APPENDIX I — UNITS

1. S I units

Quantity	Name (symbol)	Definition
Basic units:		
Length	metre (m)	
Mass	kilogram (kg)	
Time	second (s)	
Temperature	Kelvin (K)	
Derived units:		
Force	newton (N)	kg m s^{-2}
Pressure	pascal (Pa)	N m^{-2}
Energy	joule (J)	N m
Power	watt (W)	J s^{-1}
Frequency	hertz (Hz)	s^{-1}

2. Multiples of units

Multiple	Prefix	(symbol)	Multiple	Prefix	(symbol)
10^{-1}	deci	(d)	10	deca	(da)
10^{-2}	centi	(c)	10^{2}	hecto	(h)
10^{-3}	milli	(m)	10^{3}	kilo	(k)
10^{-6}	micro	(μ)	10^{6}	mega	(M)
10^{-9}	nano	(n)	10^{9}	giga	(G)
10^{-12}	pico	(p)	10^{12}	tera	(T)

APPENDIX II — CONVERSION TABLES

1. Temperature

Table A1. Celsius to Fahrenheit

°C	−40	−35	−30	−25	−20	−15	−10	−5	0	5	10	15	20	25	30	35	40	45	50
°F	−40	−31	−22	−13	−4	5	14	23	32	41	50	59	68	77	86	95	104	113	122

differences

°C	1	2	3	4	5
°F	2	4	5	7	9

Table A2. Fahrenheit to Celsius

°F	−40	−30	−20	−10	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140
°C	−40	−34	−29	−23	−18	−12	−7	−1	4	10	15	21	27	32	38	43	49	54	60

differences

°F	1	2	3	4	5	6	7	8	9
°C	1	1	2	2	3	3	4	4	5

2. Distance

1 inch	= 25.4 mm	1 cm	= 0.39 inch
1 foot	= 30.48 cm	1 m	= 3.28 feet
1 mile	= 1.61 km	1 km	= 0.62 mile
1 n.mile	= 1.85 km	1 km	= 0.54 n mile

Table A3. Nautical miles to kilometres

n mile	10	20	30	40	50	60	70	80	90	100
km	18	37	56	74	93	111	130	148	167	185

Table A4. Kilometres to nautical miles

km	10	20	30	40	50	60	70	80	90	100
n mile	5	11	16	22	27	32	38	43	49	54

3. Area

1 hectare = $(100\ m)^2$ = 2.47 acres

$(1\ km)^2$ = 100 hectares = 247 acres

4. Speed

Table A5. Knots to metres/second and kilometres/hour

knots	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
m s^{-1}	0.5	1	1.5	2	2.5	5	10	15	21	26	31	36	41	46	51
km h^{-1}	1.8	3.7	5.6	7.4	9.3	19	37	56	74	93	111	130	148	167	185

1 knot = 0.515 m s^{-1} = 1.85 km h^{-1}

Table A6. Miles/hour to knots and kilometres/hour

m.p.h.	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
knots	0.9	1.7	2.6	3.5	4.4	9	17	26	35	44	52	61	70	78	87
km h^{-1}	1.6	3.2	4.8	6.4	8.1	16	32	48	64	81	97	113	129	145	161

1 m.p.h. = 0.87 knot = 1.61 km h^{-1}

Table A7. Metres/second to kilometres/hour and knots

$m\ s^{-1}$	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
$km\ h^{-1}$	3.6	7.2	10.8	14.4	18.0	36	72	108	144	180	216	252	288	324	360
knots	1.9	3.9	5.8	7.8	9.7	19	39	58	78	97	117	136	155	175	194

$1\ m\ s^{-1} = 3.60\ km\ h^{-1} = 1.94$ knots

Table A8. Kilometres/hour to knots and metres/second

$km\ h^{-1}$	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
knots	0.5	1.1	1.6	2.2	2.7	5	11	16	22	27	32	38	43	49	54
$m\ s^{-1}$	0.3	0.6	0.8	1.1	1.4	3	5	8	11	14	17	19	22	25	28

$1\ km\ h^{-1} = 0.54$ knots $= 0.28\ m\ s^{-1}$

Table A9. Feet/minute to knots and metres/second

$ft\ min^{-1}$	10	25	50	75	100	200	300	400	500	1000
knots	0.10	0.25	0.49	0.74	1.0	2.0	3.0	3.9	4.9	9.9
$m\ s^{-1}$	0.05	0.13	0.25	0.38	0.5	1.0	1.5	2.0	2.5	5.1

$1000\ ft\ min^{-1} = 9.87$ knots $= 5.08\ m\ s^{-1}$

Table A10. Runway cross-wind components

		Angle between wind direction and runway heading (deg. true)								
		10	20	30	40	50	60	70	80	90
	5	1	2	2	3	4	4	4	5	5
	10	2	3	5	6	7	8	9	9	10
	15	3	5	7	9	11	13	14	14	15
	20	3	7	10	13	15	17	18	19	20
	25	4	8	12	16	19	22	23	24	25
Wind	30	5	10	15	19	23	26	28	29	30
	35	6	12	17	22	26	30	32	34	35
speed	40	7	14	20	25	30	35	37	39	40
in	45	8	15	22	29	34	39	42	44	45
	50	9	17	25	32	38	43	47	49	50
knots	55	10	19	27	35	42	48	52	54	55
	60	10	20	30	38	46	52	56		
	65	11	22	32	42	50	56			
	70	12	24	35	45	54				
	75	13	26	37	48					
	80	14	27	40						

APPENDIX III — PHYSICAL TABLES AND CONSTANTS

1. The Earth

Dimensions

Equatorial radius	6378 km (3963 miles	
Polar radius	6357 km (3950 miles)	
Rate of rotation (Ω)	7.29×10^{-5} s^{-1}	
Total surface area	510×10^6 km^2	
Land surface area	150×10^6 km^2	(29.2% of total area)
Ocean surface area	360×10^6 km^2	(70.8% of total area)

Table A11. Gravity at mean sea level

Latitude (deg)	0	50	60	90
g (m s^{-2})	9.78	9.81	9.82	9.83

Table A12. Distance of sea horizon from viewpoint at given heights

Height (ft)	6	10	20	30	50	100	200	400	600	800
Distance (n mile)	2.8	3.6	5.1	6.3	8.1	11	16	23	28	32

Table A13. Distance corresponding to 1 degree of longitude at given latitudes

Latitude (deg)	0	15	30	45	50	55	60	75	85	90
Distance (n mile)	60.4	58.3	52.2	42.6	38.7	34.5	30.1	15.5	5.2	0

Table A14. Value of Coriolis Parameter ($f = 2\Omega\sin\varphi$)

	Latitude (φ) degrees								
	0	15	30	45	50	55	60	75	90
f (10^{-4} s^{-1})	0.00	0.38	0.73	1.03	1.12	1.19	1.26	1.41	1.46
f (h^{-1})	0.00	0.14	0.26	0.37	0.40	0.43	0.45	0.51	0.52
$\partial f/\partial y$ (10^{-11} m^{-1} s^{-1})	2.29	2.12	1.98	1.62	1.47	1.31	1.14	0.59	0.00

2. The atmosphere

(a) **Some physical properties**

Mass of atmosphere = 5.27×10^{18} kg

Surface pressure:
1 'atmosphere' = 1.03 kg cm^{-2} = 14.7 lb in^{-2} = 29.9 in Hg
1 millibar = 100 dynes cm^{-2} = 100 N m^{-2} = 1 hPa

Speed of light = 2.998×10^8 m s^{-1}

Speed of sound in dry air

Temperature (°C)	−40	−20	0	20	40
Speed (m s^{-1})	306	318	331	343	354

(b) **Specific heats (J deg^{-1} kg^{-1}) of atmospheric constituents:**

Dry air (c_p)	1004
Dry air (c_v)	717
Water vapour (c_p)	1952
Water vapour (c_v)	1463
Liquid water (0°C)	4218
Ice (0°)	2106

(c) **Latent heats (J kg^{-1}) of water substances**

Vapour/Liquid	2 500 000
Liquid/Solid	334 000
Solid/Vapour	2 834 000

Table A15. ICAO Standard atmosphere (dry air)

Pressure	Temperature	Density	Height		Thickness of 1 hPa layer	
hPa	°C	g m^{-3}	m	ft	m	ft
1013.2	15.0	1225	0	0	8.3	27
1000	14.3	1212	111	364	8.4	28
950	11.5	1163	540	1773	8.8	29
900	8.6	1113	988	3243	9.2	30
850	5.5	1063	1457	4781	9.6	31
800	2.3	1012	1949	6394	10.1	33
750	−1.0	960	2466	8091	10.6	35
700	−4.6	908	3012	9882	11.2	37
650	−8.3	855	3591	11780	11.9	39
600	−12.3	802	4206	13801	12.7	42
550	−16.6	747	4865	15962	13.7	45
500	−21.2	692	5574	18289	14.7	48
450	−26.2	635	6344	20812	16.1	53
400	−31.7	577	7185	23574	17.7	58
350	−37.7	518	8117	26631	19.7	65
300	−44.5	457	9164	30065	22.3	75
250	−52.3	395	10363	33999	25.8	85
200	−56.5	322	11784	38662	31.7	104
150	−56.5	241	13608	44647	42.3	139
100	−56.5	161	16180	53083	63.4	208
90	−56.5	145	16848	55275	70.5	231
80	−56.5	128	17595	57726	79.3	260
70	−56.5	112	18442	60504	90.6	297
60	−56.5	96	19419	63711	105.7	347
50	−55.9	80	20576	67507	127.0	417
40	−54.5	64	22000	72177	160	525
30	−52.7	47	23849	78244	215	706
20	−50.0	31	26481	86881	326	1072
10	−45.4	15	31055	101885	669	2195

Table A16. The Sun

Date	Noon sun overhead (lat.)	Noon solar altitude 50° N (deg.)	Noon solar altitude 60° N (deg.)	Sunrise/sunset times (UTC) London	Manchester	Glasgow	Lerwick
Jan. 1	23° S	17	7	0805/1600	0825/1600	0850/1555	0925/1440
Jan. 16	21° S	19	9	0800/1620	0815/1620	0835/1615	0905/1500
Feb. 1	17° S	23	13	0740/1650	0755/1650	0810/1650	0830/1540
Feb. 16	13° S	27	17	0715/1715	0725/1720	0740/1720	0745/1625
Mar. 1	8° S	32	22	0645/1740	0700/1745	0710/1750	0700/1705
Mar. 16	2° S	38	28	0615/1805	0625/1815	0630/1820	0620/1745
Apr. 1	4° N	44	34	0535/1835	0545/1845	0550/1855	0535/1825
Apr. 16	10° N	50	40	0505/1855	0510/1910	0510/1925	0450/1910
May 1	15° N	55	45	0435/1925	0435/1935	0435/1955	0410/1945
May 16	19° N	59	49	0405/1945	0405/2005	0405/2025	0340/2010
June 1	22° N	62	52	0350/2005	0345/2025	0340/2050	0310/2030
June 16	23° N	63	53	0340/2020	0340/2040	0330/2105	0255/2105
July 1	23° N	63	53	0345/2020	0345/2040	0335/2105	0310/2100
July 16	21° N	61	51	0400/2010	0400/2030	0355/2050	0325/2045
Aug. 1	18° N	58	48	0420/1950	0425/2005	0420/2025	0345/2010
Aug. 16	14° N	54	44	0445/1920	0450/1935	0450/1950	0420/1930
Sept. 1	8° N	48	38	0510/1850	0515/1900	0520/1915	0500/1850
Sept. 16	3° N	43	33	0535/1815	0545/1825	0550/1835	0545/1810
Oct. 1	3° S	37	27	0600/1740	0610/1745	0620/1755	0630/1730
Oct. 16	8° S	32	22	0625/1705	0635/1710	0650/1715	0710/1645
Nov. 1	14° S	26	16	0655/1635	0705/1640	0720/1640	0755/1600
Nov. 16	18° S	22	12	0720/1610	0735/1610	0755/1610	0835/1525
Dec. 1	22° S	18	8	0745/1555	0800/1555	0820/1550	0910/1500
Dec. 16	23° S	17	7	0800/1550	0820/1550	0840/1545	0930/1440

Table A17. Rossby Long Waves — wavelength of stationary waves

Latitude (deg.)	Mean zonal wind speed (knots)									
	10	20	30	40	50	10	20	30	40	50
	wavelength									
	kilometres					degrees of longitude				
70	5100	7200	8800	10200	11400	134	190	232	268	300
60	4200	6000	7300	8400	9400	76	108	132	152	170
50	3700	5300	6400	7400	8300	52	74	90	104	116
40	3400	4800	5900	6800	7600	40	57	69	80	90
30	3200	4500	5600	6400	7200	33	47	57	66	74

APPENDIX IV — FORECASTING WEATHER BELOW 15,000 FT

In order to prepare a low-level forecast of weather for a short period ahead (e.g.6–12 hours) for a specific region, the following elements must be considered:

- visibility (Chapter 3)
- cloud (4.3; 4.6; 5.1; 5.2; 5.4–5.6; 5.8)
- weather, including fog/hill fog (3.3; 3.4; 3.5.2; 3.6)
- low-level turbulence (6.2)
- lee-wave activity (1.3.2)
- icing and turbulence in cloud (2.9; 6.1.1)
- variations in freezing level, with possible sub-zero layers, across the area (2.9.7; 2.9.8; 2.9.9; 2.9.10)

A brief ten-point summary of the main aspects of preparing a low-level aviation chart is as follows:

- Must know weather and cloud distribution now
- How does model represent weather at data time?
- Make necessary adjustments throughout forecast period.
- Check upper-air pattern — as above, is model correct?
- Allow for possible changes in development/decay, e.g. of large rain or shower areas; use trajectories.
- Consider effects of clearing skies — fog formation.
- Check gradient wind forecasts — consider turbulence.
- Run/modify lee-wave program results according to wind direction and vertical shear in relation to topography.
- Always examine actual and forecast ascents or profiles.
- Consider sub-zero layer(s) when calculating freezing levels.

Bibliography

Hall, B.A. 1996: Forecasting weather below 15,000 feet. 4th Joint UK Met. Office/WMO Aeronautical Forecasting Seminar, Meteorological Office College, July 1996.