

Beaufort Wind Scale

The Beaufort Wind Scale			
Force	Speed (Knots)	Name	Description of Effects on Land
0	<1	Calm	Smoke rises vertically
1	1 - 3	Light Air	Direction of wind shown by smoke drift, but not by wind vanes
2	4 - 6	Light Breeze	Wind felt on face; leaves rustle; sensitive vane moved by the wind
3	7 - 10	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
4	11 - 16	Moderate Breeze	Raises dust and loose paper; small branches are moved
5	17 - 21	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets on lakes
6	22 - 27	Strong Breeze	Large branches in motion; whistling heard through telegraph wires; umbrellas very awkward to use
7	28 - 33	Near Gale	Whole trees in motion; walking against the wind difficult
8	34 - 40	Gale	Breaks twigs off trees; generally impedes progress
9	41 - 47	Strong Gale	Slight structural damage; chimney pots, slates and tiles removed
10	48 - 55	Storm	Trees uprooted; considerable structural damage
11	56 - 63	Violent Storm	Very rare inland; extensive damage
12	>=64	Hurricane	Extremely rare inland; limited to coastal fringe, and mountain tops

Beaufort Code

Beaufort Code: a system which uses letters and numbers to denote various weather types. The tables below provide full details of Beaufort Code as well as the international symbols used on

synoptic charts. At the end of this document is a section describing how to write and interpret Beaufort Code.

State of the Sky - Cloud cover	
b	Cloud cover: 0 to 2 oktas (0 - 25%)
bc	Cloud cover: 3 to 5 oktas (26 - 74%)
c	Cloud cover: 6 to 8 oktas (75 - 100%)
o	<i>Uniform</i> thick layer of cloud completely covering the sky (100%)

Hydrometeors - Water & Ice		
r		Rain (drops of water >0.5mm diameter)
r _x		Freezing Rain (i.e. rain which freezes on contact with the ground and vegetation)
d		Drizzle (drops of water <0.5mm diameter)
d _x		Freezing Drizzle (i.e. drizzle which freezes on contact with the ground and vegetation)
s		Snow (ice crystals, often branched into 'flakes' in 'warmer conditions', temperatures >-5°C)
h		Snow Pellets (often referred to as 'soft hail', and typical of wintry showers, especially in coastal regions; white and spherical or conical, 2 to 5mm; fall only from cumulus and cumulonimbus clouds)
h		Hail (transparent or opaque particles , usually spheroidal, but sometimes conical; over 5mm; can fall as larger aggregated lumps in heavy thunderstorms; most larger hailstones show evidence of concentric layering)

h		Small Hail (as above but consisting of snow pellets encased in a thin layer of clear ice, not easily crushable; under 5mm; very common in showery weather in Britain; falls only from cumulus and cumulonimbus clouds)
h		Ice Pellets (spherical, conical or irregular transparent ice particles <=5mm; fall mainly from altostratus and nimbostratus clouds)
h		Diamond Dust (tiny ice crystals which fall from a clear sky; requires very cold weather; rare in Britain; common in polar regions)
sh		Snow Grains (white opaque particles <1mm; fall usually from low stratus and stratocumulus clouds)
f		Fog (Visibility <1km)
f _x		Freezing Fog (water droplet fog, that freezes on contact with solid objects)
f		Ice Fog (minute ice crystal fog; requires temperatures below -30°C)
f _e		Wet Fog (damp fog which deposits a film of water on exposed solid surfaces)
f _s		Shallow Fog Patches (fog limited to a depth of 2 metres or less; if it is a continuous layer, the lower line of the symbol is continuous, but the Beaufort code stays the same)
m		Mist (Visibility 1 to 2 km; there are a variety of definitions of mist; the British Met Office also require a relative humidity between 95 and 100%)
ks		Drifting Snow (snow raised to heights below eye level - 1.8 metres; no overall reduction in visibility)
ks		Blowing Snow (snow raised to a great height above the land surface causing severe reduction of visibility, e.g. a 'white-out'; strong winds needed; usually limited to upland areas in Britain)
		Spray (limited to sea area, large lakes, coastal regions)
w		Dew (produced by night-time radiation cooling)
w		Advection Dew (caused by condensation on upright surfaces, usually after a cold spell as warm moist air blows against cold surfaces)
w		White Dew (frozen dew drops, as opposed to hoar frost)

x		Hoar Frost (the 'usual' white frost, produced by radiation cooling; takes the form of small needles, scales, feathers or fans)
x		Advection Hoar Frost (forms in the same way as advection dew, but with temperatures still below freezing)
		Rime (a deposit of ice formed on 'solid' objects by freezing fog)
		Soft Rime (fragile deposit of needles and scales of ice on upright surfaces; limited to temperatures <-8°C and calm or light wind conditions; the deposit can be easily shaken off objects)
		Hard Rime (As above but hard granular and crystalline ice; forms in strong winds with temperatures -2°C to -10°C; the deposit is difficult to shake off objects)
		Clear Ice (Similar to glaze, but formed by supercooled water droplets freezing on exposed surfaces; unlike the above two, clear ice lacks air pockets)
		Glaze (a deposit of clear ice produced by freezing rain)
		Water Spout (tornado over sea or lake)

Mixed Precipitation		
dr		Drizzle and rain
rs		Rain and snow (Sleet)
hs		Hail and snow
hr		Hail and rain

Lithometeors		
'Lithometeors' are phenomena caused by the presence in the atmosphere of solid particles, e.g. dust, pollen, sand, smoke, etc.		
z		Haze (the presence of microscopic particles in the air in sufficient quantities to give the sky an opalescent appearance; visibility is often reduced; most common in calm anticyclonic weather in summer in Britain, when pollen, dust and pollution contaminate the air)

	Dust Haze (common in desert regions and in downwind areas, which can stretch for over 1000km)
	Smoke (suspension of mainly carbon and hydrocarbon particles produced by combustion; much reduced in Britain since the Clean Air Acts; common where forest fire occur)
	Drifting or Blowing Dust or Sand (associated with turbulent winds in deserts, dunes and drought-stricken areas)
	Drifting Dust or Sand (dust and sand not rising above eye-level: 1.8 metres)
	Blowing Dust or Sand (dust and sand rising to greater heights; it may be enough to veil the sky or sun at times)
	Duststorm or Sandstorm (sand or dust raised to great heights by strong turbulent wind; visibility <1km; desert and drought-stricken areas only)
	Wall of Sand or Dust (common at the leading edge of a duststorm or sandstorm)
	Dust Whirl or Sand Whirl - 'Dust Devil' (swirling cloud of dust/sand raised from the ground in a vortex; caused when air at ground level becomes very unstable, e.g. by rapid heating in strong sunshine; usually short lived < 60 seconds)

Photometers	
'Photometers' are luminous optical phenomena caused by the refraction of light due to passage through ice crystals (especially in cirrus clouds), rain, water droplets, etc. There are no Beaufort Letters for photometers.	
	Solar Halo (a ring of bright light around the sun, usually white, but sometimes running from reddish nearer the sun to yellow, green or even violet on its outer edge. The 22° halo is most common and often 'complete'. The 46° halo is rarer and almost always incomplete.
	Lunar Halo (as above but surrounding the moon))
	Solar Corona (one or more sequences of coloured rings of small diameter - 5° for the inside ring ; the inside of each ring is violet or blue and the outside red; solar coronae can only be seen if the sun is much dimmed due to cloud cover; coronae are caused by passage of light through very small water droplets)
	Lunar Corona (as above, but for the moon, and much more frequently seen)
	Irisation (colours, often resembling mother of pearl, appearing on clouds, especially in bands parallel to their margins; the effect is usually to be seen within 10° to 40° of the sun)

	Glory (one or more sequences of coloured rings seen by an observer around his/her own shadow on a cloud; occurs frequently on mountains when there is mist or cloud on one side of the observer but not on the other; the phenomena is similar to a corona feature, but the light is refracted backwards; when the shadow is large it is often described as a Brocken Spectre , after the German mountain where it was first described)
	Rainbow (a group of concentric arcs with colours ranging from violet to red; caused by refraction of light by precipitation; Inside the primary rainbow, the brightest one, there may be further, fainter, supernumerary rainbows; viewed from above, rainbows appear as complete circles)
	Fog-bow (With fine and very small water droplets < 0.05 mm all the colours except perhaps violet are lost. Artificial fogbows can sometimes be seen on dark foggy nights when you stand with a streetlight to your back. They appear like ghostly arches over a darker core. Natural fogbows are best seen when the sun is very low and red, e.g. dusk or dawn.)
	Bishop's Ring (a whitish ring centred on the sun or moon, bluish on the inside and reddish brown on the outside; inner radius 10o; outer radius 20o; very rare - they tend to occur after violent volcanic eruptions, e.g. Krakatoa 1883, and after the impact of meteorites, e.g. Siberia 1908, or close passes of comets; they therefore seem to be associated with the passage of light through very fine high altitude dust)
	Mirage (an image, usually wavering, of distant objects, which appear distorted, often inverted; mirages are caused by large temperature gradients in the air immediately above the ground producing different refractive indices)
	Zodiacal Light (This occasional appears a cone shaped area above the horizon in the position where the sun has just set, or in the position where it is just about to rise. The light can remain visible with the stars in an otherwise dark sky; it is extremely rare outside the tropics)

Electrometeors		
'Electrometeors' are phenomena associated with electrical discharges in the atmosphere		
tl		Thunderstorm (thunder must be audible at the site before a thunderstorm can be recorded)
l		Lightning (there are three common types: ground discharge - where the lightning strikes the ground; it is often in a branched form, hence the name 'forked' lightning; cloud discharge - lightning that is within the cloud - its channel is often indistinguishable and we normally refer to it as 'sheet' lightning; air discharge - often sub-horizontal, it runs from cloud to air outside the cloud; sometimes called 'streak' lightning; a fourth and rare form is ball lightning , which appears near the ground usually after a ground discharge; it varies between 10cms and 1 metre in diameter, 'floats' around for several seconds and usually dissipates with a violent explosion)

		Saint Elmo's Fire (a rare bluish-purplish white electrical discharge that 'coats' projecting objects, e.g. church spires, masts, aircraft wings, etc. causing them to glow; it only occurs in thundery weather when very strong electrical field develop)
		Polar Aurora (luminous arcs, bands, drapes and curtains of light, that form due to the impact of electrically charged particles from the sun impacting on rarefied gases high in the atmosphere, between 60 and 1000 km; concentrated over the magnetic poles; rarely visible in southern Britain)

Miscellaneous		
j		Within Sight (used as a suffix for other phenomena, e.g. pj = shower within sight, but not over the recording station).
		Within Sight and within 5 km (i.e. if the phenomena is 'close' to the station; in this case the symbol means 'rain within sight')
		Within Sight and beyond 5 km (i.e. if the phenomena is 'far' to the station)
		Precipitation not reaching the ground (in this case, rain; this is a common occurrence in showery weather when the relative humidity is low, e.g. in cool polar maritime air over Britain, trails of falling rain or snow can be seen beneath clouds, but the air is so dry that they evaporate before touching the surface)
e		Wet Air (wet air, but without rain falling)
y		Dry Air (relative humidity < 60%)
u		Ugly Threatening Sky (e.g. before the onset of a thunderstorm)
v		Abnormally good visibility (e.g. over 50 miles)
p		Shower (a relatively short period of precipitation; the type is indicated by additional letters or symbols)

Surface Wind		
g		Gale (wind speed averaging between 34 and 47 knots for a period of 10 minutes or more)
G		Storm (wind speed averaging over 47 knots for a period of 10 minutes or more)
q		Squall (a strong wind that rises suddenly and lasts for at least a minute then dies away relatively quickly; an increase of 16 knots to a speed over 22 knots is required)

kq		Line Squall (as above but occurring along the line of a cold front and accompanied by a roll shaped cloud with a horizontal axis and a sharp fall in temperature)
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Beaufort Code Conventions

Assessing Intensity

We need to differentiate between, light/weak, moderate, heavy and violent/Severe events, such as rainfall, thunderstorms, lightning, (and to a lesser extent with fog), fog, etc.

- **Weak/Light:** a subscripted suffixed 'o' is used, e.g. r_o, s_o, d_o mean light rain, snow and drizzle respectively. For **very** light precipitation a double 'o' may be used, e.g. s_{oo}. This, however, is non-standard.
- **Moderate:** simple lower case letters, e.g. r, s, d, f, tl
- **Heavy:** capital letters, e.g. R, S, D, H, F, TL
- **Violent/Severe:** a subscripted suffixed '2' is used, following a capital letter e.g. R₂ indicates torrential rain.

Where international symbols are used on a synoptic chart, the symbols are repeated according to the severity, e.g.

Light Snow		Moderate Snow		Heavy Snow	
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The same procedure is used for rain, hail, etc.

Assessing Continuity

If a phenomenon is **continuous**, the code is simply repeated, e.g. rr represents continuous rain, s_os_o represents continuous light snow. If a phenomena is **intermittent** (i.e. broken by intervals less than an hour long) the prefix 'i' is used, e.g. ir_o means intermittent light rain.

Shower Length

The difference between a lengthy shower and a period is rather subtle. By definition showers can only fall from convective cloud (cumulus and cumulonimbus), and are usually broken by sunny spells or clear interludes. There is **no standard way** of differentiating between short, medium and lengthy showers. However, an easily applied non-standard solution is to use the same suffixes as for intensity, to refer to length, e.g.

- p_oR = short shower of heavy rain.
- p_{oo}r_{oo} = fleeting shower of very light rain, e.g. just a few drops, not enough to completely wet the ground.

- Pr_o = lengthy short of light rain.

Shower Frequency

This is another non-standard convention. Official staffed weather stations would actually record the precise times of showers. For those of us who have other jobs to do the following method may suffice:

- (f)p_oRH = frequent short showers of heavy rain and hail
- (o) pr_o = occasional showers of light rain

Ensure that the brackets are used, otherwise 'f' means 'fog' and 'o' means 'overcast'.

Code Order

When several phenomena occur together they are recorded in the following order:

1. State of sky
 2. Thunderstorm
 3. Precipitation
 4. Atmospheric obscurity (visibility)
 5. Other phenomena
- **Example:** cTLrzu = cloudy with a heavy thunderstorm and moderate rain, haze present and an ugly threatening sky.

Coding a Sequence of Weather

Beaufort Code can be used for a current weather status report, i.e. for a fixed point in time, or it can be used to record weather throughout the day, to show the sequence of weather events. Where it is used to represent a sequence a comma can be used to separate events, e.g.

- **Code:** b, bc, c, oir_o, or_or_o, orr, cRR, bc(o)pR
- **Translation:** cloud cover less than 2 oktas increasing to over 6 oktas, eventually 8 oktas with a dull featureless sky and intermittent light rain, becoming continuous, moderate and heavy, with a more differentiated cloudy sky of 8 oktas, followed by a cloud cover of 3 to 5 oktas and occasional showers of heavy rain

Most observers will add additional information in code sequences, often in brackets, e.g. the time of certain events, descriptions of phenomena which have no Beaufort Code (the international symbols may be used), number of discharges in a thunderstorm, types of cloud present, etc.

Curly brackets are used to indicate sunrise } and sunset {, e.g.

RR } c = continuous heavy rain before sunrise, followed by cloudy dry weather after sunrise

Cloud cover and types of cloud are also embedded in the Beaufort Code strings, inside square brackets, e.g. [50Cu(con)], which would indicate a cover of 50% Cumulus congestus.

There is a separate download available covering cloud codes.

Thunderstorms

The details of thunderstorms are included inside a double set of backslashes, e.g.

\\[0130-0215][33cc25cg]\\ which means the storm lasted from 0130 to 0215 GMT/UTC and consisted of 33 inter-cloud discharges (usually appearing as sheet lightning, especially at night) and 25 cloud to ground (or vice-versa) discharges.

Snow Lying

Snow lying (over 50% ground cover) at any point in the day is indicated by the usual Beaufort letters, plus a double superscripted asterisk, e.g.

C**[3cm]

The average snow depth is indicated inside square brackets using centimetres or millimetres]

Fronts

Fronts are indicated by a double set of capital letters:

- **W_F** warm front
- **C_F** cold front
- **O_F** occluded front
- **S_F** stationary front

which are colour coded with the F subscripted in downloaded excel spreadsheets, but not in queries running from the website, which simply return two capital letters.

Assessing Visibility

Visibility is of major importance for safe functioning of transport systems, especially aircraft, motor vehicles and shipping. Most major accidents occur at times when visibility is reduced by fog, snow, heavy rain, spray, etc.

Assessing visibility, however, is not an easy task. The simplest method involves selecting easily identified objects in the landscape at specified distances from the weather station. Depending on whether a chosen object can be clearly seen, the point on the Met Office visibility scale can be recorded.

Object	Standard Distance	Visibility Description	Visibility Code
None	<20m	Dense Fog	X
A	20m	Dense Fog	E
B	40m	Thick Fog	0
C	100m	Thick Fog	1
D	200m	Fog	2
E	400m	Moderate Fog	3
F	1000m	Very Poor	4
G	2km	Poor	5
H	4km	Moderate	6
I	7km	Moderate	6
J	10km	Good	7
K	20km	Very Good	8
L	30km	Very Good	8
M	40km	Excellent	9