# Weather Theory

Air masses, pressure systems and fronts · from the FAA-H-8083-28B Aviation Weather Handbook FAA GUIDANCE

**Study route:** the cards (pp. 2–10), then the four fronts side by side (p. 11), then recall from memory (p. 12), then Apply it (pp. 13–14). Sources: p. 15.

## What a front is

- A front is a boundary or transition zone between two air masses. Cold and warm fronts are classified by which air mass is replacing the other.
- At the surface, a front is usually detectable three ways: a significant temperature difference across it, winds that usually converge on it, and pressure that typically falls as it approaches and rises after it passes.
- A front is not vertical: it slopes over the colder, denser air.

## On the surface chart


Redrawn from FAA-H-8083-28B, Figure 27-25

On a surface chart, the symbols on a front show its type and point the way it is moving.

**Stationary or occluded?** TECHNIQUE Both alternate triangles and half-circles. On a stationary front they sit on OPPOSITE sides of the line, in two colours; on an occluded front, on the SAME side, in one colour. The handbook shows this in its drawings (Figures 11-4 and 27-25), not in its text.

**Not specified** Not specified means the cited handbook section does not give that detail. It never means no weather or no hazard.

### Typical is not guaranteed TECHNIQUE

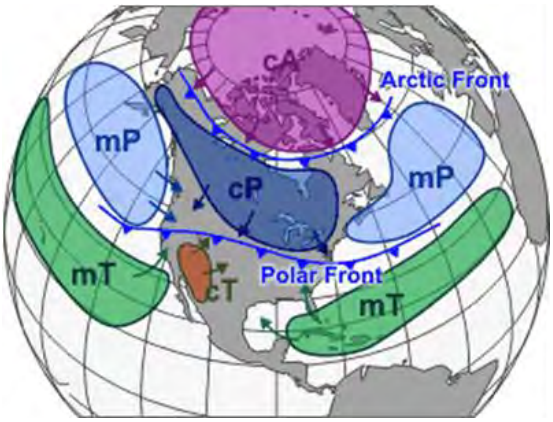
The handbook describes its fronts in hedged words — typically, usually, may, if the warm rising air is unstable. Read every card with those words still attached: a card says what to look for, not what will happen. Brief the actual weather before you fly.

Every front card follows the same order: what it is, a figure, and its key numbers. Then the cold and warm cards show before, during and after; the stationary and occluded cards show what to expect, because the handbook gives no before/during/after passage breakdown for them. Every card ends with its pilot hazards (any exception first) and one source line.

Source: AWH 11.3, pp. 11-4, 11-5 · 25.2.2.1.3, p. 25-6 · chart symbols redrawn from Figure 27-25

# Air masses

**ACS PA.I.C.K3e** · Source regions, the air-mass code, and air-mass modification FAA GUIDANCE




FAA-H-8083-28B, Figure 11-1 (cropped)

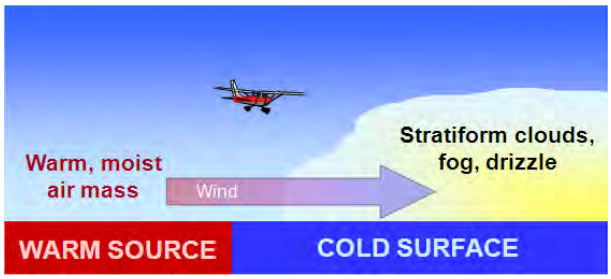
An air mass forms over a source region. The longer it stays there, the more likely it is to acquire the properties of the surface below.

**Read the code: small letter = moisture, capital letter = temperature.**

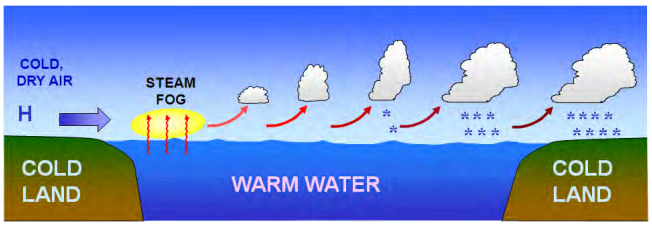
| | **Continental (c)** — over land, dry | **Maritime (m)** — over water, moist |
|---|---|---|
| **Arctic (A)**<br>Extremely deep and cold; forms mostly in winter over ice and snow. | **cA Continental Arctic**<br>Cold, dry. | **mA**<br>There is no maritime Arctic (mA) on the list: it seldom, if ever, forms. |
| **Polar (P)**<br>Relatively shallow, cool to cold; forms over high latitudes. | **cP Continental Polar**<br>Cold, dry. | **mP Maritime Polar**<br>Cool, moist. |
| **Tropical (T)**<br>Warm to hot; forms over low latitudes. | **cT Continental Tropical**<br>Hot, dry. | **mT Maritime Tropical**<br>Warm, moist. |

## How an air mass changes as it moves

- Warm, moist air moving over a cold surface becomes stable: stratiform clouds, fog and drizzle.
- Lake effect: in autumn and winter, cold, dry, stable polar air flowing over relatively warm lake water is heated and moistened, and stability decreases. Cumuliform clouds and showers often develop in bands over, and to the lee of, large, ice-free lakes.
- Air masses change as they travel: in winter, an arctic air mass can move over the ocean, picking up some warmth and moisture and becoming a maritime polar (mP) air mass.




FAA-H-8083-28B, Figure 11-2

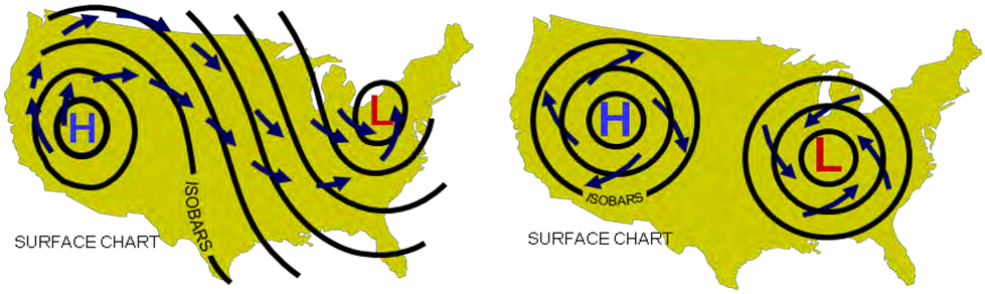



FAA-H-8083-28B, Figure 11-3

Source: AWH 11.2, 11.2.1, 11.2.1.1, 11.2.1.2, 11.2.1.3, p. 11-2 · 11.2.2, p. 11-3 · 11.2.2.1, p. 11-4 · Figures 11-1, 11-2, 11-3

# Pressure systems

**ACS PA.I.C.K3b** · Highs, lows, troughs, ridges and the isobars between them FAA GUIDANCE

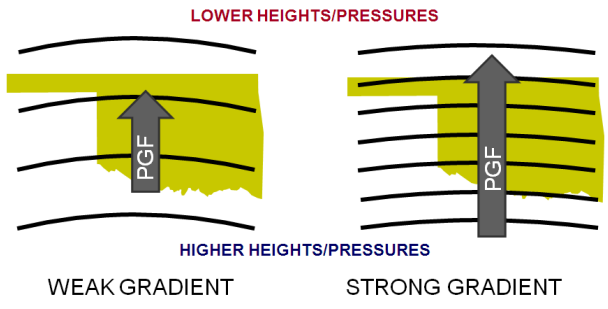



FAA-H-8083-28B, Figure 10-11

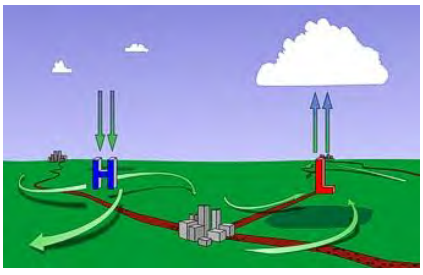
| | High | Low | Trough | Ridge |
|---|---|---|---|---|
| **What it is** | A maximum of pressure: closed isobars on a surface chart. Also called an anticyclone. | A minimum of pressure: closed isobars on a surface chart. Also called a cyclone. | An elongated area of relatively low pressure. | An elongated area of relatively high pressure. |
| **Surface wind** | Northern Hemisphere: surface wind spirals clockwise and outward. | Northern Hemisphere: surface wind spirals counterclockwise and inward. | Winds converge around surface troughs. | *Not specified* |
| **Weather** | At the surface: winds diverge, so air sinks, compresses and warms, which favors the dissipation of clouds and precipitation. | At the surface: winds converge, so air rises, expands and cools, which favors the formation of clouds and precipitation given sufficient moisture. | Typically associated with clouds and precipitation. | Typically associated with fair weather, except in winter when valley fog may occur. |

## Reading the isobars

- Read wind speed from isobar spacing: closely spaced means strong wind, widely spaced means lighter wind.
- Surface wind does not follow the isobars. Friction slows the wind, so Coriolis force weakens and the stronger pressure gradient force turns the wind across the isobars toward lower pressure: about 10° over water, as much as 45° over rugged terrain.




FAA-H-8083-28B, Figure 10-2



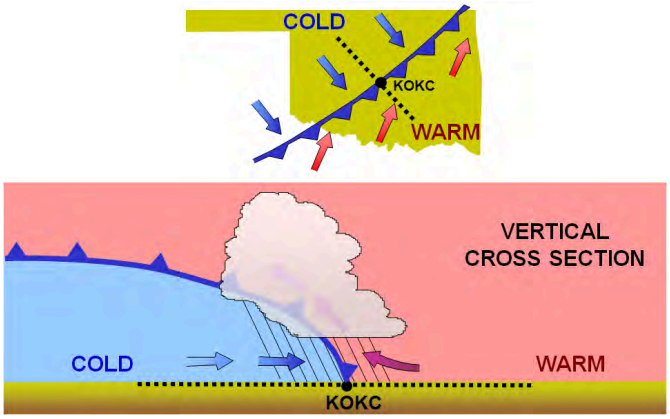

FAA-H-8083-28B, Figure 12-5

Source: AWH Table 25-2, p. 25-7 · 10.5, p. 10-7 · 12.4.2, p. 12-6 · 22.2, p. 22-2 · 25.3.1.1, p. 25-20 · 10.3.1, p. 10-2 · Figures 10-11, 12-5, 10-2

# Cold front

**ACS PA.I.C.K3e** · Front 1 of 4 · before, during and after passage FAA GUIDANCE

Cold, dense, stable air advances and replaces warmer air, sliding under it like a snowplow.




FAA-H-8083-28B, Figure 11-6

**Speed:** 25–30 mph; extreme fronts up to 60 mph.

**Slope:** Steep. Warm air is forced upward abruptly.

**Where the weather sits:** A narrow band along, or just ahead of, the front, if the warm rising air is unstable.

| | Before | During | After |
|---|---|---|---|
| **Clouds and precipitation** | Cirriform or towering cumulus; cumulonimbus may develop. Rain showers may develop. | Towering cumulus or cumulonimbus dominate the sky. Depending on the intensity of the front: heavy rain showers, which may be accompanied by lightning, thunder and/or hail. | Towering cumulus and cumulonimbus dissipate to cumulus. Precipitation decreases. |
| **Visibility and wind** | *Not specified* | Poor visibility. Variable, gusty wind. | Good visibility, eventually. Wind typically from the west-northwest. |
| **Temperature and dewpoint** | High dewpoint. | Temperature and dewpoint drop rapidly. | Remains cooler. |
| **Pressure** | Falling. | Bottoms out, then begins a gradual increase. | Continues to rise. |

## Pilot hazards — and the exception

**Exception** If the warm air being overtaken is relatively stable, overcast skies and rain may continue for some distance behind the front.

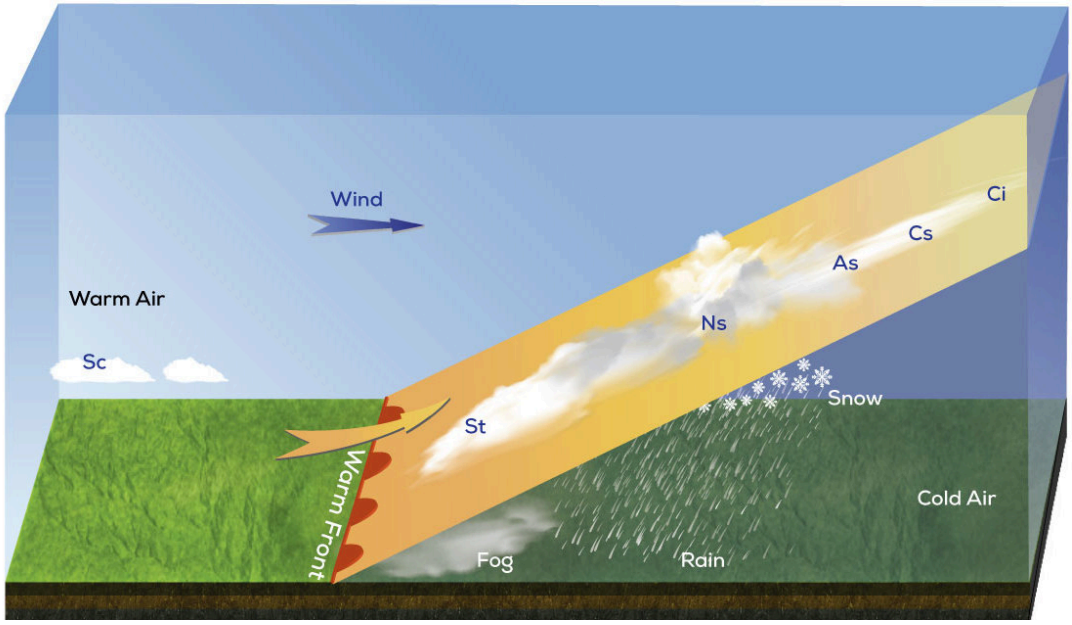
- A squall line, a continuous line of thunderstorms, may form along or ahead of the front. Squall-line storms are intense and move quickly.
- Heavy rain showers at passage, which may be accompanied by lightning, thunder and/or hail. More severe cold fronts can also produce tornadoes.
- Behind a fast-moving front the skies usually clear rapidly, but it leaves behind gusty, turbulent winds and colder temperatures.

Source: AWH 11.3.2, p. 11-6 · Figure 11-6

# Warm front

**ACS PA.I.C.K3e** · Front 2 of 4 · before, during and after passage FAA GUIDANCE

Warm air advances and replaces colder air, sliding up over the top of it.




"Cross section through a warm front (cropped)" by Kh1604, Wikimedia Commons (a crop of Kh1604's "Cross section through a cold front and warm front"), CC BY-SA 4.0 (creativecommons.org/licenses/by-sa/4.0). Km scale and distance bar removed by RunupLab; this cropped version is licensed CC BY-SA 4.0.

**Reading the picture** TECHNIQUE Schematic, not to scale.

**Speed:** Slow: typically 10–25 mph.

**Slope:** Typically gentle. Warm air rises gradually along it.

**Where the weather sits:** Widespread, along and ahead of the front, if the warm rising air is stable.

| | Before | During | After |
|---|---|---|---|
| **Clouds and precipitation** | Cirriform or stratiform clouds, with fog; cumulonimbus likely in summer. Light to moderate rain, sleet, snow or drizzle. | Stratiform clouds. Drizzle may be falling. | Stratocumulus predominate. Rain showers possible. |
| **Visibility and wind** | Poor visibility. Wind typically from the south-southeast. | Visibility generally poor, but improving. Variable wind. | Visibility improves eventually; may stay hazy for a short period. Wind typically from the south-southwest. |
| **Temperature and dewpoint** | Cool or cold; dewpoint increasing. | Rises steadily; dewpoint mostly steady. | Warming; dewpoint rises, then levels off. |
| **Pressure** | Falls until the front passes. | Levels off. | A slight rise, then a decrease. |

## Pilot hazards — and the exception

**Exception** In summer, thunderstorms are likely.

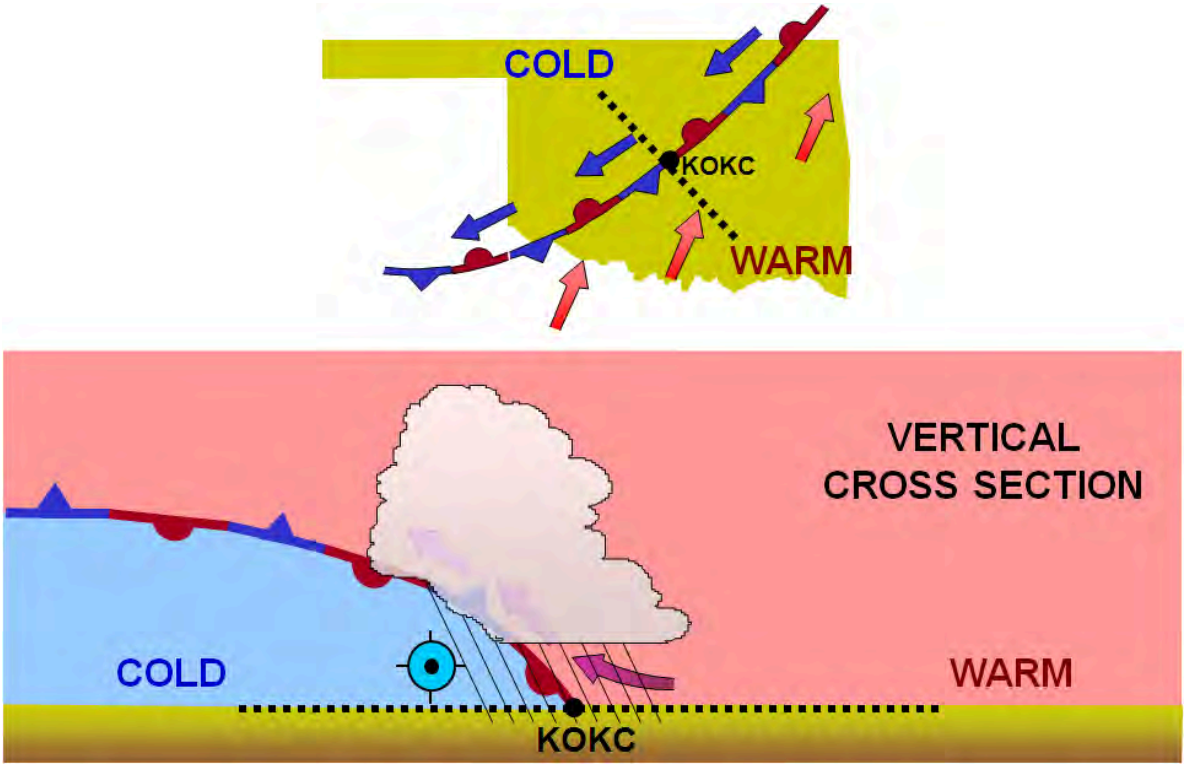
- Poor visibility in light to moderate precipitation ahead of the front.
- Fog along the frontal boundary before passage.

Source: AWH 11.3.1, p. 11-5 · Figure: Kh1604, Wikimedia Commons, CC BY-SA 4.0

# Stationary front

**ACS PA.I.C.K3e** · Front 3 of 4 · what to expect FAA GUIDANCE

Two air masses of roughly equal force: the boundary between them stays put.




FAA-H-8083-28B, Figure 11-7

**Speed:** Stationary.

**Slope:** Can vary.

**Where the weather sits:** In the warm rising air along the front.

## What to expect

- It influences the local weather for days.
- Clouds and precipitation still form in the warm air rising along the front.
- The weather is typically a mixture of what both warm and cold fronts bring.

### Pilot hazards

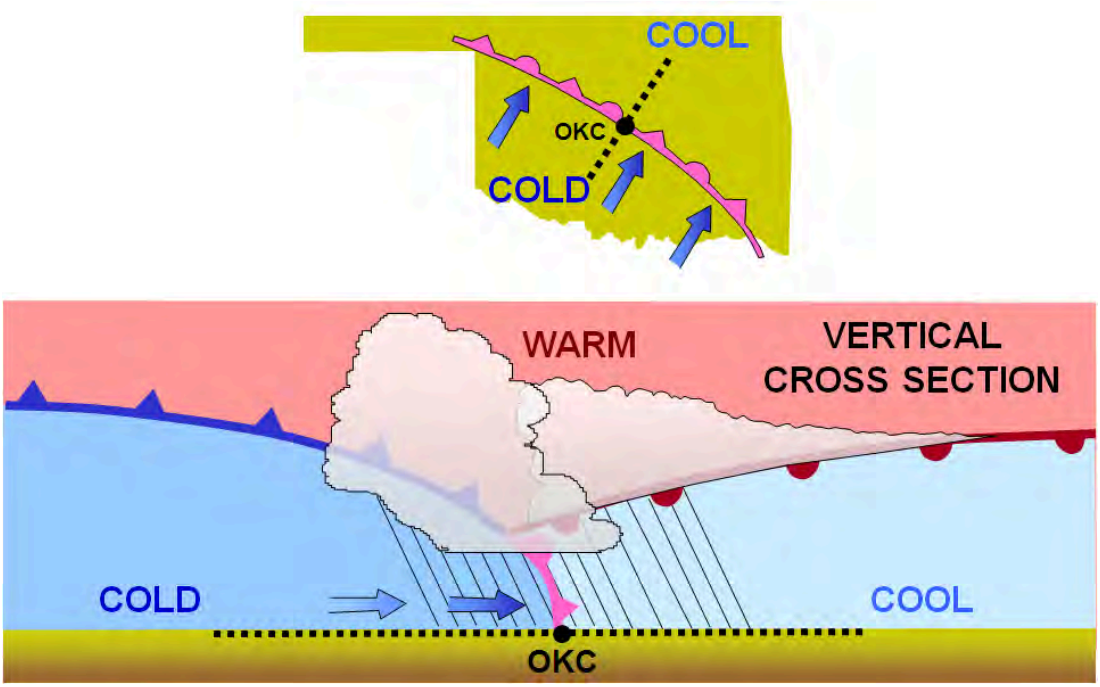
*Not itemized in AWH 11.3.3 — this is not a statement that no hazards exist.*

Source: AWH 11.3.3, p. 11-7 · Figure 11-7

# Occluded front

**ACS PA.I.C.K3e** · Front 4 of 4 · what to expect, and the two kinds of occlusion FAA GUIDANCE

Cold fronts typically move faster than warm fronts, so in time they catch up to a warm front and the two merge.




FAA-H-8083-28B, Figure 11-8

**Speed:** *Not specified*

**Slope:** *Not specified*

**Where the weather sits:** Clouds and precipitation can occur along, ahead of, and behind the surface front.

## What to expect

- At the front, the cold air undercuts the retreating cooler air mass of the warm front, further lifting the already rising warm air.
- As it approaches: warm-front weather, immediately followed by cold-front weather.
- Cold front occlusion: the cold front is colder than the air ahead of the warm front. Cold air replaces cool air and forces the warm front aloft. Typically a mixture of warm-front and cold-front weather, providing the air is relatively stable.
- Warm front occlusion: the air ahead of the warm front is colder than the air behind the cold front. The cold front rides up and over the warm front.

### Pilot hazards — and the exception

**Exception** A warm front occlusion lifting unstable air brings more severe weather than a cold front occlusion: embedded thunderstorms, rain and fog are likely.

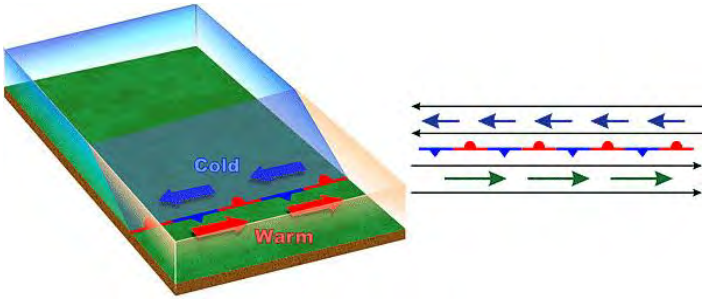
*No other hazards itemized in AWH 11.3.4 — this is not a statement that no hazards exist.*

Source: AWH 11.3.4, p. 11-8 · Figure 11-8

# Life of a low (the wave cyclone)

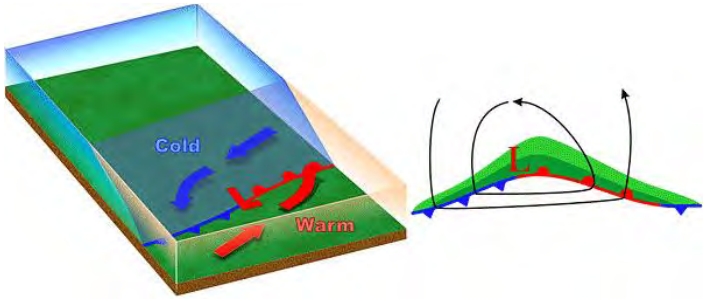
**ACS PA.I.C.K3e** · The handbook's five stages, in order FAA GUIDANCE

A wave cyclone is a low that forms and travels along a front, generally west to east, lasting from a few days to more than a week. It is the main weather producer of the mid-latitudes.



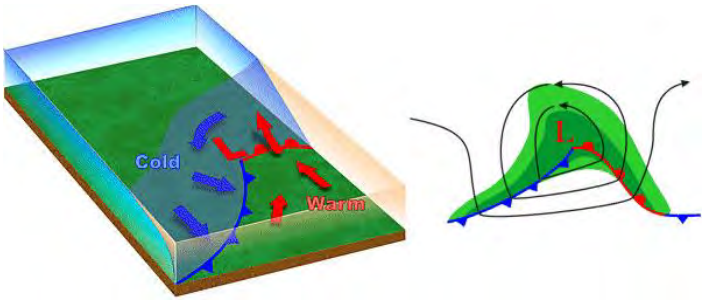

FAA-H-8083-28B, Figure 11-9

**1** A stationary front separates warm air from cold air.



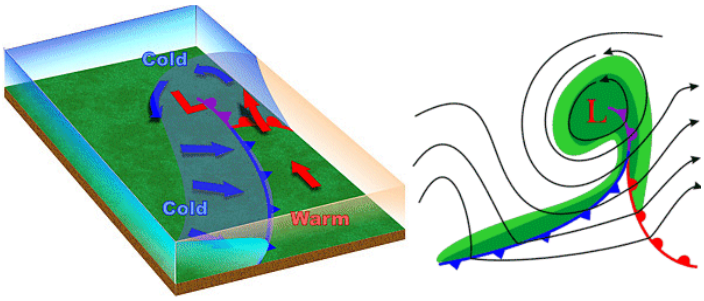

FAA-H-8083-28B, Figure 11-10

**2** A low-pressure wave forms and the front kinks. Precipitation develops.



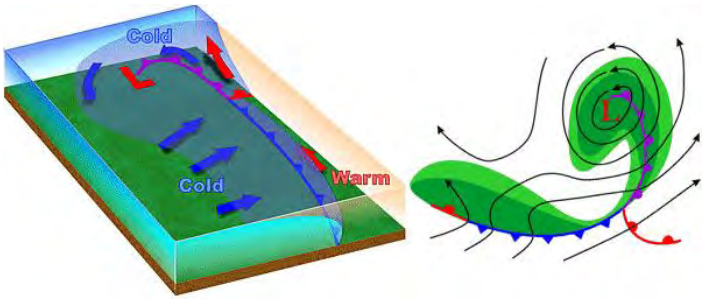

FAA-H-8083-28B, Figure 11-11

**3** The wave intensifies; the cold and warm fronts become better organized.




FAA-H-8083-28B, Figure 11-12

**4** Mature low. The cold front overtakes the warm front and the occluded front forms.




FAA-H-8083-28B, Figure 11-13

**5** The occlusion grows and cuts off the supply of warm, moist air. The low gradually dissipates.

Source: AWH 11.4, pp. 11-9, 11-10 · Figures 11-9, 11-10, 11-11, 11-12, 11-13

# Drylines and squall lines

Two more lines you will meet on a surface chart FAA GUIDANCE

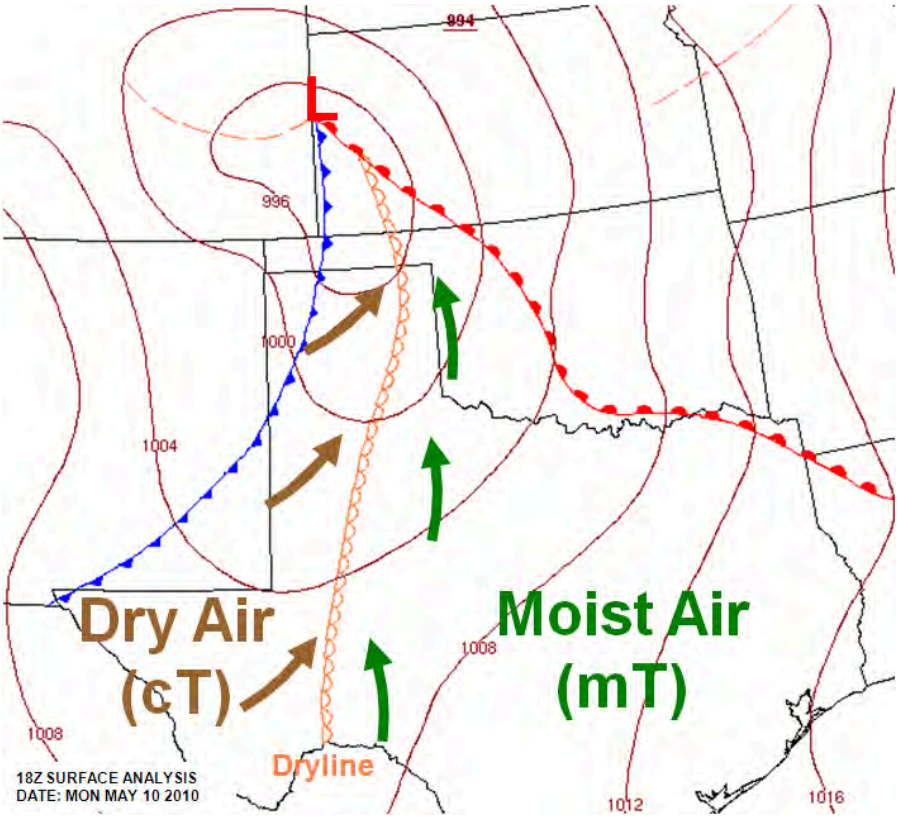
## Dryline

A low-level boundary, hundreds of miles long, between moist and dry air masses. In the United States it typically lies north-south across the southern and central High Plains during the spring and early summer.

- Typically advances east in the afternoon and retreats west at night.
- Moist side: low clouds and early-morning fog. Dry side: generally clear skies.
- Passage: a sharp drop in humidity, clearing skies, and a wind shift from south or southeast to west or southwest.

### Pilot hazards

- Severe, sometimes tornadic thunderstorms along the dryline or just east of it, especially as it starts moving east.
- Blowing dust may follow a daytime passage.




FAA-H-8083-28B, Figure 11-14

Source: AWH 11.5, p. 11-11 · Figure 11-14

# Squall line

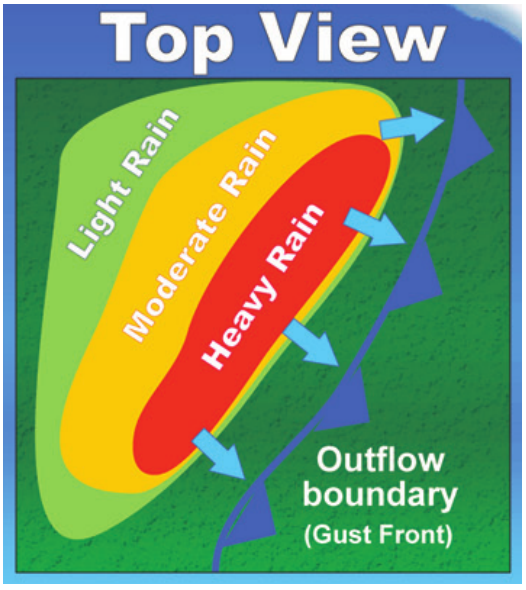
Thunderstorms in a narrow band that can extend laterally for hundreds of miles. It often develops on or ahead of a cold front in moist, unstable air, but it may develop in unstable air far removed from any front.

- New cells continually re-form at the leading edge, with rain, and sometimes hail, following behind.
- The line can persist for many hours as long as the three ingredients a thunderstorm needs continue to exist.

## Pilot hazards

- The thunderstorm type that presents the most effective barrier to air traffic: usually too tall to fly over, too dangerous to fly through or under, and difficult to circumnavigate.
- About 25 percent of all tornadoes in the United States are spawned by squall lines.


Illustration: NOAA National Weather Service, "Multicellular Line", Weather Spotter's Field Guide (June 2011), p. 28. Public domain (U.S. Government work); same artwork as FAA-H-8083-28B Figure 22-4.




Detail: the "Top View" inset of the same NOAA National Weather Service illustration, cropped by RunupLab and printed larger. Public domain (U.S. Government work).

**Reading the inset** TECHNIQUE In its Top View inset, shown enlarged here, the figure labels the line of blue triangles drawn beyond the heavy-rain band "Outflow boundary (Gust Front)". They mark the edge of this storm's outflow, its gust front: not a cold front, and not the squall-line symbol a surface chart uses (see the legend on the first page).

Source: AWH 22.4, p. 22-4 · Figure: NOAA National Weather Service, Weather Spotter's Field Guide

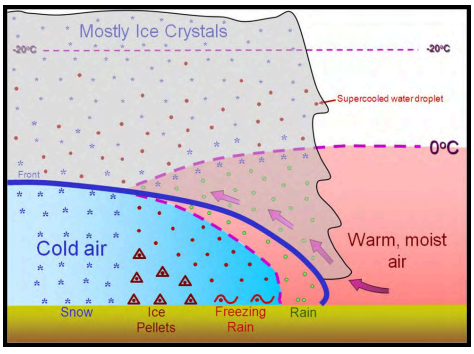
# The four fronts, side by side

The same slots for all four fronts — read across a row FAA GUIDANCE

| | Cold front | Warm front | Stationary front | Occluded front |
|---|---|---|---|---|
| **What is happening** | Cold, dense, stable air advances and replaces warmer air, sliding under it like a snowplow. | Warm air advances and replaces colder air, sliding up over the top of it. | Two air masses of roughly equal force: the boundary between them stays put. | Cold fronts typically move faster than warm fronts, so in time they catch up to a warm front and the two merge. |
| **Speed** | 25–30 mph; extreme fronts up to 60 mph. | Slow: typically 10–25 mph. | Stationary. | *Not specified* |
| **Slope** | Steep. Warm air is forced upward abruptly. | Typically gentle. Warm air rises gradually along it. | Can vary. | *Not specified* |
| **Typical weather** | Showers and thunderstorms, if the warm air being lifted is unstable. | Widespread layered cloud and precipitation if the warm air is stable; thunderstorms likely in summer. | Typically a mixture of warm-front and cold-front weather. | Warm-front weather, immediately followed by cold-front weather. |
| **Where the weather sits** | A narrow band along, or just ahead of, the front, if the warm rising air is unstable. | Widespread, along and ahead of the front, if the warm rising air is stable. | In the warm rising air along the front. | Clouds and precipitation can occur along, ahead of, and behind the surface front. |
| **Pressure trend** | Falls quickly, bottoms out at passage, then rises gradually. | Falls until the front passes; then a slight rise, followed by a decrease. | *Not specified* | *Not specified* |
| **Exception** | If the warm air being overtaken is relatively stable, overcast skies and rain may continue for some distance behind the front. | In summer, thunderstorms are likely. | *Not specified* | A warm front occlusion lifting unstable air brings more severe weather than a cold front occlusion: embedded thunderstorms, rain and fog are likely. |
| **Main hazard** | Squall lines: intense, fast-moving thunderstorms along or ahead of the front. | Poor visibility in light to moderate precipitation, with fog along the frontal boundary. | *Not itemized in AWH 11.3.3 — this is not a statement that no hazards exist.* | Embedded thunderstorms, rain and fog in a warm front occlusion lifting unstable air. |

## Near any front

- Most icing reports come from near fronts, both above and below the frontal surface.
- Above the front: if the warm air is unstable, icing may be sporadic; if it is stable, icing may be continuous over an extended area.
- Below the front: freezing rain or freezing drizzle is a favored location for severe clear icing.
- Icing in freezing precipitation often extends over a broad area, so a pilot may be unable to escape it by descending to a lower altitude.
- Non-convective low-level wind shear (LLWS) is commonly associated with passing frontal systems.




FAA-H-8083-28B, Figure 20-1

Source: AWH 11.3.2, p. 11-6 · 11.3.1, p. 11-5 · 11.3.3, p. 11-7 · 11.3.4, p. 11-8 · 20.3.7, pp. 20-4, 20-5 · 19.2.4.1, p. 19-8 · Figure 20-1

# Recall it from memory

Fill every box before you look back — a few words or a quick sketch is plenty. Then mark it against the cards and the four-fronts page.

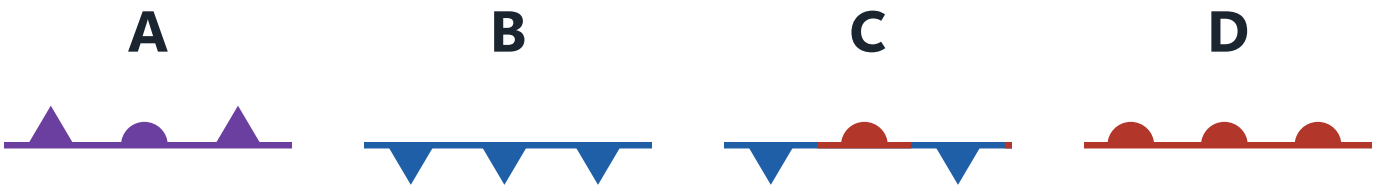
| | Cold front | Warm front | Stationary front | Occluded front |
|---|---|---|---|---|
| **Air movement** *sketch and label* | | | | |
| **Speed and slope** *if the handbook gives them* | | | | |
| **Weather and where it sits** *include stability* | | | | |
| **Pressure trend** *if given* | | | | |
| **Hazards and exceptions** *what can a simple rule miss?* | | | | |

# Apply it

Six situations, written by RunupLab. Answer on paper first; the answers and the handbook lines behind them come next.

### 1 · Read the chart

Name the front each symbol stands for.




Redrawn from FAA-H-8083-28B, Figure 27-25

### 2 · What just passed?

Temperature and dewpoint drop rapidly, the wind is variable and gusty, and the pressure bottoms out and starts to rise. Which front is passing? Give two clues.

### 3 · A front that stays put

A boundary barely moves for days. Why can cloud and precipitation keep forming?

### 4 · Two cold fronts

Why might one cold front bring towering cloud and showers while another leaves overcast and rain behind it?

### 5 · Which occlusion?

Occlusion A: the air behind the cold front is the coldest. Occlusion B: the air ahead of the warm front is the coldest. Name each, and say what the cold front does.

### 6 · Correct the student

A student says: “The stationary-front card lists no hazards, so it is a benign front. And warm air above a front cannot cause icing.” Correct both.

# Answers and reasoning

Each short answer, and the italic note under it, is RunupLab's. The bullets are the handbook's reasoning, in this booklet's short form, and the source line says where to read it.

### 1 · Read the chart  A occluded · B cold · C stationary · D warm

- The symbols on a front show its type and point the way it is moving.

*The handbook line above says the symbols show a front's type, not which shape is which: the identification comes from the first page's legend, redrawn from the handbook's Figure 27-25. Stationary or occluded? A stationary front's triangles and half-circles sit on opposite sides of the line, an occluded front's on the same side.*

Source: AWH 25.2.2.1.3, p. 25-6

### 2 · What just passed?  A cold front.

- During cold front passage the wind is variable and gusty, and the temperature and dewpoint drop rapidly.
- A quickly falling pressure bottoms out during frontal passage, then begins a gradual increase.
- A warm front passes differently: the wind is also variable and the pressure levels off, but the temperature rises steadily from the inflow of relatively warmer air.
- As an occluded front approaches, warm-front weather prevails but is immediately followed by cold-front weather.

*The deciding clue is the rapid drop in temperature and dewpoint: at a warm front the temperature rises. The gusty wind is a second clue. Variable wind, and a pressure that stops falling at passage, happen at a warm front too, so they cannot settle it alone. If warm-front weather came just before, the cold-front half of an occluded front is also a fair answer.*

Source: AWH 11.3.2, p. 11-6 · 11.3.1, p. 11-5 · 11.3.4, p. 11-8

### 3 · A front that stays put  Because warm air is still rising along the front.

- When two air masses push with roughly equal force, the front between them stays put and can influence the local weather for days.
- Clouds and precipitation still form in the warm air rising along the front.

Source: AWH 11.3.3, p. 11-7

### 4 · Two cold fronts  The stability of the warm air being lifted.

- The type of cloud a cold front makes depends on the stability of the warmer air.
- Unstable warm air: often a narrow band of showers and thunderstorms along, or just ahead of, the front.
- Relatively stable warm air: overcast skies and rain may continue for some distance behind the front.

Source: AWH 11.3.2, p. 11-6

### 5 · Which occlusion?  A: a cold front occlusion — the cold air replaces the cool air and forces the warm front aloft. B: a warm front occlusion — the cold front rides up and over the warm front.

- A is a cold front occlusion: the cold front is colder than the air ahead of the warm front, so the cold air replaces the cool air and forces the warm front aloft.
- B is a warm front occlusion: the air ahead of the warm front is colder than the air of the cold front, so the cold front rides up and over the warm front.

Source: AWH 11.3.4, p. 11-8

### 6 · Correct the student  Both are wrong: a stationary front typically brings a mixture of warm- and cold-front weather, and warm air lifted above a front and cooled to saturation below freezing holds supercooled droplets that freeze on impact.

- The weather at a stationary front is typically a mixture of the weather found in both warm and cold fronts.
- Most icing reports come from near fronts, and the icing can be above or below the front.
- For significant icing above a front, the warm air must be lifted and cooled to saturation below freezing; it then holds supercooled water droplets, which freeze on impact with an aircraft.
- Below the front: rain forms above the frontal surface at temperatures warmer than freezing, falls through below-freezing air, becomes supercooled and freezes on impact with an aircraft. Freezing rain or drizzle below a front is a favored location for severe clear icing.

*"Not itemized" is this booklet's label, not the handbook's: it means the cited section lists no hazards — never that there are none.*

Source: AWH 11.3.3, p. 11-7 · 20.3.7, pp. 20-4, 20-5

# Sources

Where every line and every figure in this booklet comes from

## The handbook

| | |
|---|---|
| **Handbook** | FAA-H-8083-28B, Aviation Weather Handbook |
| **Edition** | 2026 edition, signed and published April 2, 2026 (the handbook's preface) |
| **Retrieved** | 2026-09-01, from https://www.faa.gov/sites/faa.gov/files/FAA-H-8083-28B.pdf |
| **Frozen copy** | PDF sha256 2a87e4a5613e2a8e… · text sha256 192a2b9042d73772… |
| **Text extraction** | pdftotext 25.07.0 (poppler), -layout, whole book |

## What "checked" means here

Every handbook sentence behind a line in this booklet is quoted in its data file and machine-checked: word for word in the frozen handbook, on the printed page the card's source line names, and with no number in our wording that the quote does not contain. The short wording you read is RunupLab's compression of those quotes. No machine can prove a compression faithful — a CFI review of the wording is still owed. The handbook is FAA guidance, not regulation.

## Figures

From FAA-H-8083-28B, each extracted as the bitmap embedded in the frozen PDF — PDF page (printed page):

**Figure 10-2. Magnitude of Pressure Gradient Force** p. 118 (p. 10-3)
**Figure 10-11. Surface Wind Flow** p. 123 (p. 10-8)
**Figure 12-5. Frictional Effects** p. 151 (p. 12-7)
**Figure 11-1. Air Mass Classification** p. 136 (p. 11-3), cropped to the globe of source regions (its table is dropped)
**Figure 11-2. Air Mass Modification—Warm, Moist Air Mass Moving Over a Cold Surface** p. 136 (p. 11-3)
**Figure 11-3. Lake Effect** p. 137 (p. 11-4)
**Figure 11-6. Cold Front** p. 140 (p. 11-7)
**Figure 11-7. Stationary Front** p. 140 (p. 11-7)
**Figure 11-8. Occluded Front** p. 141 (p. 11-8)
**Figure 11-9. Wave Cyclone Model—Stage 1** p. 142 (p. 11-9)
**Figure 11-10. Wave Cyclone Model—Stage 2** p. 142 (p. 11-9)
**Figure 11-11. Wave Cyclone Model—Stage 3** p. 143 (p. 11-10)
**Figure 11-12. Wave Cyclone Model—Stage 4** p. 143 (p. 11-10)
**Figure 11-13. Wave Cyclone Model—Stage 5** p. 143 (p. 11-10)
**Figure 11-14. Dryline Example** p. 144 (p. 11-11)
**Figure 20-1. Icing with Fronts** p. 247 (p. 20-5)

**Chart-symbol legend and the symbol quiz** Redrawn from FAA-H-8083-28B, Figure 27-25, by RunupLab

## Pictures from outside the handbook

Two pictures come from outside the handbook, with the owner's approval; each prints its credit and licence under it and here. CC BY-SA 4.0 covers the warm-front picture and RunupLab's crop of it, not the rest of this booklet. A credit says where a picture came from; it does not mean its author or publisher reviewed or endorses this booklet.

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https://commons.wikimedia.org/wiki/File:Cross_section_through_a_warm_front_(cropped).jpg

**Multicellular Line (Weather Spotter's Field Guide, p. 28).** Illustration: NOAA National Weather Service, "Multicellular Line", Weather Spotter's Field Guide (June 2011), p. 28. Public domain (U.S. Government work); same artwork as FAA-H-8083-28B Figure 22-4. · Retrieved 2026-09-23 · PDF p. 30 (printed p. 28), extracted as embedded
https://www.weather.gov/media/bis/Weather_Spotter_Field_Guide.pdf · https://www.weather.gov/disclaimer

**Multicellular Line — its Top View inset (detail).** Detail: the "Top View" inset of the same NOAA National Weather Service illustration, cropped by RunupLab and printed larger. Public domain (U.S. Government work).

## ACS elements covered (FAA-S-ACS-6C)

- PA.I.C.K3e — e. Weather system formation, including air masses and fronts (covered here: air masses, fronts, the wave cyclone)
- PA.I.C.K3b — b. Wind (e.g., windshear, mountain wave, factors affecting wind, etc.) (covered here: pressure systems, surface wind, and frontal low-level wind shear)
- PA.I.C.K3i — i. Icing and freezing level information (covered here: icing near fronts only)

## Written by RunupLab

RunupLab wrote the practice questions, their short answers, the italic notes under the answers, the recall prompts, the sheet subtitles, the notes marked TECHNIQUE, and the reading notes on the first page. Those are our words, not the handbook's. The reasoning bullets under each answer are the handbook's, in this booklet's short form — the same compression every card uses.