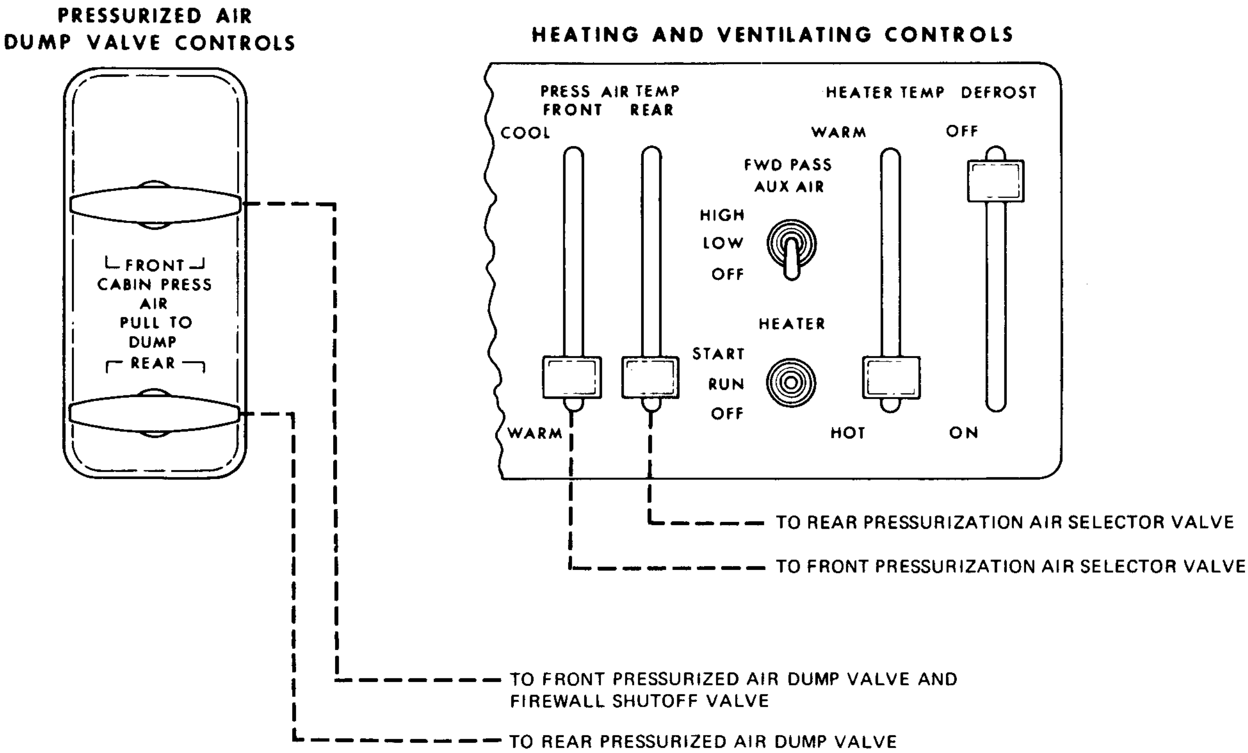
Standard equipment also includes a recirculating blower located beneath the instrument panel on the left side of the forward firewall. The only purpose of the blower is to circulate cabin air back through the heater when operating in the "HEAT" mode, or through ventilators above the radios

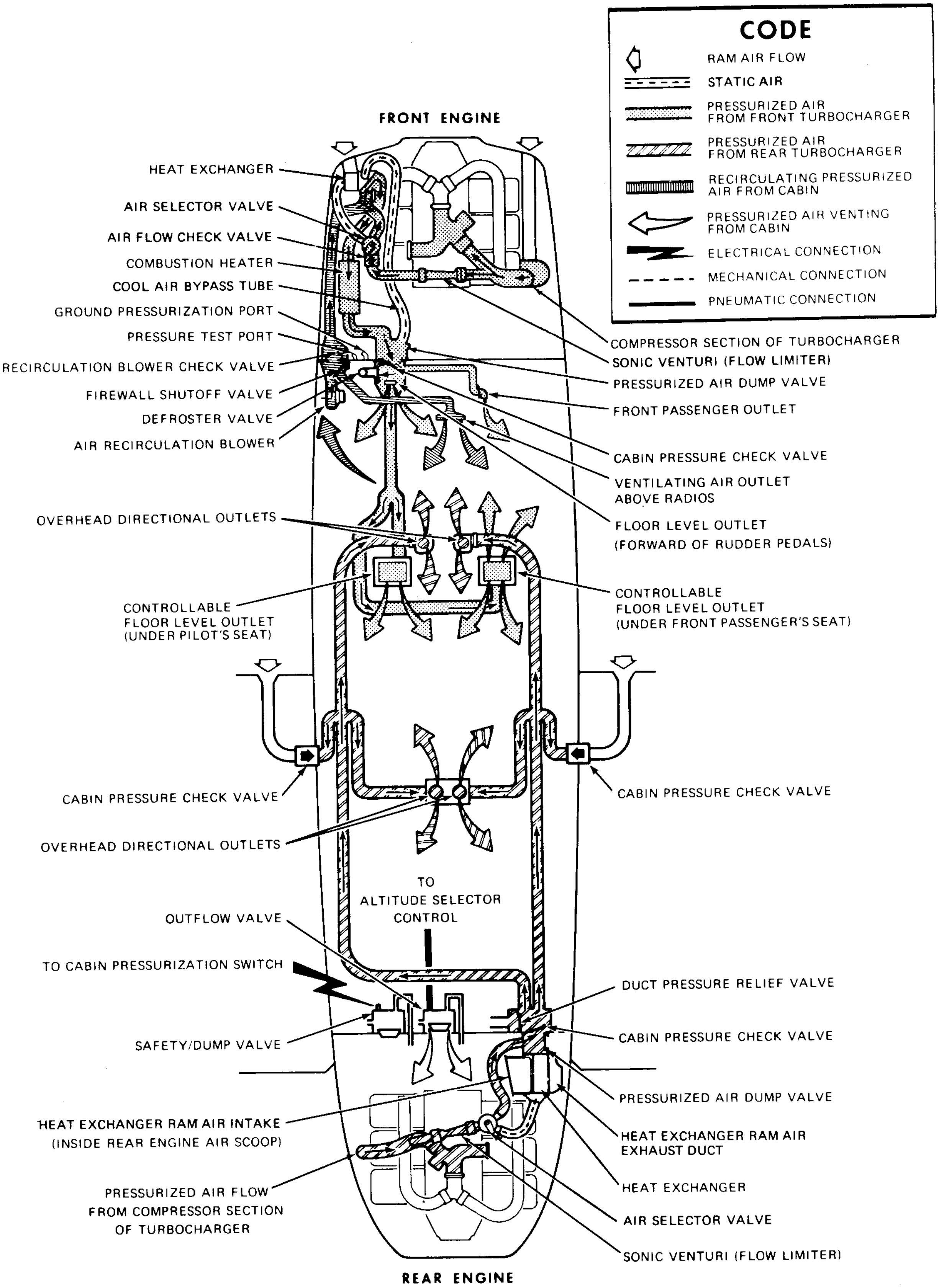


1. Blower
2. Firewall Shutoff Valve
3. Diverter Valve
4. Inlet Valve
5. Recirculation Tube
6. Heater Assembly
7. Adapter
8. Inlet Duct
9. Heat Exchanger
10. Adapter
11. Air Selector Valve
12. Venturi
13. Copilot Outlet (Heater)
14. Defroster Outlet
15. Auxiliary Ventilation Outlet
16. Floor Level Outlet
17. Selector Assembly
18. Overhead Outlets
19. Air Scoop
20. Diverter
21. Air Dump Valve
22. Outflow Valve
23. Safety Valve
24. Stop
25. Control Assembly
26. Control Cable

PRESSURIZATION AIR DISTRIBUTION SYSTEMS

when operating in the "COOL" mode. It also incorporates a FIREWALL SHUT-OFF VALVE which closes to prevent loss of pressurization when the front DUMP VALVE is opened for rear engine only operations. All the selector valves are manually operated by slide controls, located on the lower mid-right instrument panel. The front and rear dump valve controls are located on the right side of the pedestal.




CODE
RAM AIR FLOW
STATIC AIR
PRESSURIZED AIR FROM FRONT TURBOCHARGER
PRESSURIZED AIR FROM REAR TURBOCHARGER
RECIRCULATING PRESSURIZED AIR FROM CABIN
PRESSURIZED AIR VENTING FROM CABIN
ELECTRICAL CONNECTION
MECHANICAL CONNECTION
PNEUMATIC CONNECTION
FRONT ENGINE
HEAT EXCHANGER
AIR SELECTOR VALVE
AIR FLOW CHECK VALVE
COMBUSTION HEATER
COOL AIR BYPASS TUBE
GROUND PRESSURIZATION PORT
PRESSURE TEST PORT
RECIRCULATION BLOWER CHECK VALVE
FIREWALL SHUTOFF VALVE
DEFROSTER VALVE
AIR RECIRCULATION BLOWER
COMPRESSOR SECTION OF TURBOCHARGER
SONIC VENTURI (FLOW LIMITER)
PRESSURIZED AIR DUMP VALVE
FRONT PASSENGER OUTLET
CABIN PRESSURE CHECK VALVE
VENTILATING AIR OUTLET ABOVE RADIOS
FLOOR LEVEL OUTLET (FORWARD OF RUDDER PEDALS)
OVERHEAD DIRECTIONAL OUTLETS
CONTROLLABLE FLOOR LEVEL OUTLET (UNDER PILOT'S SEAT)
CONTROLLABLE FLOOR LEVEL OUTLET (UNDER FRONT PASSENGER'S SEAT)
CABIN PRESSURE CHECK VALVE
CABIN PRESSURE CHECK VALVE
OVERHEAD DIRECTIONAL OUTLETS
TO ALTITUDE SELECTOR CONTROL
OUTFLOW VALVE
TO CABIN PRESSURIZATION SWITCH
DUCT PRESSURE RELIEF VALVE
CABIN PRESSURE CHECK VALVE
SAFETY/DUMP VALVE
PRESSURIZED AIR DUMP VALVE
HEAT EXCHANGER RAM AIR INTAKE (INSIDE REAR ENGINE AIR SCOOP)
HEAT EXCHANGER RAM AIR EXHAUST DUCT
HEAT EXCHANGER
PRESSURIZED AIR FLOW FROM COMPRESSOR SECTION OF TURBOCHARGER
AIR SELECTOR VALVE
SONIC VENTURI (FLOW LIMITER)
REAR ENGINE

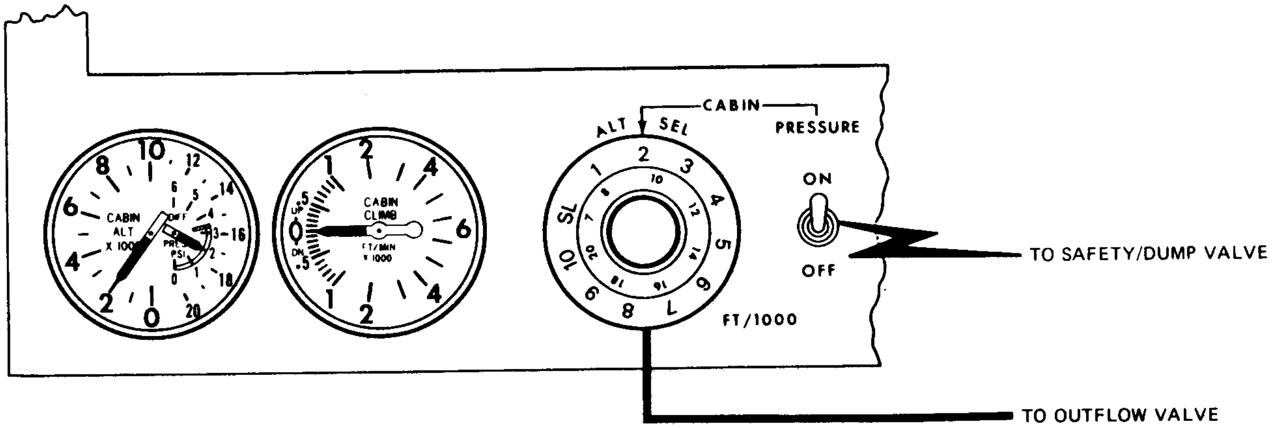
REAR AIR DISTRIBUTION

The rear distribution system is the same as the front, with the exception of the ducting. The ducts are modified to match the rear engine mounting. The distribution network within the cabin is the overhead ventilation system. Note that the front engine supplies air to only the floor ducts and rear engine supplies air to just the overhead ducts.

The turbocharger for the rear engine is mounted below the engine on the left side of the engine compartment. Compressor discharge from the rear engine is routed up across the engine through the SONIC VENTURI (flow limiter) to the CABIN AIR SELECTOR VALVE. The REAR cabin air selector valve diverts the air around the heat exchanger when the control is in the "WARM" mode. Air is directed through the heat exchanger when the control is in the "COOL" mode. Ambient ram air for cooling the heat exchanger is ducted through the rear engine air scoop. There is no combustion heater on the rear engine assembly.

Pressurized air is then routed to the rear MANUAL DUMP VALVE PLENUM and through the rear FIREWALL INLET CHECK VALVE. The air then enters a DIVERTER ASSEMBLY in the cabin which distributes the air through the overhead outlets. If all overhead outlets are closed, a RELIEF VALVE in the DIVERTER ASSEMBLY "OPENS" and allows air to enter the cabin at the rear firewall.

NOTES



PRESSURIZATION SYSTEM CONTROLS AND INSTRUMENTS

The OUTFLOW and SAFETY VALVE on the Pressurized Skymaster are located on the lower half of the rear pressure bulkhead. The function of these valves is the same as for the Pressurized Centurion; to control the amount of air that leaves the pressure capsule or aircraft cabin, and as a safety back-up, should the outflow valve stick closed.

The CONTROLLER for the pressurization system is located to the lower left of the pilot's instrument panel. The "ON-OFF" switch, CABIN RATE-OF-CLIMB INDICATOR, and CABIN ALTIMETER/DIFFERENTIAL PRESSURE INDICATOR are also located to the pilot's lower left.

A CABIN ALTITUDE WARNING LIGHT on the instrument panel is also included as a means of monitoring cabin altitude. Oxygen should be used when this light is on. The light is automatically turned on by a barometric switch at a cabin altitude of 12,500 ± 500 feet. The light will go out at approximately 11,500 feet.

THIS CONCLUDES SECTION THREE. ANSWER THE QUESTIONS ON THE FOLLOWING PAGES.

SECTION 3 - REVIEW QUESTIONS

INSTRUCTIONS: CIRCLE THE LETTER BY THE CORRECT ANSWER

1. WHEN THE FRONT PRESSURIZED AIR TEMPERATURE CONTROL IS IN THE "WARM" MODE:

   A. Pressurized air is routed through the heat exchanger and cabin combustion heater

   B. Pressurized air bypasses the heat exchanger and cabin combustion heater

   C. Pressurized air bypasses the heat exchanger and is routed through the cabin combustion heater

   D. Pressurized air is routed through the heat exchanger only

2. THE FRONT ENGINE:

   A. Is not used for pressurization

   B. Provides air to overhead ducts only

   C. Provides air to floor ducts and defroster

   D. Supplies air to both overhead and floor ducts

3. THE FIREWALL SHUT-OFF VALVE INCORPORATED WITH THE RECIRCULATING BLOWER:

   A. Allows cabin air to circulate through the combustion heater

   B. Directs recirculated air to ventilators over the radios

   C. Routes front engine pressurized air overboard

   D. Closes to prevent loss of pressurization when the front dump valve is opened for rear engine only operations

4. THE REAR ENGINE PROVIDES PRESSURIZED AIR THROUGH:

   A. The overhead ventilation system

   B. The floor outlets

   C. The overhead and floor outlets

   D. The combustion heater

SECTION 3 - REVIEW QUESTIONS

5. THE REAR CABIN AIR SELECTOR VALVE:

   A. Diverts air through the heat exchanger when in the WARM mode

   B. Diverts air around the heat exchanger when control is in WARM mode

   C. Route fresh air into cabin

   D. Sends air through the combustion heater

6. IF ALL OVERHEAD AIR OUTLETS ARE CLOSED, WHAT PREVENTS PRESSURIZED AIR FROM DAMAGING THE DUCTS?

   A. Air will enter cabin through the floor vents

   B. Air will enter through the defroster vents

   C. A relief valve in the diverter assembly opens and allows air to enter at the rear firewall

   D. The system will cut off the air flow to prevent damage

7. THE PRESSURIZED SKYMASTER OUTFLOW AND SAFETY VALVE ARE LOCATED:

   A. On the bottom fuselage skin

   B. On the rear pressure bulkhead

   C. On the forward pressure bulkhead

   D. In the forward bulkhead of the right tailboom

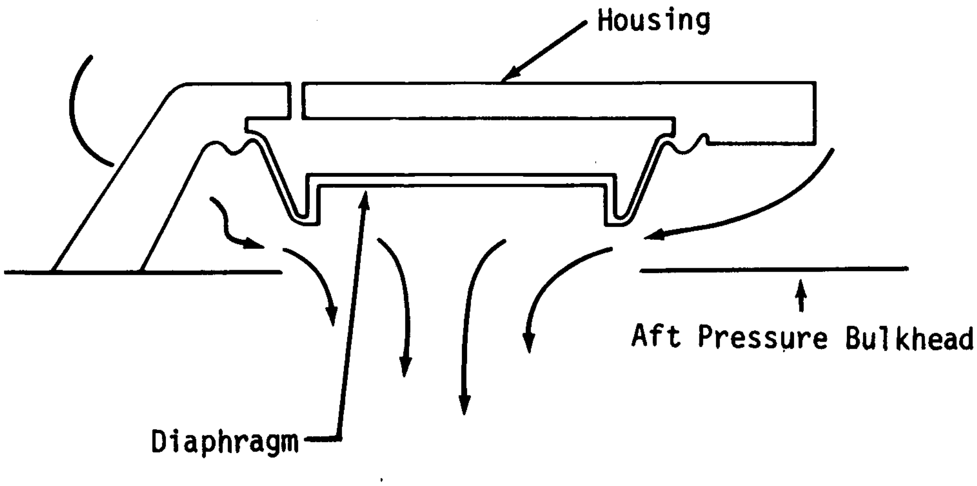
8. THE CABIN ALTITUDE WARNING LIGHT:

   A. Comes on when cabin altitude exceeds 12,500 ± 500 feet

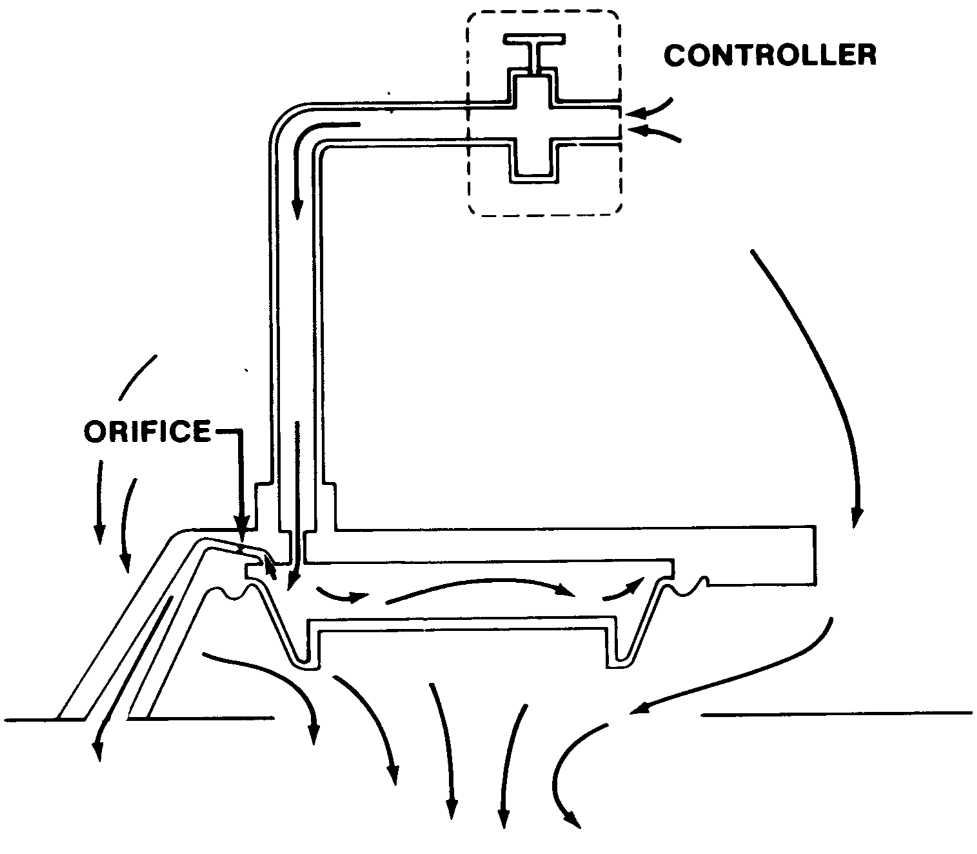
   B. Comes on when cabin altitude exceeds 11,000 feet

   C. Comes on when aircraft altitude exceeds 12,500 ± 500 feet

   D. Is not used on the Skymaster



BASIC OUTFLOW VALVE



CONTROLLED OUTFLOW VALVE

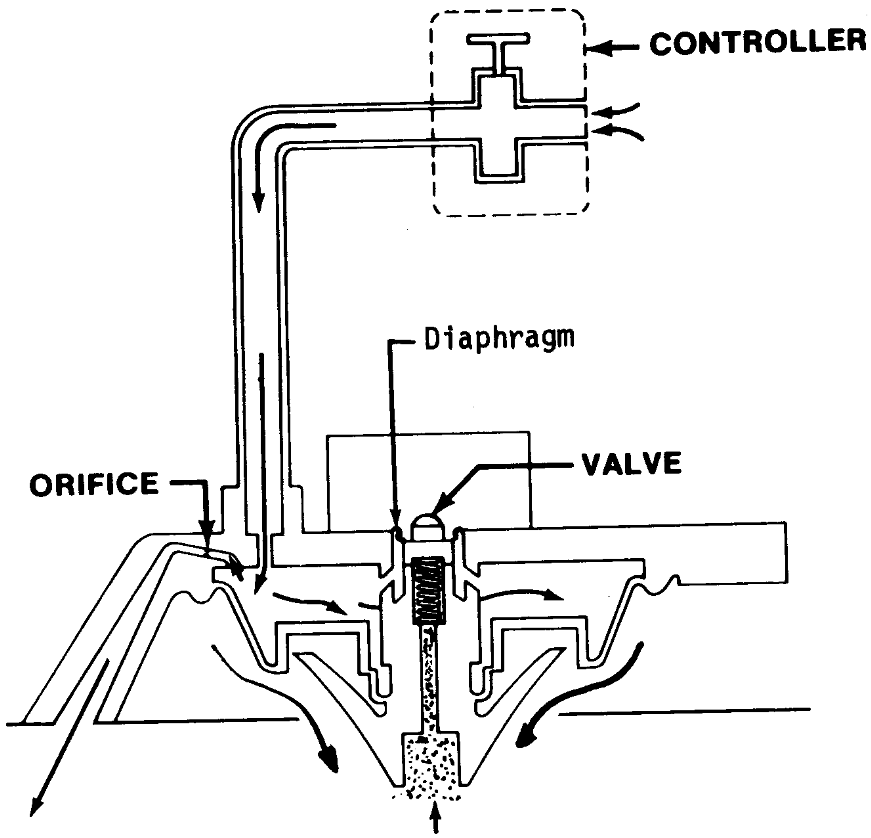
SECTION 4 - COMPONENT OPERATION

OUTFLOW VALVE-ISOBARIC CONTROL MODE

The construction of the outflow valve begins with a diaphragm and housing which creates an internal chamber. As the diaphragm expands, the outflow of cabin air is restricted. As the diaphragm contracts, the air is allowed to flow out freely. The natural shape of the diaphragm tends to open the valve.

In order to control the position of the outflow valve, we can install a valve labeled "the CONTROLLER". The purpose of the controller is to control the air pressure inside the outflow valve chamber. But, unless we provide some means to allow a flow of air through the outflow valve chamber, the pressure in the chamber will be trapped, the valve will close and we will not be able to open it.

By installing a bleed line to ambient air and incorporating an orifice in the line, an air flow is created. Now we can expand the chamber and close the outflow valve by opening the controller completely. Although some of the pressure will bleed off through the overboard vent, the remaining pressure will be more than sufficient to close the valve. By closing off the controller, air pressure in the chamber will bleed overboard, and the natural shape of the diaphragm will open the outflow valve. Thus, we control the position of the outflow valve by the amount of air pressure we direct to it through the controller.



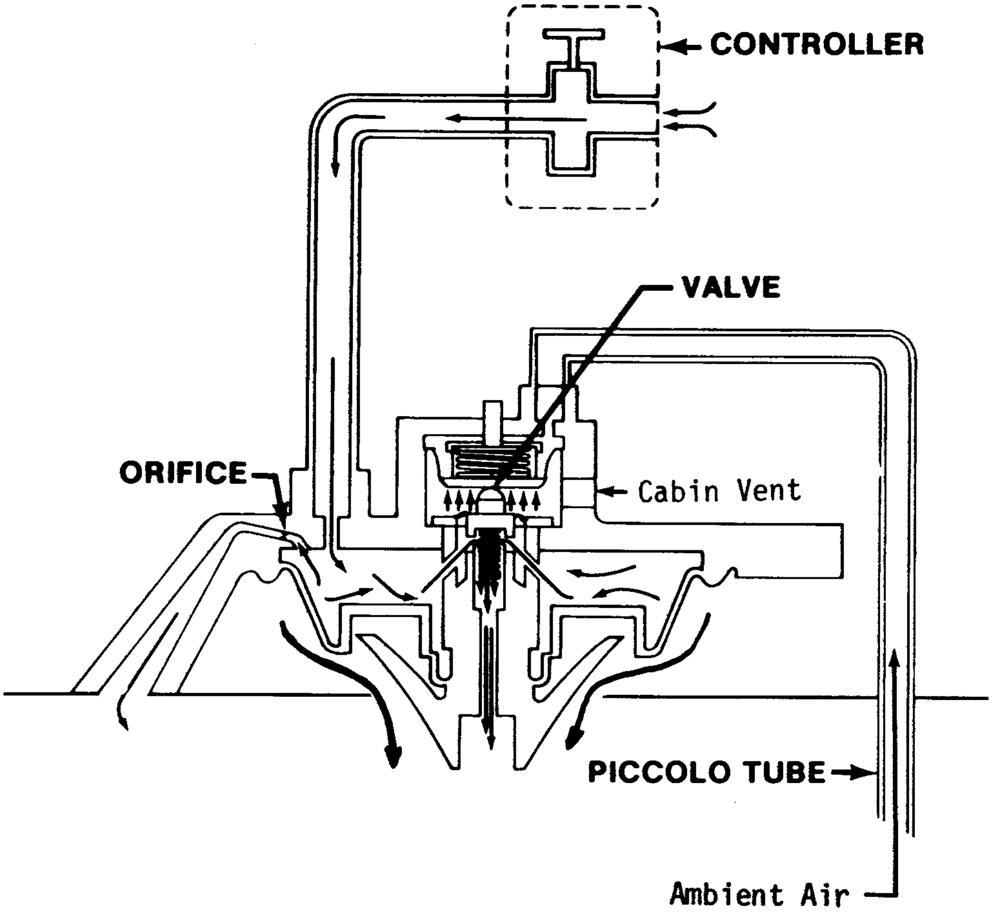
OUTFLOW VALVE - INCLUDING DIFFERENTIAL VALVE

OUTFLOW VALVE-DIFFERENTIAL CONTROL MODE

The outflow valve will operate to maintain a selected cabin altitude. However, we must incorporate some means of providing safety when maximum cabin differential pressure is reached (3.35 PSI). Since cabin differential pressure is determined by the difference between the pressure inside the aircraft compared to the pressure around the outside of the aircraft, we will utilize these sources to automatically control maximum differential pressure.

Utilizing the same outflow valve, we place a cylinder in the middle of our valve. Down the center of the cylinder we drill a passage to ambient air. Additional passages lead from the outflow valve chamber to the center passage. To isolate the chamber air from ambient air, install a differential valve, but spring load the valve to the open position. A diaphragm is also installed between the differential valve and housing.

NOTES

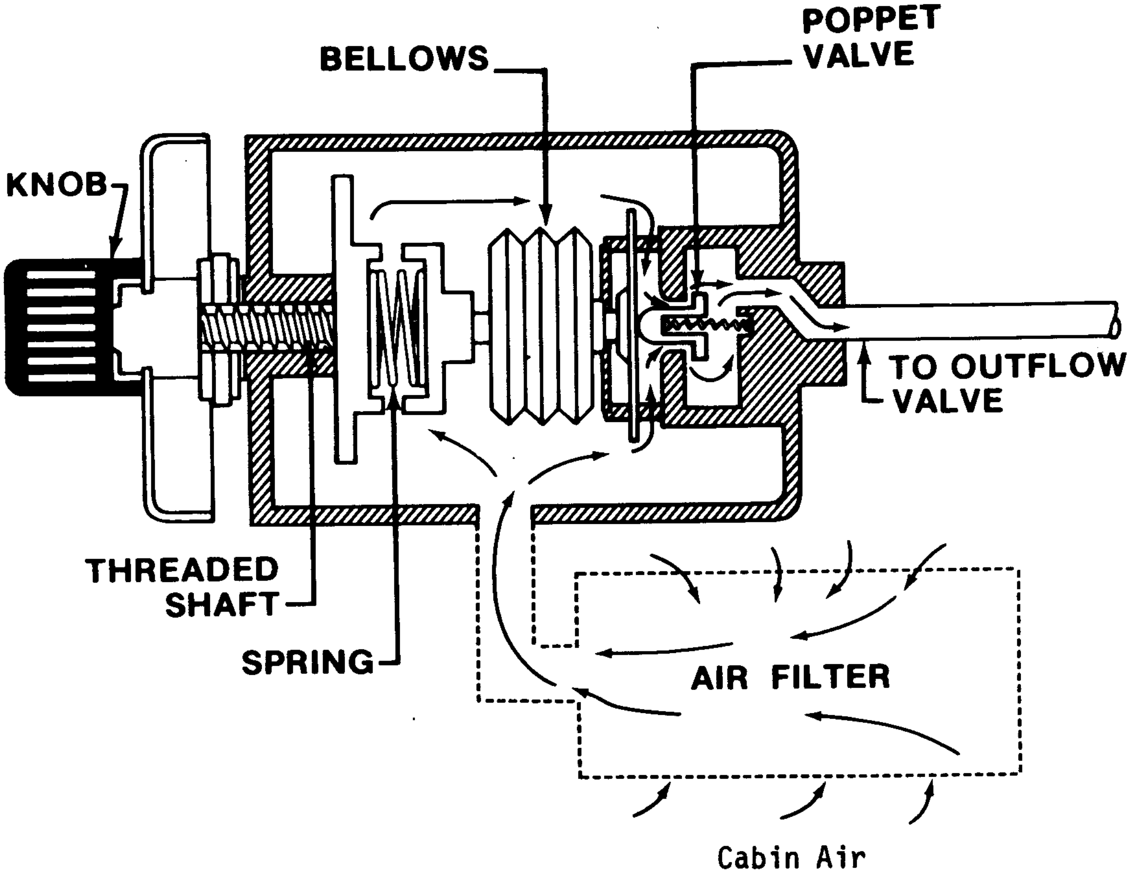


OUTFLOW VALVE WITH COMPLETE DIFFERENTIAL PRESSURE REGULATOR

Above the differential valve, we create a diaphragm chamber, spring -loaded to hold the valve closed. On one side of the diaphragm we will vent cabin air pressure. On the other side of the diaphragm we vent ambient air pressure through a line called a PICCOLO TUBE. Thus, we have a differential pressure regulator.

When at altitude, ambient air pressure is low and cabin pressure is high. At maximum differential pressure, the force created across the diaphragm compresses the larger spring, allowing the smaller spring to lift the differential valve, and bleeding outflow valve chamber pressure overboard. The natural shape of the outflow valve diaphragm opens and thus maintains 3.35 PSI maximum differential pressure.

NOTES

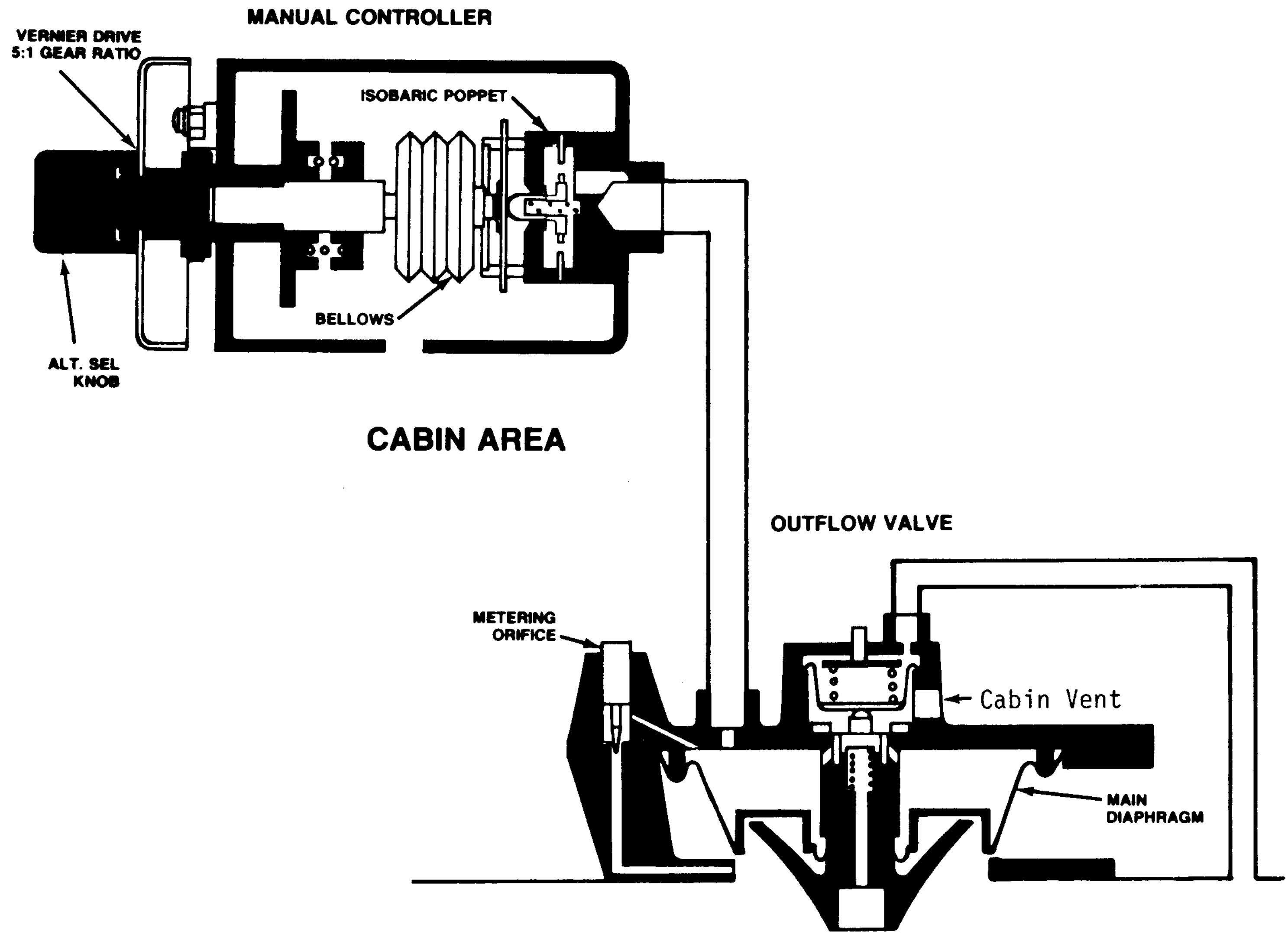


SYSTEM CONTROLLER

CONTROLLER

In its simplest form, the controller is an altitude sensitive valve. By opening and closing the valve, we control the amount of air pressure directed to the outflow valve. In order to make it responsive to altitude change, we control the valve position with a sealed bellows (29.92 IN. Hg. - Sea Level Pressure Altitude). An increase in altitude causes the bellows to expand, opening the poppet valve, and thus closing the outflow valve. Likewise, a decrease in altitude contracts the bellows, closing the poppet valve, and allowing the outflow valve to open. The controller now operates, but we are unable to select cabin altitudes. By incorporating a knob, spring and screw mechanism, we can set and adjust the amount of tension or preload on the bellows, and thus select the point at which the poppet will begin to open. The last component we need to install is an air filter to prevent contamination to the system.

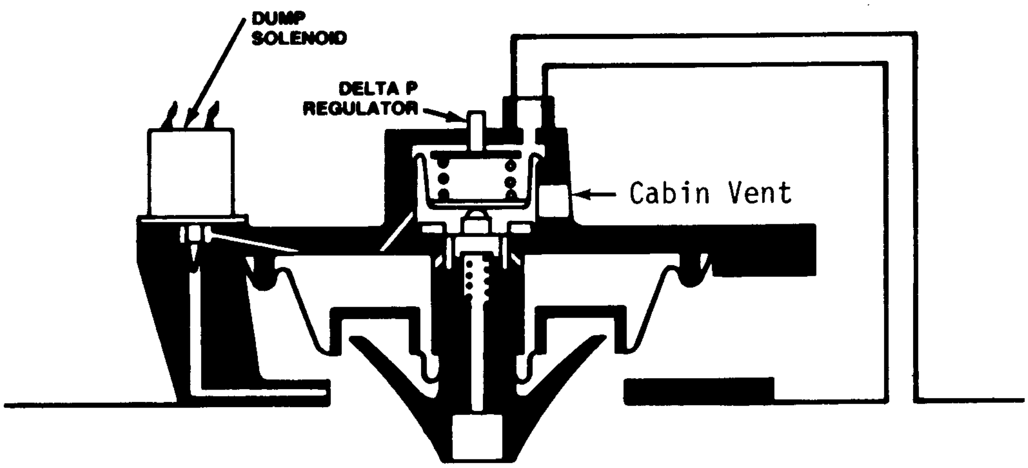
NOTES



OUTFLOW VALVE AND CONTROLLER SYSTEM

The outflow valve/controller system is now complete. Remember the controller is altitude selectable and altitude sensitive. Also, the outflow valve is referenced to three different levels of air pressure. The highest of these pressures is cabin air pressure in the differential pressure regulator lower section. It enters the chamber through a micron wafer filter in the side of the differential control section of the valve. The second highest pressure in the outflow valve is metered control pressure from the controller to the main diaphragm chamber. The lowest pressure reference is in the differential pressure regulator upper section, which is ambient air pressure obtained from the piccolo tube.

NOTES



SAFETY VALVE

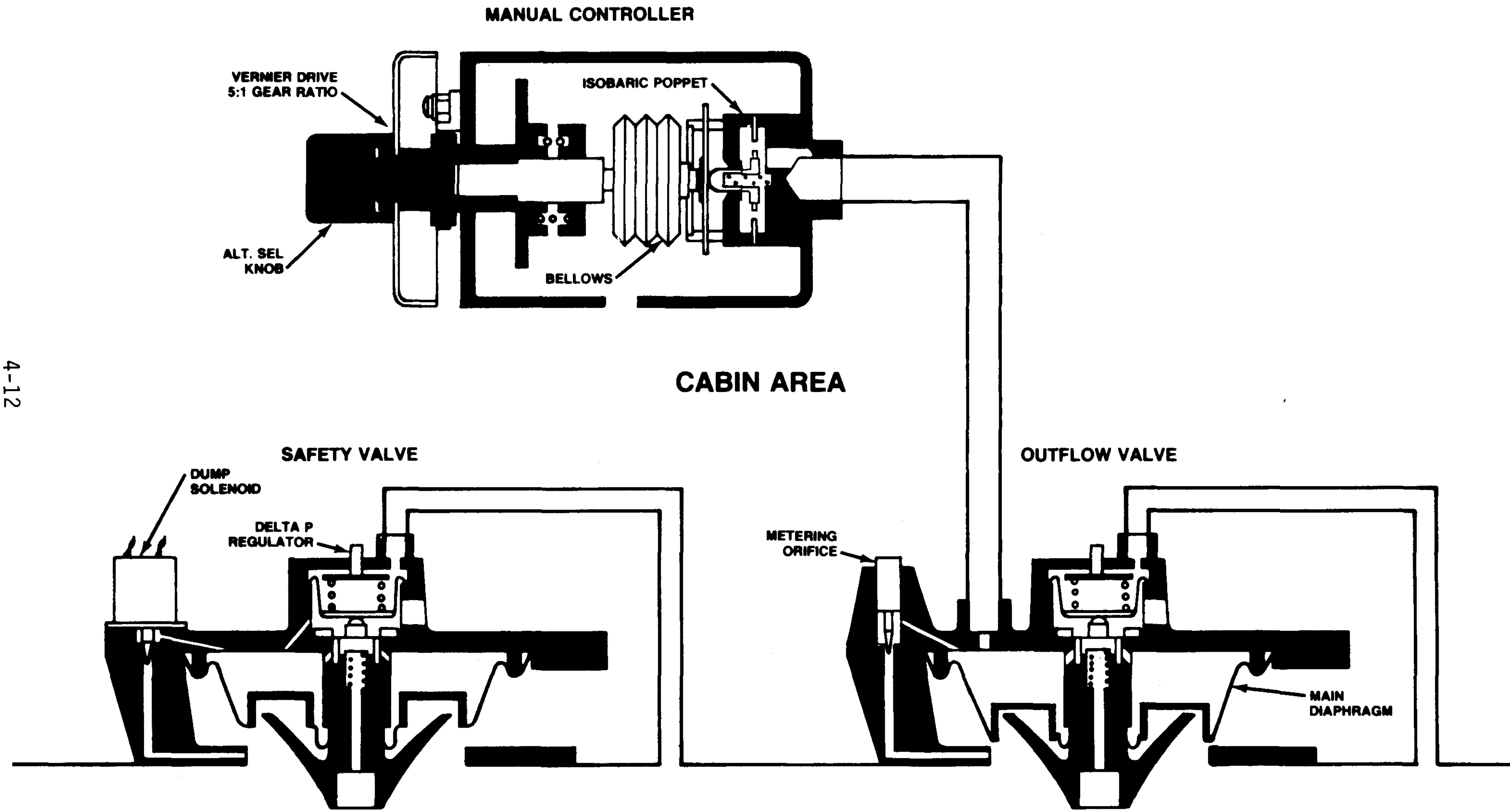
SAFETY VALVE

The final component in the pressurization system is the safety valve. The safety valve is installed to limit cabin pressure in the event the outflow valve sticks closed.

The safety valve is very similar to the outflow valve in construction. It consists of a chamber created by a diaphragm and a housing with an overboard bleed and solenoid control valve. The same type of pressure regulator utilized on the outflow valve is also used on the safety valve. The safety valve is designed to be fully open, or fully closed. During normal pressurized operation the pressurization switch is placed in the "ON" position. This de-energizes the dump solenoid, closing the bleed valve, and blocking off the small bleed passage on the left. Cabin air pressure then enters the diaphragm chamber and closes the valve. Remember, the safety valve is <u>not</u> connected to the controller or outflow valve!

In the event the outflow valve malfunctions, and fails to regulate maximum cabin differential pressure, (3.35 PSI) the safety valve pressure regulator will open the safety valve. At 3.45 PSI differential pressure, the differential valve will allow the diaphragm chamber pressure to bleed overboard through the center drilled passage. The natural form of the safety valve diaphragm will open the safety valve, and cabin air will be vented overboard.

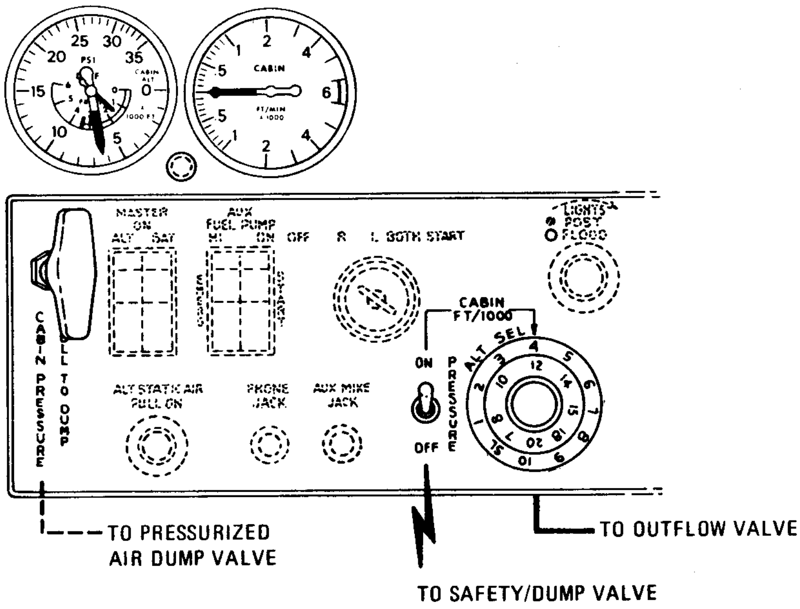
If the pilot does not wish to operate in the pressurized mode, he moves the pressurization switch to the "OFF" position. This energizes the dump solenoid, lifting the bleed valve, and allowing the safety valve to remain in the open position.



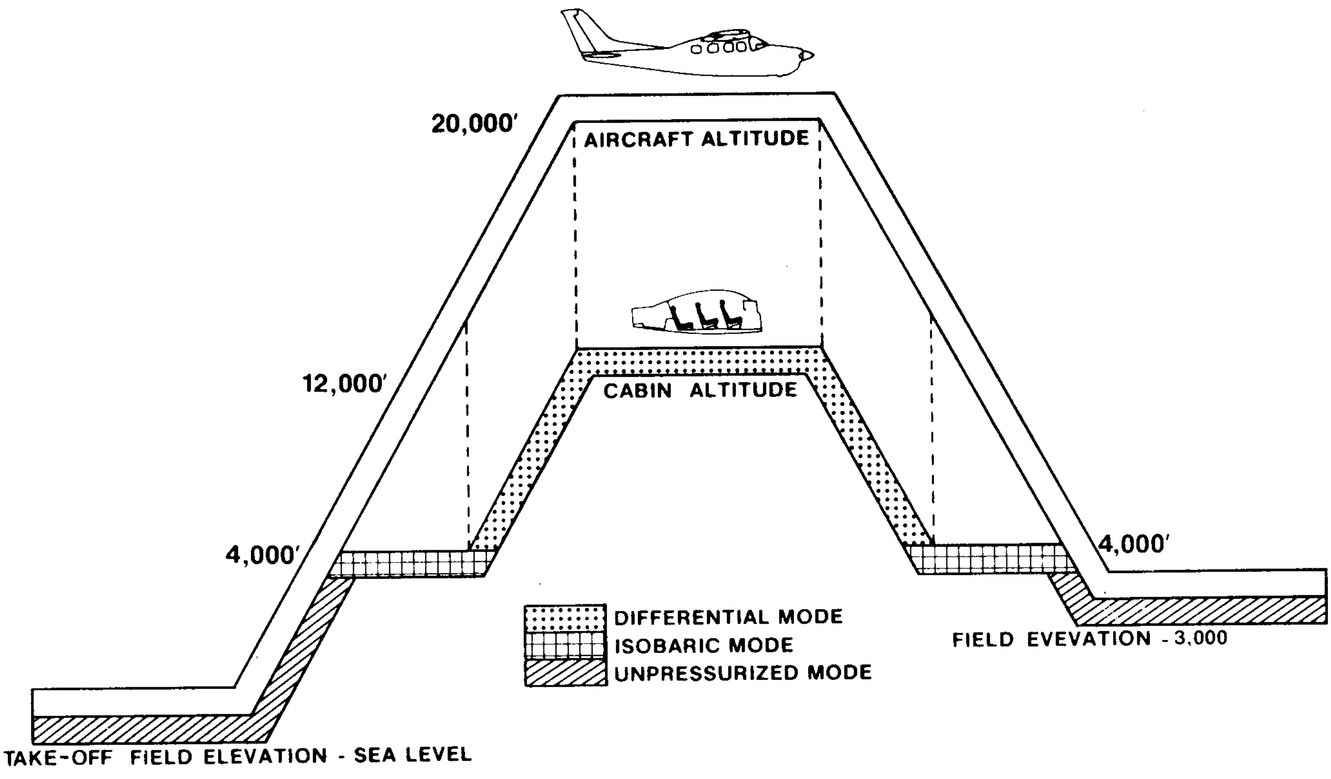
PRESSURIZATION CONTROL SYSTEM

Summarizing what we have learned, we have an outflow valve modulating to control cabin pressure. The outflow valve is repositioned by the controller in the instrument panel. The controller is altitude sensitive as well as being adjustable. If the outflow valve should malfunction, the safety valve will limit maximum differential pressure before structural damage can occur.

NOTES



PRESSURIZATION SYSTEM CONTROLS AND INSTRUMENTS



PRESSURIZATION SYSTEM OPERATIONAL FLIGHT

SYSTEM OPERATION

Now that we have an overall picture of the pressurization system as applied to the Pressurized Centurion and Pressurized Skymaster, let's take a more in-depth look at the control system from a total operational view.

The controller allows the pilot to select a pressure altitude at which the cabin will begin to pressurize, as shown on the outer scale. The inner scale represents the altitude at which maximum differential pressure will be reached. The difference between the outer scale and the inner scale is referred to as the "ENVELOPE". We can best illustrate the envelope by assuming that the controller is selected to hold a 4,000' pressure altitude in the cabin--as shown on the outer scale. The maximum differential pressure altitude will then be 12,000' as shown on the inner scale. So the "envelope" in this case has a base of 4,000' and an upper limit of 12,000'. As long as the aircraft is flown at an altitude <u>inside</u> this envelope, the controller will influence the outflow valve to regulate cabin pressure altitude at a constant pressure equivalent to 4,000'.

As the aircraft climbs and descends within the envelope, the differential pressure increases and decreases accordingly, in order to maintain a constant absolute pressure altitude of 4,000' in the cabin. Remember, AS ALTITUDE INCREASES, AMBIENT PRESSURE DECREASES. In order to compensate for the decrease in ambient pressure as we climb, we must compress <u>more</u> air into the cabin to build up the differential pressure to keep a constant cabin altitude. Upon descent, the opposite is true.

As long as the aircraft is BELOW the envelope as selected on the controller, the outflow valve remains open and the cabin is unpressurized.

When the aircraft climbs and penetrates the lower limit of the envelope, the outflow valve is positioned to restrict outflow which causes pressure to start building inside the cabin. As the climb continues within the envelope, the outflow valve slowly closes to maintain preselected cabin altitude as the outside ambient pressure decreases. Thus, cabin absolute pressure remains constant, keeping cabin pressure altitude at the value selected on the controller.

If the airplane levels off at any altitude within the envelope, the outflow valve will stabilize, and differential pressure stops building. The outflow valve will then modulate, only as necessary, to hold that particular differential pressure.

But if the climb continues through the envelope above maximum differential pressure altitude, the outflow valve will open to prevent the cabin from exceeding 3.35 PSI maximum differential pressure. Now the system has shifted from isobaric control by the controller to differential pressure control by the outflow valve differential pressure regulator. Once the cabin is pressurized to maximum differential pressure, a continued climb will LOWER ambient pressure. As a result, cabin pressure also decreases at the same rate in order to maintain a 3.35 PSI maximum differential between the cabin pressure and ambient pressure.

In review, the outflow valve position is influenced by the controller while the aircraft is being operated BELOW the envelope and INSIDE the envelope. When the aircraft is operated ABOVE the envelope, the outflow valve has a built-in maximum differential pressure regulator, or limiter, which overrides the influence of the controller when "red-line" (3.35 PSI) differential pressure is reached.

THIS CONCLUDES SECTION FOUR. ANSWER THE QUESTIONS ON THE FOLLOWING PAGES.

SECTION 4 - REVIEW QUESTIONS

INSTRUCTIONS: CIRCLE THE LETTER BY THE CORRECT ANSWER

1. THE CONTROLLER CONTROLS CABIN PRESSURE BY:

   A. Controlling the pressure in the safety valve chamber

   B. Adjusting the size of outflow valve orifice

   C. Controlling the air pressure inside the outflow valve chamber

   D. Adjusting spring tension on the outflow valve

2. THE SAFETY VALVE IS CONTROLLED BY:

   A. Controller selector knob and the piccolo tube

   B. Outflow valve and controller

   C. Outflow valve and dump solenoid switch

   D. Cabin pressure, ambient atmospheric pressure and the pressurization "ON-OFF" switch and safety solenoid

3. THE SAFETY VALVE IS SET:

   A. At 3.35 differential pressure

   B. At .10 PSI above outflow valve maximum differential pressure setting

   C. To remain closed, unless "ON and OFF" switch is in the ON position

   D. To open at one (1) PSI above outflow valve setting

4. AS YOU CLIMB THROUGH THE ENVELOPE ABOVE MAXIMUM DIFFERENTIAL PRESSURE ALTITUDE, THE OUTFLOW VALVE WILL:

   A. Close, to prevent excessive loss of air from the engine turbocharger

   B. Open, to prevent the cabin from exceeding 3.45 PSI maximum differential pressure

   C. Open, to prevent the cabin from exceeding 3.35 PSI maximum differential pressure

   D. Close, to prevent the cabin from exceeding 3.35 PSI maximum differential pressure

SECTION 4 - REVIEW QUESTIONS

5. THE OUTFLOW VALVE IS REFERENCED TO THREE PRESSURES OF WHICH,

   A. the highest is cabin air pressure

   B. the second highest pressure is metered control pressure from the controller to the main diaphragm chamber

   C. the lowest pressure reference is ambient air pressure

   D. All of the above are true statements

6. DURING NORMAL PRESSURIZED OPERATION, BELOW MAXIMUM DIFFERENTIAL

   A. the solenoid on the safety valve is de-energized

   B. the controller is controlling the position of the outflow valve as altitude increases

   C. the safety valve solenoid is energized

   D. Both A and B are correct

7. WHEN A PRESSURIZED CENTURION CLIMBS UP THROUGH THE PRESSURIZED ENVELOPE, CABIN DIFFERENTIAL PRESSURE WILL BE CONTROLLED BY:

   A. Safety valve at 3.35 PSI differential

   B. The outflow valve differential pressure regulator

   C. Controller and outflow valve

   D. Safety valve and controller

8. WITH THE CONTROLLER SET AT 4,000 FT. AND THE FLIGHT ENVELOPE ALTITUDE EXCEEDED, THE CABIN PRESSURE WILL BE:

   A. 3.35 PSI differential

   B. 3.35 PSI

   C. 3.45 PSI differential

   D. 12.35 PSI

9. THE CONTROLLER IS BOTH SELECTABLE AND ALTITUDE SENSITIVE. WHICH PART OF THE CONTROLLER MAKES IT ALTITUDE SENSITIVE?

   A. The altitude select knob

   B. The isobaric poppet valve

   C. The sealed bellows

   D. The internal spring

10. WHAT POSITION WILL THE OUTFLOW AND SAFETY DIAPHRAGMS TAKE WHEN AIR PRESSURE IS REMOVED FROM THE DIAPHRAGM CHAMBER?

   A. Outflow valve open, safety valve closed

   B. Safety valve open, outflow valve closed

   C. Outflow valve open, safety valve open

   D. Outflow valve closed, safety valve closed

SECTION 5 - INSPECTION AND MAINTENANCE

Generally, maintenance of pressurization components consists of visual inspection, preventive maintenance, and a complete functional test to verify proper operation.

INSPECTION

Areas that require inspection are covered in detail in the Service Manual. The areas mentioned below are but a few of those items:

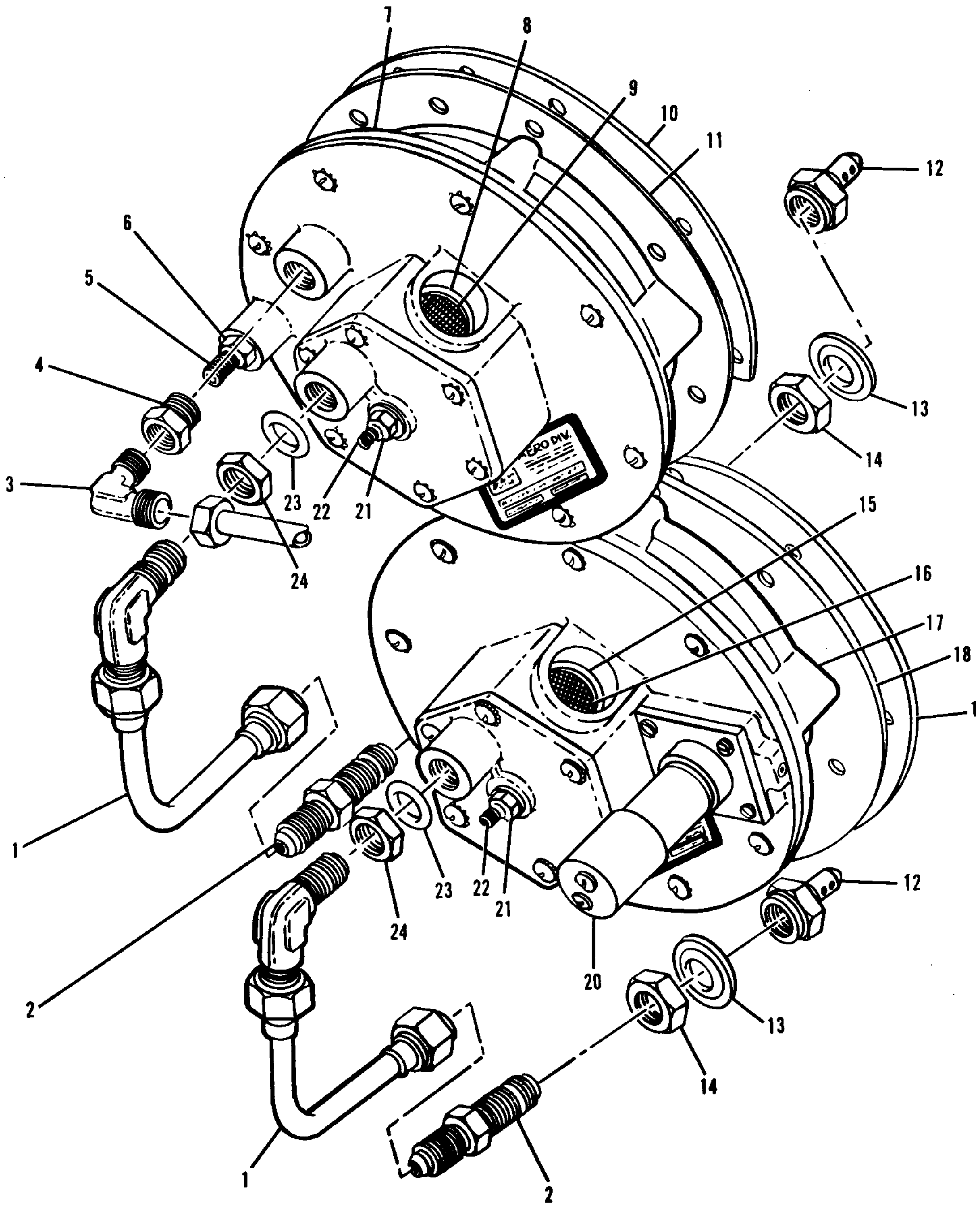
The controller, outflow valve, safety valve and pneumatic line between the controller and outflow valve should be checked for condition and security.

All manually operated valves and various check valves in the distribution systems should be checked for proper operation and sealing.

Cabin windows and doors should be inspected around seal areas for possible leakage. The door seal should be inspected for tears and cuts as repairs can be made to this seal.

Each control cable which is routed through a bulkhead from a pressurized to a non-pressurized section must be inspected to determine if they are adequately sealed.

Controls should be checked for freedom of movement and proper rigging.



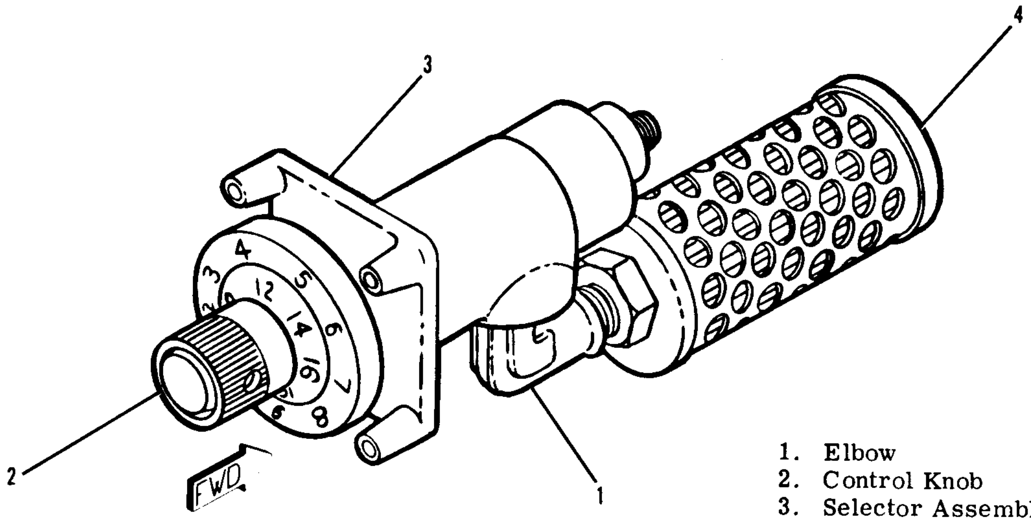
1. Tube
2. Union
3. Nylon Elbow
4. Bushing
5. Adjusting screw
6. Lock Nut
7. Outflow Valve
8. Snap Ring
9. Screen
10. Spacer
11. Gasket
12. Piccolo Tube
13. Lock-O-Seal
14. Nut
15. Snap Ring
16. Screen
17. Safety Valve
18. Gasket
19. Spacer
20. Dump Solenoid
21. Lock Nut
22. Adusting Screw
23. O-Ring
24. Nut

OUTFLOW VALVE AND SAFETY VALVE ASSEMBLIES

There are special inspection requirements detailed in Chapter 2 of the Service Manual for the pressure capsule. These inspections are to be conducted at various intervals, ranging from each 50 hours to every 15,000 hours to ensure continued safety and reliability.

MAINTENANCE

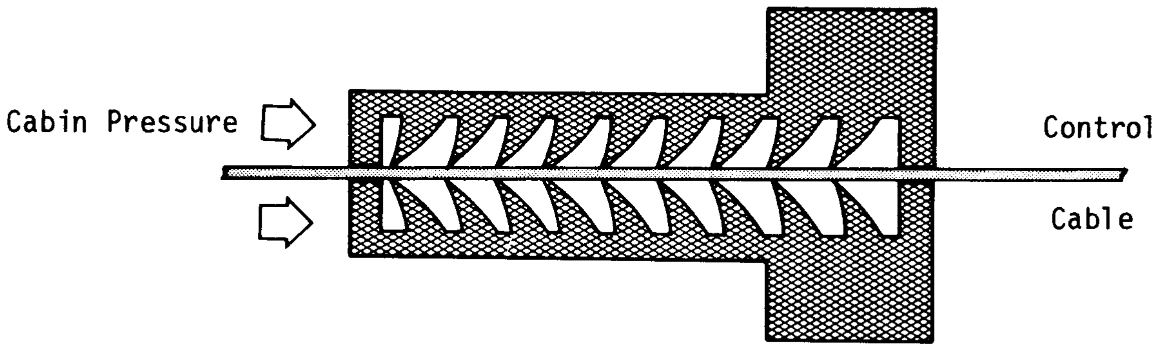
Maintenance on the pressurization control system is limited to component replacement, replacement of the controller filter, cleaning of the outflow valve and safety valve. The valves should be cleaned with isopropyl alcohol or mild detergent solution. BE SURE TO WIPE AWAY ANY RESIDUE TO PREVENT THE VALVES FROM STICKING! Cleaning of the outflow and safety valve micron wafer filters may be accomplished by using a vacuum cleaner and hose. Do not apply full vacuum or you may damage the micron wafer. Hold the suction hose away far enough to keep the suction low. The micron wafer should not be removed as it fits so snugly, it could be damaged upon removal.

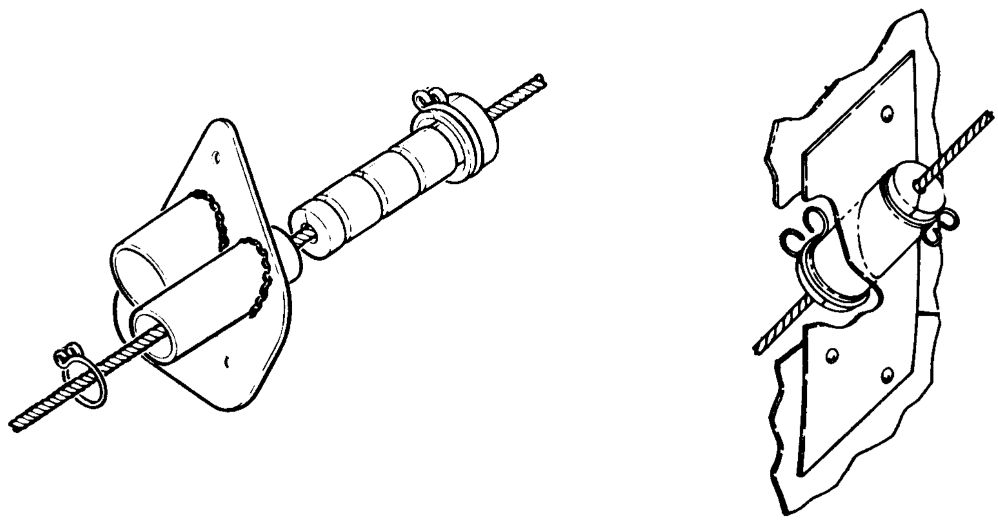


1. Elbow
2. Control Knob
3. Selector Assembly
4. Filter

ALTITUDE CONTROL SELECTOR ASSEMBLY

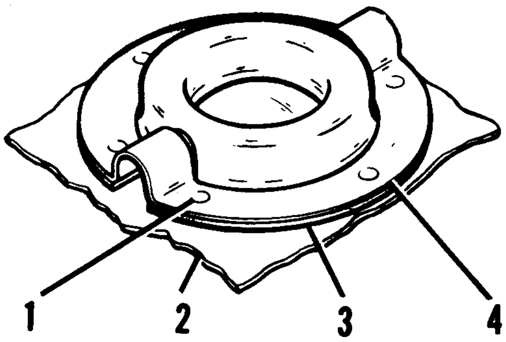
The Labyrinth Seals, used wherever cables exit the pressure capsule, must be installed with the slant of the "teeth" toward the pressure capsule. This allows air pressure to push the teeth out to form a seal around the cable. These cable seals are packed with MIL-G-81322 grease prior to installation, and the cable is lubricated for the full length of its travel within the seals. At scheduled intervals, the seals must be removed, cleaned, inspected, and repacked with grease.





LABYRINTH CABLE SEAL

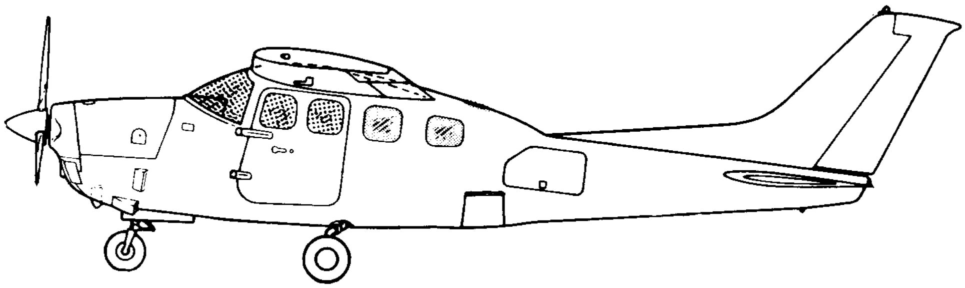
Pressure drain seals located in the lower skin of the fuselage should be cleaned as necessary. Caution should be used when cleaning these drains. Never insert sharp tools or metal objects into the drains as this will puncture the pressure seals.



1. Rivet	2. Retainer
2. Skin	3. Seal

PRESSURE DRAIN SEAL

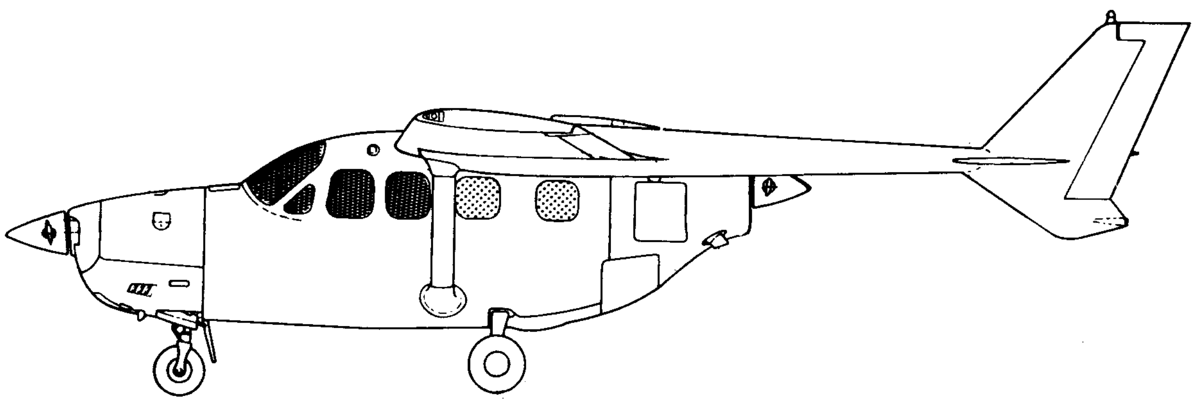
When special installations or repairs are being made, care must be taken not to induce leaks into the pressure capsule. The Service Manual covers structural repairs and should be referenced when making any repairs or installations in or near the pressure capsule.



CRITICAL VISION AREA

NON-CRITICAL VISION AREA

Left windows typical for right windows.



Left windows typical for right windows.

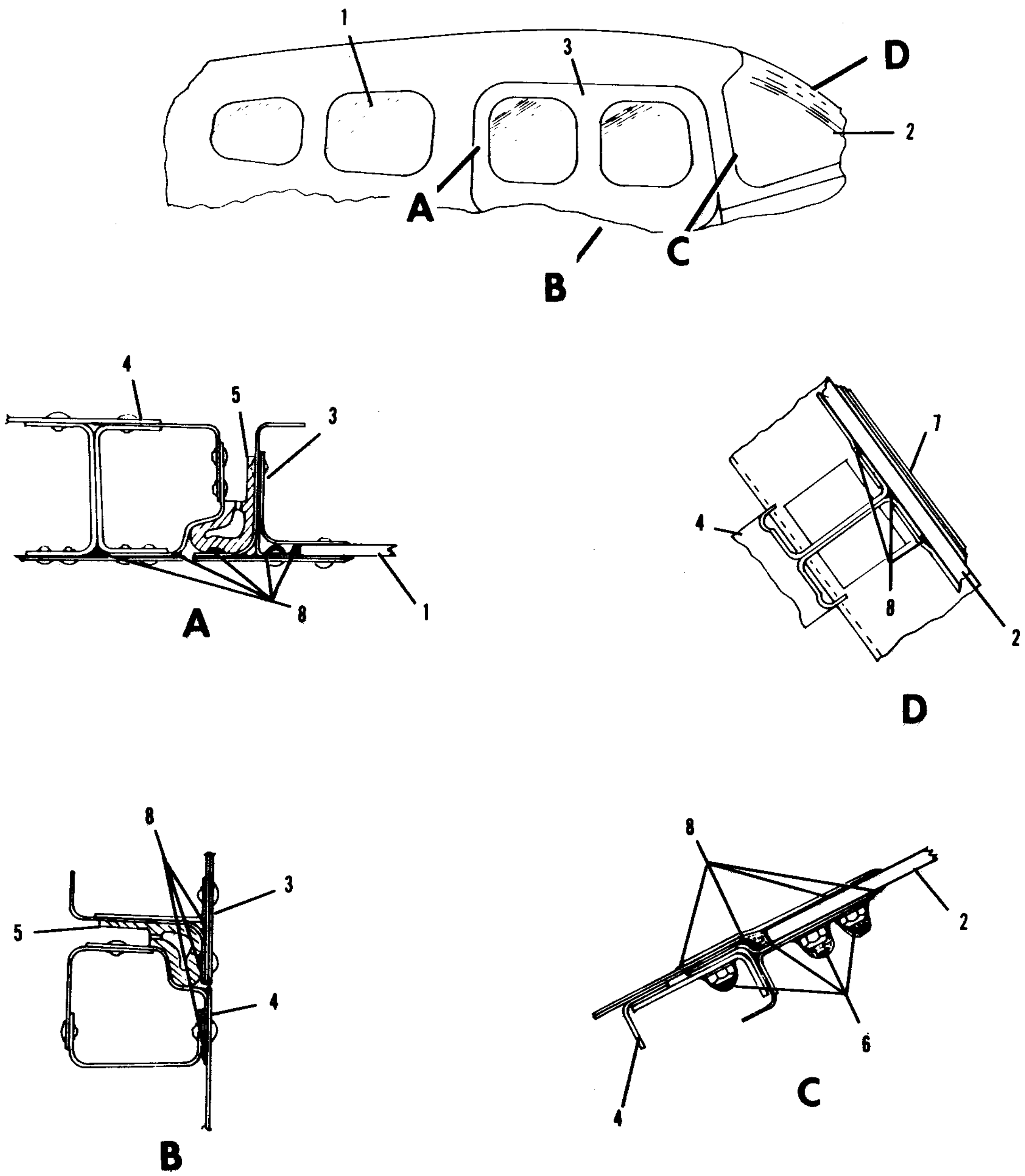
CRITICAL VISION AREA

NON-CRITICAL VISION AREA

Maintenance of cabin windows is critical. Damaged window panels and windshields should be removed and replaced if the damage is extensive. Windows are sealed with EC-1675B and EC-1675A accelerator (3M Co.). The windshield is sealed with EC-1608B and EC-1608A (3M Co.).

Certain repairs to window panels and windshields are allowed and can be made without removing the damaged part from the aircraft. "WARNING" If temporary repairs are made, the aircraft must be operated in the unpressurized mode until replacement of windows can be made. No repairs are recommended on stressed or compounded curves where repairs would affect the pilot's or copilot's vision. Minute scratches may be removed by rubbing with automobile body cleaner or fine-grade rubbing compound.

NOTES



1. Window
2. Windshield
3. Door
4. Frame
5. Seal
6. Sealer (Type I)
7. Retainer
8. Sealer (Type II)

CABIN DOOR, EMERGENCY EXIT AND WINDOW SEALING

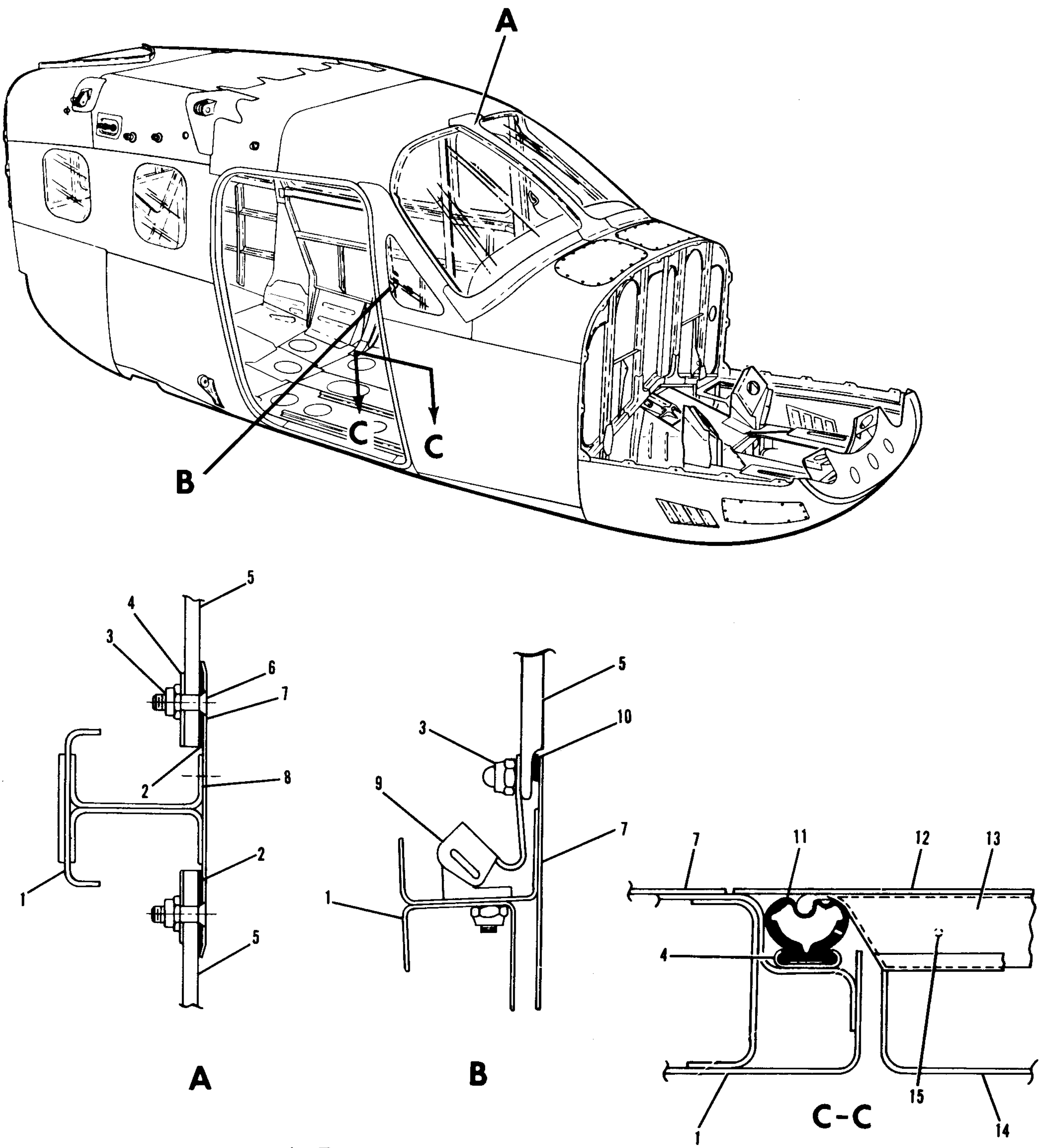
Maintenance of the door includes removal and installation, rigging, door seal repair and replacement, repairs to the cabin upper door lift assist on the Pressurized Skymaster and emergency exit door assist replacement on the Pressurized Centurion.

When repairing the cabin door seal the work area must be clean. The door seal need not be removed from the door. Remove only enough damaged seal to allow installation of the rubber mold.

Seals with a damaged area of holes or gaps in excess of six inches in length should not be repaired. The seal should be replaced. Ensure that the door frame seal is installed with existing air holes in the seal toward the pressure source.

Repairs are allowed to the Pressurized Skymaster door lift assist. It uses a nitrogen air charge in the lower portion and hydraulic fluid in the upper portion.

The Pressurized Centurion emergency exit door assist requires only removing and replacing.



1. Fuselage Structure
2. Sealer
3. Nut
4. Retainer
5. Window
6. Screw
7. Cabin Skin
8. Doubler
9. Hinge
10. Seal
11. Door Seal
12. Door Skin
13. Lower Door Seal
14. Lower Door Structure
15. Air Hole

CABIN WINDOW AND DOOR RETAINERS AND SEALS

TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
CABIN DOES NOT PRESSURIZE.	Safety valve will not close.	Check position of pressurization switch; should be ON.
		Check vent screen, if dirty, clean.
		Check circuitry to valve solenoid.
	Outflow valve will not control.	Check setting of cabin altitude controller.
		Check screen on altitude controller, if obstructed, clean.
	Insufficient air supply.	Check position of pressurized air dump controls; "Push in" for pressurization. Check engine power settings. Check venturi, ducting, connections, valving and rigging for leaks; repair.
CABIN PRESSURE WILL NOT GO TO MAXIMUM DIFFERENTIAL.	Insufficient air supply.	Check position of pressurized air dump controls; "Push in" for pressurization. Check engine power settings. Check venturi, ducting, connections, valving and rigging for leaks; repair.
	Excessive cabin leakage.	Locate leakage areas and repair as required.
	Outflow valve not regulating properly.	Replace valve.
	Cabin differential gage not indicating properly.	Replace gage.
	Fresh air check valve not sealing.	Inspect valves. Clean or repair as required.

TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
CABIN PRESSURE EXCEEDS MAXIMUM DIFFERENTIAL.	Outflow valve not regulating properly.	Replace valve.
	Cabin differential gage not indicating properly.	Replace gage.
	Safety valve not regulating properly.	If more than 3.5 psi, replace valve.
CABIN PRESSURE GOES TO MAXIMUM DIFFERENTIAL INDEPENDENT OF AIRCRAFT ALTITUDE.	Outflow valve controlling immediately.	Control line plumbing leaking or ruptured.
		Leak in casting of outflow valve; replace.
CABIN ALTITUDE OVERSHOOTS ALTITUDE ON SELECTOR.	Poppet valve is sticking in closed position.	Replace controller.
CABIN PRESSURE FLUCTUATION ON FULL DIFFERENTIAL.	Safety Valve Discrepant	Replace Safety Valve.
CABIN ALTITUDE INCREASES WITH REDUCED POWER.	Cabin leakage rate too high. Upper deck pressure too low.	Verify and pinpoint discrepant area per instruction.
	Faulty turbocharger controller.	Troubleshoot turbocharger.
CABIN DEPRESSURIZES SUDDENLY OR INTERMITTENTLY.	Switch inadvertently turned to OFF or intermittent electrical malfunctions.	Place switch ON; check switch, wiring or solenoid valve in safety valve for operation and security.

NOTES

FOLLOWING ARE ADDITIONAL TROUBLESHOOTING PROCEDURES FOR THE PRESSURIZED SKYMASTER ONLY.

TROUBLE	PROBABLE CAUSE	REMEDY
CABIN DEPRESSURIZES WITH FRONT ENGINE AIR DUMPED (MAXIMUM POWER REAR ENGINE).	Front firewall check valve leak.	Replace or repair.
	Cabin leakage rate excessive.	Seal cabin as required.
	Fresh air check valves not sealing.	Inspect valves. Clean or repair.
CABIN DEPRESSURIZES WITH REAR ENGINE AIR DUMPED (MAXIMUM POWER FRONT ENGINE).	Aft firewall check valve leaking.	Replace or repair.
	Cabin leakage excessive.	Seal cabin as required.
	Fresh air check valves not sealing.	Inspect valves. Clean or repair.
CABIN DEPRESSURIZES WITH FRONT ENGINE NOT RUNNING - PROP IN FEATHER (MAXIMUM POWER REAR ENGINE).	Heater check valve leaking.	Replace or repair.
	Cabin leakage excessive.	Seal cabin as required.
	Fresh air check valves not sealing.	Inspect valves. Clean or repair.
CABIN ALTITUDE EXCESSIVE WHILE PRESSURIZING WITH REAR ENGINE PROPELLER FEATHERED.	Cabin leakage excessive.	Seal cabin as required.
	Fresh air check valves not sealing.	Inspect valves; clean or repair.
CABIN FAILS TO DEPRESSURIZE COMPLETELY WHEN BOTH PRESSURIZATION AIR CONTROLS ARE PULLED.	Cabin differential pressure gage not indicating properly	Check gage; replace if necessary.
	Improper sealing of firewall shutoff valve and/or pressurized air dump valve at rear firewall.	Repair or replace and rig as required.

THIS CONCLUDES SECTION FIVE. ANSWER THE FINAL REVIEW QUESTIONS ON THE FOLLOWING PAGES.

FINAL REVIEW QUESTIONS

INSTRUCTIONS: CIRCLE THE LETTER BY THE CORRECT ANSWER.

1. MINUTE HAIRLINE SCRATCHES CAN OFTEN BE REMOVED FROM WINDSHIELD OR WINDOWS BY:

   A. Sanding and rubbing with 200 grit wet and dry sandpaper

   B. Cutting out a section and installing a repair section

   C. Rubbing with automobile body cleaner or fine grade rubbing compound

   D. All of the above can be accomplished

2. THE PRESSURIZED SKYMASTER DOOR SEAL IS HELD IN PLACE BY:

   A. EC-1675B and EC-1675A adhesive

   B. EC-1608B and EC-1608A adhesive

   C. A metal strip and rivets

   D. Channel retainer

3. WHAT IS RECOMMENDED FOR CLEANING OUTFLOW AND SAFETY VALVES?

   A. Mild detergent solution or isopropyl alcohol

   B. MEK applied with a clean cloth

   C. Vacuum cleaner and window cleaner

   D. Water and soft brush

4. WHAT ITEM CAN BE REPLACED ON THE CONTROLLER?

   A. The control knob

   B. The diaphragm chamber

   C. Air filter

   D. The threaded shaft and spring

FINAL REVIEW QUESTIONS

5. LABYRINTH SEALS ARE USED TO:

   A. Seal around the windows of the Skymaster

   B. Seal around the doors of both the P210 and P337

   C. Provide a seal where cables enter the pressure capsule

   D. Allows water to drain from the bottom of the aircraft

6. WHAT IS USED TO CLEAN THE MICRON WAFER FILTERS:

   A. Vacuum cleaner

   B. MEK and soft cloth

   C. Mild detergent

   D. Isopropyl alcohol

7. DOOR SEALS ARE INSTALLED WITH:

   A. The rubber gap facing the outside

   B. Air holes in the seal toward the pressure source

   C. Sealant on both the Skymaster and Centurion

   D. Both A and C are correct

8. Door seals may be repaired up to a maximum of:

   A. 8 inches

   B. 4 inches

   C. 6 inches

   D. 3 inches

9. IF THE CABIN DIFFERENTIAL PRESSURE GAGE INDICATION EXCEEDS THE RED LINE, A PROBABLE CAUSE COULD BE:

   A. Outflow valve not regulating properly

   B. Cabin differential pressure gage not indicating properly

   C. Safety valve not regulating properly

   D. All of the above could cause the problem

10. THE DOOR SEAL OF THE PRESSURIZED CENTURION IS HELD IN PLACE:

   A. By adhesive only

   B. By rivets and metal strip

   C. By a channel groove

   D. By screws and a locking plate

11. HEAT FOR THE PRESSURIZED CENTURION IS ACCOMPLISHED BY:

   A. A combustion heater

   B. Routing warm air over the pressurization heat exchanger

   C. Heat exchanger and combustion heater

   D. Both A and C are correct

12. THE PURPOSE OF THE ALTITUDE WARNING LIGHT ON THE PRESSURIZED CENTURION IS TO:

   A. Notify the pilot when to turn on the pressurization system

   B. Provide a means for troubleshooting the altitude controller

   C. Let the pilot know that the safety valve is closed

   D. Let the pilot know when cabin altitude exceeds 12,400 ± 100 feet

13. THE "ON-OFF" SWITCH CONTROLS:

    A. The position of the outflow valve

    B. The position of the solenoid valve on the safety valve

    C. The operation of the altitude control

    D. The amount of air entering the cabin

14. Cable seals should be installed:

    A. With teeth on the seals pointing away from pressure capsule

    B. With dry rubber lube

    C. With teeth on the seal pointing toward the pressure capsule

    D. Without lubricant

15. CABIN DIFFERENTIAL PRESSURE IS INDICATED BY:

    A. Cabin altitude and differential pressure instrument

    B. Cabin rate-of-climb indicator

    C. Air distribution gauge

    D. A warning light

16. WITH THE AIRCRAFT PRESSURIZED, WHAT WOULD HAPPEN TO PRESSURIZATION IF A COMPLETE ELECTRICAL FAILURE OCCURRED?

    A. De-pressurize immediately

    B. De-pressurize slowly

    C. Continue to operate normally

    D. Continue to operate only in the differential mode

FINAL REVIEW QUESTIONS

17. IF THE CONTROL LINE BETWEEN THE CONTROLLER AND OUTFLOW VALVE WAS LEAKING OR RUPTURED, THE PRESSURIZATION SYSTEM WOULD:

    A. Continue to operate normally

    B. Depressurize the cabin

    C. Depressurize the cabin slowly

    D. Continue to operate only in the differential mode

18. IF THE SAFETY VALVE LARGE DIAPHRAGM WAS LEAKING OR RUPTURED, THE AIRCRAFT WOULD:

    A. Not pressurize

    B. Pressurize in the isobaric mode only

    C. Pressurize in the differential mode only

    D. Pressurize above maximum differential pressure

19. THE FRONT ENGINE ON A PRESSURIZED SKYMASTER IS OPERATING AT MAXIMUM POWER. UPON PULLING THE DUMP VALVE FOR THE REAR ENGINE, THE CABIN DEPRESSURIZES. TO TROUBLESHOOT THIS MALFUNCTION, WHAT WOULD YOU CHECK FIRST.

    A. Safety valve

    B. Outflow valve

    C. Fresh air check valves

    D. Aft firewall check valve

20. WHAT WOULD YOU SUSPECT TO BE THE PROBLEM IF THE CABIN ALTITUDE OVERSHOOTS THE SELECTED ALTITUDE?

    A. An open safety valve diaphragm

    B. A defective controller

    C. A sticking firewall inlet check valve

    D. An open outflow valve diaphragm