# Water Awareness and Charge Certificate Manual

## Module 23: Weather Conditions and Cloud Formations

Current Document Revision Number: 1.4

Revision Date: 18 November 2019

### Module Contents

| Module Title | | Comments | Rev No | Revision Date |
|---|---|---|---|---|
| Module 23: | Weather Conditions and Cloud Formations | Initial Release | 1.0 | 23 Mar 2010 |
| Module 23: | Weather Conditions and Cloud Formations | Formatting | 1.1 | 23 Mar 2010 |
| Module 23: | Weather Conditions and Cloud Formations | Completed Section 1.2 | 1.2 | 3 Jan 2016 |
| Module 23: | Weather Conditions and Cloud Formations | Outcomes Added | 1.3 | 1 Aug 2017 |
| Module 23: | Weather Conditions and Cloud Formations | Section on Lightning | 1.4 | 18 Nov 2019 |

# Outcomes

After completing this module, the certificate holder will be able to:

- Explain the importance of weather in planning activities.
- List ways of obtaining weather forecasts
- Recognize major could types and their associated weather patterns

# 1 WEATHER CONDITIONS

This is probably the most important factor to consider when planning a trip or expedition. Each geographical area has a weather pattern of its own. The mountains have a different pattern to the Highveld and the coastal zones differ again even to being different along the length of coastline and East and West coasts.

Highveld weather changes very quickly especially in summer and violent storms can suddenly build up with hail and lightning a definite danger. All large bodies of water have their own micro climate formed by hot air passing over the cooler water creating wind currents, thermals etc. The large open expanse allows winds to build up speed and this has a dramatic effect on the surrounding areas and especially on the surface of the water. Bad weather is usually accompanied by poor visibility and this, coupled with a very choppy wave action due to the shallow formation of dams can make for a very uncomfortable and dangerous journey.

It is far better to have an indication of what weather to expect before commencing any journey and avoid unpleasant surprises. Learn to judge local weather conditions through experience and obtain forecasts.

Rather be safe than sorry but there is always going to be a time when, after all precautions have been taken, the weather will turn bad. This is when the skills of the person in charge will really be put to the test and the lives of others are dependent upon your decisions. Rather take early evasive action than place yourself in danger. Always exercise great caution in fog, mist, heavy rain or any other condition of poor visibility and head for the nearest safe shore.

Be observant of clouds and any murkiness in the southern sky as this usually heralds the build-up of Highveld storms. The wind will start to blow in fitful sudden gusts, blowing TOWARDS the budding storm. A cold front is pushed ahead of the storm and this drop in temperature is a sure sign of bad things to come. The puffy CUMULUS clouds suddenly turn dark and form masses of black clouds. Thunder and lightning flashes make themselves known. The thunderheads can rise up for thousands of meters into the sky creating updrafts which suck up the water droplets. These freeze and stick together to form hail when the reach the cold upper air and fall to earth as their mass increases.

A sure sign of impending weather change is the high wispy horses' tails of CIRRUS clouds indicating winds and water vapour in the upper atmosphere. A change can usually be expected WITHIN 24 hours.

Most areas have a seasonal pattern of expected weather and this is usually a good indication of what to expect. For example, the Highveld is a summer rainfall area, whereas the Western Cape is a winter rainfall area. Local knowledge should also be sought before beginning journeys or activities.

Wind is a very important weather factor that must at all times be taken into account when boating/swimming. Never allow boating to take place in high wind conditions as this could prove dangerous even at times for experienced persons.

*Discretion is the better part of valour.*

## 1.1 Beaufort Wind Scale

| Beaufort Scale | Wind strength in knots | Land signs | Dinghy criteria |
|---|---|---|---|
| 0 | Calm Less than 1 | Smoke rises vertically. Leaves do not stir. | Drifting conditions. Heel the boat to reduce the wetted surface and enable the sails to assume an aerofoil shape. Make no sudden movements. |
| 1 | Light airs 1-3 | Smoke drifts. Wind vanes do not respond | Sufficient to maintain gentle forward motion. Sails should be flattened. Crew balance boat to keep it slightly bow down and heeled toward leeward. |
| 2 | Light breeze 4-6 | Wind felt on the face. Leaves rustle. Light flags not extended. Wind vanes respond. | Sufficient to sail at an even speed with the boat upright. Sails can be full but must be adjusted to changes in wind speed and direction. |
| 3 | Gentle breeze 7-10 | Light flags extended. Leaves in constant motion. | Most dinghies will sail at hull speed. Planing possible for thoroughbred dinghies. Ideal conditions for learners. |
| 4 | Moderate breeze 11-16 | Most flags extend fully. Small branches move. Dust and loose paper may be raised. | Crew fully extended. Planing on most points of sailing. A learners gale -make for shore. |
| 5 | Fresh breeze 17-21 | Small trees in leaf sway. Tops of all trees in noticeable motion | Ideal sailing conditions for experienced sailors. Capsizing common amongst more inexperienced crews. |
| 6 | Strong breeze 22-27 | Large branches in motion. Whistling heard in wires. | Dinghy sailors gale. Often difficult to make progress without reefing. Only experienced crews race. |
| 7 | Near Gale 28-33 | Whole trees in motion. Inconvenience felt when walking against wind. | Most dinghies remain on shore. Those who go afloat risk gear failure and being overpowered. |
| 8 | Gale 34-40 | Twigs broken off trees. Generally impeded progress on foot. Rarely experienced on land. | Dinghies should be securely tied down to prevent them blowing over. |

| Force | km/h (knots) * | Pressure kpa | Desc. | Wave pattern | Wave heights | Effects on land | Small cruiser |
|---|---|---|---|---|---|---|---|
| Force 1 | 2 - 6 (1–3) | 0.03 - 0.25 | Light airs | Glassy calm, some ripples | Flat | Flag hangs limp, windvanes do not respond. | Use motor. Steerageway possible; full main and large drifter. |
| Force 2 | 7 - 11 (4–6) | 0.44 - 1.35 | Light breeze | Overall ripple pattern | 0-12cm | Flag stirs, leaves rustle, wind felt on face, wind vanes move. | Boat begins to heel, full main and drifter or #1 genoa. |
| Force 3 | 13 - 19 (7–10) | 1.77 - 3.97 | Gentle breeze | Small glassy waves | 12 - 30cm | Flag occasionally extends, leaves and twigs in constant motion. | Comfortable sailing. Noticeable heeling; full main and #1 genoa. |
| Force 4 | 20 - 30 (11–16) | 4.66 - 8.89 | Moderate breeze | Longer waves | 30 - 45cm | Flag flaps, small branches move, dust and paper raised. | Great sailing. Boat making speed. Full main and #1 genoa. |
| Force 5 | 31 - 39 (17–21) | 9.93 - 15.9 | Fresh breeze | Some whitecaps | 45 - 80cm | Flag ripples, small leafy trees begin to sway. | Leeward rail near water. Single reef in main and #2 genoa. |
| Force 6 | 40 - 50 (22–27) | 17.2 - 26.5 | Strong breeze | Whitecaps, some spray | 80 - 120cm | Flag snaps, large branches in motion, whistling in wires. | Sailing becomes strenuous. Second reef in main and working jib. |
| Force 7 | 51 - 61 (28–33) | 28.2 - 39.8 | Moderate gale | Swells form with whitecaps | 1.2 - 1.7m | Flag extended, whole trees in motion. | Progress to windward impossible. Three reefs in main and working jib. |
| Force 8 | 62 - 74 (34–40) | 41.9 - 58.3 | Fresh gale | Foam blown off wave tops in well marked streaks | 1.7 - 2.3m | Twigs and small branches broken, difficult to walk. | Limit of boat's sailing ability. Use motor or seek shelter. |
| Force 9 | 75 - 87 (41–47) | 61 - 80 | Strong gale | Waves begin to heighten and roll | 2.3 - 3m | Slight structural damage occurs. | Run under bare poles, lie ahull, or sit to sea anchor. |
| Force 10 | 88 - 100 (48–55) | 83 - 109 | Whole gale | Very high rolling waves with long over-hanging crests | 3 - 4m | Trees broken or uprooted, considerable damage. | Swear oaths you will not keep once back on land. |

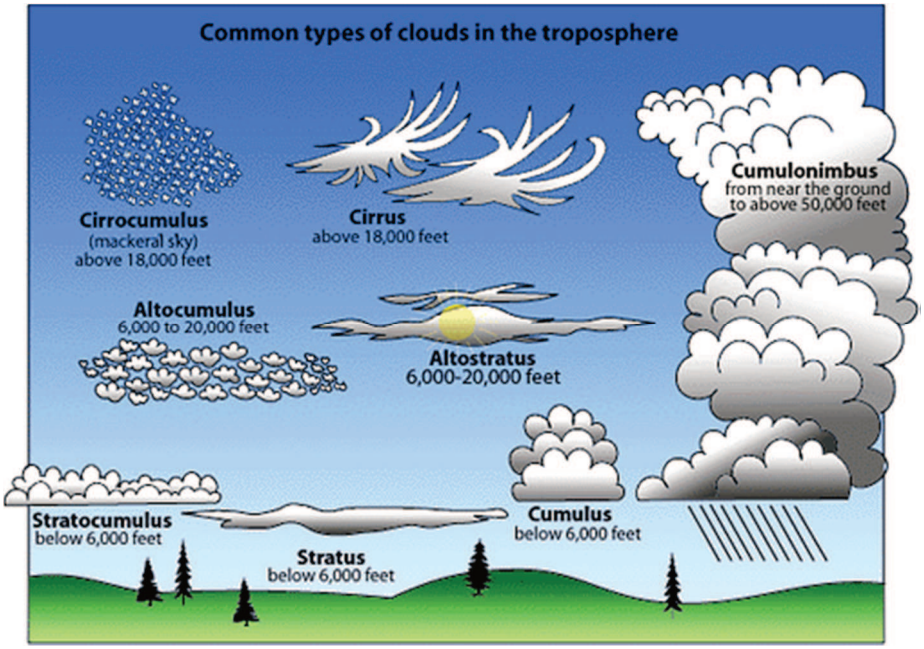
## 1.2 Obtaining Weather Information

Weather information is widely available today via TV, print media and the Internet. All major TV news channels provide fairly detailed weather forecasts for up to 3 days. The South African Weather Service (http://www.weathersa.co.za/) provides 7 day forecasts, satellite photos, synoptic charts and weather warnings.

Smartphone apps such as Accuweather provide forecasts on an hourly basis

# 2 CLOUD FORMATIONS

## CLOUD IDENTIFICATION




## 2.1 Warning Clouds

These clouds warn of potential danger in terms of lightning, thunder, possible hail and (usually) heavy rain.

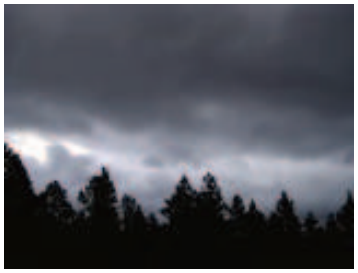
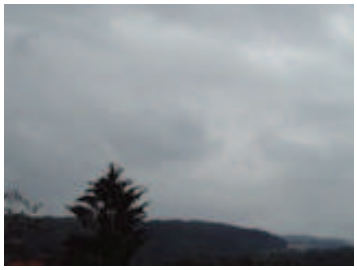
**Cumulonimbus clouds** are thunderstorm clouds that form if cumulus congestus clouds continue to grow vertically. Their dark bases may be no more than 300 m (1000 ft) above the Earth's surface. Their tops may extend upward to over 12,000 m (39,000 ft). Tremendous amounts of energy are released by the condensation of water vapour within a cumulonimbus. Lightning, thunder, and even violent tornadoes are associated with the cumulonimbus

## 2.2 Other Clouds

### 2.2.1 Stratus Clouds

**Stratus clouds** are uniform grayish clouds that often cover the entire sky. They resemble fog that does not reach the ground. Usually no precipitation falls from stratus clouds, but sometimes they may drizzle. When a thick fog "lifts," the resulting clouds are low stratus.

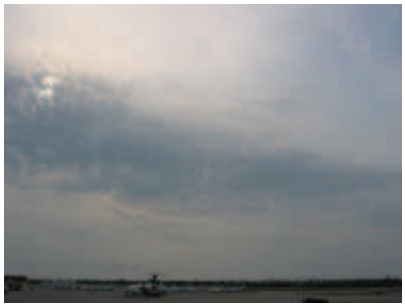

**Nimbostratus** clouds form a dark gray, "wet" looking cloudy layer associated with continuously falling rain or snow. They often produce precipitation that is usually light to moderate.

**Alto Clouds**

Clouds with the prefix "alto" are middle level clouds that have bases between 2000 and 7000 m.

**Altocumulus** clouds are middle level clouds that are made of water droplets and appear as gray, puffy masses, sometimes rolled out in parallel waves or bands. The appearance of these clouds on a warm, humid summer morning often means thunderstorms may occur by late afternoon.




**Altostratus clouds** are gray or blue-gray middle level clouds composed of ice crystals and water droplets. These clouds usually cover the entire sky. In the thinner areas of the cloud, the sun may be dimly visible as a round disk. Altostratus clouds often form ahead of storms that will produce continuous precipitation.

### 2.2.2 Cirrus Clouds

**Cirrus clouds** are thin, wispy clouds blown by high winds into long streamers. They are considered "high clouds" forming above 6000 m. Cirrus clouds usually move across the sky from west to east. They generally mean fair to pleasant weather.

**Cirrocumulus clouds** appear as small, rounded white puffs. The small ripples in the cirrocumulus sometimes resemble the scales of a fish. A sky with cirrocumulus clouds is sometimes referred to as a "mackerel sky."

### 2.2.3 Cumulus Clouds

**Cumulus clouds** are puffy clouds that sometimes look like pieces of floating cotton. The base of each cloud is often flat and may be only 1000 m (330 ft) above the ground. The top of the cloud has rounded towers. When the top of the cumulus resembles the head of a cauliflower, it is called cumulus congestus or towering cumulus. These clouds grow upward, and they can develop into a giant cumulonimbus, which is a thunderstorm cloud.

# 3 LIGHTNING

## 3.1 Introduction

Lightning is a naturally occurring electrostatic discharge during which two electrically charged regions in the atmosphere or ground temporarily equalize themselves, causing the instantaneous release of as much as one gigajoule of energy. This discharge may produce a wide range of electromagnetic radiation, from very hot plasma created by the rapid movement of electrons to brilliant flashes of visible light in the form of black-body radiation. Lightning causes thunder, a sound from the shock wave which develops as gases in the vicinity of the discharge experience a sudden increase in pressure. Lightning occurs commonly during thunderstorms and other types of energetic weather systems.

The three main kinds of lightning are distinguished by where they occur: either inside a single thundercloud, between two different clouds, or between a cloud and the ground. In general, cloud-to-ground (CG) lightning flashes account for only 25% of all total lightning flashes worldwide. Because human beings are terrestrial and most of their possessions are on the Earth where lightning can damage or destroy them, CG lightning is the most studied and best understood of the three types, even though IC and CC are more common types of lightning.

In the case of CG lightning, the negatively charged bottom part of the storm sends out an invisible charge toward the ground. When the charge gets close to the ground, it is attracted by all the positively charged objects, and a channel develops. The subsequent electrical transfer in the channel is lightning. Not all lightning forms in the negatively charged area low in the thunderstorm cloud. Some lightning originates in the top of the thunderstorm, the area carrying a large positive charge. Lightning from this area is called positive lightning.

Positive lightning is particularly dangerous, because it frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles

(8 or 16 kilometers) from the storm, in areas that most people do not consider to be a lightning-risk area.

## 3.2 Dangers

Scaring from a lightning strike

Lightning can kill or cause cardiac arrest. Injuries range from severe burns and permanent brain damage to memory loss and personality change. About 10 percent of lightning-stroke victims are killed, and 70 percent suffer serious long-term effects.

Objects struck by lightning experience massive heat and magnetic forces. The heat created by lightning currents traveling through a tree may vaporize its sap, causing a steam explosion that bursts the trunk. As lightning travels through sandy soil, the soil surrounding the plasma channel may melt, forming tubular structures called fulgurites.

People on or in or near water are among those most at risk during thunderstorms. Swimming is particularly dangerous, as not only do swimmers protrude from the water, presenting a potential channel for electrical discharge, but also because water is a good conductor of electricity.

## 3.3 Lightning detection

A lightning detector is a device that detects lightning produced by thunderstorms. There are three primary types of detectors: ground-based systems using multiple antennas, mobile systems using a direction and a sense antenna in the same location (aircraft or handheld system), and space-based systems. The first such device was invented in 1894 by Alexander Stepanovich Popov. It also was the first radio receiver in the world.

Ground-based and mobile detectors calculate the direction and severity of lightning from the current location using radio direction-finding techniques along with an analysis of the characteristic frequencies emitted by lightning. Ground-based systems use triangulation from multiple locations to determine distance, while mobile systems estimate distance using signal frequency and attenuation. Space-based detectors on satellites can be used to locate lightning range, bearing and intensity by direct observation

Decent hand held portable detectors are available in South Africa for around R4000 (2019 price). Some apps such as "Lightning Alarm" are available for iPhone and Android at no cost. These apps use space based identification systems.

### 3.3.1 The 30-30 rule

When visibility is good and there is nothing obstructing your view of the thunderstorm, you can apply the 30-30 rule. When you see lightning, count the time until you hear thunder. If that time is 30 seconds or less, the thunderstorm is within six miles (ten kilometers) of you and is dangerous. Seek shelter immediately.

The threat of lightning continues for a much longer period than most people realize. Wait at least 30 minutes after the last clap of thunder before leaving shelter. Don't be fooled by sunshine or blue sky!

## 3.4 Safe Areas

When you hear thunder, immediately move to safe shelter: a substantial building with electricity or plumbing or an enclosed, metal-topped vehicle with windows up.

- NO PLACE outside is safe when thunderstorms are in the area!!
- If you hear thunder, lightning is close enough to strike you.
- Stay off corded phones, computers and other electrical equipment that put you in direct contact with electricity.
- Avoid plumbing, including sinks, baths and faucets.
- Stay away from windows and doors, and stay off porches.

If you are caught outside with no safe shelter anywhere nearby the following actions may reduce your risk:

- Immediately get off elevated areas such as hills, mountain ridges or peaks
- Never lie flat on the ground
- Never shelter under an isolated tree
- Never use a cliff or rocky overhang for shelter
- Immediately get out of ponds, lakes and other bodies of water
- Stay away from objects that conduct electricity (barbed wire fences, windmills, etc.)