PART A

OBSERVING PROCEDURES – GENERAL

CHAPTER 1

SKY

1.1 CELESTIAL DOME – In this manual "celestial dome" refers to that portion of the sky which is visible in all directions of the local horizon from the point of observation.

1.1.1 Sky Condition – An observation of the sky requires an examination and identification of the clouds and obscuring phenomena (fog, smoke, precipitation, etc.) which prevent an uninterrupted view of the sun, moon, stars or the clear blue of the celestial dome. Such obstructions occur as layers aloft with comparatively level bases or as surface–based layers. Each layer is analysed for its type, amount, opacity, and height of base or vertical visibility.

1.1.2 Clear Sky – Describes the complete absence of layers of cloud or other phenomena obscuring the celestial dome.

1.2 LAYER DETERMINATION

1.2.1 Single Layer – A layer is any amount of cloud or obscuring phenomena, the bases of which are at approximately the same level. A layer may be continuous or formed of detached elements. A similarity in cloud form indicates a formation at about the same level and is therefore a guide in determining that a number of detached elements compose a single layer.

1.2.2 Multiple Layers – The existence of more than one layer is a common occurrence. Differences in cloud form or in direction of motion are valuable aids in distinguishing different layers. Upper layers may also be seen through openings or thin spots in lower layers.

1.2.3 Interconnected Layers – Clouds of vertical development may build up to reach or penetrate upper layers. Also, by horizontal extension, swelling Cumulus or Cumulonimbus may form Stratocumulus, Altocumulus, or dense Cirrus. Careful examination is often necessary to determine the relationship and to distinguish such layers.

1.2.4 Layers Aloft – Most layers occur as "layers aloft" whose bases are sufficiently high above the surface to show clear spaces beneath, e.g., Stratus Fractus at 120 metres; Smoke at 600 metres; Stratocumulus at 1500 metres; Altocumulus at 3000 metres.

1.2.5 Surface–Based Layers – A surface–based layer is a layer whose base is at ground level; e.g., fog, smoke, blowing dust, blowing sand, falling snow, blowing snow.

1.3 LAYER IDENTIFICATION.

1.3.1 Cloud Layers – The description and pictures given in the International Cloud Atlas shall be used for identifying cloud types.

1.3.2 Obscuring Layers – An "Obscuring Layer" is a non–cloud layer which either wholly or partly prevents an observer from seeing the sky or clouds at higher levels. It may be a layer aloft such as smoke, or a surface–based layer such as fog or blowing snow. Precipitation, if heavy enough, can constitute an obscuring surface–based layer.

1.4 LAYER AMOUNT AND OPACITY

1.4.1 Layer Amount is the amount in tenths of the whole sky that is observed to be covered (not necessarily concealed) by a layer aloft or concealed by a surface–based layer.

1.4.1.1 Layer amount (and layer opacity, para. 1.4.4) are observed and recorded in tenths of the whole sky (celestial dome). An amount of less than one tenth shall be called a trace.

1.4.1.2 Layer amount is determined by mentally dividing the sky in halves and estimating the amounts in each half. The halves should be selected to suit the prevailing sky condition. For example, if most or all of the layer is in the northern portion of the sky, the sky should be mentally divided into a northern half and a southern half.

1.4.1.3 During darkness, if stars are plainly visible and no cloud or obscuring phenomenon is observed, the sky shall be considered to be clear. When the stars are dimmed, the dimming is evidence of the presence of cloud or obscuring phenomenon and will be of assistance in determining the amount and opacity of the layer.

1.4.1.4 If the sky is covered by middle or high cloud on a dark night, and a lower layer is present, the amount of the lower layer may be estimated with the aid of the ceiling projector beam or ceilometer recorder record. The proportion of time the layer is observed crossing the projector beam gives some indication of the amount. If the layer is very low, the rotating beam is also useful in this respect. Reflection (sky glow) from city or other lights may also be used to estimate the amount of low cloud. Refer 1.8.6 (g).

1.4.2 Summation Amount at any level is the amount in tenths of the whole sky that " is covered by layers at and below that level.

1.4.2.1 In general, the summation amount is the sum of individual layer amounts. However, traces of layers aloft or surface–based shall be disregarded when determining summation amount. The summation amount cannot exceed 10 tenths.

Example: A trace of Cumulus, 9/10 Altocumulus, and a trace of Cirrus would give a summation amount of 9/10.

1.4.2.2 Portions of upper layers seen through transparencies in lower layers do not increase the amount of sky cover and shall not be counted when determining the summation amount.

Example: 5/10 Stratus with a layer above of 4/10 Altostratus, of which 2/10 are seen through thin portions of the Stratus layer, would give a Summation Amount of 7/10.

1.4.3 Total Amount – is the amount in tenths, of the whole sky that is covered by all layers observed. It is determined in the same way as the summation amount taking all layers into consideration.

1.4.4 Layer Opacity – Represents the portion of the whole sky that is observed to be concealed (hidden, rendered invisible) by the layer. Layer opacity is reported in tenths. No layer can exceed ten tenths, nor can the total of the opacities for all layers exceed ten tenths.

1.4.4.1 If a layer does not conceal any part of the sky, its opacity is zero.

1.4.5 Summation Opacity – is reported in tenths and represents the portion of the whole sky concealed by layers at and below a given level. It is the sum of the opacities of the layers at and below a given level. The opacity of a layer whose amount is a trace shall be disregarded when determining summation opacity.

1.4.6 Total Opacity – is reported in tenths and represents the portion of the whole sky that is concealed by all layers observed. It is determined in the same way as the summation opacity taking all layers into consideration.

1.5 DIRECTION OF MOTION OF LAYERS.

1.5.1 The direction of motion of a layer shall be the direction from which the layer is moving with respect to True North.

1.5.2 Direction of motion is recorded to eight points of the compass, i.e. N, NE, E, SE, etc.

1.5.3 Layers at different levels are often seen to move in different directions and the observer must guard against being deceived when the lower layer is moving rapidly. In such cases higher layers appear to move in the opposite direction to that in which the lower layers are moving, regardless of the true direction of motion of the higher layers.

1.5.4 The observer will find that the direction of motion may be most readily observed if he looks at the layer along a stationary object such as a vertical pole, the side of a building, a tower, etc. If the object and observer are aligned in one of the cardinal directions, it will be simpler to estimate the direction of motion of the layer.

1.5.5 In order that the observer may have ample time to make an accur^ ate observation of the direction of motion of layers, he may make this part of the observation before the main portion of the observation.

1.6 HEIGHT.

1.6.1 Height to be observed.

1.6.1.1 For a layer whose base is above the surface the height of the base of the layer shall be observed.

1.6.1.2 When it is possible to see a considerable distance into the layer, (as shown by a balloon fading very slowly from sight, or by a considerable penetration by the beam of a ceiling projector, or by examination of a ceilometer record) or if it is possible to see out of the layer (as reported by a pilot), the height of the upper limit of such visibility shall be noted. This information, in addition to the height of the base, is important to aircraft operators.

1.6.2 Reference Level. At airport locations, height shall be determined with reference to the official aerodrome level. At non–airport locations, it will be with reference to ground level at the observing station.

1.6.3 Units. Height of layers shall be determined to the nearest 30 m as this represents the order of accuracy that is usual

1.6.4 Vertical Visibility. Vertical visibility is the distance an observer on the ground can see vertically into a surface–based layer. To an observer in an aircraft, ascending or descending through a surface–based layer which completely obscures the sky, vertical visibility is the maximum height from which the observer can see the ground directly below.

1.6.4.1 Vertical visibility shall be considered as unlimited for a given layer when the observer can see through the layer.

1.6.4.2 The height at which a balloon disappears from sight may be used as a guide when estimating the vertical visibility.

1.6.5 Variable height. When the height of the base of a layer is observed to be fluctuating, rising and falling from a mean value by 1/4 or more of the mean value, the height is said to be "variable". Use the mean (average) of all observed values as the recorded height. Example: When the height varies from 300 to 600 m it is considered to be 450 m, variable.

1.7 CEILING.

1.7.1 Ceiling. The term ceiling is usually used with reference to the base of a layer aloft. It may on other occasions refer to the height of vertical visibility in a surface–based layer. In determining the ceiling, both the height and the opacity of the layer/s are considered.

1.7.2 Ceiling Definition: The ceiling is defined as the lesser of:

(a) the height above ground of the base of the lowest layer aloft, at which the summation opacity is 6/10 or more of the whole sky;

(b) the vertical visibility in a surface–based layer which completely obscures the whole sky.

1.7.2.1 Tower Ceiling – a Ceiling (see para. 1.7.2) as considered to exist when observed from the inside of a Control Tower Cab.

Note: Tower Ceilings are observed only by Transport Canada air traffic control personnel, certified to take limited observations from control towers equipped with AES approved ceilometers.

1.8 METHOD OF DETERMINING HEIGHTS OF LAYERS.

1.8.1 Ceiling Balloons and Pilot Balloons – The free flight of balloons which have been inflated with gas to rise at certain assumed rates may be used in determining heights. The Table of Cloud Heights From Ceiling Balloon Ascent (Para. 1.8.8) is provided to convert the elapsed time of flight into height. When a ceiling balloon or pilot balloon is used to determine the height of a layer aloft, the height at which the balloon begins to fade or appears to change colour shall be considered as the base of the layer. When a ceiling balloon or a pilot balloon is used to determine the vertical visibility in a surface–based layer, the point at which the balloon disappears shall be used as a guide in estimating the vertical visibility. Weather conditions, however, may adversely affect the accuracy of balloon determinations as indicated below.

1.8.1.1 Rain and wet snow reduce the rate of ascent and the results in such conditions must be used with caution. Light precipitation such as drizzle or very light rain, and dry forms of precipitation such as snow, do not greatly affect the rate of ascent.

1.8.1.2 Strong winds with poor horizontal visibility may result in too low an indication of height. The large horizontal movement of the balloon in flight aâ nd the reduced visibility may make it appear that the balloon entered cloud before it actually did.

1.8.1.3 Breaks in the layer may result in inaccurate heights unless the balloon is watched carefully to see whether it enters the base of the layer or goes through a break. Although the height at which a balloon enters a break, or the side of a cloud, is a guide for estimating the height of the layer, another balloon should be used if time is available in an attempt to hit the cloud base.

1.8.2 Radiosonde balloons. The height of a layer may be computed at Radiosonde stations by making an entry on the record to indicate the point at which the radiosonde balloon enters the cloud or disappears from sight. Radiosonde balloons are free from the errors inherent in computing heights from assumed rates of ascent, but are subject to the difficulties given in paras. 1.8.1.2 and 1.8.1.3.

1.8.3 Ceiling Projector. This is a small searchlight which projects a narrow beam of light upwards. Heights are determined by the use of an alidade or clinometer. For layers aloft, the alidade shall be directed at the lowest portion of the spot as this represents the actual base of the layer. The remainder of the spot represents penetration into the layer. The apparent top of the beam of light may serve as a guide in estimating the vertical visibility into a surface–based layer.

1.8.3.1 Multiple layers are indicated by the appearance of two or more spots at different levels.

1.8.3.2 False spots, due to reflection from ice crystals, may occur in cold weather. Stepping 5 to 6 metres to one side of the alidade will make such false spots disappear. A false spot will appear only when the projector is directed at an angle to the vertical. For projectors directed at 71° 34′, the height of the false spot will appear at:

450 m (1500′) if the base line is 1000′ (305 m).

342 m (1125′) if the base line is 750′ (230 m).

230 m (750′) is the base line is 500′ (152 m).

1.8.3.3 Just before daylight the heights of layers shall be measured with the projector, to provide a reliable and recent check during the uncertain light at dawn, before it is light enough to use a balloon. In some instances it may also be possible to use a balloon during the faint light of dawn, if the height of the layer is very low.

1.8.4 Ceilometers. These are electronic devices which measure cloud heights during daylight and darkness. A ceilometer consists of a projector/transmitter and detector/receiver either combined in a single unit, or housed in two separate units, and generally installed at the approach end of the principal ILS runway. Indicator and recorder units in the observing office are connected to the field unit(s) by signal and control cables. Two types of ceilometer currently in use are the rotating beam ceilometer and the laser ceilometer. Instrument Manual 75 contains a detailed description and operating instructions for the rotating beam ceilometer. Operating and first line maintenance procedures for the Asea laser ceilometer QL 1212 are given in information bulletins IB 07–005 and IB 07–006 .

1.8.4.1 At stations equipped with a Ceilometer, cloud heights obtained from this instrument shall be used in preference to those obtained by other means. The Ceiling Projector and Ceiling Balloon equipment shall be used as standby or supplementary equipment at these stations.

1.8.4.2 Data from the Ceilometer shall be correlated with visual observations to determine cloud amount and to ensure that the cloud height is representative of the layer.

1.8.4.3 Every time the ceilometer recorder is turned on and/or recalibrated, the observer shall make a time mark beside the calibration marking on the chart, in addition to recording the date and time(UTC). When the ceilometer recorder is operated continuously, a time mark and the date and time(UTC) shall be entered on the chart at least daily.

1.8.4.4 When changing the recorder chart, enter the date and "time on (UTC)" on the new chart and the date and "time off (UTC)" on the old one. Recorder chart rolls shall be retained at the station for two months. The recommended practice is to discard the first month's record at the end of the third month.

1.8.4.4.1 In a case where an Accident Check Observation (para. 10.3.7) is filed, a date/time mark (UTC) shall be made on the recorder chart. Operate the ceilometer recorder for an additional two hours, then remove and store the recorder record under lock and key at the station until all conditions required and described in para. 10.3.7 have been fulfilled. In accident investigation cases chart rolls may be released only upon instructions from the Regional Director AES.

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1.8.4.5 Rotating Beam Ceilometer. It is most important that the observer (operator) be familiar with the calibration of the recorder and attention is especially directed to para. 4.2 on Page 5 and to Fig. 5 on Page 13 of Instrument Manual 75. In Fig. 5 the mark on the extreme left illustrates a recorder in proper calibration, with the projector and recorder – 0° pulses superimposed. Records not showing proper 0 calibration are unacceptable for all purposes.

1.8.4.5.1 When surface–based layers are observed, the top portion of the Rotating Beam Ceilometer reaction pulse should be used as a guide in estimating the vertical visibility. Also, the Rotating Beam Ceilometer may penetrate a surface–based layer and give a return from the base of higher cloud.

1.8.4.6 Laser Chart Record Interpretation. The chart used on the laser ceilometer recorder has a dual logarithmic scale. One scale has a range of 0 to 5000 feet; the other has a range of 0 to 10 000 feet. Each of the two scales uses the full width of the recorder chart. The ceilometer may be operated in either the 5 000 or 10 000 foot range. When the ceilometer is set to and operating in the 5 000 foot (1 500 m) range, a range mark is traced on the recorder chart near the "zero", or left hand edge of the chart. When operating in the 10 000 foot (3 000 m) range, a range mark is traced on the recorder chart near and parallel to the right hand edge of the chart.

1.8.4.6.1 The recorder pen moves from left to right as the ceilometer is scanning and records the beginning of a trace when cloud base is detected. The length of the trace will depend on the penetration of the laser pulse into the cloud, which in turn is dependent on the density of the cloud. The width of the cloud trace should not be interpreted as "cloud thickness", however, the base of cloud is read from the left hand end of the cloud trace.

1.8.4.6.2 The trace on the recorder chart during periods of surface obscuration or precipitation must be treated with extreme caution. Whenever the left hand edge of the recorder trace indicates a layer or vertical visibility of less than 1000 feet (300 m) and it is either precipitating or there is a surface based obscuration, the height of the layer or the vertical visibility should be confirmed by other means such as a ceiling balloon, ceiling projector, etc.

1.8.4.6.3 The laser ceilometer will, at times, detect and record two layers of cloud, the upper layer being detected through breaks in the lower layer.

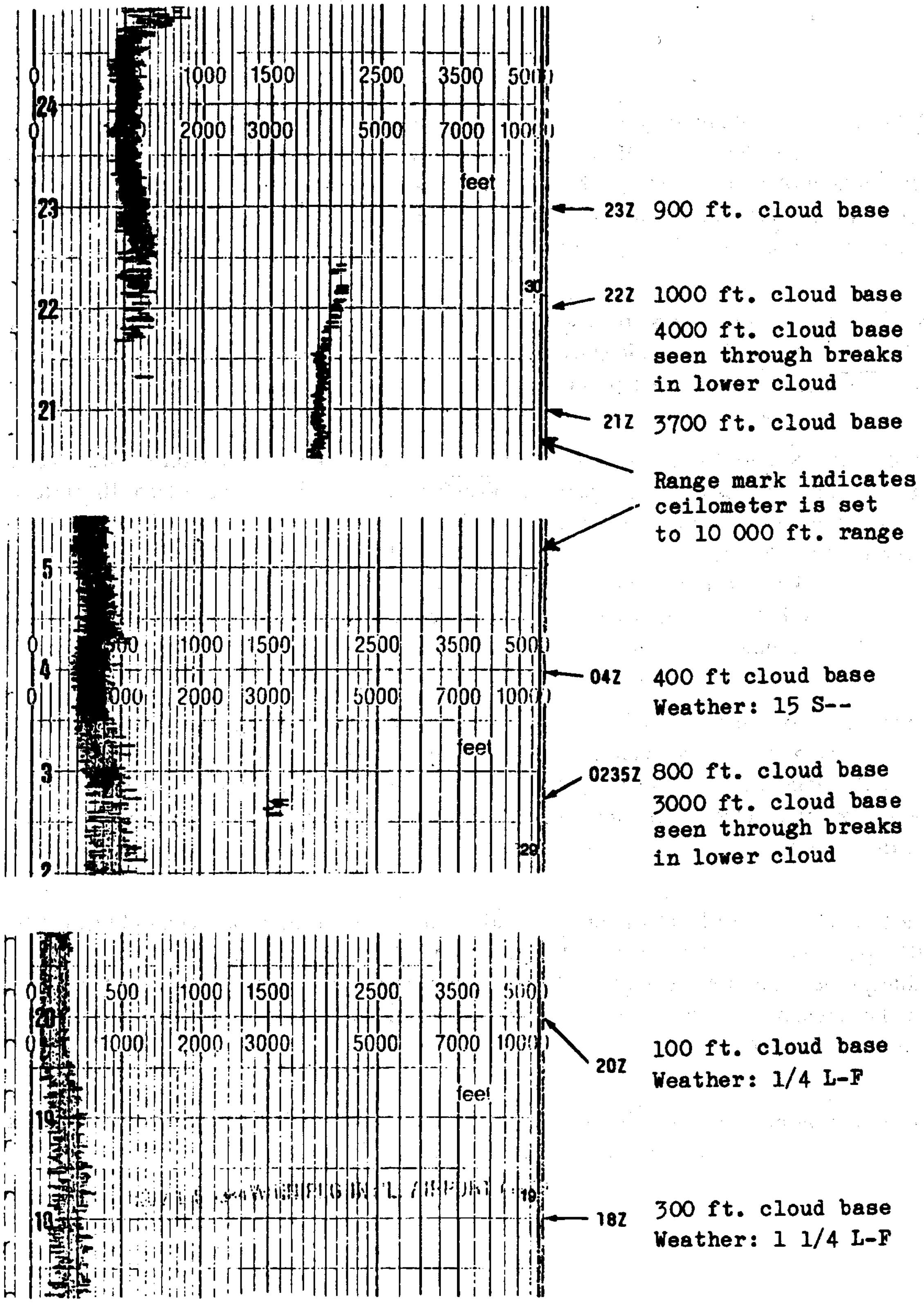

Figure 1. Examples of Laser Ceilometer Recorder Charts

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1.8.5 Pilot Reports – Heights reported by pilots are usually given as heights above mean sea level (in feet) and require conversion to heights above aerodrome or ground level as appropriate. A report by a pilot on the height of cloud bases or vertical visibility as observed within 1 1/2 miles of the observing site may be regarded as highly accurate and representative of conditions at the observing site. Such reports, taken at greater distances from the site should be used by the observer in estimating heights.

1.8.6. Estimation – Heights of layers may be estimated with a reasonable degree of accuracy. Vertical visibility, however, is very difficult to estimate even with the aid of balloons or a ceiling projector. Estimation is a matter that requires careful study and continual practice on the part of the observer. Correlation of estimated values with those determined by other methods, such as pilot reports or balloon measurements will improve the observer's ability. When the lack of a more accurate method requires the observer to estimate, he may be guided by the following:

(a) The apparent size of the elements, rolls or features visible in the layer, i.e., large rolls or elements usually indicate that the layer is relatively low while small rolls or elements usually indicate that the layer is relatively high.

(b) The height of one layer relative to another.

(c) The known heights of hills, towers, etc. in the vicinity.

(d) The difference between temperature and dewpoint may be used as a guide in estimating the height of cumuliform cloud when the surface temperature is above freezing in non–mountainous country (para. 1.8.6.2).

(e) The height at which a balloon enters the side of a cloud or a break in a cloud.

(f) During strong winds, the height at which a balloon disappears in a surface–based layer should be used as a guide only in estimating vertical visibility.

(g) Reflection of city lights at night. During darkness the reflection of city lights may serve not only to indicate the presence of a layer but may also be used as a guide in estimating its height. For example, through experience and reliable measurements obtained from the ceiling projector and from pilot reports, observers located at an airport six km east of a city and two km west of a village learned that during darkness when cloud over the city was based at approximately 1500 m or lower, its base would in most cases be noticeably illuminated by the city lights. However, a layer over the village showed appreciable illumination from the village lights only when the layer was based at 300 m or lower.

1.8.6.1 Although no rigid rules can be given relating the types and heights of clouds, it is possible to specify the height ranges in which clouds of each genera are usually found. The observer must understand that there are large divergencies from these heights. In general, cloud bases follow the temperature; lower in winter and in Arctic regions, and higher in summer and in southerly regions. At middle latitudes the following may be used as a guide.

DEFINITIONS OF CLOUDS	APPROXIMATE HT. OF BASE	REMARKS
Cirrocumulus Thin, white patch, sheet or layer of cloud without shading, composed of very small elements in the form of grains, ripples, etc., merged or separate, and more or less regularly arranged; most of the elements have an apparent width of less than one finger held at arm's length. Cirrus Detached clouds in the form of white, delicate filaments of white or mostly white patches or narrow bands. These clouds have a fibrous (hair–like) appearance, or a silky sheen, or both.	6 – 12 km	Average height of base 9 km in summer, in winter 8 km in . If very thin, average height of base 10 km.
Cirrostratus Transparent, whitish cloud veil of fibrous (hair–like) or smooth appearance, totally or partly covering the sky, and generally producing halo phenomena.	6 – 12 km	Bases more often near the lower 6 – 12 km limit of this range averaging about 6. km in winter and 8 km in summer.

Note: Cirriform clouds in the high Arctic may be observed at very low levels.

DEFINITIONS OF CLOUDS	APPROXIMATE HT. OF BASE	REMARKS
Altocumulus White or grey, or both white and grey, patch, sheet or layer of cloud, generally with shading, composed of laminae, rounded masses, rolls, etc., which are sometimes partly fibrous or diffuse and which may or may not be merged; most of the regularly arranged small elements usually have an apparent width of between one and three fingers held at arms length. Altocumulus Castellanus Altocumulus with cumuliform protuberances, at least in some portion of the upper part. The turrets, some of which are taller than they are wide, are connected by a common base and seem to be arranged in lines.	2 – 6 km	Small elements with little shading usually based at approximately 5 km, larger and darker elements based lower.
Altostratus Greyish or bluish cloud sheet or layer of striated,fibrous or uniform appearance,totally or partly covering thesky, and having parts thinenough to reveal the sun atleast vaguely, as through thin layers higher.ground glass. Altostratus does not show halo phenomena.	2 – 6 km	When no sun or moon is visible the average height of the base is 2.5 km, thin layers higher.
Nimbostratus Grey cloud layer, often dark,the appearance of which isrendered diffuse by more orless continuously falling rainor snow, which in most cases reaches the ground. It is thick enough throughout to blot out the sun.	Near surface to 2 Km	Usually the darker the cloud the lower the base. Stratus Fractus usually forms in precipitation below Nimbostratus and may or may not merge with the higher layer.

DEFINITIONS OF CLOUDS	APPROXIMATE HT. OF BASE	REMARKS
Stratocumulus Grey or whitish, or both grey and whitish, patch, sheet or layer of cloud which almost always has dark parts, composed of tessellations, rounded masses, rolls, etc., which are non–fibrous (except for virga) and which may or may not be merged; most of the regularly arranged small elements have an apparent width of more than three fingers at arm's length.	150 m – 300 m 300 m – 2 km	Few rolls, large cloud elements. More rolls and smaller cloud elements as the height of the base increases.
Stratus Generally grey cloud layer with a fairly uniform base, which may give drizzle, ice Near Surface "Usually" based be prisms or snow grains. When the sun is visible through the cloud, its outline is clearly" discernible.	Near surface to 450 m	"Usually" based below 300 m.
Stratus Fractus (ragged stratus)		
Cumulus Detached clouds, generally dense and with sharp outlines,developing vertically in theform of rising mounds, domes ortowers, of which the bulging upper part often resembles acauliflower. The sunlit parts these clouds are mostly very dry air.	Usually 450 m to 2 km but up to 3 km or higher.	Highest bases occur in summer in very dry air.
Cumulus Fractus (ragged cumulus)		

DEFINITIONS OF CLOUDS	APPROXIMATE HT. OF BASE	REMARKS
Cumulonimbus Heavy and dense cloud with a considerable verticalextent, in the form of amountain or huge tower. Atleast part of its upper portion is usually smooth, or fibrous or striated, and nearly always flattened; this part often spreads out in the shape of an anvil or vast plume. Under the base of this cloud which is often very dark, there are frequently low ragged clouds either merged with it or not, and precipitation, sometimes in the form of Virga.	Usually 450 m to 2 km but upto 3 km or higher.	Highest bases occur in summer in very dry air.

1.8.6.2 The height of the base of cumuliform cloud may be estimated with a fair degree of accuracy by multiplying the difference between the temperature and the dew point (°C) by 120 to give the height in metres. Observers in mountainous districts should not use this rule; it does not apply in these regions. Also, this method should be used with caution when the temperature is below freezing, because of the difficulties inherent in the accurate determination of the dew point at low temperature. To facilitate the use of this method the following table may be used:

APPROXIMATE HEIGHT OF BASE OF CUMULIFORM CLOUD

Temp./Dew Pt. Difference °C	Height		Temp./Dew Pt. Difference °C	Height	
	Nearest 30 m	Coded Value*		Nearest 30 m	Coded Value*
3	360	12	17	2040	68
4	480	16	18	2160	72
5	600	20	19	2280	76
6	720	24	20	2400	80
7	840	28	21	2520	84
8	960	32	22	2640	88
9	1080	36	23	2760	92
10	1200	40	24	2880	96
11	1320	44	25	3000	100
12	1440	48	26	3120	100
13	1560	52	27	3240	110
14	1680	56	28	3360	110
15	1800	60	29	3480	120
16	1920	64	30	3600	120

*Refer to para. 10.2.8.6.

1.8.6.2.1 The above table gives the lower limit of the cumulus cloud when the temperature–dewpoint spread is representative of a location of the cumulus formation. When the air mass is reasonably dry aloft the base of the cumulus cloud may be considerably higher than the height suggested by the above table.

1.8.6.3 Since the estimation of the height of such clouds as Stratus, Nimbostratus and Altostratus is particularly difficult due to the lack of pronounced structure in the cloud base, the observer whenever possible, should use information obtained from pilot reports, cei& ling balloons etc., to provide reliable measurements, or reliable estimated cloud heights. For example, even though a ceiling balloon disappears before entering the cloud base the observer may have gained definite knowledge that the cloud base was above the height at which the balloon was last observed and he is thus able to provide a more reliable estimate.

1.8.7 Comparison With Heights of Objects. When a layer intersects a hill or mountain, the height of the layer may be estimated with considerable accuracy. However, the base of such a layer should be studied carefully to determine and allow for any difference in the layer at the hill or mountain and at the station. Towers and buildings at known heights are also valuable aids in determining heights of layers which intersect them.

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Nov. 1, 1989

1.8.8 Table of Cloud Heights From Ceiling Balloon Ascent

(Rate of Ascent 460 ft/min, 140m/min)

Time from release (min:sec)	Cloud Height (metres)	Reportable value
0:07–0:19	30	1
0:20–0:32	60	2
0:33–0:45	90	3
0:46–0:58	120	4
0:59–1:12	150	5
1:13–1:24	180	6
1:25–1:37	210	7
1:38–1:50	240	8
1:51–2:04	270	9
2:05–2:17	300	10
2:18–2:30	330	11
2:31–2:43	360	12
2:44–2:56	390	13
2:57–3:09	420	14
3:10–3:22	450	15
3:23–3:35	480	16
3:36–3:48	510	17
3:49–4:01	540	18
4:02–4:14	570	19
4:15–4:27	600	20
4:28–4:40	630	21
4:41–4:53	660	22
4:54–5:06	690	23