

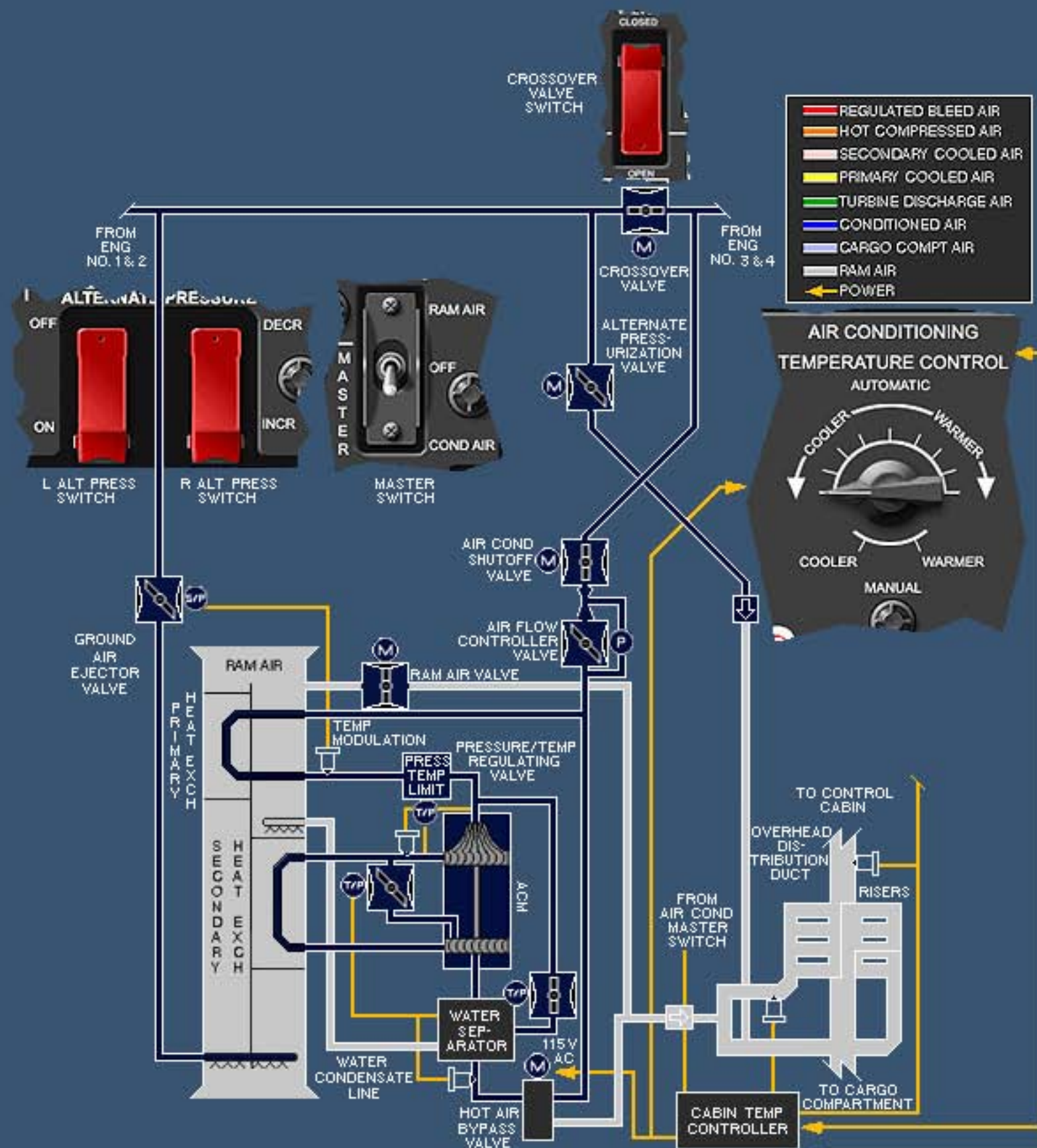
Air Conditioning Operation

You learned about the pneumatic components in the previous lesson. In this lesson, we'll focus on how the air conditioning and pressurization systems operate, pneumatic system limitations, and noncritical emergency procedures.

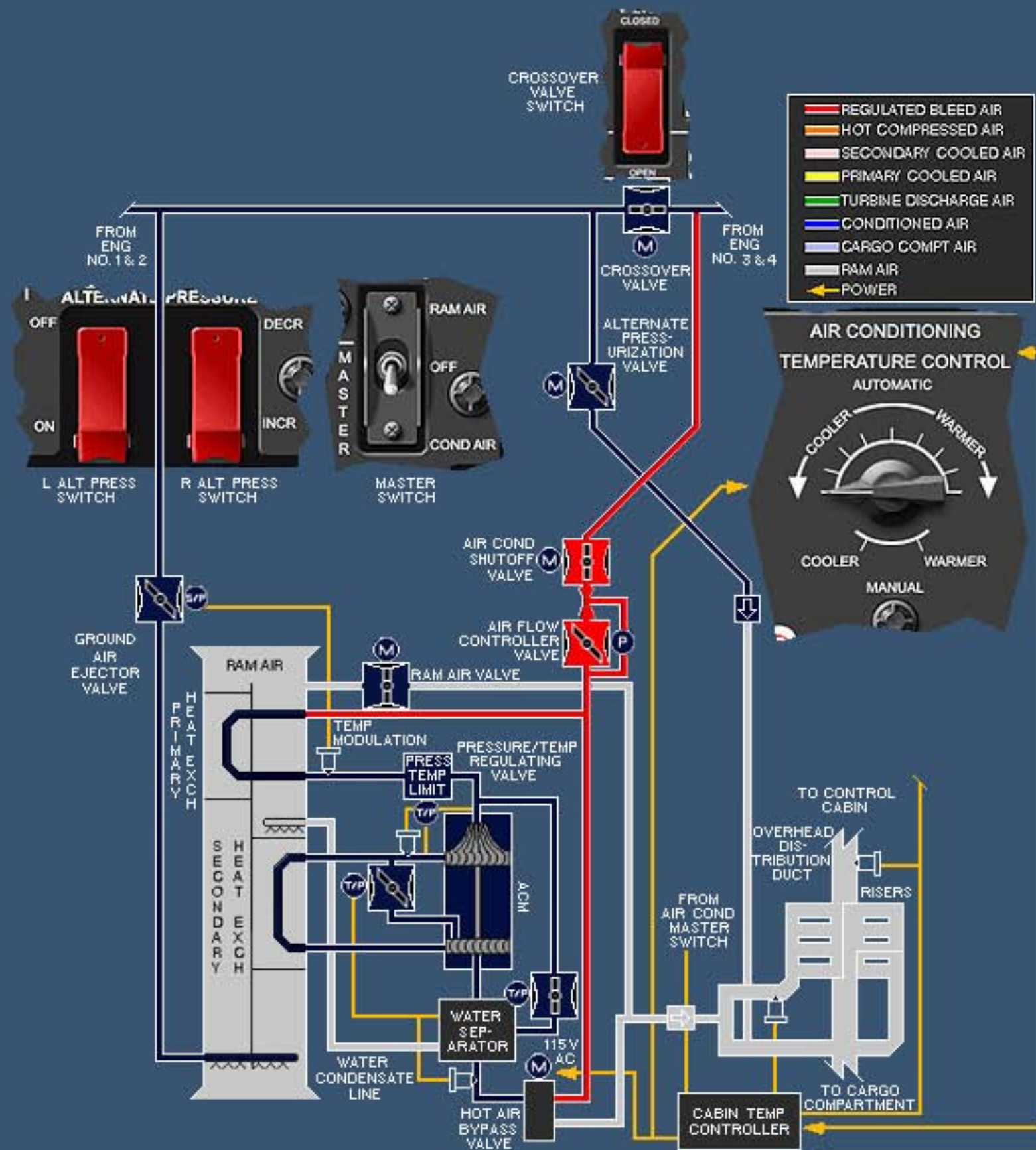


As you know, the bleed air system funnels air to the air conditioning system. If the MASTER switch is set to COND AIR, air flows from the wing manifold through the air conditioning shutoff and airflow controller valves. Shortly thereafter, the path splits: some air goes to the hot air bypass valve, and some air goes to the primary heat exchanger.

Click the schematic to watch the air move through the system to the primary heat exchanger and the hot air bypass valve.



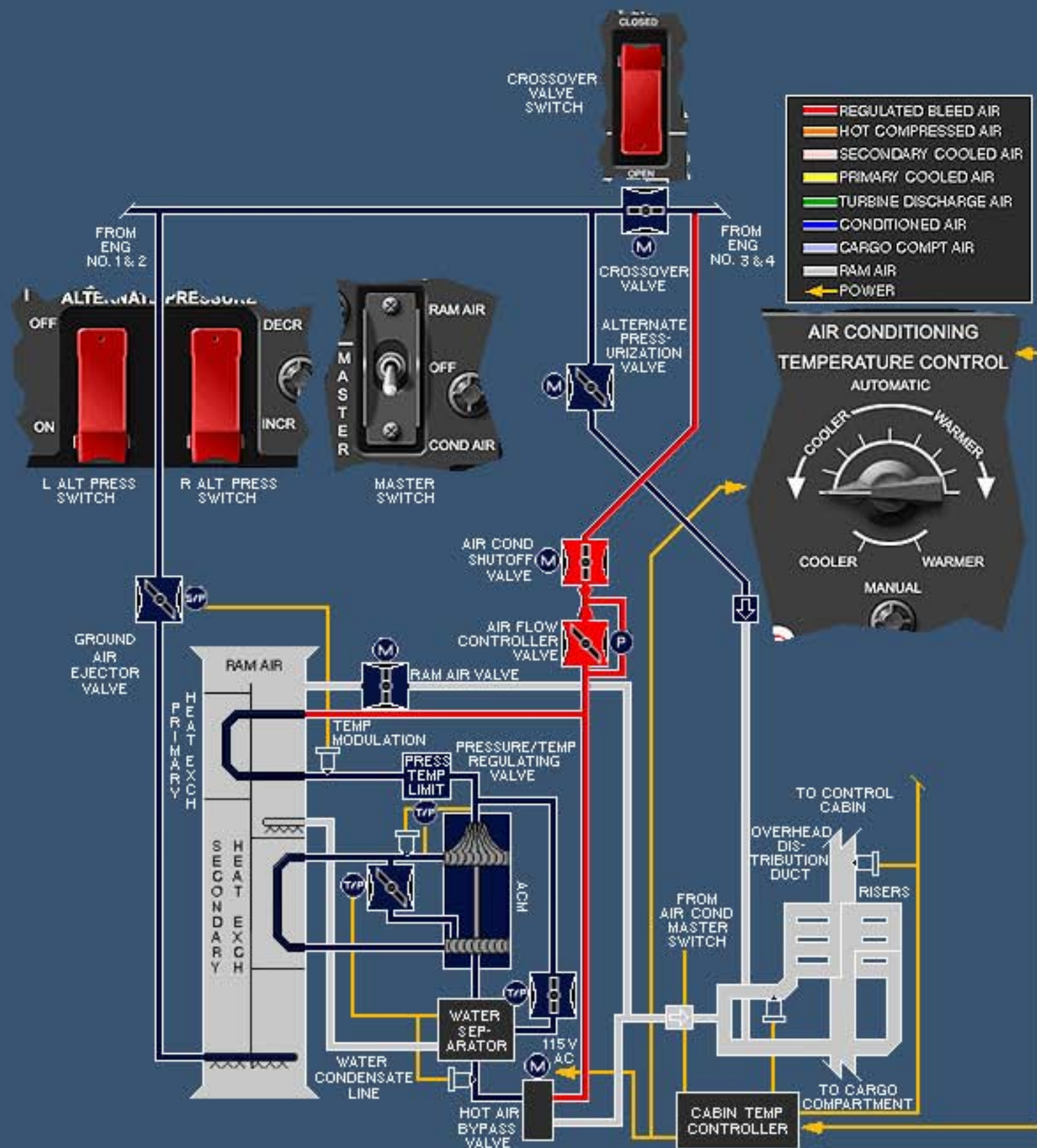
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For the purposes of our discussion, air in the hot air bypass valve has reached a temporary stopping point, while we continue to follow the path of the air through the air conditioning pack.

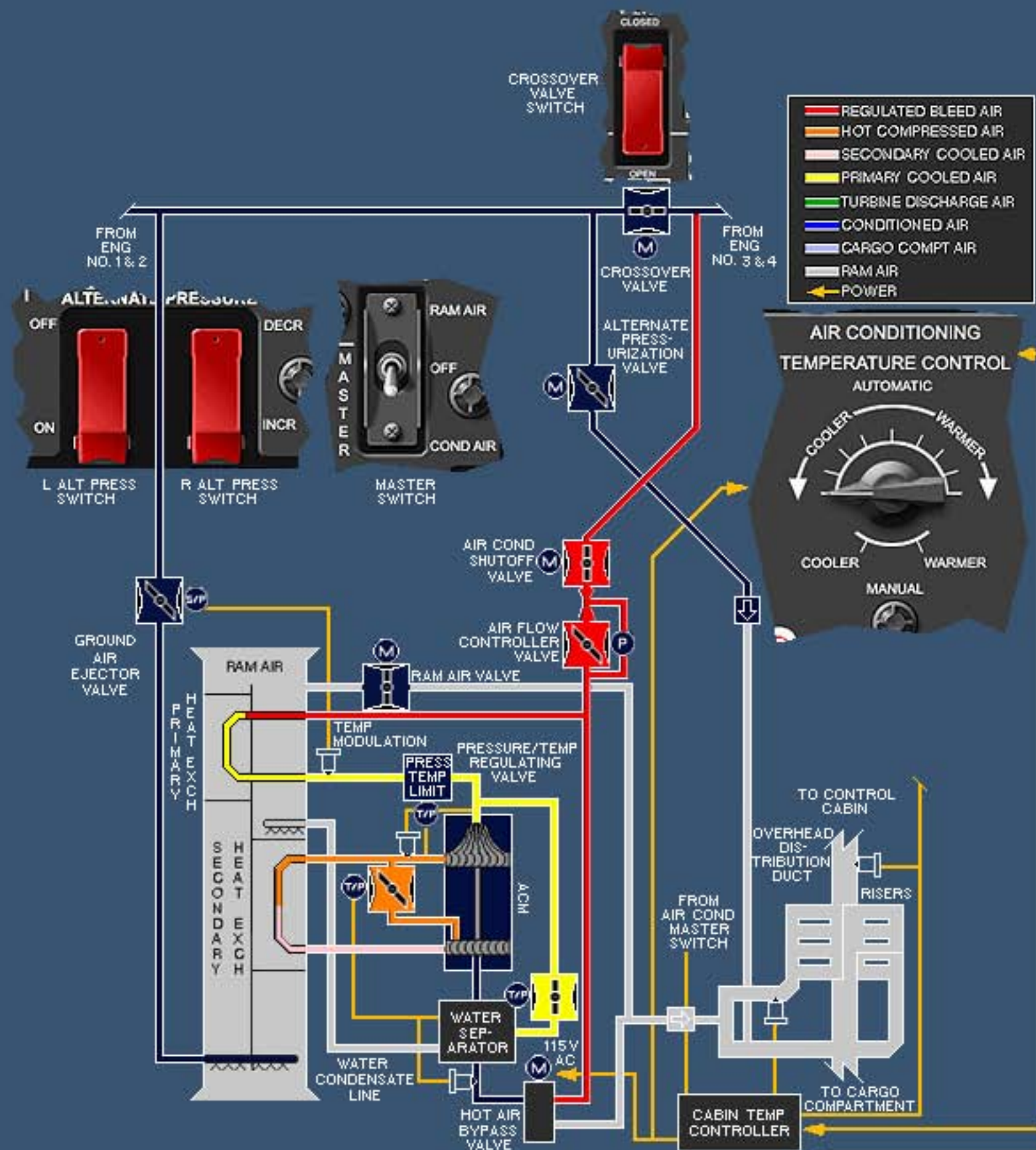
The air loses some of its heat as it flows across the primary heat exchanger cooling tubes. Then it's moved through the air cycle machine (ACM) into the secondary heat exchanger, where it encounters more ram air for further cooling. Ram air cooling is most effective at altitude, where airspeed is higher and temperatures are lower.

Click the schematic to watch the air progress to the water separator.



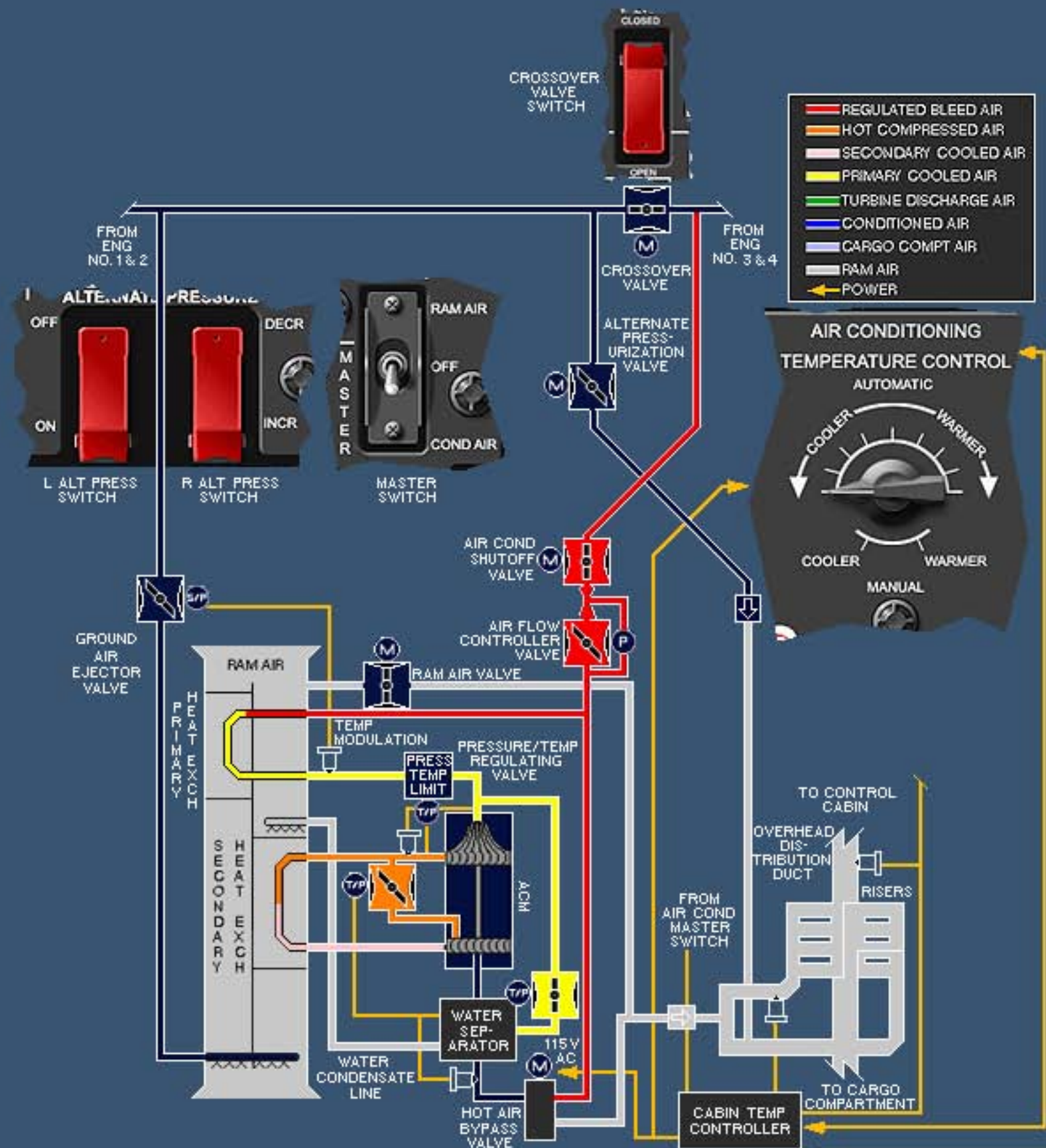
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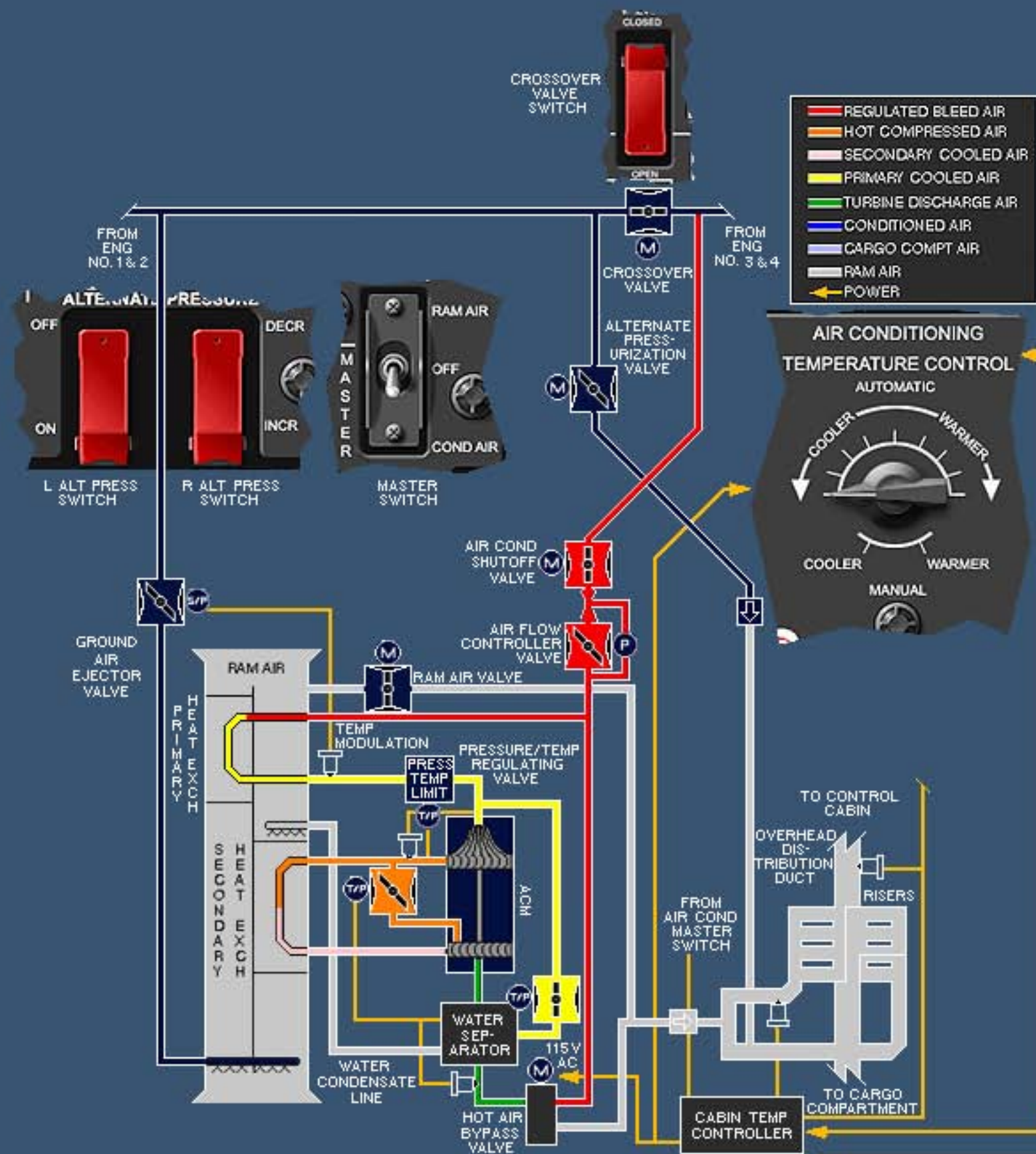


After a second trip through the ACM, which expands the air to cool it even further, the air progresses to the water separator. Water is removed from the air before it moves on to the hot air bypass valve.

Click the schematic to watch the air progress to the hot air bypass valve.

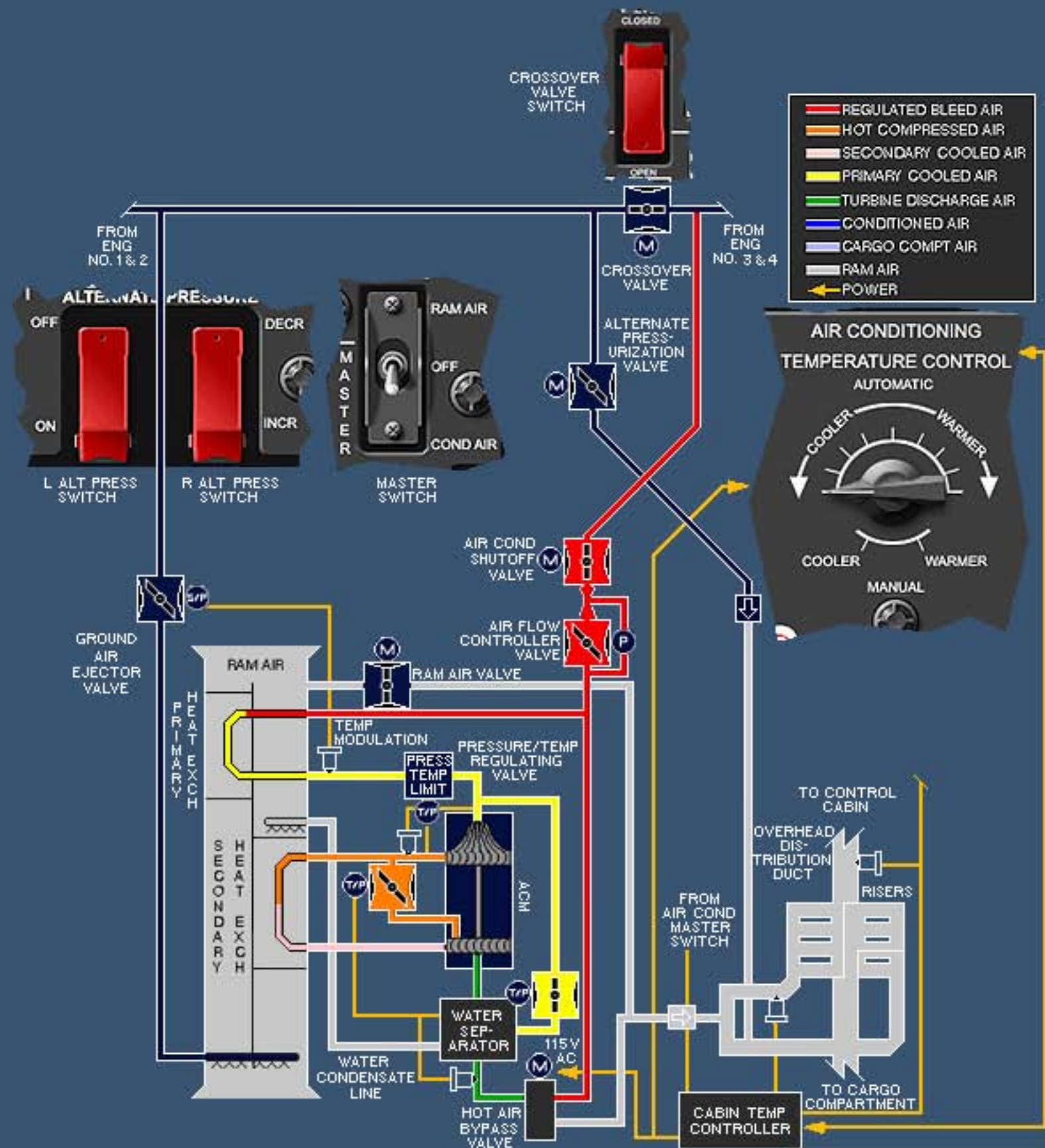


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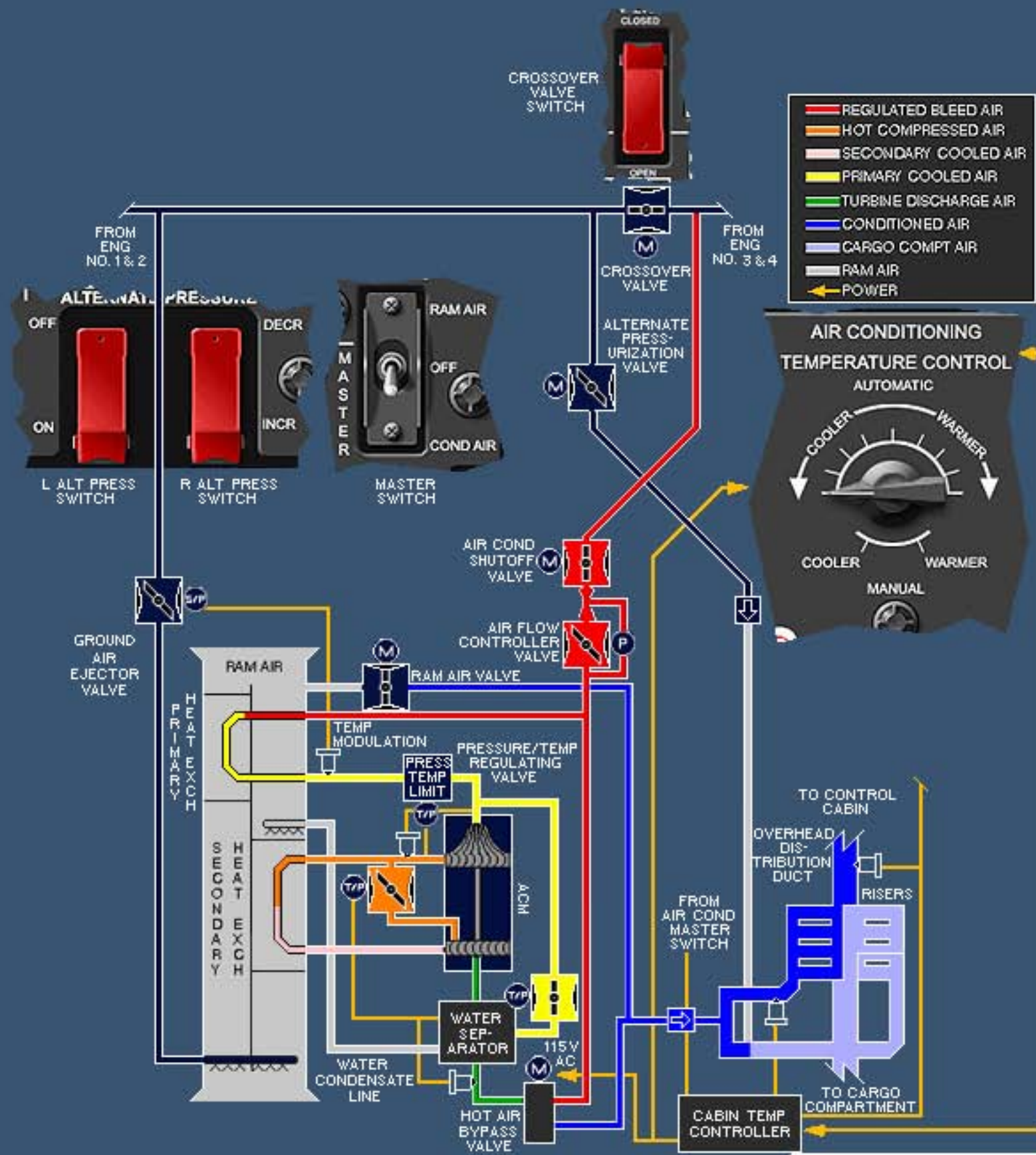


In the hot air bypass valve, the 35°F air is mixed with the appropriate amount of hot air to reach the temperature you selected with the **TEMPERATURE CONTROL** knob in the cockpit.

Click the schematic to watch the air progress through the air conditioning system.



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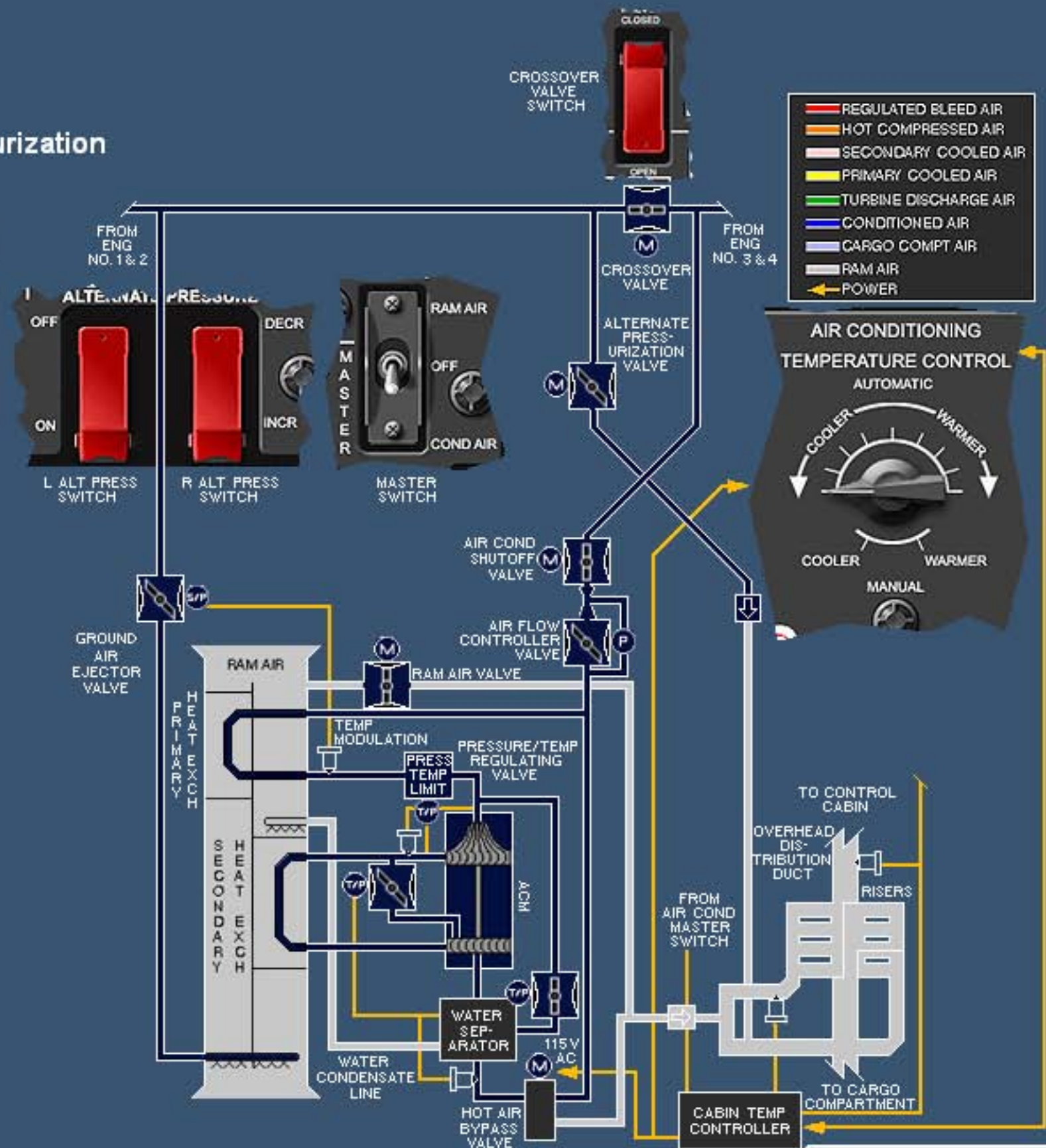


Before moving on to the alternate pressurization system, answer a quick question.

While it's in the primary and secondary heat exchangers, the bleed air is cooled by _____.

Select the best answer.

- ram air
- warm air
- recycled air
- pressurized air



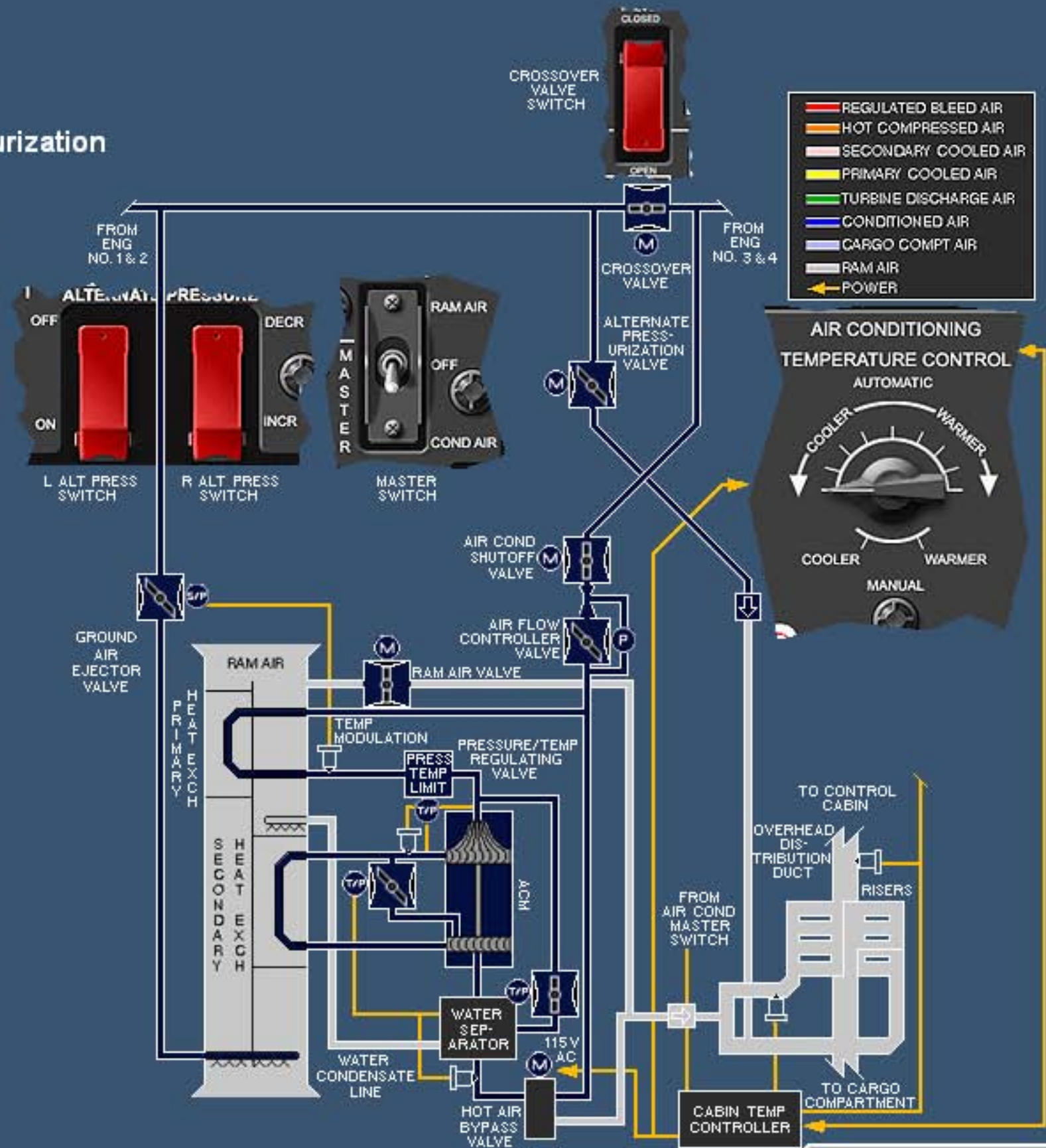
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While it's in the primary and secondary heat exchangers, the bleed air is cooled by _____.

- ram air
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- recycled air
- pressurized air

Click Here To Move

That's right. The bleed air's temperature drops when it is cooled by ram air (if you're at altitude).



Before moving on to the alternate pressurization system, answer a quick question.

While it's in the primary and secondary heat exchangers, the bleed air is cooled by _____.

a. ram air

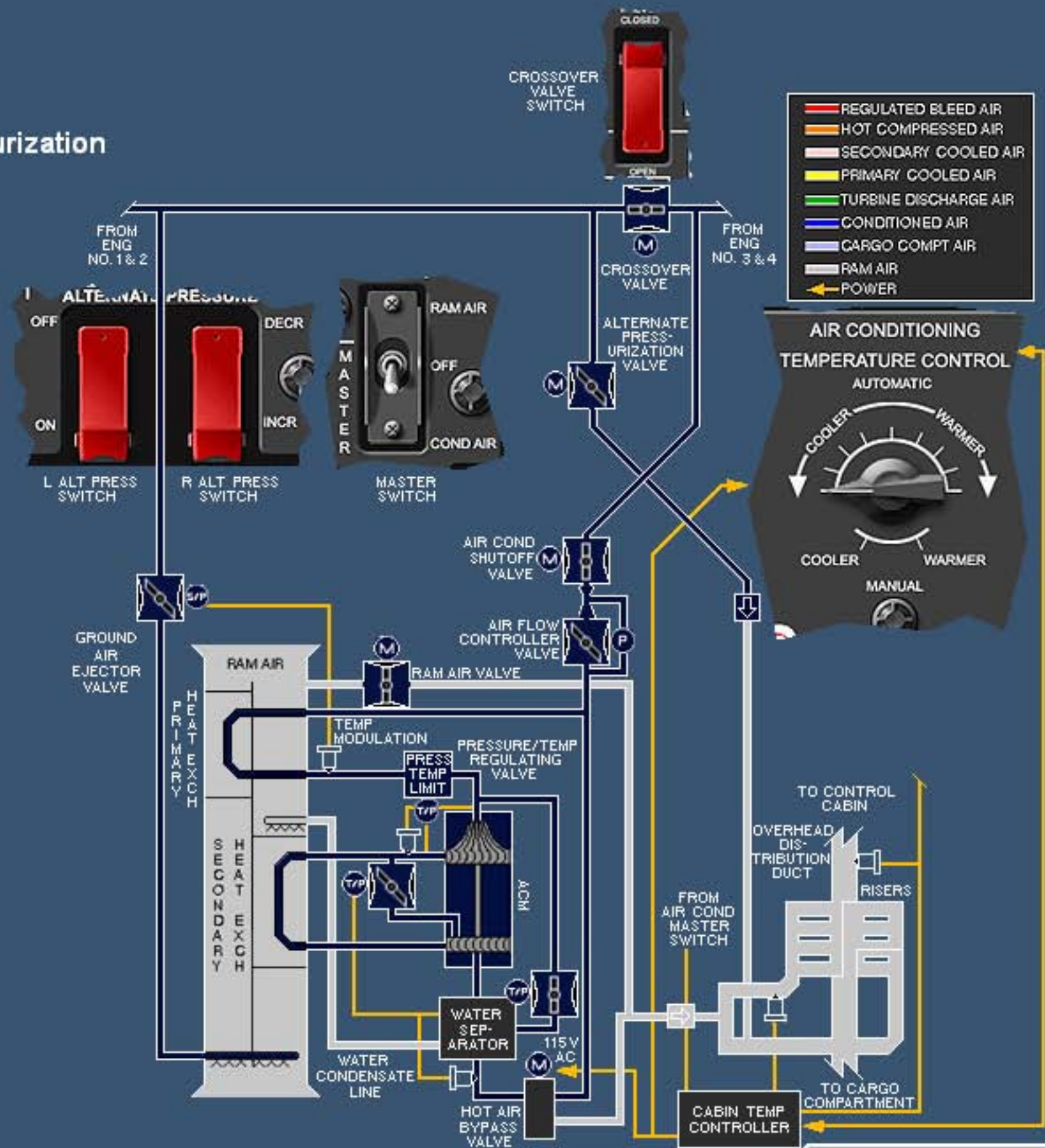
b. warm air

c. recycled air

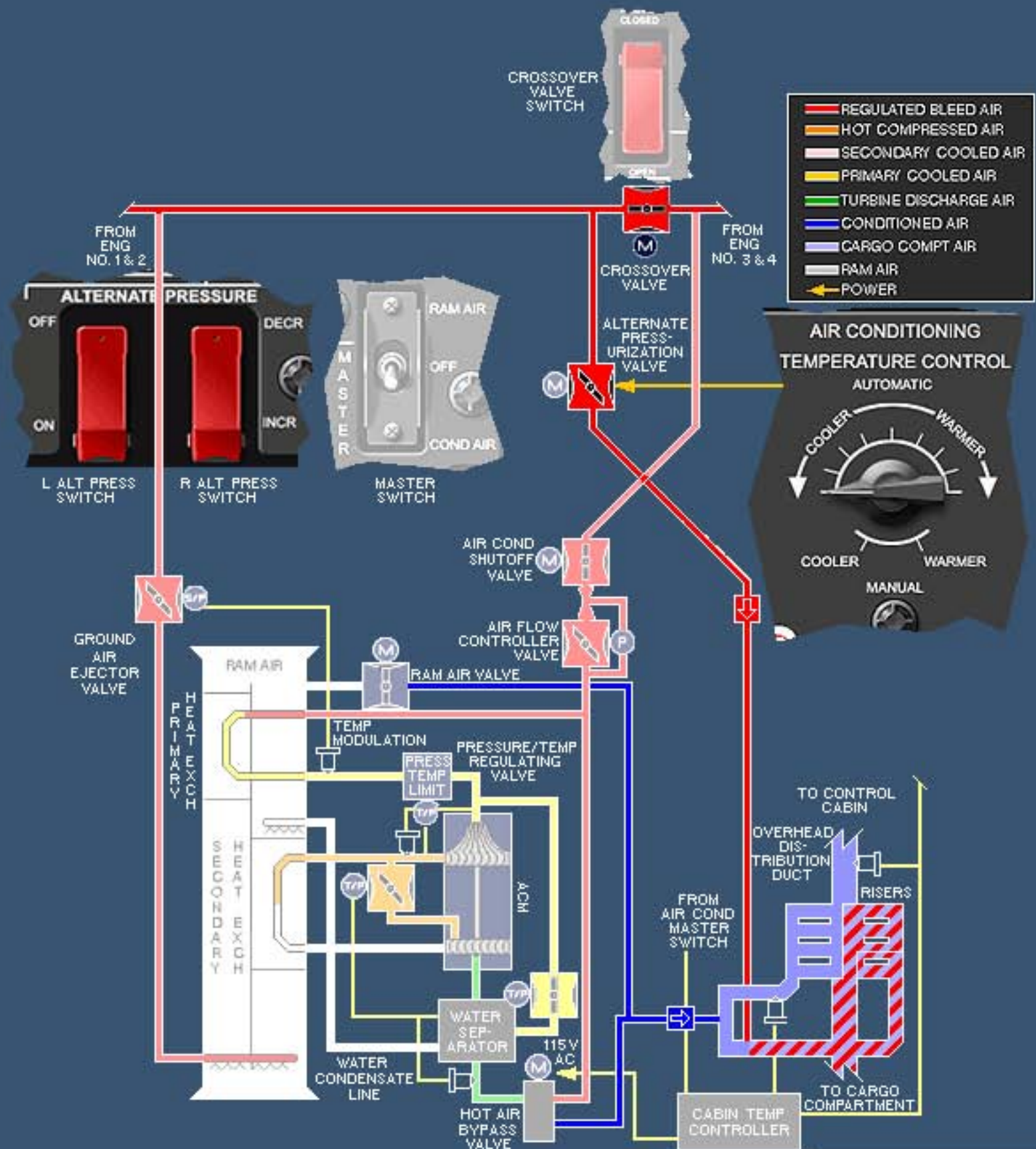
d. pressurized air

Click Here To Move

Sorry, answer "a" is correct. The bleed air's temperature drops when it is cooled by ram air (if you're at altitude).

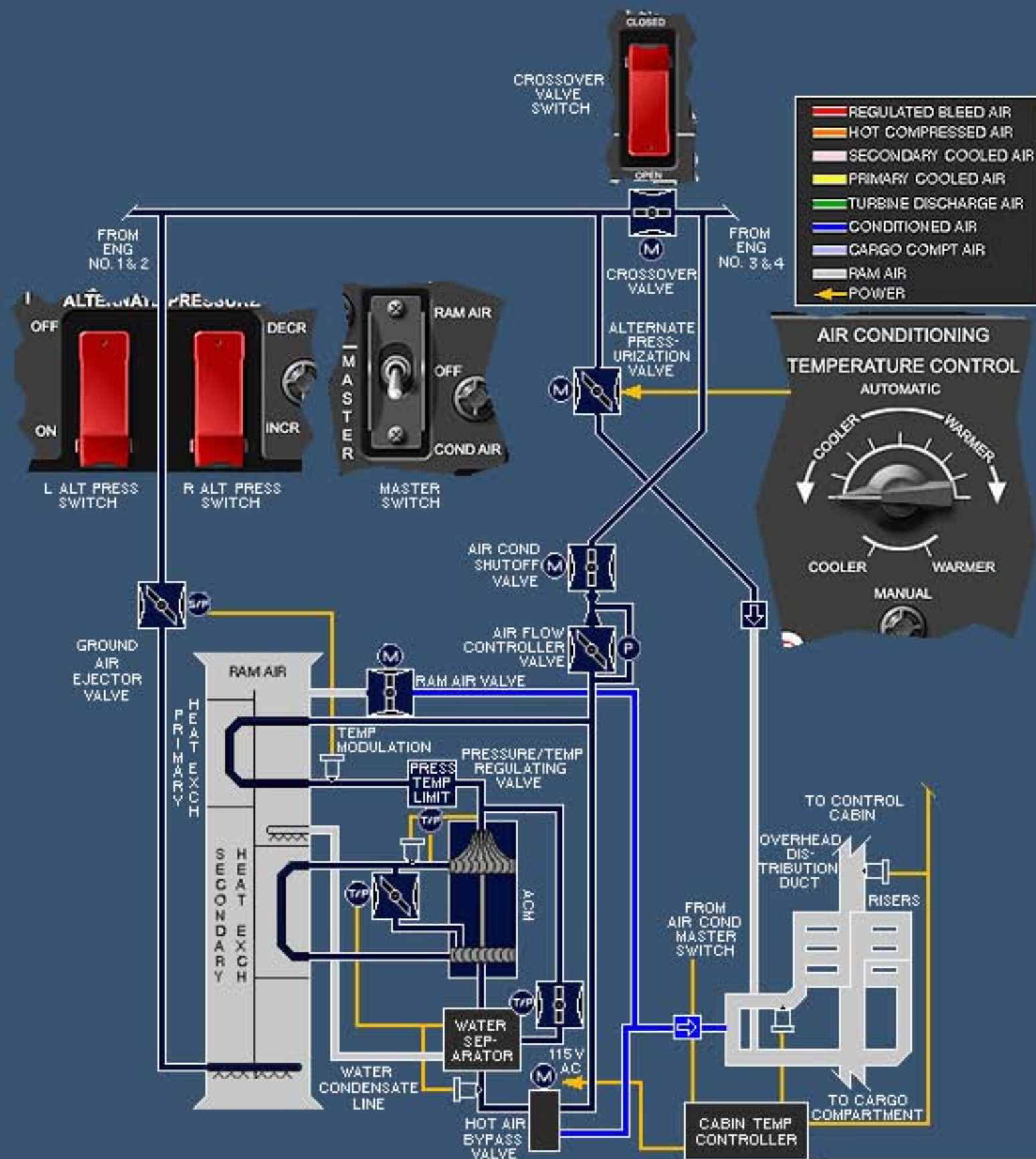


You might recall the alternate pressurization system sometimes heats the cargo compartment and the boom pod. When it's in the OFF position, the left ALTERNATE PRESSURE switch enables the cargo compartment TEMPERATURE CONTROL knob to function. When the left ALTERNATE PRESSURE switch is in the ON position, the right ALTERNATE PRESSURE switch regulates the amount of heat flowing to the cargo compartment.

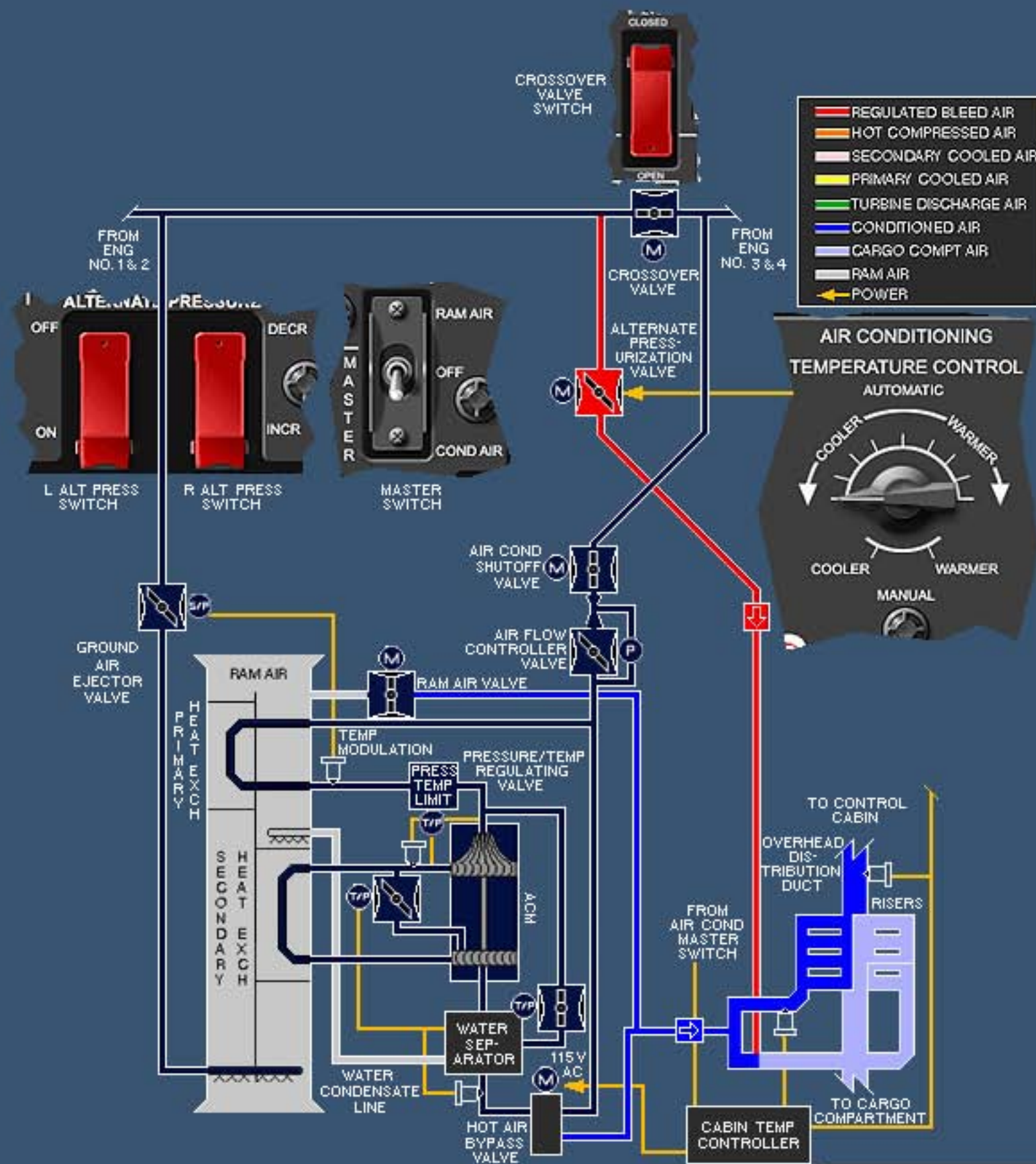


When it is in use, the alternate pressurization system funnels air from the bleed air system directly to the cargo compartment, rather than through the air conditioning system.

Click the schematic to watch the air progress through the alternate pressurization system.



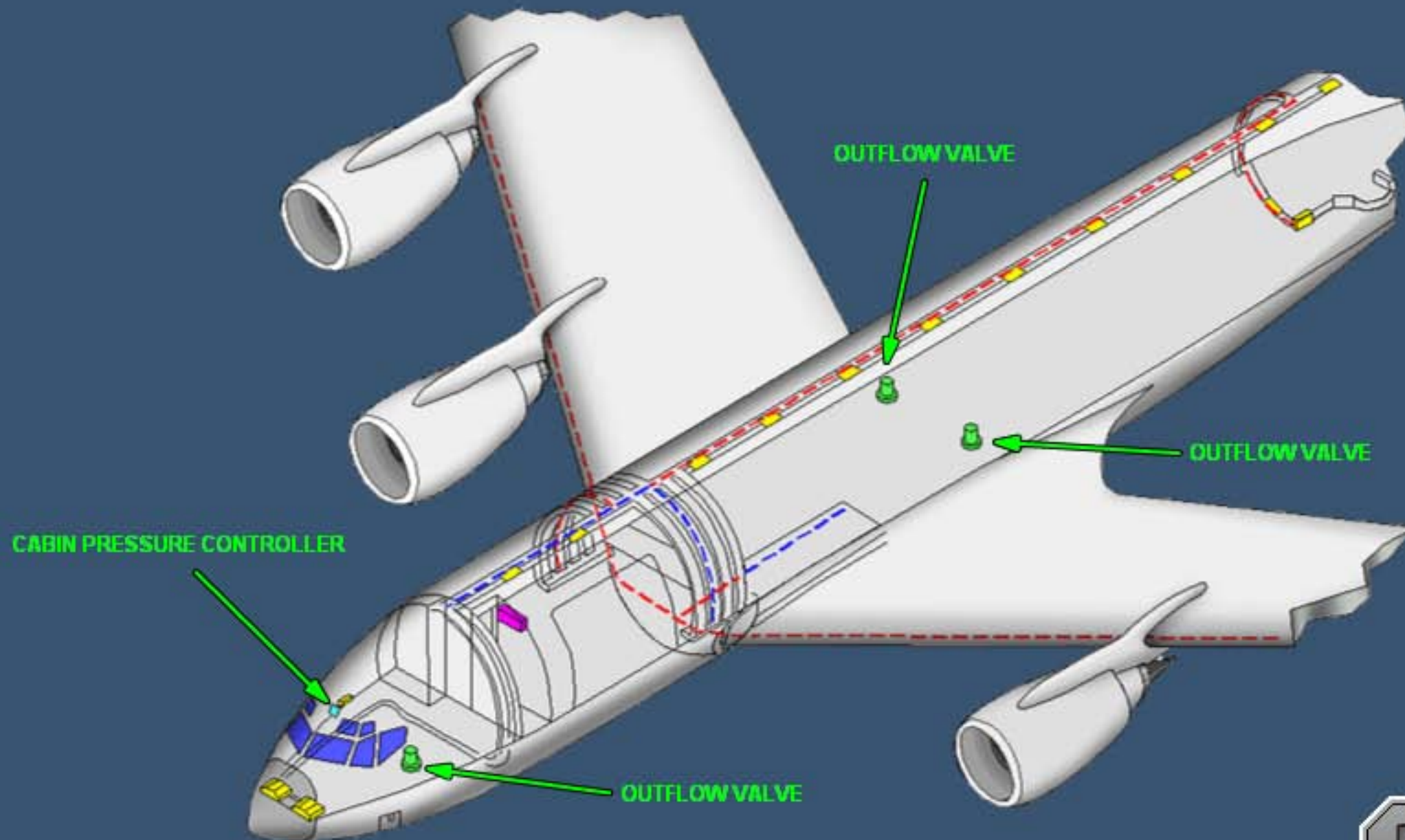
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Pressurization System Limits and Operations

We've talked about operating the air conditioning system; now we'll cover operating the pressurization system. Remember, the same air is used for both functions.

First, we'll talk about a component and the pressurization system's limits; then we'll highlight some *Reference Data* manual recommendations.



The CABIN ALT (altitude) gage displays the differential between the cabin and ambient pressures. The differential ranges, which are indicated in the accompanying graphic, are as follows:

- Normal: between 0.0 and 8.6 pounds per square inch (psi)
- Caution: between 8.6 and 9.42 psi
- Maximum: 9.42 psi

MAXIMUM PRESSURE

CAUTION PRESSURE

NORMAL PRESSURE



These ranges apply only if the CABIN PRESS (pressure) CONT (controller) is operating properly. If the controller is inoperative, you can maintain cabin pressure below 9.42 psi with the MANUAL PRESSURE CONTROL.

If cabin pressure reaches 9.42 psi, the outflow valves act as overpressure safety valves and relieve the pressure.



In addition to the limits listed above, the *Reference Data* manual has some recommendations for efficient crew operation.

First, depending upon the time of day, set the cabin altitude as follows:

- Day: 8,000 feet, maximum
- Night: 5,000 feet, maximum

With these settings, the cabin altitude is set up to an 8.6-psi differential.

In the accompanying graphic, the yellow needle depicts the maximum daytime cabin altitude; the blue needle depicts the maximum nighttime cabin altitude.

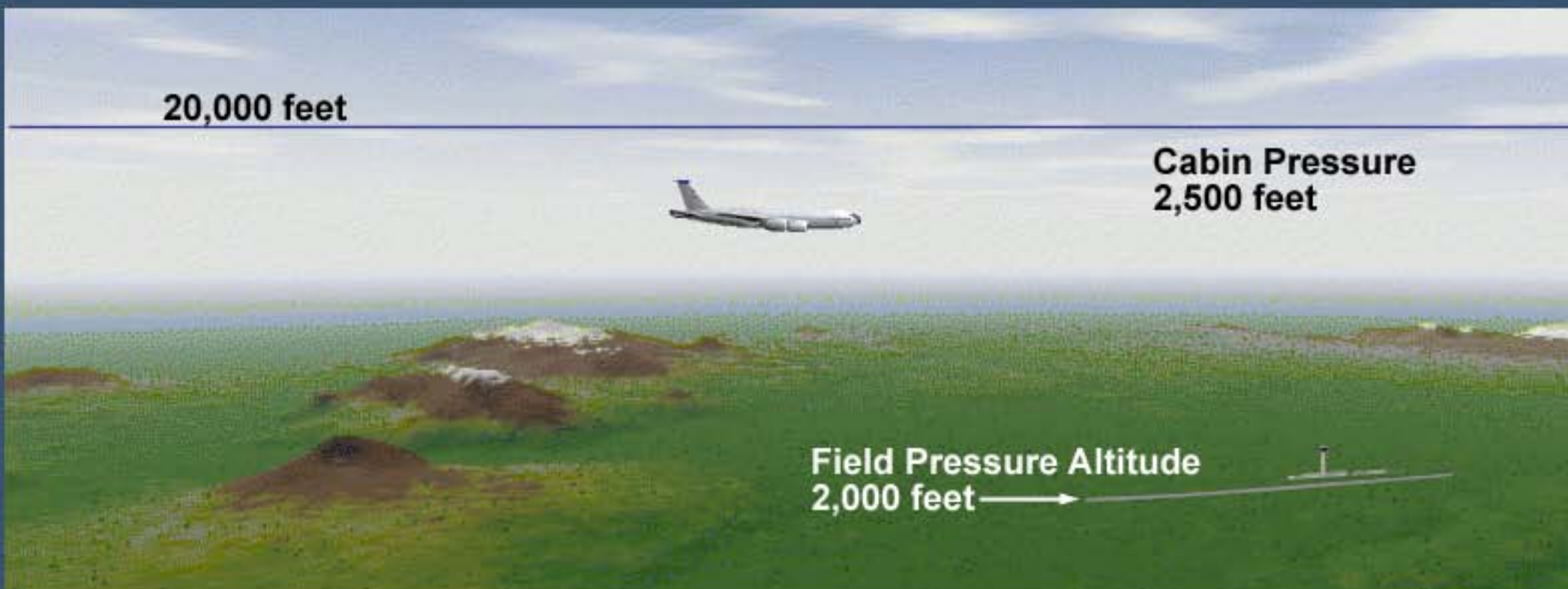


Alternatively, you can set the A/P ALT (airplane altitude) scale in the CAB PRESS CONT (cabin pressure controller) above the highest planned cruising altitude to ensure flight within the operational limits of the pneumatic system.



To ensure a depressurized cabin when landing or during flight below 20,000 feet, set the cabin altitude to the field pressure altitude plus 500 feet.

Additional requirements must be considered when landing with a wing manifold failure. See bullet two of this [CAUTION](#) for information.



Time for a couple of cabin altitude questions.

Select the cabin pressure controller graphic that represents the maximum daytime recommended cabin pressure.

Select the best answer.



Time for a couple of cabin altitude questions.

Select the cabin pressure controller graphic that represents the maximum daytime recommended cabin pressure.

Click Here To Move

That's correct. The maximum daytime recommended cabin altitude is 8,000 feet. With this setting, the cabin/ambient pressure differential is no more than 8.6 psi.



Time for a couple of cabin altitude questions.

Select the cabin pressure controller graphic that represents the maximum daytime recommended cabin pressure.

Click Here To Move

Incorrect. The maximum daytime recommended cabin altitude is 8,000 feet. With this setting, the cabin/ambient pressure differential is no more than 8.6 psi.



Now select the cabin pressure controller graphic that represents the maximum nighttime recommended cabin pressure.

Select the best answer.



Now select the cabin pressure controller graphic that represents the maximum nighttime recommended cabin pressure.

Click Here To Move

That's correct. The maximum nighttime recommended cabin altitude is 5,000 feet. Like the maximum daytime cabin pressure, this setting keeps the cabin/ambient pressure differential at no more than 8.6 psi.



Now select the cabin pressure controller graphic that represents the maximum nighttime recommended cabin pressure.

Click Here To Move

Incorrect. The maximum nighttime recommended cabin altitude is 5,000 feet. Like the maximum daytime cabin pressure, this setting keeps the cabin/ambient pressure differential at no more than 8.6 psi.



Airplane Depressurization

In this segment, we'll cover a few more components and two noncritical emergency procedures: Airplane Depressurization and Airplane Fails to Pressurize.



Two cabin altitude monitors—the CBN PRS (cabin (pressure) warning light and the altitude alerter—help you keep an eye on cabin pressure.

The CBN PRS warning light illuminates if cabin altitude is approximately 12,000 ($\pm 1,000$) feet or above and climbing. It turns off by the time you descend to 9,500 feet.





You probably remember from a previous lesson that the altitude alerter aurally alerts you with “CABIN ALTITUDE” when cabin altitude is above 10,000 feet. Additionally, the alert light illuminates, and the cabin altitude counter flashes.

Click on the altitude alerter to hear the aural warning.





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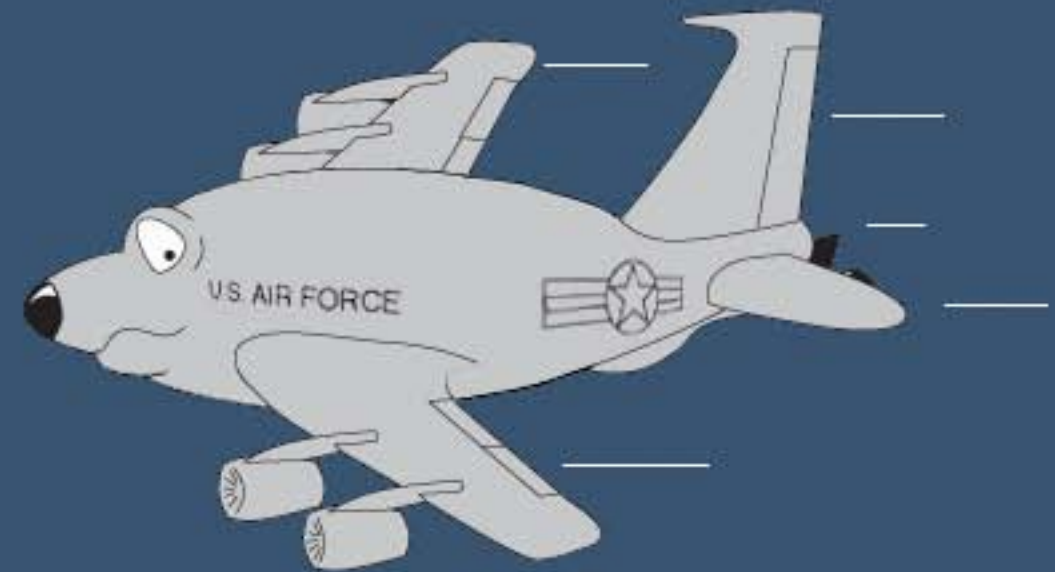
The alert light turns off and the cabin altitude counter stops flashing when the cabin pressure descends to below 10,000 feet.

If the CBN PRS warning light illuminates or the altitude alerter issues a warning, remember to use an oxygen mask.



Airplane Depressurization Procedure

If the situation allows, complete the following procedure outlined on the next page. Before completely depressurizing the plane, make sure you turn off the heat to hot liquids—such as coffee—to ensure their containers do not rupture.



Airplane Depressurization

Complete the steps below on the panel graphic (as appropriate) to depressurize the plane. For this CBT, assume you already donned an oxygen mask.

1. Don oxygen masks, if needed (All).
2. Move the MANUAL PRESSURE CONTROL knob to full DECREASE.



Airplane Depressurization

Complete the steps below on the panel graphic (as appropriate) to depressurize the plane. For this CBT, assume you already donned an oxygen mask.

1. Don oxygen masks, if needed (All).
2. Move the MANUAL PRESSURE CONTROL knob to full DECREASE.
3. Move the MASTER switch to the OFF position. If you want some ventilation, and you decide the emergency exit hatches will remain in place, move the MASTER switch to the RAM AIR position.



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4. Open the left ALTERNATE PRESSURIZATION switch cover, then move the switch to the ON position.



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5. Open the right ALTERNATE PRESSURIZATION switch cover, then move and hold the switch in the DECR position for 20 seconds.

For the purposes of this CBT, holding the switch in the DECR position is not necessary.



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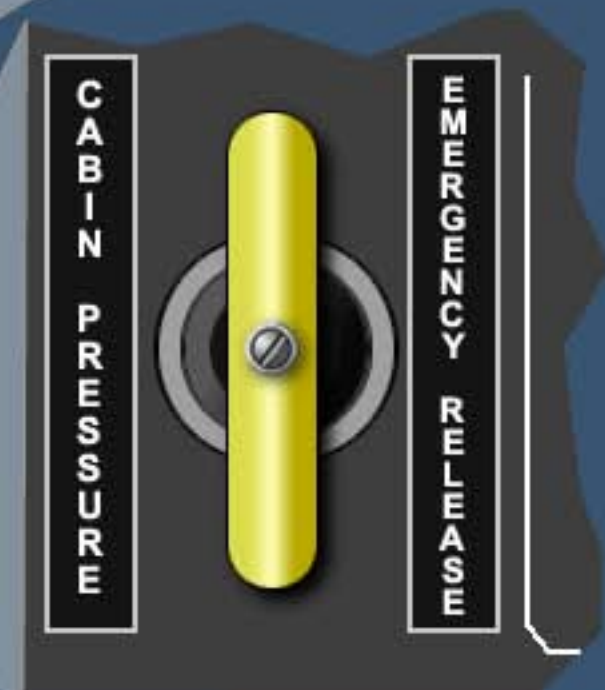
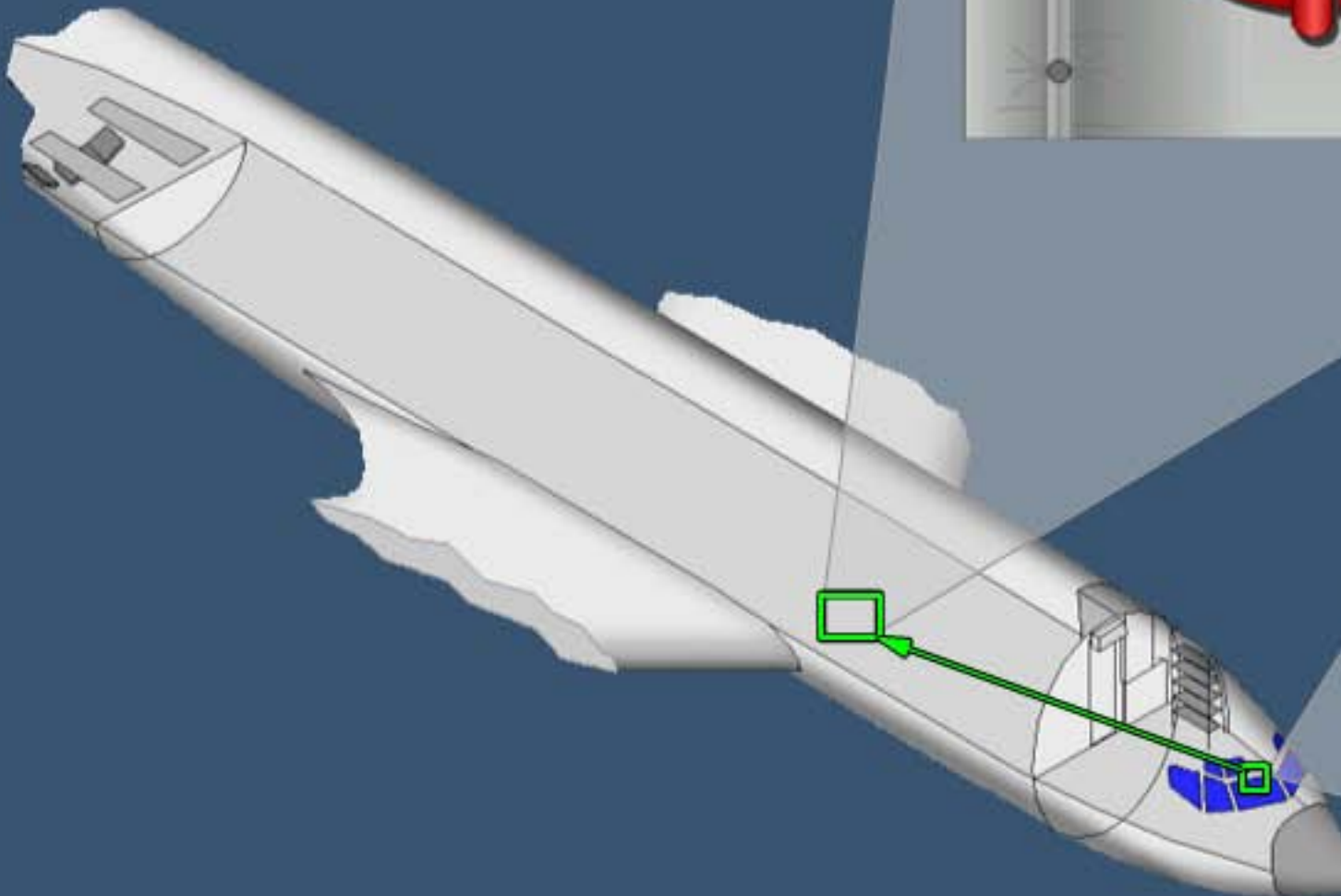
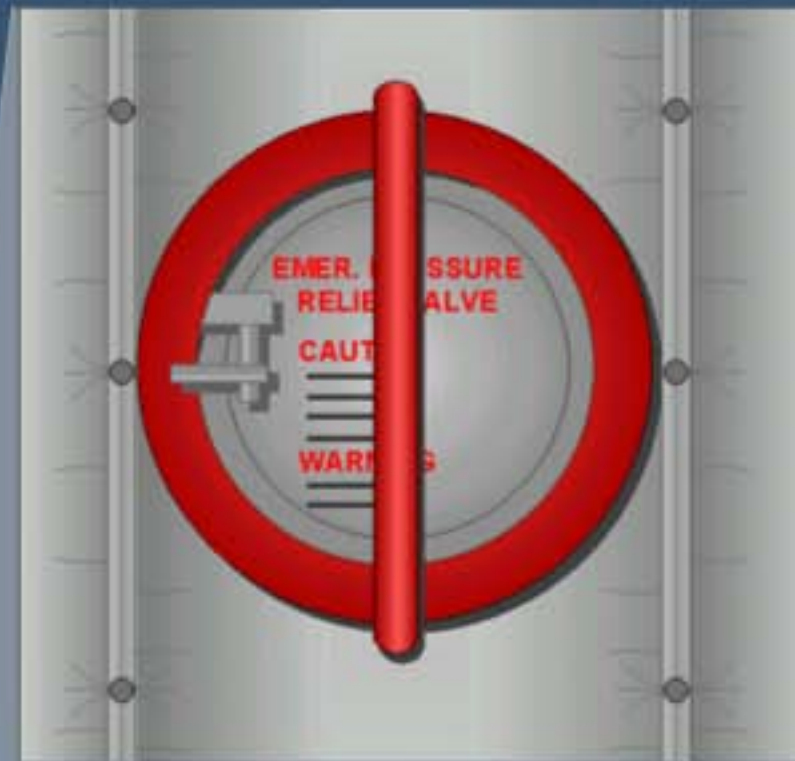


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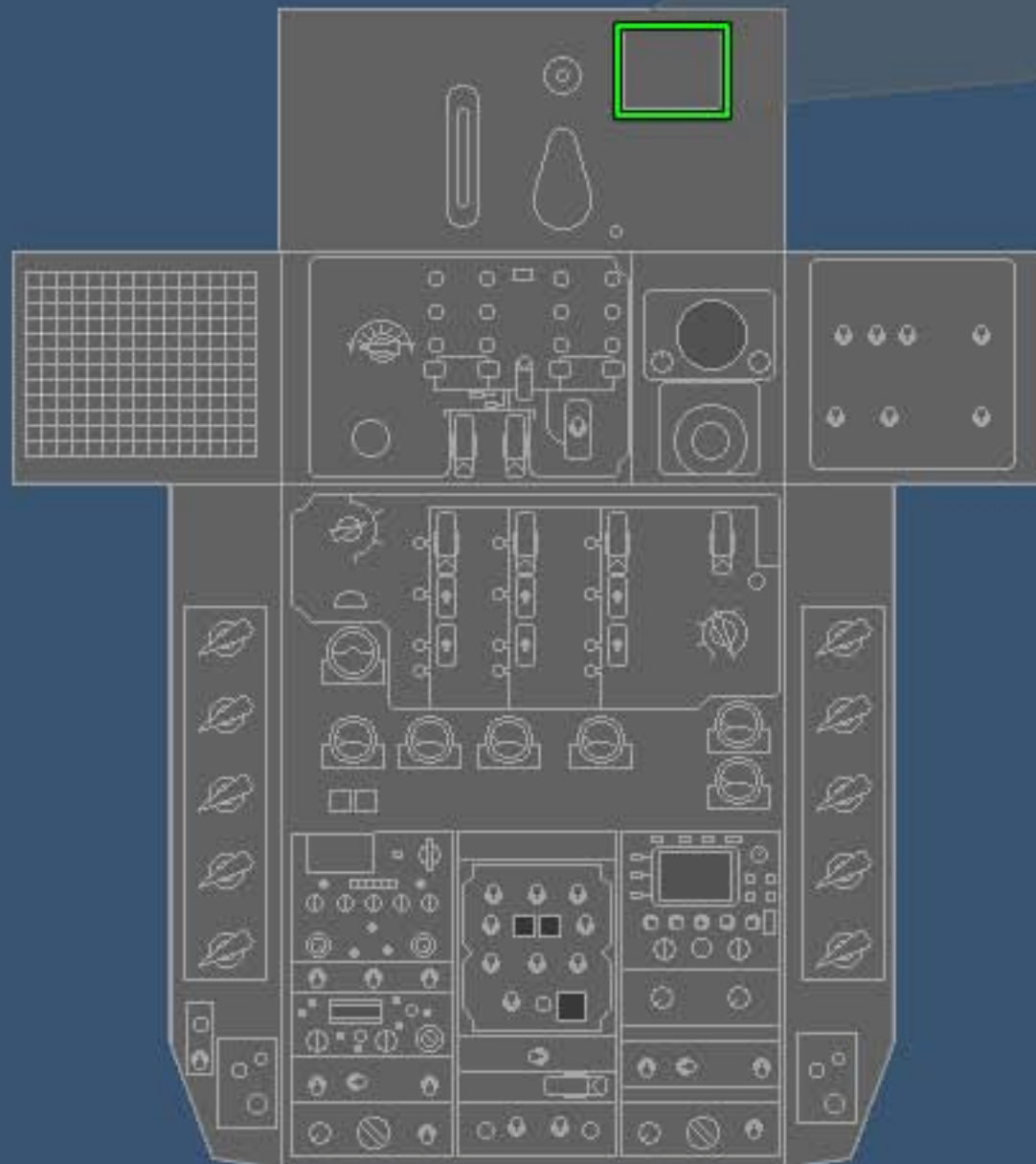
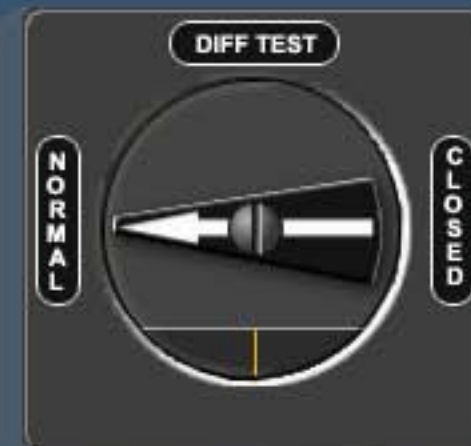


You can also depressurize the plane very rapidly by pulling the **CABIN PRESSURE EMERGENCY RELEASE** handle approximately eight inches. Pulling this handle opens the cabin pressure emergency release door through a cable connection. After the door is opened, you cannot repressurize the plane while in flight.



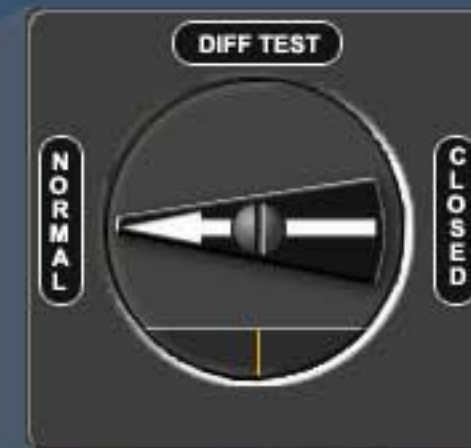
Before going into the Airplane Fails to Pressurize procedure, we need to introduce one more component: the **CABIN PRESSURE TEST VALVE** handle. This handle controls the cabin pressure controllers with three settings.

Click on the **NORMAL** position for a description.

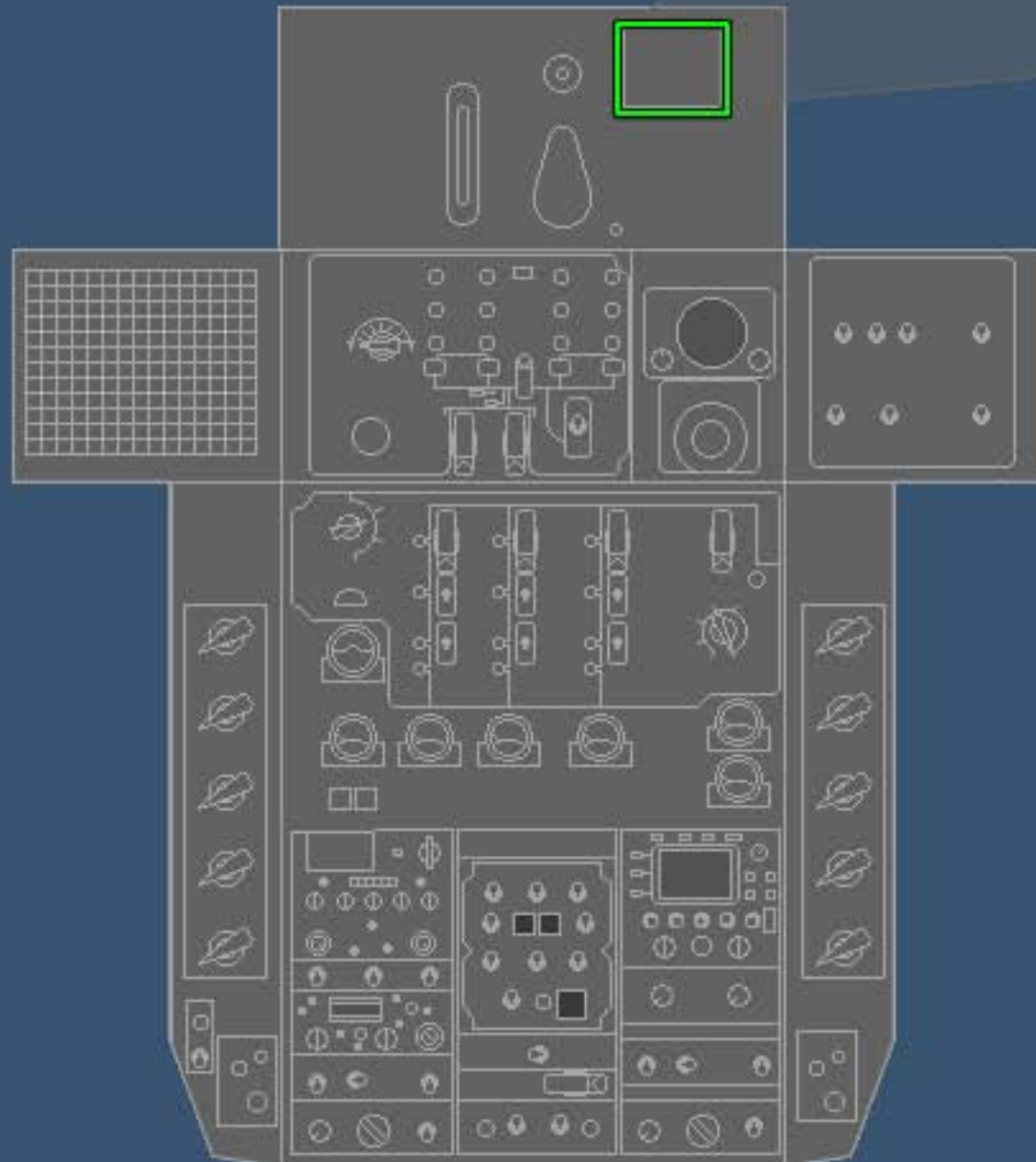


Before going into the Airplane Fails to Pressurize procedure, we need to introduce one more component: the **CABIN PRESSURE TEST VALVE** handle. This handle controls the cabin pressure controllers with three settings.

Click on the **DIFF TEST** position for a description.



NORMAL: Allows normal operation of the CABIN PRESS CONT.

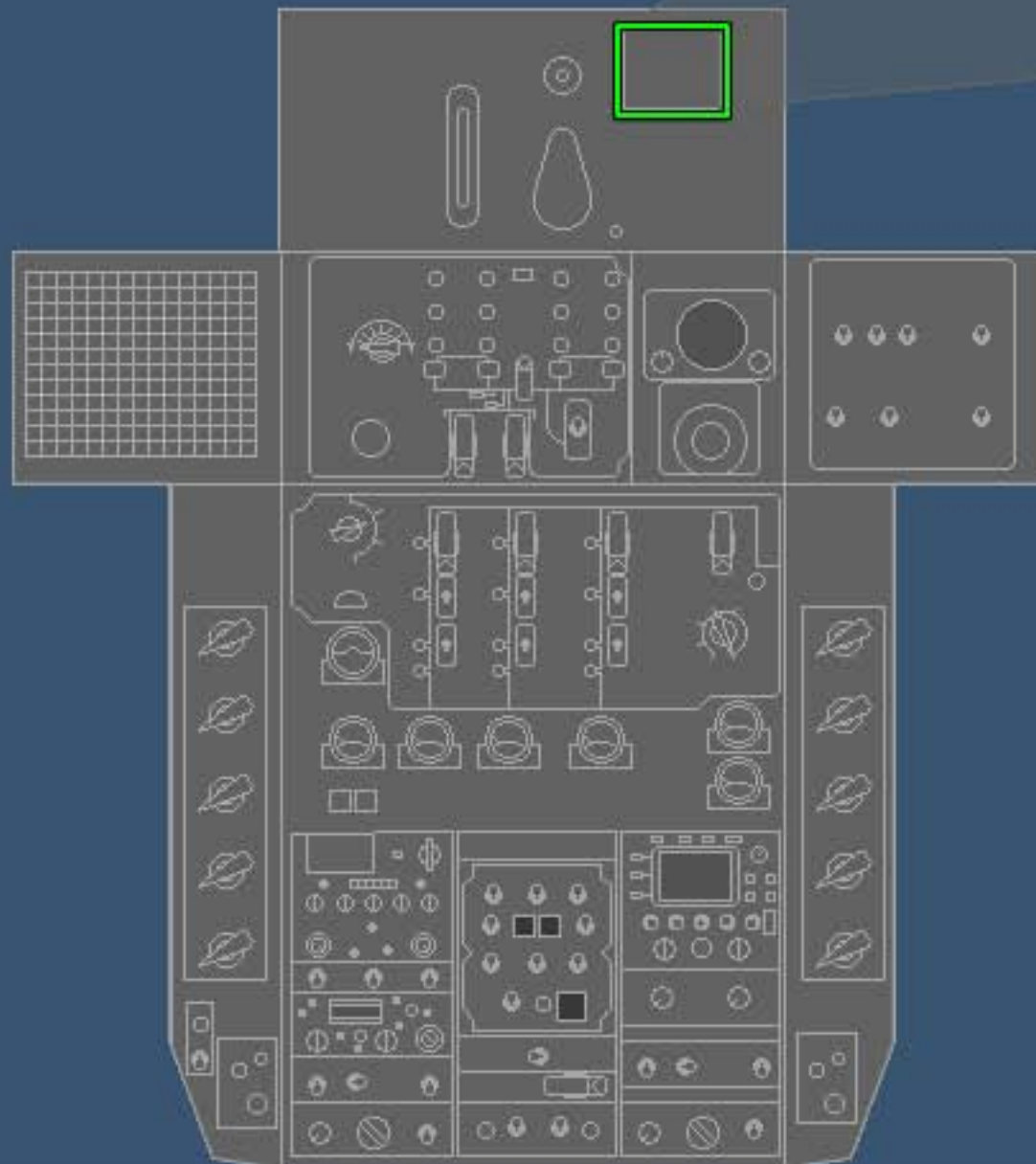


Before going into the Airplane Fails to Pressurize procedure, we need to introduce one more component: the **CABIN PRESSURE TEST VALVE** handle. This handle controls the cabin pressure controllers with three settings.

Click on the **CLOSED** position for a description.



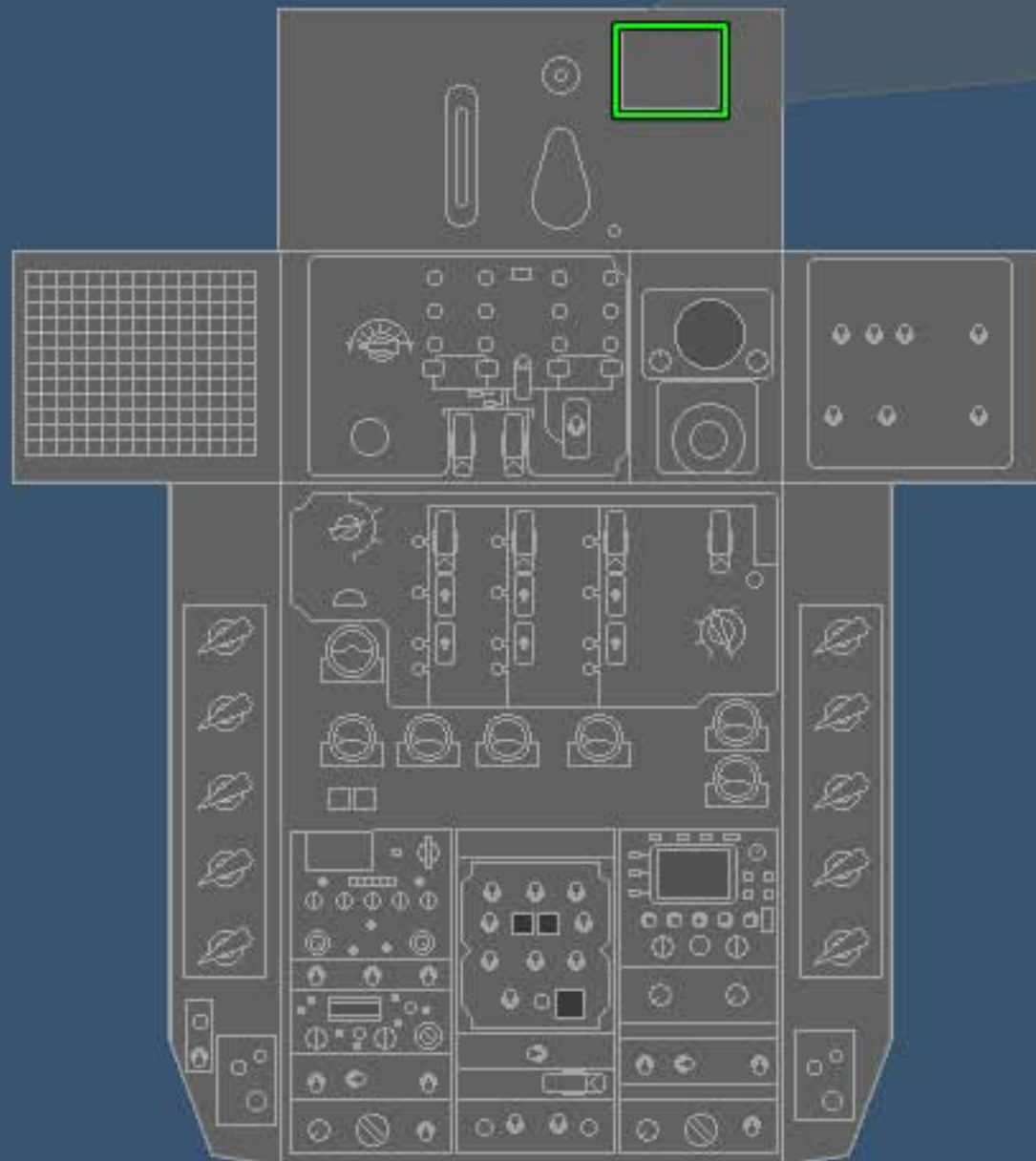
DIFF (differential) TEST:
Keeps a constant differential cabin pressure of approximately 8.6 psi, depending upon airplane altitude.



Before going into the Airplane Fails to Pressurize procedure, we need to introduce one more component: the **CABIN PRESSURE TEST VALVE** handle. This handle controls the cabin pressure controllers with three settings.



CLOSED: Inactivates the automatic **CABIN PRESS CONT**, thereby allowing regulation of the cabin pressure through the **MANUAL PRESSURE CONTROL** only.



Airplane Fails to Pressurize Procedure

So, say you're flying along, and you hear "CABIN ALTITUDE" from the altitude alerter. The alert light is on, and the cabin altitude counter is flashing. Besides making sure you use oxygen (if needed), what should you do?

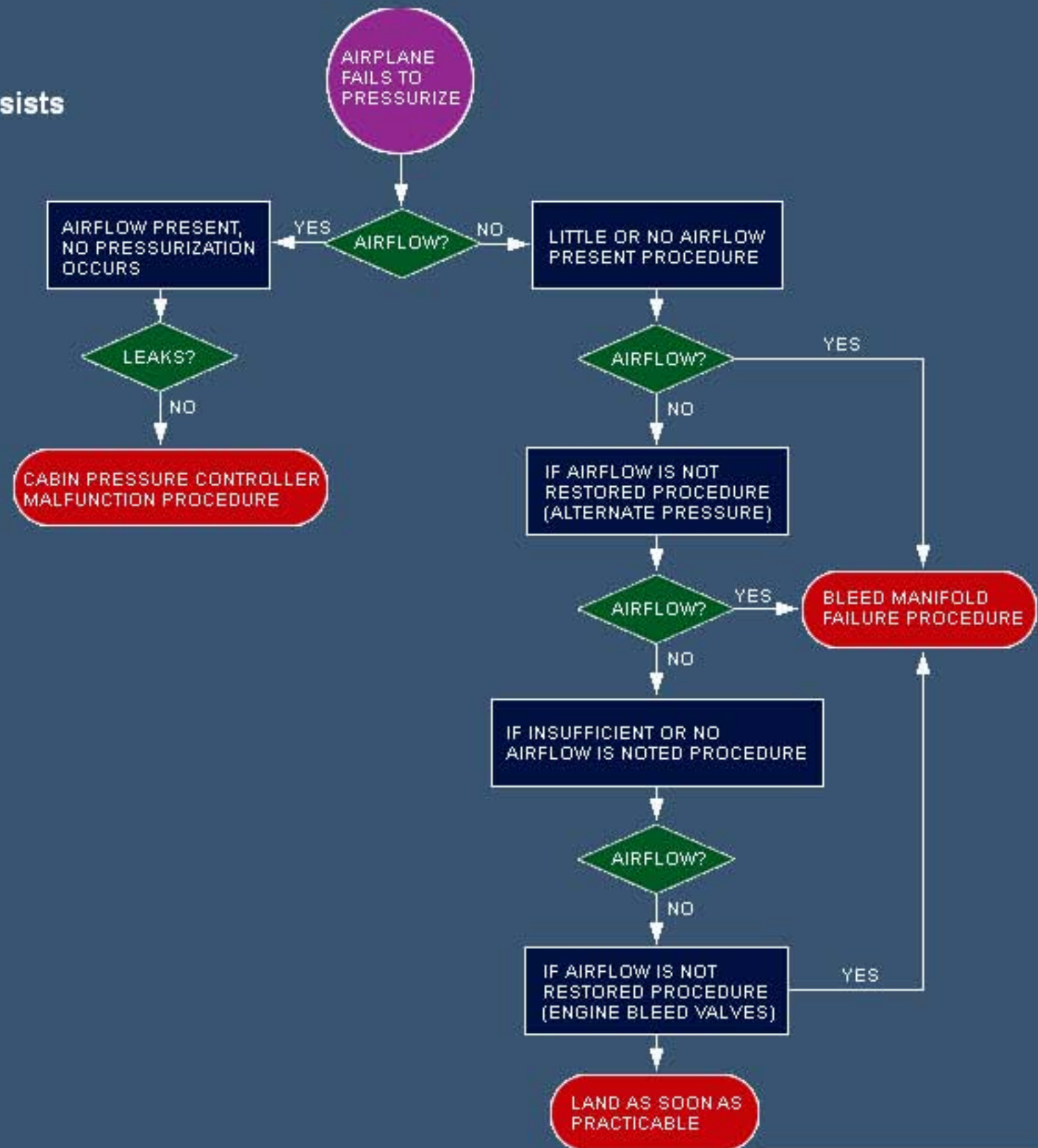
First, you need to determine if there is enough airflow to pressurize the plane. The Airplane Fails to Pressurize procedure troubleshoots the situation.



The Airplane Fails to Pressurize procedure consists of the following parts:

- Little or No Airflow Present
- If Airflow is Not Restored
- If Insufficient or No Airflow is Noted
- If Airflow is Restored
- If Airflow is Not Restored
- Airflow Present, No Pressurization Occurs

These parts of the procedure, which are further explained in the following pages, progress as shown in the flowchart.

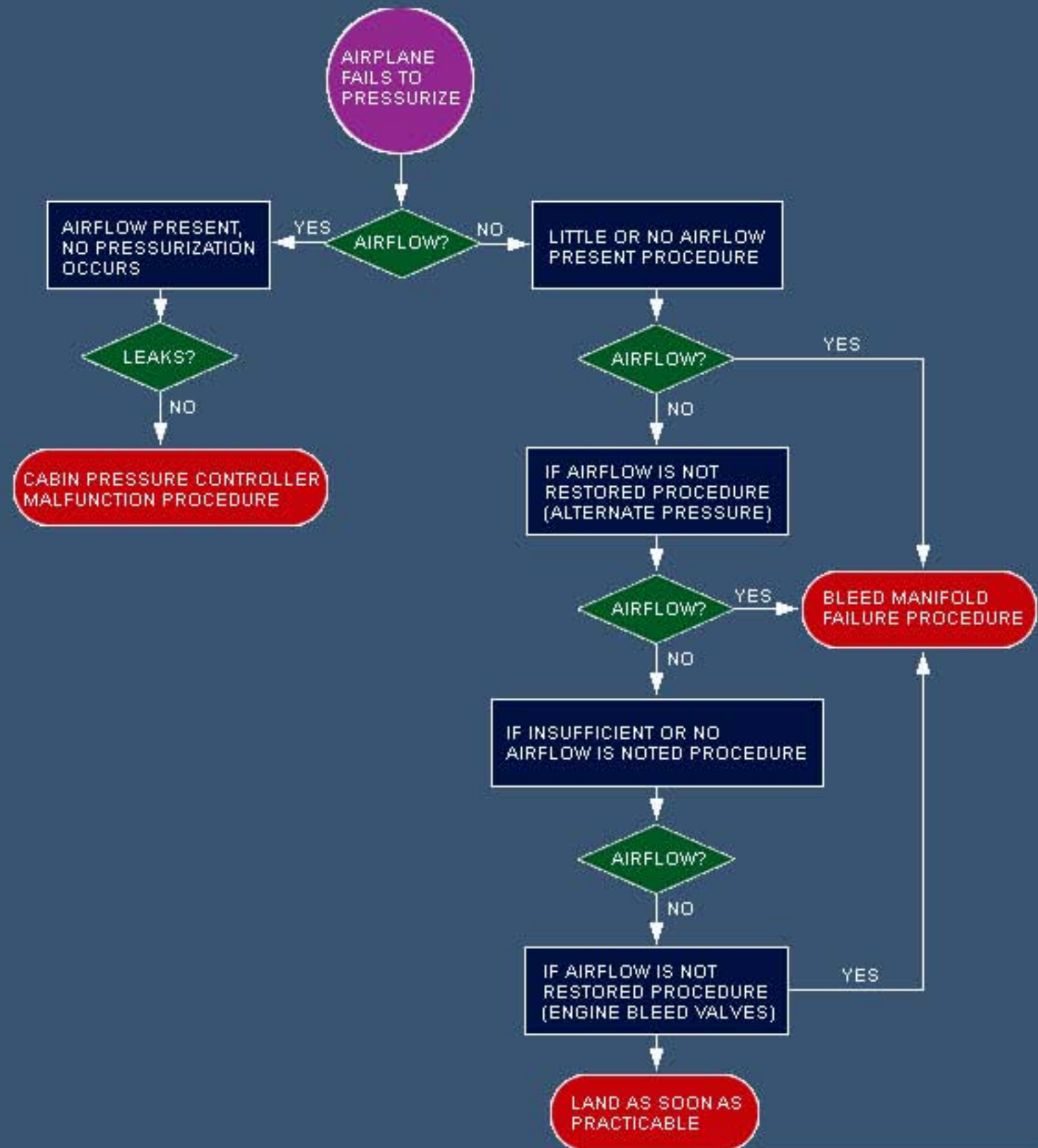


The Airplane Fails to Pressurize procedure incorporates two other procedures: the Bleed Manifold Failure and the Cabin Pressure Controller Malfunction. Both are described later in this lesson.

After restoring airflow, use the Bleed Manifold Failure procedure to determine the cause of the problem.

The Cabin Pressure Controller Malfunction procedure identifies or corrects pressurization issues.

Now we'll begin with the first section of the Airplane Fails to Pressurize procedure.



Little or No Airflow Present

If the airplane is not pressurizing sufficiently, the first step is to determine whether airflow is present. If it is not, the pilot must ensure the following:

1. The MASTER switch is in the COND AIR position.
2. The engine bleed and CROSSOVER valves are in the OPEN positions.
3. The AIR CONDITIONING VALVES circuit breakers are set, with the boom operator's assistance.



If Airflow is Not Restored

If airflow is still insufficient, the pilot continues the Airplane Fails to Pressurize procedure with the following steps:

4. Move the left ALTERNATE PRESSURE switch to the ON position.
5. Move the right ALTERNATE PRESSURE switch to the INCR position until proper airflow is established.

When the alternate pressurization system is used, airflow is felt more quickly in the aft part of the cargo compartment and the boom pod than in the cockpit.



If Insufficient or No Airflow is Noted

As a last step to restore airflow, move the **CROSSOVER VALVE** switch to the **CLOSED** position to separate bleed air between engines 1 and 2 and engines 3 and 4.



The next step depends upon whether airflow is sufficient.

If airflow is sufficient, complete the Bleed Manifold Failure procedure to determine if the problem exists in the left or right half of the manifold. This procedure is discussed on the next page.

If airflow is still not sufficient, close the engine bleed valves and consider landing as soon as practicable.



Bleed Air Manifold Failure Procedure

To determine which side of the bleed (or wing) manifold failed, the copilot positions the switches on the bleed air and air conditioning panel as indicated below (if they aren't there already).

Because we are continuing from the If Insufficient or No Airflow is Noted procedure, the ALTERNATE PRESSURE switches are already positioned as indicated in steps 1 and 2.

1. Move the left ALTERNATE PRESSURE switch to the ON position.
2. Move and hold the right ALTERNATE PRESSURE switch in the INCR position for at least 20 seconds.
3. Move the CROSSOVER VALVE switch to the CLOSED position, if needed. It's already closed for you here.
4. Move the MASTER switch to the OFF position. If airflow stops, the left side failed; if it continues, the right side failed.

Click the switch to complete the procedure.



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3. Move the CROSSOVER VALVE switch to the CLOSED position, if needed. It's already closed for you here.
4. Move the MASTER switch to the OFF position. If airflow stops, the left side failed; if it continues, the right side failed.
5. Close the engine bleed valves on the malfunctioning side of the manifold. (In this case, the left side malfunctioned.)

Click the switches to complete the procedure.



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4. Move the MASTER switch to the OFF position. If airflow stops, the left side failed; if it continues, the right side failed.
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Click the switches to complete the procedure.



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2. Move and hold the right ALTERNATE PRESSURE switch in the INCR position for at least 20 seconds.
3. Move the CROSSOVER VALVE switch to the CLOSED position, if needed. It's already closed for you here.
4. Move the MASTER switch to the OFF position. If airflow stops, the left side failed; if it continues, the right side failed.
5. Close the engine bleed valves on the malfunctioning side of the manifold. (In this case, the left side malfunctioned.)

Subsequent steps depend upon which side of the bleed manifold failed.



Bleed Air Manifold Failure Procedure (continued)

If the left side failed, you would complete the following steps:

1. Move the MASTER switch to the COND AIR position.
2. Move the left ALTERNATE PRESSURE switch to the ON position.
3. Move and hold the right ALTERNATE PRESSURE switch in the DECR position for at least 20 seconds.

This provides pressurization and temperature control to the cockpit, while reducing heat to the cargo compartment and boom pod.



Bleed Air Manifold Failure Procedure (continued)

If the right side failed, shut down the air conditioning pack by moving the MASTER switch to the OFF position.

See the **CAUTION** about failure to close the engine bleed valves on the malfunctioning side of the airplane.

We mentioned the Airplane Fails to Pressurize procedure addresses situations in which airflow is present, but the airplane does not pressurize. We'll return to that part of the procedure now.



Bleed

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CAUTION

- Failure to close the engine bleed valves on the malfunctioning side of the manifold could cause damage to airplane wing components due to escaping bleed air.
- If the crossover valve and engine bleed valves 1 and 2 are closed, set the air conditioning master switch to OFF immediately prior to landing to prevent overheat and possible damage to the air cycle machine.

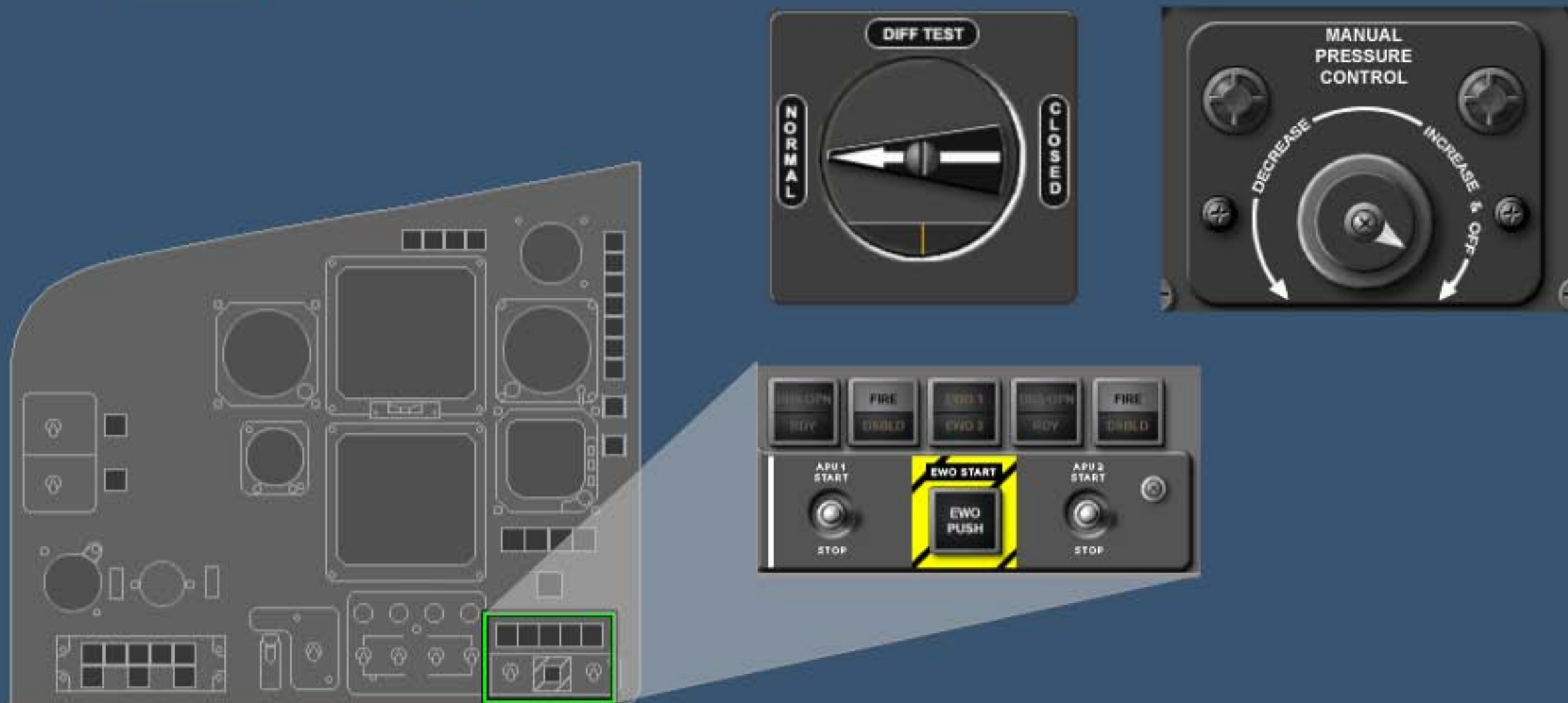


Airflow Present, No Pressurization Occurs

Check for airflow leaks by confirming the following:

1. The CABIN PRESSURE TEST VALVE handle is in the NORMAL position.
2. The MANUAL PRESSURE CONTROL knob is in the INCREASE & OFF position.
3. All hatches and APU exhaust doors are closed.

See this **WARNING** about checking hatches while in flight.



Airflo

Check

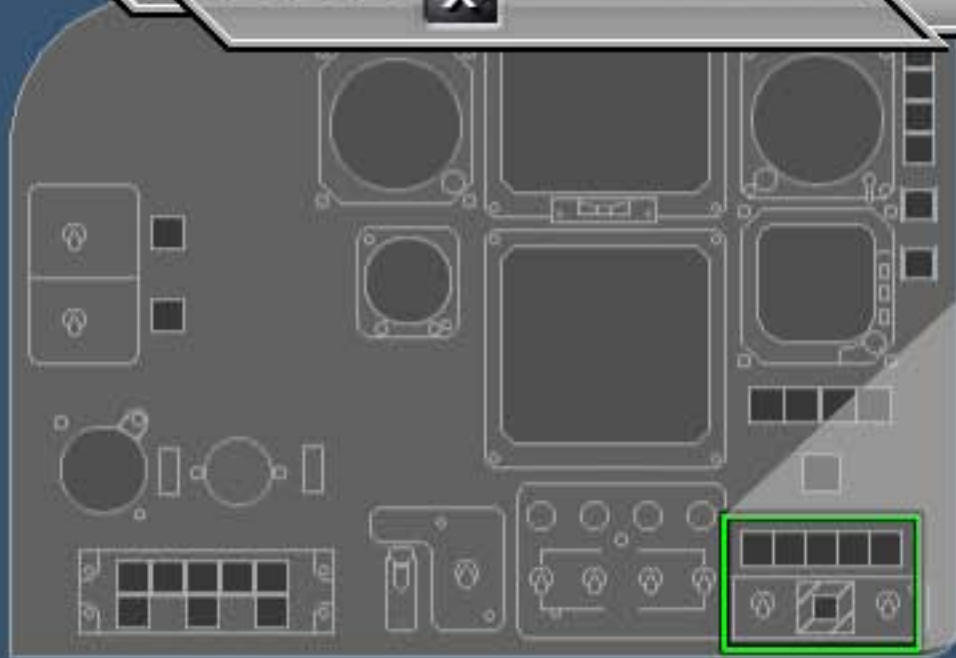
- 1. The
- 2. The
- 3. All

See th

WARNING

When checking or reinstalling hatches in flight, the crewmember making the check shall wear a parachute or restraint harness (if installed) and helmet (if available).

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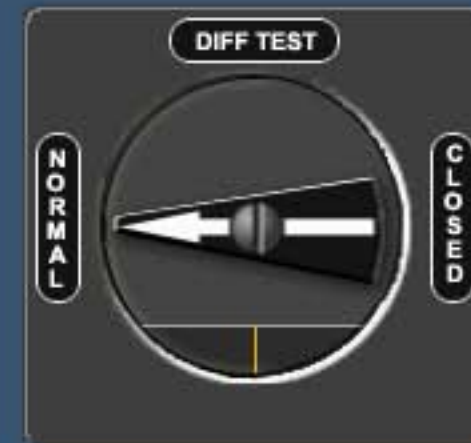
Cabin Pressure Controller Malfunction

If no leaks are evident, determine if the automatic cabin pressure controller is malfunctioning by completing the steps outlined below.

Complete steps that involve the **CABIN PRESSURE TEST VALVE** and the **MANUAL PRESSURE CONTROL**, as directed.

1. All crewmembers must put on oxygen masks.
2. Move the **CABIN PRESSURE TEST VALVE** handle to the **CLOSED** position.

When the pressure decreases, or after 30 seconds, move the same handle to the **NORMAL** position. (For our purposes, pressure decreased immediately after moving the handle to the **CLOSED** position.)



Cabin Pressure Controller Malfunction

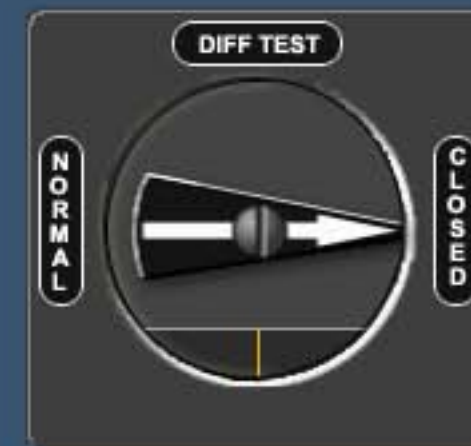
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1. All crewmembers must put on oxygen masks.
2. Move the CABIN PRESSURE TEST VALVE handle to the CLOSED position.

When the pressure decreases, or after 30 seconds, move the same handle to the NORMAL position. (For our purposes, pressure decreased immediately after moving the handle to the CLOSED position.)

See this **NOTE** about what not to do if cabin altitude does not decrease after the CABIN PRESSURE TEST VALVE is in the CLOSED position for 30 seconds.



Cabin

If no inflow
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TEST
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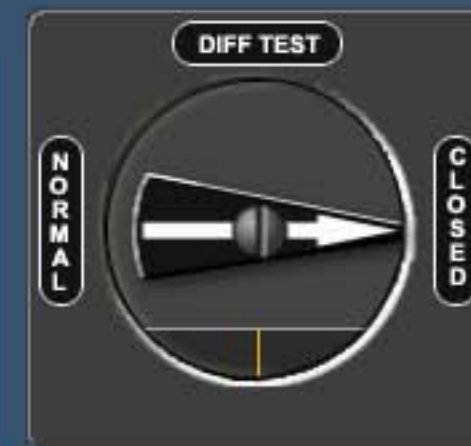
1. All
- 2.

NOTE: (Cabin pressure decreased immediately after moving the handle to the CLOSED position.)

See this [NOTE](#) about what not to do if cabin altitude does not decrease after the CABIN PRESSURE TEST VALVE is in the CLOSED position for 30 seconds.

NOTE

If the cabin altitude does not decrease with the test valve handle in the CLOSED position, subsequent use of the manual pressure control will not improve cabin pressurization. Rotation of the control toward DECREASE will probably cause a substantial loss of existing pressurization. If more inflow is not available, the only option is to descend to an appropriate lower altitude.

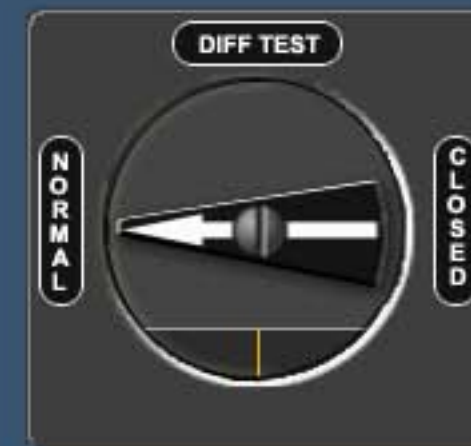


Cabin Pressure Controller Malfunction

If no leaks are evident, determine if the automatic cabin pressure controller is malfunctioning by completing the steps outlined below.

Complete steps that involve the **CABIN PRESSURE TEST VALVE** and the **MANUAL PRESSURE CONTROL**, as directed.

3. If pressure decreased while the **CABIN PRESSURE TEST VALVE** handle was in the **CLOSED** position, rotate the **MANUAL PRESSURE CONTROL** knob toward the **DECREASE** position until the device controls cabin pressure, or until you reach the full **DECREASE** position.

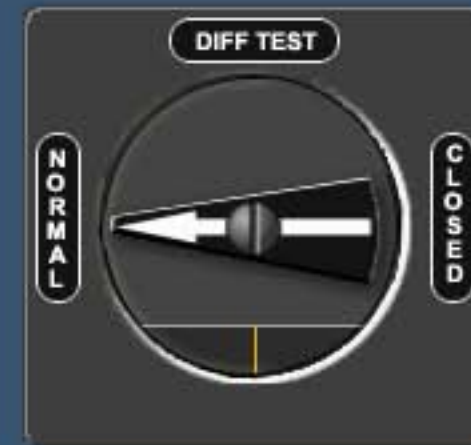


Cabin Pressure Controller Malfunction

If no leaks are evident, determine if the automatic cabin pressure controller is malfunctioning by completing the steps outlined below.

Complete steps that involve the **CABIN PRESSURE TEST VALVE** and the **MANUAL PRESSURE CONTROL**, as directed.

4. Move the **CABIN PRESSURE TEST VALVE** handle back to the **CLOSED** position.



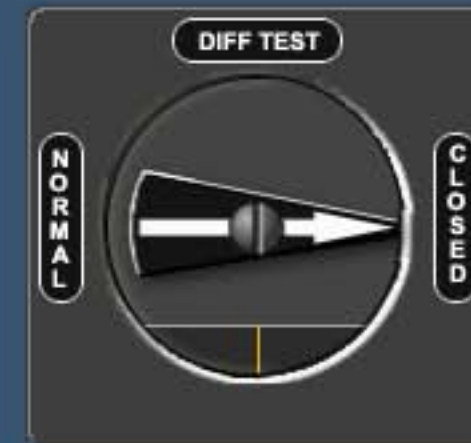
Cabin Pressure Controller Malfunction

If no leaks are evident, determine if the automatic cabin pressure controller is malfunctioning by completing the steps outlined below.

Complete steps that involve the **CABIN PRESSURE TEST VALVE** and the **MANUAL PRESSURE CONTROL**, as directed.

5. Set the **MANUAL PRESSURE CONTROL** knob to the desired cabin altitude in approximately five-degree increments.

For our purposes, click the knob one more time to move it to the **INCREASE** position.



Cabin Pressure Controller Malfunction

If no leaks are evident, determine if the automatic cabin pressure controller is malfunctioning by completing the steps outlined below.

Complete steps that involve the CABIN PRESSURE TEST VALVE and the MANUAL PRESSURE CONTROL, as directed.

5. Set the MANUAL PRESSURE CONTROL knob to the desired cabin altitude in approximately five-degree increments.



We'll wrap up this lesson with a couple of questions.

When cabin altitude is above 10,000 feet, what aural warning does the altitude alerter issue?

Select the best answer.

- a. ALTITUDE
- b. PNEUMATICS
- c. CABIN ALTITUDE
- d. PRESSURIZATION



We'll wrap up this lesson with a couple of questions.

When cabin altitude is above 10,000 feet, what aural warning does the altitude alerter issue?

- a. ALTITUDE
- b. PNEUMATICS
- c. CABIN ALTITUDE**
- d. PRESSURIZATION



Click Here To Move

That's right. The altitude alerter notifies you cabin pressure is above 10,000 with an aural warning of "CABIN ALTITUDE."

We'll wrap up this lesson with a couple of questions.

When cabin altitude is above 10,000 feet, what aural warning does the altitude alerter issue?

- a. ALTITUDE
- b. PNEUMATICS
- c. CABIN ALTITUDE
- d. PRESSURIZATION



Click Here To Move

The correct answer is "c." The altitude alerter notifies you cabin pressure is above 10,000 with an aural warning of "CABIN ALTITUDE."

As mentioned in the Cabin Pressure Controller Malfunction procedure, if the cabin pressure controller fails, use the _____ to maintain cabin pressure.

Select the best answer.

- a. cabin pressure selector valve
- b. air conditioning MASTER switch
- c. cabin TEMPERATURE CONTROL knob
- d. MANUAL PRESSURE CONTROL knob



As mentioned in the Cabin Pressure Controller Malfunction procedure, if the cabin pressure controller fails, use the _____ to maintain cabin pressure.

- a. cabin pressure selector valve
- b. air conditioning MASTER switch
- c. cabin TEMPERATURE CONTROL knob
- d. MANUAL PRESSURE CONTROL knob**

Click Here To Move

Correct. If the cabin pressure controller fails to automatically control cabin pressure, use the **MANUAL PRESSURE CONTROL knob** to control cabin pressure.



As mentioned in the Cabin Pressure Controller Malfunction procedure, if the cabin pressure controller fails, use the _____ to maintain cabin pressure.

- a. cabin pressure selector valve
- b. air conditioning MASTER switch
- c. cabin TEMPERATURE CONTROL knob
- d. MANUAL PRESSURE CONTROL knob

Click Here To Move

The correct answer is "d." Use the MANUAL PRESSURE CONTROL knob to control pressure when it is no longer automatically controlled through the cabin pressure controller.

