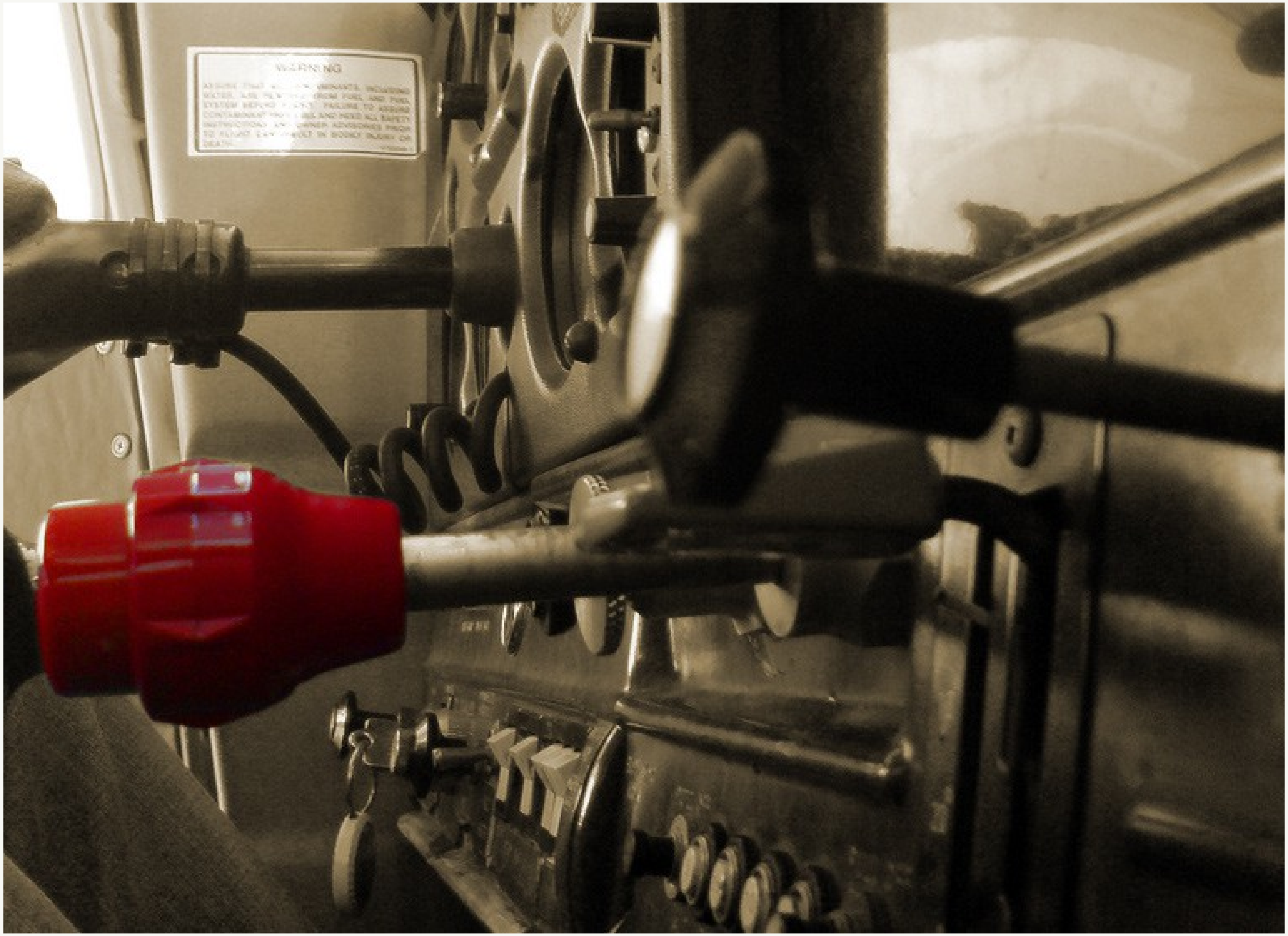
Ex. 3 – Ancillary Controls



What you will learn

The purpose and operation of:

- carburetor heat control
- mixture control
- cabin heat, cabin air, overhead vents.

Why learn all this?

Does “secondary” stuff matter?

- ✓ Ancillary controls are a vital part of the aircraft systems
- ✓ You need to know how they work to make sure your flights are safe, comfortable and not stressing out the plane
- ✓ Not understanding how these controls work can lead to a system malfunction and even engine failure.

Links

- ✓ You already had a chance to operate the primary controls and are developing an understanding of how they work
- ✓ Today you will learn about function and operation of ancillary controls and how to use them in different in-flight situations.

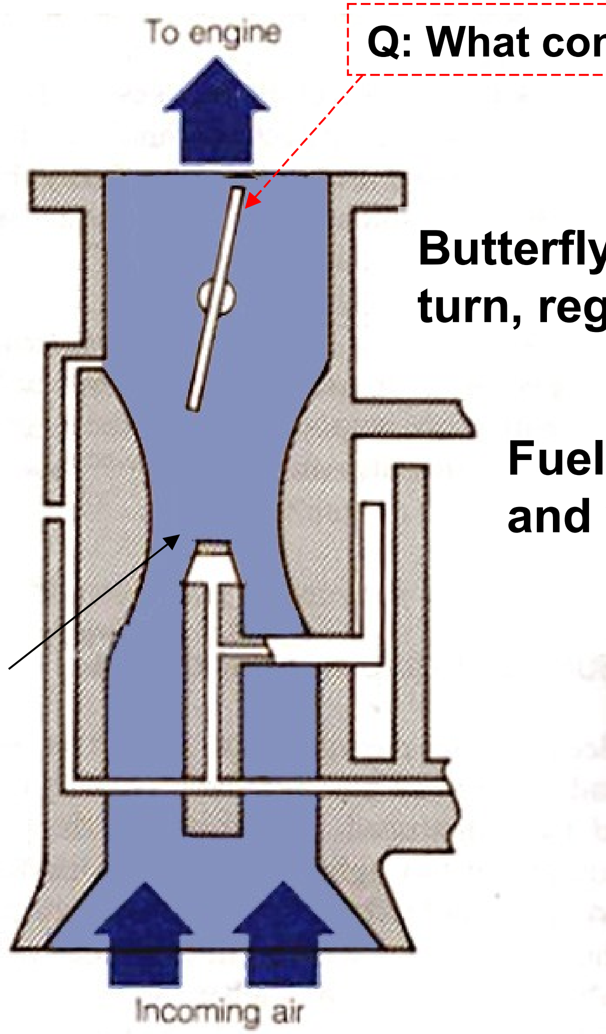
Let's see how much you already know:

- What type of engine does the plane you fly have? How does it work?
- What does fuel have to be mixed with before it can be burned in the cylinders?
- What device regulates the flow of the air-fuel mixture to the engine?
- What factors does air density depend on?
- What is Dew Point?

Carburetor Heat Control

- ✓ How The Carburetor Works
- ✓ How Carburetor Ice Forms
- ✓ Conditions Causing Carburetor Ice
- ✓ How Carburetor Heat Works
  - to prevent carb ice from forming
  - to melt carb ice
- ✓ Carburetor Heat Effects
- ✓ Carburetor Heat Considerations

How Carburetor Works



Q: What controls the butterfly valve?

Butterfly valve can open turn, regulating the flow

Creates area of low pressure

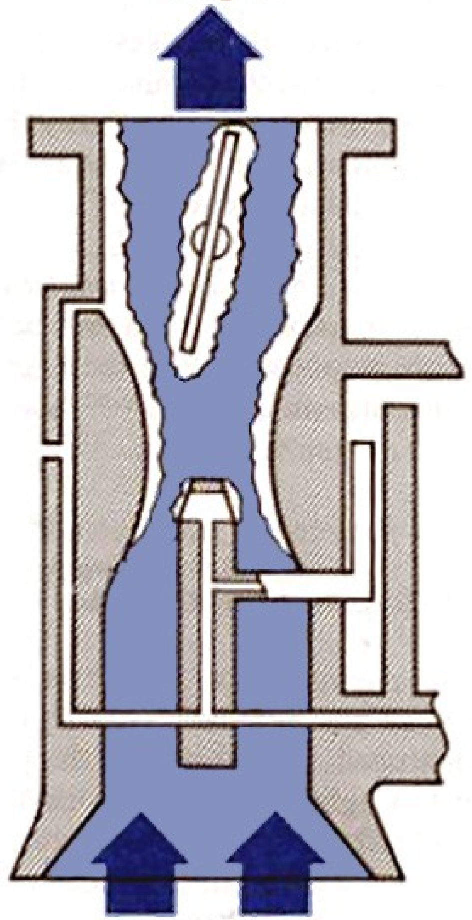
Fuel is drawn into carburetor and vaporized

Accelerates

Passes through venturi (narrow tube)

Outside air enters here

How Carburetor Ice Forms



- Air in the carburetor is cooled by:
  - fuel vaporization
  - decrease in pressure

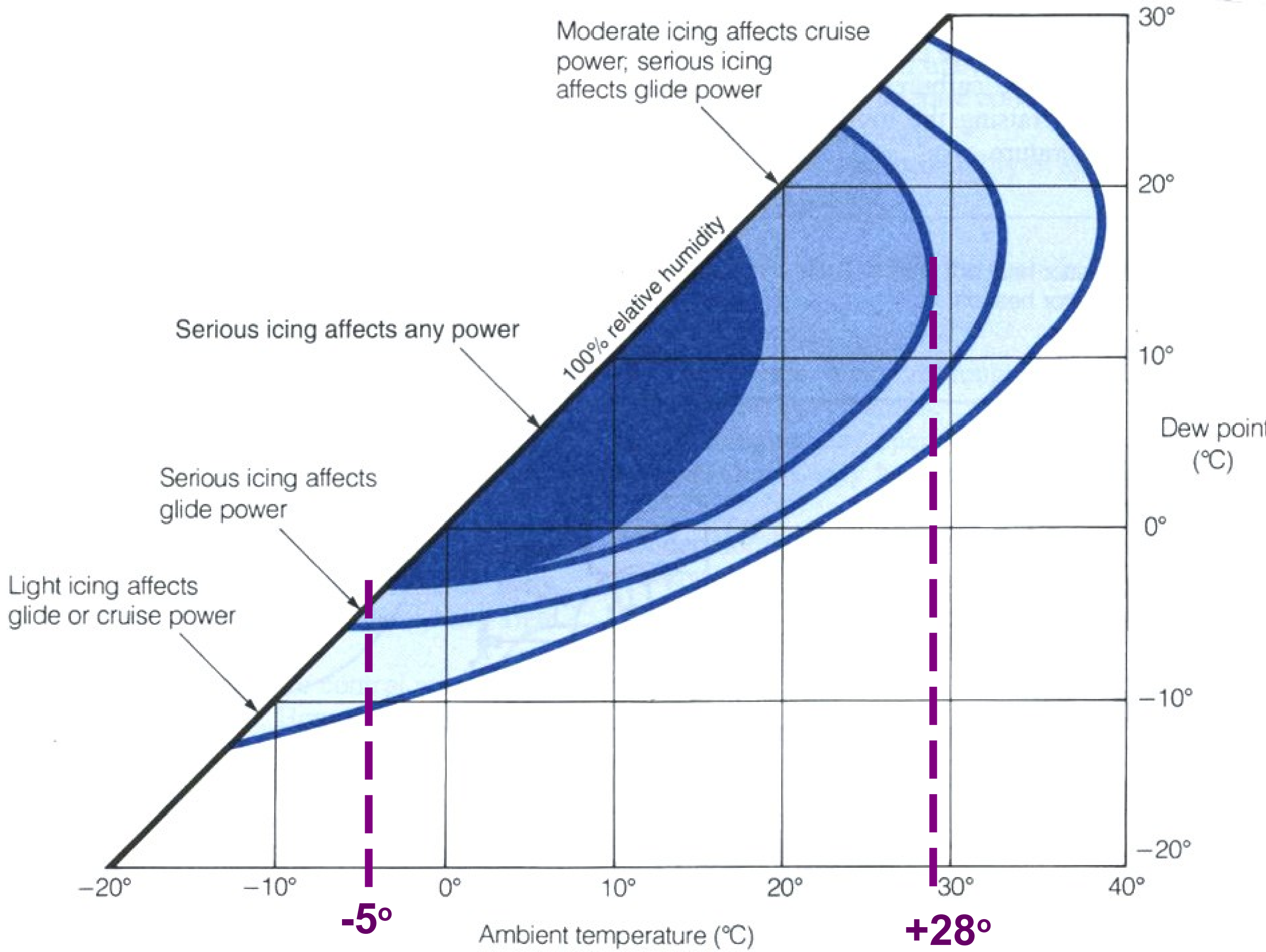
Why?

- If temperature drops enough and moisture is present, ice may form
- Ice build-up may constrict or block the opening causing:
  - drop in rpm
  - rough-running engine
  - complete engine failure!

Conditions Causing Carburetor Ice

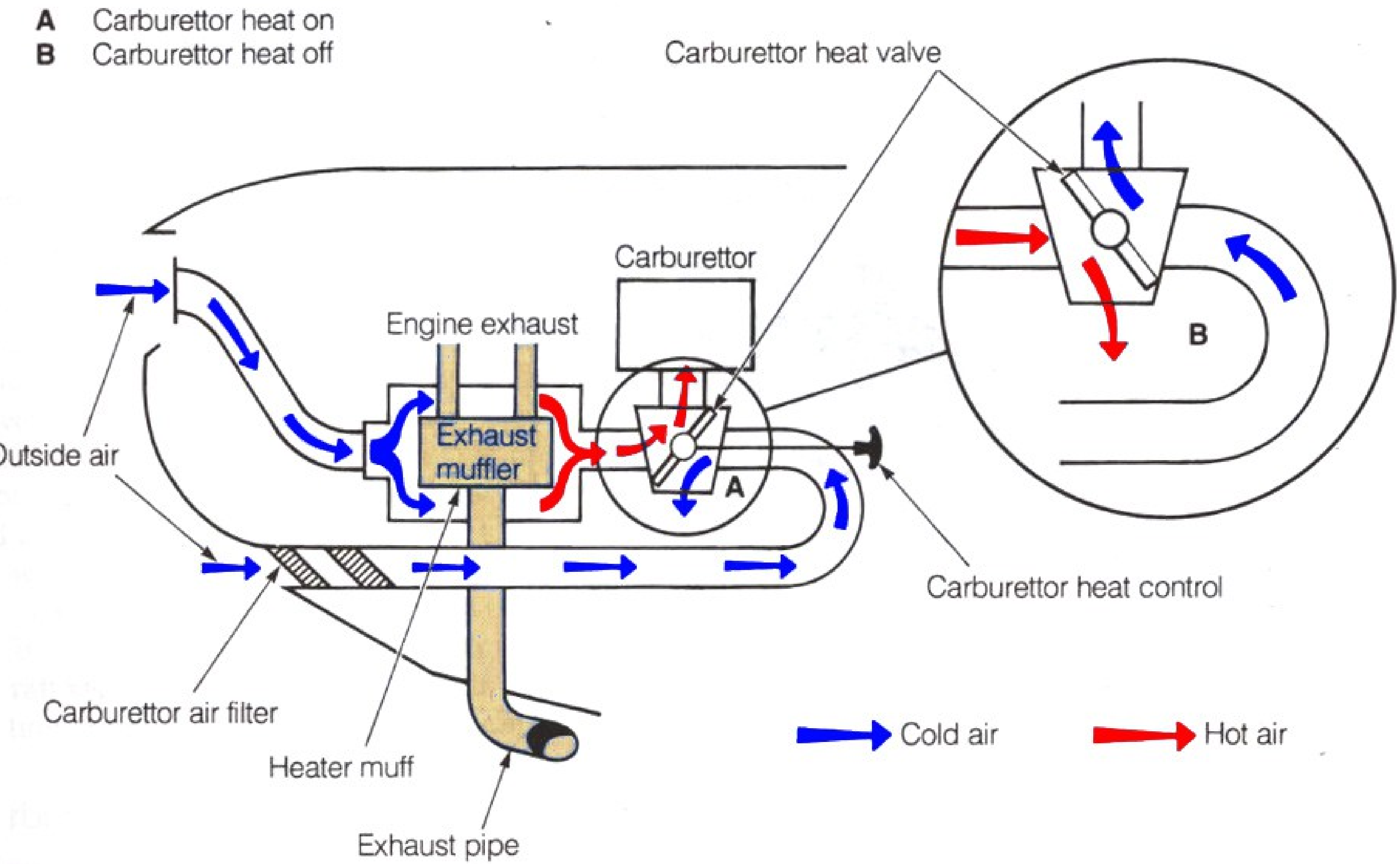
- Carb ice can happen in a wide range of temperatures
- Icing affecting cruise power is most likely to occur in the -5° to +25-30° range
- Most severe icing occurs in the -5° to +15°.

Why?



How Carburetor Heat Works

To melt ice and prevent more from forming, carburetor heat may be applied



To prevent carb ice from forming:

- ✓ Check for carb ice before take-off and periodically in cruise
- ✓ Apply carb heat when operating when operating at low power (outside of tachometer green arc) **Why?**
- ✓ "Clear" the engine during long low-power descents by applying power periodically, because carb heat loses effectiveness when the engine is at low rpm **Why?**

To melt carb ice:

What are the signs?

- ✓ At first signs of carb ice, apply full carb heat
  - important to detect carb ice early

    Why?
  - engine will run rougher at first and rpm may drop as water and ice chunks are ingested by the engine
- ✓ If carb ice persists after a period of full heat, add power smoothly
- ✓ During descents, periodically apply sufficient power to maintain carb heat effectiveness
- ✓ Leave carb heat on until ice is fully melted.

Carburetor Heat Effects

- ✓ Fuel-air mixture heats up
- ✓ Unfiltered air enters the engine
  - another use for carb heat: alternate air supply for engine, if engine filter is blocked
- ✓ Air-fuel mixture gets richer (more fuel in air, by mass)
- ✓ Engine power drops. **Why?**

Carburetor Heat Considerations

- ✓ Do not use carb heat for take-off or at high power setting **Why?**
- ✓ Minimize use of carb heat on the ground **Why?**
- ✓ Avoid using partial carb heat (unless carb air temp gauge is installed) **Why?**
- ✓ When ice crystals are likely to be present, avoid carb heat use **Why?**

When is that?

Mixture Control

- ✓ Why Have Mixture Control
- ✓ Mixture vs. Air Density
- ✓ Mixture Control Operation
- ✓ Importance of Proper Mixture.

Why Have Mixture Control

- ✓ Engine needs air mixed in to be able to burn fuel
- ✓ The engine has optimal air-to-fuel ratio (by mass) that allows for:
  - best engine performance
  - less spark plug fouling by products of incomplete combustion
- ✓ At different altitudes (and at different temperature and pressure settings), the amount of air (by mass) that goes into the cylinders will be different
- ✓ Mixture control allows pilot to regulate the amount of fuel going into the carburetor to match air density.

Mixture vs. Air Density

- ✓ Less the density of the air ➔ less weight per volume ➔ leaner mixture required

- ✓ Therefore, leaner mixture is required for:
  - higher altitudes (lower pressure ➔ less dense air)
  - hotter air (less dense than cold air)
  - more humid air (less dense than dry air).

Mixture Control - Operation

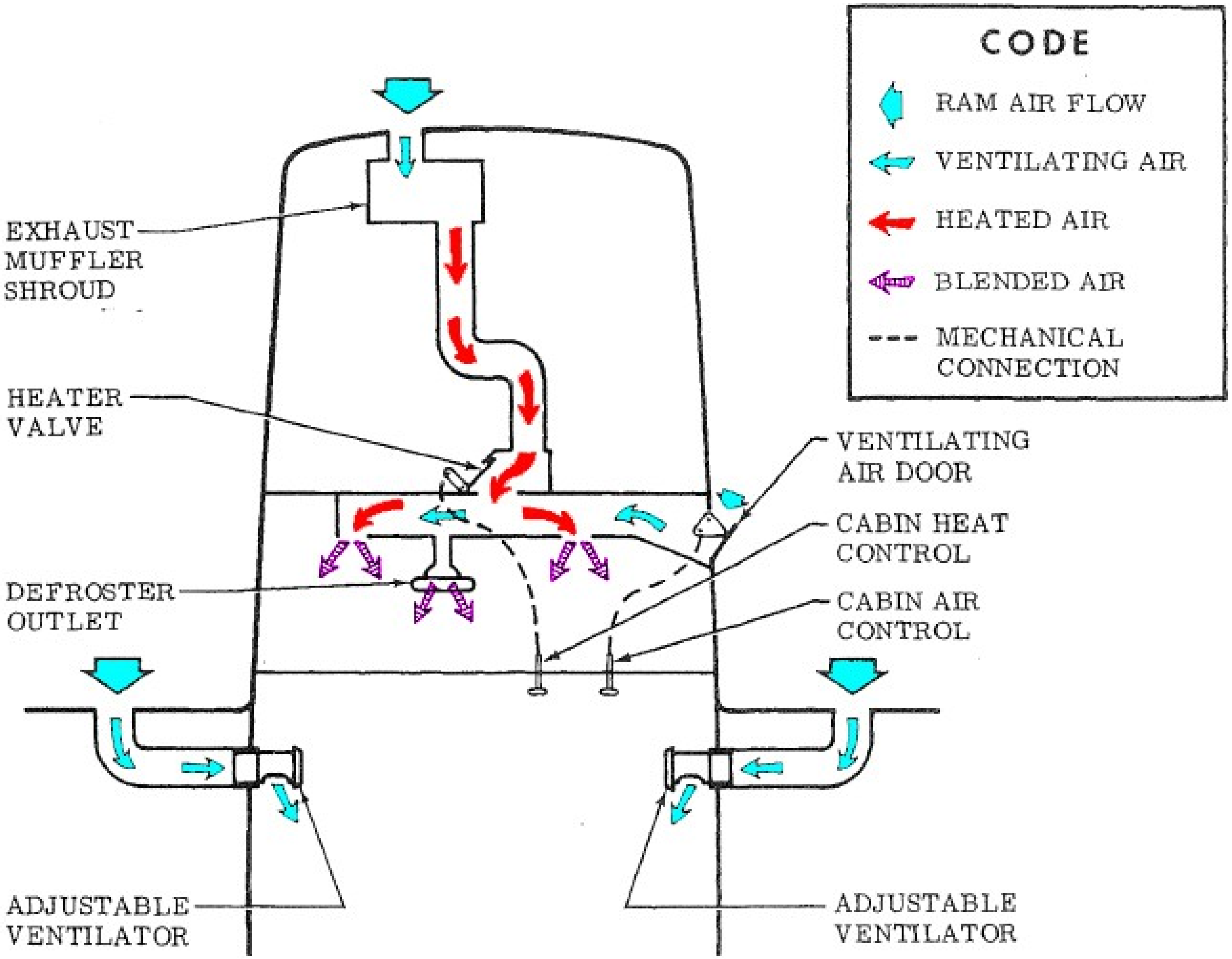
- Taxi: lean mixture as per checklist
  - reduces plug fouling, slight fuel savings
- Take-off and climb: full rich mixture
  - helps cool the engine (engine runs cooler on rich mixture due to cool unburned fuel)
  - exception: high-altitude airports
- Cruise: lean mixture as appropriate for altitude **How?**
  - reduces plug fouling, improves engine performance, saves fuel
  - the higher the altitude, the more leaning is necessary
- Descent: rich mixture **Why?**
  - richer mixture is required at lower altitudes
  - enrich mixture gradually on long descents (to prevent excessive cooling)

Importance of Proper Mixture

- Mixture **too rich** may have these effects:
  - engine not developing full power
  - fuel is wasted
  - range is reduced
  - excessive engine cooling
  - spark plug fouling

- Mixture too lean may lead to:
  - loss of power
  - rough-running engine
  - excessive engine heat
  - detonation

Cabin Air, Cabin Heat, Vents



Review

- At what temperature range is serious icing likely to occur?
- What effect does using carb heat have on mixture?
- How can mixture control be used to improve engine performance when carb heat is on?

Conclusion

- ✓ Now you know how to operate carb heat and mixture controls to achieve safe and efficient flight in various configurations
- ✓ These procedures will be demonstrated and practiced throughout your training

QUESTIONS?