CHAPTER 7

WIND

7.1 GENERAL: Wind is defined as air in motion. It represents the horizontal flow of air at a height of 10 m. Wind information is included in all surface weather reports and shall contain both velocity (direction and speed) and character. For meteorological purposes, the wind direction is reported with respect to True North and the speed is expressed in nautical miles per hour (kt).

7.1.1 Direction: the wind direction is the direction from which the air is moving. It represents the average direction during the TWO minute period ending at the time of observation.

7.1.2 Speed: the wind speed is the rate of air flow past a fixed point. It represents the average speed during the TWO minute period ending at the time of observation. The term CALM is used to describe an apparent absence of wind flow.

7.1.3 Character: wind character is reported when there are significant variations in the wind speed, during the TEN minute period ending at the time of the observation. The character will be reported as a GUST or SQUALL depending on the magnitude and duration of the variation.

7.1.3.1 Gusts: gusts are sudden, rapid, and brief changes in the wind speed. They are characterized by the more or less continual fluctuations between the high (peak) and low (lull) speed.

7.1.3.1.1 These criteria for reporting gusts are the same as criteria used by autostations. Gusts shall be reported when:

(a) the highest peak speed is at least 5 kt higher than the current two minute average and

(b) the highest peak is at least 15 kt.

7.1.3.2 Squalls: Squalls are essentially gusts with a longer duration of higher speeds. Squall speeds are reported only by stations with a recording wind instrument and then only when the following criteria are recorded:

(a) the wind speed increases by 15 kt over the two minute average speed that preceded the increase

(b) the duration of the peak speed period is at least two minutes

(c) the wind speed attains a one minute mean of at least 20 kt, during the peak speed period

(d) the wind speed diminishes by at least 5 kt.

7.1.3.2.1 The speed to be reported is the highest one minute mean speed.

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7.1.3.2.2 When the Beaufort scale is used for estimating wind speed, (refer para. 7.6) the following criteria should be used for the reporting of squalls. "A sudden increase in wind speed by at least three stages of the Beaufort Scale, the speed rising to force 6 or more, lasting for at least two minutes and then diminishing by at least one stage or more."

7.1.4 Wind Shift is a definite change in the general direction from which the wind is blowing.

7.1.4.1 A wind shift shall be recorded when all of the following occur:

(a) The direction from which the wind is blowing changes by 45° or more

(b) The change in direction takes place in less than 15 minutes

(c) The average wind speed at the completion of the shift is 10 kt or more.

7.1.4.2 The time of the wind shift shall be the time at which the wind begins to shift.

Note: A change in wind speed from calm to 10 kt or more is not considered a wind shift.

7.1.5 Variable Direction: Wind direction is defined as variable when the wind direction varies by 60° or ore in the 10 minute period preceeding a wind observation and the mean wind speed has been greater than 3 knots.

7.1.5.1 When direction is variable, the two extreme directions shall be reported in a clockwise fashion.

7.2 WIND INSTRUMENTS. The standard instrument for measuring the wind is the anemometer, which is normally exposed at the internationally agreed height of 10 m. Several types of anemometers are used in Canada. They are described in detail in the appropriate instrument manuals and briefly below.

7.2.1 Type 45 Anemometer. This type of anemometer is usually connected to a step recorder which is equipped with pens to record the wind direction and speed. Wind direction (to eight points of the compass) and speed values may be obtained for any desired period by examining the recorder charts.

7.2.1.1 A lamp type flashing light indicator may also be used with this equipment; the wind speed being indicated by the rate of flashing of a lamp, and the wind direction by the lighting of lamps corresponding to the main points of the compass. Care shall be taken that the minor points of the compass, such as NNE, ENE, etc., are not neglected when observing wind direction. When one lamp burns steadily, with or without occasional flashes of either or both adjacent lamps, the direction of the lamp burining steadily shall be taken as the mean wind direction. When one lamp burns steadily with an adjacent lamp buring more than 50% of the time or when both lamps burn intermittently, the direction is in between the direction indicated by these lamps.

7.2.1.2 The Type 45 Anemometer does not indicate or record peak speeds but gives reliable mean values. The observer should use visual observation and estimations to supplement the instrument data during gusty and squally conditions.

7.2.2 The U2A System. This system consists essentially of two parts, a wind speed measuring system and a wind direction measuring system.

7.2.2.1 The wind speed measuring system comprises a small direct current generator driven by a cup wheel, which in turn is driven by the force of the wind. The output voltage of the generator is proportional to the speed of rotation of the cup wheel, and therefore proportional to the wind speed. The output of the wind speed detector is connected to a remote dial indicator by means of cables.

7.2.2.2 The wind direction measuring system comprises a precision positional motor or synchro, controlled by a wind vane, which in turn reacts to the ambient wind direction. The output of the detecting positional motor is connected to a receiving positional motor by means of cables. The receiving positional motor is fitted with a pointer and housed in a remote dial indicator.

7.2.2.3 The outputs from the wind speed and wind direction detectors may also be connected to a remote strip chart recorder, which provides a continuous analog record of the wind speed and wind direction at the station.

7.2.2.4 The wind speed system is self energized and requires no external power supply.

7.2.2.5 The wind direction system requires a power supply of 32 or 115 volts, 60 Hz connected through a suitable transformer and normally applied at an indicator panel.

7.2.2.6 The U2A Anemometer has a fairly low lag factor and produces more or less instantaneous values of speed and direction. By examining the chart record for the appropriate period or by observing the dial indicators over a period of time, mean values of wind speed and direction can be approximated and gust or squall conditions determined.* To obtain mean values, the dial indicators or the recorder chart traces should be observed for the required period. The position on the dial or chart over which the indicator or recorder pen moved for the major part of the time shall be determined, neglecting brief movements above and below this position. The mid–point of this position shall be taken as the mean value, for example, if the dial indicator or recorder pen moved mainly in the range 12 to 18 knots, with gusts up to 28 knots, and lulls down to 8 knots, the mean wind speed shall be taken as 15 knots. The same method shall be followed in determining the mean wind direction.

*Note: Refer paras. 7.4.4 and 7.5.4 for order of preference when both U2A Dial and U2A Recorder equipment are available.

7.2.3 The 78D Anemometer System. The basic system consists of a 78D anemometer and a display. The anemometer is a cup and vane anemometer using U2A cups, vanes, and housings. The 78D anemometer uses low power, high reliability, optoelectronic transducers and has a built in microcomputer to sample and calculate five second vector components of wind. Every five seconds a wind message is transmitted to the display unit which provides further averaging for periods of two and ten minutes as well as displaying these values and determining and displaying significant wind gusts. The display unit operates on 115 VAC and supplies the 12 VDC necessary for the anemometer. The observer can select the two or ten minute average wind on the display by means of a simple switch. Different configurations possible with the 78D system include the addition of an analog type chart display and multiple displays on a single anemometer.

7.2.4 Collocated Automatic Weather Stations. Wind direction and speed may be derived hourly from transmitted reports of collocated automatic stations. Automatic stations currently in use – MARS I, MARS II, MAPS I, MAPS II, and READAC – use a variety of sensors, generally exposed at the standard 10 metre height. The wind velocity is generally averaged over a 10 minute period, however in the case of MAPS I, the direction is averaged over two minutes and the speed over 10 minutes. The MAPS I and MARS I report wind speeds in miles per hour; the other autostations mentioned above report wind speed in knots. Hourly wind reports from a READAC station are averaged over a two minute period; synoptic wind reports from a READAC station are averaged over 10 minutes. Wind directions from all of the above autostations are reported in tens of degrees.

7.2.5 Anemometers at Low Wind Speeds. The standard types of anemometer do not give accurate results at speeds less than 2 knots. The observer must estimate the direction and speed of the wind in such circumstances to the best of his ability (see para. 7.3). However such estimates shall be considered as equivalent to an instrumental observation of the wind because the indications of the anemometer have been considered.

7.3 ESTIMATION OF WIND. When suitable instruments are lacking or when the instruments are not in operating condition, the wind direction (to 8 points of the compass) and the wind speed and character shall be estimated. This can be done with a fair degree of accuracy by observing the common effects of the wind.

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7.3.1 The direction of the wind may be determined by watching a wind cone, wind vane, or the drift of smoke.

7.3.2 The speed may be estimated by using the Beaufort Scale of Winds which relates common effects of the wind and equivalent speeds in knots (para. 7.6).

7.4 REPORTING WIND – HOURLY OBSERVATIONS

7.4.1 The wind direction and speed reported in the Hourly Observation shall be a two–minute mean. The direction shall be determined to the nearest ten degrees and the speed to the nearest knot. The occurrence of gusts, squalls and wind shifts, and the time of the latter shall also be reported.

7.4.2 The two–minute mean may be readily determined at stations equipped with dial or digital indicators or with a U2A recorder or other analog chart recorder.

7.4.3 When only a step–recorder (Type 45B) is available, the time for the last mile recorded, supplemented by a visual observation of the effects of the wind, shall be used to estimate the two–minute mean.

7.4.4 When there is more than one type of wind instrument installed at a station, the following order of preference shall apply in determining both direction and speed.

(a) U2A or other analog chart recorder

(b) 78D Display or voice generated module output

(c) U2A Indicator (dial)

(d) Flashing Light Indicator (type 45)

(e) Step–recorder (Type 45 – to obtain an estimated two–minute mean).

(f) Collocated Automatic Station (to obtain an estimated two–minute mean).

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7.5 REPORTING WIND – SYNOPTIC OBSERVATIONS

7.5.1 The wind direction and speed reported in the Synoptic Observation shall be a ten–minute mean. If the ten–minute interval prior to the observation includes a discontinuity in the wind data i.e., an abrupt change in direction or speed or a break in the record, only data occurring after the discontinuity shall be used for obtaining mean values: hence the time interval in these circumstances will be correspondingly reduced. The wind direction shall be reported in tens of degrees, using WMO Code 0877 (refer 12.3.2.2) and the speed shall be reported in knots.

7.5.2 The wind direction shall be observed to the nearest ten degrees or to the nearest sixteen points of the compass, depending on the type of anemometer available or to eight points of the compass when it is necessary to estimate the wind direction. For record purposes the wind direction shall be recorded to the nearest ten degrees.

7.5.3 Wind speeds in knots shall be determined from the anemometer. If speeds from the anemometer are obtained in miles per hour they shall be converted to knots, using the table given in para. 12.3.2.3.

7.5.4 When there is more than one type of wind instrument installed at a station, the following order of preference shall apply in determining both direction and speed:

(a) U2A Recorder

(b) Step–recorder (Type 45)

(c) 78D Display

(d) Collocated Automatic Station

(e) U2A Indicator (dial)

(f) Flashing Light Indicator (type 45)

7.6 BEAUFORT SCALE OF WINDS

Descriptive Term	Beaufort Force	Speed Range	Knots Average	Specification for Estimating Speed
Calm	0	Less Than 1		Smoke rises vertically.
Light Air	1	1–3	2	Direction of wind shown by smoke drift but not wind vanes.
Light Breeze	2	4–6	5	Wind felt on face; leaves rustle; ordinary vane moved by wind.
Gentle Breeze	3	7–10	9	Leaves and small twigs in constant motion; wind extends light flag.
Moderate Breeze	4	11–16	14	Raises dust and loose paper; small branches are moved.
Fresh Breeze	5	17–21	19	Small trees in leaf begin to sway; crested wavelets form on inland waters.
Strong Breeze	6	22–27	25	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
Near Gale	7	28–33	31	Whole trees in motion; inconvenience felt in walking against wind.
Gale	8	34–40	37	Breaks twigs off trees; generally impedes progress.
Strong Gale	9	41–47	44	Slight structural damage occurs, e.g., to roofing shingles, TV antennae, etc.
Storm	10	48–55	52	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
Violent Storm	11	56–63	60	Very rarely experienced; accompanied by widespread damage.
Hurricane	12	above 63		