

CHAPTER 4 • REFERENCE DEPTH

Q-Codes, Abbreviations & Definitions

Three-letter shorthand born in the Morse era still runs the cockpit today. The pressure and bearing Q-codes are among the most reliable marks on the paper and the viva — and a wrong altimeter setting is one of aviation's oldest killers. This chapter builds them from the physics up.

SYLLABUS MAP

Part I (ii) General & Aeronautical 'Q' Code signals and other abbreviations (ICAO Annex 10, Vol I & II)

🎯 Learning objectives — by the end of this chapter you will be able to...

- Explain what a Q-code is, where it came from, and why aviation keeps a few.
- Define and apply QNH, QFE, QNE and QFF, and explain the altimetry behind each.
- Explain transition altitude/level and when each pressure setting is used.
- Distinguish the bearing codes QDM, QDR, QTE, QUJ (and QGH) and solve bearing problems.

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- Recall common operational Q-codes and standard abbreviations.
- State precisely the definitions of altitude, height, elevation and flight level.

4.1 What a Q-code is

4.2 The pressure-altimeter — how it works

4.3 QNH, QFE, QNE & QFF

4.4 Transition altitude & level

4.5 The bearing Q-codes

4.6 Working bearing problems

4.7 Other operational Q-codes

4.8 Standard abbreviations

4.9 Altitude · height · elevation · flight level

4.1 What a Q-code is



FIRST PRINCIPLES — THREE LETTERS FOR A WHOLE SENTENCE

Q-codes were invented for **Morse telegraphy**, where every character costs time. A three-letter group beginning with **Q** was agreed to stand for a complete phrase, so a long sentence could be sent as three letters. Cleverly, the same code can be a **question or its answer** depending on context: "QFE?" asks the field pressure; "QFE 1004" answers it. Voice radio later made full sentences cheap, so most Q-codes faded — but a handful proved so **compact and unambiguous** (and impossible to mishear as

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ordinary words) that aviation kept them: above all the **pressure settings** and a few **bearings**.

DEFINITION — Q-CODE

A standardised three-letter code, each group beginning with **Q**, representing a fixed phrase, listed in ICAO documentation (Annex 10 and related). It is international and language-independent, and may be used as a question or an answer.

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Navigation and pressure instruments rely heavily on correct Q-code settings like QNH and QDM for safe operation.

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4.2 The pressure-altimeter — how it works

i FIRST PRINCIPLES — PRESSURE AS A PROXY FOR HEIGHT

Atmospheric pressure **falls with height** — roughly **1 hPa per 27–30 ft** near sea level. A pressure altimeter is simply an aneroid barometer with its scale marked in feet: it measures the outside static pressure and displays the corresponding altitude. But "the corresponding altitude" depends entirely on **what pressure you call the datum**. The **subscale (Kollsman window)** lets the pilot set that datum. Setting a different datum slides the whole scale up or down — which is exactly what the pressure Q-codes select.

4.3 QNH, QFE, QNE & QFF

Pressure Q-Codes

Code	What you set on the subscale	Altimeter then reads
QNH	Pressure reduced to mean sea level for the area	Altitude above mean sea level — and the aerodrome elevation when on the ground

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Code	What you set on the subscale	Altimeter then reads
QFE	The actual pressure at the aerodrome / runway datum	Height above that datum — zero on the runway
QNE	The standard setting 1013.2 hPa (29.92 inHg)	Pressure altitude / flight level
QFF	The <i>true</i> mean-sea-level pressure (meteorological)	Used by met services; not normally set for flying

THE RULE OF THUMB TO CARRY

$\approx 1 \text{ hPa} = 27 \text{ ft}$ near sea level (often rounded to 30 ft). So a **1 hPa** error in the subscale setting puts the altimeter out by $\approx 27 \text{ ft}$; a **10 hPa** error $\approx 270 \text{ ft}$. Always set the *correct* datum — this small number is why a wrong setting is so dangerous near the ground.

WORKED EXAMPLE — A MIS-SET SUBSCALE

QNH is 1013 hPa but you mistakenly set **993 hPa** (20 hPa low).

Error $\approx 20 \text{ hPa} \times 27 \text{ ft} = \mathbf{540 \text{ ft}}$. With the lower pressure set, the altimeter **over-reads** — it shows you higher than you are, so you are actually $\sim 540 \text{ ft}$ **lower** than indicated. On an approach in cloud, that is the difference between clearing terrain and not.

Memory aid: "High to Low, look out below." Flying from high pressure to low (or setting too low a value) makes you lower than indicated.

💡 MNEMONICS

QFE = Field Elevation → reads **zero on the Field**. **QNH = Nautical Height** → reads height above the **sea** (altitude AMSL). **QNE = Normal/National standard** → the fixed **1013** setting for flight levels.

⚠️ EXAM TRAP — THE WORD MATTERS

"Altitude" vs "height" is the catch. **QNH** → **altitude** (above sea level). **QFE** → **height** (above the airfield). Naming the right code but the wrong word loses the mark. And QNE is a **fixed value** (1013.2), not a number passed by ATC.

▼ 🔍 Deep dive — QNH vs QFF

Both reduce pressure to sea level, but differently. **QNH** uses the **ISA** (standard atmosphere) relationship, so on the ground the altimeter reads the aerodrome's surveyed elevation. **QFF** uses the *actual* temperature/conditions to give the true MSL pressure — more accurate meteorologically, but it would not make the altimeter read field elevation. For flying you use **QNH**; QFF appears on weather charts.

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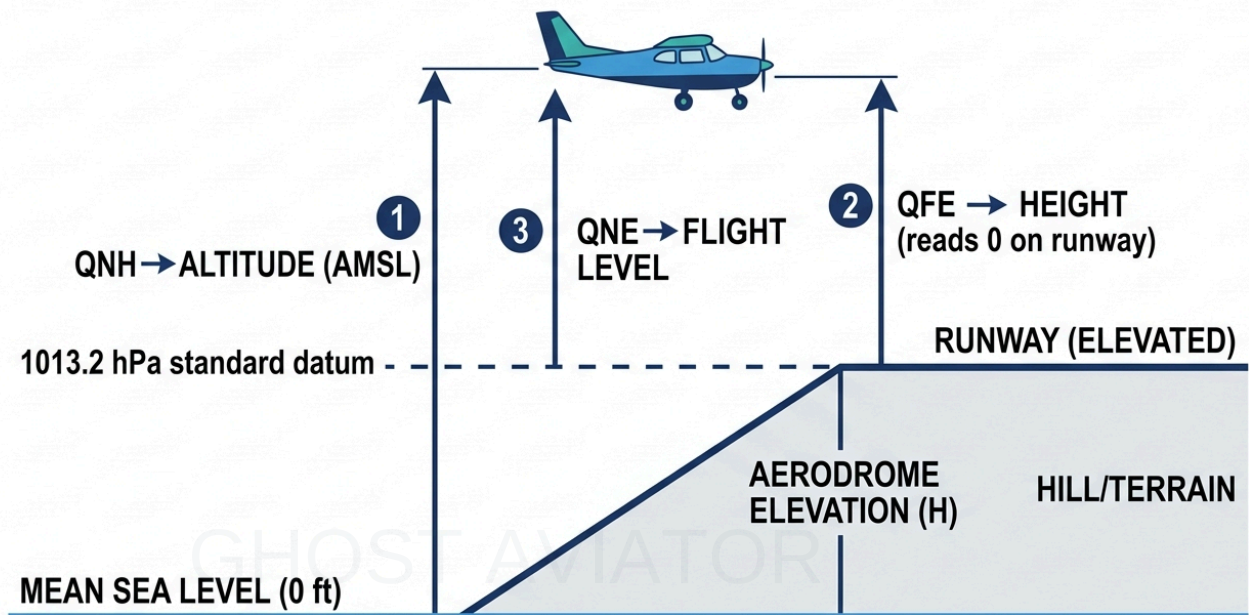


Figure 4.1 — QNH, QFE and QNE altimeter datums visualized relative to sea level, runway, and the standard pressure surface.

4.4 Transition altitude & level

i IN PLAIN TERMS

Low down, near terrain, everyone wants altitude above the actual sea-level pressure (QNH). High up, for traffic separation, everyone wants a *common* datum so two aircraft's altimeters agree — so all switch to the standard 1013.2 (QNE) and call levels "flight levels". The switch happens at a defined boundary.

✓ THE THREE TERMS

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Transition Altitude — the altitude at or below which vertical position is expressed as **altitude on QNH**. **Transition Level** — the lowest **flight level (on 1013.2)** available above the transition altitude. **Transition Layer** — the airspace between the two. **Climbing:** set 1013 (QNE) passing the transition **altitude**. **Descending:** set QNH passing the transition **level**.

💡 MNEMONIC

Climb → **Standard at the Altitude**; **Descend** → **QNH at the Level**. Going up you reach the altitude first; coming down you reach the level first.

| 4.5 The bearing Q-codes

📘 IN PLAIN TERMS

These four answer "which way?" relative to a station. Two are **magnetic** (QDM, QDR), two are **true** (QUJ, QTE); two point **to** the station, two point **from** it.

Bearing Q-Codes

Code	Meaning	Reference
QDM	Magnetic heading to steer (zero wind) to reach the station	Magnetic · TO

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Code	Meaning	Reference
QDR	Magnetic bearing from the station (the radial)	Magnetic · FROM
QUJ	True bearing to the station	True · TO
QTE	True bearing from the station	True · FROM

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THE RECIPROCAL RELATIONSHIPS

QDR = QDM ± 180° (the bearing from is the reciprocal of the heading to). Likewise **QTE = QUJ ± 180°**. And magnetic ↔ true differs by the local **variation**: True = Magnetic ± Variation (East least, West most → "Variation East, magnetic least").

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QDM = Direction to Mother — the magnetic heading home to the station. Its reciprocal **QDR** goes away. Letter cue: the **M**agnetic pair share "QD" (QDM/QDR); the **T**True pair are QUJ/QTE.

▼  Deep dive — QGH, QGE & other navigation Q-codes

QGH is a controlled descent through cloud flown on **bearings given by a ground direction-finding (DF) station** — an older "let-down by bearings" before ILS. You may also meet **QGE** (distance/height from a station), **QTF** (a position fix from two or more DF bearings), and **QDL** (a series of bearings). These are rarely flown today but appear as recognition questions; know **QGH = controlled descent / DF let-down**.

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4.6 Working bearing problems



Understanding QDM (TO) and QDR (FROM) is fundamental for VOR and NDB navigation.

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WORKED EXAMPLE 1 — HEADING TO A STATION

An ADF gives QDM **090°** to an NDB.

QDR (radial you are on) = $090 \pm 180 = \mathbf{270^\circ}$.

So you are on the 270° radial (west of the station) and would steer 090° in nil wind to reach it.

WORKED EXAMPLE 2 — MAGNETIC TO TRUE

QDM is **090°** and the local magnetic variation is **5° West**.

True bearing to the station (QUJ): with West variation, True = Magnetic – Variation = $090 - 5 = \mathbf{085^\circ}$.

QTE (true from) = $085 \pm 180 = \mathbf{265^\circ}$. ("Variation West, magnetic best" — the magnetic figure is the larger.)

4.7 Other operational Q-codes

Other Operational Q-codes

Code	Meaning
QSY	Change frequency (to ...)
QAM	The latest meteorological report (for ...)

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Code	Meaning
QFE / QNH / QNE	Pressure settings (see 4.3)
QDM / QDR / QUJ / QTE	Bearings (see 4.5)
QGH	Controlled descent through cloud (DF let-down)
QTF	Position (fix) from DF bearings

4.8 Standard abbreviations you must read on sight

Standard Aviation Abbreviations			
Abbr.	Meaning	Abbr.	Meaning
UTC	Coordinated Universal Time ("Zulu")	AMSL/AGL	Above Mean Sea Level / Above Ground Level
ATIS	Automatic Terminal Information Service	VOLMET	En-route met broadcast

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Abbr.	Meaning	Abbr.	Meaning
METAR/TAF	Weather report / aerodrome forecast	RVR	Runway Visual Range
CAVOK	Ceiling and visibility OK (defined)	WILCO	Will comply
ROGER	Received all your last transmission	SELCAL	Selective Calling (tone alert)
ETA/ETD	Estimated Time of Arrival / Departure	QDM	Magnetic heading to a station

4.9 Altitude ▪ height ▪ elevation ▪ flight level

THE FOUR VERTICAL DEFINITIONS — RECITE PRECISELY

Altitude — the vertical distance of a level, point or object measured **from mean sea level** (read on QNH).

Height — the vertical distance of a level, point or object measured **from a specified datum**, e.g. the aerodrome (read on QFE).

Elevation — the vertical distance of a *point on or affixed to the surface* above mean sea level.

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Flight Level (FL) — a surface of constant atmospheric pressure related to the standard datum **1013.2 hPa** (read on QNE); e.g. FL100 = 10,000 ft pressure altitude.

✈ **COCKPIT REALITY — THREE SETTINGS IN ONE FLIGHT**

On departure you fly on **QNH** reading altitude; passing the transition altitude you wind the subscale to **1013** (QNE) and read flight levels; arriving at a small field you might use **QFE** so the altimeter reads height above the runway. Three codes, three readings — set the wrong one and your "1,000 ft" may be 1,000 ft lower than you think (recall 4.2).

☆ Numbers to memorise

Essential Facts for Chapter 4

Fact	Value
Pressure lapse	≈ 1 hPa per 27 ft near sea level
QNH	Set → altimeter reads ALTITUDE (AMSL); reads elevation on the ground
QFE	Set → reads HEIGHT above aerodrome; zero on the runway
QNE	Standard 1013.2 hPa / 29.92 inHg → FLIGHT LEVEL

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Fact	Value
QFF	True MSL pressure — meteorological, not flown
Transition	Climb: set 1013 at transition ALTITUDE · Descend: set QNH at transition LEVEL
QDM / QDR	Magnetic heading TO / bearing FROM = $QDM \pm 180^\circ$
QUJ / QTE	True bearing TO / FROM the station
QSY / QGH	Change frequency / controlled descent (DF let-down)

Question bank

Part A — MCQs (click an option to check)

1. With QNH set, the altimeter reads:

Altitude above mean sea level

Height above the aerodrome

Flight level

Zero on the runway

Answer: Altitude above mean sea level.

QNH → altitude (AMSL); on the ground it reads the aerodrome elevation.

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2. With QFE set, on the runway the altimeter reads:

The aerodrome elevation

Zero

1013 hPa

The flight level

Answer: Zero.

QFE is the aerodrome datum pressure, so it reads height above it — zero on the field.

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3. The standard pressure setting QNE is:

1003.2 hPa

1013.2 hPa (29.92 inHg)

1023.2 hPa

760 hPa

Answer: 1013.2 hPa (29.92 inHg).

QNE = 1013.2 hPa / 29.92 inHg — used for flight levels.

4. Approximately how much does 1 hPa correspond to in altitude near sea level?

2.7 ft

27 ft

270 ft

1 ft

Answer: 27 ft.

≈ 1 hPa per 27 ft near sea level — a 10 hPa error ≈ 270 ft.

5. You set 993 hPa when the QNH is 1013 hPa. The altimeter will:

Read correctly

Under-read (show you lower than you are)

Over-read (show you higher than you are — you are lower)

Read zero

Answer: Over-read (show you higher than you are — you are lower).

Setting too low a value over-reads: "High to Low, look out below" — you are about 540 ft lower than indicated.

6. QFF differs from QNH in that QFF is:

The aerodrome pressure

The true MSL pressure (meteorological), not normally flown

The standard 1013 setting

A bearing

Answer: The true MSL pressure (meteorological), not normally flown.

QFF gives the true sea-level pressure for met charts; QNH (using ISA) makes the altimeter read field elevation.

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7. When climbing, you set 1013 hPa (standard) on passing the:

Transition level

Transition altitude

Transition layer top

Aerodrome elevation

Answer: Transition altitude.

Climb → standard at the transition ALTITUDE; descend → QNH at the transition LEVEL.

8. QDM is the:

Magnetic heading to steer (zero wind) to the station

Magnetic bearing from the station

True bearing from the station

Distance to the station

Answer: Magnetic heading to steer (zero wind) to the station.

QDM — magnetic heading TO the station ("Direction to Mother"). QDR is its reciprocal, FROM.

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9. If QDM is 090°, the corresponding QDR is:

090°

180°

270°

000°

Answer: 270°.

QDR = QDM $\pm$ 180°, so 090° $\rightarrow$ 270°.

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10. QTE is a:

Magnetic heading to the station

True bearing from the station

Pressure setting

Request to change frequency

Answer: True bearing from the station.

QTE — True bearing FROM the station. QUJ is True bearing TO.

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11. QDM 100° with variation 6° East gives a true bearing to the station (QUJ) of:

094°

106°

100°

286°

Answer: 106°.

Variation East → True = Magnetic + Variation = $100 + 6 = 106^\circ$. ("Variation East, magnetic least.")

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12. QSY means:

Say again

Change frequency

Standby

Report position

Answer: Change frequency.

QSY — change your frequency to the one specified.

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13. QGH describes a:

Pressure setting

Controlled descent through cloud using DF bearings

Met report request

True bearing

Answer: Controlled descent through cloud using DF bearings.

QGH — a DF let-down / controlled descent through cloud on ground-station bearings.

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14. "Altitude" is measured from:

The aerodrome

Mean sea level

The 1013.2 datum

The terrain below

Answer: Mean sea level.

Altitude = vertical distance from mean sea level (QNH). Height is from a specified datum (QFE).

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15. A flight level is referenced to:

The local QNH

The aerodrome QFE

The standard pressure 1013.2 hPa

True sea-level pressure (QFF)

Answer: The standard pressure 1013.2 hPa.

Flight levels are surfaces of constant pressure referenced to 1013.2 hPa (QNE).

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16. "Elevation" applies to:

An aircraft in flight

A point on or affixed to the surface, above MSL

A pressure setting

A radio bearing

Answer: A point on or affixed to the surface, above MSL.

Elevation is the height of a surface point above MSL (e.g. aerodrome elevation).

17. A Q-code can function as:

Only a question

Only an answer

Either a question or an answer, depending on context

A frequency

Answer: Either a question or an answer, depending on context.

The same three-letter code serves as the question and its reply.

18. Descending, you change from 1013 to QNH on passing the:

Transition altitude

Transition level

Aerodrome elevation

Middle marker

Answer: Transition level.

Descend → QNH at the transition LEVEL; climb → standard at the transition ALTITUDE.

Part B — Oral / viva (tap to reveal model answers)

▼ ? What is a Q-code and why does aviation still use a few?

Model Answer:

A standardised three-letter code beginning with Q that represents a complete phrase, used as a question or answer. They came from Morse telegraphy; aviation kept the compact, unambiguous ones — principally the pressure and bearing codes.

▼ ? Explain QNH, QFE and QNE and what the altimeter reads on each.

Model Answer:

QNH is the pressure reduced to mean sea level, so the altimeter reads altitude above MSL

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(and field elevation on the ground). QFE is the aerodrome datum pressure, so it reads height above the airfield, zero on the runway. QNE is the standard 1013.2 hPa, on which it reads flight levels.

▼ ? Why is the standard setting 1013.2 used above the transition altitude?

Model Answer:

So that every aircraft uses a common datum and their altimeters agree, giving reliable vertical separation by flight level regardless of the local pressure.

▼ ? What is the difference between QDM and QDR, and how are they related?

Model Answer:

QDM is the magnetic heading to steer in nil wind to reach the station; QDR is the magnetic bearing from the station. They are reciprocals: $QDR = QDM \pm 180^\circ$.

▼ ? Define altitude, height, elevation and flight level.

Model Answer:

Altitude — vertical distance from mean sea level. Height — vertical distance from a specified datum (e.g. the aerodrome). Elevation — height of a point on the surface above MSL. Flight level — a constant-pressure surface referenced to 1013.2 hPa.

▼ ? If you set too low a pressure on the subscale, what happens, and what is the saying?

Model Answer:

The altimeter over-reads, so you are lower than indicated — about 27 ft per hPa of error. The saying is "High to Low, look out below."

▼ ? What does QGH mean?

Model Answer:

A controlled descent through cloud flown on bearings provided by a ground direction-finding station — a DF let-down.

⚡ 60-SECOND REVISION CARD

QNH → altitude (AMSL, elevation on ground). **QFE** → height (0 on runway). **QNE** → flight level (1013.2 hPa). **QFF** → true MSL pressure (met).

≈ 1 hPa = 27 ft; too-low setting over-reads — "High to Low, look out below."

Climb: 1013 at transition **altitude**; **Descend:** QNH at transition **level**.

QDM mag TO; **QDR** mag FROM = QDM ± 180°; **QUJ/QTE** true TO/FROM; **QGH** DF let-down;

QSY change freq.

Altitude (MSL) · Height (datum) · Elevation (surface point) · FL (1013.2).